Australian Government

BUILDING OUR FUTURE

NSW GOVERNMENT

# Hexham Straight Widening

## Review of environmental factors

Transport for NSW | November 2021

# Hexham Straight Widening

Review of Environmental Factors

Transport for NSW

Hexham Straight Widening

Review of Environmental Factors

Transport for NSW | November 2021

Prepared by Jacobs and Transport for NSW

TfNSW Publication Number 21.306 ISBN 978-1-922549-44-0

## Document controls

### Approval and authorisation

| | |
|---|---|
| **Title** | Hexham Straight Widening review of environmental factors |
| **Accepted on behalf of Transport for NSW by:** | Andrew Thompson<br>Project Development Manager |
| **Signed:** |  |
| **Dated:** | 11 November 2021 |

### Document status

| Document status | Date | Prepared by | Reviewed by |
|---|---|---|---|
| Rev01 | 14 April 2021 | Abbee Warskitt, Oliver Edgson | Rachel Vazey |
| Rev 02 of chapter 1-5/ Rev 1 of chapter 7 onwards | 11 June 2021 | Abbee Warskitt, Oliver Edgson | Rachel Vazey |
| Rev03 | 29 August 2021 | Melissa Laginha, Oliver Edgson | Rachel Vazey |
| Rev 04 | 6 October 2021 | Melissa Laginha | Rachel Vazey |
| Rev 05 | 10 November 2021 | Melissa Laginha | Rachel Vazey |
| Rev06 | 11 November 2021 | Melissa Laginha | Rachel Vazey |

# Executive summary

## The proposal

Transport for NSW (Transport) is proposing to widen a six kilometre section of the Pacific Highway (Maitland Road) from four lanes to six lanes, starting about 290 metres south of the intersection with the Newcastle Inner City Bypass at Sandgate, and extending through to about 760 metres north of Hexham Bridge, in Hexham, NSW (the proposal). The proposal would create two additional lanes in each direction and would include the replacement twin bridges across Ironbark Creek The section of road is known as the 'Hexham Straight' and is located within the City of Newcastle local government area (LGA) with a small portion of the construction area within the Port Stephens Council LGA.

Maitland Road is a critical link as part of the National Land Transport Network (NLTN) and is among the busiest transport corridors carrying some of the highest traffic volumes in the Hunter. The proposal is required to reduce congestion and improve safety along Maitland Road.

The proposal is subject to assessment under two planning pathways, a review of environmental factors (REF) under Part 5, Division 5.1 of the *Environmental Planning and Assessment Act* 1979 (EP&A Act) and an environmental impact statement (EIS) under Part 4 of the EP&A Act. The majority of the proposal (the REF area) is subject to approval under Division 5.1 of the EP&A Act that would be determined though this REF by Transport. However, a small part of the proposal (3.28 hectares) is within land mapped as 'Coastal Wetlands' under State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP). As such, that part of the proposal (known as the EIS areas) is subject to approval under Part 4 of the EP&A Act and will be assessed within an EIS.

Key features of the proposal include:

- Widening a six kilometre section of Maitland Road starting about 290 metres to the south of the intersection with the Newcastle Inner City Bypass (A37) at Sandgate and extending to about 760 metres north of Hexham Bridge at Hexham on Maitland Road. The highway would be widened from generally two lanes in each direction to three lanes in each direction
- Replacement of the bridge which spans Ironbark Creek with new twin bridges. The existing bridge and all piers would be demolished and the outlet of a small drainage channel would be relocated about 10 metres to the east of its existing location
- Minor improvements to nine signalised intersections
- Minor improvements to access roads, unsignalised intersections, entry and exit ramps connecting to the A1 Pacific Highway and the U-turn facility at the northern end of the proposal
- Closure of breaks in the existing median and direct access to two local side roads, one private access road and one U-turn facility
- Provision of a three metre wide shared use path northbound between the Oak Factory and the northern end of the proposal and a new section of off-road shared use path heading east along the Newcastle Inner City Bypass
- Widening of existing footpaths at intersections and bus stops
- Adjustments to property accesses and bus stops
- Provision of U-turn facilities on Sparke Street, Shamrock Street, and Old Maitland Road at Hexham
- Relocation of utilities including power, communications, water, gas and wastewater services
- Modifications and maintenance of existing drainage structures including pits, pipes, headwalls and culverts to suit the road widening and to maintain capacity
- Construction of retaining walls to minimise impacts on nearby properties

- Property acquisition, leases and adjustments
- Construction of hardstand for oversize and overmass (OSOM) vehicle parking at the southern and northern end of the proposal
- Intrusive investigation works such as geotechnical investigations
- Temporary construction facilities, including site compounds and stockpile sites at four separate locations.

Construction of the proposal would be staged and would take about 30 months.

## Need for the proposal

Maitland Road is a critical link as part of the NLTN and is among the busiest transport corridors carrying some of the highest traffic volumes in the Hunter. Maitland Road currently experiences substantial congestion, particularly during peak periods where vehicles commonly travel lower than the posted speed limit. Maitland Road impacts the flow of traffic across the Lower Hunter with about 50,000 vehicles using this route every day.

Substantial delays are experienced at the A1 Pacific Highway and Maitland Road intersection at Hexham during morning and afternoon peak periods. The high traffic demands on the New England Highway, combined with the relatively high traffic demand southbound on Maitland Road, result in queuing and delays to all movements at A1 Pacific Highway and Maitland Road intersection. Local and through traffic is substantially increased during holiday periods, due to travel between the M1 Pacific Motorway and the A1 Pacific Highway via John Renshaw Drive, the New England Highway and Hexham Bridge.

Increased congestion has resulted in reduced speeds and increased travel times along the alignment. Traffic modelling indicates a number of intersections along the Maitland Road are contributing to increased travel times and reduced speeds during peak periods. Intersection performance is expected to continue to deteriorate over the next few decades leading to further increases in travel times.

Maitland Road currently allows right turn movements into a number of local roads. This not only contributes to reducing the flow of vehicles along Hexham Road but also poses a safety risk as vehicles waiting to turn from Maitland Road are at risk of rear end crashes. In the five years between October 2013 and 2018, 178 crashes have occurred along the road corridor between the Maitland Road and Wallsend intersection, and the Maitland Road and the A1 Pacific Highway with 15 per cent of them resulting in serious injury or a fatality. Of these, almost 65 per cent were rear end collisions.

Without investment in upgrades to Maitland Road, congestion is expected to increase. This has the potential to impact economic growth for local and regional businesses and industry by restricting access and connectivity to key employment and strategic growth areas in the Lower Hunter region, including Black Hill – Beresfield, Tomago, Raymond Terrace, Hexham, the Port of Newcastle and Newcastle central business district.

## Proposal objectives

The key objectives of the proposal are to:

- Improve travel times on the Pacific Highway for the existing congested east-west route from the junction with the M1 Pacific Motorway to the Newcastle Inner City Bypass
- Provide a route which reduces the overall freight transport time and cost for heavy vehicles along the Pacific Highway, and other key strategic freight routes around the Greater Newcastle area, improving opportunity for increased freight capacity and efficiency
- Improve the long-term route reliability along the Pacific Highway
- Improve road safety (reduce fatalities and serious injuries) for all road users, including vulnerable road users

- Provide more efficient access to facilitate economic growth to and from key employment areas such as the Port of Newcastle and Greater Newcastle.

# Options considered

Three options were considered in developing this proposal. All options have assumed that the M1 Pacific Motorway to Raymond Terrace project would be open to traffic.

- **Option A** – 'Do minimum' would include normal road maintenance only
- **Option B** – Broader network considerations. This option investigated a broader array of road user and development issues and aspects associated with the outer Newcastle road network
- **Option C** – Upgrade the Hexham Straight corridor as per the proposal description of this REF.

Option C is considered the preferred option as it best meets the objectives of the proposal and has the highest benefit to traffic movements, economic growth and safety.

# Statutory and planning framework

### Review of Environmental Factors (REF)

Transport is the proponent and determining authority for the REF area of the proposal under Clause 94 and Clause 68(4) of the State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) which provides that the proposal may be carried out without the need for development consent. The REF area of the proposal is therefore subject to assessment and determination under Division 5.1 of the EP&A Act.

### Environmental Impact Statement (EIS)

A small part of the proposal (3.28 hectares) is located on land mapped as Coastal Wetlands under the CM SEPP. Development within Coastal Wetlands is classed as designated development and consequently the EIS areas of the proposal requires consent from the City of Newcastle under Part 4 of the EP&A Act. A separate EIS has been prepared and only assesses impacts of the proposal within the EIS area. Transport applied to the Secretary of DPIE to obtain Secretary's Environmental Assessment Requirements (SEARs) for the EIS proposal on the 12 September 2019 under Section 4.12(8) of the EP&A Act. A request for an extension was made on the 25 May 2021 and a one year extension was approved by DPIE on the 10 June 2021 along with the provision of revised SEARs.

Together, the EIS and the REF assess the potential environmental impacts of the proposal and it is intended that these documents be read in conjunction with each other.

# Community and stakeholder consultation

Transport sought feedback on the corridor strategy and preliminary concept design during a nine-week consultation period from December 2020 to February 2021. Consultation included a project update, a project webpage and map, a business survey and consultation with stakeholders online or over the phone.

Key feedback from the consultation related to property and access, traffic issues including lane configurations, concerns about construction and operational impacts such as flooding and noise, bicycle transport and queries relating to the proposed design.

Transport has consulted with the City of Newcastle, National Parks and Wildlife Services, the State Emergency Services (SES), the Australian Rail Track Corporation (ARTC) in accordance with the requirements of ISEPP. Transport has also consulted with the Department of Primary Industries (DPI) (Fisheries) under Section 199 of the *Fisheries Management Act 1994* (FM Act).

Transport has also consulted on an ongoing basis with key State and local government agencies, utility service owners as well as a number of businesses in the proposal area. This has included a site inspection with National Parks and Wildlife Services and the Environment Protection Authority. This consultation was designed to ensure issues and concerns were understood, documented and addressed, and that stakeholders had an opportunity to discuss any aspect of the proposal.

Transport will continue to consult with the community and stakeholders as planning progresses.

# Environment impacts

The proposal would have some adverse impacts during construction. There would also be longer-term impacts once the proposal is operating. The main environmental impacts of the proposal are:

## Biodiversity

The proposal would require the removal of 3.82 hectares within the REF area of native vegetation belonging to four Threatened Ecological Communities (TECs) including:

- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (*Biodiversity Conservation Act 2016* (BC Act): listed as Endangered)
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act: listed as Endangered)
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act): listed as Endangered)
- Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions (BC Act: listed as Endangered); and Subtropical and Temperate Coastal Saltmarsh (EPBC Act: listed as Vulnerable).

The native vegetation to be removed provides habitat (or potential habitat) for 14 threatened fauna species that were either identified in the study area (i.e. Southern Myotis) or are considered at least moderately likely to occur based on the presence of suitable habitat (e.g. Grey-headed Flying Fox).The biodiversity assessment for the REF area concluded that there is a high level of certainty that the impacts to threatened ecological communities and threatened species are unlikely to be significant.

The Hunter Estuary Important Areas Mapping (DPIE) for migratory shorebirds indicates that habitat for the threatened Curlew Sandpiper, Bar-tailed Godwit and Red Knot may occur within the REF area along with the Lesser Sand-plover, Greater sand-plover, Great Knot, Australian Painted Snipe. It is unlikely that these species would be reliant on these small, mapped areas of habitat.

During survey, Southern Myotis were found to be using Ironbark Creek Bridge for foraging, roosting and breeding. Injury or death to microbat species has the potential to occur during the works carried out in relation to Ironbark Creek Bridge. The removal of the bridge would remove structures that are currently used for roosting / breeding which has potential to result in direct mortality of bats if present at that time. Due to the presence of a breeding population of Southern Myotis, it is recommended that a Microbat Management Plan (MMP) be prepared.

Offsets are required for proposed impacts to two saline wetlands formations (mangroves and saltmarsh) in accordance with the NSW DPI policy on ‘no net loss’ of fisheries habitat (DPI, 2013).

## Flooding and hydrology

Stormwater discharge modelling has been completed of 26 of the drainage systems that exist along the proposal and which discharge into the Hunter River catchment. The results of the modelling indicate that modifications to the existing drainage infrastructure and increases in the area of road pavement may impact stormwater discharges causing some minor increases in rates, volumes and velocity into the existing receiving environments. Impacts potentially include increased erosion and water turbidity, geomorphological impacts including reduced bank stability and minor increases to the duration and depth of flood events to areas downstream of stormwater discharge locations being upgraded by the proposal. The proposal design includes appropriate mitigations including scour protection to manage impacts.

The proposal will maintain existing water flow (i.e. quantity) under Maitland Road to Hexham Swamp during operation and no changes are expected from the proposal to the existing surface water hydrology including for sensitive receiving environments such as Hexham Swamp, the surrounding Coastal Wetlands, freshwater wetlands or Ramsar listed wetlands.

During construction, flood level increases are generally between 0.02 and 0.1 metres in the one per cent Annual Exceedance Probability (AEP) event. Residential properties along the proposal would experience an afflux of up to 0.1 metres and industrial properties would experience an afflux of up to 0.05 metres.

During operation, flood level is expected to increase up to 0.25 metres at the rail maintenance facility located along the north-western boundary of the proposal. In the two per cent AEP event, flood levels increases between 0.01 and 0.1 metres are expected to occur. The large majority of flood-affected residential, commercial and industrial properties in the existing case experience negligible change in flood depth (less than 0.01 metres change) and flood hazard during operation of the proposal.

### Surface water, groundwater and coastal processes

The existing surface water quality of waterways and wetlands within the study area generally do not meet the default guideline values for protection of nominated environmental values. Based on existing water quality data, elevated nutrients and turbidity together with low dissolved oxygen and occasional elevated metals are the key water quality indicators that frequently exceed the *Australian and New Zealand Guidelines* (ANZG) (2018) guidelines.

The construction and operation of the proposal could further impact on these indicators, particularly as increased sediment could further impact water quality potentially leading to algal blooms, impacts on visual amenity and smothering of aquatic vegetation. These impacts would be managed through the establishment of erosion and sediment controls.

Changes to groundwater levels are anticipated to be negligible. Groundwater level reduction when dewatering for the purpose of basin construction would result in a reduction of less than 0.1 metres, which would only occur for a period of about one month. Groundwater quality could potentially be impacted if accidental spills or leaks of hazardous materials occur during construction or operation or if potential or actual acid sulfate soils are excavated and oxidised due to disturbance or groundwater level reduction.

Temporary works during the construction of the proposal to facilitate the construction of the new bridges and removal of the existing bridges have the potential to impact on coastal processes within Ironbark Creek. These impacts are predicted to be mostly confined to additional erosion and sedimentation within the tidal waterway near to the temporary work platform. During the operational phase, the proposal is expected to have no significant impacts on coastal processes within the study area or the wider Hunter Estuary. The proposal is not considered to significantly impact on the coastal inundation hazards exposure of surrounding properties.

### Non-Aboriginal heritage

A Statement of Heritage Impact (SoHI) was completed for the proposal. There are eight local heritage listed items and one unlisted potential heritage item that was identified as part of the heritage survey within the REF area.

There would be direct physical impacts to one item of local significance (Ironbark Creek crossing point) during the construction of the proposal in the REF area as part of the installation of the new Ironbark Creek Bridge and the demolition of existing Ironbark Creek Bridge. The Ironbark Creek crossing point has been considered an archaeological 'work' rather than a relic and would be managed in accordance with Transport's *Cultural Heritage Guideline*.

Potential direct impacts may also occur during construction due to inadvertent impacts from construction plant to four of the listed heritage items. In addition, there may also be indirect impacts from vibration during construction to five of the listed heritage items according to minimum safe working distances for vibration identified in Transport's (2016) *Construction Noise and Vibration Guideline*.

### Aboriginal heritage

An assessment of impacts to Aboriginal heritage has been carried out in accordance with Stage 3 of the *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (Roads and Maritime Services, 2011) (PACHCI). This has included completion of an Aboriginal Cultural Heritage Assessment Report (ACHAR) and consultation with the Aboriginal community in accordance with the requirements of the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (Office of Environment and Heritage (OEH), 2011).

The proposal in the REF area would not impact on any tangible Aboriginal sites or items but is located within areas identified as having Aboriginal cultural values. This includes the three cultural value items identified as the Burraghihnbihng Wetlands, Hunter River and estuary islands, and Water Spirit (Bunyip or Wau-wai, Yaa-hoo or Wowee Wowee). An Aboriginal cultural heritage interpretation plan would be developed to promote understanding and awareness of the cultural values of the study area, including, but not limited to, development of interpretative signage.

### Traffic and access

Traffic modelling shows that peak period traffic demand along the proposal would increase by between two and 10 per cent (depending on location and peak) by 2028, resulting in average speeds across the network reducing by 34 per cent in peak periods. By 2038, additional planned network changes and proposed urban renewal are forecast to further increase peak period traffic demands.

The proposal would result in:

- Improved average travel speeds by about 34 per cent in 2028, about 31 per cent in 2038 and by about 27 per cent in 2048
- The removal of existing breaks in the median resulting in loss of right turn access at a number of local streets along the proposal. This would improve safety, but would result in less direct local access
- Reduce risk of right turn related crashes at intersections and reduced congestion related crashes along the proposal.

During construction there would be travel delays that would affect commuter, bus and heavy vehicle traffic. There may also be temporary restrictions on property access for residents and businesses.

To mitigate impacts to traffic, businesses and residents, construction is proposed to be staged to ensure Maitland Road remains open in both directions during the extent of construction works, minimising disruptions to general traffic, public transport, pedestrian and cyclist, rail and maritime traffic movements. Transport would consult with affected people along the corridor about property access before the start of construction.

### Noise and vibration

Construction would result in noise impacts at nearby sensitive receiver locations, including residential, businesses and churches land uses. The nearest receivers to the proposal in all Noise Catchment Areas (NCAs) are predicted to be subject to 'Highly Intrusive' worst-case noise impacts, particularly when noise intensive equipment such as rockbreakers or concrete saws are in use near to receivers based on all equipment working simultaneously. There would frequently be periods when works would result in construction noise levels being much lower than the worst-case levels predicted. There would also be times when no equipment is in use and no impacts occur.

Where possible the proposal would be constructed during standard construction hours. However, many activities such as the bridge construction and demolition, utility relocation works, and civil works would be required to be carried out outside of standard construction hours due to safety and traffic disruption reasons.

Consultation would be carried out with the potentially affected receivers. Respite periods would be provided in accordance with Roads and Maritime Services, *Construction Noise and Vibration Guidelines*.

During construction, the main potential sources of construction vibration upon residential receivers are from vibratory rollers and rockbreakers. Some receivers, including five heritage listed items are within minimum working distances for vibration generating activities and impacts may occur.

During operation, exceedances of the criteria are predicted at all NCAs due to cumulative limit exceedances and acute noise levels due to increases in traffic volumes over time. It is noted that an increase of more than 2.0 dB is not expected at any receivers within the REF area. A total of 74 receivers are predicted to have exceedances of the operational road traffic noise criteria. Transport have identified potential mitigation measures to reduce these noise impacts. This includes management of noise and vibration during construction such as deploying acoustic screening around noisy plant and programming construction work to avoid out of hours work where possible. At-property architectural treatments would be assessed on a case by case basis and provided where feasible and reasonable to mitigate any operational noise impacts.

### Socio-economic, property and land use

The proposal would have both wider regional and local benefits through travel time savings, enhanced travel reliability and improved road safety that would support improved access and connectivity for local and regional communities, business and industry. This would have long-term benefits and support improved access to employment areas and future growth and development of strategic centres in Greater Newcastle. Locally, the proposal would require changes to local access routes to residential properties, businesses and community facilities that are likely to be an inconvenience for motorists currently making these movements and require a minor increase to travel distances.

During construction, the community and businesses in the area would likely experience temporary traffic delays, noise and air quality and visual amenity impacts. In addition, it is expected that construction would have an impact on community values, including the Hexham sports fields and riverfront recreational areas used for fishing. Relocation and adjustment of utility services including power, water, sewerage, gas and telecommunications networks would occur as part of the proposal. Minor disruptions to these utility services may occur. Property owners likely to be impacted by any disruptions and access restrictions would be notified before work starts.

The proposal requires strip acquisition of 424 square metres of one privately owned commercial property and 628 square metres of Crown land at Old Maitland Road, Hexham. In addition, the proposal would impact on land within the Main North Rail Line corridor owned by Transport and maintained by ARTC, and vacant land owned by Transport next to the Newcastle Inner City Bypass at the southern end of the proposal and next to the A1 Pacific Highway onramp connection with Hexham Bridge at the northern end of the proposal. The private property affected by the proposal would be acquired by Transport prior to construction in accordance with the provisions of the *NSW Land Acquisition (Just Terms Compensation) Act 1991* and the *Land Acquisition Reform 2016* process.

## Justification and conclusion

The proposal is considered to be consistent with a number of strategies and plans including:

- *Greater Newcastle Future Transport Plan*
- *Hunter Regional Transport Plan*
- *Road Safety Plan 2021*
- *Future Transport Strategy 2056*
- *NSW Freight and Ports Plan 2018-2023.*

The proposal is considered to be important to the region with positive social and economic impacts. Maitland Road is a critical link from the Port of Newcastle to the NLTN and is among the busiest transport corridors carrying some of the highest traffic volumes in the Hunter. Implementation of the proposal is expected to result in reduced congestion and improved safety along Maitland Road between Sandgate and Hexham. This would benefit the local area, the city and port of Newcastle, the Hunter Valley region, as well as wider interstate freight and tourism transport.

Although environmental impacts would occur, safeguards outlined in the REF would be implemented that would manage and mitigate the impacts.

The REF area of the proposal is subject to assessment under Division 5.1 of the EP&A Act. The REF has examined, and considered to the fullest extent possible, all environmental matters affecting or likely to be affected by the proposal.

The proposal's environmental impacts are not considered significant and an environmental impact statement is not required for the REF area. Therefore, approval is not required from the Minister for Planning under Division 5.2 of the EP&A Act. The proposal is unlikely to significantly affect threatened species, populations or ecological communities or their habitats, within the meaning of the *Biodiversity Conservation Act 2016* (BC Act) or FM Act and a Species Impact Statement or entry into the NSW Biodiversity Offset Scheme is not required. The proposal is unlikely to affect Commonwealth land or have a significant impact on any matters of national environmental significance (MNES).

On balance, the proposal's long-term benefits outweigh its impacts, and the proposal is considered to be justified.

## Display of the review of environmental factors

This REF is on display for comment between Tuesday 16 November 2021 to Tuesday 14 December 2021. You can access the documents in the following ways:

### Internet

The documents are available as pdf files on the Transport website at [Pacific Highway improvements at Hexham - Projects - Roads and Waterways – Transport for NSW]

There is also an interactive portal available here: nswroads.work/hexhamportal

### Staffed displays

Transport will host online information sessions where you can learn more about the upgrade and ask the project team questions. The community will be informed of the date and times via the project webpage and on social media.

Currently face-to-face sessions will not be held due to COVID-19 restrictions.

## How can I make a submission on the proposal and REF

Transport for NSW will accept submissions through the REF project portal at nswroads.work/hexhamportal

You can also send your written comments to:

Hexham Straight Project Manager

Locked Bag, 2030

Newcastle NSW 2300

hexhamstraight@transport.nsw.gov.au

Submissions must be received by Tuesday 14 December 2021.

Submissions will be managed in accordance with the Transport Privacy Statement which can be found here https://www.transport.nsw.gov.au/privacy-statement or by contacting 1800 515 141 for a copy.

## How can I comment on the EIS?

The EIS is available online at the City of Newcastle Council Development Application Tracker. Feedback on the EIS proposal must be sent to City of Newcastle Council. Please include the development application reference number **DA2021/01515** and send your written comments to:

By post:

Council postal address PO Box 489 Newcastle NSW 2300

By email:

Council email address DA Submissions at dasubmissions@ncc.nsw.gov.au

## What happens next

After the submission period closes, a report responding to the REF submissions will be drafted and shared with the community. A report responding to the EIS submissions will also be prepared for Council's assessment.

We will consider all feedback received during the display period and continue to consult with the community in the next stage of the project.

# Table of Contents


Executive summary ..... iv

1 Introduction ..... 1
1.1 Proposal identification ..... 1
1.2 Purpose of the report ..... 7
1.3 Terms and definitions ..... 8

2 Need and options considered ..... 9
2.1 Strategic need for the proposal ..... 9
2.2 Existing environment ..... 14
2.3 Proposal objectives and development criteria ..... 25
2.4 Statement of strategic need ..... 27
2.5 Alternatives and options considered ..... 29

3 Description of the proposal ..... 32
3.1 The proposal ..... 32
3.2 Design ..... 40
3.3 Construction methodology ..... 53
3.4 Ancillary facilities ..... 68
3.5 Public utility adjustment ..... 74
3.6 Property acquisition ..... 75

4 Statutory planning framework ..... 77
4.1 Environmental Planning and Assessment Act 1979 ..... 77
4.2 State Environmental Planning Policies ..... 77
4.3 Local Environmental Plans ..... 82
4.4 Other relevant legislation ..... 86
4.5 Commonwealth legislation ..... 92
4.6 Confirmation of statutory position ..... 94

5 Consultation ..... 95
5.1 Consultation strategy ..... 95
5.2 Community involvement ..... 96
5.3 Aboriginal community involvement ..... 97
5.4 ISEPP consultation ..... 100
5.5 Government agency and stakeholder involvement ..... 105
5.6 Ongoing or future consultation ..... 115

6 Environmental assessment ..... 116
6.1 Biodiversity ..... 116
6.2 Flooding and hydrology ..... 146
6.3 Surface water ..... 167
6.4 Groundwater ..... 176
6.5 Coastal processes ..... 180
6.6 Traffic and transport ..... 187
6.7 Aboriginal heritage ..... 206
6.8 Non-Aboriginal heritage ..... 212
6.9 Noise and vibration ..... 221
6.10 Socio-economic, property and land use ..... 241
6.11 Urban design, landscape character and visual impacts ..... 253
6.12 Soils and contamination ..... 268
6.13 Air quality ..... 275
6.14 Climate change ..... 280
6.15 Sustainability ..... 284
6.16 Waste management ..... 287
6.17 Other impacts ..... 289
6.18 Cumulative impacts ..... 291

7 Environmental management ....................................................................297
7.1 Environmental management plans (or system) ......................................297
7.2 Summary of safeguards and management measures .............................298
7.3 Licensing and approvals.........................................................................320

8 Conclusion.............................................................................................321
8.1 Justification ...........................................................................................321
8.2 Objects of the EP&A Act .........................................................................323
8.3 Conclusion .............................................................................................327

9 Certification ............................................................................................329

10 References.............................................................................................330
Terms and acronyms used in this REF...........................................................334

# Appendices

| | |
|---|---|
| Appendix A | Concept design and property acquisition drawings |
| Appendix B | Drainage design figures |
| Appendix C | Urban Design, Landscape Character and Visual Impact Assessment |
| Appendix D | Construction staging figures |
| Appendix E | Consideration of clause 228(2) factors and MNES and Commonwealth land |
| Appendix F | Statutory consultation checklists |
| Appendix G | Consultation |
| Appendix H | Biodiversity Assessment Report |
| Appendix I | Aboriginal heritage |
| Appendix J | Statement of Heritage Impact |
| Appendix K | Phase 1 Soils and Contamination Assessment |
| Appendix L | Flooding and Hydrology Assessment |
| Appendix M | Noise and Vibration Assessment |
| Appendix N | Surface Water and Groundwater Assessment |
| Appendix O | Coastal Processes Assessment |
| Appendix P | Traffic and Transport Assessment |
| Appendix Q | Socio-economic, Property and Land Use Assessment |
| Appendix R | Air Quality Assessment |
| Appendix S | Climate Change Assessment |
| Appendix T | Sustainability Assessment |

# Figures

Figure 1.1 Proposal local area ........ 4
Figure 1.2 The proposal ........ 5
Figure 1.3 The EIS area and REF area ........ 6
Figure 3.1 The proposal ........ 34
Figure 3.2 Typical cross section for proposed road corridor ........ 42
Figure 3.3 Proposed bridge ........ 43
Figure 3.4 Construction activities ........ 54
Figure 4.1 Approval processes under Part 4 and Part 5, Division 5.1 of the EP&A Act ........ 78
Figure 4.2 Location of Coastal Wetlands and proximity areas ........ 80
Figure 4.3 Land use zoning ........ 84
Figure 4.4 National park estate and Hunter Estuary Wetlands Ramsar site ........ 93
Figure 6.1 Threatened ecological communities ........ 120
Figure 6.2 Key fish habitat as mapped by the NSW Department of Primary Industries ........ 127
Figure 6.3 Groundwater dependent ecosystems ........ 133
Figure 6.4 Key waterways and drainage features ........ 150
Figure 6.5 Daily traffic volumes of key routes in the network ........ 191
Figure 6.6 Construction haulage routes ........ 195
Figure 6.7 Items of local heritage significance ........ 214
Figure 6.8 Mapping overlay showing the location of the previous bridge alignments ........ 217
Figure 6.9 Site plan, receivers and noise monitoring locations ........ 225
Figure 6.10 Worst-case predicted change in operational noise (2038 night time, REF area minus without REF area) ........ 237
Figure 6.11 Landscape character zones ........ 256
Figure 6.12 Key viewpoints ........ 260
Figure 6.13 Acid sulfate soil risk ........ 270
Figure 6.14 Areas of environmental interest ........ 272

# Tables

Table 2.1 Hexham Railway Station operating hours and service frequencies ........ 23
Table 2.2 Proposal design criteria ........ 25
Table 2.3 Urban and landscape design objectives ........ 26
Table 2.4 Design refinements ........ 30
Table 3.1 Proposed intersection and access roads design changes ........ 44
Table 3.2 Proposed water quality controls and indicative sizes ........ 48
Table 3.3 Indicative construction plant for each construction scenario ........ 65
Table 3.4 Materials and estimated quantities required ........ 66
Table 3.5 Daily construction traffic movements ........ 67
Table 3.6 Description of ancillary facilities activities ........ 70
Table 3.7 Construction compound access details ........ 73
Table 3.8 Public utility adjustments ........ 74

Table 3.9 Proposed property acquisition ..... 75
Table 4.1 Consistency of REF area with Newcastle LEP zones ..... 82
Table 5.1 Summary of issues raised by the community ..... 96
Table 5.2 Summary of PACHCI ..... 97
Table 5.3 Issues raised through Aboriginal community consultation ..... 98
Table 5.4 Issues raised through ISEPP consultation ..... 100
Table 5.5 Issues raised through formal consultation with DPI (Fisheries) ..... 106
Table 5.6 Issues raised during consultation with agencies and stakeholders ..... 107
Table 6.1 PCTs in the REF area of the proposal ..... 118
Table 6.2 Threatened flora considered to have potential to occur within the study area ..... 124
Table 6.3 Targeted fauna species recorded in the study area ..... 124
Table 6.4 Fish habitat classification ..... 130
Table 6.5 MNES identified within the study area ..... 135
Table 6.6 Direct impacts to PCTs ..... 136
Table 6.7 Direct impacts to TEC's ..... 137
Table 6.8 Potential impacts of proposal construction on aquatic habitats ..... 137
Table 6.9 Safeguards and management measures – biodiversity ..... 142
Table 6.10 Offset contribution option for impacts to aquatic impacts (DPI 2013) ..... 146
Table 6.11 Quantitative flood management objectives ..... 147
Table 6.12 Number of buildings flooded above floor in the existing case ..... 153
Table 6.13 Number of buildings flooded above floor during the one per cent AEP flood event for Stages 1-3 ..... 157
Table 6.14 Number of buildings flooded below floor during the one per cent AEP flood event for Stages 1-3 ..... 158
Table 6.15 Estimate of construction water demands ..... 158
Table 6.16 Summary of estimated changes to stormwater discharges from the 26 culverts that were assessed ..... 160
Table 6.17 Number of buildings flooded above during operation of the proposal ..... 165
Table 6.18 Number of buildings impacted below floor during operation of the proposal ..... 165
Table 6.19 Safeguards and management measures – hydrology and flooding ..... 166
Table 6.20 Existing surface water quality of key waterways, wetlands and drains ..... 169
Table 6.21 Safeguards and management measures – surface water ..... 174
Table 6.22 Groundwater levels at monitoring bores ..... 177
Table 6.23 Groundwater quality ..... 178
Table 6.24 Safeguards and management measures – groundwater ..... 180
Table 6.25 Potential direct impacts on coastal processes associated with the REF area ..... 184
Table 6.26 Safeguards and management measures – coastal processes ..... 186
Table 6.27 LoS of service criteria ..... 188
Table 6.28 Performance of modelled intersections in 2017 ..... 192
Table 6.29 Existing public transport services ..... 192
Table 6.30 Daily construction traffic movements ..... 194
Table 6.31 Network statistics (2028) ..... 197

Table 6.32 Network statistics (2038) .... 198
Table 6.33 Network statistics (2048) .... 199
Table 6.34 Performance of modelled intersections with and without the proposal in 2028, 2038 and 2058 200
Table 6.35 Safeguards and management measures – traffic and transport .... 204
Table 6.36 Summary of Aboriginal cultural values .... 209
Table 6.37 Safeguards and management measures –Aboriginal heritage .... 211
Table 6.38 Listed heritage items within the vicinity of the REF area .... 213
Table 6.39 Summary timeline of the Ironbark Creek crossing point .... 216
Table 6.40 Direct and indirect construction impacts on listed heritage items located next to the REF area 218
Table 6.41 Safeguards and management measures – non-Aboriginal heritage .... 220
Table 6.42 Construction noise and vibration guidelines .... 222
Table 6.43 NCAs and surrounding land uses .... 224
Table 6.44 Summary of unattended noise logging results .... 227
Table 6.45 Specific construction noise management levels - $L_{Aeq(15min)}$ (dBA) - for proposal .... 228
Table 6.46 Human comfort intermittent vibration limits (BS6472-1992) .... 229
Table 6.47 Guidance on effects of vibration levels for human comfort (BS 5228.2-2009) .... 229
Table 6.48 Guideline values for short term vibration on structures .... 229
Table 6.49 NCG criteria for residential receivers .... 230
Table 6.50 NCG criteria for other sensitive receivers .... 230
Table 6.51 NML exceedance bands and corresponding subjective response to impacts .... 232
Table 6.52 Predicted worst-case construction noise exceedances – residential receivers .... 233
Table 6.53 Overview of commercial/industrial and other sensitive receiver NML exceedances .... 234
Table 6.54 Construction vibration – heritage items .... 235
Table 6.55 Predicted road traffic noise levels at most affected residential receivers in each NCA .... 236
Table 6.56 Receivers eligible for consideration for 'additional noise mitigation' .... 239
Table 6.57 Safeguards and management measures – noise and vibration .... 239
Table 6.58 Community profile (*Source: ABS 2016 Census*) .... 243
Table 6.59 Social infrastructure .... 245
Table 6.60 Safeguards and management measures – socio-economic, land use and property impacts .... 251
Table 6.61 Visual and landscape character impacts rating matrix .... 254
Table 6.62 Summary of landscape character zones .... 254
Table 6.63 Impacts on landscape character zones .... 263
Table 6.64 Impacts on viewpoints .... 265
Table 6.65 Safeguards and management measures – urban design, landscape character and visual impacts .... 267
Table 6.66 Safeguards and management measures – soils and contamination .... 274
Table 6.67 Measured parameters at nearby DPIE monitoring stations .... 276
Table 6.68 Assumed background levels in the vicinity of the proposal. .... 277
Table 6.69 Safeguards and management measures – air quality .... 279
Table 6.70 Current and projected climate change in the Southern Hunter region in the near future (2030, 2050 and 2090) .... 280
Table 6.71 Safeguards and management measures – climate change impacts .... 283

Table 6.72 Sustainability focus areas that relate to key environmental constraints for the proposal ........... 285
Table 6.73 Safeguards and management measures –sustainability impacts .............................................. 286
Table 6.74 Waste quantities and reuse potential from demolition of the existing bridge ............................. 288
Table 6.75 Safeguards and management measures – waste management................................................ 288
Table 6.76 Summary of existing environment and potential impacts for other minor environmental factors 289
Table 6.77 Safeguards and management measures – other minor environmental impacts......................... 290
Table 6.78 Summary of cumulative impacts.............................................................................................. 294
Table 6.79 Safeguards and management measures – cumulative impacts ................................................ 296
Table 7.1 Summary of safeguards and management measures ................................................................ 298
Table 7.2 Summary of licensing and approvals required ............................................................................ 320
Table 8.1 Objects of the EP&A Act............................................................................................................ 323

# 1 Introduction

This chapter introduces the proposal and provides the context of the environmental assessment. This chapter also outlines the proposal objectives and development history and the purpose of the report provided.

## 1.1 Proposal identification

Transport for NSW (Transport) is proposing to widen about six kilometres of the Pacific Highway (Maitland Road) from four lanes to six lanes, starting about 290 metres south from the intersection with the Newcastle Inner City Bypass (NICB) at Sandgate, and extending through to about 760 metres north of Hexham Bridge, in Hexham, NSW (the proposal). The proposal would create two additional lanes in each direction and would include the replacement twin bridges across Ironbark Creek. The section of road is known as the 'Hexham Straight' and is located within the City of Newcastle local government area (LGA) with a small portion of the construction area within the Port Stephens Council LGA (refer to **Figure 1.1**).

Maitland Road is a critical link as part of the National Land Transport Network (NLTN) and is among the busiest transport corridors carrying some of the highest traffic volumes in the Hunter. The proposal is required to reduce congestion and improve safety along Maitland Road. The proposal forms a part of the wider Pacific Highway upgrade program to provide a four lane divided road from Hexham to the Queensland border. Upgrade works on the Pacific Highway originally began in 1996 and 657 kilometres are now operational. The improvements support regional development and provide safer travel, reduced travel times with improved efficiency, more consistent and reliable travel and improved amenity for local communities.

The proposal is subject to assessment under two planning pathways, a review of environmental factors (REF) under Part 5, Division 5.1of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and an environmental impact statement (EIS) under Part 4 of the EP&A Act. The majority of the proposal (the REF area) is subject to approval under Division 5.1 of the EP&A Act that would be determined through this REF by Transport. However, a small part of the proposal (3.28 hectares) is within land mapped as 'Coastal Wetlands' under State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP). As such, that part of the proposal (known as the EIS areas) is subject to approval under Part 4 of the EP&A Act and considered within an EIS.

Together, this REF and the separate EIS assess the potential environmental impacts of the proposal and it is intended that these documents be read in conjunction with each other.

### 1.1.1 The proposal

Key features of the proposal would include:

- Widening of Maitland Road for about six kilometres starting about 290 metres to the south of the intersection with the NICB (A37) at Sandgate and extending to about 760 metres north of Hexham Bridge at Hexham on Maitland Road. The highway would be widened from generally two lanes in each direction to three lanes in each direction
- Replacement of the bridge which spans Ironbark Creek with new twin bridges. The existing bridge and all piers would be demolished, and the outlet of a small drainage channel would be relocated about 10 metres to the east of its existing location
- Minor improvements to nine signalised intersections, including:
    - NICB and Maitland Road intersection
    - Old Maitland Road, Sandgate to the south of the Calvary St Joseph's Retirement Community at Sandgate and the Maitland Road intersection

  - Northbound U-turn facility and pedestrian facility opposite Calvary St Joseph's Retirement Community at Sandgate
  - Sparke Street and the Maitland Road intersection
  - Shamrock Street and the Maitland Road intersection
  - Old Maitland Road to the south of Hexham Bowling Club and the Maitland Road intersection
  - Old Maitland Road, Hexham to the north of Hexham Railway Station, rail maintenance access road, and the Maitland Road intersection
  - The southbound A1 Pacific Highway exit ramp off Hexham Bridge and the Maitland Road intersection
  - Southern access to the Oak Factory and Maitland Road intersection.
- Minor improvements to access roads, unsignalised intersections, entry and exit ramps connecting to the A1 Pacific Highway and the U-turn facility at the northern end of the proposal
- Closure of breaks in the existing median and direct access two local side roads, one private access road and one U-turn facility including:
  - Northbound access into and out of the Millams Road and Maitland Road intersection
  - Southbound access into and out of the Fenwick Street and Maitland Road intersection
  - Northbound access into and out of the Gilbert and Roach Trucks Newcastle access road on Maitland Road
  - Southbound access into the signalised U-turn facility on Maitland Road to the south of Hexham Railway Station
- Provision for a three metre wide shared use path northbound between the Oak Factory and the northern end of the proposal and a new section of off-road shared use path heading east along the NICB
- Widening of existing footpaths at intersections and bus stops
- Adjustments to property accesses and bus stops
- Provision of U-turn facilities on Sparke Street, Shamrock Street, and Old Maitland Road at Hexham
- Relocation of utilities including power, communications, water, gas, and wastewater services
- Modifications and maintenance of existing drainage structures including pits, pipes, headwalls, and culverts to suit the road widening and to maintain capacity
- Construction of retaining walls to minimise impacts on nearby properties
- Property acquisition, leases, and adjustments
- Intrusive investigation works such as geotechnical investigations
- Construction of hardstand for oversize and overmass (OSOM) vehicle parking at the southern and northern end of the proposal
- Temporary construction facilities, including site compounds and stockpile sites at:
  - One area located in the industrial estate located on Old Maitland Road, Sandgate to the south of Calvary St Joseph's Retirement Community (Compound 1)
  - Two areas located in the industrial estate located to the east of Maitland Road and the west of Old Maitland Road, Hexham extending north from the northern boundary of the Hexham sports field to the area of road corridor underneath the entry ramps to the A1 Pacific Highway and Hexham Bridge (Compound 2)
  - Two areas located in the industrial estate located to the west of Maitland Road, Hexham near the Oak Factory (Compound 3)

- One area located on vacant land at the northern end of the proposal to the east of the U-turn facility on Maitland Road at Hexham and to the west of the Hunter River (Compound 4).

An overview of the proposal is shown in **Figure 1.2** and the concept design drawings are included in **Appendix A. Chapter 3** describes the proposal in more detail. Construction of the proposal would be staged and would take about 30 months to construct.

### 1.1.2 The EIS area

The EIS areas assesses impacts of the proposal within land subject to the CM SEPP, which are referred to as the EIS area and is comprised of three separate locations (refer to **Figure 1.3**):

- EIS Area 1 – A small area located to the south of Ironbark Creek on the eastern side of Maitland Road and to the west of a parcel of Crown land and a section of Hunter Wetlands National Park. The land mapped as Coastal Wetlands includes areas of remnant mangrove and saltmarsh vegetation and also crosses sections of an existing track that provides access to the south bank of Ironbark Creek and to the base of Ironbark Creek Bridge.
- EIS Area 2 – A small area located to the north of Ironbark Creek on the eastern side of Maitland Road. The land mapped as Coastal Wetlands includes areas of remnant mangrove, saltmarsh and freshwater wetland vegetation.
- EIS Area 3 – A small area located on the west bank of the south channel of Hunter River to the east of Maitland Road and to the northwest of Millams Road and the Ash Island Bridge. The land mapped as Coastal Wetlands includes areas of the road shoulder and remnant mangrove vegetation.

There is potential for the proposal to indirectly impact other areas mapped as Coastal Wetlands under the CM SEPP. These impacts have been assessed within the EIS and relevant specialist reports. The proposal within the EIS areas would be constructed and operated together with the proposal within the REF area, which has been assessed in this REF prepared by Transport.

### 1.1.3 The REF area

The REF area assesses all other aspects of the proposal included in **Section 1.1.1** that are outside the footprint of the EIS area described in **Section 1.1.2** and shown in **Figure 1.3**.

### 1.1.4 Relationship of the REF and EIS

Detailed discussion of the planning approval framework and consent requirements is provided in **Chapter 4**. In summary, development consent under Part 4 is usually not required for development for the purposes of a road being undertaken by Transport as a public authority. Rather, this development is ordinarily assessed as an 'activity' under Division 5.1 of the EP&A Act.

However, on those parts of the land which are identified as Coastal Wetland under the CM SEPP, the development is classified as designated development and requires consent from City of Newcastle under Part 4 of the EP&A Act. The part of the proposal located within the Coastal Wetlands is therefore assessed under Part 4 of the EP&A Act. An EIS is required to assess the impacts of any works located within the Coastal Wetlands or any impacts on a coastal wetland. The EIS provides an assessment of the EIS area in accordance with Part 4 of the EP&A Act.

This REF has been prepared for the assessment of the REF area in accordance with Division 5.1 of the EP&A Act to assess the REF area of the proposal. This document would be determined by Transport. The EIS area would be constructed and operated together with the REF area. Together, the EIS and the REF assess the potential environmental impacts of the proposal and it is intended that these documents be read in conjunction with each other. The cumulative impacts of the proposal are considered in **Section 6.18**.


**Legend**

- Construction area
- National Park
- Waterway
- Railway
- Road

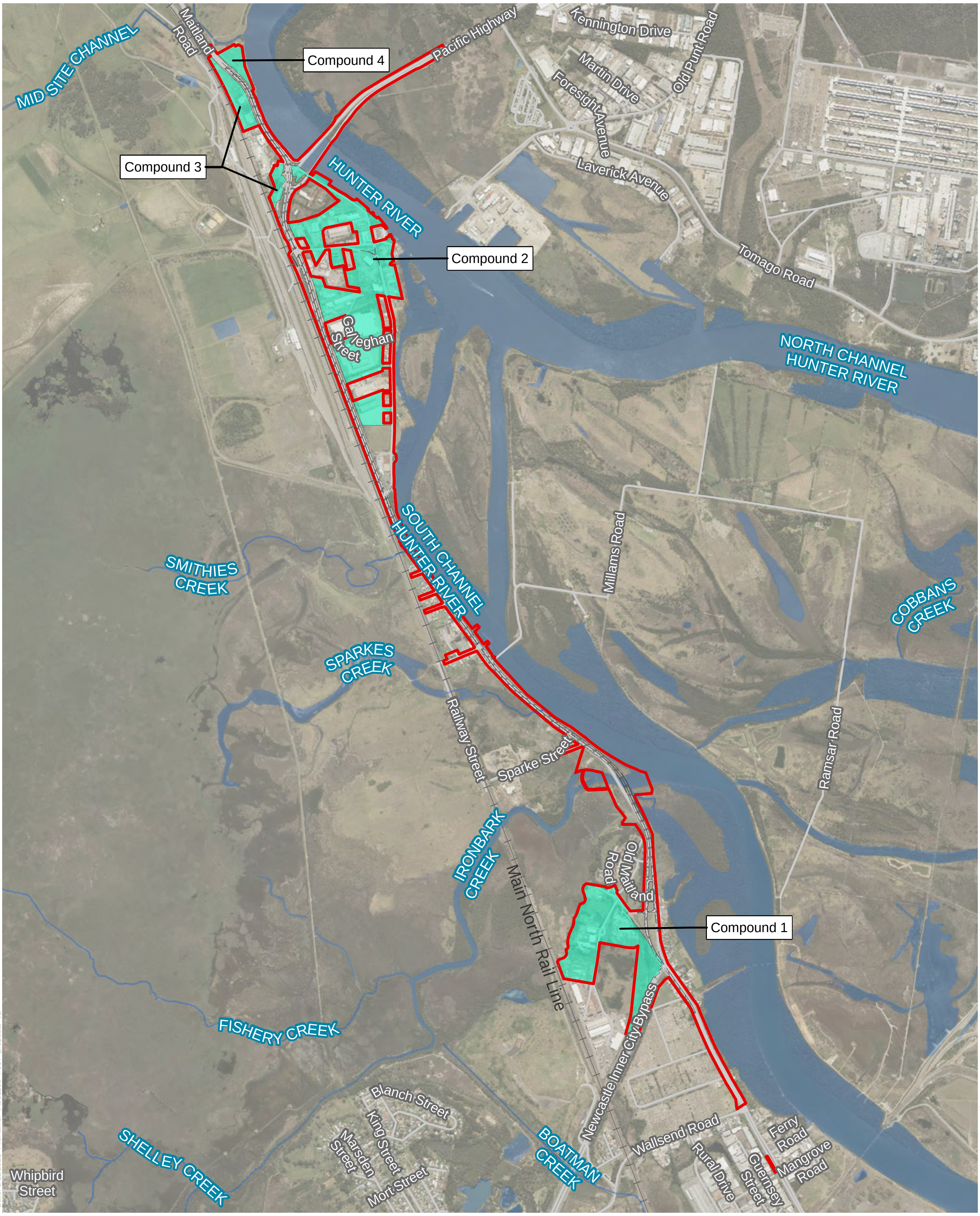
0 1 2 km

Scale 1:100,000 at A4

GDA94 MGA56

**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

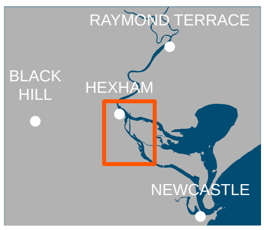
**Figure 1.1** Proposal local area




## Legend

- The proposal
- Construction area
- Construction compound
- Waterway
- Road
- Railway

0 200 400 m
Scale 1:30,000 at A4
GDA94 MGA56




**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 1.2** The proposal

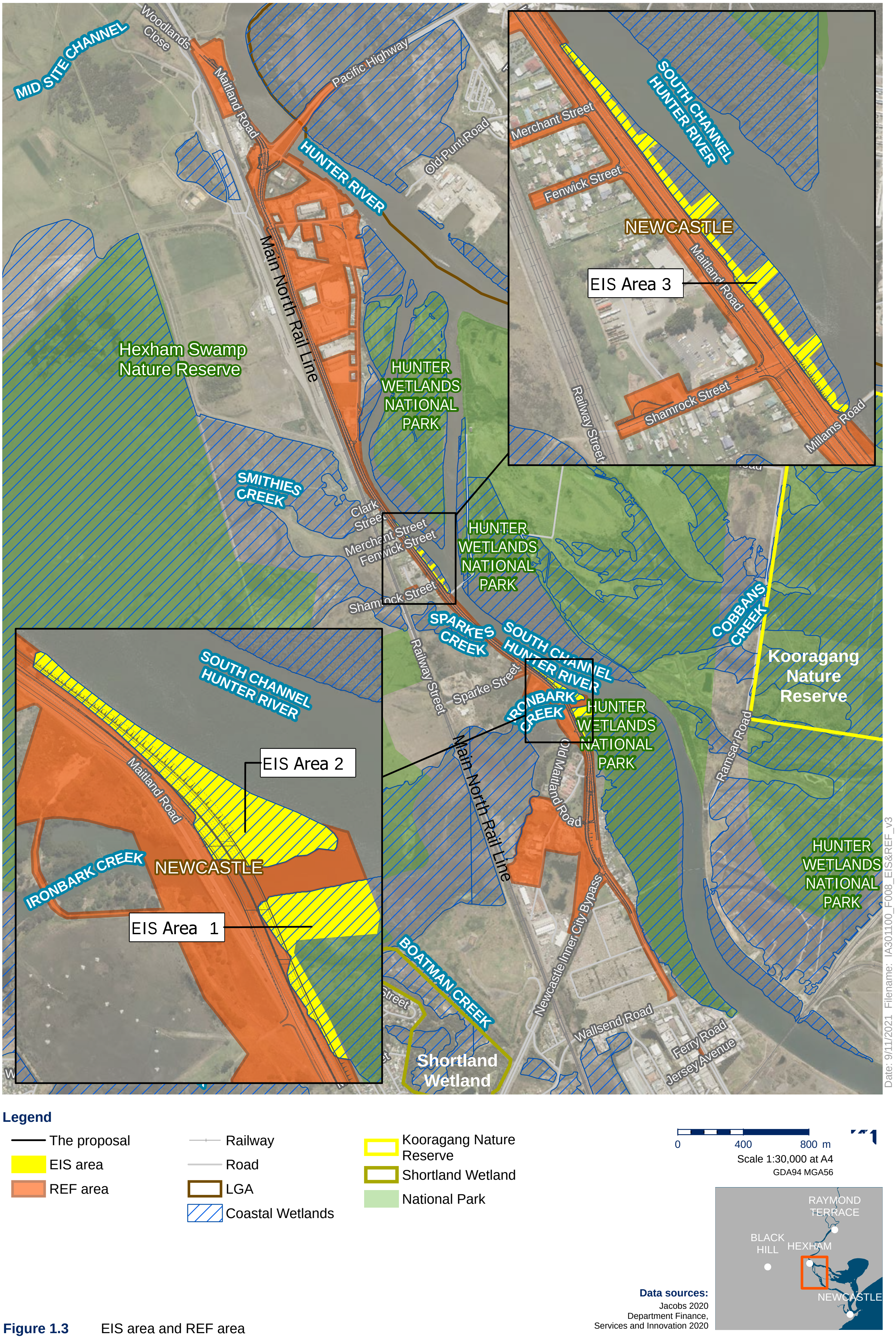



**Figure 1.3** EIS area and REF area

### 1.1.5 Location

The proposal is located about ten kilometres north of the City of Newcastle in the suburbs of Sandgate and Hexham. To the east and in some locations next to the proposal is the Hunter River and the South Channel of the Hunter River and the proposal crosses Ironbark Creek. The major freight rail line into the Port of Newcastle uses the Main North Rail Line and this is located to the west of the proposal and in some locations immediately next to the proposal. The Hunter Wetlands National Park is located both to the east and west of the proposal and the area to the west is also known as Hexham Swamp Nature Reserve. Much of the low-lying national park estate as well as some other low-lying swamp areas including the larger back barrier Hexham Swamp areas are identified as wetlands under the CM SEPP. These low-lying areas connect to two areas of Ramsar listed wetlands identified as the (Hunter Estuary Wetlands) include Kooragang Nature Reserve about one kilometre to the east and Shortland Wetlands (including Hunter Wetlands Centre Australia) about 800 metres to the west of the proposal.

The land use along the REF area is characterised by a mix of transport corridors (road and rail), environmental areas including wetlands and waterways, recreational areas both public and private and light and heavy industrial areas.

The main features of the construction area and its surrounds include:

- Sandgate Cemetery
- Calvary St Joseph's Retirement Community
- Hexham Bowling Club
- Hexham Park and Cricket Grounds
- Hexham Railway Station
- Residential properties which are located on both sides of Maitland Road to the south of the Calvary St Joseph's Retirement Community, to the west of the proposal along Shamrock Street, Fenwick Street, Merchant Street and Clark Street and along Old Maitland Road behind the industrial estate at Hexham
- Industrial and commercial properties located to the north of the NICB, off Sparke Road at Sandgate and at the northern end of the proposal to the east and north of the Hexham Railway Station.

## 1.2 Purpose of the report

This REF has been prepared by Jacobs on behalf of Transport. For the purposes of these works, Transport is the proponent and the determining authority under Division 5.1 of the EP&A Act.

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

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

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

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

The findings of the REF would be considered when assessing:

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

## 1.3 Terms and definitions

The following terms are used in this report:

- **Proposal** – the widening of a six kilometre section of Maitland Road from four lanes to six lanes, starting about 290 metres south of the intersection with the NICB at Sandgate, and extending through to about 760 metres north of Hexham Bridge, in Hexham, NSW
- **Construction area** – the area to be directly impacted by the proposal. This comprises the future construction footprint of the proposed bridge over Ironbark Creek and the upgrade of Maitland Road, including all roadside cut and fill, construction compound areas and parking areas for OSOM vehicles, refer further to **Section 1.1.1**
- **Study area** – the construction area of the proposal and additional areas that are likely to be affected by the proposal, either directly or indirectly
- **EIS area** – the areas of the proposal to be assessed by the EIS and within land subject to the CM SEPP as defined in **Section 1.1.2**
- **REF area** – the areas of the proposal to be assessed by this REF and this covers all other aspects of the proposal included in **Section 1.1.1** that are outside the footprint of the EIS areas described in **Section 1.1.2**
- **Proposal local area** – the area within 10 kilometres of the proposal.

# 2 Need and options considered

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

## 2.1 Strategic need for the proposal

### 2.1.1 NSW State Infrastructure Strategy 2018-2038

The *State Infrastructure Strategy 2018-2038* (the State Infrastructure Strategy) (Infrastructure NSW, 2018) sets the strategic vision for infrastructure across NSW over 20 years and combined with the Future Transport Strategy 2056 and the Regional Development Framework (NSW Government, 2018), brings together infrastructure investment and land-use planning for cities and regions within NSW.

The State Infrastructure Strategy outlines Infrastructure NSW's recommendations for priority transport infrastructure projects and initiatives for NSW to 2038, to ensure the transport system creates opportunities for people and businesses to access the services and support they need.

The State Infrastructure Strategy aligns with the benefits of the proposal, such as improving travel times and improving road safety within the proposal. The State Infrastructure Strategy identifies Hexham as a priority area of the NLTN and identifies the proposal as one of the last major upgrades required along the Pacific Highway to complete a high-quality, free flowing route. The proposal is considered a critical link in the NLTN, particularly for the coastal Sydney to Brisbane corridor. The NLTN is a national network of important road and rail infrastructure determined under the *National Land Transport Act 2014*.

The proposal would support key recommendations made for the transport sector as it would increase freight capacity and efficiency of the road network (Recommendations 41 and 42) and develop pedestrian and cycle links to support the mass transit system while enhancing accessibility and improving road safety in the area (Recommendations 50 and 51).

### 2.1.2 Future Transport Strategy 2056

The *Future Transport Strategy 2056* (the Future Transport Strategy) (Transport, 2018a) underpins and supports the State Infrastructure Strategy and sets the 40-year vision, strategic directions, and outcomes for customer mobility in NSW. It is delivered through a series of supporting plans, including the Regional NSW Services and Infrastructure Plan which is further underpinned by supporting plans. The relevant supporting plans include the *Greater Newcastle Future Transport* (Transport 2018b), *Plan, Road Safety Plan 2021* (Road Safety Plan) (Transport, 2018d) and the *NSW Freight and Ports Plan 2018-2023* (Transport, 2018c).

To support these outcomes, the strategy contains policy, service and (road, rail, active) infrastructure improvements and potential initiatives. The proposal is identified in *Greater Newcastle Future Transport Plan* as a committed initiative for the next 0 to 10 years. The proposal would help meet a number of outcomes of the Future Transport Strategy including:

- A strong economy, by providing efficient public transport and road connections for passengers and freight
- Safety and performance, by helping to move people and goods safely, efficiently, and reliably
- Sustainability, by making the best use of available resources and assets.

### 2.1.3 NSW Freight and Ports Plan 2018-2023

The *NSW Freight and Ports Plan 2018-2023* (Transport, 2018c), as a supporting plan to the Future Transport Strategy, is central to the NSW Government's long-term vision for freight transport to be more efficient, more accessible, safer and more sustainable for the benefit of producers, operators, customers and communities across NSW.

The *NSW Freight and Ports Plan 2018-2023* identifies the freight routes between the New England Highway at Hexham, the M1 Pacific Motorway and the Pacific Highway at Black Hill and Raymond Terrace as key initiatives to improve the capacity of the freight network in the next 5-10 years (2023-2028).

One of the key objectives of the plan is to increase efficiency, connectivity, and access by improving the efficiency of existing infrastructure and ensuring greater connectivity and access along key freight routes. The proposal would provide a more efficient route along Maitland Road, the Pacific Highway and New England Highway between Sandgate and Hexham and provide better access for high productivity vehicles to key employment areas in the region, such as Hexham, Sandgate, Tomago, Beresfield, Black Hill, the Port of Newcastle and Greater Newcastle.

### 2.1.4 Road Safety Plan 2021

The *Road Safety Plan* (Transport, 2018d) details the NSW Government's commitment to improving safety on NSW roads. It outlines the State Priority Target to reduce fatalities by 30 per cent by 2021 (compared to average annual fatalities over 2008–2010) and aligns with the Towards Zero vision of the *Future Transport Strategy*, which aims to have zero fatalities and serious injuries on NSW roads by 2056.

The delivery of the proposal is consistent with the goals of the Road Safety Plan. The proposal would generally improve road safety by:

- Improving traffic flow, reducing the number of stops vehicles make leading to a decreased risk of rear end crashes
- Removal of the southbound merge to the south of the Old Maitland Road, Hexham (south) and Maitland Road intersection would decrease lane change crashes
- Improvements to the cycle network at the northern end of the proposal through improved cycling infrastructure would reduce the risk of cyclist crashes in this location
- Removal of uncontrolled U-turn provisions.

### 2.1.5 Regional NSW Services and Infrastructure Plan

The *Regional NSW Services and Infrastructure Plan* (NSW Government, 2018) is a supporting study to the Future Transport Strategy which focuses on regional centres throughout NSW. The Regional NSW Services and Infrastructure Plan aims to produce a modern multi-modal freight transport network and identify the need to lift freight productivity above previous results as a key objective.

The proposal would enable economic development by increasing the capacity and efficiency on Maitland Road including sections of the Pacific Highway and New England Highway while improving road safety, travel times, accessibility, and reliability (Customer Outcomes 6, 7 and 10). The proposal would also improve passenger and freight movements from key employment areas such as Tomago, Black Hill, and Beresfield to the Global Gateway of Newcastle (with its trade port, new cruise terminal and airport) (Customer Outcome 4).

### 2.1.6 Australian Infrastructure Plan and Priority List

The *Australian Infrastructure Plan* (the Plan) (Infrastructure Australia, 2016) sets out the infrastructure challenges and opportunities that Australia faces over the next 15 years and the solutions required. The Plan was informed by a comprehensive review of existing and required infrastructure over the coming decades. The Plan has four main themes:

- Productive cities, productive regions
- Efficient infrastructure markets
- Sustainable and equitable infrastructure
- Better decisions and better delivery.

The *Infrastructure Priority List* (Infrastructure Australia, 2020), which is part of the Plan, is designed to give guidance to decision makers and provide transparency for industry and the community. It is a 'rolling' list that is updated periodically as proposals move through development and delivery and in response to emerging challenges and opportunities.

The 2020 *Infrastructure Priority List* identifies the regional NSW road network safety improvements as a high priority initiative. The proposal would address this initiative by improving traffic flow, including lane modifications that would decrease lane change crashes and improving the cycle network. The priority list provided an indicative timeframe for this initiative as 0-5 years.

The 2020 Infrastructure Priority List is available on the Infrastructure Australian website: https://www.infrastructureaustralia.gov.au/publications/infrastructure-priority-list-2020-august.

### 2.1.7 National Freight and Supply Chain Strategy

The *National Freight and Supply Chain Strategy* (Transport and Infrastructure Council, 2019) (the Strategy) is the national approach to Australia's freight and supply chains. This strategy builds on the foundation laid through the *National Ports Strategy* (Australian Government, 2012) and *National Land Freight Strategy* (Australian Government, 2013), and expands freight and supply chain networks as an integrated whole. The Strategy sets an agenda for government and industry action across all freight modes over the next 20 years and beyond and is supported by the National Action Plan which details key actions to be delivered by government to achieve goals of the Strategy. The Strategy commits to action in four critical areas:

- Smarter and targeted infrastructure
- Enable improved supply chain efficiency
- Better planning, coordination, and regulation
- Better freight location and performance data.

The proposal would improve access to major freight gateways to support the critical area of smarter and targeted infrastructure investment. The proposal has been designed to accommodate heavy vehicles and would increase efficiency in freight movements between Sydney and Brisbane.

### 2.1.8 National Road Safety Strategy 2021-2030

A new *National Road Safety Strategy* for the decade 2021-2030 is currently being developed and is expected to be finalised and approved in the first half of 2021. This new strategy will recognise that road safety is achieved by three key themes: Safe Roads, Safe Vehicles and Safe Road Use.

The current strategy, the *National Road Safety Strategy 2011–2020* (Australia Transport Council, 2011), represents the commitment of federal, state and territory governments to road safety by setting out an agreed set of national goals, objectives and action priorities to reduce fatal and serious injury crashes on Australian roads.

The proposal would provide the opportunity to reduce crashes, as it would improve the design of the existing Maitland Road, via additional lanes, new twin bridges across Ironbark Creek and improvements to access roads, intersections and ramps connecting to the A1 Pacific Highway. By improving road safety, the proposal would directly support the aims of the current *National Road Safety Strategy 2011–2020*.

### 2.1.9 Lower Hunter Regional Strategy 2006-2031

The *Lower Hunter Regional Strategy* (NSW Department of Planning, 2006) represents an agreed NSW Government position on the future of the Lower Hunter. It is the primary planning document for the Lower Hunter Region and has been prepared to complement and inform other relevant State planning instruments.

The proposal aligns with the *Lower Hunter Regional Strategy* by improving traffic movement through the lower Hunter to facilitate the increase in traffic anticipated due to growth in housing and employment lands in the area.

### 2.1.10 Greater Newcastle Metropolitan Plan 2036

The *Greater Newcastle Metropolitan Plan 2036* (Metropolitan Plan) (DPE, 2018) (the Metropolitan Plan) sets out strategies and actions that will drive sustainable growth across the Greater Newcastle area. The plan aligns with the vision and goals of the *Hunter Regional Plan 2036* (Department of Planning, Industry and Environment ((DPIE), 2016)) and guides local planning across the Greater Newcastle LGAs of Cessnock City, Lake Macquarie City, Maitland Council, City of Newcastle and Port Stephens Council.

The vision for Greater Newcastle is to be “Australia’s newest and emerging economic and lifestyle city, connected with northern NSW and acknowledged globally as:

- Dynamic and entrepreneurial, with a globally competitive economy and the excitement of the inner city and green suburban communities
- Offering great lifestyles minutes from beaches or bushland, the airport or universities, and from the port to the lake
- A national leader in the new economy, with smarter cities and carbon neutral initiatives, and with collaborative governance that makes it a model to others in creating and adapting to change.”

The Metropolitan Plan recognises Tomago as a major trading hub and manufacturing site and identifies it as one of the 11 ‘catalyst areas’ within Greater Newcastle. These areas will underpin new job opportunities for Greater Newcastle with Tomago projected to provide an additional 700 jobs, with a total of 8500 jobs. The Metropolitan Plan recognises that good access to transport services is critical for new employment opportunities to be realised within the catalyst areas and that opportunities exist to better connect trade movements across NSW and nationally via major road networks, including the Pacific Highway, and the national rail network.

The proposal is recognised in the Metropolitan Plan and would support the vision and outcomes for Greater Newcastle by providing improved access and connectivity to key employment precincts such as Tomago, allowing the safe, efficient and reliable movement of people and freight.

### 2.1.11 Hunter Regional Plan 2036

The *Hunter Regional Plan 2036* (DPIE, 2016) is the NSW Government’s strategy for guiding land use planning decisions for the Hunter Region for the next 20 years.

The *Hunter Regional Plan’s* vision recognises that infrastructure investment is an important factor for economic development across the Hunter. It supports freight, health and education services, agribusiness, and tourism, as well as building resilience to global economic cycles and climate change.

The plan sets four goals and a number of directions to achieve the vision ‘to create a leading regional economy in Australia, with a vibrant metropolitan city at the heart’. The Hunter Region is the largest regional economy in Australia and largest regional contributor to NSW’s gross domestic product. The proposal would help expand the regional economy (Goal 1) by enhancing inter-regional transport linkages to support economic growth (Direction 4).

### 2.1.12 Hunter Regional Transport Plan

The *Hunter Regional Transport Plan* (NSW Government, 2014) and *Hunter Regional Transport Plan Update* (NSW Government, 2016a) identify the need to ensure the efficient movement of freight within the Hunter region. Key transport challenges identified in the Hunter Regional Transport Plan which are relevant to the proposal include:

- Accessibility to regional facilities, such as education, health, jobs, and Newcastle Airport
- Road congestion and safety
- Freight capacity constraints on the road and rail networks
- Impact of freight transport on towns
- Improving connections between smaller towns to regional centres.

The proposal would address these challenges by improving access to facilities within the Lower Hunter region, including to the Newcastle Airport and key employment areas. The proposal would also improve access for heavy vehicles within the road network and improve road safety. The Hunter Regional Transport Plan identifies a commitment to maintaining a high-quality road corridor between Sydney and Brisbane to support anticipated growth. The proposal is one of the last major upgrades required to complete a high-quality route between Sydney and Brisbane.

The *Hunter Regional Transport Plan* notes that the Pacific Highway can experience congestion associated with daily peak periods and holiday periods and identifies a commitment to plan for the proposal to ensure efficient freight movement. The proposal would substantially reduce travel times in both the morning and evening peaks, including during holiday periods. The proposal would also provide a route which reduces the overall freight transport time and cost for heavy vehicles along the major north-south and east-west connections.

### 2.1.13 Greater Newcastle Future Transport Plan

The *Greater Newcastle Future Transport Plan* (Transport, 2018b) is a supporting study to the Future Transport Strategy and provides the overarching strategic transport network and vision that will guide future transport planning for the Greater Newcastle area. The plan builds on the platform being established to increase liveability in Greater Newcastle through more sustainable travel behaviour.

The plan identifies that the population within the metro Newcastle area is expected to increase over the next forty years. Transport service planning is required to respond to this population change, with one of the key outcomes of the *Greater Newcastle Future Transport Plan* being to improve connection to jobs, services, and recreation. The proposal would support this objective by increasing the connection, travel time and safety of key roads within the Greater Newcastle area, including the Maitland Road and New England Highway, which the Plan identifies as important in providing through movements as well as north-south and east-west connections within Greater Newcastle.

The proposal would also support expansion of Newcastle Airport, which the plan identifies as currently expanding, by improving access, and the movement of freight through Greater

Newcastle, which the plan identifies as important to the economic function and development of the Hunter region and New South Wales.

Upgrades to the strategic network of primary freight routes comprising of the New England Highway, M1 Pacific Motorway through to the A1 Pacific Highway at Raymond Terrace and the strategic junction with the New England Highway and Maitland Road are identified as committed initiatives (0-10 years) within this plan.

#### 2.1.14 City of Newcastle Local Strategic Planning Statement

The *City of Newcastle Local Strategic Planning Statement* (City of Newcastle, 2020) is the City of Newcastle's plan to guide land use planning from 2020 to 2040. The Beresfield to Black Hill area is classified as a catalyst area under this plan, as it is ideally positioned to be a leading freight and logistics hub with easy access to the M1 Pacific Motorway, Hunter Expressway, Newcastle Port and Newcastle Airport. The proposal would support this by providing an improved connection between Newcastle and Black Hill and Beresfield. The proposal would also prioritise pedestrian and cycle links and protect freight movement in accordance with the planning priorities of the Statement.

## 2.2 Existing environment

### 2.2.1 Road network

#### Main route

The existing road network around the proposal is comprised of the Maitland Road from the southern extent of the proposal to the northern extent of the proposal. From the south of the intersection with the A1 Pacific Highway on the western side of Hexham Bridge and the Hunter River, Maitland Road is also recognised as the A43 Pacific Highway. To the north of the intersection with the A1 Pacific Highway on the western side of Hexham Bridge and the Hunter River, Maitland Road is also recognised as the A43 New England Highway and the A1 Pacific Highway.

Maitland Road is a key movement corridor for both commuter and freight traffic and serves as a major access corridor into the City of Newcastle, Port of Newcastle, Newcastle Airport, Hunter Valley mining developments and other major employment and commercial centres in the Hunter Region. The urban arterial sections of the New England Highway and the Pacific Highway also form part of the NLTN, and the Sydney to Brisbane interstate road link.

The Maitland Road corridor is generally four lanes wide, comprised of two lanes in each direction except at intersections where turning lanes of varying lengths are provided for. The road has a speed limit of 80 kilometres per hour and is separated for its whole length by either a concrete median or by a grassy median that varies in width from three metres wide to 52 metres wide. The grassy median also has a large, raised grass mound to the north of the intersection of the NICB until the intersection with Old Maitland Road, Sandgate to the south of the Calvary St Joseph's Retirement Community.

#### Ironbark Creek Bridge

The existing Ironbark Creek Bridge is a twin bridge made from a combination of steel and concrete and was built in 1963 to carry the Pacific Highway over Ironbark Creek. The bridge has 8.5 metre wide roadways for two traffic lanes and shoulders and a 1.8 metre pathway for each travel lanes. It comprises of five spans, each about 17 metres long and overall length of 98 metres.

### Intersections

The proposal connects to a number of intersections along the route but only intersections that would be modified are described:

- The NICB and Maitland Road intersection is located about 180 metres to the north of Sandgate Cemetery. The intersection is signalised and comprised of two northbound lanes, two southbound lanes and two southbound right turn lanes on Maitland Road and two left turning eastbound lanes and two westbound lanes on the NICB. All movements allowed except right turn out of NICB. Cycle lanes are on all legs of the intersection and pedestrian facilities includes a signalised pedestrian crossing across the entrance to the NICB and a staggered signalised pedestrian crossing across the southern section of Maitland Road (refer to **Plate 2.1**)
- The Old Maitland Road, Sandgate (to the south of the Calvary St Joseph's Retirement Community) and Maitland Road intersection is located about 310 metres north of the NICB. The intersection is signalised on the northbound lanes of Maitland Road and is comprised of two northbound lanes and one 130 metre long left turning lane (refer to **Plate 2.2**). The northbound exit of Old Maitland Road, Sandgate is comprised of one through lane and one left lane. Provision for turning south is included in a U-turn facility that is located about 150 metres to the north of the intersection and includes a 130 metre right turn lane. A signalised pedestrian crossing is also provided to the north of the U-turn facility on the north and southbound travel lanes of Maitland Road. A 130 metre right turn lane is also provided on the southbound approach to the intersection, which needs to cross the large median before the signalised intersection to cross the northbound travel lanes of the Maitland Road (refer to **Plate 2.3**)
- Sparke Street and the Maitland Road intersection is located about 300 metres north of Ironbark Creek Bridge near an electricity sub-station. Maitland Road is comprised of two northbound lanes and a 170 metre left turn lane on the northbound approach and two southbound lanes and a 170 metre right turn lane on the southbound approach. Sparke Street is comprised of one lane in each direction. The intersection is only signalised on the northbound travel lanes of Maitland Road and traffic exiting Sparke Street can only travel north. A pedestrian crossing is provided on the left slip lane entering Sparke Street and a signalised pedestrian crossing is provided on the northern exit lane of Sparke Street (refer to **Plate 2.4**)
- Millams Road and Maitland Road intersection is located about 110 metres to the south of Shamrock Street, Hexham. The intersection is unsignalised and includes a 190 metre long right turn lane on the northbound travel lanes that enters into Millams Road via a break in the median strip and a 90 metre long right turn lane on the southbound travel lanes of Maitland Road. Millams Road connects to a one lane bridge that crosses the Hunter River to Kooragang Island. Traffic can currently exit from Millams Road onto Maitland Road in both directions (refer to **Plate 2.5**)
- Shamrock Street and Maitland Road intersection is signalised and located immediately to the south of Hexham McDonalds. The intersection is comprised of two northbound lanes and a 130 metre left turn lane on the northbound approach and two southbound lanes and a 90 metre right turn lane on the southbound approach on Maitland Road. Shamrock Street is comprised of one westbound lane and two eastbound lanes that includes a right and left turn lane. A signalised pedestrian crossing is provided at the intersection on the northern leg of the Maitland Road (refer to **Plate 2.6**)
- Fenwick Street and Maitland Road intersection is unsignalised. The median between the north and south bound lanes is currently broken and a 50 metre right turn is provided on the inside of the travel lanes in both directions of Maitland Road. This allows for U-turns for northbound

traffic and access into and out of Fenwick Street on the southbound travel lanes of Maitland Road (refer to **Plate 2.7**)

- Old Maitland Road, Hexham (to the south of Hexham Bowling Club) and Maitland Road intersection is signalised and comprised of two northbound lanes and a 140 metre right turn lane on the northbound approach and two southbound lanes and a 100 metre right turn lane on the southbound approach of Maitland Road. Old Maitland Road, Hexham (south) is comprised of one lane in each direction and traffic entering Maitland Road can only turn left and enter the southbound travel lanes (refer to **Plate 2.8**)
- The Old Maitland Road, Hexham (to the north of Hexham Railway Station), rail maintenance access road, and the Maitland Road intersection is signalised and comprised of three northbound and three southbound lanes on Maitland Road. On the southbound approach to the intersection there is one 90 metre long left turn lane that accesses Old Maitland Road, Hexham (to the north of Hexham Railway Station), and one 100 metre long right turn that accesses a rail maintenance access road and U-turn facility on the western side of the intersection. Old Maitland Road, Hexham (north) connects to Old Punt Road to the east and is comprised of one lane in each direction. Traffic exiting the intersection from Old Maitland Road, Hexham (north) can turn northbound or southbound on Maitland Road. Signalised pedestrian facilities are provided across Old Maitland Road and on the southern leg of Maitland Road (refer to **Plate 2.9**)
- The A1 Pacific Highway northbound entrance ramp is unsignalised and comprised of two northbound lanes that are located about 140 metres north of the Old Maitland Road, Hexham (north and Maitland Road intersection (refer to **Plate 2.10)**. The entrance ramp is a viaduct that links to a bridge over the Hunter River. At the northern connection point of Maitland Road and the A1 Pacific Highway there is a small section of road that is signalised and comprised of one lane that is used for contra-flow in emergencies
- The intersection of Maitland Road and the A1 Pacific Highway exit ramp off Hexham Bridge is signalised. The northbound travel lanes of Maitland Road is comprised of three lanes and the southbound travel lanes of Maitland Road is comprised of two lanes. The A1 Pacific Highway is comprised of three right turning lanes that connect to the northbound travel lanes of Maitland Road and one left turn filter lane that is not signalised that connects to the southbound travel lanes of Maitland Road (refer to **Plate 2.11**)
- Intersection of Maitland Road and a U-turn facility underneath the northbound entrance ramp of the A1 Pacific Highway is signalised and comprised of three northbound lanes and one 80 metre left turning lane and one eastbound and one westbound lane connecting to the U-turn facility that can also be used for contraflow (refer to **Plate 2.12**)
- The A1 Pacific Highway southbound entrance ramp/viaduct is unsignalised and comprised of one lane that starts about 700 metres to the west of the northbound entrance ramp. The northbound and southbound entrance lanes link together just before they join up on to form a three lane northbound bridge that crosses the Hunter River (refer to **Plate 2.13**). The entrance ramp is a viaduct that links to a bridge over the Hunter River. The southbound A1 Pacific Highway is located to the east on a separate older bridge known as Hexham Bridge.

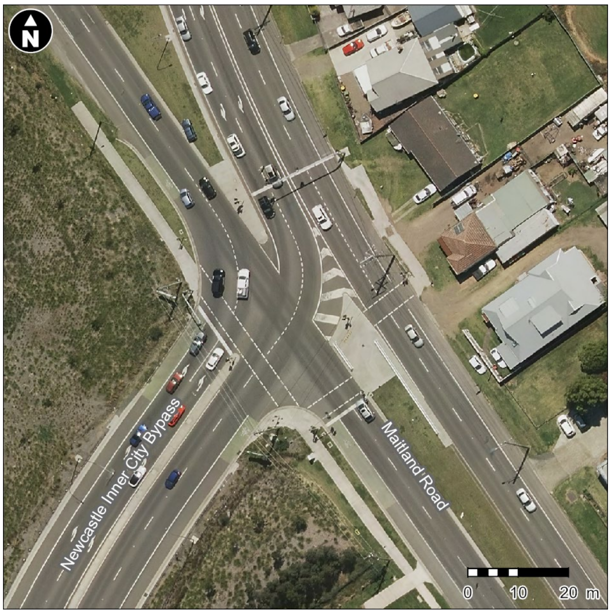



Plate 2.1 NICB and Maitland Road intersection


Plate 2.2 Northbound approach to Old Maitland Road Sandgate and Maitland Road intersection


Plate 2.3 Southbound approach to Old Maitland Road, Sandgate and Maitland Road intersection


Plate 2.4 Sparke Street and Maitland Road intersection


Plate 2.5 Millams Road and Maitland Road intersection


Plate 2.6 Shamrock Street and Maitland Road intersection


Plate 2.7 Fenwick Street and Maitland Road intersection


Plate 2.8 Old Maitland Road Hexham (to the south of Hexham Bowling Club) and Maitland Road intersection


Plate 2.9 Old Maitland Road, Hexham (north), rail maintenance access road and Maitland Road intersection


Plate 2.10 A1 Pacific Highway northbound entrance ramp and A1 Pacific Highway contra-flow signalised intersection


Plate 2.11 Intersection of Maitland Road and the A1 Pacific Highway southbound exit ramp


Plate 2.12 Intersection of Maitland Road and a U-turn around facility underneath the northbound entrance ramp of the A1 Pacific Highway to the right and the southern access road to the Oak Factory and Maitland Road to the left of the image


Plate 2.13 The A1 Pacific Highway south-eastbound entrance ramp and three lane northbound bridge over the Hunter River.

### Access roads

The proposal connects to a number of access roads along the route but only access roads that would be modified are described as follows:

- The intersection of the Calvary St Joseph's Retirement Community main access and Maitland Road is located about 270 metres to the north of the signalised intersection of Old Maitland Road, Sandgate and Maitland Road. A 70 metre northbound left turning lane and a 20 metre right merge lane is provided for into and out of the Calvary St Joseph's Retirement Community access. An emergency U-turn facility is provided in the median opposite this intersection (refer to **Plate 2.14**)
- The intersection of the Gilbert and Roach Trucks Newcastle main access and Maitland Road is located about one kilometre to the north of the signalised intersection of Old Maitland Road, Hexham (south) and Maitland Road. A 50 metre northbound right turning lane is provided on the northbound travel lanes and provides access into and out of the facility northbound via a break in the median (refer to **Plate 2.15**)
- Signalised emergency U-turn facility and contra-flow facility located about 250 metres south of the intersection of Old Maitland Road and Maitland Road provides an opportunity for vehicles travelling south to safely conduct a U-turn (refer to **Plate 2.16**). Signals only operate in an emergency
- The intersection of the southern access to the Oak Factory Maitland Road and a U-turn and contra-flow facility to the east of Maitland Road is signalised and located about 100 metres to the north of the Maitland Road and A1 Pacific Highway southbound intersection. Maitland Road is comprised of three northbound travel lanes and a 60 metre northbound right turn lane that connects to the U-turn facility. Maitland Road southbound is comprised of two southbound through lanes and one southbound 120 metres right turn lane. The Oak Factory access road is comprised of one right in, one left out and one through/right out lane that are all signalised and one left turn in lane that is unsignalised. The U-turn facility has one lane in and one lane out. All movements are permitted but signalised, (refer to **Plate 2.12**)

- The intersection of Brancourts access road and Maitland Road is signalised. Maitland Road. There is a 110 metres long right turn lane southbound on Maitland Road. All movements are permitted (refer to **Plate 2.17**).


Plate 2.14 Intersection of the Calvary St Joseph's Retirement Community main access and Maitland Road


Plate 2.15 Intersection of the Gilbert and Roach Trucks Newcastle main access and Maitland Road


Plate 2.16 Emergency U-turn and contra-flow facility on Maitland Road


Plate 2.17 Intersection of Brancourts access road and Maitland Road

### 2.2.2 Existing traffic conditions

#### Road network

Maitland Road typically experiences heavy eastbound and westbound traffic during the morning and afternoon peak periods. A large proportion of traffic from the M1 Pacific Motorway travels toward Newcastle and the A1 Pacific Highway via John Renshaw Drive and the New England Highway as an alternative to using the Newcastle Link Road at the M1 Pacific Motorway and John Renshaw Drive intersection. This traffic movement contributes to congestion during morning and afternoon peak periods on Maitland Road.

Substantial delays are experienced at the intersection of the Maitland Road and the exits to the A1 Pacific Highway at Hexham during morning and afternoon peak periods. The high traffic demands on the New England Highway, combined with the relatively high traffic demand southbound on Maitland Road, result in queuing and delays to all movements at this intersection. Local and through traffic is significantly elevated during traditional holiday periods, due to travel between the M1 Pacific Motorway and the A1 Pacific Highway via John Renshaw Drive, the New England Highway and Hexham Bridge.

Approved B-Double routes in the construction area include Maitland Road, NICB, Old Maitland Road, Sparke Street, Shamrock Street and the Pacific Highway ramps. The road corridor supports local, regional and international freight transport including transport to and from the Port of Newcastle, which is the largest bulk shipping port on the east coast of Australia, and one of the world's leading coal export ports.

#### *Crash statistics*

A total of 178 crashes were recorded along the road corridor between Maitland Road and Wallsend intersection and Maitland Road and the A1 Pacific Highway between October 2013 and September 2018. Fifteen per cent of those crashes being fatal or serious injury crashes. The most prevalent crash movement type in the corridor was found to be rear-end crashes (65 per cent). The majority of crashes involved a motor vehicle, accounting for 88 per cent of all crashes. Location which exhibit a high number of crashes include:

- Maitland Road and A1 Pacific Highway intersection (eight per cent of crashes)
- Maitland Road and Old Maitland Road (north) intersection (seven per cent of crashes)
- Midblock road section between the Maitland Road and A1 Pacific Highway intersection and Old Maitland Road (south) (eight per cent of crashes).

#### Public transport

#### *Bus*

Bus services are provided by Hunter Valley Buses between Raymond Terrace and Newcastle via Hexham (route 140 and route 160). The 140 bus route is serviced by up to two buses per hour during the commuter peak periods, with one service per hour during off peak periods and weekends. The 160 bus route has a total of five bus services during the week and two bus services during the weekend. There are seven bus stops in the 140 bus route and five bus stops for the 160 bus route within the construction area.

Maitland Road within the study area is also used by 22 school bus routes that provide access for students in Raymond Terrace, Maitland, Clarence Town, Woodberry and Beresfield to schools and educational facilities in Newcastle, Raymond Terrace and Maitland.

#### *Rail*

Rail infrastructure within the study area provides passenger transport to and from the Hunter Region. The Main North Rail Line within the study area is located between Sandgate and Tarro with stations at Sandgate, Hexham and Tarro. The existing rail network also supports local, regional and international freight transport including transport to and from the Port of Newcastle.

Hexham Railway Station is located about 100 metres south of the Old Maitland Road (north) Maitland Road and rail maintenance access road intersection. Access to the station is via the northbound lanes of Maitland Road only and includes access from an access road to the south of the station and from the rail access maintenance road to the north. This station is serviced by the Hunter Line. **Table 2.1** provides information on train operating hours and frequencies.

Table 2.1 Hexham Railway Station operating hours and service frequencies

| Direction of travel | Operating hours | | Frequency | |
|---|---|---|---|---|
| | Weekday | Weekend and Public holiday | Weekday | Weekend |
| Scone to Newcastle Interchange | 04:01 to 02:01 | 02:05 to 00:55 | 40 min to 1 hour | 1 hour |
| Newcastle Interchange to Scone | 03:35 to 02:43 | 02:05 to 02:43 | 40 min to 1 hour | 1 hour |

### 2.2.3 Pedestrians and cyclists

The cycle network in the REF area is facilitated by Maitland Road shoulders which provides dedicated on road bike baths for most of the study area. There is an off-road cycle path northbound from Hexham Railway Station to the northbound on-ramp of the A1 Pacific Highway and another off-road shared use path on the eastern side of Maitland Road from the A1 Pacific Highway and Maitland Road intersection to a pedestrian crossing at Old Maitland Road and another.

The existing pedestrian facilities include footpaths provided along Hexham Road for most of the study area. In addition, there are signalised pedestrian crossings at the following locations:

- NICB and Maitland Road intersection – Across the southern and eastern leg of the intersection
- Pedestrian operated signals on Maitland Road about 10 metres to the north of the northbound U-turn facility opposite Calvary St Joseph's Retirement Community at Sandgate
- Sparke Street and Maitland Road intersection – Across the southwest leg of the intersection
- Shamrock Street and Maitland Road intersection – Across the northern leg of the intersection
- Old Maitland Road (south) and Maitland Road intersection – Across the southern and eastern leg of the intersection
- Old Maitland Road (north) and Maitland Road intersection – Across the southern and eastern leg of the intersection.

### 2.2.4 Drainage

Existing hydrological drainage features that drain stormwater within the construction area of the proposal includes:

- Surface drainage features including, kerb and gutters and open channels including a drainage channel to the southwest of Ironbark Creek that drains a section of Hunter Wetlands National Park. There is also one existing grassed swale located to the west of the northbound lanes of Maitland Road opposite Old Maitland Road (north) that offers some minor stormwater quality treatment

- Sub-surface drainage features including a networks of pits, headwalls, inlets and pipes that intercept pavement runoff from the existing roadway and transport the stormwater to 44 drainage systems located along the length of the proposal, refer to **Appendix B**. The existing 44 drainage systems are comprised of two major reinforced concrete box culverts and 42 minor drainage networks that include cross drainage systems and pavement drainage systems which are discussed further below.

### Cross drainage

There are 18 existing cross drainages along the length of the proposal, most of which are small diameter pipes ranging in size from 375 millimetres to 525 millimetres diameter that drain small catchments on the western and eastern side of the highway to the other side. The cross drainage systems are relatively shallow with a surface cover ranging from 260 to 760 millimetres. Pavement drainage lines also connect to these cross drainages at several locations.

There are two major cross drainage systems along the proposal each consisting of two 1500 by 1200 millimetre reinforced concrete box culverts. One is located about 270 metres north of Sparke Street, Hexham and links an area of Coastal Wetlands and Sparkes Creek to the South Channel Hunter River, refer to **Plate 2.18**. The second structure is located about 120 metres north of Clark Street, Hexham and drains surface water located between the Main North Rail Line and Maitland Road draining from Smithies Creek to the South Channel Hunter River, refer to **Plate 2.19.** These cross drainages systems also drain the larger surface water catchment areas and flood flow from the west of the proposal from Hexham Swamp Nature Reserve catchment to the east of the proposal into the Hunter River and the South Channel Hunter River. The majority of the inlets, pipes and outlets are located in the road corridor but some of the inlets and outlets are located outside the road corridor on the edge of the Hunter River and in private property next to the road corridor, refer to **Appendix B**.

Plate 2.18 Reinforced concrete box culvert 01 – drainage system 12

Plate 2.19 Reinforced concrete box culvert 02, drainage system 24

### Pavement drainage

The existing pavement drainage consists of networks of pits, headwalls, inlets and pipes that intercept pavement runoff from the existing highway. The drainage networks discharge the flows to the Hunter River and Hunter River South Channel through several outlet points along the length of the proposal. The existing pavement drainage appears to have sufficient capacity to convey the 10 per cent Annual Exceedance Probability (AEP) (10-year Annual Recurrence Interval (ARI)) flood event flows. There is no stormwater quality treatment provided in the existing pavement drainage system.

## 2.3 Proposal objectives and development criteria

### 2.3.1 Proposal objectives

The proposal objectives align with the strategic objectives identified in the *Greater Newcastle Future Transport Plan* (Transport, 2018b), the *Road Safety Plan* (Transport 2018d) and the *Future Transport Strategy* (Transport 2018a) (refer to **Section 2.1**). The primary objectives of the proposal are to:

- Improve travel times on the Pacific Highway for the existing congested east-west route from the junction with the M1 Pacific Motorway to the NICB
- Provide a route which reduces the overall freight transport time and cost for heavy vehicles along the Pacific Highway, and other key strategic freight routes around the Greater Newcastle area, improving opportunity for increased freight capacity and efficiency
- Improve the long-term route reliability along the Pacific Highway
- Improve road safety (reduce fatalities and serious injuries) for all road users, including vulnerable road users
- Provide more efficient access to facilitate economic growth to and from key employment areas such as the Port of Newcastle and Greater Newcastle.

### 2.3.2 Development criteria

The following considerations have informed the design:

- The proposal objectives, as detailed in **Section 2.3**
- Minimise traffic congestion
- Improve connectivity to the wider road network for all road users
- Urban design objectives and principles
- Minimise impacts to existing utilities
- Minimise adverse environmental impacts.

The adopted design criteria for the proposal are summarised in **Table 2.2**.

Table 2.2 Proposal design criteria

| Key element | Description |
|---|---|
| Design speed | 80 kilometres per hour |
| Posted speed | 80 kilometres per hour |
| Minimum sight distance | Stopping sight distance: 103 metres<br>Approach sight distance: 103 metres<br>Safe intersection sight distance: 170 metres |
| Design vehicles | 26-metres B-Double (Maitland Road, NICB, Old Maitland Road (south), Sparke Street, Shamrock Street, Old Maitland Road (north), Pacific Highway ramps)<br>19.0 metres semi-trailer (all other roads) |
| Vertical grade | Existing pavement: existing grade<br>Reconstructed pavement: 0.5 - 1.7 per cent |
| Minimum lane width | Northbound: 3.2 metres |

| Key element | Description |
|---|---|
| | Southbound: 3.1 metres |
| Minimum auxiliary lane width | 3.3 metres |
| Bus bay width | 3.5 metres |
| Shoulder width | Nearside shoulder – 2 metres<br>Offside shoulder – 0.4 metres |
| Raised median width | 1.08 metres (minimum) – 6.4 metres (maximum) |
| Horizontal alignment:<br>Minimum horizontal radius | Northbound: 202 metres<br>Southbound: 170 metres |
| Cut and fill batter slope | 1 in 2 – maximum slope<br>1 in 4 – desired slope |
| Verge width | 1 metre |

Ironbark Creek is noted to be non-navigable and vessel collision loads would therefore not be considered.

### 2.3.3 Urban and landscape design objectives

The urban and landscape design objectives for the proposal are derived from the nine urban design principles defined in Transports' *Urban Design Policy - Beyond the Pavement* (Transport, 2020). The objectives reflect both the unique character of the road, its rural context and key issues which adjoin it.

Urban and landscape design objectives for the proposal are outlined in **Table 2.3**.

Table 2.3 Urban and landscape design objectives

| Urban design principles | Objectives |
|---|---|
| Principle 1 – Contribute to the overall landscape structure and revitalisation of the region | • Develop an alignment which permits the ongoing development of Newcastle through the provision of upgraded capacity and intersections to service the new and expanding residential precincts<br>• Design an alignment which is responsive to its landscape setting and does not detract from it<br>• Minimise negative physical impacts on drainage corridors and open space networks associated with these. |
| Principle 2 – Respect the land uses and built form of the corridor | • Minimise the footprint of the corridor to limit impacts to adjoining vegetation, communities, services and service corridors, and industrial lands<br>• Respond to the ecological communities of the area and landscape character of the corridor<br>• Minimise the intrusion of road-related elements on the local landscape. |
| Principle 3 – Connecting modes and communities | • Provide safe and efficient access to the developing residential communities of Newcastle and Industrial precincts<br>• Provide pedestrian and cycle opportunities both within the alignment and connecting to the broader local context and networks, where a need has been identified. A key consideration would be connection to the Hexham Railway Station. |
| Principle 4 – Fit the landform of the corridor | • Minimise the footprint of the corridor to limit impacts to adjoining vegetation communities and adjoining land uses |

| Urban design principles | Objectives |
|---|---|
| | • Provide a formation which addresses local flood events<br>• Consider form of potential cut and fills and how this sits within this flat landscape. |
| Principle 5 – Responding to natural pattern | • Provide a response which addresses the close proximity to the Hunter River and its tributaries and the protected vegetation communities associated with this environment<br>• Drainage and its management should reflect the fact the alignment is on the floodplain and respond accordingly<br>• Preserve existing cultural patterns within the landscape where evident within the corridor<br>• Vary the gradient of earthworks to provide visual interest and reflect characteristics of the surrounding landform and landscape. |
| Principle 6 – Protect and enhance the heritage and cultural values of the corridor | • Preserve the integrity of heritage items and areas of cultural importance to the local community<br>• Avoid, where possible areas of identified historic and cultural value<br>• Acknowledge and respond to the heritage and cultural values of the Hexham Straight precinct<br>• Acknowledge and respond to Aboriginal values and places in the broader landscape<br>• Consider the interpretation of the heritage areas along the corridor. |
| Principle 7 – Designing an experience in movement | • Minimise disruption to the visual qualities of the land use<br>• Use landscape to frame or define views from the road, providing a backdrop and context to the road in what is a rapidly changing environment. |
| Principle 8 – Creating self-explaining road environments | • Provide plantings that reinforce the character and connections of the corridor with the adjoining development<br>• Provide a landscape design which reflects the needs and performance requirements of intersections along the corridor. |
| Principle 9 – Achieving integrated and minimal maintenance design | • Develop a consistent approach to the design of soft landscaping along the alignment which is responsive to the character and feel of the road environment with which it connects as well as the character of the corridor through which it passes. Planting design Principles to be consistent with those outlined in the *Landscape Design Guideline: Design guideline to improve the quality, safety and cost effectiveness of green infrastructure in road corridors* (Roads and Maritime Services, 2018a)<br>• Provide plantings to frame views and guide the driver along the alignment, provide a backdrop and screen in part to the development that is adjacent. |

## 2.4 Statement of strategic need

### 2.4.1 Consistency with strategic planning and policy framework

A review of relevant strategic planning documents was carried out to identify whether the REF area as part of the proposal is consistent with the aims and directions of these documents (refer to **Section 2.1**). The REF area when considered as part of the proposal is considered to be consistent with these strategic planning documents.

### 2.4.2 Need for the proposal

#### Improve travel times and relieve congestion

Traffic modelling was undertaken to compare the performance of the road network with and without the proposal for the years 2028 (the proposal opening year), 2038 (10 years after opening) and 2048 (20 years after opening).

The model showed the proposal would provide positive outcomes for the performance of the road network across both the morning and evening peaks in the 2028, 2038 and 2048 modelled scenarios. This is demonstrated by the improvements to network statistics such as average network-wide speed, delays, vehicle hours travelled, travel times on Maitland Road and intersection level of service.

Overall, the proposal results in faster travel times along the Maitland Road corridor in both the northbound and southbound directions in all modelled scenarios. The main outcomes to travel time and level of service (LoS) include:

- In comparison to the 'Do minimum' option, the proposal would reduce travel times on Maitland Road in the study area by about 34 per cent in 2028, about 31 per cent in 2038 and by about 27 per cent in 2048
- The operational performance at the main intersections in the study area shows a generally improved LoS as a result of the proposal
- In the southbound direction, the most significant reduction in travel times occurs between Old Maitland Road (north) and the northern extent of the proposal. In this section of the road, travel time is reduced by about 60 per cent. This occurs due to the reduction in delays at the A1 Pacific Highway and Maitland Road intersection.

The proposal would result in improved outcomes for the road network as the increased capacity would cater to a higher volume of vehicles, while also maintaining faster travelling speeds for motorists. The proposal would positively contribute to the transport network in the Hunter region and fulfils the proposal objectives.

### Improve road safety

The proposal includes separate carriageways with a central median with solid barrier, which would improve safety for all road users (including cyclists and pedestrians). The proposal would generally improve road safety by:

- Improving traffic flow, reducing the number of stops vehicles make leading to a decreased risk of rear end crashes and reducing the risk of fatal and serious injury crashes
- Removal of the southbound merge to the south of the Old Maitland Road, Hexham (south) and Maitland Road intersection would decrease lane change crashes
- Improving the cycle network at the northern end of the proposal through upgraded cycling infrastructure that would reduce the risk of cyclist crashes in this location
- Removal of uncontrolled U-turn provisions.

### Improve pedestrian and cyclist access and safety

The proposal would improve access and safety for pedestrians within the study area. The proposal would also increase connectivity to bus stops and residential, commercial and industrial uses through the relocation of existing pedestrian facilities and provision of new facilities. Changes to existing pedestrian network would include relocation of signalised pedestrian crossings at the Shamrock Street and Maitland Road intersection and Old Maitland Road (south) and Maitland Road intersection. These changes would support improved access to the relocated bus stops which includes one opposite Shamrock Street and two either side of Maitland Road near to Hexham Railway Station.

A new signalised pedestrian crossing would also be provided at the A1 Pacific Highway and Maitland Road intersection and across the access road to the Oak Factory along with a new 900 metre shared user path along the western side of Maitland Road, north of the A1 Pacific Highway and Maitland Road intersection. This would have positive impacts for residents, workers and visitors within the study area.

The proposal would include dedicated two-metre wide shoulders for cyclists and a new 900 metre shared user path. This would improve cyclist access and connectivity through the study area and would support increased cycling for residents and workers in the study area and surrounding suburbs.

### Integration with existing infrastructure

The proposal would integrate with the existing and planned transport network including rail, pedestrian, cycling and freight infrastructure. It also helps cater to the future demand generated from Tomago and Black Hill regions and ensures improved connectivity for all modes of transport.

### Improve economic growth

The proposal would have positive impacts for local and regional business and industry by supporting improved access and connectivity to key employment and strategic growth areas in the Lower Hunter region, including Black Hill – Beresfield, Tomago, Raymond Terrace, Hexham, the Port of Newcastle and Newcastle central business district. In particular, the proposal would reduce congestion and improve travel time reliability for motorists and freight vehicles.

Locally, the proposal would improve road safety and accessibility, including through reduced congestion, travel time savings and improved travel reliability for staff, customers and deliveries. This would impact positively on businesses, supporting general improvements to local business and industry within the study area and surrounding suburbs.

## 2.5 Alternatives and options considered

### 2.5.1 Proposal options

Following the strategic option analysis three options were considered for further assessment and included:

- **Option A** – 'Do minimum' option. The 'Do minimum' option assumes no further upgrades along the corridor. Normal road maintenance would continue to be carried out
- **Option B** – Broader network considerations. This option investigated a broader array of road user and development issues and aspects associated with the outer Newcastle road network
- **Option C** – Upgrade the Hexham Straight corridor as per the proposal description in **Section 1.1.1**.

### Analysis of options

Each option was reviewed against the proposal objectives outlined in **Section 2.3.1**.

#### *Option A: 'Do minimum' option*

When considering the 'Do minimum' option against the primary proposal objectives, it was found that this option:

- Would not improve travel times, safety and trip reliability along the Maitland Road corridor. Intersection delays would increase noticeably as population grows and major projects begin operation.

#### *Option B: Broader network considerations*

When considering Option B against the primary proposal objectives, it was found that this option:

- Would not improve travel times, safety and trip reliability within the along the Maitland Road corridor. Intersection delays would increase noticeably as population grows and major projects begin operation.

### *Option C: Upgrade the main intersections along the proposal corridor*

When considering Option C against the primary proposal objectives, it was found that this option would:

- Improve travel times on Maitland Road between the NICB at Sandgate and extending to about 760 metres north of the A1 Pacific Highway and Maitland Road intersection
- Provide a route which caters for heavy vehicles and reduces the overall freight transport time and cost for heavy vehicles along the Maitland Road, and other key strategic freight routes around the Greater Newcastle area, improving opportunity for increased freight capacity and efficiency
- Improve the long-term route reliability along Maitland Road
- Improve road safety (reduce fatalities and serious injuries for all road users, including vulnerable road users
- Provide more efficient access to facilitate economic growth to and from key employment areas such as the Port of Newcastle and Greater Newcastle
- Align with the strategic objectives articulated in the *Greater Newcastle Future Transport Plan* (Transport, 2018b), *Hunter Regional Transport Plan* (NSW Government, 2014), the *Road Safety Plan* (Transport, 2018d), the *Future Transport Strategy* (Transport, 2018a) and the *NSW Freight and Ports Plan 2018-2023* (Transport, 2018c).

As it best meets the proposal objectives and the overall strategic need identified in **Section 2.1**, Option C was selected as the preferred proposal option.

### 2.5.2 Design refinement

In January 2020, following completion of the strategic design, and prior to the commencement of the concept design development, a three month challenge period was held with the project team. The purpose of the challenge period was to undertake a detailed multi-disciplinary review and challenge the strategic design to confirm major elements such as alignment, grades, cross section, connections to existing route, before proceeding into the concept design phase.

A value management workshop was undertaken in August 2020 to evaluate options for certain design elements including the Ironbark Creek Bridge design, OSOM vehicle access, Hexham Railway Station maintenance access road and the Landscaping and urban design themes. The objectives of the workshop were to review and determine which option represented the best value from a non-cost perspective for each of the design elements.

Key outcomes of the challenge period and value management workshop and subsequent design refinements are outlined in **Table 2.4**.

Table 2.4 Design refinements

| Design refinement | Details | Justification for refinement |
|---|---|---|
| New Ironbark Creek Bridge design | Four bridge options were considered for the Ironbark Creek crossing. All options would use precast, pretensioned concrete members with a composite cast in-situ deck but would differ in the form of the precast members, their depth and span length and their connection to the piers. | Shorter plank spans were preferred over the Super-T spans due to the smaller change in the road vertical alignment from the existing bridge crossing and to simplify the tie in with the existing highway. The integral abutments were seen as a benefit in both cost and safety in avoiding inspection and maintenance on bearings over the creek. |

| Design refinement | Details | Justification for refinement |
|---|---|---|
| Over size and over mass vehicle | Two options were proposed for over size over mass (OSOM) vehicles, including:<br>• Left turn option: Upgrade the left turn at Maitland Road and NICB intersection<br>• M1 option: Reroute OSOM vehicles to the new M1 to Raymond Terrace Update via the Hexham Straight. | The M1 option was preferred as it:<br>• Eliminates additional impacts on existing utilities<br>• Provides the clearer of the two alignment for OSOM vehicles<br>• Provides better future proofing as the 'left turn' option is impacted by and impacts on future projects along its alignment<br>• Provides the clearest route to the motorway and avoids passing through heavily populated residential and commercial precincts where vulnerable people are present during the OSOM movement. |
| Hexham Railway Station maintenance access road | Four options were proposed to connect the proposal to the Hexham Railway Station access maintenance road at the intersection with Maitland Road and Old Maitland Road, Hexham (north), including:<br>• Option 1: Maintaining the existing arrangement with an additional signalised U-turn<br>• Option 2: Existing arrangement including a U-turn at Hexham Bowling Club<br>• Option 3: Northern access to Hexham Railway Station with a right turn in from Old Maitland Road (southbound)<br>• Option 4: Northern access to Hexham Railway Station with a U-turn at Old Punt Road. | Option 4 is the preferred option as:<br>• It has similar impacts on utilities to Options 1 and 2 but less impact than Option 3<br>• While Option 2 primarily utilises the existing carriage way and reduces rework of existing infrastructure, option 2 would require widening of concrete which would impact on utilities<br>• Option 3 provides the best wayfinding solution as the most direct route; however, Option 4 is the second best as it provides direct access to the train station.<br>• While Option 2 minimises interactions with the rail corridor and avoids the need to acquire land, Option 4 could be modified through design development as there is a possibility of agreeing on a different arrangement than acquisition, subject to discussion with the asset owner.<br>• Option 4 would maintain best performance for through traffic as it utilises the existing arrangements whilst increasing traffic marginally. All options would be subject to a left out only arrangement and utilise the existing turn bay near Hexham Bridge for southbound access.<br>• While Option 3 is the most direct route to the station, Option 4 is the second most direct.<br>• Option 4 maximises safety and is does not introduce any new traffic phases and has all traffic movements under signals. |
| Landscaping and urban design themes | Three landscaping and urban design theme options were considered, including:<br>• Aboriginal theme incorporating a diverse variety of native vegetation<br>• European theme incorporating European vegetation<br>• Low maintenance theme incorporating robust native vegetation that would require minimal maintenance. | The low maintenance option is the preferred option as:<br>• It provides the best option of minimising maintenance in the clear zone<br>• It minimises impacts on utilities and road infrastructure<br>• While the Aboriginal theme is the best option for integration with ecological communities and native fauna, the low maintenance option allows for a selection of the most robust native vegetation<br>• Vegetation species can be selected to ensure they are drought resistant. |

# 3 Description of the proposal

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

## 3.1 The proposal

The proposal includes the widening of a six kilometre section of Maitland Road from four lanes to six lanes, starting about 290 metres south from the intersection with the NICB at Sandgate, and extending through to about 760 metres north of Hexham Bridge, in Hexham, NSW. The proposal would create two additional lanes in each direction and would include the replacement twin bridges across Ironbark Creek. Detailed figures of the proposal are included in **Figure 3.1** and the concept design drawings are provided in **Appendix A**.

The construction area is made up of the area to be directly impacted by the proposal. This includes the future construction footprint of the proposed bridge over Ironbark Creek and the upgrade of Maitland Road, including all roadside cut and fill, construction compound areas and parking areas for OSOM vehicles.

As discussed in **Section 1.1.4**, the proposal is divided into the REF area and the EIS area. The EIS area comprises three discrete areas located within mapped Coastal Wetlands. Direct and indirect impacts of any works located within coastal wetland or any impacts on coastal wetland are assessed as part of the EIS in parallel with this REF.

Key features of the proposal would include:

- Widening of Maitland Road for about six kilometres starting about 290 metres to the south of the intersection with the NICB (A37) at Sandgate and extending to about 760 metres north of Hexham Bridge at Hexham on Maitland Road. The highway would be widened from generally two lanes in each direction to three lanes in each direction
- Replacement of the bridge which spans Ironbark Creek with new twin bridges. The existing bridge and all piers would be demolished, and the outlet of a small drainage channel would be relocated about 10 metres to the east of its existing location
- Minor improvements to nine signalised intersections, including:
    - NICB and Maitland Road intersection
    - Old Maitland Road, Sandgate to the south of the Calvary St Joseph’s Retirement Community at Sandgate and the Maitland Road intersection
    - Northbound U-turn facility and pedestrian facility opposite Calvary St Joseph’s Retirement Community at Sandgate
    - Sparke Street and the Maitland Road intersection
    - Shamrock Street and the Maitland Road intersection
    - Old Maitland Road to the south of Hexham Bowling Club and the Maitland Road intersection
    - Old Maitland Road, Hexham to the north of Hexham Railway Station, rail maintenance access road, and the Maitland Road intersection
    - The southbound A1 Pacific Highway exit ramp off Hexham Bridge and the Maitland Road intersection
    - Southern access to the Oak Factory and Maitland Road/ intersection.
- Minor improvements to access roads, unsignalised intersections, entry and exit ramps connecting to the A1 Pacific Highway and the U-turn facility at the northern end of the proposal

- Closure of breaks in the existing median and direct access to local side roads, one private access road and one U-turn facility including:
    - Northbound access into and out of the Millams Road and Maitland Road intersection
    - Southbound access into and out of the Fenwick Street and Maitland Road intersection
    - Northbound access into and out of the Gilbert and Roach Trucks Newcastle access road on Maitland Road
    - Southbound access into the signalised U-turn facility on Maitland Road to the south of Hexham Railway Station
- Provision for a three metre wide shared use path northbound between the Oak Factory and the northern end of the proposal and a new section of off-road shared use path heading east along the NICB
- Widening of existing footpaths at intersections and bus stops
- Adjustments to property accesses and bus stops
- Provision of U-turn facilities on Sparke Street, Shamrock Street, and Old Maitland Road at Hexham
- Relocation of utilities including power, communications, water, gas and wastewater services
- Modifications and maintenance to existing drainage structures including pits, pipes, headwalls and culverts to suit the road widening and to maintain capacity
- Construction of retaining walls to minimise impacts on nearby properties
- Property acquisition, leases and adjustments
- Intrusive investigation works such as geotechnical investigations
- Construction of hardstand for OSOM vehicle parking at the southern and northern end of the proposal
- Temporary construction facilities, including site compounds and stockpile sites at:
    - The industrial estate located on Old Maitland Road, Sandgate to the south of Calvary St Joseph's Retirement Community (Compound 1)
    - Two areas located in the industrial estate located to the east of Maitland Road and the west of Old Maitland Road, Hexham extending north from the northern boundary of the Hexham sports field to the area of road corridor underneath the entry ramps to the A1 Pacific Highway and Hexham Bridge (Compound 2)
    - Two areas located in the industrial estate located to the west of Maitland Road, Hexham near the Oak Factory (Compound 3)
    - One area located on vacant land at the northern end of the proposal to the east of the U-turn facility on Maitland Road at Hexham and to the west of the Hunter River (Compound 4).

These features are described in greater detail in the remainder of the chapter.

Timing for construction of the proposal has not been confirmed and is subject to approval. Construction of the proposal would be staged and would take about 30 months.


**Figure 3.1a Hexham Straight Widening improvements**

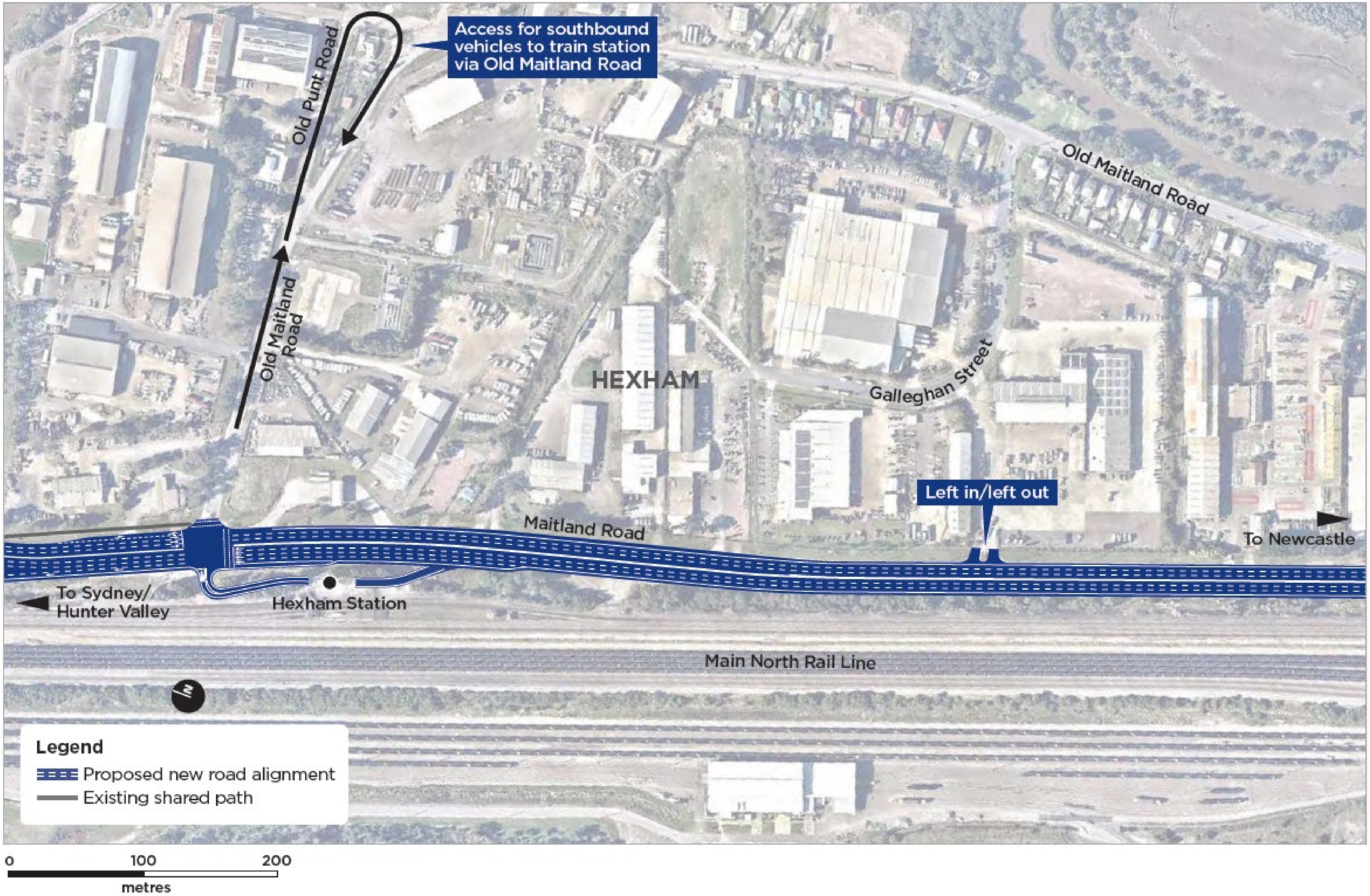



**Figure 3.1b** **Hexham Straight Widening improvements**

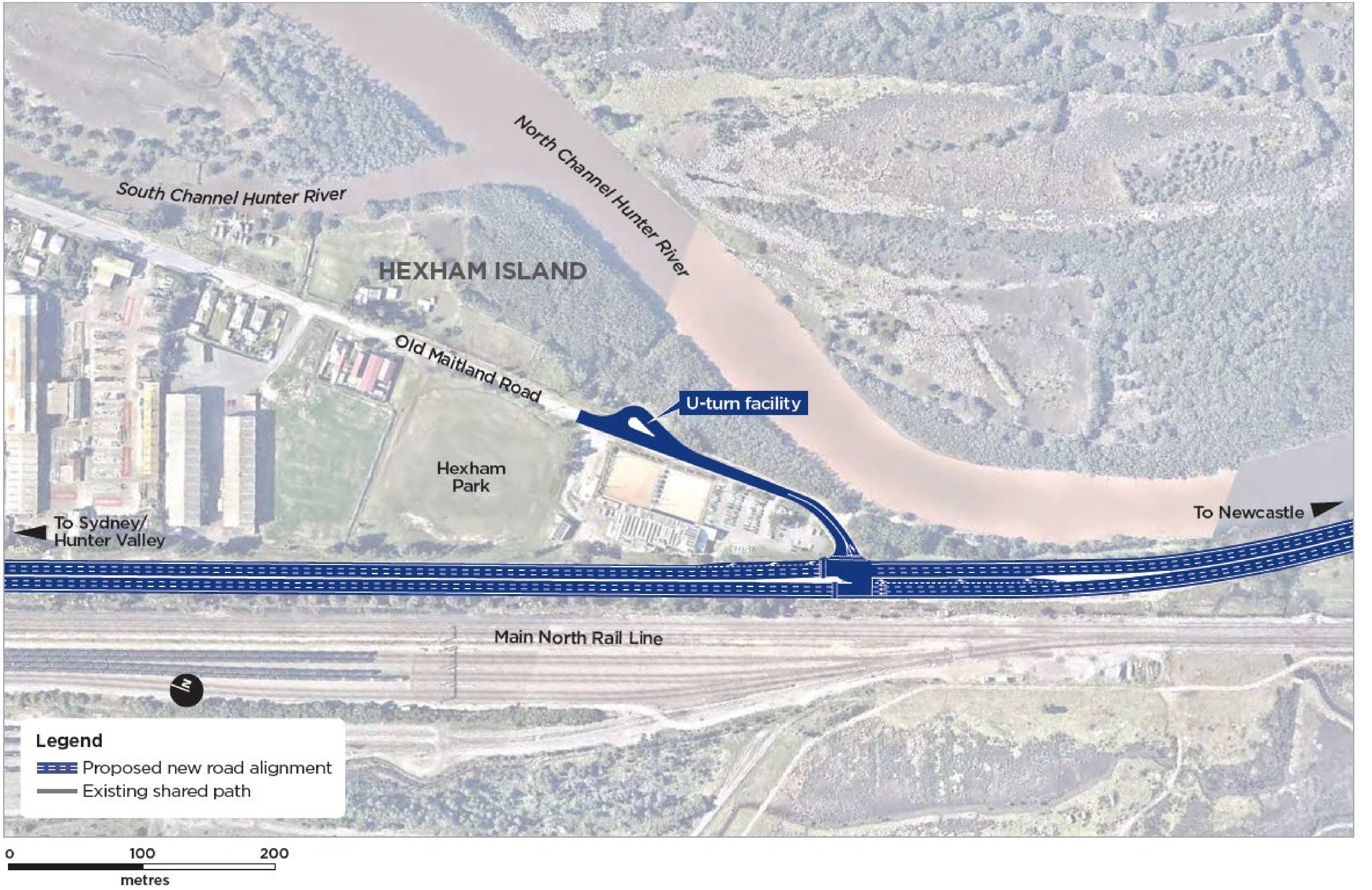



**Figure 3.1c Hexham Straight Widening improvements**


**Figure 3.1d Hexham Straight Widening improvements**


**Figure 3.1e** Hexham Straight Widening improvements


**Figure 3.1f** **Hexham Straight Widening improvements**

## 3.2 Design

The following sections provide a description of the design criteria, design features and engineering constraints of the proposal. These features have been based on drawings of the current design for the proposal. The construction drawings may be subject to refinement during detailed design and the construction phase.

### 3.2.1 Design criteria

Design guides, standards and policies considered during the development of the proposal included, but were not limited, to:

- *Guide to Road Design* (Austroads, 2015) including Transport Supplements
- Beyond the Pavement 2020 (Transport, 2020)
- Transport technical directions, specifications and quality alerts, including:
  - Roads and Maritime Services Bridge Policy Manual which includes Bridge Technical Direction Manual, Bridge Policy Circulars, Chief Bridge Engineer's Circulars
  - Roads and Maritime Services Standard Bridge Drawings
  - Roads and Maritime Services Bridgeworks QA Specifications (PS 261)
- Austroads guides and Australian standards, including AS5100-2017 Bridge Design
- Australian Rainfall and Runoff 2019
- NSW Bicycle Guidelines.

Details of the design development criteria are provided in **Section 2.3.2**.

#### Drainage and water quality design criteria

Drainage and water quality design criteria has been developed based on Transport *QA Specification PS271*, industry standard reference documents and experience on other similar Transport projects. The approach to drainage design for is to provide a practical design solution that does not exacerbate the existing drainage conditions.

Drainage elements have been designed to provide a design life as below:

- New drainage pits and headwalls – 100 years
- New drainage pipes and culverts – 100 years
- Drainage basins – 40 years.

Pavement drainage pits and pipes is to be designed for the 10 per cent AEP (10-year ARI) storm event and transverse drainage is to be designed for the one per cent AEP (100-year ARI) storm event.

The development criteria for the proposal include:

- Pavement drainage pits and pipes must be designed for 10 per cent AEP event
- Transverse drainage is to be designed for one per cent AEP event
- Gutter flow spread must be limited to 1.25 metre in the 10 per cent AEP event where there is no shoulder, and to the width of the shoulder where a shoulder has been provided on the road
- Gutter flow width for deck drainage must be limited to marked traffic lanes in the five per cent AEP event
- Minimum pipe grade shall be 0.5 per cent
- Minimum freeboard at drainage pit to be 150 millimetres in 10 per cent AEP event

- Minimum size of longitudinal pavement drainage pipe shall be 375 millimetres and minimum transverse pipe shall be 450 millimetres in diameter
- The tops of pipes and box culverts are to be a minimum 300 millimetres below the underside of the bottom of the selected material zone
- A 50 per cent blockage factor is to be applied to the inlets of transverse drainage culverts and/or pipes with headwalls less than or equal to 600 millimetres in height or diameter
- The maximum water depths at any point on the main travel lanes travel lanes, at intersections, super elevation transition areas and on auxiliary lanes on the approaches to interchanges and intersections must not be more than four millimetres
- The pavement drainage system must be designed to separate from the cross-drainage system and vice versa.

#### Urban design objectives

The urban design objectives are outlined in **Section 2.3.3**. Further consideration of urban design and landscaping of the proposal is detailed in **Section 6.11**. The *Hexham Straight Widening Urban Design, Landscape Character and Visual Impact Assessment* (Tract, 2021) is provided in **Appendix C**.

### 3.2.2 Engineering constrains

Key engineering constraints considered in the design of the proposal include:

- Property: Crown Land, National Parks and Wildlife Service land (NPWS), Australian Rail Track Corporation (ARTC) land, Sandgate Cemetery, Electrical substation (Sparke Street), Calvary St Joseph's Retirement Community, industrial, commercial and residential properties
- Existing major structures: Hexham Bridge, Gas Main Bridge, Ironbark Creek Bridge, Ash Island Bridge, and retaining wall near Calvary St Joseph's Retirement Community
- Utilities: Electrical, gas, telecommunications, water, sewer and stormwater utilities are present in the construction area. A number of assets would have to be relocated or protected
- Environmental: Hunter Rive South Channel Hunter River and Ironbark Creek, ecology (wetlands), potential Aboriginal land claims and other non-Aboriginal heritage items (Sandgate Cemetery, McDonalds (former Traveller's Rest Hotel), Hexham Railway Station, Oak Factory).

### 3.2.3 Major design features

The major design features of the proposal are described in the following sections and shown in **Figure 3.2**.

#### Road configuration

The existing Maitland Road between the NICB at Sandgate and the Hexham Bridge would be widened from four lanes each direction to six lanes each direction, separated by a central median. The main travel lanes would have a design speed of 80 kilometres per hour, with an anticipated posted speed limit of 80 kilometres per hour.

The southbound travel lanes would consist of three traffic lanes starting 100 metres south of the existing turn around bay and continue until the intersection of Maitland Road and Old Maitland Road at the Sandgate industrial area. The northbound travel lanes would consist of two traffic lanes at the Sandgate Cemetery and would widen to three traffic lanes just before the start of the NICB. A fourth auxiliary lane would be provided on the western side of the travel lanes at Hexham Railway Station and would continue as the northbound ramp of the A1 Pacific Highway over the Hunter River.

Traffic lanes would generally be between 3.3 metres and 3.5 metres wide with a 2.0 metre shoulder. Between the Gas Main Bridge and the Oak Factory lane widths would vary between 3.7 metres and 4.0 metres before narrowing again north of the Oak factory. Turn lanes would be 3.0 metres wide.

A typical cross section for the proposed road corridor can be seen in **Figure 3.2.**

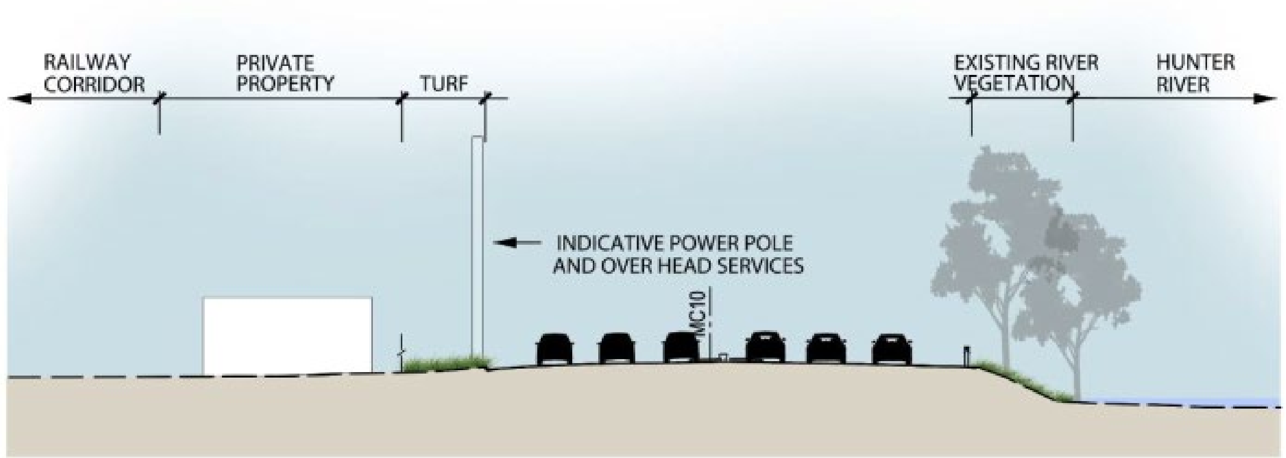



Figure 3.2 Typical cross section for proposed road corridor

### Twin bridges over Ironbark Creek

The new twin bridges spanning Ironbark Creek would be located to the east of the existing bridge. The northbound bridge would have four spans with three piers and an overall length of about 82 metres. The southbound bridge would have seven spans with six piers and an overall length of about 142 metres, refer to **Figure 3.3**. The piers consist of two 1200 millimetre diameter columns. The three northbound piers would be located in Ironbark Creek and the three most northerly piers on the southbound bridge would be located in Ironbark Creek. Three additional land based piers are required on the southern abutment of the southbound bridge and have been used to minimise the footprint of the proposal to avoid impacts to the Hunter Wetlands National Park. The abutments are supported on 900 millimetre diameter bored cast in-situ piles. The southbound bridge would have an expansion joint at Pier 3 in line with the southern abutment of the northbound bridge.

The substructure consists of reinforced concrete abutment headstocks with spill through abutments. Pier headstocks are supported by two 1200 diameter concrete columns. Each column is supported on 1500 millimetre bored cast in place piles with permanent casing. The girders are connected to the headstock via a stitchpour method to provide an integral connection. The abutments are supported on three 900 millimetre bored cast in place piles with permanent casing. Each abutment includes a six metre long reinforced concrete approach slab. The deck of each bridge would be constructed of 16 metres by 700 metre deep gapped NSW plank girders.

The new bridges would provide three lanes plus shoulders for both directions of travel. The bridge cross section would be around 27 metres wide, comprising six traffic lanes (consisting of one 3.2 metre lane, one 3.4 metre lane, one 3.5 metre lane and a 2.0 metre shoulder in each direction).The bridge deck drainage is designed for the five per cent AEP (20-year ARI) storm event to minimise flow across bridge deck joints and to limit the flow within the bridge shoulders. The drainage system on the bridge would consists of stainless-steel scupper drains connected to longitudinal pipes suspended below the deck and would be connected to the road stormwater drainage system. The traffic barrier is proposed to be a Truncated Type F with two right hand side rails providing an overall height of 1400 millimetres above finished surface level. In between the two carriageways, a high profile redirective kerb is proposed.

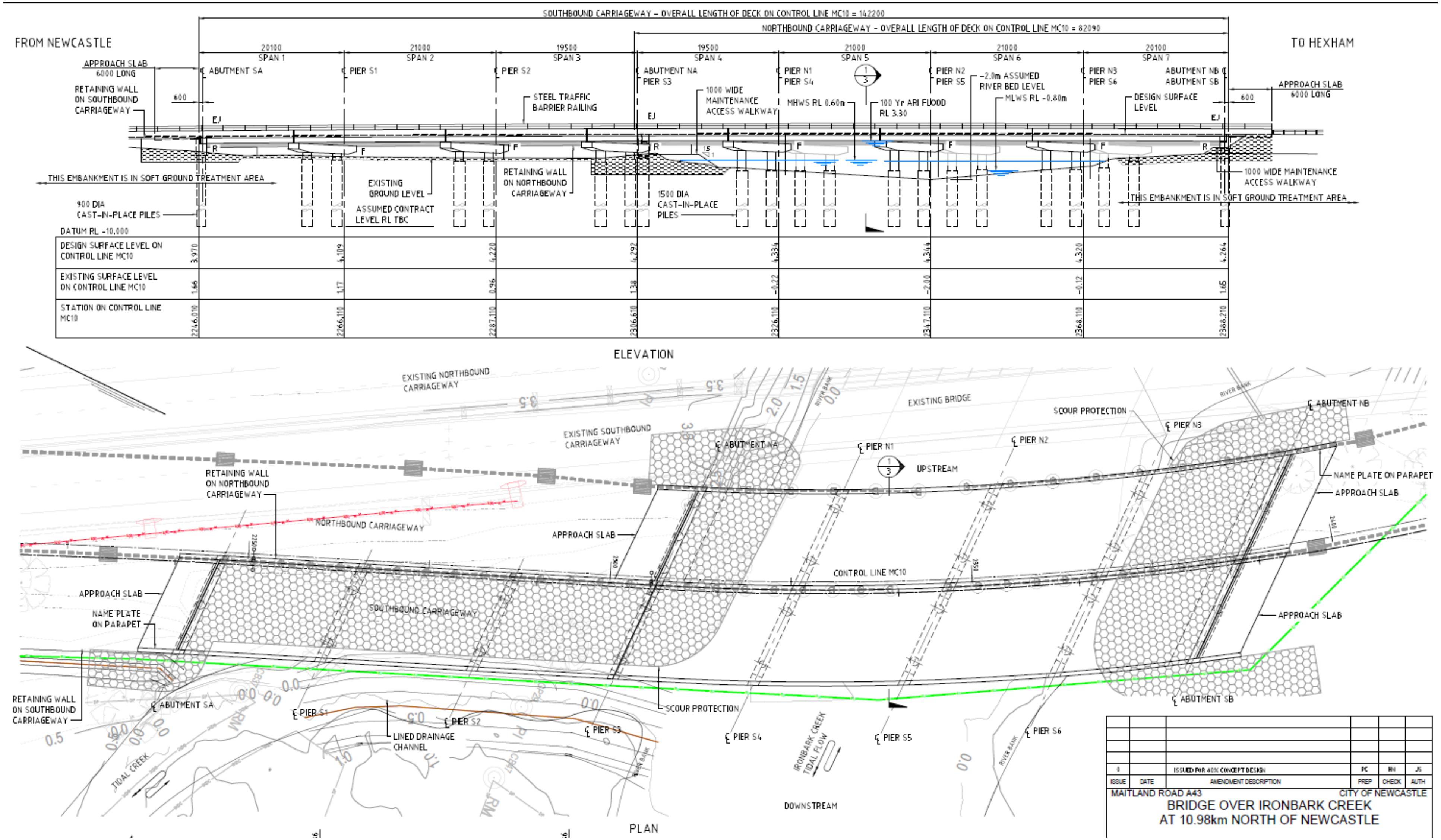



Figure 3.3 Proposed bridge

### Intersections

The impacts to the layout of existing intersections, access roads and U-turn facilities by the proposal are described in **Table 3.1**.

Table 3.1 Proposed intersection and access roads design changes

| Intersection | Existing condition | Changes to intersection from the proposal |
|---|---|---|
| NICB (signalised) | All movements allowed except right turn out of the NICB, refer to **Plate 2.1**. | The proposal includes an additional third eastbound left turning lane on the NICB as well as a third lane on the northbound approach for 290 metres, refer to **Appendix A**. |
| Old Maitland Road, Sandgate (signalised) | All movements allowed except right turn out to access southbound travel lanes of Maitland Road, refer to **Plate 2.2**. | No changes. |
| U-turn north to south (signalised) that is located about 150 metres to the north of the Maitland Road and Old Maitland Road, Sandgate intersection | U-turn north to south refer to **Plate 2.3**. | No changes. |
| Access to St Joseph's Home (unsignalised) | Left in and left out with emergency crossover between travel lanes, refer to **Plate 2.14**. | No changes. |
| Sparke Street (part signalised) | All movements except right turn out of Sparke Street southbound onto Maitland Road, refer to **Plate 2.4**. | No changes to the intersection layout. A U-turn facility would be added to Sparke Street about 70 metres west of the Sparke Street and Maitland Road intersection, refer to **Appendix A**. |
| Millams Road (unsignalised) | All movements allowed, refer to **Plate 2.5**. | The break in the median would be removed along with the right in/ right out movements, refer to **Appendix A**. |
| Shamrock Street (signalised) | All movements allowed, refer to **Plate 2.6**. | The existing pedestrian crossing would be relocated to the southern leg of the intersection. A new bus stop would be installed on the southbound side of Maitland Rd, just south of the pedestrian crossing. A U-turn facility would be added to Sparke Street about 140 metres west of the intersection, refer to **Appendix A**. |
| Fenwick Street (unsignalised) | All movements allowed, refer to **Plate 2.7**. | The break in the median on Maitland Road would be removed and the right in/ right out movements closed. To access Fenwick Street from the southbound travel lanes of Maitland Road, road users would use the new U-turn facility at Shamrock Street, refer to **Appendix A**. To head south from Fenwick Street on |

| Intersection | Existing condition | Changes to intersection from the proposal |
|---|---|---|
| | | Maitland Road, road users would have to head north to Old Maitland Road, Hexham (south) and use the new U-turn facility opposite Hexham Bowling Club, refer to **Appendix A**. |
| Merchant Street (unsignalised) | Left in and left out of Merchant Street | No changes |
| Clarke Street (unsignalised and unformed) | Left in and left out of Clarke Street | No changes |
| Old Maitland Road, Hexham (south) | All movements allowed except right turn out of Old Maitland Road onto Maitland Road, refer to **Plate 2.8**. | The existing pedestrian crossing would be relocated to the northern leg of the intersection and converted into a two stage crossing. A new bus stop would be included on the northbound side of Maitland Road. A new U-turn facility would be added to Old Maitland Road, opposite Hexham Bowling Club, refer to **Appendix A**. |
| Gilbert and Roach access on Maitland Road (unsignalised) | All movements allowed, refer to **Plate 2.15**. | The median would be extended and the right in and right out movements removed. Vehicles leaving Gilbert and Roach and travelling north would need to use the rear exit turning left onto Old Maitland Road to access Maitland Road via Old Maitland Road, Hexham (north), refer to **Appendix A**. |
| U-turn south to north Maitland Road (signalised) | Emergency U-turn and contra-flow facility south to north Maitland Road, Hexham. Traffic signals are covered except for use in emergencies, refer to **Plate 2.16**. | This U-turn facility has been removed, refer to **Appendix A**. |
| Hexham Railway Station access road (unsignalised) | Left in / left out of the Hexham Railway Station access road, refer to **Plate 2.9**. | The existing access to Hexham Railway Station would be closed and relocated 80 metres north.<br><br>An auxiliary left turn lane would be added to the northbound travel lanes of Maitland Road. The new proposed location provides better connectivity to the Hexham Railway Station via the signalised intersection with Old Maitland Road Hexham (north), refer to **Appendix A**. |
| Old Maitland Road, Hexham (north), rail maintenance access road to Hexham Railway Station (signalised) | All movements except right turn in from Old Maitland Road, Hexham (north) eastbound, refer to **Plate 2.9**. | A new westbound movement from Old Maitland Road, Hexham (north) would provide connectivity to the rail maintenance access road and the new proposed entrance to Hexham Railway Station.<br><br>The northbound right turn from Maitland Road would remain closed. The existing southbound right turn into the U-turn facility would be closed and road users |

| Intersection | Existing condition | Changes to intersection from the proposal |
|---|---|---|
| | | would need to turn left into Old Maitland Road, Hexham (north) and then turnaround at Old Punt Road, refer to **Appendix A**. |
| A1 Pacific Highway ramp northbound (unsignalised) | A1 Pacific Highway entrance ramp – two northbound lanes, refer to **Plate 2.10**. | No changes. |
| A1 Pacific Highway ramp contraflow crossover (signalised) | One lane A1 Pacific Highway ramp contraflow crossover is only used in emergencies, refer to **Plate 2.10**. | The crossover would be closed, and a new median barrier installed in the median refer to **Appendix A**. |
| The intersection of Maitland Road and A1 Pacific Highway southbound exit ramp off Hexham Bridge (signalised) | Three right turn lanes from the A1 Pacific Highway ramp southbound controlled by traffic signals and one left turn lane that is not signalised that connects to the southbound travel lanes of Maitland Road, refer to **Plate 2.11**. | The layout would be reconfigured to have two right signalised turn lanes and three left signalised turn lanes. A new staged pedestrian crossing would be provided across Maitland Road, refer to **Appendix A**. |
| Oak Factory entrance (signalised) | Left turn in from Maitland Road northbound is unsignalised, all other movements are signalised, refer to **Plate 2.11**. | The northbound access to the Oak Factory would be via a new left hand slip lane immediately after the interception with the A1 Pacific Highway. A new pedestrian crossing would be provided across the slip lane and the throat of the intersection, refer to **Appendix A**. |
| Brancourts Dairy (unsignalised) | All movements allowed, refer to **Plate 2.16**. | The break in the median would be removed along with the right in and right out movements. Access to Brancourts northbound would be maintained and access southbound would be via the signalised intersection of Maitland Road and the Oak Factory southern access road where traffic could access the southern access to Brancourts Dairy, refer to **Appendix A**. |
| South-eastbound ramp to A1 Pacific Highway northbound and bridge over the Hunter River | One lane south-eastbound entrance ramp to A1 Pacific Highway that connects to the northbound A1 Pacific Highway ramp at the entrance to the bridge over the Hunter River and the A1 Pacific Highway northbound route to Raymond Terrace and interstate to Queensland, refer to **Plate 2.13**. | No changes. |

### Rail interface

The existing access to Hexham Railway Station would be relocated to the reconfigured signalised intersection at Old Maitland Road (north) and Maitland Road. This relocated access encroaches within the Main North Rail Line rail corridor for about 100 metres and would require consultation with ARTC.

### Pedestrian facilities

The proposal includes upgraded pedestrian crossing facilities at some of the signalised intersections along Maitland Road and including:

- Across the eastbound and westbound lanes of the NICB and across the northbound travel lanes of Maitland Road
- Across the north bound and southbound Maitland Road travel lanes to the north of the U-turn crossing near Calvary St Joseph's Retirement Community entrance
- Across the northbound access road into Sparke Street
- At Shamrock Street intersection across the northbound and southbound Maitland Road travel lanes and across the eastbound and westbound Shamrock Street travel lanes
- At Old Maitland Road (south) intersection across the northbound and southbound Maitland Road travel lanes
- At the A1 Pacific Highway intersection across the northbound and southbound Maitland Road travel lanes and across the A1 Pacific Highway travel lanes into Newcastle
- At the Oak Factory access road, two signalised pedestrian crossings are proposed and includes one across the northbound access road into the Oak Factory and one across the eastbound and westbound travel lanes of the Oak Factory access road and the Maitland Road intersection.

These changes to the pedestrian network would improve connectivity, improve desire lines and provide safer access to bus stops, Hexham Railway Station and adjacent commercial and industrial properties.

### Cycle facilities

The proposal includes a dedicated two metre-wide shoulders for cyclist which would improve cycle connectivity through the study area and encourage an increased mode share to cycle.

The proposal also includes changes to the cycling network in the following locations:

- The short cycle lane at the east approach to the A1 Pacific Highway and Maitland Road intersection would be removed. This would be replaced with off-road provisions at the intersection which would connect to the off-road shared path located on the eastern side of Maitland Road between the A1 Pacific Highway and Maitland Road intersection and the Old Maitland Road (north), the rail access maintenance road and Maitland Road intersection
- The dedicated-on road cycle lane at the northern approach to the A1 Pacific Highway intersection and Maitland Road would be removed. A shoulder would be provided at the intersection for southbound cyclists to use
- A new 900 metre shared user path along Maitland Road on the western side of Maitland Road north of the Oak Factory access road and the Maitland Road intersection
- A new 330 metre shared user path along the western side of NICB on the approach to Maitland Road.

### Drainage infrastructure

The proposed drainage system would use a combination of the existing drainage infrastructure and new pits, pipes, open channels and cross drainage lines. This would support stormwater drainage from the road pavements as well as the management of upslope catchment runoff through the highway embankment (refer to **Appendix B**).

### *Cross drainage*

The existing cross drainage would be retained and extended to suit the road widening where required. No new culvert crossings are proposed.

New cross drainage pipes or box culverts have been provided adjacent to the existing cross drainage to:

- Provide flood immunity to the highway upgrade up to one per cent AEP (100-year ARI) for the local catchment flows
- Not increase the upstream headwater level more than the existing headwater levels to minimise potential adverse impacts upstream railway corridor, private properties or crown lands.

Along the length of the proposal there are 44 existing drainage systems and two new drainage systems proposed as part of the proposal, refer to **Appendix B**. The 46 drainage systems are comprised of two major reinforced concrete box culverts, 42 smaller drainage systems of which 26 were used in the hydrology modelling refer to **Section 2.2.4** for further detail.

### *Pavement drainage*

Drainage pits, pipes and open drains would be provided to collect and convey storm water runoff from the upgraded road pavements (refer to **Appendix B**). The proposed drainage has been designed for the 10-year ARI storm event.

The proposed drainage networks either connect to the existing drainage network or discharge into the inlet or outlet headwall of the proposed or existing cross drainage. Where a water quality treatment device has been provided, the proposed drainage network would discharge the runoff into the water quality treatment device before discharging the flow into the drainage outlet at the Hunter River, the Hunter River South Channel or Ironbark Creek.

New pits and pipes have been added on the new kerb and gutters along the proposal to capture the pavement runoff. The placement of pits would be carried out in a way that the gutter flow spread on the highway meets the design criteria for the 10 per cent AEP (10-year ARI) flood event.

### *Bridge deck drainage*

The bridge deck drainage is designed for the five per cent AEP (20-year ARI) flood event to minimise flow across bridge deck joints and to limit the flow within the bridge shoulders.

### *Water quality treatment controls*

Five water quality basins and five new grassed swales are proposed to capture and treat runoff from the road pavement areas of the proposal before discharging into the receiving waterways (refer to **Appendix B**). The proposed water quality controls would deliver annual average pollutant loads that are less than pollutant loads for existing conditions. The locations of the proposed water quality controls are described in **Table 3.2**.

Table 3.2 Proposed water quality controls and indicative sizes

| Control name (Id) | Description | Location |
|---|---|---|
| Basin 1 (B1) | Basin 1 connected to Basin 2 through a culvert connection to avoid draining into Hunter Wetlands National Park and areas of Coastal Wetlands at the outlet of Drainage System 3. | Located in the median of Maitland Road to the south of the connection to Old Maitland Road at Sandgate. |

| Control name (Id) | Description | Location |
| --- | --- | --- |
| Basin 2 (B2) | Basin 2 discharges downstream to Drainage System 4 via a grassed swale (S1) to provide additional water quality treatment before discharging to downstream sensitive receivers which include areas of Coastal Wetlands and Hunter Wetlands National Park. | Located in the median of Maitland Road to the north of the connection to Old Maitland Road at Sandgate. |
| Basin 3 (B3) | Basin 3 would treat stormwater drainage discharging from the southern side of the new Ironbark Creek Bridge before it enters into Ironbark Creek. | Located to the west of Maitland Road about 110 metres to the south of Ironbark Creek between an old road alignment and the proposed road in a depression that already contains freshwater wetland vegetation. |
| Basin 4 (B4) | Basin 4 would treat stormwater drainage discharging from the northern side of the new Ironbark Creek Bridge before it enters into Ironbark Creek. | Located about 22 metres from the northern bank of Ironbark Creek to the west of the proposal. Basin 4 will be located within the existing Maitland Road alignment at the same level as the existing road |
| Basin 5 (B5) | Maximum size basin has been adopted at this location. | Located about 25 metres to the north-east of the intersection of the A1 Pacific Highway and Maitland Road at the northern end of the proposal. |
| Swale 1 (S1) | Located immediately downstream of Basin 2 and extending north to connect to Drainage System 4. Provides additional water quality treatment between Basin 1 and Basin 2. Provides additional water quality treatment to sensitive downstream receivers including Hunter Wetlands National Park and areas of Coastal Wetlands to the east. | Located in the median of Maitland Road to the north of the connection to Old Maitland Road at Sandgate. |
| Swale 2 (S2) | Provides additional water quality treatment between Basin 3 and Ironbark Creek and sensitive receivers including Coastal Wetlands to the east. | Located on the southwestern side of Basin 3 to the west of Maitland Road and extending to the north to the southern bank of Ironbark Creek. |
| Swale 3 (S3) | Provides additional water quality treatment at Sparke Street. | Located on the eastern side of the proposed U-Turn facility on Sparke Street and extending to the north to tie in with an existing concrete culvert to the west of the Maitland Road and Sparke Street intersection. |
| Swale 4 (S4) | Provides additional water quality treatment at Shamrock Street. | Located to the north of the proposed U-turn facility on Shamrock Street. |

| Control name (Id) | Description | Location |
|---|---|---|
| Swale 5 (S5) | Provides additional water quality treatment at Old Maitland Road and areas of Coastal Wetlands immediately to the east on the South Channel Hunter River. | Located to the east of the proposed U-turn facility on Old Maitland Road at Hexham. |

### *Scour protection*

Scour protection would be provided where required on culverts that are upgraded as part of the proposal and is designed for a two per cent AEP (50-year ARI) storm event. The extent of scour protection in the bridge design would be considered further during detailed design.

### Retaining walls

The following two cast in-situ reinforced concrete retaining walls, refer to **Appendix A** are proposed:

- A retaining wall between the northbound travel lanes and the extension of the Ironbark Creek Bridge on the southbound travel lanes. The wall would be connected to the bridge abutment wing wall. The total length of the wall is about 56 metres
- A retaining wall south of the proposed bridge across Ironbark Creek on the southbound travel lanes to avoid encroachment into the Hunter Wetlands National Park. The wall would be connected to the bridge abutment wing wall. The total length of the wall is about 123 metres.

### Pavements

The proposal would involve the following pavement works:

- Widening flexible composite and full depth asphalt pavements
- New build pavement on the approach to the new bridges over Ironbark Creek
- Strengthening of flexible composite pavement sections
- Resurfacing the existing flexible composite and full depth asphalt pavements with asphalt
- Widening concrete pavements with steel fibre reinforced concrete pavement
- Replacing existing concrete pavements with steel fibre reinforced concrete pavement.

The subsurface drainage beneath the pavements would drain to the stormwater drainage system.

### Safety barriers and pedestrian fences

Safety barriers would be provided to protect against roadside hazards, such as roadside cuttings, steep batters and culvert headwalls, while minimising the impact on flooding, utilities and adjacent properties.

New pedestrian fences and adjustments to existing pedestrian fences are proposed on Maitland Road to improve safety of pedestrians.

### Landscaping

A landscape strategy has been developed for the proposal, including the identification of landscape precincts to inform the overall character development along sections of the route and the landscape responses associated with these precincts. The landscape strategy forms part of the overall Urban and Landscape Design Strategy as described in **Section 3.2.1** and **Appendix C**. The urban design, and the landscape concept have been developed to achieve an integrated outcome that helps fit the proposal as sensitively as possible into its context and to minimise the impacts of the proposal on the existing landscape character of the construction area.

The landscape strategy has considered both future precinct character and its existing character as the landscape solution needs to be responsive to the needs of both. The proposal has been divided into the following four distinct character precincts as part of the overall landscape strategy:

- Precinct 1 – Interchange / Industrial / Waterway
- Precinct 2 – Industrial (two sub-precincts)
  - Industrial / Screening
  - Industrial / Railway
- Precinct 3 – Riverfront (two sub-precincts)
  - Riverfront residential / Commercial
  - Riverfront / Floodplain
- Precinct 4 – Gateway.

Nine landscape character units have been identified and assessed as part of the landscape character assessment as summarised in **Section 6.11.**

### Property access and adjustments

The proposal would impact access to a few informal locations and private properties through the closure of the median at four locations and minor changes in access arrangements. The removal of the median has been adopted by the proposal as an unsignalised turn across three lanes is a safety risk, as there is increased driver exposure to high volumes of opposing traffic on multiple lanes and at increased speeds. Transport has commenced consultation with impacted property owners and would continue to consult with affected landowners regarding access during detailed design. Locations with impacted accesses on completion of construction are summarised below:

- Closure of the median along Maitland Road at Millams Road would impact access to and from Ash Island Bridge and Hunter Wetlands National Park. Millams Road access would be left-in and left out only. Vehicles accessing Millams Road from the south would be required to travel an additional 470 metres to use the U-turn facility in Shamrock Street to access Millams Road from the north. Vehicles departing Millams Road to the north would be required to travel an additional 1.7 kilometres to the south to use the U-turn facility in Sparke Street
- The informal service road located on the western side of Maitland Road at the approach to Shamrock Street would be removed. Access to three properties (15 to19) on Maitland Road would be maintained via new driveways constructed off Maitland Road via the shoulder
- The median on Maitland Road at Fenwick Street would be closed and the right turn into and out of Fenwick Street would be removed. Access to Fenwick Street would be left in and left out only. Vehicles accessing Fenwick Street from the north, would be required to travel an additional 840 metres and turn right at the Shamrock Street and Maitland Road intersection in order to use the new U-turn facility that would be provided on the western end of Shamrock Street. Vehicles departing Fenwick Street to travel south would be required to travel an additional 1.4 kilometres turning right at the Old Maitland Road and Maitland Road intersection to the south of the Hexham Bowling Club and then using the new U-turn facility located about 220 metres to the north-east of the intersection. The closure of the median at Fenwick Street would impact all residential properties located to the west of Maitland Road and north of the service station
- The closure of the median on Maitland Road north of Shamrock Street and the subsequent rerouting of vehicles to the U-turn facility on Shamrock Street would result in additional vehicles on Shamrock Street. Analysis undertaken using the Guide to Traffic Generating

Developments (Roads and Traffic Authority, 2002) found that the closure of the medians expected to lead to approximately 45 additional vehicles traveling on Shamrock Street daily. Traffic counts undertaken in March 2021 indicate approximately 2,150 vehicles currently use Shamrock Street daily, therefore the closure of the median is expected to lead to a two per cent increase in traffic movement which is not considered significant and the Shamrock Street and Maitland Road intersection would continue to operate at a satisfactory level of service

- Closure of the median and the right-turn facility at Gilbert & Roach trucks would mean drivers would have to make a detour when accessing the facility form the south. Two options are available and include:
    - Accessing the rear of the property from Galleghan Street via Old Maitland Road (south). This would be an increase of between 200 metres but would only be available for light vehicles
    - Using the existing U-turn facility at the northern end of the proposal opposite the Oak Factory access road (heavy and light vehicles permitted) which would be increase in 2.4 kilometres. Vehicles could access the front access on Maitland Road
- Closure of the right-turn facility at Gilbert & Roach trucks would mean drivers of light vehicles accessing Industrial Galvanizers Corporation from the south are unable to perform U-turns on Maitland Road and would be required to access the property from the entrance at Old Maitland Road, or alternatively use the detours proposed for Gilbert & Roach trucks discussed above
- Access to the Hexham Railway Station for northbound vehicles would be modified to include a new left slip lane about 150 metres to the south of the existing access road. For southbound vehicles travelling to the Hexham Railway Station the closure of the U-turn facility on Maitland Road opposite Truckline Newcastle would require vehicles to use Old Maitland Road (either north or south) at Hexham to access the station. A new access road has been added to the western side of the intersection of Old Maitland Road (north) and Maitland Road to Hexham Railway Station
- Closure of the median and the U-turn facility on Maitland Road opposite Truckline Newcastle at Hexham would mean drivers of light vehicles exiting the Ampol Hexham Diesel Stop and Truckline Newcastle to head north to Beresfield would be required to use turn around at the intersection of Old Maitland Road (south) and Maitland Road, increasing travel distance by up to 2.7 kilometres. Heavy vehicles would need to continue south to use the U-turn facility at Sparke Street, increasing travel distance by up to six kilometres
- Access to the Oak Factory to the north of the A1 Pacific Highway and Maitland Road intersection would be upgraded to a short left-turn slip lane from Maitland Road to provide safer access. Access southbound to this site would be via the existing right turn lane at the signalised intersection. The uncontrolled right turn 150 metres to the north of this would be removed as a solid median barrier would be in place
- Closure of the median at Brancourts Dairy along with the right in and right out movements. Access to Brancourts Dairy northbound would be maintained as left in and left out only. Access for southbound traffic would be via the existing signalised intersection of the Oak Factory southern access road. Vehicles exiting the site and travelling south would use the existing southern access signalised intersection to turn right onto Maitland Road.

No property has been identified as requiring a permanent property adjustment. All impacted driveway accesses would be reinstated following the completion of the proposal.

### Safety barriers

Safety barrier systems have been selected with the intention to improve safety while minimising the impact on utilities, flooding and adjacent properties. Safety barriers along the length the proposal would include a combination of the following:

- Wire rope safety barriers
- High profile redirective kerb
- Steel rail safety barrier
- Steel barrier railing.

### Bus stops

Access to existing bus stops would be temporarily impacted during the concrete and asphalt pouring. If bus stops are required to be relocated to maintain access, bus stops would be located as close as possible to the original bus stop locations, and pathways would be provided.

## 3.3 Construction methodology

Construction activities would be carried out in accordance with a Construction Environmental Management Plan (CEMP) to ensure work complies with Transport's commitments and legislative requirements. Construction activities required for the proposal are shown in **Figure 3.4**.

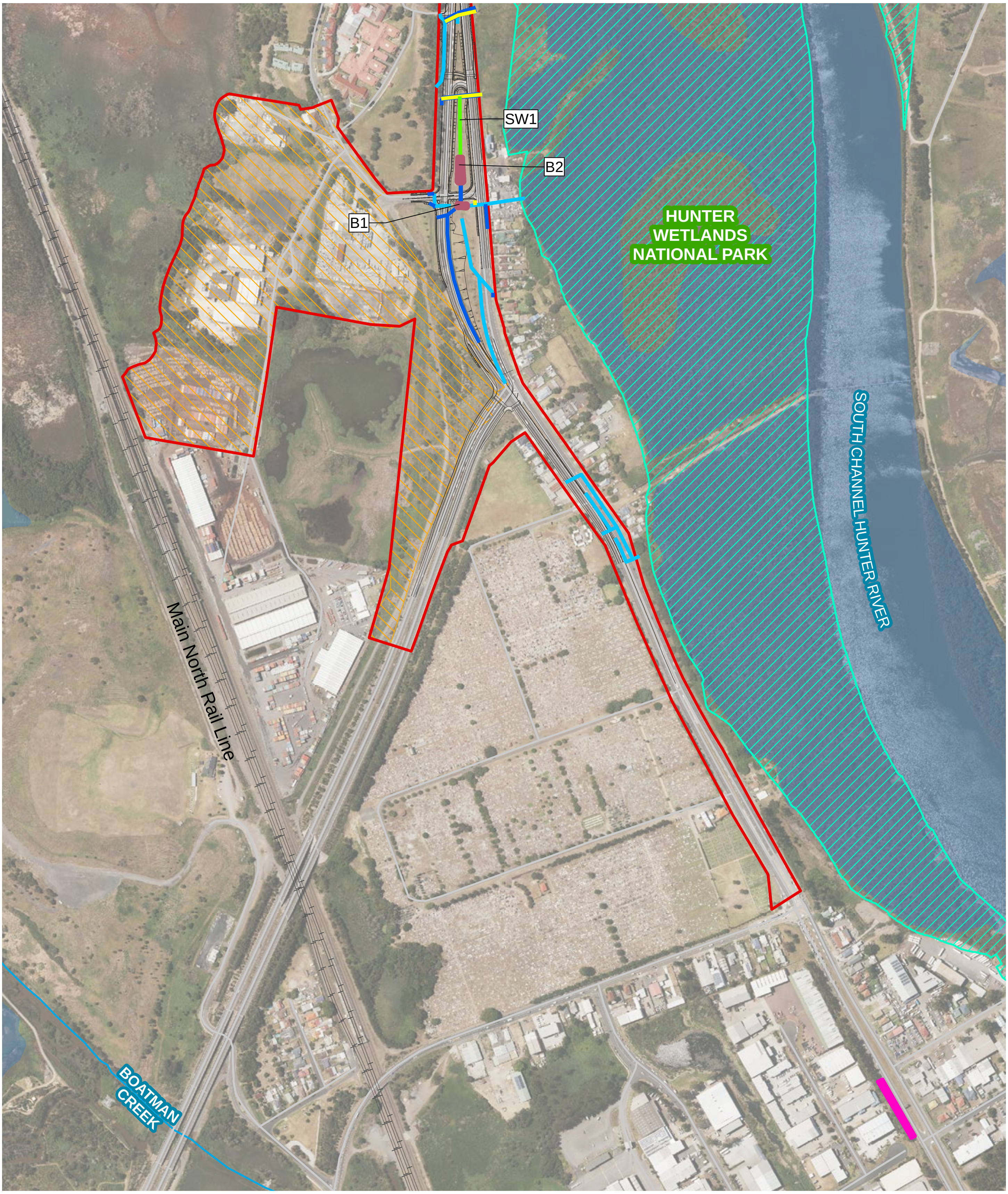
Detailed work methodologies would be identified by the construction contractor.

### 3.3.1 Construction scenarios and activities

The proposal is anticipated to involve the following general construction scenarios and sequencing:

- Establishment work including establishment of construction compounds/ancillary facilities
- Utility relocations
- Earthworks and drainage
- Construction of bridge approaches
- Bridge construction
- Retaining walls
- Pavement construction including local road works
- Demolition of existing bridge when the new bridge is open to traffic
- Landscaping, finishing works, removal of ancillary facilities and site rehabilitation
- Operation of the site compounds.

Activities included in each construction scenario are described below.




Date: 15/11/2021 Filename: IA301100_REF

**Legend**

The proposal
REF area
OSOM vehicle parking locations
Construction compound
Hunter Wetlands National Park
Railway
Waterway

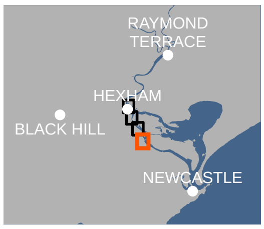
Culverts
Existing
Proposed
To be removed

Water quality controls
Proposed grassed swale

Basin

0 100 200 m

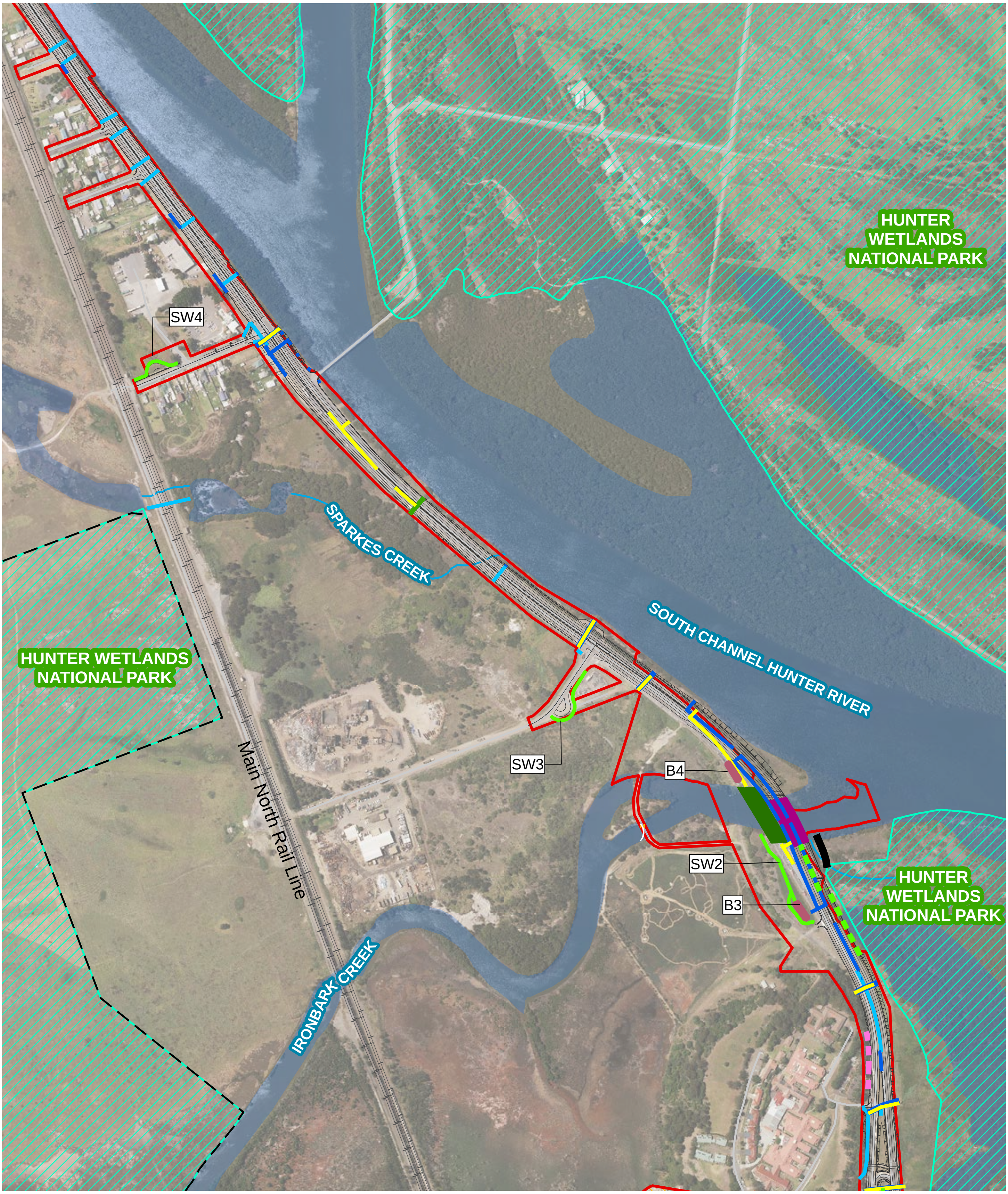
1:8,000 at A4
GDA94 MGA56






**Data sources**
Jacobs 2021
Ausimage 2018
Department Finance, Services Innovation Dec 2020

**Figure 3.4a** Construction activities




**Legend**

The proposal
REF area
Construction compound
Hexham Swamp Nature Reserve
Hunter Wetlands National Park
Railway
Waterway

Culverts
Existing
Reinforced concrete box culvert
Proposed
To be removed
Channel diversion

Water quality controls
Proposed grassed swale

Basin
Existing bridge
Proposed bridge
Existing retaining wall
Proposed retaining wall
Floodgate

0 100 200 m

1:8,000 at A4
GDA94 MGA56

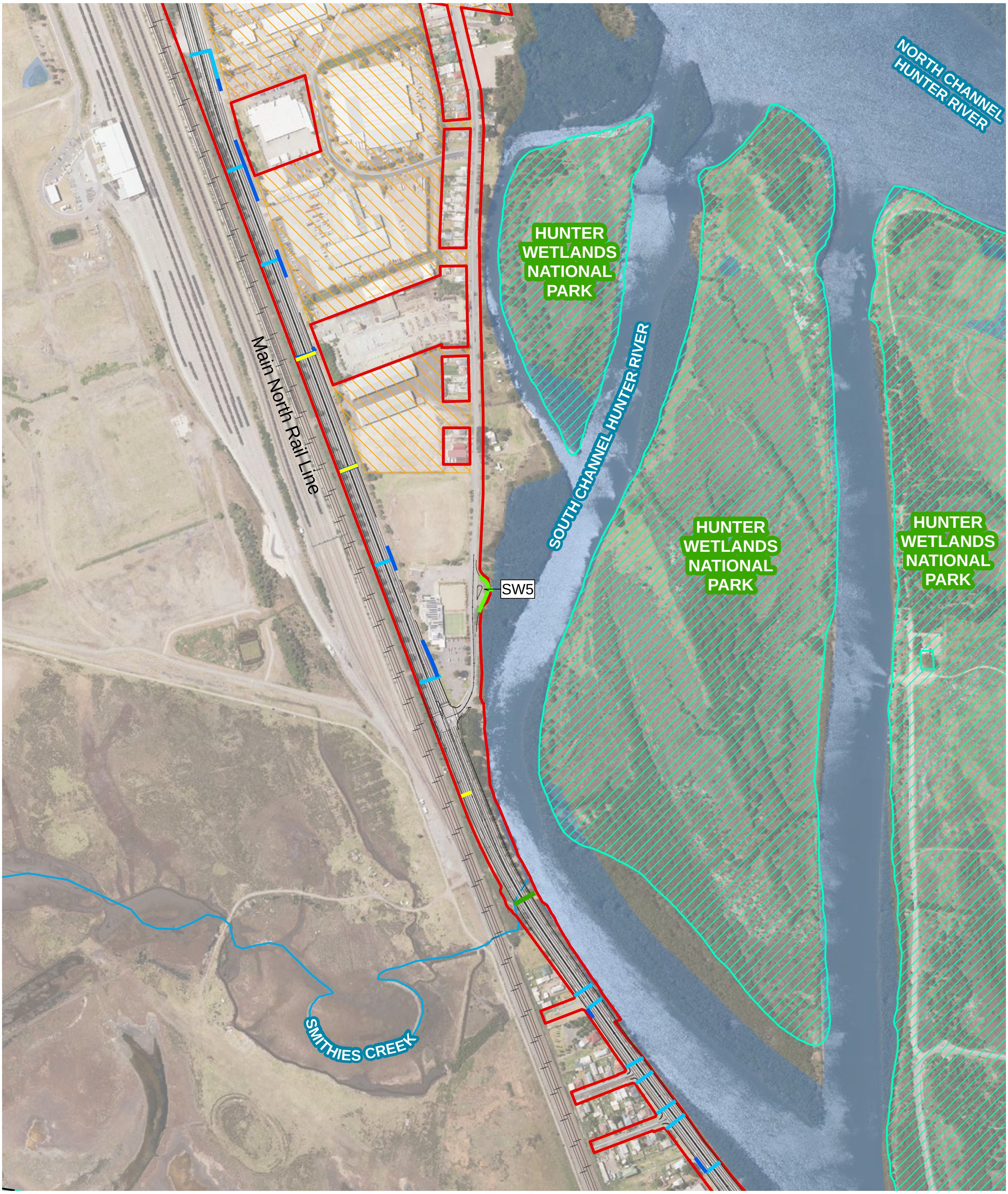


Page 2 of 4

**Data sources**
Jacobs 2021
Ausimage 2018
Department Finance, Services Innovation Dec 2020

**Figure 3.4b** Construction activities

Hexham Straight Widening




**Legend**

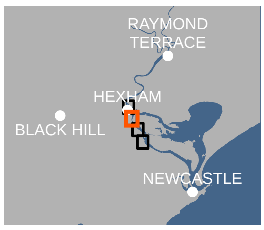
The proposal
REF area
Construction compound
Hexham Swamp Nature Reserve
Hunter Wetlands National Park
Railway
Waterway

Culverts
Existing
Reinforced concrete box culvert
Proposed
To be removed

Water quality controls
Proposed grassed swale

0 100 200 m

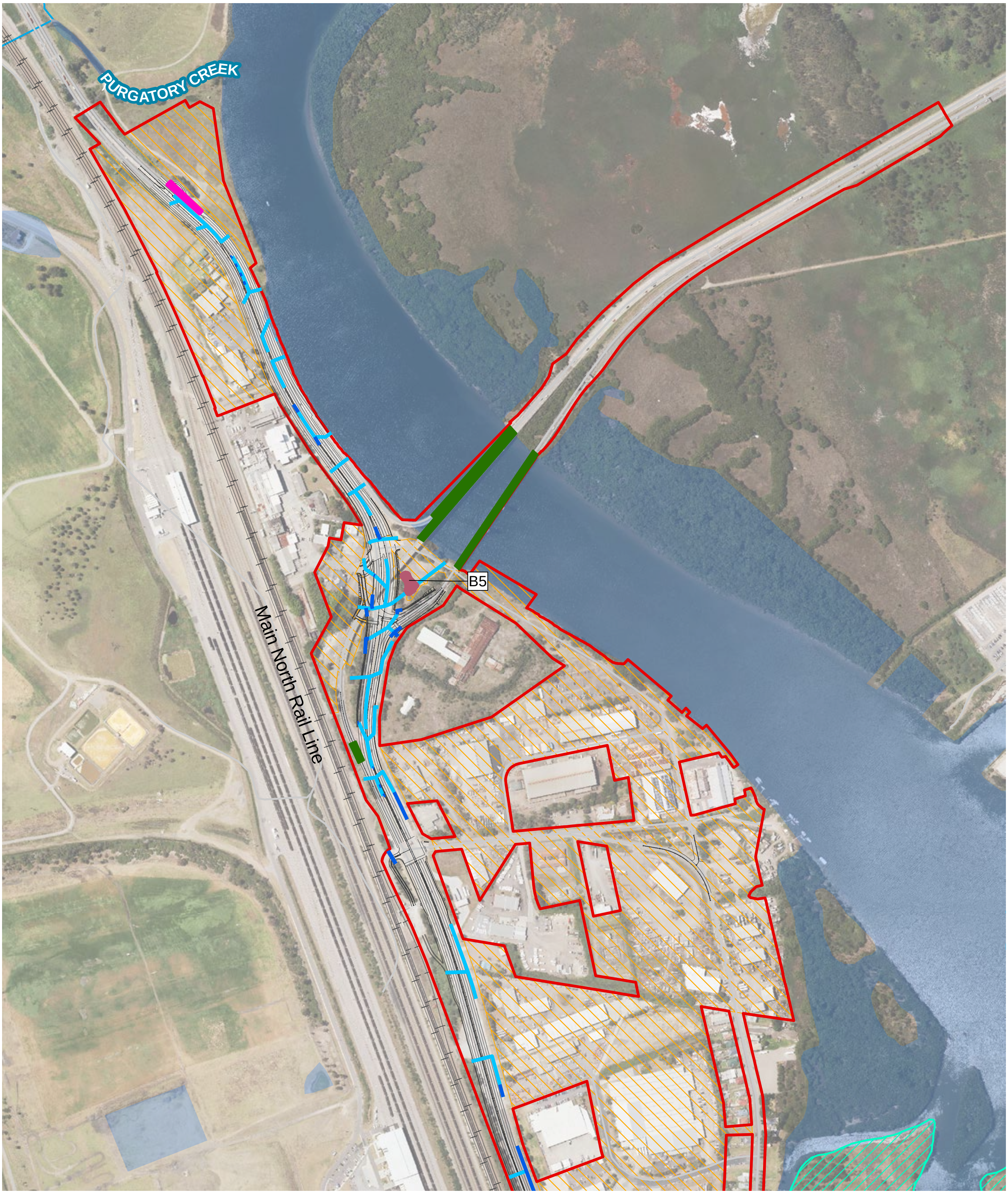
1:8,000 at A4
GDA94 MGA56






**Data sources**
Jacobs 2021
Ausimage 2018
Department Finance, Services Innovation Dec 2020

**Figure 3.4c** Construction activities




Date: 15/11/2021 Filename: IA301100_REF

**Legend**

- The proposal
- REF area
- OSOM vehicle parking locations
- Construction compound
- Hunter Wetlands National Park
- Railway
- Waterway

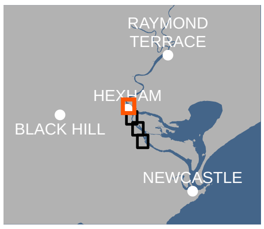
Culverts

- Existing
- Proposed

- Basin
- Existing bridge
- Floodgate

0 100 200 m

1:8,000 at A4
GDA94 MGA56




**Page 4 of 4**

**Data sources**
Jacobs 2021
Ausimage 2018
Department Finance, Services Innovation Dec 2020

**Figure 3.4d** Construction activities

### *Establishment work*

Establishment works would include:

- Installation of fencing and sediment and erosion control works
- Installation of architectural noise treatment to identified properties
- Property adjustment works including relocating fences and boundary features
- Minor earthworks to establish temporary construction roads, level areas for site compounds and water quality control ponds
- Minor vegetation clearing and grubbing works
- Geotechnical investigations
- Utility connection works
- Establishment of construction compounds and ancillary facilities
- Minor road works to establish access points
- Drilling of temporary piles from construction barges and/or construction of a temporary bridge or rock platforms for the piling and pier construction in the creek.

### *Utility relocations*

Utility relocations would be one of the first tasks undertaken during construction and may be undertaken by service providers. The activities that would be undertaken to relocate land based utilities include:

- Excavation and construction of new underground cutover locations within the existing utility network. These would be generally located in pits
- Installation of new poles to carry overhead services
- Excavation of trenches along the new utility routes
- Installation of bedding material and new utilities within the trenches or onto new poles
- Testing and cutover of utilities into new infrastructure
- Decommissioning and removal of redundant utilities where required.

### *Earthworks and drainage*

Earthworks and drainage activities for the new approaches include:

- Clear and grub vegetation, including the removal and/or trimming of vegetation
- Stripping, stockpiling and management of topsoil and unsuitable material
- Excavate and fill to the road formation levels, including excavations for embankments and cuttings and boxing out the new pavement
- Dispose of unsuitable and/or surplus excavated material to a licensed facility
- Install new drainage lines, pits and subsoil drains to connect into the existing drainage lines within the road formation.

### *Construction of bridge approaches*

Land based structural works would be required for the bridge approaches, including retaining walls, stabilised embankments and bridge approach slabs. Typical construction activities would include:

- Ground preparation including minor earthworks
- Bored piling to provide foundation to support structural elements where required due to ground conditions

- For cast in-situ elements, erection of formwork, placement of steel reinforcing and pouring concrete
- For pre-cast elements, lifting, placing and securing precast components
- Stitching, joining and other similar processes to join structural elements together
- Back filling and compaction of engineered fill or concrete.

### *Construction of new bridge*

For purposes of this REF, construction of the new bridge has been assumed to be using bored cast in place piles, cast in-situ concrete substructure and superstructure consisting of precast concrete planks and barriers with a cast in-situ concrete deck. An alternative construction methodology may be identified during detailed design.

*Land-based construction*

The land-based construction components associated with the new bridge would include construction of the abutments on each bank of Ironbark Creek and the construction of the land piers. The piers in Ironbark Creek could be constructed from barges, from a temporary steel bridge or from rock platforms placed on geofabric over the creek bed. The planks would be craned in from the platforms or bridge and the deck spans cast using concrete pumps initially behind the abutments and then on the completed desk.

The construction of the abutments would include:

- Importation of fill. Local fill won from the proposal construction sites would be used where possible, although additional general and select imported fill is required (refer to **Section 3.3.7**)
- Completion of earthworks to create temporary level working platforms
- Installation of piles at abutment locations by boring to the required depth, placing a steel reinforcement cage in the hole then placing concrete in each pile. Three piles of about 900 millimetres in diameter are required directly under each abutment
- Construction of the abutment walls and retaining structures for the bridge approaches including placement of beams
- Backfilling and compaction of engineered fill
- Construction of the land piers would include:
    - Preparation of temporary level working areas
    - Installing piles at pier locations to the required depth by boring, placement of steel cages and pouring concrete
    - Installing pile caps and pier columns using a combination of precast and cast in-situ methods.

The proposed new bridge superstructure would be constructed using the precast concrete planks lifted into position with cranes from behind the abutments. The cast in-situ desk would then be constructed in stages to suit the integral connection of the desk to the piers and composite action between the desk and the planks. Typically this would involve a sequence of casting a small width of deck over the piers planks and when it has gained sufficient strength casting the midspan sections of the deck over the planks.

Finishing works on the bridge superstructure would include:

- Installing precast concrete traffic barriers
- Placing an asphalt road pavement surface

- Installing other road furniture such as steel traffic barrier railings on the concrete barriers, lighting, signs and safety rails
- Line marking and other minor works.

*Water-based construction*

Construction of the creek piers requires piling rigs and cranes to be over Ironbark Creek and could include one of the following construction methods:

- Placement of geofabric on the floor of Ironbark Creek followed by gravel or rock to create a platform for the piling rigs to install the piles for the creek piers. The platform would be constructed on one side of the creek at a time or both depending on the potential flood impacts. The platforms would be removed after the completion of the pier construction
- Installation of temporary steel bridge across the creek potentially consisting of driven steel tube piles, steel headstocks and steel spans. A temporary steel bridge would have less of an impact on the creek flows than the rock platforms and could be necessary to prevent flood impacts
- Temporary barges would likely be required in addition to both the rock platforms and temporary bridge but could also be used instead of either option for all of the pier construction. The distance from Ironbark Creek to a suitable location to load the barges and the shallow water depth at the pier locations at low tide may however prevent the use of the barges for the construction of some piers.

Piling rigs and cranes would be used to:

- Install piles at pier locations to the required depth by boring, placement of steel cages and pouring concrete
- Install pile caps and pier columns using a combination of precast and cast in-situ methods.

As with the land-based components, the construction methods would be either based on precast or cast in-situ concrete components. If precast methods are used, the components of the pile caps or pier columns would be cast at an appropriately licensed off-site facility, before being transported to the intended location. The components would be lifted into place by cranes. Cast in-situ methods for construction of the pile caps and pier columns would involve installation of formwork or precast concrete shells supported by a temporary scaffold system and fixing of steel reinforcement into which concrete would be poured from barges.

Barges would be moored to the east of the new bridge structure for the duration of construction to facilitate the piling and installation of the piers and headstocks. Access to the Ironbark Creek to transport material to the barges is expected to be via the boat ramp at Ferry Road about 2.5 kilometres downstream of the bridge site. This is based on there being sufficient clearance under the pipe bridge across the South Channel Hunter River between the boat ramp and the bridge site. If not, the barge loading would be required to come from further upstream around Hexham.

#### Pavement construction including local road works

Pavement construction would be required to tie the bridge approaches Maitland Road. Work would include:

- Installing new kerb and gutter including driveway crossings where required
- Constructing new pavement, including placing and compacting select fill, sub base and asphalt wearing surface
- Amending shared use paths or pedestrian crossing facilities.

### *Landscaping and finishing works*

Finishing and landscaping would include:

- Installing new street lights
- Rehabilitating disturbed areas and landscape in accordance with the urban design and landscaping plan
- Line marking and sign posting.

### *Demolition of the existing bridge*

The existing bridge would be removed including superstructure, piers and abutments to ensure safe navigation of Ironbark Creek. The methodology for demolition of the existing bridge would be refined during detailed design. For the purposes of this REF, a methodology has been developed and used to identify and assess potential impacts. This is described in the following sections.

#### *Removing the bridge superstructure*

Removal of the superstructure would involve removing the services, railings and barriers and then cutting the deck longitudinally between the girders. The girders would then be lifted out in pairs with the deck using cranes positioned behind the abutments and onto trucks to be removed from site. For the central spans, it may be necessary to demolish the concrete deck in-situ to reduce the weight of the crane lifts for the steel girders from behind the abutments or sufficient enough to allow a much lighter crane onto the deck to lift the girders out. For both options, a lined temporary platform would be placed beneath the desk spans to capture any slurry from saw cutting or rubble from the deck demolition.

Removal of dismantled items would be via trucks to a licenced waste disposal facility for recycling.

#### *Removing the bridge substructure*

Pier and structural elements including piles would be demolished to below creek bed level. The substructure would be cut into sections and then removed using a crane behind the abutment

Containment measures would be installed around underwater sections of the piers and piles to protect water quality and minimise disturbance of the creek bed. A suction dredge with a storage tank on a barge would then be used to remove sediment from around the piles to enable access for cutting.

Existing bridge abutments and approaches would be demolished using excavators and rock hammers.

#### *Removal of ancillary facilities and site rehabilitation*

Upon completion of works ancillary facilities and other construction areas would be removed and the site rehabilitated in consultation with the relevant property owner.

### *Operation of site compounds*

The operation of the site compounds is discussed in detail in **Section 3.4** and would include the following activities:

- Construction compound that would operate during standard and out of hours
- Delivery of equipment and materials
- Stockpile management
- Staff car parking
- Storage of construction plant and equipment.

### 3.3.2 Construction staging

The proposal would be constructed during six main stages as shown in **Appendix D** and would take place over the 30 month construction period.

The proposed construction work and methodology provided is based on the current concept design and would be further refined during detailed design. Detailed construction staging plans and methods would be determined by the construction contractor(s) after completion of the detailed design in consultation with Transport. In the event that construction activities result in any environmental impact above that assessed in this REF, further environmental assessment would be required to be carried out and approved by Transport.

The staged approach to construction is proposed to meet the following conditions:

- Minimum two lanes maintained for each travel direction
- The widths of construction lanes in each travel direction are as follows:
    - Near side shoulder: 1.5 metres
    - Lane 1: 3.0 metres
    - Lane 2: 3.0 metres
    - Offside shoulder: 0.5 metres
- Speed limit reduced to 60 kilometres per hour approaching and next to construction works
- Temporary safety barriers approved by Transport are installed between opposing traffic and between construction zones and life traffic to ensure the safety of road users and construction personnel
- Driveway access to properties are maintained, or alternate arrangements made where required
- Pedestrian and cyclist access is maintained across the construction area.

The six stages of construction as shown in **Appendix D** are summarised below and include:

#### Stage 1

- Establishment work including establishing construction compounds and ancillary facilities, vegetation clearing, site preparation, geotechnical investigations, utilities potholing
- Installation of traffic barriers to facilitate works within the median. Live traffic would remain within the existing lanes
- Construction of median pavement (not including permanent redirective kerbs)
- Construction of temporary steel bridge or rock platforms (if required) to install piers within Ironbark Creek
- Installation of bridge pier piles, erection of bridge piers and installation of bridge abutments
- Construction of the northern and southern bridge abutment earthworks
- Protection of underground and overhead utility crossings to be retained
- Relocation of utilities on the south and north bridge abutments
- Relocation of traffic signals that are placed on the median widening areas.

#### Stage 2

- Installation of traffic barriers to facilitate works mainly along the southbound shoulder and some works along the northbound shoulder at the southern end of the proposal. Generally southbound traffic would utilise the median pavement completed in Stage 1
- Temporary line marking

- Construction of pavement widening mainly along southbound shoulder and pavement widening along northbound shoulder at the southern end of the proposal
- Construction of the Ironbark Creek Bridge superstructure
- Construction of new southbound bridge pavements and earthworks
- Extension of culverts
- Construction of retaining walls to the south of Ironbark Creek
- Protection of underground and overhead utility crossings to be retained
- Completion of the relocation of utilities to the southbound bridge abutments
- Relocation of water main currently attached to the superstructure of the existing bridge
- Relocation of utilities that are interfacing with the proposed widening area on the southbound.

### Stage 3

- Installation of traffic barriers to facilitate works mainly along the northbound shoulder. Generally northbound traffic would utilise the median pavement completed in Stage 1 and southbound traffic would utilise the shoulder pavement widening completed in Stage 2. Southbound traffic would also be diverted to the new southbound lanes on the completed bridge
- Construction of pavement widening along northbound shoulder of the proposal
- Construction of new northbound bridge pavements and earthworks
- Extension of culverts
- Construction of retaining walls
- Construction of shared use path at the northern end of the proposal
- Protection of underground and overhead utility crossings to be retained
- Completing relocation of utilities to the northbound bridge abutments
- Completing relocation of water main currently attach ed to the superstructure of the existing bridge
- Relocation of utilities that are interfacing with the proposed widening area on the northbound lanes of the proposal
- Relocation of utilities interfacing with shared use path at the northern end of the proposal.

### Stage 4

- Installation of traffic barriers to facilitate works mainly along the northbound shoulder around the new northbound bridge. Southbound traffic would remain as per Stage 3 and northbound traffic would utilise the new pavement on the completed bridge
- Construction of pavement widening along northbound shoulder at the new bridge
- Demobilisation and removal of temporary crane pads/work platforms
- Demolition of old bridge (potentially requiring installation of temporary cofferdams to remove bridge piles which would be removed once the bridge demolition is completed)
- Installation of road furniture
- Line marking
- Protection of existing buried utilities crossings Ironbark Creek western of existing bridge during its demolition
- Protection of overhead utility crossings to be retained
- Completion of utilities relocations and protections

- Landscaping and signage installation
- Rehabilitation of areas impacted by the proposal and demobilisation of construction compounds.

### Stage 5

- Replacement of concrete slabs at the northern end of the proposal in multiple sub stages under night works
- Stage 5 night works can be constructed in parallel with works proposed in Stages 1, 2, 3 and 4.

### Stage 6

- This stage comprises mill and re-sheet new asphalt. and new asphalt overlays. This work would be completed in multiple sub stages under night works
- Diamond grinding and joint resealing of concrete pavement.

### 3.3.3 Construction workforce

The total workforce number across the proposal is anticipated to be about 500 staff per day on average. However, this number is expected to fluctuate considerably throughout construction as it progresses. These numbers are based on each main construction compound catering for about 200 staff during construction, with satellite compounds catering for about 100 staff.

### 3.3.4 Construction hours and duration

Where possible, construction would be undertaken during recommended standard hours in accordance with the *Interim Construction Noise Guideline* (DECC, 2009) (ICNG). The recommended standard hours for construction are:

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

Work with impulsive or tonal noise emissions would be carried out in continuous blocks not exceeding three hours each with a minimum respite of at least one hour between each block.

To minimise disruption to daily traffic and disturbance to surrounding landowners and businesses, it would be necessary to carry out a large portion of the work outside of these hours.

Out of hours work would be subject to permitted road occupancy licences and construction staging. Any out of hours works would be undertaken in accordance with the ICNG and the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) (CNVG).

### 3.3.5 Plant and equipment

An indicative list of plant and equipment that would typically be required is provided in **Table 3.3** and has been separated according to the construction scenarios identified in **Section 3.3.1**. Additional equipment is likely to be used and would be identified during construction planning by the construction contractor.

Table 3.3 Indicative construction plant for each construction scenario

| Construction scenario | Construction plant |
|---|---|
| Establishment works | Backhoe 7.5 tonne, mobile crane – franna, truck, underbore rig, concrete saw, excavator breaker, excavator (22 tonne), hand tools, suction truck, lighting – diesel generator, bobcat, chainsaw, concrete mixer truck, grader, chipper, 2 tonne tipper, light vehicles, tub grinder/mulcher 40-50 horsepower, vacuum truck, water carts, piling rig. |
| Utility relocation | Backhoe 7.5 tonne, mobile crane – franna, truck, underbore rig, concrete saw, excavator breaker, excavator (22 tonne), hand tools, suction truck, lighting – diesel generator, bobcat, chainsaw, concrete mixer truck, grader, chipper, 2 tonne tipper, light vehicles, welding equipment, roller. |
| Earthworks and drainage | Backhoe 7.5 tonne, mobile crane – franna, truck, underbore rig, concrete saw, excavator breaker, excavator (22 tonne), hand tools, suction truck, lighting – diesel generator, bobcat, chainsaw, concrete mixer truck, grader, chipper, light vehicles, roller, road truck (bogie), road truck (hiab). |
| Road pavement construction | Concrete mixer truck, concrete pump, concrete vibrator, excavator breaker, excavator (22 tonne), grader, hand tools, lighting – diesel generator, piling rig – impact, paving machine, roller – vibratory (12 tonne), suction truck, truck, underbore rig, asphalt paver, asphalt truck and sprayer, compactors and rollers, diamond grinder, hydraulic jack, jack hammer, light vehicles, pavement profiler, milling machine, pulvi-mixers, road marking machine, slip-forming machine, smooth drum roller, spray seal equipment, vibratory roller 20-30 tonne, water carts. |
| Construction of bridge, piers and bridge supports | Backhoe 7.5 tonne, mobile crane – franna, truck, underbore rig, concrete saw, excavator breaker, excavator (22 tonne), hand tools, suction truck, bobcat, chainsaw, concrete mixer truck, grader, cherry picker, dump truck (bogie truck) / 2 tonne tipper, dump truck (truck and dog), elevated work platforms, excavator (tracked) 35 tonne, excavator (tracked) 5-12 tonne (for stumps only), front end loader, light vehicles, plate compactor/tamper rammer, pneumatic hammer, power generator, concrete pump, concrete vibrator, mobile crane (100 tonne), piling rig – impact, truck, concrete mixer truck, concrete pump, mobile crane (franna), barges, drills, forklifts, launching trusses / moving gantries, scissor lift, screed boards (petrol driven), skid steer, suction dredges, temporary jetties, welding equipment. |
| Bridge demolition | Concrete saw, excavator – breaker, hand tools, mobile crane (100 tonne), truck, underbore rig, hydraulic jack, jack hammer, launching trusses / moving gantries, light vehicles, barge / marine vessels, scissor lift, scissor lift / ewp (o/h power relocation), suction dredges, temporary jetties, water carts. |
| Landscaping and finishing works | Backhoe 7.5 tonne, bobcat, concrete mixer truck, concrete vibrator, hand tools, line marking plant, mobile crane (franna), truck, dump truck (bogie truck) / 2 tonne tipper, light vehicles, water carts. |
| Operation of site compounds | Backhoe 7.5 tonne, truck, dump truck (bogie truck) / 2 tonne tipper, front loader, light vehicles, water carts |

### 3.3.6 Earthworks

The proposal would result in about 65,000 cubic metres of bulk cut/fill material throughout the construction. The suitability of cut material for reuse within the proposal would be determined during the construction of the proposal. Any material unsuitable for reuse within the proposal would be classified in accordance with the *NSW EPA Waste Classification Guidelines* (Environment Protection Authority (EPA), 2014) and disposed of at an approved materials recycling or waste disposal facility.

The proposal would also require about 17,028 cubic metres of fill material to construct ground treatments.

The final earthwork requirements and source of materials would be confirmed during detail design.

### 3.3.7 Source and quantity of materials

Materials to be used to construct the proposal would be sourced from local quarries and appropriately licensed commercial suppliers in nearby areas. The estimated quantities of materials associated with REF area are provided in **Table 3.4**. None of the materials proposed to be used are considered to be in short supply.

Table 3.4 Materials and estimated quantities required

| Material | Volume |
|---|---|
| Imported material | 42,500 $m^3$ |
| Concrete, cement, aggregates and sand | 17,000 $m^3$ |
| Asphalt | 48,770 t |
| Steel (excluding steel in safety barriers, signs and fencing) | 1,230 t |
| Water | 7,747 kL |
| Safety barriers | 4,500 m |
| Line marking | 45,000 m |
| Signs | 136 units |
| Geotextile | 102,000 $m^2$ |

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

The amount of water that would be required during construction is unknown at this stage however about 8,000 kilolitres have been estimated (refer to **Table 3.4**). The amount would depend on material sources and methodologies applied by the contractor. It is proposed that water would be obtained from the local water supply network.

### 3.3.8 Traffic management and access

#### Construction traffic

There are about 400 daily vehicle in and out movements expected as part of construction activities. This includes about 300 daily heavy vehicle movements and 106 construction workforce (light vehicle) movements. On average there are about 30 heavy vehicle movements and 10 construction workforce (light vehicle) in and out movements during the peak hour across the four ancillary facilities. When compared to traffic volumes along Maitland Road without construction, additional traffic volumes generated are relatively minor (refer to **Table 3.5**).

Table 3.5 Daily construction traffic movements

| Compound | Additional vehicle movements | | | |
|---|---|---|---|---|
| | Heavy vehicles | Light vehicles | Total vehicles | Peak hour vehicles |
| C1 | 121 | 42 | 162 | 16 |
| C2 | 91 | 32 | 122 | 12 |
| C3 | 45 | 16 | 61 | 6 |
| C4 | 45 | 16 | 61 | 6 |
| **Total** | **302** | **106** | **406** | **40** |

### Site access for construction vehicles

Construction related traffic would use the surrounding road network to:

- Provide access for the workforce to the ancillary sites and construction access locations
- Haul construction related materials to and from the construction access locations
- Carry equipment and materials from one area of the construction site to another.

Construction haulage routes would use the Maitland Road to the north and south of the proposal or the A1 Pacific Highway to the east of the proposal (refer to **Figure 6.6**). These major highways are sufficient to cater for heavy construction vehicles without imparting significant road user delay to other vehicles. It is assumed that the majority of building materials would originate from north of the proposal from the New England Highway and the Pacific Highway, which offers potential sources of fill material. Heavy machinery would need to be transported to and from site during off peak hours to minimise road user delays due to turning movements. Oversize and overmass vehicles are likely to be escorted and travel at slower speeds than other vehicles on the existing road network.

### Property access

Property access will be maintained at all times during construction. Any changes to access arrangements or alternative access that are necessary during construction will be done in consultation with the landowner. Any changes to access will provide the same equivalent pre-existing level of access unless agreed to by the landowner. Property access is discussed further in **Section 6.6**.

Property access that is physically affected by the proposal would 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.

### Road closures

Maitland Road and the A1 Pacific Highway would remain open in both directions during construction works and all movements would be maintained.

The construction contractor will liaise with Transport, Council (where relevant), emergency services and public transport authorities regarding any road closures, diversions or reconfigurations of the road and cycle network during construction.

### Construction traffic management plan

A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the *Traffic Control at Work Sites Manual* (Roads and Traffic Authority, 2010) and *QA Specification G10 Control of Traffic*. The TMP will include:

- Confirmation of haulage routes
- Measures to maintain access to local roads and properties
- Site specific traffic control measures (including signage) to manage and regulate traffic movement
- Measures to manage temporary changes to the road network including use of barriers or lane occupancies
- 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 construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads
- A response plan for any construction traffic incident
- Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic
- Any licences or permits required before starting activities
- Monitoring, review and amendment mechanisms.

## 3.4 Ancillary facilities

Ancillary facilities would be required throughout construction of the proposal. Identification of potential ancillary facility locations involved consideration of the following site assessment criteria:

- Operational during a flood event and avoid or minimise impacts to surrounding properties
- More than 40 metres from a watercourse
- More than 50 metres from residential dwellings
- In previously disturbed areas that do not require the clearing of native vegetation
- In plain view of the public to deter theft and illegal dumping
- Outside the drip line of trees
- On relatively level ground
- Away from areas of heritage value.

The proposal is located within close proximity to a number of waterways including Hunter River, South Channel Hunter River and Ironbark Creek, and it was difficult to identify suitable compound locations that were more than 40 metres from watercourses while still meeting the other criteria and balancing the need to minimise heavy vehicles travelling on public roads. To offset the increased risk to watercourses due to the proximity of ancillary facilities, suitable erosion and sedimentation mitigation measures would be adopted.

Four potential compound locations (refer to **Figure 1.2**) were identified and considered against the site assessment criteria (refer to **Table 3.6**). These four compound locations and details are as follows:

- Compound 1 – located in the industrial estate located on Old Maitland Road, Sandgate to the south of Calvary St Joseph's Retirement Community

- Compound 2 – Comprised of two areas located in the industrial estate located to the east of Maitland Road and the west of Old Maitland Road, Hexham extending north from the northern boundary of the Hexham sports field to the area of road corridor underneath the entry ramps to the Pacific Highway and Hexham Bridge
- Compound 3 – comprised of two areas located in the industrial estate located to the west of Maitland Road, Hexham near the Oak Factory
- Compound 4 – located on vacant land at the northern end of the proposal to the east of the U-turn facility on Maitland Road at Hexham and to the west of the Hunter River.

The construction compounds generally would operate during standard working hours (7am-6pm), however there would be limited periods when night work would occur (6pm-7am). A description of the activities that would occur at the ancillary facilities is summarised in **Table 3.6**. Currently the areas identified for construction compounds are larger than the actual area that would be used as lease agreements are yet to be made with property owners prior to construction. As such the impacts identified in this REF are greater than would be expected during construction.

A description of the proposed access arrangements for each compound is provided in **Table 3.7**.

Table 3.6 Description of ancillary facilities activities

| Compound | Description | Compliance with site assessment criteria | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Outside 10% AEP and avoids flooding impacts | More than 40m from a watercourse | More than 50 m from residential dwellings | In previously disturbed area with no clearing | In plain view of the public | Outside drip line of trees | On relatively level ground |
| Compound 1 | Compound 1 is located in Sandgate to the west of the proposal and is comprised of a large area currently zoned as IN3 Heavy Industrial and a smaller area near to the NICB zoned as SP2 Infrastructure.<br><br>The following lots would potentially be impacted including: Lot 200 DP867471, Lot 22 DP627724, Lot 1101 DP570856, Lot 14 DP1146286, Lot 1 DP234073, Lot 2 DP234073, Lot 3 DP234073, Lot 16 DP1146286, Lot 17 DP1146286, Lot 124 DP755232, Lot 2 DP156388, Lot 13 DP1117058, Lot 11 DP531499.<br><br>The total area of the site is 17.56 hectares.<br><br>This site is proposed for use during all stages of construction and is located at the southern end of the proposal.<br><br>The site would include portable buildings with amenities (such as lunchrooms and toilets), office space for on-site personnel and associated parking, parking of plant and stockpile sites. | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ |
| Compound 2 | Compound 2 is comprised of two areas located in the industrial estate located to the east of Maitland Road in Hexham and includes a large area currently zoned as IN3 Heavy Industrial and a smaller area near to the A1 Pacific Highway and Hexham Bridge that is zoned as SP2 Infrastructure.<br><br>The following lots would potentially be impacted including: Lot 2 DP565347, Lot 1 DP546494, Lot 3 DP565347, Lot 4 DP565347, | ✓ | | | ✓ | ✓ | ✓ | ✓ |

| Compound | Description | Compliance with site assessment criteria | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Outside 10% AEP and avoids flooding impacts | More than 40m from a watercourse | More than 50 m from residential dwellings | In previously disturbed area with no clearing | In plain view of the public | Outside drip line of trees | On relatively level ground |
| | Lot 1 DP565347, Lot 54 DP32517, Lot 1 DP520947, Lot 64 DP32517, Lot 65 DP32517, Lot 1 DP1095613, Lot 8 DP629865, Lot 78 DP32517, Lot 6 DP629865, Lot 11 DP1087952, Lot 10 DP1087952, Lot 1 DP88366, Lot 301 DP536839, Lot 1 DP804657, Lot 3 DP813606, Lot 1 DP608445, Lot 12 DP864533, Lot 101 DP499013, Lot 1 DP813606, Lot 292 DP558995, Lot 1 DP738880, Lot 1 DP194650, Lot 1 DP88584, Lot 1 DP197273, Lot 2 DP598846, Lot 4 DP270447, Lot 1 DP270447, Lot 2 DP270447, Lot 5 DP270447, Lot 6 DP270447, Lot 3 DP270447, Lot 2 DP270447, Lot 53 DP755232, Lot 117 DP755232, Lot 2 DP729023, Lot 2 DP363871, Lot 1 DP363871.<br>The total area of the site is 33.27 hectares.<br>This site is proposed for use during all stages of construction and is located at the northern end of the proposal.<br>The site would include portable buildings with amenities (such as lunchrooms and toilets), office space for on-site personnel and associated parking, parking of plant and stockpile sites. | | | | | | | |
| Compound 3 | Compound 3 is comprised of two small areas located in the industrial estate located to the west of Maitland Road in Hexham and includes an area currently cleared and zoned as IN3 Heavy Industrial and smaller areas near to the Maitland Road and the Main North Rail Line that are zoned as SP2 Infrastructure.<br>The following lots would potentially be impacted including: Lot 100 DP1034798, Lot 2 DP843622, Lot 1 DP843622, Lot 1DP854055, Lot 4 DP854055, Lot 115 DP755232, Lot 101 DP1175201, Lot | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |

| Compound | Description | Compliance with site assessment criteria | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Outside 10% AEP and avoids flooding impacts | More than 40m from a watercourse | More than 50 m from residential dwellings | In previously disturbed area with no clearing | In plain view of the public | Outside drip line of trees | On relatively level ground |
| | 102 DP1175201, Lot 12 DP1176475, Lot 11 DP1176475, Lot 2 DP1112109, Lot 1 DP1112109, Lot 1 DP360976, Lot 1 DP508669, Lot 19 DP1113876, Lot 14 DP1176475, Lot 13 DP1176475, Lot 192 DP583511.<br>The total area of the site is 4.60 hectares.<br>This site is proposed for use during all stages of construction and is located at the northern end of the proposal.<br>The site would include portable buildings with amenities (such as lunchrooms and toilets), office space for on-site personnel and associated parking, parking of plant and stockpile sites. | | | | | | | |
| Compound 4 | Compound 4 is comprised of one small, cleared area located to the east of Maitland Road in Hexham and includes a small area zoned as Infrastructure and the rest of the area zoned as E2 Environmental Conservation that is zoned as SP2 Infrastructure.<br>The following lots would potentially be impacted including: Lot 1 and Lot 2 DP 707984.<br>The total area of the site is 1.73 hectares.<br>This site is proposed for use during all stages of construction and is located at the northern end of the proposal.<br>The site would include portable buildings with amenities (such as lunchrooms and toilets), office space for on-site personnel and associated parking, parking of plant and stockpile sites. | ✓ | | | ✓ | ✓ | ✓ | ✓ |

Table 3.7 Construction compound access details

| Site | Direct entry access | Direct exit access | Indicative traffic movements to arrive at site | Indicative traffic movements leaving site |
|---|---|---|---|---|
| C1 | Straight in from Old Maitland Road (north of NICB), Sandgate | Straight in from Old Maitland Road (north of NICB), Sandgate | Southbound vehicles on Maitland Road would need to turn right at the U-turn provision at Old Maitland Road (north of NICB) and continue through to the site<br>Northbound vehicles would need to turn left using the slip lane onto Old Maitland Road (north of NICB) | Vehicles would need to exit site by heading northbound on Maitland Road via a left turn from Old Maitland Road (north of NICB)<br>Vehicles wanting to head south could turn around at the U-Turn provision 160 metres north of Old Maitland Road (north of NICB) |
| C2 | Northern access: Straight in from Old Maitland Road (north), Hexham<br>OR<br>Southern access: Straight in from Old Maitland Road (south), Hexham | Northern access: Straight out from Old Maitland Road (north), Hexham<br>OR<br>Southern access: Straight out from Old Maitland Road, Hexham | Northern access: Southbound vehicles on Maitland Road can enter the site by turning left at the signalised intersection at Old Maitland Road.<br>Southern access: Southbound and northbound vehicles on Maitland Road can enter the site by turning left or right respectively at the signalised intersection at Old Maitland Road | At the northern exit, vehicles can exit the site and head in either direction on Maitland Road at the Old Maitland Road intersection with Maitland Road.<br>At the southern exit, vehicles can exit the site only turn left to travel in the southbound direction on Maitland Road. Vehicles travelling north are to use the northern exit |
| C3 | Left in from northbound Maitland Road and A1 Pacific Highway intersection | Straight out to Maitland Road/New England Highway/Pacific Highway (A43) near the Oak Factory industrial area | Vehicles would need to enter the site from northbound on Maitland Road.<br>Southbound vehicles could turn around at the turning provision at Old Maitland Road (north) 400m from northern compound | Vehicles can exit the site and head either in either direction on Maitland Road at the /Maitland Road and A1 Pacific Highway intersection |
| C4 | Left in from southbound Maitland Road just to the north of the southbound exit to the A1 Pacific Highway | Left out to southbound Maitland Road just to the north of the southbound exit to the A1 Pacific Highway | Vehicles would need to enter the site southbound on Maitland Road.<br>Northbound vehicles could turn around at the turning provision at the U-Turn bay at the sight entrance | Vehicles would need to exit site by heading south-east on Maitland Road.<br>Vehicles wanting to head north-west would need to travel about 400 metres southbound on Maitland Road and perform a U-turn underneath the on-ramps to the A1 Pacific Highway opposite the access road into the Oak Factory. |

## 3.5 Public utility adjustment

A number of utilities have been identified in the construction area that would need to be relocated or adjusted for the REF area, as described in **Table 3.8**. This has been informed by the Utility Services Strategy Report, which has been prepared in parallel to the concept design (Jacobs, 2020).

Table 3.8 Public utility adjustments

| Utility | Description | Adjustments |
| --- | --- | --- |
| Jemena Gas Land Services NSW<br><br>Jemena Gas North | Two high pressure gas mains | Protection: No adjustments proposed. Services would be protected rather than relocated. |
| AGL | The high pressure Hexham to Tomago gas main | No protection or adjustments proposed. |
| Ausgrid | Various high voltage and low voltage overhead cables powerlines and underground conduits. | Relocation and protection: Overhead powerlines and poles and some underground electricity cables would be relocated outside of the road corridor. Other overhead and underground cables would be protected during construction and demolition of the existing bridge. |
| Hunter Water Corporation | One pressure sewer main | Protection: No adjustments proposed. Services would be protected rather than relocated. |
| | Various water mains | Relocation and protection: Water mains attached to the existing Ironbark Creek Bridge would be relocated via underboring to the western side of the existing bridge. Various other water mains would require relocation or protection, depending on further development of the pavement design and construction methodologies and validation via potholing. |
| Unknown private provider (likely Calvary St Joseph Retirement Community) | One sewer main | Protection: No adjustments proposed. Services would be protected rather than relocated. |
| Telstra | Various optical fibre and telephone conduits located along both sides of Maitland Road and Old Punt Road. | Protection: Services would be protected rather than relocated. Relocations would be avoided where possible since significant coordination between Telstra and other telecommunication utility authorities would be required. |
| AAPT / PowerTel | Various optical fibre cables along both sides of Maitland Road (contained within Telstra and TPG conduits) | Protection: Services would be protected rather than relocated. |
| NBN | Various optical fibre and copper cables (some contained within Telstra conduits) | Protection: Services would be protected rather than relocated. |

| Utility | Description | Adjustments |
|---|---|---|
| Nextgen | Various optical fibre cables along both sides of Maitland Road (contained within Nextgen and Telstra conduits) | Protection: Services would be protected rather than relocated. |
| Optus | Three optical fibre cables along both sides of Maitland Road (contained within Telstra conduits). | Protection: Services would be protected rather than relocated. |
| Transport (TCS and Cameras) | Various traffic camera, traffic control systems and associated communication and power cables which are located at intersections along the route. | Relocation and protection: Where services cannot be retained, they would be relocated to a suitable position. |

## 3.6 Property acquisition

The proposal would require the partial acquisition of one parcel of private land and one parcel of public land, refer to **Appendix A**.

The extent of property acquisition would be refined and confirmed during detailed design in consultation with the property owners. Property acquisition would be undertaken in accordance with Transport's *Land Acquisition Information Guide 2014* and the *Land Acquisition (Just Terms Compensation) Act 1991*. Property adjustment plans would be developed in consultation with the relevant property owner.

Properties to be acquired are listed in **Table 3.9** and includes the approximate area to be acquired. There would be no change to property access for the two properties listed in **Table 3.9** as a result of the property acquisition required for the proposal. Land use zones identified in the table are based on zoning from the relevant Local Environmental Plan (LEP).

Table 3.9 Proposed property acquisition

| Area ID | Description | Total area ($m^2$) | Acquisition type | Current owner | Lot and DP | Land use zone (LEP) |
|---|---|---|---|---|---|---|
| 01 | 25 Maitland Road, Hexham (Vacant lot next to service station and Main North Rail Line) | 424 | Partial acquisition | Private | Lot 1 DP 623278 | E2 |
| 02 | 8 Old Maitland Road, Hexham (Vacant lot on Old Maitland Road) | 628 | Partial acquisition | State of NSW | Lot 7002 DP 1052280 | E2 |

All driveway accesses (urban or rural) impacted by kerb and gutter work or the inclusion of new road barriers that are proposed as part of the proposal would be reinstated and no property acquisition is required for these works as all work would occur in the road corridor. It is noted that there are some changes in property access to three properties to the south of Shamrock Street on Maitland Road, Hexham (15 to 19). These three properties currently access Maitland Road via an informal side road however this would be changed as part of the proposal so that each of the three driveways connects directly to Maitland Road. All changes in this location would be within the existing road corridor. Further discussion on property access is included in **Section 6.6**.

There are a number of properties that would also be partially or fully leased for ancillary facility sites and include the areas identified as compound sites in **Figure 1.2**. Properties that would potentially be leased are zoned IN3 (Heavy industrial) and would be confirmed in detailed design in consultation with the property owner. Access to private properties near to construction works would also be maintained. Where temporary changes are required to driveway accesses during construction, suitable access arrangements would be implemented in consultation with affected property and business owners. Leased land would be rehabilitated and returned to the property owner once the construction of the proposal is completed.

# 4 Statutory planning framework

## 4.1 Environmental Planning and Assessment Act 1979

The EP&A Act provides the statutory basis for planning and environmental assessment in NSW. The EP&A Act provides the framework for environmental planning and development approvals and includes provisions to ensure that the potential environmental impacts of a development are assessed and considered in the decision making process.

The proposal is subject to assessment under two planning pathways, a REF under Part 5, Division 5.1 of EP&A Act and an environmental impact statement (EIS) under Part 4 of the EP&A Act. The majority of the proposal is subject to approval under Division 5.1 of the EP&A Act (known as the REF area) and is assessed within this REF. A small part of the proposal (3.28 hectares) falls on land mapped as Coastal Wetlands under State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP). As such, that part of the proposal (known as the EIS areas) is subject to approval under Part 4 of the EP&A Act and will be assessed within an EIS, refer further to **Section 4.2.2**.

The planning and assessment framework for the REF area is outlined in the following sections. **Figure 4.1** shows the approval process for the proposal under both Parts 4 and 5 of the EP&A Act. For an assessment under Division 5.1 of the EP&A Act, Clause 228(2) of the Environmental Planning and Assessment Regulation 2000 applies. Consideration of these Clause 228(2) factors has been completed for the REF area of the proposal, refer to **Appendix E**.

## 4.2 State Environmental Planning Policies

### 4.2.1 State Environmental Planning Policy (Infrastructure) 2007

The State Environmental Planning Policy (Infrastructure) (ISEPP) aims to facilitate the effective delivery of infrastructure across the State. Clause 94 of ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

The provisions of the ISEPP do not apply to works located on land regulated under the CM SEPP. Parts of the proposal located outside of the CM SEPP Coastal Wetlands are for the purposes specified under Clause 94 and would to be carried out by or on behalf of Transport and can therefore be assessed under Division 5.1 of the EP&A Act. Responses to the ISEPP statutory checklists for the assessment of impacts associated with the REF area of the proposal are included in **Appendix F.** The remainder of the proposal (i.e. the EIS area) would be assessed under Part 4 of the EP&A Act.

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


Figure 4.1 Approval processes under Part 4 and Part 5, Division 5.1 of the EP&A Act

Part 2 of ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. The Hunter Wetlands National Park is located next to the proposal. According to clause 16(2)(b) of the ISEPP, Transport have to consult with the NPWS regarding any development on land adjacent to land reserved under the NP&W Act. Consultation, required by the ISEPP and undertaken for the REF is summarised in **Section 5** and included in **Appendix G**.

### 4.2.2 State Environmental Planning Policy (Coastal Management) 2018

State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP) aims to promote an integrated and coordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the *Coastal Management Act 2016* (CM Act) (refer to **Section 4.4.2**).

The CM SEPP identifies and maps the coastal zone according to four coastal management areas defined in the CM Act (refer further to **Section 4.4.2**) and include:

- Coastal Wetlands and littoral rainforests area
- Coastal vulnerability area
- Coastal environment area
- Coastal use areas.

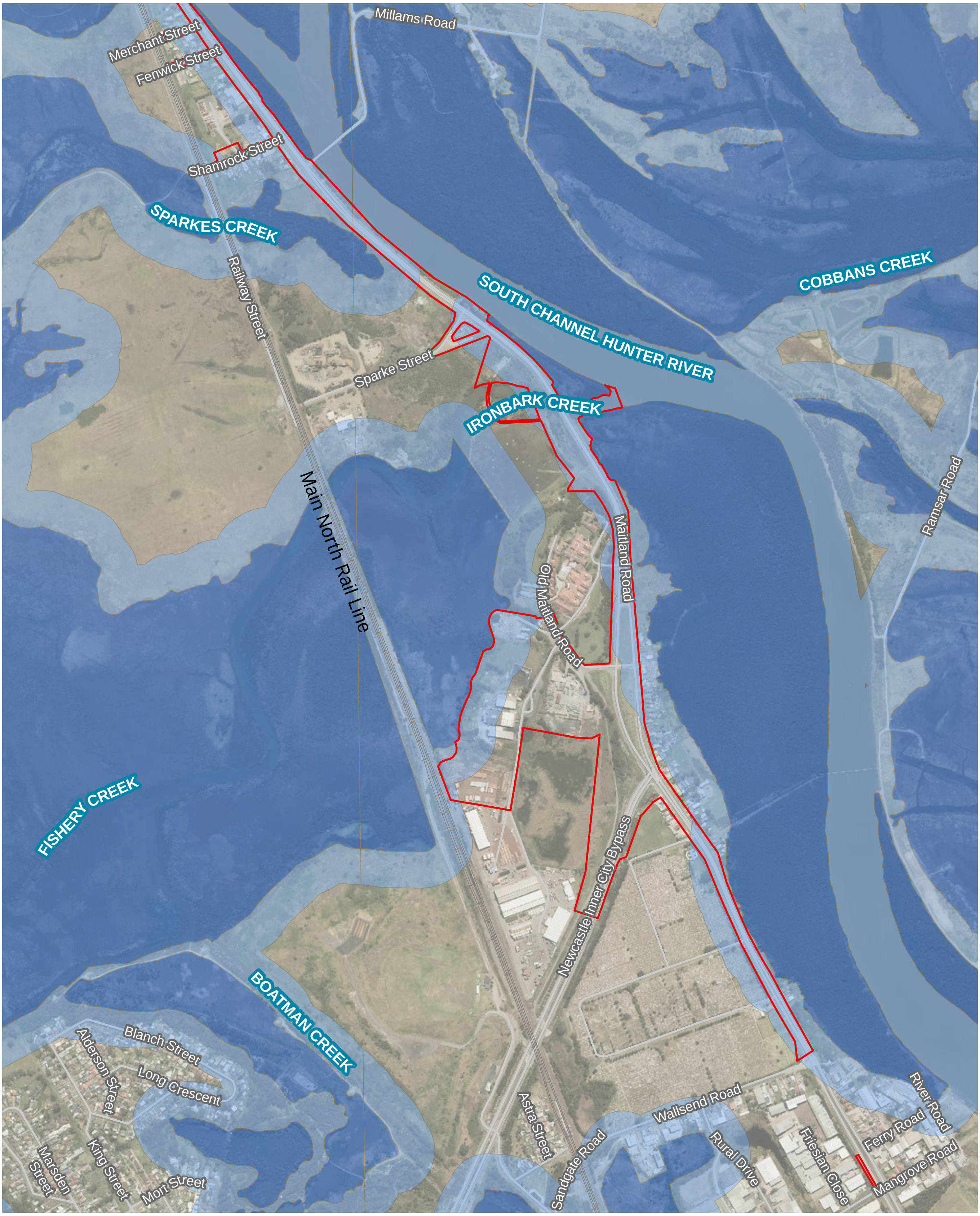
The CM SEPP also specifies development controls to help protect and manage these sensitive coastal environments and to manage risks from coastal hazards and support appropriate development.

The REF area of the proposal is located on land mapped as Coastal Wetlands Proximity Areas and the EIS area of the proposal is located on land mapped as Coastal Wetlands under the CM SEPP (refer to **Figure 4.2**). Both the REF area and the EIS area of the proposal are within land defined as a coastal environment area and coastal use area under the CM Act (refer to **Section 4.4.2**).

Development within Coastal Wetlands is classed as designated development and consequently the EIS areas of the proposal requires consent from the City of Newcastle under Part 4 of the EP&A Act. An EIS has been prepared to assess the proposal within the EIS area that would directly impact Coastal Wetlands and also assess any indirect impacts on the Coastal Wetlands.

The remainder of the proposal is assessed in this REF under Division 5.1 of the EP&A Act in accordance with Clause 94 of the ISEPP (refer to **Section 4.2.1**). Direct and indirect impacts of the REF area on the adjacent Coastal Wetlands are considered as part of the REF. Together, the EIS and this REF assess the potential environmental impacts of the proposal and it is intended that these documents be read in conjunction with each other.

Clause 11, Clause 13 and Clause 14 of the CM SEPP relate to land classed as proximity to Coastal Wetlands area, coastal environment areas and coastal use areas respectively and set out matters for consideration prior to the granting of development consent on land within these areas. As the REF area does not require development consent, Clause 11, Clause 13 and Clause 14 do not apply, however an assessment of the proposal against these clauses of the CM SEPP has been provided in **Appendix F**, to determine whether the proposal is consistent with the CM SEPP. The cumulative impacts of the proposal are discussed in **Section 6.18**.




Date: 9/11/2021 Filename: IA301100_REF_F020_CoastalWetlands_v2

**Legend**

REF area

Railway

Road

CM SEPP Protected Areas

Coastal Wetlands

Coastal Wetlands Proximity Area

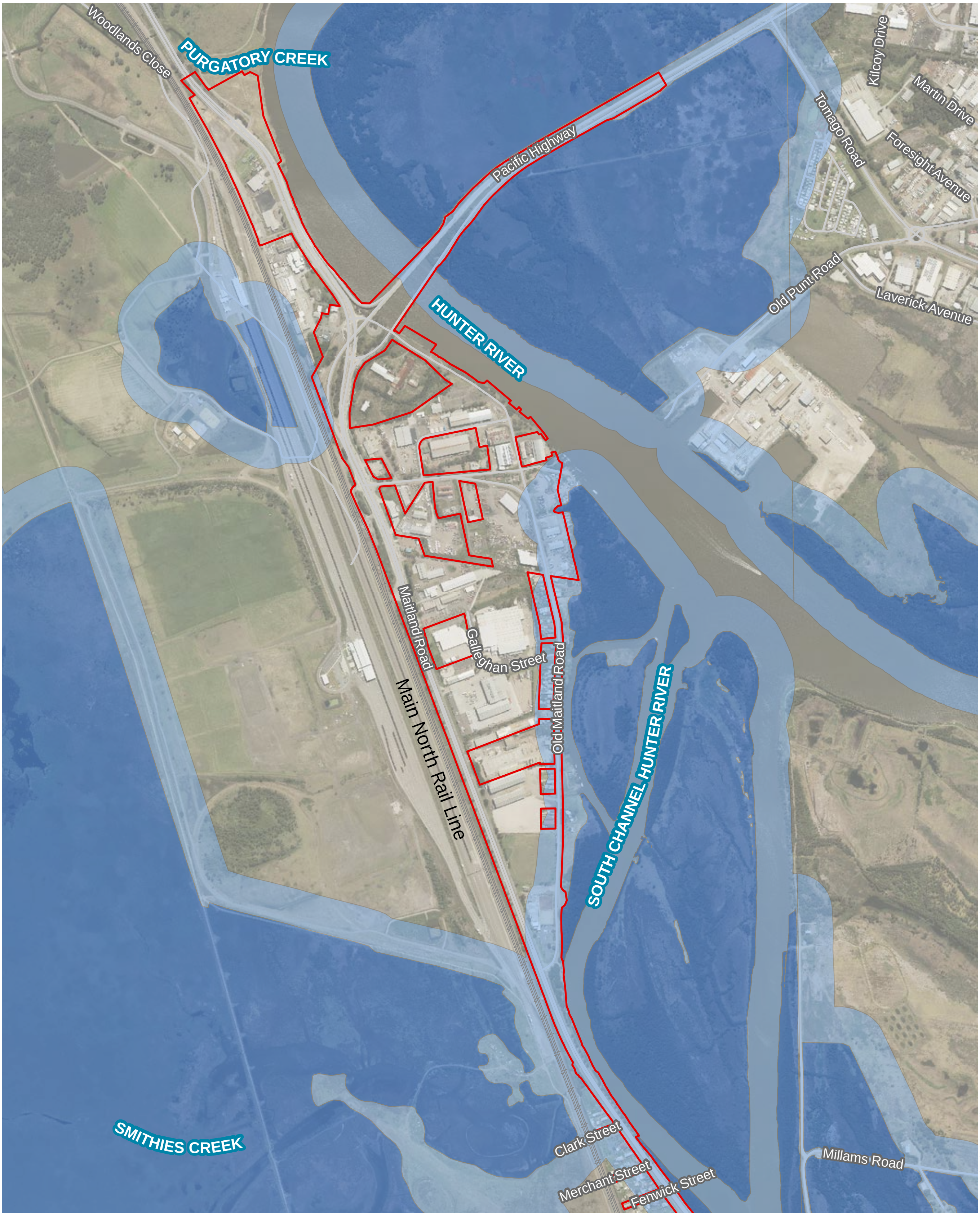
0 200 400 m

Scale 1:15,000 at A4

GDA94 MGA56


**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 4.2a** Location of Coastal Wetlands and Coastal Wetland Proximity Areas




Date: 9/11/2021 Filename: IA301100_REF_F020_CoastalWetlands_v2

**Legend**

REF area

Railway

Road

CM SEPP Protected Areas

Coastal Wetlands

Coastal Wetlands Proximity Area

0 200 400 m

Scale 1:15,000 at A4

GDA94 MGA56


**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 4.2b** Location of Coastal Wetlands and Coastal Wetland Proximity Areas

Hexham Straight Widening

### 4.2.3 State Environmental Planning Policy 55 – Remediation of Land

The objective of State Environmental Planning Policy No. 55 – Remediation of Land (SEPP 55) is to provide a State-wide approach to the remediation of contaminated land for the purpose of minimising the risk of harm to the health of humans and the environment. In accordance with Clause 7(1) of SEPP 55, a consent authority must not consent to the carrying out of any development on land unless it has considered whether the land is contaminated and whether remediation is required. SEPP 55 also requires consideration of whether the land use is suitable for the intended use.

The *Hexham Straight Widening Phase 1 Soils and Contamination Assessment* produced by Jacobs (2020) (refer to **Appendix K**) identified nine potential areas of environmental interest (AEIs) within or near to the REF area that may present a low to moderate contamination risk to the proposed construction activities. The contamination assessment recommended that further contamination investigations are carried out prior to construction at areas of moderate risk within the REF area. The findings from the contamination investigation and recommended environmental management measures are detailed in **Section 6.12**.

## 4.3 Local Environmental Plans

### 4.3.1 Newcastle Local Environmental Plan 2012

The REF area of the proposal is mostly located within the City of Newcastle LGA, to which the Newcastle Local Environmental Plan 2012 (Newcastle LEP) applies. **Figure 4.3** outlines the land use zones under the Newcastle LEP within the study area.

Under clause 5.12(1), the Newcastle LEP does not restrict or prohibit the carrying out of development by or on behalf of a public authority that is permitted to be carried out without consent under the ISEPP. As the REF area is permitted without consent under the ISEPP, refer **Section 4.2.1**, the consent requirements of the LEP do not apply to the REF. However, **Table 4.1** outlines the consistency of the REF area against the objectives of each land use zone.

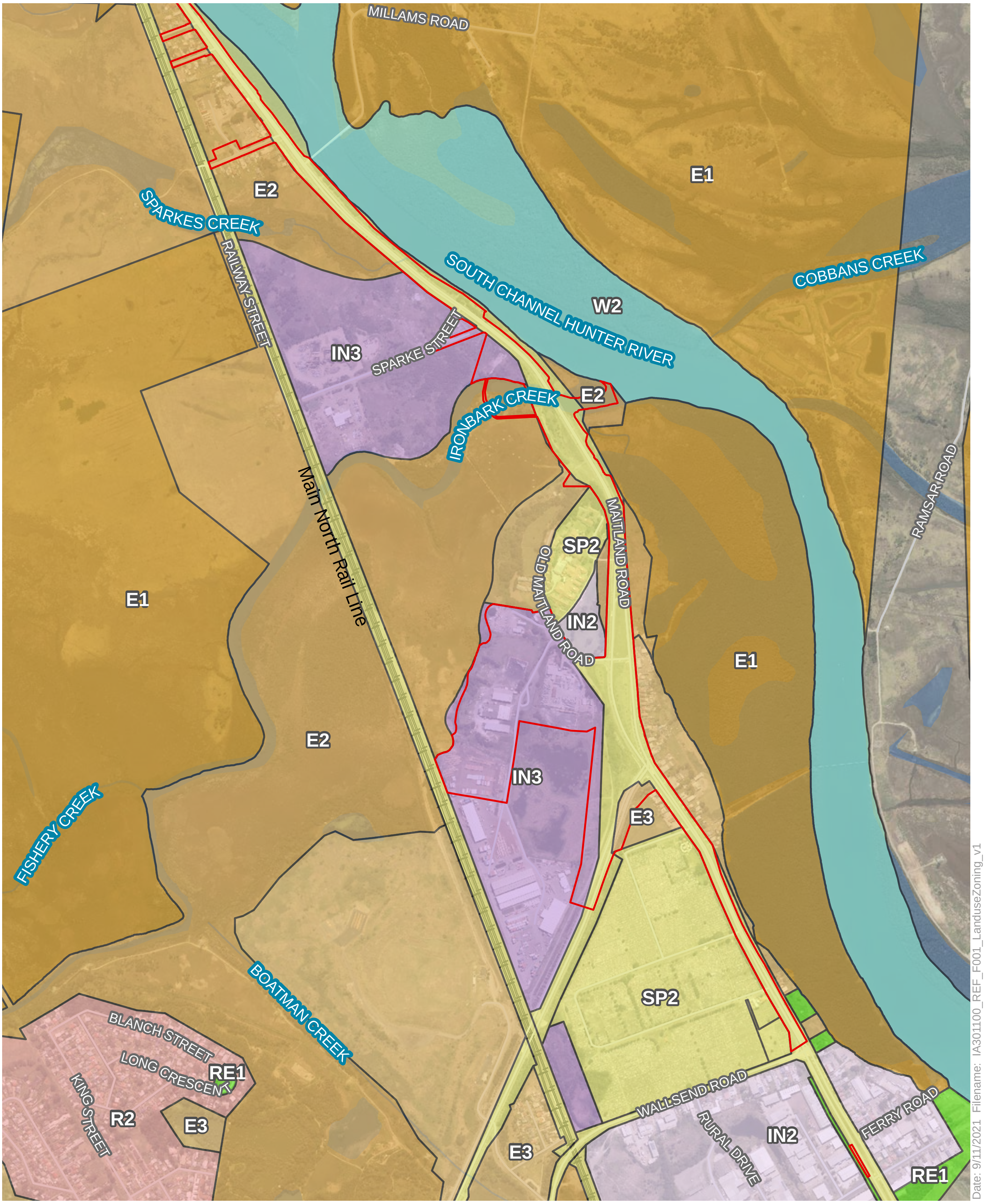
Table 4.1 Consistency of REF area with Newcastle LEP zones

| Zone | Objectives of zone | Consistency of proposal with objectives |
|---|---|---|
| E2 | To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values.<br>To prevent development that could destroy, damage or otherwise have an adverse effect on those values.<br>To provide for the management of the majority of the Hunter River floodplain by restricting the type and intensity of development to that compatible with the anticipated risk to life and property.<br>To provide for the conservation, enhancement and protection of the Hexham Wetlands. | The proposal has been designed to minimise its impact on areas with high ecological, scientific, cultural or aesthetic values. |
| E3 | To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values.<br>To provide for a limited range of development that does not have an adverse effect on those values. | The proposal has been designed to minimise its impact on environmental values of the area. |

| Zone | Objectives of zone | Consistency of proposal with objectives |
|---|---|---|
| | To provide for the conservation of the rural and bushland character of the land that forms the scenic edge of and the gateway to urban Newcastle. | |
| IN3 | To provide suitable areas for those industries that need to be separated from other land uses.<br>To encourage employment opportunities.<br>To minimise any adverse effect of heavy industry on other land uses.<br>To support and protect industrial land for industrial uses. | The proposal has been designed to minimise its impact on industrial land of the area. |
| RE1 | To enable land to be used for public open space or recreational purposes.<br>To provide a range of recreational settings and activities and compatible land uses.<br>To protect and enhance the natural environment for recreational purposes. | The proposal would have a minor impact on access to public space. There would be temporary construction impacts. The proposal may strengthen and improve links between existing open spaces. |
| RE2 | To enable land to be used for private open space or recreational purposes.<br>To provide a range of recreational settings and activities and compatible land uses.<br>To protect and enhance the natural environment for recreational purposes. | The proposal would have a minor impact on access to public space. There would be temporary construction impacts. The proposal may strengthen and improve links between existing open spaces. |
| SP2 | To provide for infrastructure and related uses.<br>To prevent development that is not compatible with or that may detract from the provision of infrastructure. | The proposal would be consistent with the objectives of this zone as it is road infrastructure. |
| W2 | To protect the ecological, scenic and recreation values of recreational waterways.<br>To allow for water-based recreation and related uses.<br>To provide for sustainable fishing industries and recreational fishing. | The proposal would be designed and constructed to meet the objectives, where possible. Overall, the proposal is unlikely to have significant impacts on ecological, recreational and fishing values. |

The Newcastle LEP also provides a listing of local heritage items. Potential impacts to heritage items located near the proposal are discussed and assessed in **Section 6.8.3**.

Consultation carried out for the REF area as required by the ISEPP is detailed in **Section 5.4**.




**Legend**

REF area

Land zoning (EPI DPE, 2019)

- E1 National Parks and Nature Reserves
- E2 Environmental Conservation
- E3 Environmental Management
- IN2 Light Industrial
- IN3 Heavy Industrial
- R2 Low Density Residential
- RE1 Public Recreation
- SP2 Infrastructure
- W2 Recreational Waterways

0 200 400 m

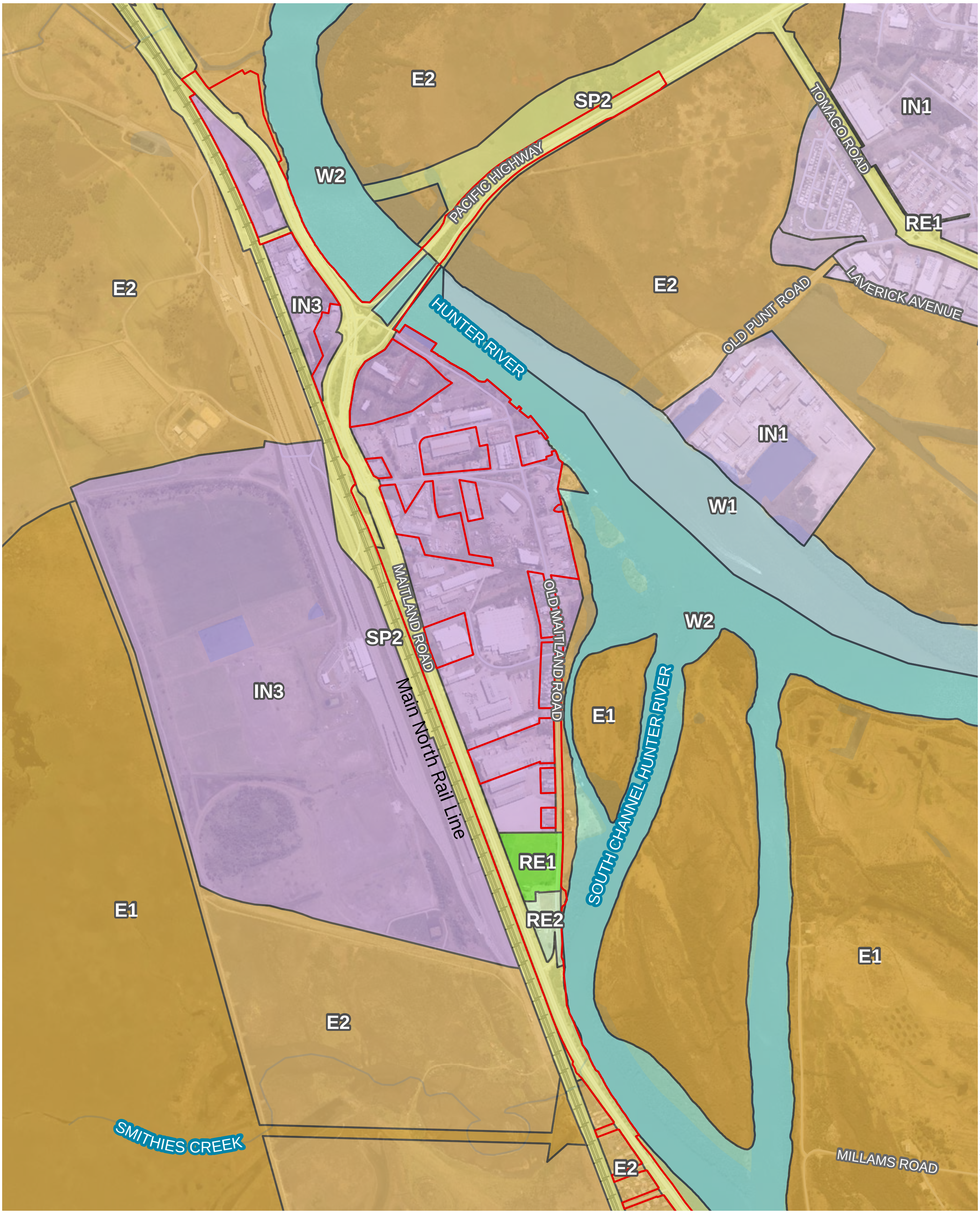
Scale 1:15,000 at A4

GDA94 MGA56




**Data sources:**
Jacobs 2020
Department of Finance, Services and Innovation 2020

**Figure 4.3a** Land use zoning




**Legend**

REF area

Land zoning (EPI DPE, 2019)

- E1 National Parks and Nature Reserves
- E2 Environmental Conservation
- IN1 General Industrial
- IN3 Heavy Industrial
- RE1 Public Recreation
- RE2 Private Recreation
- SP2 Infrastructure
- W1 Natural Waterways
- W2 Recreational Waterways

0 200 400 m

Scale 1:15,000 at A4

GDA94 MGA56




**Data sources:**
Jacobs 2020
Department of Finance, Services and Innovation 2020

**Figure 4.3b** Land use zoning

### 4.3.2 Port Stephens Local Environmental Plan 2013

A small portion of the construction area is within the REF area to the east of the Hunter River within the Port Stephens Council LGA, to which the Port Stephens Local Environmental Plan 2013 (Port Stephens LEP) applies. Activities required as part of the proposal would mainly be associated with the installation of signage for construction and operation of the proposal. The proposal would be located within land zoned as SP2 Infrastructure in the Port Stephens Council LGA, as shown in **Figure 4.3**.

Under Clause 5.12(1), the Port Stephens LEP does not restrict or prohibit the carrying out of development by or on behalf of a public authority that is permitted to be carried out without consent under the ISEPP. As the REF area is permitted without consent under the ISEPP (refer **Section 4.2.1**), the consent requirements of the LEP do not apply to the REF.

The objectives of the SP2 Infrastructure zone under the Port Stephens LEP are:

- To provide for infrastructure and related uses
- To prevent development that is not compatible with or that may detract from the provision of infrastructure.

The proposal would be consistent with the objectives of the SP2 Infrastructure zone as it is road infrastructure.

Clause 7.3(3) of the Port Stephens LEP requires consent authorities to consider if the development:

(a) is compatible with the flood hazard of the land, and

(b) will not significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and

(c) incorporates appropriate measures to manage risk to life from flood, and

(d) will not significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and

(e) is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding'.

The potential for the proposal to be impacted by flooding or to affect flood behaviour is discussed in **Section 6.2**.

There are no local heritage items listed under the Port Stephens LEP within the proposal.

## 4.4 Other relevant legislation

### 4.4.1 Biodiversity Conservation Act 2016

The BC Act provides for the conservation and protection of threatened species, populations, ecological communities of animals and plants, and Areas of Outstanding Biodiversity Value through specific objectives relating to the conservation of biodiversity and promoting ecologically sustainable development.

Part 7 of the BC Act requires that the significance of the impact on threatened species, populations and endangered ecological communities listed under the BC Act or FM Act, are assessed using a five-part test. Where a significant impact is likely to occur, a Species Impact Statement (SIS) or Biodiversity Development Assessment Report (BDAR) must be prepared in accordance with the SEARs.

A BAR was prepared for the proposal and is provided in **Appendix H**. The findings of the BAR are discussed in **Section 6.1**.

The assessments concluded that the proposal is not likely to have a significant impact on Areas of Outstanding Biodiversity Value, threatened ecological communities (TECs) or threatened species listed under the BC Act as discussed in **Section 6.1**. Neither a SIS, nor a BDAR is required for the REF area.

### 4.4.2 Coastal Management Act 2016

The CM Act establishes a strategic framework and objectives for managing coastal issues in NSW to “protect and enhance natural coastal processes and coastal environmental values”. Under this Act, four coastal management areas are identified and include:

- Part 2, Division 1 Coastal Wetlands and littoral rainforests area: areas which display the characteristics of Coastal Wetlands or littoral rainforests that were previously protected by the now repealed SEPP 14 (Coastal Wetlands) and SEPP 26 (Littoral Rainforests)
- Part 2, Division 2 Coastal vulnerability area: areas subject to coastal hazards such as coastal erosion and tidal inundation
- Part 2, Division 3 Coastal environment area: areas that are characterised by natural coastal features such as beaches, rock platforms, coastal lakes and lagoons and undeveloped headlands. Marine and estuarine waters are also included
- Part 2, Division 4 Coastal use area: land adjacent to coastal waters, estuaries and coastal lakes and lagoons.

The EIS area is within land identified as Coastal Wetlands and parts of the REF area is within land identified as Coastal Wetland Proximity Areas, refer to **Figure 4.2**. Both the REF area and the EIS areas of the proposal are within land defined as a coastal environment area and coastal use area under the CM Act. The proposal local area includes two areas of Ramsar listed wetlands identified as the Hunter Estuary Wetlands that include Kooragang Nature Reserve and Shortland Wetlands.

The management objectives specific to Coastal Wetlands are outlined in Part 2, Section 6 of the CM Act. These include, but are not limited to, protecting Coastal Wetlands in their “natural state”, and promoting the objectives of related State policies and programs. The objectives for Coastal Wetlands must be considered as part of the EIS being completed for the proposal within areas designated by the CM SEPP as being Coastal Wetlands (refer to **Section 4.2.2**).

The CM SEPP also specifies development controls to help protect and manage development within a Coastal Wetland Proximity Area, coastal environment area and coastal use area (refer further to **Section 4.2.2** and **Appendix F**).

### 4.4.3 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NP&W Act) provides the basis for legal protection and management of National Parks estate and Aboriginal sites and objects in NSW. Section 86 lists offences relating to harming or desecrating Aboriginal objects.

The Hunter Wetlands National Park is located immediately to the east and a short distance to the west of the proposal, refer to **Figure 1.3**. The national park estate area to the west is also known as Hexham Swamp Nature Reserve. Under clause 16 of the ISEPP, Transport are required to consult with the NPWS regarding any development on land adjacent to land reserved under the NP&W Act.

Part 6 of the NP&W Act relates to Aboriginal heritage. An Aboriginal Cultural Heritage Assessment Report (ACHAR) was undertaken for the proposal (refer to **Appendix I** and **Section 6.7**). The REF area of the proposal would not impact on any tangible Aboriginal sites or items but is located within areas identified as having Aboriginal cultural values. One Aboriginal site, Hexham Straight Isolated Find 1 (HS-IF 1), was however recorded as a result of the survey in the EIS area. A proposal wide Aboriginal heritage impact permit (AHIP) would be sought for the proposal area under sections 87 and 90 of the NP&W Act to harm or damage an Aboriginal heritage object or place, refer further to the Hexham Straight Widening EIS.

Part 7 and 8 of the NP&W Act, relating to protected fauna and native plants (respectively), prohibits the harm of protected fauna and native plants, including threatened species, populations and endangered ecological communities (EECs). Section 118A of the NP&W Act states that a person must not harm any animal or pick plants that are of, or part of, a threatened species, an endangered population or an endangered ecological community. However, the provisions of section 118A do not apply to activities being carried out by a determining authority under Division 5.1 of the EP&A Act.

#### 4.4.4 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) aims to protect items of State and local heritage significance and outlines the process for the approval of development that may impact on items of heritage significance.

Matters protected under the Heritage Act include items subject to an Interim Heritage Order and items listed on the State Heritage Register, the heritage schedules of local council LEPs, and the heritage and conservation registers established under section 170 of the Act by NSW Government agencies (section 170 Registers). The Heritage Act also provides for the protection of archaeological ‘relics’, being any deposit, object or material evidence that relates to the non-Aboriginal settlement of NSW and is of State or local heritage significance.

Approval from the Heritage Council of NSW is required under Part 4 of the Heritage Act for certain works to items or on land that is the subject of an interim heritage order or listing on the State Heritage Register. An excavation permit is required under Section 139 of the Heritage Act for the disturbance or excavation of any land containing or likely to contain a relic.

A Statement of Heritage Impact (SoHI) was completed for the proposal (refer to **Appendix J** and **Section 6.8**). Provided that management and mitigation measures are followed, the proposal would not have any impacts to non-Aboriginal heritage (refer to **Section 6.8.4**).

#### 4.4.5 Roads Act 1993

The *Roads Act 1993* (Roads Act) sets out rights of members of the public to pass along public roads, establishes procedures for opening and closing a public road and provides for the classification of roads. It also provides for the declaration of Transport, local councils, and other public authorities as roads authorities for both classified and unclassified roads and confers certain functions (in particular the function of carrying out roadwork) on Transport and other roads authorities.

Part 2 of the Roads Act sets out the provisions for the opening of public roads, including notification procedures. Part 4 of the Roads Act sets out the provisions for the closing of public roads, including notification procedures.

The proposal requires construction work on Maitland Road, which is a classified road within the City of Newcastle LGA, and temporary interruption to traffic along the proposal. A Road Occupancy Licence is required for any activity likely to impact on traffic flow, even if that activity takes place off-road. Transport is the proponent and the relevant roads authority for the proposal.

The proposal involves the replacement of the existing bridge which spans Ironbark Creek with new twin bridges. As a roads authority, Transport has the power to construct bridges across navigable waters under Section 78 of the Roads Act. The Roads Act provides that such bridges are lawful obstructions of navigable waters.

### 4.4.6 Fisheries Management Act 1994

The FM Act provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. The Act establishes mechanisms for the listing of threatened species, populations and ecological communities or key threatening processes, the declaration of critical habitat and the consideration and assessment of threatened species impacts in the development assessment process.

The proposal would be constructed within and adjacent to the Hunter River and its tributaries that are mapped as Class 1 Major Key Fish Habitat by the Department of Primary Industries (DPI) (refer to **Figure 6.2**). In addition, construction activities in Ironbark Creek would include the installation of bridge piers into the bedrock beneath. Potential impacts to aquatic habitats and species in the REF area of the proposal are assessed in the BAR (**Appendix H**) and results are summarised in **Section 6.1**. Offsets are required for impacts to Class 1 Major Key Fish Habitat from the proposal and these are also summarised in **Section 6.1.5**.

Section 199 of the FM Act states that an approval is not required for a public authority to undertake dredging or reclamation work. Transport is however required to consult with NSW Fisheries before carrying out or authorising dredging or reclamation work. Consultation carried out for the REF area is required by the FM Act and is detailed in **Section 5.4**.

The REF area would include work on the banks of the Hunter River for the upgrade of culvert outlets, work would require the removal of 0.72 hectares of Grey Mangrove low closed forest (Plant Community Type (PCT) 1747) and would require a permit to harm marine vegetation under Section 205 of the FM Act. The REF area would not obstruct fish passage and a permit would not be required under Section 219 of the FM Act.

### 4.4.7 Water Management Act 2000

The *Water Management Act 2000* (WM Act) provides for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations. The Act controls the extraction of and use of water, the construction of works such as dams and weirs, and the carrying out of activities in or near water sources in NSW. ‘Water sources' are defined broadly and include the whole or any part of a river, lake, estuary, place where water occurs naturally on or below the surface of the ground, and NSW coastal waters. The Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009 apply to the proposal.

The proposal would carried out on land defined as waterfront lands and the proposal would likely meet the requirements for needing a controlled activity approval under section 91(2) given that there would likely be works within 40 metres of waterfront land. However, under Clause 41 of the Water Management (General) Regulation 2018, public authorities (such as Transport) are exempt from the requirement to obtain a controlled activity approval. A notification of the activity would need to be provided to the NSW Office of Water at least 30 days before the activity commences.

Section 56 of the WM Act establishes access licences for the taking of water within a particular water management area within a water sharing plan. Under Section 21(1) and Schedule 4 Part 1(2) of the Water Management (General) Regulation 2018, Transport, as a roads authority, is exempt from the need to obtain an access licence in relation to water required for road construction and road maintenance. However, notification to the water owner would be required. In addition, should water be required to be drawn from the Hunter River, a water supply approval would be required for the REF area under Section 90(2) of the WM Act.

Construction work in the REF area would likely intercept groundwater during construction of the road as groundwater tables are very shallow in the immediate area of the proposal. However the potential groundwater impacts are predicted to be less than the NSW Aquifer Interference Policy’s (DPI, 2012) ‘minimal impact considerations’, the groundwater criterion adopted for assessment. All activities that interfere with an aquifer (‘aquifer interference activities’) will require an aquifer interference approval under Section 91(3) of the WM Act once this element is active in the WM Act. Currently, this element is not active in the WM Act.

### 4.4.8 Contaminated Land Management Act 1997

The *Contaminated Land Management Act 1997* (CLM Act) establishes a process for investigating and, where appropriate, remediating land that the EPA has reason to believe is significantly contaminated so as to warrant regulation under the CLM Act. The CLM Act allows the EPA to declare land as significantly contaminated land and to order a public authority to carry out actions or prepare a plan of management for such land.

There is a risk that development within the REF area of the proposal may encounter potentially contaminated land during construction. The EPA contaminated land register has records of several regulated contaminated sites around the proposal and nine areas of environmental interest where identified in the *Hexham Straight Widening Phase 1 Soils and Contamination Assessment* (Jacobs, 2020) (refer to **Appendix K**). In accordance with Section 60 of the CLM Act, if contamination is identified which poses significant risk of harm, reporting to the EPA must occur. Refer to **Section 6.12** for further details on potential areas of contamination within the proposal.

### 4.4.9 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) provides the legal framework for the management of air, noise, water and waste pollution. Under section 48 of the POEO Act, scheduled activities or scheduled development (as defined in Schedule 1 of the POEO Act) require an Environment Protection Licence (EPL).

The following scheduled activities set out in Schedule 1 are most relevant to the proposal:

- Road construction if it results in four or more traffic lanes (not including bicycle lanes or lanes used for entry or exit), where the road is classified or proposed to be classified as a main road for at least three kilometres of its length in the metropolitan area, and for at least five kilometres in any other area
- Extractive activities, where excavation required for the proposal is greater than 30,000 tonnes per year
- Cement or lime handling, meaning the handling of cement, fly ash, powdered lime (other than agricultural lime) or any other similar dry cement products.

The REF area would meet the criteria for road construction and would therefore require an EPL. It is estimated that the cut/fill requirements for the proposal would be about 65,000 tonnes over a three year period and would be unlikely to meet the criteria for extractive activities which is more than 30,000 tonnes of extractive materials per year. An EPL may also be required for concrete works or cement works if over 30,000 tonnes per year. The need for the EPL to include any of these additional activities would be determined during detailed design when cut requirements are refined.

The POEO Act would also require construction to be managed to prevent and avoid the potential to cause water, noise and/or air pollution and includes requirements in relation to the management of waste. This would be achieved through implementing the mitigation and management measures identified in **Section 7**. Notification to the EPA would be required (as the administrators of the POEO Act) in instances where any pollution incident has the potential to ‘cause or threaten material harm to the environment’ (refer to section 148 of the POEO Act).

In addition, the POEO Act require Transport to manage any future road upgrade in the study area to limit its potential to cause water, noise, air pollution and potential waste streams during construction.

### 4.4.10 Crown Land Management Act 2016

The *Crown Land Management Act 2016* (Crown Land Act) is intended to ensure that Crown land is managed for the benefit of the people of NSW and to provide for the proper assessment and management of Crown land in accordance with the principles of the Crown Land Act. The Act sets out the conditions under which Crown land is permitted to be occupied, used, sold, leased, licensed or otherwise dealt with.

The following areas are identified as Crown land along the REF area:

- Sandgate Cemetery at the southern end of the proposal (Lot 12 DP1146286)
- The lot to the north of the cemetery alongside NICB (Lot 30 DP1162927)
- The area immediately southeast of the Ironbark Creek Bridge (Lot 7314 DP1160521)
- Some areas of road corridor along Maitland Road, Shamrock Street, Fenwick Street, Merchant Street and Clark Street
- The waterways along the proposal including the Hunter River, the South Channel Hunter River, Ironbark Creek, Smithies Creek and Purgatory Creek
- An area of land that extends from the South Channel Hunter River to Old Maitland Road at the northern end of the proposal where a U-turn facility is proposed, however this area of land would be acquired for the proposal.

Under Division 5.8 of the Crown Land Act, the Minister may on the application of a holder of land, grant a permit (an enclosure permit) to the holder of the land to enclose, whether wholly or partly, any Crown road or Crown watercourse that crosses or bounds the land.

In accordance with the Crown Land Act, work proposed to be carried out on Crown Land requires a permit from the DPIE (Crown land). A licence would be sought following consultation with the DPIE (Crown land).

### 4.4.11 Land Acquisition (Just Terms Compensation) Act 1991

The *Land Acquisition (Just Terms Compensation) Act 1991* applies to the acquisition of land (by agreement or compulsory process) by a public authority authorised to acquire the land by compulsory process. It provides a guarantee that, when a public authority requires the acquisition of land, the amount of compensation will not be less than the market value of the land.

The proposal would require partial acquisition of properties along Maitland Road to accommodate the proposed road upgrade. All land acquisitions would be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*. Property requirements for the proposal are discussed in **Section 3.6**.

### 4.4.12 Waste avoidance and Resource Recovery Act 2001

The purpose of the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) is to develop and support the implementation of regional and local programs to meet the outcomes of a State-wide strategy for waste avoidance and resource recovery. It also aims to 'minimise the consumption of natural resources and final disposal of waste by encouraging the avoidance of waste and the reuse and recycling of waste'.

Waste generation and disposal reporting would be carried out during the construction and operation of the proposal. Procedures would be implemented during construction in an attempt to promote the objectives of the WARR Act.

### 4.4.13 Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) provides a framework to manage biosecurity risks from animal and plant pests and diseases, weeds and contaminants and outlines the responsibilities of government, councils, private landholders and public authorities in the management of biosecurity matters. Under section 21 of the Biosecurity Act, any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised as is reasonably practicable.

The Biosecurity Act and Regulations provide specific legal requirements for high risk activities and State level priority weeds. The State level priority weeds and associated legal requirements relevant to the region are outlined in the *Hunter Regional Strategic Weed Management Plan 2017 - 2022* (Hunter LLS, 2017), together with the high risk priority weeds from the regional prioritisation process.

As such, if present, priority weeds on the site would be assessed and controlled to fulfil the General Biosecurity Duty and minimise biosecurity risks. The BAR (**Appendix H**) provides mitigation measures to manage weeds at the construction area. This is discussed further in **Section 6.1.**

## 4.5 Commonwealth legislation

### 4.5.1 Environment Protection and Biodiversity Conservation Act 1999

Under the EPBC Act a referral is required to the Australian Government for proposed actions that have the potential to significantly impact on MNES or the environment of Commonwealth land. MNES are considered in **Appendix E** and **Section 6.1**.

Threatened and migratory species, ecological communities and a wetland of international importance (Ramsar) identified as MNES are located near the REF area.

Subtropical and Temperate Coastal Saltmarsh is a federally listed TEC protected under the EPBC Act that has been mapped within the REF area. This TEC is located on riverbanks and has the potential to be impacted by changes in surface water and groundwater hydrology and flooding from the proposal.

The EPBC Act also identifies important wetlands that are Ramsar listed and are collectively known as the Hunter Estuary Wetlands are close to the proposal (refer to **Figure 4.4**) and include:

- Kooragang Nature Reserve, located a minimum distance of about one kilometre east of the proposal and is within the larger Hunter Wetlands National Park
- Shortland Wetlands (including Hunter Wetlands Centre Australia) is located about 800 metres west of the proposal, to the south of Hexham Swamp Nature Reserve.

These areas are identified as sensitive receiving environments in this assessment as these wetlands have the potential to be impacted by changes in surface water and groundwater hydrology and flooding from the proposal. However, due to distance of the proposal from the Hunter Estuary Wetlands Ramsar site areas, no direct or indirect impacts are anticipated from surface water hydrology changes resulting from changes in drainage infrastructure or flooding changes resulting from changes in road levels and proposal infrastructure, refer further to **Section 5.3**.

Further details on MNES are presented in the BAR (Jacobs, 2021a) (refer to **Appendix H**) completed for the REF and the BDAR (Jacobs, 2021b) completed for the EIS and an assessment of impacts has been completed in accordance with the Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (Department of the Environment, 2013).

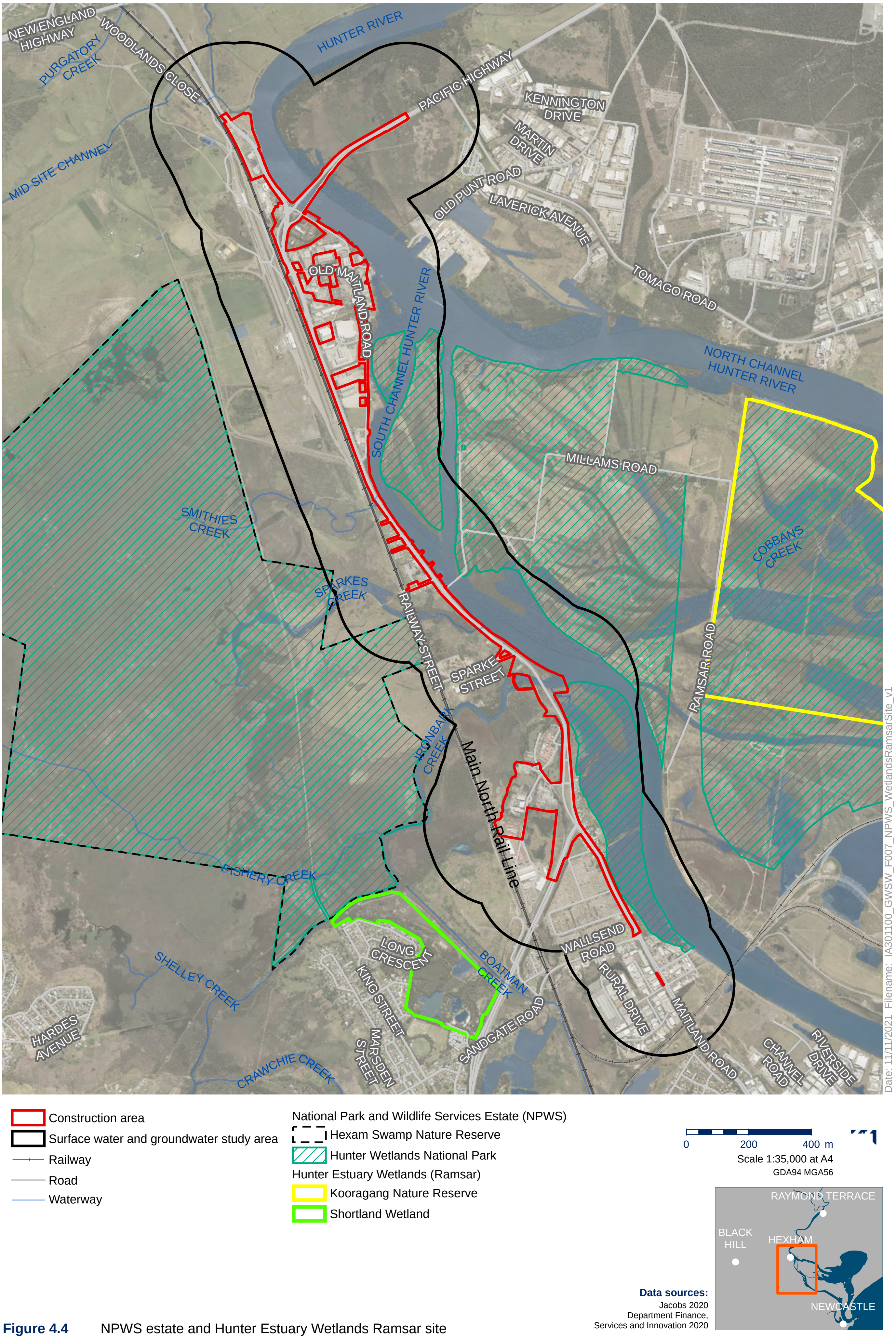



**Figure 4.4** NPWS estate and Hunter Estuary Wetlands Ramsar site

### Findings – matters of national environmental significance

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

### 4.5.2 Native Title Act 1993

The *Native Title Act 1993* (NT Act) provides a framework for the determination of native title claims within Australia, and for negotiations and decision making regarding the use and management of native title lands and waters. Exclusive rights to land are only available on certain unallocated or vacant Crown lands.

A Native Title Registrar is responsible for maintaining three Registers under the NT Act: the National Native Title Register, the Register of Native Title Claims, and the Register of Indigenous Land Use Agreements (ILUAs).

The proposal would not affect land subject to native title or to which an Indigenous Land Use Agreement applies.

## 4.6 Confirmation of statutory position

The REF area is categorised as development for the purpose of road or road infrastructure facilities. The proposal would be carried out by or on behalf of a public authority. Under Clause 94 and Clause 68(4) of the ISEPP the REF area is permissible without consent. The REF area is not State significant infrastructure or State significant development. The REF area of the proposal can be assessed under Part 5, Division 5.1 of the EP&A Act. Transport is the determining authority for the REF area.

This REF fulfils Transport's obligation under Section 5.5 of the EP&A Act to examine and consider to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

Part of the proposal is located on land identified as Coastal Wetlands under the CM SEPP. This part of the proposal is identified as the EIS area (refer to **Figure 1.3**) and is required to be assessed under Part 4 of the EP&A Act. A separate EIS document has been prepared for the EIS area and would be assessed by City of Newcastle. Together, the EIS and this REF assess the potential environmental impacts of the proposal and it is intended that these documents be read in conjunction with each other. The cumulative impacts of the proposal are discussed in **Section 6.18**.

# 5 Consultation

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

## 5.1 Consultation strategy

A Stakeholder and Community Engagement Plan (SCEP) was prepared in April 2021 by Transport to outline the communication and consultation process and to support strategic planning activities for the proposal. As stated in the SCEP, consultation objectives for the proposal are to:

- Provide regular and targeted information to build awareness about the proposal and likely impacts and benefits of the proposal
- Give clear direction to the community and stakeholders about whether we are providing information or seeking feedback so that expectations are clear at all stages of engagement
- Ensure community and stakeholder views are continuously fed into the proposal's development and used to understand and effectively assess impacts.

The relevant stakeholders identified as part of the SCEP included:

- State Premier and Federal Ministers and Members of Parliament (MPs)
- Government agencies including:
  - Department of Infrastructure, Transport, Cities and Regional Development (Federal)
  - Department of Environment and Energy (Federal)
  - DPIE
  - NSW EPA
  - NPWS
  - DPI (Fisheries)
  - Hunter Water Corporation
  - ARTC
  - Transport Management Centre
- Emergency Services:
  - State Emergency Services
  - NSW Police Force
  - NSW Ambulance Service
  - Rural Fire Service
  - Fire and Rescue, NSW
  - Subsidence Advisory NSW
- Local Councils, including City of Newcastle and Port Stephens Council.

Other stakeholders include utilities, residents and businesses impacted by the proposal, business chambers and groups, public transport users and providers, road users, media, community groups and Aboriginal community including Awabakal Local Aboriginal Land Council (LALC), Mindaribba LALC and Aboriginal knowledge holders.

The following sections outline the consultation that has been carried out specifically for the proposal.

## 5.2 Community involvement

Transport sought feedback on the proposal during a nine week consultation period from 2 December 2020 to 5 February 2021 (see December 2020 Project Update at **Appendix G**). The aim of the consultation was to introduce the Proposal to the community and obtain community feedback on perceived issues, including local traffic.

Community members were encouraged to provide their feedback, leave comments and make submissions at information sessions or via mail, email or phone contact with the project team.

Transport received 45 submissions about a range of issues that are detailed in **Appendix G** and summarised in **Table 5.1**.

Where appropriate, concerns raised have been addressed in the concept design development or would be further considered in detailed design. Transport will continue to work closely with local residents and stakeholders in relation to the potential impacts of the proposal.

Table 5.1 Summary of issues raised by the community

| Issue raised | Where addressed in REF |
|---|---|
| Suggestions to improve traffic flow at the NICB intersection | Minor upgrades to the NICB and Maitland Road intersection and these are discussed **Section 3.2.3** and in **Section 6.6**. A third 300 metre long left turn lane has also been included on the approach to the intersection with Maitland Road. |
| Suggestions about additional access to Hexham Railway Station | Access to Hexham Railway Station has been provided as part of the proposal and includes an upgrade of the southern approach and a new northern access from the intersection with Old Maitland Road north and Maitland Road, refer further to **Section 6.6**. |
| Request to reduce traffic lights on Maitland Road | No new traffic lights are proposed as part of the proposal. Existing traffic lights would be retained to allow continued local road access to and from Maitland Road for residents and businesses in Sandgate and Hexham, r**efer to Section 6.6**. |
| Access and safety improvements including properties and businesses | The development of the design has included consideration of relevant Australian standards in regard to road safety and to property accesses where these are modified as part of the proposal, refer further to **Section 6.6**<br><br>Note, the existing access at the Calvary St Joseph's Retirement Community will be maintained. |
| Cyclist connectivity | The proposal includes a three metre wide shared use path northbound between the Oak Factory and the northern end of the proposal. The existing cycling provision for northbound cyclists over the Hunter River Bridge at Hexham would be retained. An off road cycle path will be added on the approach to Maitland Road from the NICB, connecting cyclists to Maitland Road and bypassing the traffic lights, refer further to **Section 6.6** |
| Flooding | Flooding has been assessed for the proposal for a number of flood events and that includes consideration of the areas surrounding the proposal and including the Hunter River, refer further to **Section 6.2**. |
| Heavy vehicles | Transport have revised the design vehicle for the proposal to cater for up to a 26 metre long B-double heavy vehicle, refer further to **Table 2.2**. |
| U-turn facilities | The U-turn facilities are required to maintain existing access. More information can be found in **Section 6.6.** |

| Issue raised | Where addressed in REF |
|---|---|
| Construction impacts | Impacts associated with construction. And mitigation measures to manage these potential impacts are included in **Table 7.1**. |
| Noise and dust | Noise and dust amenity is discussed in **Section 6.9** and **Section 6.13** respectively |

## 5.3 Aboriginal community involvement

Consultation has been undertaken in accordance with Stage 2 and Stage 3 of the *Procedure for Cultural Heritage Consultation and Investigation* (Roads and Maritime Services, 2011) (PACHCI). The stages of Transport's PACHCI's procedure and the consultation activities undertaken during each stage is summarised in **Table 5.2**.

This includes consultation with the relevant LALCs and includes Awabakal LALC and Mindaribba LALC. Formal consultation was also undertaken with Registered Aboriginal Parties (RAPs) and included Aboriginal cultural knowledge holders for the cultural significance assessment of Aboriginal heritage.

Table 5.2 Summary of PACHCI

| Stage | Description | Consultation activities undertaken during stage |
|---|---|---|
| Stage 1 | Initial Transport assessment | No consultation activities were undertaken at this stage as this included a desktop due diligence assessment to identify if any potential Aboriginal heritage constraints were present in the construction area of the proposal. |
| Stage 2 | Site survey and further assessment | Stage 2 involved the presentation of information and gathering of cultural information. This included:<br>• Completing a site survey with the Awabakal and Mindaribba LALCs on the 8 and 9 April 2019<br>• Completing an archaeological assessment in accordance with Stage 2 of the PACHCI. |
| Stage 3 | Formal consultation and preparation of a cultural heritage assessment report | Stage 3 included the formal notification and registration of Aboriginal parties in accordance with the requirements of the *Aboriginal Consultation Requirements for Proponents 2010* (Department of Environment Climate Change and Water (DECCW), 2010c). This involved:<br>• Sending letters to government agencies to identify potential Aboriginal parties and knowledge holders to invite for consultation<br>• Newspaper advertisements in the Koori Mail, National Indigenous Times and Newcastle Herald<br>• Emails to potential Aboriginal parties identified by government agencies inviting them to register interest by the 3 June 2020. Twenty-five RAPs were identified for the proposal.<br>Stage 3 included a second site survey on the 10 September 2020 of the EIS area that was not previously surveyed and included RAPs and representatives from the Awabakal LALC.<br>An Aboriginal Focus Group (AFG) meeting was hosted digitally via Zoom video teleconference on the 30 November 2020. All RAPs and Heritage NSW were invited to attend. |

| Stage | Description | Consultation activities undertaken during stage |
|---|---|---|
| | | The following information was presented:<br>• An overview of the proposal<br>• The PACHCI Stage 2 Archaeological Assessment<br>• The methodology for the preparation of the Aboriginal Cultural Heritage Assessment Report (ACHAR)<br>• The methodology for the preparation of the Cultural Values Assessment.<br>The draft ACHAR and the draft Cultural Values Assessments were then provided to the RAPs on the 25 May 2021 to provide comment and feedback by the 25 June 2021. Follow up reminders were sent to all the RAPs throughout this period reminding of the closing date for the consultation period |
| | Implement environmental impact assessment recommendations | Consultation would be undertaken with Heritage NSW to obtain an AHIP for the proposal once the REF has been determined and Council has provided approval for the EIS. An Aboriginal Site Impact Recording Form (ASIRF) would be submitted to Heritage NSW and Aboriginal Heritage Information Management System (AHIMS) in accordance with the AHIP conditions.<br>Continuous consultation would also be undertaken with the RAPs during detailed design and during construction if unexpected finds are identified. |

The Stage 2 PACHCI assessment involved a site inspection with representatives from the Awabakal LALC and the Mindaribba LALC and each group provide a cultural heritage survey reports advising on cultural issues within the REF area the results are detailed in the Stage 2 Aboriginal Archaeological Survey Report completed by EMM for the proposal in November 2019. The results of consultation with the Aboriginal community during the Stage 2 PACHCI process is summarised in **Table 5.3**.

The Stage 3 PACHCI assessment involved the preparation of an ACHAR and formal consultation with the Aboriginal community in accordance with the requirements of the *Aboriginal Consultation Requirements for Proponents 2010* (Department of Environment Climate Change and Water (DECCW), 2010c). This included consultation with the RAPs and the knowledge holders for the cultural significance assessment of Aboriginal heritage. The results of consultation with the Aboriginal community during the Stage 3 PACHCI process is summarised in **Table 5.3**.

Table 5.3 Issues raised through Aboriginal community consultation

| PACHCI Stage | Issue raised | Response/where addressed in REF |
|---|---|---|
| Stage 2<br>Awabakal LALC and Mindaribba LALC | The main issues raised during the Stage 2 PACHCI consultation are as follows:<br>• The study area contains areas of minor disturbances and natural landforms including a natural intact sand dune in the east.<br>• The study area has intangible Aboriginal heritage value as it is located within a culturally and spiritually significant landscape including song lines.<br>• The study area would have been frequently used by Aboriginal people to source a wide variety of food and material resources.<br>• One Aboriginal artefact, HS IF-1, was | An ACHAR has been prepared for the proposal and is provided in **Appendix I** and summarised in **Section 6.7**.<br>Transport recognises that the study area has intangible Aboriginal heritage value as it is located within a culturally and spiritually significant landscape including song lines. Transport also recognises that the study area would have been historically used by Aboriginal people to source food and material resources. |

| PACHCI Stage | Issue raised | Response/where addressed in REF |
|---|---|---|
| | identified within the EIS area<br>• Shell material was identified within the study area believed to be possible cultural middens<br>• The study area is likely to contain Aboriginal objects not identified during survey including within disturbed contexts.<br>• Mindaribba LALC have requested cultural heritage monitoring during construction works.<br>• Awabakal LALC Have requested that archaeological testing, salvage and community collection be completed. | |
| Stage 3 | The main issues raised during the Stage 3 PACHCI consultation as part of the AFG meeting are as follows:<br>• RAPs noted that despite disturbed contexts, artefacts may still be present within the landscape.<br>• The results of the survey located one isolated find (Hexham Straight Isolated Find (HS-IF 1)), recorded near the edge of existing pavement on the edge of the Hunter River (within the EIS area). Disturbance was evident with fill material clearly visible surrounding the artefact. However, the predicted locations of objects contained within highly disturbed contexts cannot be scientifically modelled.<br>• Due to the significant levels of disturbance and landform type and modification, no areas of potential archaeological deposit (PAD) were identified by the assessment which would be suitable for test excavation.<br>• Advised that no further archaeological assessment is required. Transport are to undertake PACHCI Stage 3, including preparation of a ACHAR and consultation with Aboriginal stakeholders.<br>• Transport will be required to apply for an AHIP to cover the entire area of the proposed proposal footprint.<br>RAPs supported the proposed ACHAR methodology, and no comments were provided by the group.<br>Two submissions were received as part of the Stage 3 PACHCI consultation for the review of the draft ACHAR and draft Aboriginal Cultural Values Assessment. Both submissions agree and support the recommendations and findings of the draft reports. | An ACHAR has been prepared for the proposal and is provided in **Appendix I** and summarised in **Section 6.7**.<br>Transport recognises that the study area has intangible Aboriginal heritage value as it is located within a culturally and spiritually significant landscape including song lines. Transport also recognises that the study area would have been historically used by Aboriginal people to source food and material resources.<br>Further consultation would be undertaken with Aboriginal stakeholders including Mindaribba LALC and Awabakal LALC to determine whether this item can be collected and relocated. |

## 5.4 ISEPP consultation

Clause 13 to 16 of the ISEPP specify the requirements for consultation with councils and other public authorities for infrastructure development carried out by or on behalf of a public authority. Consultation is required in relation to specified development or development that impacts on:

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

Transport has consulted with the following agencies about the proposal in accordance with the ISEPP:

- City of Newcastle have been consulted with on the 25 February 2021 as per the requirements of clause 13, 14 and 15 of ISEPP. Transport also held formal meetings with the City of Newcastle on 10 May 2019 and 24 March 2021
- SES have been consulted with on the 2 March 2021 as per the requirements of section 15AA of the ISEPP
- NPWS were consulted with on 22 February 2021 as per the requirements of clause 16 of the ISEPP.

Issues that have been raised as a result of the ISEPP consultation are summarised in **Table 5.4**. A copy of the letters sent, and the response received are provided in **Appendix G** contains an ISEPP consultation checklist that documents how ISEPP consultation requirements have been considered as part of this REF.

Table 5.4 Issues raised through ISEPP consultation

| Agency | Issue raised | Response/where addressed in REF |
|---|---|---|
| City of Newcastle | Stormwater assets<br>Transport is to determine the location of City of Newcastle's stormwater assets in the REF area. To assist you in this regard the attached map shows most of City of Newcastle's of stormwater assets in the REF area, but it may not be complete or accurate. | The map of City of Newcastle's stormwater assets is noted. Transport would undertake investigations to confirm the precise location of any stormwater assets prior to the start of construction. |
| | Where the existing stormwater assets are located within the REF area or likely to be impacted by the works, assess for retention/renewal/upgrade. This assessment must include consideration to pipe condition, capacity, cover, location and accessibility. City of Newcastle can provide condition assessments on City of Newcastle owned infrastructure if given sufficient notice. | Any existing stormwater asset impacted by the proposal would be assessed for retention and where retention is not possible would be renewed or upgraded. |
| | Where existing outlets are impacted by the widening, extend the drainage system to City of Newcastle's standards (to be approved by City of Newcastle). This includes outlet headwalls, tide gates etc. | Any existing outlets, including outlet headwalls and tide gates, impacted by the proposal would be constructed in accordance with the relevant standards. |

| Agency | Issue raised | Response/where addressed in REF |
|---|---|---|
| | Safe access from the road is required for each headwall for maintenance (i.e. safe location to stop, removable barriers to move machinery to headwall). If a Road Occupancy Licence is required to maintain assets that benefit the road, the assets would become TfNSW owned. TfNSW would also need to ensure appropriate access is provided to perform routine maintenance. City of Newcastle can provide details on specific access requirements for each site i.e. truxor, backhoe or manual labour/hand tools. | Transport will review this request in consultation with the City of Newcastle during detailed design. |
| | Investigate and implement WASTOP tide gates or similar to protect the upstream catchment from inundation where appropriate. | The use of WASTOP tide gates or similar to protect the upstream catchment from inundation would be investigated during the detailed design phase of the proposal. |
| | Runoff is directly connected to Hunter River. Treat all drainage systems prior to discharge to meet water quality targets. | Water quality basins and swales are proposed to capture and treat runoff from the road pavement areas of the proposal before discharging into the receiving waterways. The proposed water quality controls would deliver annual average pollutant loads that are less than pollutant loads for existing conditions (refer to **Appendix C**). |
| | A solid redirective kerb would impede flood water and adversely impact properties. Investigate impacts to overland flow paths. | A detailed flood assessment has been undertaken or the proposal and is provided in **Appendix L** and summarised in **Section 6.2**. The assessment considers the potential impacts of the proposal during the 10% AEP and 1% AEP including impacts on overland flow paths and existing buildings. |
| | Safely maintain stormwater conveyance through minor (10% Annual exceedance probability (AEP)) and major (1% AEP) events. | |
| | Works as Executed documentation is required all new City of Newcastle stormwater assets and dilapidation for all retained assets within the REF area as per attached CN document 'Stormwater WAE Requirements'. | Transport would provide Works as Executed documentation to City of Newcastle for any assets impacts by the proposal. |
| | Pre and post closed-circuit television (CCTV) inspection of City of Newcastle owned drainage assets in the REF area that is to be retained (project area defined as area likely to be subject to construction loading throughout the projects life span). The pre and post CCTV survey shall act as the dilapidation survey. This CCTV is to be undertaken in accordance with Appendix 11 – Specification of Drainage Inspection of City of Newcastle's Stormwater and Water Efficiency for Development Technical Manual April 2019. | Transport acknowledges receipt of the City of Newcastle's Stormwater Works as Executed (WAE) Requirements and associated plans.<br><br>Transport would provide Works as Executed documentation to City of Newcastle for any Council assets impacts by the proposal.<br><br>Transport will continue to consult with City of Newcastle in relation to any Council owned assets. |
| | All new stormwater drainage assets to be dedicated to the City of Newcastle shall be inspected in accordance with Appendix 11 – Specification of Drainage Inspection of CN's | |

| Agency | Issue raised | Response/where addressed in REF |
|---|---|---|
| | Stormwater and Water Efficiency for Development Technical Manual April 2019.<br>CCTV inspection to be undertaken after risk of damage to the assets due to construction loading is negligible. | |
| | All new stormwater drainage assets to be dedicated to the City of Newcastle shall be assessed to identify any defects in accordance with Appendix 10 – Specification of Acceptance of Drainage Defects City of Newcastle's Stormwater and Water Efficiency for Development Technical Manual April 2019.<br>Council's minimum condition standards for new drainage infrastructure are set out by this Specification which references WSA 05-2008 2.2 for acceptability of defects. Defects that are unacceptable would require remediation in order to achieve the minimum standard for Council to accept as public assets within the Defects Liability Period. | |
| | WAE drawings shall be prepared and certified by a Registered Land Surveyor in the State of New South Wales or a suitably qualified Engineer.<br>The WAE Engineering Survey of all stormwater drainage assets to be dedicated to the City of Newcastle shall comply with the following:<br>• Survey to be delivered as 12D compatible to City of Newcastle<br>• Drainage Asset Engineering Survey to be completed and capture data.<br>• Survey to be undertaken after risk of damage of the assets due to construction loading is negligible.<br>• PDF plan of WAE survey to be supplied to City of Newcastle | |
| | Traffic and roads<br>It is requested that TfNSW address how the proposed works may impact on development along either side of the corridor. Concern is raised specifically in relation to managing vehicular access for existing sites and the proposal potentially limiting the future development potential of the properties along the road corridors. | Construction of the proposal would not preclude any future development along either side of the corridor. Potential impacts of any future development on traffic, access and the road network would need to be considered on a case by case basis following completion of the detailed design. |
| | The potential traffic impact on the local roads network is also a matter of concern as additional traffic would be directed to these roads. | A traffic model has been developed for the proposal incorporating the REF area and the EIS areas of the proposal as well as the nearby local road network. The model has been used to determine any potential impacts of the proposal during |

| Agency | Issue raised | Response/where addressed in REF |
|---|---|---|
| | | construction and operation on local roads (refer to **Section 6.6**). |
| | It is requested the design of the proposal is amended to provide a right turn in (right turn lane) to Old Maitland Road from the Pacific Highway.<br><br>This turning facility is required because presently trucks travelling from the east to the industrial properties turn right at Old Maitland Road at the Hexham Bowling Club end. The trucks are travelling through residential areas and causing vibration to residents' homes. The road was not design for heavy vehicles and is deteriorating over time.<br><br>While the proposed U-turn facility is helpful it would not assist the drivers of the trucks if their destination is west of Galleghan Street because they cannot run right at Old Maitland Road (western end).<br><br>CN did not approve as a heavy vehicle route that section of Old Maitland Road from Galleghan Street to the eastern end (near Hexham Bowling Club). As a result, heavy vehicles heading west are continuing along the Pacific Highway to find a turning area to turn around to turn left into Old Maitland Road. | Transport will consider inclusion of a right turn lane to Old Maitland Road, Hexham (south of Hexham Bowling Club) from Maitland Road (Pacific Highway) in consultation with the City of Newcastle as part of the detailed design.<br><br>A Noise and Vibration Assessment (SLR, 2021) has been completed as part of the proposal, and is provided in **Appendix M** and summarised in **Section 6.9**<br><br>Noted. The purpose of the U-turn facility on Old Maitland Road is primarily to service road users and residents on Fenwick Street, Merchant Street and Clarke Street seeking to go southbound on Maitland Road.<br><br>Noted. |
| | Flooding<br><br>The full length of the proposed works is subject to Ocean and River flooding during the 1% AEP and Probable Maximum Flood (PMF) flooding events. | A hydrology and flooding assessment has been prepared for the proposal and is provided in **Appendix L** and summarised in **Section 6.2**. |
| | It is recommended that TfNSW obtain a site/locality specific flood study to demonstrate that the proposed works would not have an adverse flooding impact on neighbouring developments or downstream allotments. | |
| | Once a flood study has been conducted for the site, TfNSW can liaise with City of Newcastle in relation to any identified impacts that the proposal may have in relation to flooding. | Transport would continue to liaise with City of Newcastle regarding any potential flood impacts during design development. |
| | Heritage<br><br>The proposed works are in the vicinity of 13 listed heritage items on Schedule 5 of the Newcastle Local Environmental Plan 2012 (Refer to attachment). | The thirteen listed heritage items on Schedule 5 of the Newcastle Local Environmental Plan 2012 have been identified and considered in **Section 6.8.2**. |
| | Generally, the proposed works do not encroach into the curtilage of any of the identified heritage items as the works are within the public road corridor. A SoHI should be prepared to assess the impact of the proposal on the setting of all heritage items along the route and in the vicinity. | A SoHI has been prepared for the proposal and is provided in **Appendix J** and summarised in **Section 6.8**. |

| Agency | Issue raised | Response/where addressed in REF |
|---|---|---|
| | The works include replacement of the existing Ironbark Creek Bridge. These works would include significant excavation. Appropriate due diligence with respect to Aboriginal cultural heritage values would need to be undertaken, particularly noting the proximity to Hexham Swamp and the Hunter River. These are known to be key locations in Aboriginal occupation of the region as identified in City of Newcastle's Aboriginal Heritage Management Strategy 2018-21. | An ACHAR has been prepared for the proposal and is provided in **Appendix I** and summarised in **Section 6.7**. |
| State Emergency Services | No response was received in response to the ISEPP consultation. However, the following issues were raised during informal consultation:<br>• A request for Transport to provide details of when Maitland Road would flood so that SES can develop an early flood evacuation warning system for residents and businesses in Hexham and Sandgate. | Details on the proposals flooding and hydrology impacts are provided in **Section 6.2**. |
| National Parks and Wildlife Services | NPWS recommends consideration of environmental matters in accordance with the Guideline for Developments Adjoining Lands Managed (OEH, 2013). | Transport has considered the Guideline for Development Adjoining Lands Managed and incorporated relevant safeguards and management measures into this REF. |
| | NPWS recommends clear instructions are provided as part of the REF, and any operation documents produced by Transport would ensure no unauthorised works, access or encroachments occurs to park. | In accordance with management measure B15, Transport will ensure no authorised works, access or encroachment occurs on lands managed by NPWS. |
| | NPWS recommends adequate sediment and erosion controls are in place, and operational especially in environmentally sensitive areas to protect the park and its interface during project work. | In accordance with management measure SW1, erosion and sediment measures would be implemented in accordance with the principles and requirements in *Managing Urban Stormwater – Soils and Construction, Volume 1* (Landcom 2004) and *Volume 2D* (NSW Department of Environment, Climate Change and Water 2008c), commonly referred to as the 'Blue Book' |
| | NPWS recommends public safety is considered and managed accordingly, where park entry points intersect with the highway corridor and the project works in particular to the parks, Ash Island entrance | Access to National Parks, including Ash Island, will be maintained at all times during construction.<br>Any changes to access arrangements or alternative access that are necessary during construction will be done in consultation with NPWS. Any changes to access will provide the same equivalent pre-existing level of access unless agreed to by the NPWS.<br>Transport will continue to liaise with NPWS during subsequent stages of design to confirm access arrangements during construction and operation. |

| Agency | Issue raised | Response/where addressed in REF |
|---|---|---|
| | NPWS recommends hygiene protocols for machinery, vehicles and material are established, and delivered throughout the proposal to limit propagule and pathogen transmission to the park interface. | All vehicles driving to and from site would follow a protocol to prevent the spread or introduction of phytophthora, namely vehicles should be clean, including the tyres and any equipment.<br>Weed management would be undertaken in areas affected by construction prior to any clearing works in accordance with the Biosecurity Act to ensure they are not spread to the surrounding environment; including during transport disposal off-site to a licenced waste disposal facility. |
| | NPWS recommends park fire and management trail access remains operational and unobstructed, unless subject to prior arrangement with the NPWS Lower Hunter Area office. | Access to park fire and management trails would be maintained unless previous arrangements have been made with the NPWS Lower Hunter Area office. |
| | NPWS recommends post works monitoring and maintenance of weed incursion and remediation works occur to protect areas where significant modification of the canopy, embankments or soil surface has occurred. | Transport will undertake monitoring and maintenance of weed incursion and remediation works of the REF areas where significant modification of the canopy, embankments or soil surface has occurred as part of regular operational maintenance activities. |
| | NPWS recommends communication between Transport and NPWS continues to ensure the proposal is delivered in a safe, efficient and environmentally sensitive manner. | Consultation with NPWS would be ongoing throughout the construction of the proposal. |
| | NPWS requests a joint inspection of the Hunter Wetlands National Park near Ironbark Creek. | Transport undertook a site inspection with NPWS on the 1st April 2021 of the Hunter Wetlands National Park and the REF area near to Ironbark Creek. |
| | NPWS requests a gate be constructed at or near the entrance to Ash Island. | Transport will consider the inclusion of a gate at or near the entrance to Ash Island as part of detailed design and in consultation with NPWS. |

## 5.5 Government agency and stakeholder involvement

Transport has also undertaken formal consultation with the DPI Fisheries on the 22 February 2021 about the proposal under section 199 of the FM Act. Transport has also consulted with the ARTC were consulted with on 25 February 2021 regarding impacts to rail infrastructure immediately alongside the proposal and including work around Hexham Railway Station. The results of the consultation are summarised in **Table 5.5**.

Transport has also consulted on an ongoing basis with key State and local government agencies, utility service owners as well as a number of businesses in the REF area. This consultation was designed to ensure issues and concerns were understood, documented and addressed, and that stakeholders had an opportunity to discuss any aspect of the proposed upgrade. Consultation has included phone calls, emails, letters and face-to-face meetings.

The summary of consultation and any issues that have been raised as a result of consultation with these agencies and stakeholders are outlined below in **Table 5.6**.

Table 5.5 Issues raised through formal consultation with DPI (Fisheries)

| Issue raised | Response/where addressed in REF |
|---|---|
| DPI requires avoidance, mitigation or offsets for any marine vegetation harmed. This is calculated on a 2:1 ratio. | The proposal has been designed to minimise potential impacts on biodiversity where possible. As outlined in **Section 6.1.5**, the REF area of the proposal would require the removal of about 0.51 hectares of Saltmarsh Estuarine Complex and 0.72 hectares of Grey Mangrove low closed forest. Offsets for these communities would be calculated at a ratio of 2:1.<br><br>Offsets relating to the EIS areas of the proposal are discussed in the EIS. |
| Where possible avoid harming by minimising the footprint of the development area. This would most likely be the use of bridging over those areas around Ironbark Creek and the wetlands to the west between Sparke and Shamrock Streets, rather than filling. This would reduce the impact on the wetland areas to the approximate footprint for the bridge piles.<br><br>If this is not possible then any walls to contain fill for abutments should be as vertical as possible to minimise the footprint of the roadway. | Transport will consider options to further reduce impacts to biodiversity associated with the design and construction of the bridge during detailed design and construction planning. |
| An assessment of the area impacted must be made, quantifying and vegetation being affected. | **Section 6.1** of this REF assesses the potential impacts of the proposal on biodiversity. Vegetation impacts have been quantified and suitable offsets calculated at a ratio of 2:1. |
| An assessment of potential offsets based on the final design of the works. This may identify areas that could be enhanced along the bank of the Hunter River beside the works (e.g. rock fillets) or potential environmental works further afield (e.g. offset area identified for the M1 Hexham Bypass). | **Section 6.1.5** outlines the biodiversity offsets for the proposal. The specific location of offsets would be determined during detailed design with preference being given to available offsets near to the proposal. |

Table 5.6 Issues raised during consultation with agencies and stakeholders

| Agency | Issue raised | Response/where addressed in REF |
|---|---|---|
| City of Newcastle | Various briefings have been held over the course of the proposal.<br>Transport have also consulted with the City of Newcastle as part of the ISEPP consultation and a formal submission was provided, refer further to **Section 5.4**. | |
| ARTC | ARTC made the following comments regarding changes to Hexham Railway Station and the access road:<br>• The existing signalling box and associated communication and fibre optic cables would need to be relocated to progress with access road works<br>• Current requirements for accessing the rail corridor for survey will be provided<br>• An advertising board immediately to the north of Hexham Railway Station (outside the rail corridor) requires access for maintenance. This is currently accessed via the concrete U-turn bay<br>• Barrier kerbing would be required on the perimeter of the new station access to stop errant vehicles entering the corridor<br>• A minimum distance of one service vehicle would be required between the back of the above mentioned barrier and the live rail, for access and maintenance (currently pinch point is about 12.5 metres)<br>• Transport to provide drawings explaining the new access routes to Hexham Railway Station. | Transport would work closely with ARTC during detailed design to ensure that the access road takes into consideration existing rail infrastructure such as the signalling box and advertising board. Transport would ensure that the access road is designed in accordance with the relevant ARTC requirements and safety standards to prevent errant vehicles from entering the rail corridor and to provide adequate space for maintenance vehicles.<br>Transport would provide concept design drawings for the access road to ARTC and detailed design drawings once they have been developed. |
| | ARTC noted that the proposal would close the existing southbound, right hand turn into the Station. Access from the north would be via Old Maitland Road, a turn around then using the Old Maitland Road signals | Noted. |
| | ARTC to provide update on the timing of construction for the Ironbark Creek Bridge upgrades | Noted. |

| Agency | Issue raised | Response/where addressed in REF |
|---|---|---|
| | ARTC to provide information on current, planned maintenance for drainage structures | Noted. |
| | ARTC commented that Transport should allow sufficient funding to cover the relocation of signalling infrastructure. | Transport would ensure all costs associated with the relocation of signalling infrastructure are included in the proposal budget. |
| | ARTC to provide a summary of upcoming maintenance within the proposal extents for the next three years | Noted. |
| EPA | 1. Environmental impacts of the proposal<br><br>Impacts related to the following environmental issues need to be assessed, quantified and reported on:<br>• Air Quality<br>• Noise and Vibration<br>• Water and Soil Quality and Management<br>• Waste Management<br>• Dangerous Goods, Chemical Storage and Bunding<br>The EIS and REF should address the specific requirements outlined under each heading below and assess impacts in accordance with the relevant guidelines mentioned. | The environmental issues identified have been assessed in the following locations:<br>• Air quality (**Section 6.13**)<br>• Noise and vibration (**Section 6.9**)<br>• Water and soil quality management (**Section 6.2, Section 6.3, Section 6.4,** and **Section 6.12**)<br>• Dangerous goods, chemical storage and bunding (**Section 6.17**) |
| | 2. Licensing requirements<br><br>The EIS & REF should confirm if the proposal would involve activities listed in Schedule 1 of the *Protection of the Environment Operations Act 1997*. If scheduled activities are to be undertaken as part of the proposal, the scale of the activity should be clearly stated. | The potential for the proposal to involve activities listed in Schedule 1 of the Protection of the *Environment Operations Act 1997* has been considered in **Section 6.12**) |
| | 3. The proposal and premises<br><br>The objectives of the proposal should be clearly stated and refer to:<br>• The size and type of the operation<br>• The nature of the processes and the products, by-products and wastes produced<br>• The types and quantities of any chemicals to be used and | The objectives of the proposal are outlined in **Section 2.3** and relate to the operation of the proposal as a road, consistent with its current purpose.<br><br>A description of the proposal has been provided in **Chapter 3**. Further information on the existing property and land use environment is provided in **Section 6.10** (Socio-economic, property and land use). |

| Agency | Issue raised | Response/where addressed in REF |
|---|---|---|
| | stored onsite<br>• Proposed operational hours, including any heavy vehicle movements<br>• Proposed maximum and average annual production rates that would occur at the premises<br>• Proposed staging and timing of the proposal.<br>The EIS and REF would need to fully identify all the processes and activities intended for the site over the life of the development. This would include details of:<br>• The location of the proposed facility and details of the surrounding environment<br>• The proposed layout of the site<br>• Appropriate land use zoning<br>• Ownership details of any residence and/or land likely to be affected by the proposed operations<br>• Maps/diagrams showing the location of residences and properties likely to be affected and other industrial developments, conservation areas, wetlands, etc. in the locality that may be affected by the facility<br>• All equipment proposed for use at the site<br>• All chemicals, including fuel, used on the site and proposed methods for their transportation, storage, use and emergency management<br>• Clearly detail the boundary of the premises<br>• Methods to mitigate any expected environmental impacts of the development. | Details on specific chemicals and fuels and their transportation, storage and emergency use would be determined during detailed construction planning.<br>Safeguards and management measures have been outlined for each specific environmental aspect in **Chapter 6**. A comprehensive list of safeguards and management measures is provided in **Chapter 7**. |
| | 4. Air quality<br>The EIS & REF should include an air quality impact assessment (AQIA) in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW. The AQIA must identify and describe in detail all possible sources of air pollution and activities/ processes with the potential to cause air pollutants including odours and fugitive dust emissions beyond the boundary of any premises proposed to be licenced by an EPL The | An air quality impact assessment (AQIA) has been prepared for the proposal and is provided in **Appendix R** and summarised in **Section 6.13**.<br>The AQIA includes consideration of potential construction and operational air quality impacts such dust, exhaust emissions, odours, and airborne hazardous materials. The AQIA includes |

| Agency | Issue raised | Response/where addressed in REF |
|---|---|---|
| | AQIA should cover both the construction and operational phases of the development. The AQIA should include cumulative impacts associated with existing developments and any developments having been granted development consent but which have not commenced.<br><br>The EIS and REF should demonstrate that the proposal would operate within EPA's objectives which are to minimise adverse effects on the amenity of local residents and sensitive land uses and to limit the effects of emissions on local, regional and inter-regional air quality.<br><br>The EIS & REF should describe in detail the measures proposed to mitigate the impacts and quantify the extent to which the mitigation measures are likely to be effective in achieving the relevant environmental outcomes.<br><br>The AQIA must describe the methodology used and any assumptions made to predict the impacts. Air pollutant emission rates, ambient air quality data and meteorological data used in the assessment must be clearly stated and justified. | an assessment of cumulative air quality impacts associated with nearby developments.<br><br>The AQIA concluded that with the implementation of safeguards and management measures outlined in **Section 6.13.4**, significant air quality impacts are not anticipated.<br><br>Details of the methodology of the air quality impact assessment are provided in **Appendix R**. |
| | 5. Noise and vibration<br><br>The following matters should be addressed in relation to noise and vibration impacts associated with the proposal. This includes identification of the hours of operations, assessment of all activities where proposed, and impacts on sensitive receivers associated with the proposed hours of operation. The following matters should be addressed as part of the EIS & REF.<br><br>General<br><br>• Construction noise associated with the proposed development should be assessed using the *Interim Construction Noise Guideline* (DECC, 2009)<br>• Vibration from all activities (including construction and operation) to be undertaken on the premises should be assessed using the guidelines contained in the *Assessing Vibration: a technical guideline* (DEC, 2006)<br>• Blast impacts should be demonstrated to be capable of | A noise and vibration impact assessment has been prepared for the proposal and is provided in **Appendix M** and summarised in **Section 6.9**.<br><br>Construction noise has been assessed in accordance with the *Interim Construction Noise Guideline* (DECC, 2009). Vibration impacts have been assessed in accordance with *Assessing Vibration: a Technical Guideline* (DEC, 2006). The proposal would not involve any blasting.<br><br>Road noise impacts have been assessed in accordance with the NSW *Road Noise Policy* (DECCW, 2011).<br><br>A Construction Noise And Vibration Management Plan (CNVMP) would be prepared for the proposal to mitigate and manage noise and vibration impacts during construction and would form part of the CEMP. The CNVMP would be implemented for the duration of construction of the proposal and would outline requirements for noise and vibration monitoring |

| Agency | Issue raised | Response/where addressed in REF |
| --- | --- | --- |
| | complying with the guidelines contained in Australian and New Zealand Environment Council - T*echnical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (ANZECC, 1990). If an alternative methodology or guidelines are presented in the EIS & REF, justification must be provided.<br>Road<br>• Noise on public roads from increased road traffic generated by land use developments should be assessed using the guidelines contained in the *NSW Road Noise Policy* (DECCW, 2011)<br>• Noise from new or upgraded public roads should be assessed using the *NSW Road Noise Policy* (DECCW, 2011).<br>Monitoring<br>• Detailed monitoring that would be conducted to assess the impacts of the proposal. | that would be carried out to monitor performance associated with the noise and vibration criteria. |
| | 6.1 Water quality<br>Describe proposal<br>• Describe the proposal including position of any intakes and discharges, volumes, water quality and frequency of all water discharges<br>• Demonstrate that all practical options to avoid discharges have been implemented and environmental impact minimised where discharge is necessary<br>• Where relevant include a water balance for the development including water requirements (quantity, quality and source(s)) and proposed storm and wastewater disposal, including type, volumes, proposed treatment and management methods and re-use options.<br>Background Conditions<br>• Describe existing surface and groundwater quality. An assessment needs to be undertaken for any water resource likely to be affected by the proposal. Issues to be discussed | The potential impacts of the proposal on groundwater and surface water have been considered in **Appendix N** and summarised in **Section 6.3** (Surface water) and **Section 6.4** (Groundwater). Detailed drainage design figures are provided in **Appendix B**.<br>The drainage design including the cross-drainage culverts and longitudinal drainage pipe system have been developed to avoid drainage catchment diversion as far as practicable to minimise hydrology impacts. Overall, there is unlikely to be a significant change in hydrology and flow distribution across the broader catchment. However, there is the potential for localised changes in flow from one pavement sub-catchment to the next.<br>A water balance is provided in **Section 6.2.3**<br>A description of the existing surface water and groundwater quality is provided in **Section 6.3.2** (Surface water) and **Section 6.4.2** (Groundwater). |

| Agency | Issue raised | Response/where addressed in REF |
|---|---|---|
| | should include but are not limited to:<br>• A description of any impacts from existing industry or activities on water quality<br>• A description of the condition of the local catchment e.g. erosion, soils, vegetation cover, etc<br>• An outline of baseline groundwater information, including, for example, depth to water table, flow direction and gradient, groundwater quality, reliance on groundwater by surrounding users and by the environment<br>Historic river flow data.<br>• State the Water Quality Objectives for the receiving waters relevant to the proposal. These refer to the community's agreed environmental values and human uses endorsed by the NSW Government as goals for ambient waters (http://www.environment.nsw.gov.au/ieo/index.htm). Where groundwater may be impacted the assessment should identify appropriate groundwater environmental values<br>• State the indicators and associated trigger values or criteria for the identified environmental values. This information should be based on the ANZECC (2000) *Guidelines for Fresh and Marine Water Quality* as a minimum given the sensitive receiving environment of the Hunter River and any advice from Water NSW<br>• State any locally specific objectives, criteria or targets which have been endorsed by the NSW Government.<br>Impact Assessment<br>• Describe the nature and degree of impact that any proposed discharges would have on the receiving environment, both surface water and groundwater<br>• Detail contractual and other arrangements that would be put in place to prevent pollution from haul roads and unsealed roads per se, particularly rights of carriageways not owned by the proponent<br>• Assess impacts against the relevant ambient water quality outcomes. Demonstrate how the proposal would be designed | The water quality objectives for key waterways, wetlands and drains is discussed in **Section 6.3**. Specific indicators and associated trigger values are identified in **Appendix N**.<br>Surface water and groundwater impacts are identified in **Section 6.3.3** (Surface water) and **Section 6.4.3** (Groundwater).<br>Water quality basins and swales are proposed to capture and treat runoff from the road pavement areas of the proposal before discharging into the receiving waterways. The proposed water quality controls would deliver annual average pollutant loads that are less than pollutant loads for existing conditions.<br>Impacts on groundwater dependent ecosystems are considered in **Section 6.1.3** (Biodiversity).<br>A Construction Soils and Water Management Plan (CSWMP) would be developed as a sub plan of the CEMP and would outline measures to manage soil and water quality impacts associated with the construction work, including contaminated land. The CSWMP will include a surface water quality monitoring program to monitor the performance of management measures. |

| Agency | Issue raised | Response/where addressed in REF |
|---|---|---|
| | and operated to:<br>• Protect the Water Quality Objectives for receiving waters where they are currently being achieved<br>• Contribute towards achievement of the Water Quality Objectives over time where they are not currently being achieved.<br>• Where a discharge is proposed that includes a mixing zone, the proposal should demonstrate how wastewater discharged to waterways would ensure the ANZECC (2000) water quality criteria for relevant chemical and non-chemical parameters are met at the edge of the initial mixing zone of the discharge, and that any impacts in the initial mixing zone are demonstrated to be reversible<br>• Propose water quality limits for any discharge(s) that adequately protects the receiving environment<br>• Assess impacts on groundwater and groundwater dependent ecosystems<br>• Describe how stormwater would be managed both during and after construction.<br>Monitoring<br>• Describe how predicted impacts would be monitored and assessed over time. | |
| Telstra | Telstra advised their preference not to relocate any part of the Telstra network. | Transport would consider opportunities to avoid or minimise impacts to the Telstra network as part of the detailed design process. Further consultation would be undertaken with Telstra. |
| Optus | Optus acknowledged potential impacts to the Optus network. | Transport would consider opportunities to avoid or minimise impacts to the Optus network as part of the detailed design process. Further consultation would be undertaken with Optus. |
| AAPT/PowerTel | TPG on behalf of AAPT acknowledged potential impacts to the AAPT/PowerTel network. | Transport would consider opportunities to avoid or minimise impacts to the AAPT network as part of the detailed design process. Further consultation would be undertaken with TPG on behalf AAPT. |

| Agency | Issue raised | Response/where addressed in REF |
|---|---|---|
| NBN | NBN acknowledged the potential impacts to the NBN and provided further information on the network. | Transport would review the information provided by NBN and consider opportunities to avoid or minimise impacts to the NBN as part of the detailed design process. Further consultation would be undertaken with NBN. |
| Nextgen | Vocus on behalf of Nextgen acknowledged the potential impacts to the Nextgen network. | Transport would consider opportunities to avoid or minimise impacts to the Nextgen network as part of the detailed design process. Further consultation would be undertaken with Vocus on behalf of Nextgen. |
| AusGrid | Ausgrid noted that poles should be outside the clear zone for 80km/h or protected. Ausgrid confirmed they were not aware of any upgrade works to their assets in the next 12-18 months. | Transport would ensure that Ausgrid poles are outside the clear zone or protected.<br>Ausgrid work schedule is noted. |
| Hunter Water Corporation | Hunter Water Corporation easements are been identified and specific easement process would need to be requested from Hunter Water Corporation. Hunter Water Corporation require maintenance access noting new sections of barrier. Hunter Water Corporation note area has contamination including acid sulphite and remnants of galvanised plant.<br>Hunter Water Corporation have no plans to carry out works in the next 12 to 14 months. A clash analysis has been undertaken. An accredited water designer has been engaged to detail the design. | Transport would consider Hunter Water Corporation easement requirements during detailed design and construction planning.<br>Transport would ensure access is maintained to Hunter Water assets.<br>Acid sulfate soils are noted and discussed in **Section 6.12**. |
| Jemena Gas | Jemena acknowledged potential impacts to Jemena assets. | Transport would consider opportunities to avoid or minimise impacts to Jemena assets as part of the detailed design process. Further consultation would be undertaken with Jemena. |
| Subsidence Advisory | SA NSW records indicate that historical mine workings are not present within the proposal and that the proposal is located entirely outside of a declared mine subsidence district. A NSW approval is not required for infrastructure that is located outside of a mine subsidence district. | N/A |

## 5.6 Ongoing or future consultation

Transport is committed to continued engagement with the community and stakeholders throughout the development of the proposal.

The REF is on display and comments are invited until 5pm on Friday 3 December 2021.

Consultation activities during this display period include:

- Project updates distributed to the community and stakeholders inviting feedback on the proposal
- Online information sessions hosted on Facebook Live or Microsoft Teams for community/affected property owners to ask questions or make comment
- Zoom, Microsoft Teams or phone calls with key stakeholders as required
- Web page and digital portal providing project overview, frequently asked questions, REF and interactive map capabilities
- Facebook posts.

Consultation (also subject to current and future COVID-19 restrictions) throughout the remainder of the proposal may include:

- Project updates and key milestones available on Transport project webpage
- Online meetings, briefings and presentations with key stakeholders, including City of Newcastle, utility providers and other government agencies
- Updates to the immediately affected community during the detailed design phase and construction phases
- Consultation with community stakeholders to help manage impacts during construction
- Follow-up meetings to discuss and agree access arrangements with directly affected landowners prior to and during construction
- Media releases and project advertisements in local media
- Project information line and enquiries email ongoing
- Facebook posts
- Continuous consultation with the Aboriginal community during the development of the detailed design and construction.

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

If approved, the community and stakeholders would continue to be consulted with and informed during the development and construction of the proposal.

# 6 Environmental assessment

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

- Potential impacts on MNES under the EPBC Act
- The factors specified in the guidelines Is an EIS required? (DUAP 1995/1996) as required under clause 228(1) *of the* Environmental Planning and Assessment Regulation 2000 and the *Roads and Related Facilities EIS Guideline (DUAP 1996)*. The factors specified in clause 228(2) of the Environmental Planning and Assessment Regulation 2000 are also considered in **Appendix E**.

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

## 6.1 Biodiversity

The potential impacts of the proposal on biodiversity are assessed in the *Hexham Straight Widening Biodiversity Assessment Report* (BAR) refer to **Appendix H**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.1.1 Methodology

A detailed methodology for the biodiversity assessment is provided in the BAR in **Appendix H**. The following provides a summary of the methodology used which included:

- Field surveys for the proposal were completed by WSP (2020) and provided to Jacobs in the form of survey results, spatial data and a brief report
- A background review of biodiversity information was undertaken to identify the existing environment of the proposal within a search area of 10 kilometres
- A desktop review of relevant database records and previous studies within the locality to identify Commonwealth and State listed threatened species, populations and ecological communities
- A habitat assessment and likelihood of occurrence was undertaken for threatened and migratory species and endangered populations occurring in the study area
- Field surveys were conducted by WSP over 2019 and 2020. Several targeted surveys were completed within the study area including threatened and migratory bird surveys, hollow bearing tree assessment, passive microbat surveys (Anabats), habitat assessments, culvert inspections, targeted seasonal flora surveys, targeted Green and Golden Bell Frog surveys and inspection for Southern Myotis roost locations under Ironbark Creek Bridge
- The plot-based vegetation survey of the study area was completed using field survey methods in line with Chapter 5 of the Biodiversity Assessment Method (BAM) (Office of Environment and Heritage, 2017a)
- Targeted searches were undertaken for threatened plant species during February and March 2019 and followed the methods described in the *NSW Guide to Surveying Threatened Plants* (Office of Environment and Heritage, 2016) using parallel transects
- Targeted search for Green and Golden Bell Frog was undertaken in March 2021
- Preliminary diurnal inspections of all existing bridges and culverts along the study area were inspected during daylight hours by a zoologist to determine whether suitable roosting habitat

for threatened microbats were present. Where suitable habitat was identified, a follow up exit survey with an Anabat was completed

- Hollow bearing trees within the study area were mapped
- Diurnal dawn and dusk surveys were completed within potential threatened and Migratory bird habitat across the study area. Surveys were completed in accordance with the *NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Working Draft) (Department of Environment and Conservation, 2004) and *Survey Guidelines for Australia's Threatened Birds* (Department of the Environment Water Heritage and the Arts, 2010)
- An aquatic desktop assessment was conducted to assess the Hunter River, the Hunter Wetlands and Ironbark Creek against the NSW DPI (Fisheries) document *Policy and Guidelines for fish habitat conservation and managemen*t (2013 update) (NSW Department of Primary Industries, 2013) and *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003)
- An assessment of significance for threatened species and ecological communities positively identified during surveys and inspections or that are considered to have a moderate or high likelihood of occurring in the study area
- Identification of impacts and associated mitigation measures to reduce and manage impacts.

#### Literature and database review

The biodiversity assessment was based on a desktop review of existing information and field survey. Government databases were reviewed to identify potential threatened species, populations and ecological communities within the study area. The following databases were reviewed in April 2020 and again in August 2020:

- BioNet - Atlas of NSW Wildlife and Threatened Biodiversity Data Collection (Environment, Energy and Science Group 2020a)
- DPI Fisheries Spatial Data Portal
- Commonwealth Department of Environment's Protected Matters Search Tool
- BioNet Vegetation Classification Database (Environment, Energy and Science Group 2020b)
- Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE)
- Department of Environment's Directory of Important Wetlands in Australia
- Department of Planning and Environment's SEPP (Coastal Management) 2018 maps
- PlantNet – (NSW Flora online - https://plantnet.rbgsyd.nsw.gov.au/floraonline.htm). Royal Botanic Gardens. 10 kilometre radius search of the study area.

The study area for this assessment comprised the REF area with a 50 metre buffer.

### 6.1.2 Existing environment

#### Environmental context

The study area is located within the Hunter sub-region of the Sydney Basin Bioregion as defined by Thackway and Cresswell (1995) and the Lower Hunter Channels and Floodplains Landscape as mapped by the NPWS (2002a) and described by the NSW Department of Environment and Climate Change (2008).

The study area is located within a disturbed landscape dominated by urban development and associated infrastructure interspaced with fragmented and modified remnants of floodplain vegetation associated with the Hunter River.

The REF area is located next to the main channel of the Hunter River and the South Channel Hunter River, refer to **Figure 1.2**. Ironbark Creek is located within the REF area towards the southern end of the proposal. Ironbark Creek is connected to Hexham Swamp Nature Reserve in the west and runs perpendicular to the proposal passing under Ironbark Creek Bridge and Maitland Road before flowing into the South Channel Hunter River to the east. Hexham Swamp Nature Reserve is located about 200 metres to the west of the proposal at its nearest point near Sparkes Creek and is separated by the Main North Rail Line. Kooragang Nature Reserve is located about one kilometre to the east of the proposal and is separated by the South Channel Hunter River.

The study area is located immediately to the west of the Hunter Wetlands National Park in several locations at the southern end of the proposal until Ironbark Creek. To the north of Ironbark Creek, the proposal is separated from the national park boundaries by the South Channel Hunter River.

There are also some areas identified as Coastal Wetlands under the CM SEPP and some areas of vegetation identified as freshwater wetlands located within study area.

### Plant community types

Four Plant Community Types (PCTs) were identified within the REF area and these are summarised in **Table 6.1**.

Table 6.1 PCTs in the REF area of the proposal

| Plant Community Type | Condition class | Area (ha) in REF area | BC Act | EPBC Act | FM Act |
|---|---|---|---|---|---|
| Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234) | Moderate (EPBC Act and BC Act) | 0.41 | Yes | Yes | - |
| | Moderate (not TEC suitable) | 0.04 | - | - | - |
| | Low (BC Act) | 0.99 | Yes | - | - |
| | Poor (not TEC suitable) | 0.09 | - | - | - |
| *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071) | Moderate (BC Act) | 1.06 | Yes | - | - |
| Grey Mangrove low closed forest (PCT 1747) | Good (FM Act) | 0.72 | - | - | Yes |
| Saltmarsh Estuarine Complex (PCT 1746) | Good (EPBC Act, BC Act and FM Act) | 0.51 | Yes | Yes | Yes |

Note 1 TEC = Threatened ecological community

The REF area is mostly cleared and dominated by exotic grasslands, and a mix of native and non-native plantings, however native vegetation is scattered across the study area varying from small intact patches to isolated trees. The remaining areas of vegetation cover are classified as native plantings, or urban/exotic plantings that were not able to be matched to a PCT.

Refer to **Appendix H** for figures showing the location of PCTs within the study area.

### Threatened ecological communities

#### *NSW Biodiversity Conservation Act, 2016*

There are three TECs listed under the BC Act that occur in the study area and which correspond to PCT 1234, PCT 1071 and PCT 1746 respectively (refer to **Table 6.1**):

- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered) - 1.44 hectares
- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered) - 1.06 hectares
- Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions (Endangered) - 0.51 hectares.

#### *Environment Protection and Biodiversity Conservation Act, 1999*

*Coastal Swamp Oak (Casuarina glauca) Forest of the New South Wales and South East Queensland Ecological Community*

WSP (2020) considered PCT 1234 a candidate to form part of the EPBC Act listed Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community.

WSP (2020) used field-based vegetation condition types to assess PCT 1234 against the EPBC Act condition thresholds.

WSP (2020) concludes that, only moderate condition patches of PCT 1234 (0.41 hectares) are consistent with the EPBC Act listing for Coastal Swamp Oak (*Casuarina glauca*) Forest of the New South Wales and South East Queensland ecological community as they met both the key diagnostic characteristics and the condition thresholds. All low condition patches of PCT 1234 failed to either meet the key diagnostic characteristics and/or condition thresholds for the EPBC Act listing. Refer to Section 4.3.2 of the BAR (**Appendix H**) for condition thresholds.

*Subtropical and Temperate Coastal Saltmarsh*

Two PCTs recorded within the REF area were considered candidates which have potential to meet the EPBC Act listing:

- PCT 1746 Saltmarsh Estuarine Complex
- PCT 1747 Grey Mangrove low closed forest.

The assessment concluded that only PCT 1746 meets the key diagnostic characteristics for the EPBC Act listing. PCT 1747 did not meet the EPBC Act key characteristics as it contains a canopy dominated by Mangroves (*Avicennia marina subsp. australasica* and *Aegiceras corniculatum*) and Casuarina (*Casuarina glauca*) with a cover greater than 50 per cent. Refer to Section 4.3.2 of the BAR (**Appendix H**) for condition thresholds.


Legend

REF area

BC Act

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)

Railway

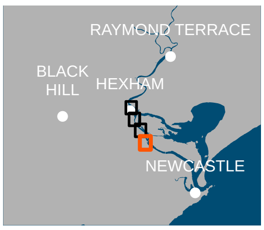
Road

Waterway

0 100 200 m

Scale 1:8,000 at A4

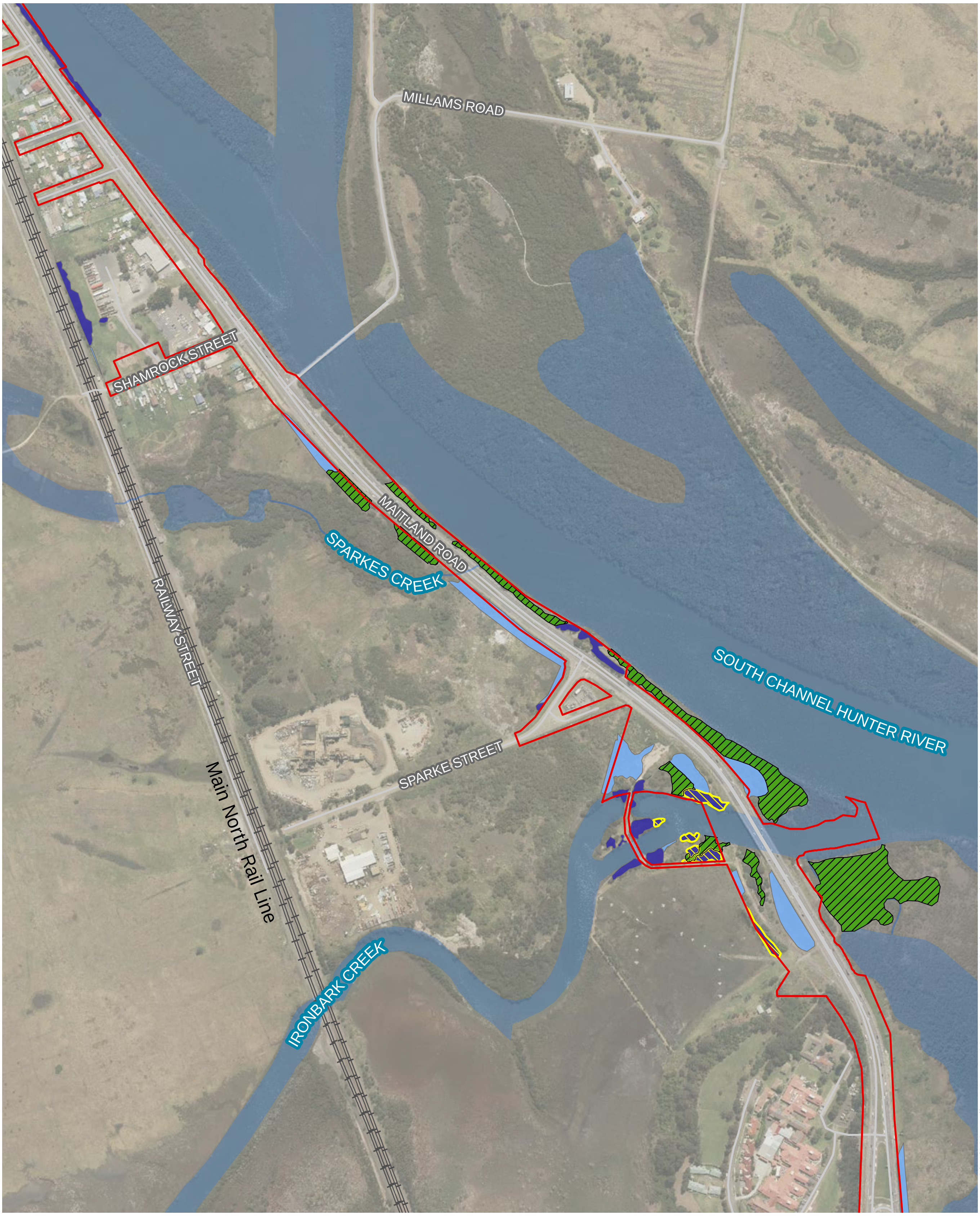
GDA94 MGA56




Page 1 of 4

**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.1a** Threatened ecological communities




**Legend**

REF area

EPBC Act

Coastal Swamp Oak (Casuarina glauca) Forest of the New South Wales and South East Queensland Ecological Community (Endangered)

Subtropical and Temperate Coastal Saltmarsh (Vulnerable)

BC Act

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions (Endangered)

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)

Railway

Road

Waterway

0 100 200 m

Scale 1:8,000 at A4

GDA94 MGA56

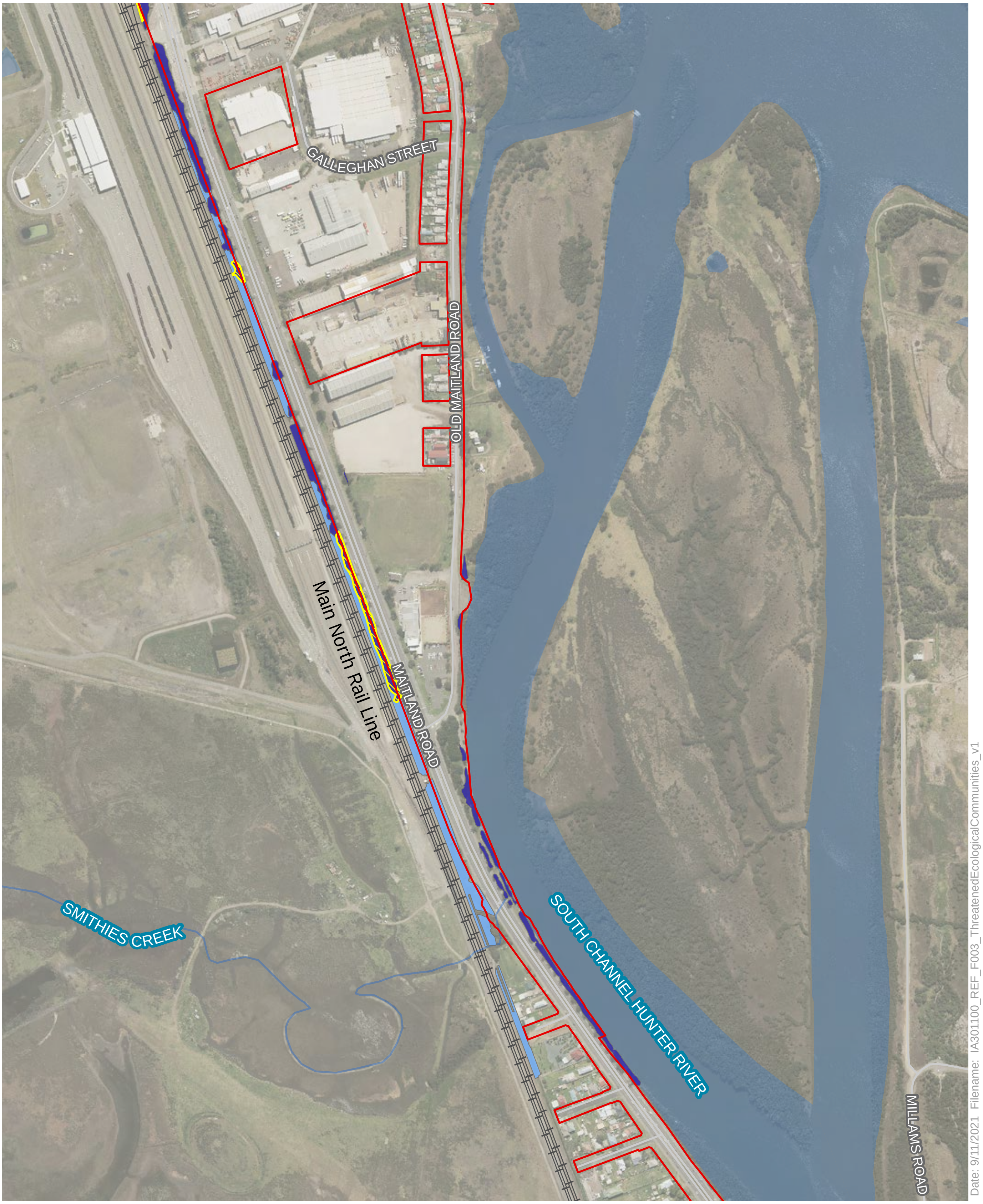

Page 2 of 4

**Data sources:**

Jacobs 2020

Department Finance, Services and Innovation 2020

**Figure 6.1b** Threatened ecological communities




**Legend**

REF area

EPBC Act

Coastal Swamp Oak (Casuarina glauca) Forest of the New South Wales and South East Queensland Ecological Community (Endangered)

BC Act

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)

Railway

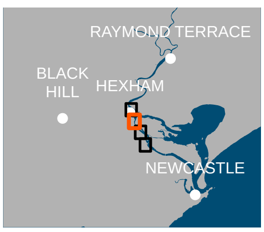
Road

Waterway

0 100 200 m

Scale 1:8,000 at A4

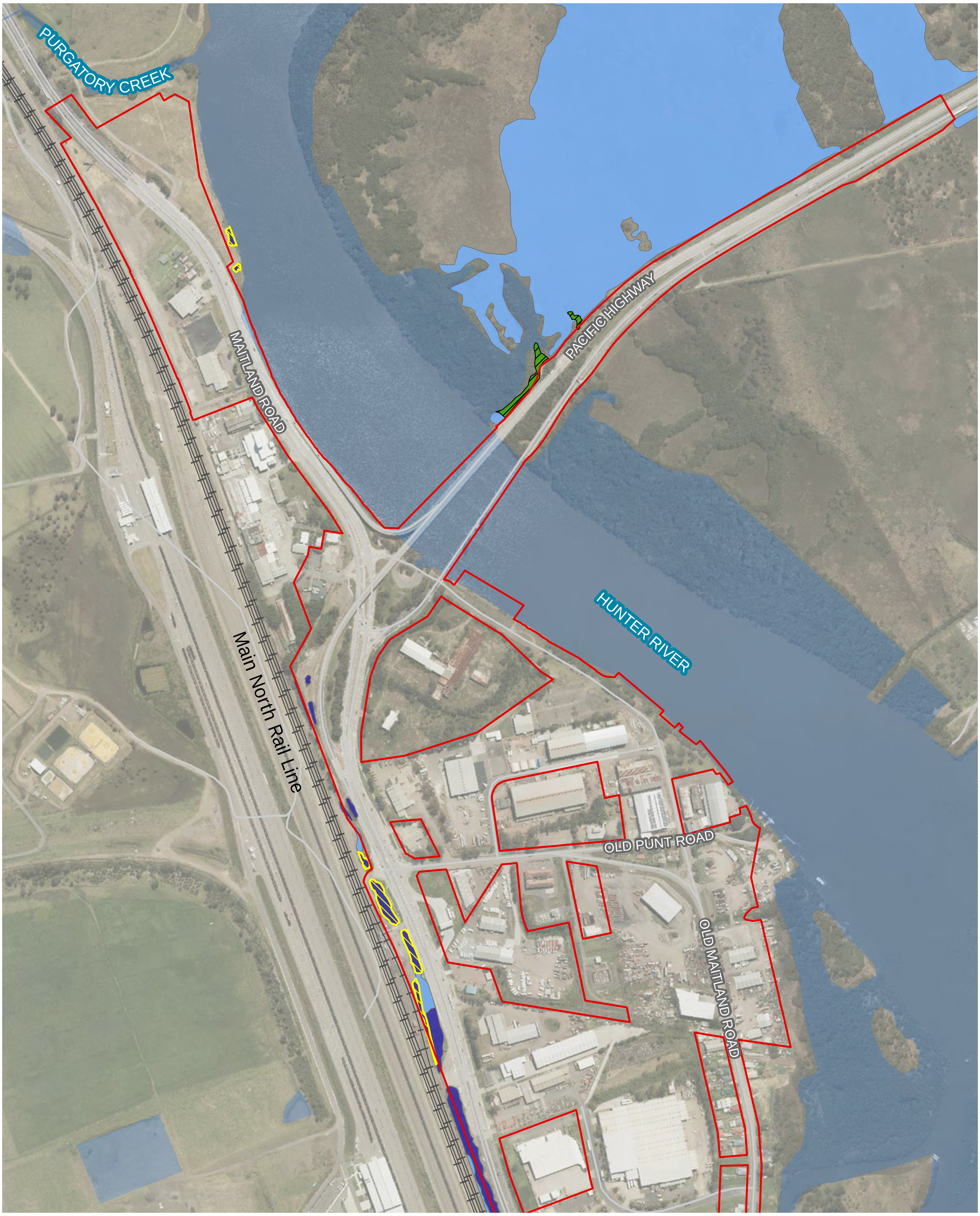
GDA94 MGA56






**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.1c** Threatened ecological communities






**Legend**

REF area

EPBC Act

Coastal Swamp Oak (Casuarina glauca) Forest of the New South Wales and South East Queensland Ecological Community (Endangered)

Subtropical and Temperate Coastal Saltmarsh (Vulnerable)

BC Act

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions (Endangered)

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)

Railway

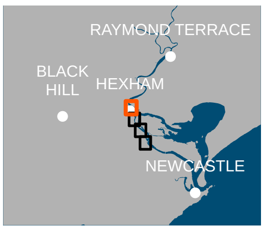
Road

Waterway

0 100 200 m

Scale 1:8,000 at A4

GDA94 MGA56






**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.1d** Threatened ecological communities

### Threatened flora

Twenty-nine threatened flora species have previously been recorded or modelled as having potential to occur in the proposal local area (**Appendix H**). Many of these species favour habitats that are not represented in the study area or are only known to exist in populations restricted to specific localities or are presumed extinct.

Five threatened flora species were initially considered moderately likely to occur within the study area and were identified as candidate species for targeted threatened flora surveys (refer to **Table 6.2**). None of these species identified were recorded during targeted surveys completed (WSP 2020). As such, these species are now considered to have a low likelihood of occurring within the study area.

Table 6.2 Threatened flora considered to have potential to occur within the study area

| Scientific name | Common name | BC Act | EPBC Act |
|---|---|---|---|
| *Maundia triglochinoides* | - | Vulnerable | - |
| *Zannichellia palustris* | - | Endangered | - |
| *Persicaria elatior* | Tall Knotweed | Vulnerable | Vulnerable |
| *Lindernia alsinoides* | Noah's False Chickweed | Endangered | - |
| *Commersonia prostrata* | Netted Bottle Brush | Endangered | Endangered |

### Threatened fauna

Based on regional records and the presence of suitable habitat, 81 threatened fauna species have been identified in the proposal local area (**Appendix H**) or have modelled habitat. Of these, seventeen threatened fauna species were initially assessed as having a moderate or higher likelihood or occurring in the study area based on the available habitat assessed from field surveys and known occurrences in associated habitats across the Hunter River flood plain (refer to Table 4.12 of **Appendix H**). These species were identified as candidate species for targeted threatened fauna surveys, however only six were recorded within the study area (refer to **Table 6.3**).

Table 6.3 Targeted fauna species recorded in the study area

| Scientific name | Common name | BC Act | EPBC Act | Recorded within study area? |
|---|---|---|---|---|
| *Litoria aurea* | Green and Golden Bell Frog | Endangered | Vulnerable | - |
| *Circus assimilis* | Spotted Harrier | Vulnerable | - | - |
| *Ixobrychus flavicollis* | Black Bittern | Vulnerable | - | - |
| *Daphoenositta chrysoptera* | Varied Sittella | Vulnerable | - | Yes |
| *Haliaeetus leucogaster* | White-belled Sea-Eagle | Vulnerable | Ma | Yes |
| *Hieraaetus morphnoides* | Little Eagle | Vulnerable | - | - |
| *Pandion cristatus (syn. P. haliaetus)* | Eastern Osprey | Vulnerable | Ma, M | - |

| Scientific name | Common name | BC Act | EPBC Act | Recorded within study area? |
|---|---|---|---|---|
| *Calidris ferruginea* | Curlew Sandpiper | Endangered | Critically endangered | - |
| *Xenus cinereus* | Terek Sandpiper | - | Vulnerable | - |
| *Limosa limosa* | Black-tailed Godwit | Vulnerable | - | - |
| *Falsistrellus tasmaniensis* | Eastern False Pipistrelle | Vulnerable | - | - |
| *Miniopterus australis* | Little Bent-winged Bat | Vulnerable | - | Yes |
| *Miniopterus schreibersii oceanensis* | Eastern Bent-winged Bat | Vulnerable | - | - |
| *Micronomus norfolkensis* | Eastern Coastal Free-tailed Bat | Vulnerable | - | Yes |
| *Myotis Macropus* | Southern Myotis, Large-footed Myotis | Vulnerable | - | Yes |
| *Pteropus poliocephalus* | Grey-headed Flying-fox | Vulnerable | Vulnerable | Yes |
| *Saccolaimus flaviventris* | Yellow-bellied Sheathtail-bat | Vulnerable | - | - |

Note 1 M = Migratory, Ma = Marine

The study area does not contain suitable habitat for some species listed in Attachment C of the BAR (**Appendix H**). No suitable habitat for threatened fish is present in the study area.

### *Southern Myotis (Myotis macropus)*

Southern Myotis is considered highly likely to occur around the REF area based on recent records in the proposal local area and the presence of suitable habitat along Ironbark Creek.

The water-based survey identified a total of five scuppers were being used by Southern Myotis for roosting and/or breeding purposes. Scuppers being utilised were observed in all the over-water spans underneath the middle/central section of the bridge (median), with varying numbers of bats using each of the structures. All bats observed roosting and/or breeding in the bridge scuppers were Southern Myotis.

A total of 20 Southern Myotis were recorded within habitat provided by Ironbark Creek Bridge. Two distinct age/size classes (i.e. adult and juvenile) of bat were recorded within two separate scupper locations within Ironbark Creek Bridge as seen in **Plate 6.1** and **Plate 6.2**.

Plate 6.1 Group of Southern Myotis recorded within Ironbark Creek scuppers 5 March 2021 (WSP 2020)

Plate 6.2 Four Southern Myotis recorded within Ironbark Creek scuppers 5 March 2020 (WSP 2020

From the results returned on the 5 March 2020 survey, it is considered very likely all scuppers observed, may be used for breeding purposes by Southern Myotis. This is supported by the occurrence of immature bats in many of the occupied scuppers.

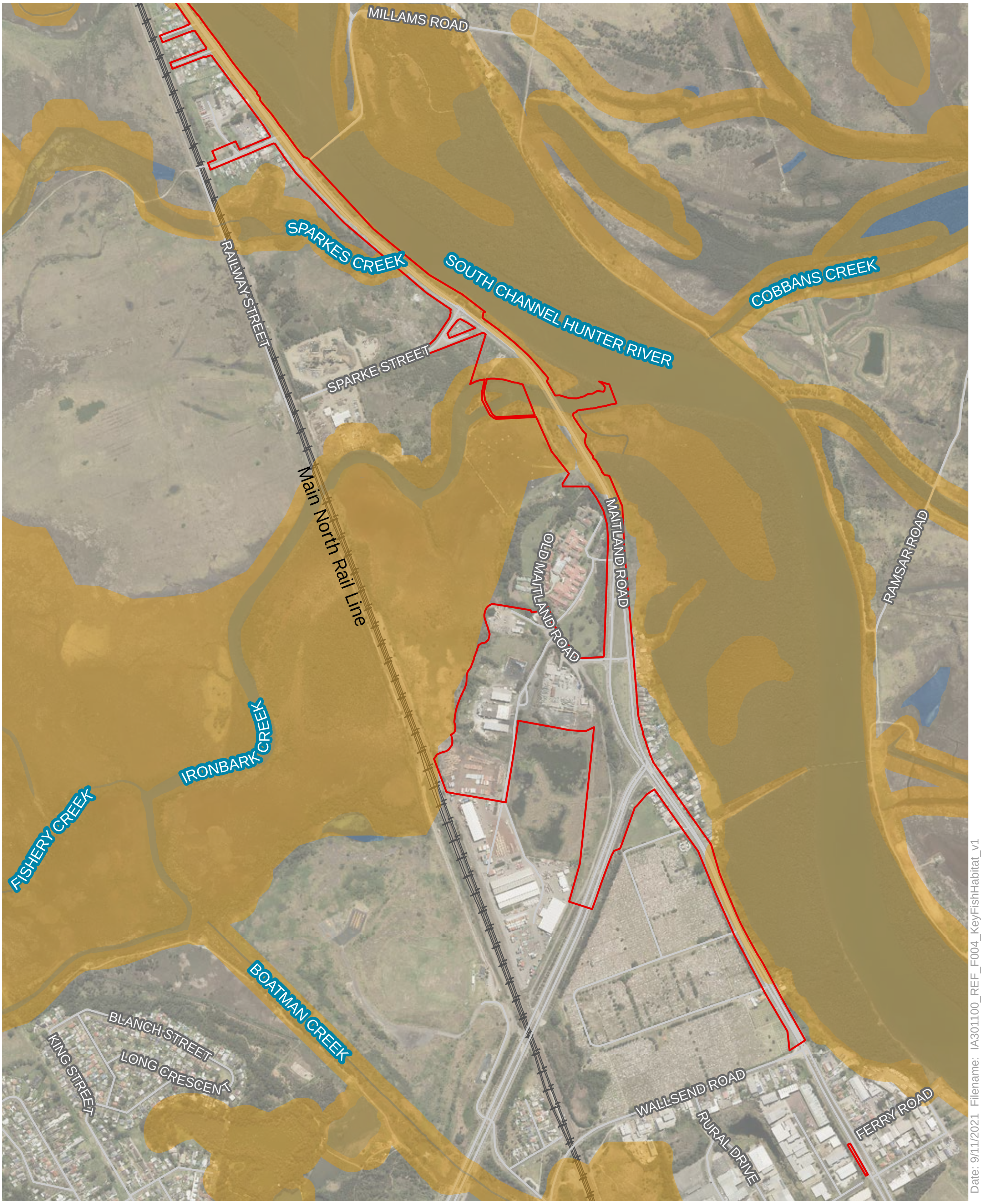
### *Other threatened fauna*

The study area also provides suitable habitat features for a range of threatened species that have been previously recorded in the proposal local area, including insectivorous bats (Little Bent-winged Bat, Large-eared Pied Bat, Eastern Bent-winged Bat, Eastern Coastal Free-tailed Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and the Yellow-bellied Sheathtail-bat), woodland birds (Dusky Woodswallow, Rufous Fantail and Varied Sittella) nectarivorous birds (Little Lorikeet and Swift Parrot), the Grey-headed Flying Fox, large predatory birds (Little Eagle, White-bellied Sea-Eagle, Spotted Harrier, Eastern Osprey), wetland birds (Black Bittern) and migratory shorebirds (Black-tailed Godwit, Curlew Sandpiper, Eastern Curlew, Terek Sandpiper, Red Knot, Bar-tailed Godwit (refer to Table 4.13 of the BAR included as **Appendix H**).

### *Threatened fish species and key fish habitat*

The aquatic habitat within the surrounding landscape buffer includes the Hunter River Estuary, Ironbark Creek, as well as wetland environments within the Hunter Wetlands National Park including Hexham Swamp Nature Reserve and Kooragang Nature Reserve. The location of ‘key fish habitats’ in the study area has been mapped on **Figure 6.2**. Importantly, barriers to fish passage currently exist on Ironbark Creek as there are one-way flow floodgates installed at the confluence with the South Channel of the Hunter River.

The Hunter River Estuary supports a substantial fishery, particularly for School Prawn (*Metapenaeus macleayi*) and is known to provide habitat for juvenile Eastern King Prawn (*Melicertus plebejus*). Hexham Swamp is an important tidal connection to the breeding grounds for the Eastern King Prawn. The lower estuary also has abundant mangrove and saltmarsh habitats which provide important nursery habitat for marine organisms and shorebird species.



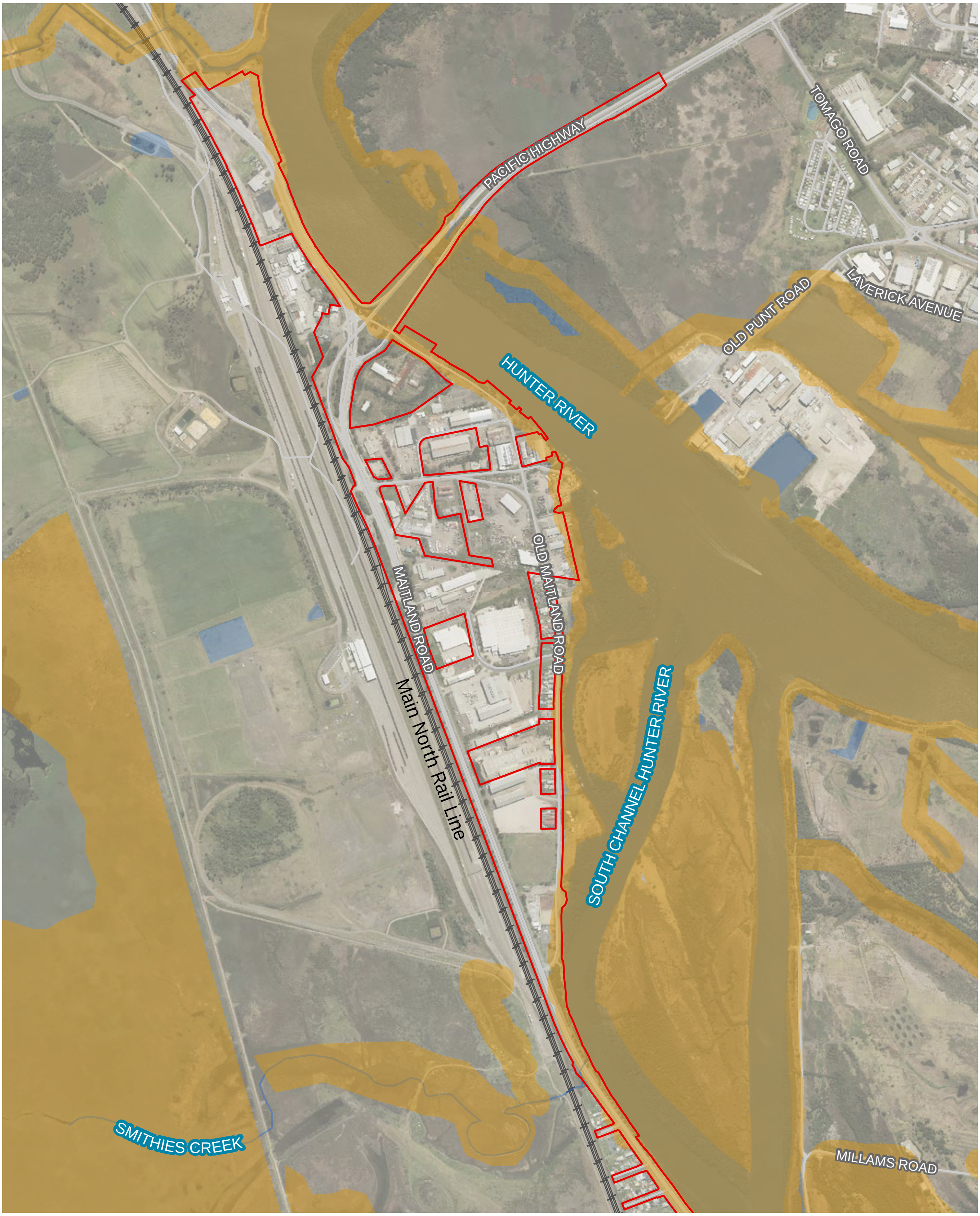

**Legend**

REF area
Key fish habitat
Railway
Road
Waterway

0 250 500 m
Scale 1:15,000 at A4
GDA94 MGA56


Page 1 of 2
**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020
DPI 2020

**Figure 6.2a** Key fish habitat mapped by the NSW Department of Primary Industries




**Legend**

- REF area
- Key fish habitat
- Railway
- Road
- Waterway

0 250 500 m

Scale 1:15,000 at A4

GDA94 MGA56


Page 2 of 2

**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020
DPI 2020

**Figure 6.2b** Key fish habitat mapped by the NSW Department of Primary Industries

The estuary exhibits large expansive shallow embayments that are connected to the north arm and Kooragang Nature Reserve on Kooragang Island which make up a portion of the Hunter Estuary Wetland Ramsar site. These embayments and island also have extensive mangrove and saltmarsh habitat. No seagrass is present within the estuary.

*Threatened aquatic species*

No targeted threatened fish surveys were conducted as part of this assessment. Database review of threatened fish species habitat and distribution identified three species with potential to occur in the study area.

Purple Spotted Gudgeon *(Mogurnda adspersa)* is listed as endangered under FM Act. Due to the highly disturbed and largely saline conditions of the Hunter River and Ironbark Creek, it is considered unlikely that the Purple Spotted Gudgeon inhabits these waterways within vicinity of the proposal.

Green Sawfish (*Pristis zijsron*) is listed as vulnerable under EPBC Act, though presumed extinct in NSW. Based on habitat present, no protected or threatened fish species are expected to occur within the construction footprint.

The Black Rock Cod (*Epinephelus daemelii*) is listed as vulnerable under the FM Act and EPBC Act. The NSW coastline forms the Black Rock Cod’s main range, both in Australia and internationally. Despite the Black Rock Cod being previously recorded within the Hunter River catchment area, the habitat and water quality in the study area is not considered suitable for this species.

*Aquatic habitat assessment*

Aquatic habitat within waterways and wetlands around the REF area have been assessed in accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) and *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003), whereby assessment sites have been classified into KFH “Type” (DPI, 2013) and waterway “Class” (Fairfull and Witheridge et al. 2003). Outcomes of this assessment are detailed in **Table 6.4**.

Table 6.4 Fish habitat classification

| Waterway | Strahler stream order (Strahler, 1952) | Mapped as KFH (DPI, 2007) | Threatened aquatic species predicted to occur (DPI, 2016) | KFH type and sensitivity (DPI, 2013) | Waterway class (Fairfull and Witheridge, 2003) | Key considerations |
|---|---|---|---|---|---|---|
| South Channel Hunter River and Main Channel Hunter River | Nine | Yes | Yes – although not expected in this section of the Hunter River | Type 1 – Highly sensitive KFH | Class 1 – Major fish habitat | • Major waterway and estuarine system<br>• Mangroves and saltmarsh present in the intertidal zone<br>• Mapped as 'Coastal Wetland' under CM SEPP<br>• Adjacent to Kooragang Island (part of Kooragang Nature Reserve). |
| Ironbark Creek | Five | Yes | Yes – Although not expected to occur due to barriers to fish passage | Type 1 – Highly sensitive KFH | Class 2 – Moderate fish habitat | • Connected to Hunter Estuary Ramsar Wetland site (Shortland Wetlands)<br>• Connected to Hexham Swamp Nature Reserve<br>• Mapped as 'Coastal Wetland' under CM SEPP<br>• Floodgates installed at downstream extent at the confluence with the South Channel of Hunter River. |
| Hexham Swamp Nature Reserve | N/A | Yes | Yes – Although not expected to occur due to barriers to fish passage | Type 1 – Highly sensitive KFH | Class 2 – Moderate fish habitat | • Mapped as 'Coastal Wetland' under CM SEPP<br>• Important freshwater wetland habitat.<br>• Tributaries within Hexham Swamp discharge to Ironbark Creek. |
| Unnamed Tributary to Hunter River | Two | Yes | No | Type 1 – Highly sensitive KFH | Class 3 – Minimal fish habitat | • Connected to Hexham Swamp Nature Reserve<br>• Mapped as 'Coastal Wetland' under CM SEPP<br>• Floodgates installed at downstream extent at the confluence with the South Channel of Hunter River. |

| Waterway | Strahler stream order (Strahler, 1952) | Mapped as KFH (DPI, 2007) | Threatened aquatic species predicted to occur (DPI, 2016) | KFH type and sensitivity (DPI, 2013) | Waterway class (Fairfull and Witheridge, 2003) | Key considerations |
|---|---|---|---|---|---|---|
| Smithies Creek | Two | Yes | No | Type 1 – Highly sensitive KFH | Class 2 – Moderate fish habitat | • Connected to Hexham Swamp Nature Reserve<br>• Mapped as 'Coastal Wetland' under the CM SEPP<br>• There are no floodgates installed on Smithies Creek. |
| Sparkes Creek | Two | Yes | No | Type 1 – Highly sensitive KFH | Class 2 – Moderate fish habitat | • Connected to Hexham Swamp Nature Reserve<br>• Mapped as 'Coastal Wetland' under the CM SEPP<br>• There are no floodgates installed on Smithies Creek. |

### Groundwater dependent ecosystems

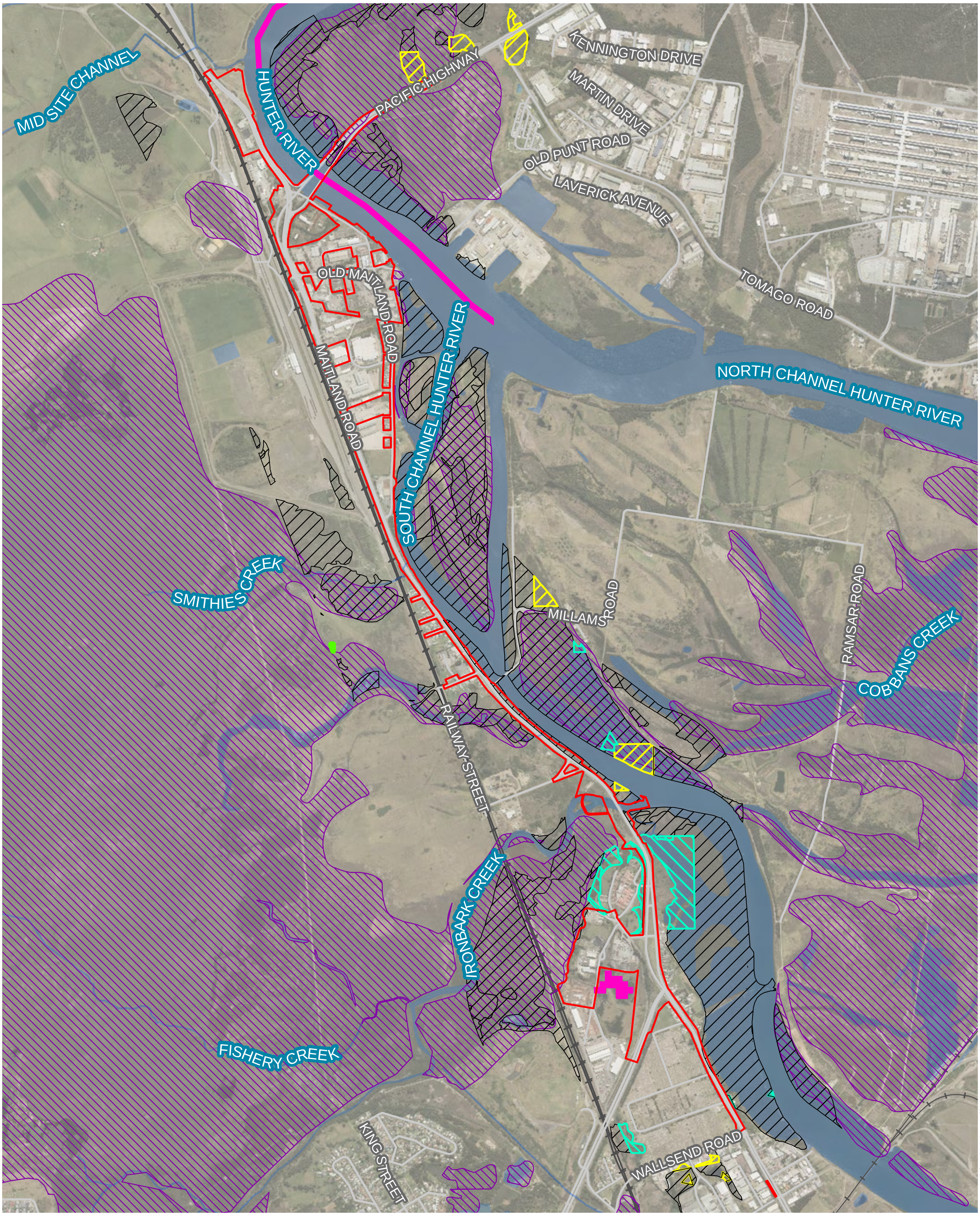
The level of groundwater dependence of vegetation communities in the study area has been identified using the Atlas of Groundwater Dependent Ecosystems (GDEs) (Bureau of Meteorology, 2021) and the High Priority GDE (HPGDE) mapping in the WSP for the North Coast Coastal Sands Groundwater Sources 2016 (NSW Government, 2016b), which maps HPGDEs in areas covered by Water Sharing Plans (WSP) as well as alluvial GDEs outside of WSP coverage.

There are three mapped aquatic and seven mapped terrestrial GDEs within the REF area or immediate surrounding landscape. Further field work was undertaken in March 2021 to determine potential for groundwater dependent terrestrial vegetation types to be present. The following plant community types were identified during field surveys:

- Grey Mangrove low closed forest (PCT 1747)
- Saltmarsh Estuarine Complex (PCT 1746)
- Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234)
- *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)

These PCTs are considered with a high likelihood to be terrestrial GDEs. However, these PCTs are not entirely dependent on groundwater and would most likely depend on the higher subsurface presence of groundwater (often accessed via the capillary fringe – subsurface water just above the water table) which is likely to occur in the REF area. This capillary water may be accessed by the plants where an alternative source of water (i.e. rainfall) cannot be accessed to maintain ecological function. As the plants within these PCTs may at times rely on capillary water in the soil that rises from the water table, any lowering of the water table may result in a reduction in groundwater availability and declining vegetation health during low rainfall periods.

HPGDEs are mapped generally outside of the proposal and within the study area (refer to **Figure 6.3**).




Date: 9/11/2021 Filename: IA301100_REF_F005_GroundwaterDependantEcosystems_v1

**Legend**

REF area

High Priority GDEs

Aquatic GDE

High potential GDE - from national assessment

Known GDE - from regional studies

Terrestrial GDE

High potential GDE - from regional studies

Low potential GDE - from regional studies

Moderate potential GDE - from regional studies

Railway

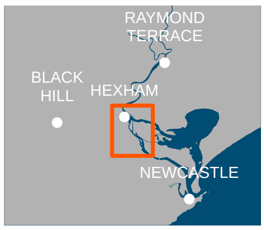
Road

Waterway

0 250 500 m

Scale 1:30,000 at A4

GDA94 MGA56




**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.3** Groundwater dependent ecosystems

### Wildlife connectivity corridors

In terms of habitat connectivity, the REF area is located within a highly disturbed landscape where the majority of habitats have been cleared. The habitats that do remain are fragmented and isolated. The REF area, however, is connected to the Hunter Wetlands National Park for most of the REF area as the national park boundary is located both to the east and west of the proposal with the section to the west also identified as Hexham Swamp Nature Reserve.

Waterways within the proposal and study area provide habitat connectivity for wildlife in the area and to the areas of national park and nature reserve located alongside the REF area.

The REF area contains vegetated areas along its margins that may allow movement for some highly mobile species. Functional connectivity for many species would exist between the study area and habitats to the west and east despite the level of fragmentation that has occurred across the landscape.

### Coastal Wetlands

The study area occurs within and immediately next to areas mapped as 'Coastal Wetlands' and within and immediately next to 'Coastal Wetlands Proximity Areas (100 metre buffer)' as determined by the CM SEPP. An overview of the extent of these wetlands with reference to the study area is provided in **Figure 4.2**.

The Hexham Swamp Nature Reserve, and the surrounding wetland area that adjoins the Hexham Swamp Nature Reserve, is classified as Coastal Wetland under the CM SEPP. The wetland receives water from tributaries and drainage channels situated to the south-west of the Hunter River and is maintained by rainfall, although flow is minimal. Hexham Swamp Nature Reserve drains to the South Channel of Hunter River via Ironbark Creek which flows north under Maitland Road. To manage floodwater incursions, flood gates are present near the confluence of Ironbark Creek and the Hunter River however these are open to allow tidal flushing and improve water quality for Hexham Swamp Nature Reserve (NCC 2020). These gates are only closed during flood events.

### Migratory bird habitat

Migratory bird species, including the Black-tailed Godwit (*Limosa limosa*), Curlew Sandpiper (*Calidris ferruginea*), Eastern Curlew (*Numenius madagascariensis*), Terek Sandpiper (*Xenus cinereus*), Bar-tailed Godwit (*Limosa lapponica baueri*) and Red Knot (*Calidris canutus*), have been identified as having 'important habitat' over the southern extent of the REF area. The Important Areas Mapping (DPIE 2020d), is a classification provided under the BAM, and is only being used as a reference for this assessment. As such, for the purpose of the BAR, the REF area has been assessed for impacts to migratory species. Further information on potential impacts associated with the Important Areas Mapping (DPIE 2020d) in relation to migratory species is provided in the BDAR completed for the EIS area including a detailed EPBC Act Assessment of Significance for the relevant species.

Targeted surveys in 2020 (WSP) and 2021 (Jacobs) did not record any of these migratory species, given the proximity to vast estuarine habitats of the Hunter Wetlands, these species, along with Lesser Sand-plover, Greater sand-plover, Great Knot, Australian Painted Snipe may potentially utilise the study area and locality on occasion. The proposal would require removal of some areas of PCT 1747 (Grey Mangrove low closed forest) and PCT 1747 (Salt Marsh Estuarine complex). It is unlikely that individuals or a nationally significant proportion of the population of any migratory wader or shorebird would be reliant on the small areas of habitat with the REF area. This has been determined due to the high disturbance from the highway and the more suitable habitats located within the locality of the REF area, such as Stockton Sandspit. These habitats within the REF area are not large enough or of high enough quality. Such species may use the land during dispersal between larger areas of habitat in the Hunter Estuary. Therefore, the proposal would not substantially modify, destroy or isolate an area of important habitat for these species and it would not seriously disrupt the lifecycle of an ecologically significant proportion of a population of these birds.

### Matters of National Environmental Significance

This section identifies the MNES that are of relevance to the study area (**Table 6.5**). An Assessment of Significance for each of these is provided in the BAR (**Appendix H**).

Subtropical and Temperate Coastal Saltmarsh TEC is listed as a Vulnerable Ecological Community under the EPBC act however it is not considered a MNES. As per the Matters of National Environmental Significance, *Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (Department of Environment, 2013), ecological communities in the vulnerable category of ecological communities listed under the EPBC Act, are not MNES for the purposes of Part 3 of the EPBC Act.

Table 6.5 MNES identified within the study area

| MNES identified in study area | MNES type | Condition thresholds met |
|---|---|---|
| TECs | Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community, listed as an Endangered Ecological Community | Only moderate condition patches of PCT 1234 (0.41 hectares) were assessed as being consistent with the EPBC Act listing for Coastal Swamp Oak (*Casuarina glauca*) Forest of the New South Wales and South East Queensland ecological community. |
| Threatened species | Green and Golden Bell Frog (listed as endangered) | Based on the results of targeted surveys, the study area is considered unlikely to provide habitat for the Green and Golden Bell Frog. As such, an assessment of significance was not provided. |
| | Swift Parrot (listed as critically endangered) | The Swift Parrot (listed as endangered under the BC Act and critically endangered EPBC Act) has shown five recent records in the proposal local area, however there is marginal habitat within the study area for this species. This species may pass through the study area during seasonal movements between larger foraging where it may rest and forage when blossom resources are in abundance. Although no significant areas of foraging habitat are present, the Swift Parrot is considered moderately likely to occur in the study area on occasion. |
| | Grey-headed Flying-fox (listed as vulnerable). | The Grey-headed Flying-fox (listed as vulnerable under the BC Act and EPBC Act) is considered moderately likely to forage in the trees within the study area, including planted trees, particularly Ficus spp. No roost camps are present in the study area but the bats from the Nationally Important Raymond Terrace camp and the East Cessnock Camp are likely to forage in the study area. |
| No threatened plants listed under the EPBC Act are considered to have a moderate or higher likelihood of occurring. | | |
| Migratory species | Eastern Osprey | Although 22 migratory bird species were identified in the EPBC Act Protected Matters Search Tool as potentially occurring in the proposal local area, only |
| | Rufous Fantail | |

| MNES identified in study area | MNES type | Condition thresholds met |
|---|---|---|
| | | two are considered moderately likely to fly over the study area and use potential foraging habitat within the study area in association with the mangroves, Hunter River and tributaries. The Rufous Fantail, was recorded in a couple of locations in the study area. |

### 6.1.3 Potential impacts

The potential for indirect impacts on biodiversity values is considered low given that much of the study area is highly fragmented, subject to existing edge effects, and surrounded by existing roads and development.

#### Construction

##### *Removal of native vegetation*

The proposal would have direct impacts on native vegetation involving removal to allow for construction. The estimated clearing of PCTs is about 3.82 hectares. This area has been calculated based on a five metre buffer on the proposal design to allow for construction activities.

The areas of direct clearing required for the proposal are summarised in **Table 6.6**.

Table 6.6 Direct impacts to PCTs

| PCT | Condition | Impacted area (ha) |
|---|---|---|
| Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234) | Moderate (EPBC/BC Act listed) | 0.41 |
| | Moderate (not TEC suitable) | 0.04 |
| | Low (BC Act listed) | 0.99 |
| | Poor (not TEC suitable) | 0.09 |
| *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071) | Moderate (BC Act listed) | 1.06 |
| Grey Mangrove low closed forest (PCT 1747) | Good (FM Act listed) | 0.72 |
| Saltmarsh Estuarine Complex (PCT 1746) | Good (EPBC/BC/FM Act listed) | 0.51 |
| **Total** | | **3.82** |

The proposal would also result in the removal and disturbance of around 13.91 hectares of non-native vegetation, which comprises native plantings, urban and exotic plantings and highly disturbed areas with limited or no native vegetation. From this, the 2.27 hectares of native plantings may provide habitat for a small number of threatened fauna species, particularly Grey-headed Flying-fox.

Much of the native vegetation within the study area exists as small, fragmented patches along the existing road verge or parklands areas along the waterways.

Some of the PCTs listed in **Table 6.6** correspond to TECs listed under the BC Act and EPBC Act. The TECs identified in the REF area are summarised in **Table 6.7**. Two of the PCTs recorded are listed as Protected under the FM Act as they contain mangroves and/or saltmarsh, including:

- PCT 1747 - Grey Mangrove low closed forest: 0.72 hectares recorded within the REF area
- PCT 1746 - Saltmarsh Estuarine Complex: 0.51 hectares recorded within the REF area.

Table 6.7 Direct impacts to TEC's

| Condition | Impacted area (ha) |
|---|---|
| **BC Act listed TECs** | |
| Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered BC Act) | 1.44 |
| Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered BC Act) | 1.06 |
| Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions (Endangered BC Act) | 0.51 |
| **EPBC Act Listed TECs** | |
| Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (Endangered) | 0.41 |
| Subtropical and Temperate Coastal Saltmarsh (Vulnerable) | 0.51 |

### *Coastal Wetlands and key fish habitat*

Potential impacts of the proposal on aquatic habitats is discussed in **Table 6.8**.

Table 6.8 Potential impacts of proposal construction on aquatic habitats

| Impact | Description |
|---|---|
| Coastal wetlands | Local indirect effects of removal of riparian vegetation potentially include degraded water quality due to increased sediment-laden runoff, long term bank erosion, mobilisation of potential acid sulphate soils, decrease in food availability for aquatic biota and water birds and loss of bank-associated aquatic habitat such as overhangs and shade. This has potential to result in direct or indirect impacts and degradation of wetland habitats in the proposal local area. The proposal impacts on 38.3 hectares of coastal wetland proximity areas (which are identified as the areas within a100 metre buffer of areas identified as coastal wetlands under the CM SEPP). The buffer area includes areas of cleared land, industrial and residential development. While the REF area of the proposal is within the 38.3 hectares of coastal proximity wetlands it would only require clearing of 8.91 hectares of land identified as coastal wetlands proximity areas as there would be no clearing of vegetation in the construction compound areas.<br><br>The impacts to the Ramsar wetland areas are considered unlikely as Shortland Wetlands (including Hunter Wetlands Centre Australia) is located about 800 metres west and Kooragang Nature Reserve is located about one kilometre to the east of the proposal and dilution of any sedimentation or poor water quality during construction is likely to be diluted over that distance. |
| Aquatic habitat | High aquatic biodiversity values are associated with the riparian vegetation present along most of the study area. Mangrove, saltmarsh and wetlands habitat present represent a significant natural aquatic feature of high conservation value. |

| Impact | Description |
|---|---|
| | Construction activities with the highest risk are those within waterways, such as bridge work (construction and demolition) and drainage works as they can potentially result in numerous water quality impacts including erosion and sedimentation. Temporary impacts may occur affecting the Eastern King Prawn, however with the implementation of the environmental management measures during bridge construction and demolition, there is not likely to be a significant impact to water quality (refer further to **Section 6.3.3**) and therefore the Eastern King Prawn population.<br><br>As described in **Section 6.1.2**, no threatened species are expected to be present within waterways in the study area due to unsuitable habitat and water quality, as such, no threatened aquatic species are likely to be impacted by the proposal |
| Erosion and sedimentation | Potential impacts may be caused by:<br>• Removal of aquatic habitat features such as large woody debris, overhanging or trailing vegetation, in-stream mangroves, aquatic vegetation and gravel streambeds<br>• Mobilisation of exposed sediment during piling or dredging activities<br>• Exposure of acid sulphate soils (ASS) to the air, causing a reaction with the iron sulphides in the soil to make sulphuric acid<br>• Displacement of groundwater during preloading for soft soil treatment as a ground improvement technique<br>• Bank destabilisation and subsequent transport of sediment due to vegetation clearing and movement across exposed earth<br>• Transportation of concrete dust, concrete slurries or washout water associated with concrete works<br>• Transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment<br>• Transportation of litter and other pollutants associated with construction works.<br><br>As a result, the following potential impacts, if unmitigated, may occur:<br>• Fish kills due to clogging fish gills<br>• Fish kills due to changes in water quality<br>• Fish kills due to interaction with equipment or machinery<br>• Noise and vibration impacts to fish during piling<br>• Contamination of waterways by acidic runoff from ASS exposure<br>• Contamination of waterways from groundwater displacement<br>• Loss of habitat or reduced suitability of habitat for native fauna that are sensitive to water quality<br>• Potential reduction in the abundance or distribution of native fauna species and increase in pest species which may be able to tolerate poorer water quality<br>• Potential temporary barriers to fish passage from temporary in-stream structures<br>• Smothering of aquatic vegetation<br>• Deposition of sediment within aquatic habitat such as deep holes<br>• A decrease in trophic interactions due to decreased visibility<br>• Reduced light penetration which can limit the growth of aquatic/estuarine vegetation. |
| Key fish habitat | The most sensitive fish habitats (Type 1) (other than the Hunter River Estuary) are located in Hexham Swamp and would not be directly impacted by the proposal, but which may be indirectly impacted through changes to water quality from nearby construction activities. The Hexham Swamp is considered Highly Sensitive Key Fish Habitat. |
| New Ironbark Creek Bridge | Construction and operation of the new Ironbark Creek Bridge could have significant impacts upon the passage of fish. Short term impacts include localised disturbance to riparian and in-stream habitats, such as increased sedimentation and shading. Long term impacts include the impediment of fish movements within their natural range, |

| Impact | Description |
|---|---|
| | habitat changes or the potential for pollution. Construction activity around watercourses has potential to result in temporary changes to natural flow and loss of aquatic habitat associated with the removal of woody snags, changes to in-stream substrate and loss of aquatic plants (macrophytes). Inappropriate design or type of water crossing can impede or prevent fish from travelling within their natural range. Furthermore, barriers to fish passage can prevent breeding or re-population of waterways through restricting access of fish to spawning grounds (Fairfull & Witheridge 2003). To avoid barriers, the new Ironbark Creek Bridge crossing has been designed to provide maintenance of fish passage and natural flow velocities in accordance with NSW Fisheries' guidelines.<br><br>Following the completion of construction, all temporary in-stream structures would be removed, riparian and aquatic habitat would be rehabilitated as required, and disturbed soils in REF areas would be stabilised. Potential impacts to aquatic ecosystems would therefore be limited to the permanent in-stream footprint and additional stormwater runoff that may occur as a result of the proposal. |

### *Removal of threatened species and habitat*

The extent of native vegetation clearing estimated to result from the proposal is outlined above in **Table 6.6**. This vegetation, with the addition of planted trees, provides suitable habitat for a range of threatened fauna species listed under the BC Act and EPBC Act. As such, direct impacts through loss of habitat for threatened fauna species (although it is only moderate to low quality) would occur during construction.

No threatened plant species were identified from the targeted survey and the proposal would not directly impact on threatened plant species or potential habitat. A detailed summary of the direct impacts of the proposal to the habitat for threatened fauna is provided in Table 5.4 of **Appendix H**.

### *Injury and mortality*

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing would take place. The extent of this impact would be proportionate to the extent of vegetation that is cleared. Less mobile species (e.g. ground dwelling reptiles), or those that are nocturnal and nest or roost in trees during the day (e.g. arboreal mammals and microbat species), may find it difficult to rapidly move away from the clearing activities when disturbed. The study area is only likely to contain a limited number of arboreal species (e.g. possums) and nesting birds that may be injured or killed during vegetation removal. Reptiles, frogs and invertebrates may also be injured or killed during construction as habitat is cleared.

Entrapment of wildlife in any trenches or pits that are dug is a possibility if the trenches are deep and steep sided. Wildlife may also become trapped in or may choose to shelter in machinery that is stored in the study area overnight. If these animals were to remain inside the machinery, or under the wheels or tracks, they may be injured or may die once the machinery is in use.

There is a chance of fauna mortality occurring during the construction phase of the proposal through vehicle collision (i.e. roadkill). Vehicle collision is a direct impact that reduces local population numbers. Mammals, reptiles, amphibians and birds are all at risk of vehicle strike. The impact on threatened species is expected to be minimal. Based on evidence from other roadways in the proposal local area most vehicle strike impacts can be expected to occur to common mammals such as birds and possums and exotic animals including foxes.

*Southern Myotis roosting /breeding habitat*

Injury or death to microbat species has the potential to occur during the works carried out in relation to Ironbark Creek Bridge. The Southern Myotis was recorded by WSP (2020) within the scuppers, predominantly underneath the median section of the bridge, and in all over-water spans, providing foraging, roosting and breeding opportunities. The decommission and dismantling of the

Ironbark Creek Bridge would remove structures currently used for roosting / breeding and has potential to result in direct mortality of bats if present in the structure.

### *Invasion and spread of weeds*

Within the study area, nine exotic species were listed as Priority Weeds under the Biosecurity Act for the Greater Hunter Local Land Service region. Eight of these species are also listed as Weeds of National Significance (WONs). The weeds of national concern recorded within the study area include:

- Madeira Vine (*Anredera cordifolia*)
- Ground Asparagus (*Asparagus aethiopicus*)
- Bridal Creeper (*Asparagus asparagoides*)
- Bitou bush (*Chrysanthemoides monilifera* subsp. rotundata)
- Lantana (*Lantana camara*)
- Drooping Pear (*Opuntia monacantha*)
- Blackberry (*Rubus fruticosus* species aggregate)
- Fireweed (*Senecio madagascariensis*).

Proliferation of weeds is likely to occur during construction, although impacts would be greatest due to vegetation clearing during the construction phase. The most likely causes of weed dispersal and importation associated with the proposal include earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery during all phases. The study area contains significant weed growth, as such, weeds must be managed during construction.

### *Invasion and spread of pests*

The study area and proposal local area are likely occupied by a range of pest species including the European Red Fox, Rabbit and Black Rat. Proposal activities have the potential to disperse pest species out of the REF area across the surrounding landscape, however the magnitude of this impact would be low and mitigation measures are not deemed necessary.

### *Invasion and spread of pathogens and disease*

Several pathogens known from NSW have potential to impact on biodiversity as a result their movement and infection during construction. Of these, three are listed as a key threatening process under either the EPBC Act and/or BC Act including:

- Dieback caused by Phytophthora (Root Rot; EPBC Act and BC Act)
- Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis (EPBC Act and BC Act)
- Introduction and establishment of exotic Rust Fungi of the order Pucciniales on plants of the family Myrtaceae (BC Act).

While these pathogens were not observed or tested for in the study area, the potential for pathogens to occur should be treated as a risk during construction. The most likely causes of pathogen dispersal and importation associated with the proposal include earthworks, movement of soil, and attachment of plant matter to vehicles and machinery during all proposal phases (construction and operation). Pathogens would be managed within the REF area in accordance with the *Biosecurity Act 2015*.

### *Noise and vibration, dust and contaminated pollution*

Noise, vibration, dust, light and contaminant pollution are direct but temporary impacts that are likely to result from proposal activities. These impacts have the potential to have cumulative effects during construction and operation. These impacts are discussed in **Section 6.9, Section 6.12** and **Section 6.13**.

### *Groundwater dependent ecosystems*

The construction and operation of the proposal has the potential to impact GDEs (refer to **Figure 6.3**) by direct clearing, as well as potential localised ground-water drawdown during construction.

The predicted groundwater level reduction associated with the dewatering for construction of water quality basin B3 is very close to areas mapped as HPGDE. Despite this, the reductions are small and would only occur for a period of about one month before commencement of recovering water levels. Such a short duration of water level change is not anticipated to impact the viability of the HPGDE.

The PCTs within the study area, including PCT 1234, 1071, 1747 and 1746, are likely to be opportunistic facultative GDEs which depend on the subsurface presence of groundwater (often accessed via the capillary fringe – subsurface water just above the water table) when an alternative source of water (i.e. rainfall) cannot be accessed to maintain ecological function. Given the proximity of the associated PCTs to the Hunter River, South Channel Hunter River and Ironbark Creek and the relatively short period of dewatering and drawdown, there is unlikely to be any impact from the temporary drawdown.

The proposal has potential to directly or indirectly interfere with subsurface or groundwater flows associated with the Hunter River and its tributaries. The new Ironbark Creek Bridge would require detailed assessment of potential impacts on the existing surface and groundwater hydrology and upstream environments associated with the Hexham Wetland National Park. If the groundwater table is shallow where the potential GDE occurs, and there is no perched aquifer above the water table (separated from the water table by a layer of impermeable rock or sediment), then impacts on vegetation health may occur.

The demolition of Ironbark Creek Bridge in the REF area could result in disturbance of sediments that could be contaminated with lead based paint, metals and contaminants from runoff from heavy industrial activities that have occurred historically in the area, including land reclamation on foreshore of Ironbark Creek. Dust associated with demolition of Ironbark Creek Bridge may contain contaminants such as concrete, asbestos, lead or other pollutants which may be harmful to aquatic ecosystems if mobilised to downstream environments.

## Operation

### *Wetlands and aquatic habitat*

Following completion of construction, disturbed soils in REF areas would be stabilised and riparian vegetation would be rehabilitated as required. Potential impacts to aquatic systems would therefore be limited to permanent clearance of riparian vegetation, as well as road runoff and associated increased vehicle traffic in future. Increased road runoff may result in localised release of contaminants (i.e. hydrocarbons, oils and grease, sediments, nutrients, heavy metals, gross pollutants and litter) into the surrounding environment (including drainage lines) may accidentally occur. This may result in reduced suitability of habitat for native fauna that are sensitive to changes in water quality, as well as potential reduction in the abundance or distribution of native fauna species and increase in pest species which may be able to tolerate poorer water quality. Accidental release of contaminants is likely to be localised.

Potential impacts on aquatic ecology are mainly due to the proposal's proximity to Ironbark Creek which is crossed by the proposal and the Hunter River and the South Channel Hunter River which run parallel and /or adjacent to Maitland Road between Sandgate and Hexham.

#### *Wildlife connectivity and habitat fragmentation*

The proposal would not break apart continuous habitats into separate smaller 'fragments'. It is considered that given the proposal's location, adjoining an existing road travel lanes, and the relatively small, linear and fragmented area of habitat to be impacted, compared to the available similar quality habitats within the proposal local area, the proposal is unlikely to have significant impact on any threatened species or ecological communities.

This impact would be of low magnitude and mitigation measures are not deemed necessary.

#### *Edge effects on adjacent native vegetation and habitat*

There is unlikely to be any further impacts from edge effects resulting from the proposal as all vegetation is suffering from edge effects in the form of weed invasion, increased light levels, increased wind speeds, and greater temperature fluctuations. No new edge habitats would be created as the study area is already connected to an existing road and currently experiences edge effects.

This impact would be of low magnitude and mitigation measures are not deemed necessary.

#### *Groundwater dependent ecosystems*

The operation of the proposal is unlikely to exacerbate impacts to GDEs given that the existing GDEs are already affected by Maitland Road at this location, with an altered surface water drainage associated with the existing road surfaces and man-made drainage features. An increase in hard surface areas associated with the proposal would further alter surface water and drainage to a small extent in the future, although the areas of GDEs which would remain in-situ would still receive surface water runoff from hard surface areas. Given no major new excavation is required for the proposal, the ongoing impacts to GDEs are unlikely to be significant.

### 6.1.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise biodiversity impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.9**.

Table 6.9 Safeguards and management measures – biodiversity

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Impact to surrounding vegetation and threatened ecological communities | A Flora and Fauna Management Plan will be prepared in accordance with the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (Roads and Traffic Authority, 2011a) and implemented as part of the CEMP. The FFMP will provide specific management for flora and fauna species (including threatened species) that will include but not limited to:<br>• Construction personnel are to be informed of the environmentally sensitive aspects of the site<br>• Construction crews will be made aware that any native fauna species encountered must be allowed to leave site without being harassed | Contractor | Prior to construction |

| Impact | Environmental safeguards | Responsibility | Timing |
| --- | --- | --- | --- |
| | and a local wildlife rescue organisation must be called for assistance where necessary<br>• Delineation of work zones, areas for parking and turning of vehicles and plant equipment prior to commencement of works<br>• Establishment of exclusion zones around high-quality vegetation<br>• Materials, plant, equipment, work vehicles and stockpiles will be placed to avoid damage to surrounding vegetation and will be outside tree drip-lines.<br>• Periodic monitoring will be undertaken to ensure all controls are in place and no inadvertent impacts are occurring.<br>• If any damage occurs to vegetation outside of the nominated work area, Transport will be notified so that appropriate remediation strategies can be developed. | | |
| Impact to native plants and animals including threatened species | A pre-clearing inspection will be carried out in accordance with *Biodiversity Guidelines: Protecting and managing biodiversity on RTA project*s (Guide 1: Pre-clearing process) (Roads and Traffic Authority, 2011a).<br>A post clearance report, including any relevant Geographical Information System files, would also be produced that validates the type and area of vegetation cleared including confirmation of the number of hollows impacted and the corresponding nest box requirements to offset these impacts. | Contractor | Construction |
| | Clearing of vegetation would follow the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (Guide 1: Pre-clearing process) (Roads and Traffic Authority, 2011a). | Contractor | Construction |
| | Where possible, hollows would be cut out of hollow-bearing trees and re-established in large trees to mitigate the loss of hollow habitat on fauna. Re-establishing existing hollows into trees is more likely to encourage uptake than use of artificial nest boxes. | Contractor | Construction |
| | The unexpected species find procedure under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects* (Roads and Traffic Authority, 2011a) will be implemented if TECs or threatened fauna, not assessed in the biodiversity assessment, are identified in the construction area of the proposal. | Contractor | Construction |
| Impacts to the Southern Myotis | Microbat Management Plan (MMP) will be prepared as part of the FFMP. The MMP will outline specific mitigation measures to be undertaken during construction of the proposal to minimise impacts on threatened microbat species including:<br>• Details on timing of construction and demolition activities that are likely to impact. The proposed works likely to impact must occur | Transport | Prior to construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| | outside of the Southern Myotis breeding season (September- December) and will also avoid winter months when bats may be in torpor due to cold conditions<br>• Roost exclusion and/or translocation methodology<br>• Ecological supervision and survey<br>• Compensatory roost installation in suitable location in the immediate surrounds and/or within the new proposed structure as compensation for the loss of existing roosting habitat<br>• Reporting and monitoring. | | |
| Impacts from introduction and spread of weeds | Weed species will be managed in accordance with *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (Roads and Traffic Authority, 2011a) (Guide 6: Weed management) and the *Biosecurity Act 2015* | Contractor | Construction |
| Impacts from introduction and spread of plant pathogens and amphibian chytrid fungus | A hygiene protocol to be included as part of the FFMP for construction vehicles and equipment to prevent the spread or introduction of weeds, pest and pathogens. | Contractor | Construction |
| Impacts to aquatic habitat including Key Fish Habitat | 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* (NSW Roads and Traffic Authority 2011a) and Section 3.3.2 Standard precautions and mitigation measures of the *Policy and guidelines for fish habitat conservation and management* (Department of Primary Industries 2013). | Contractor | Construction |
| | A Biodiversity Offset Strategy (BOS) will be prepared in accordance with the *Policy and guidelines for fish habitat conservation and management* (DPI, 2013), for impacts to key fish habitat, in consultation with DPI (Fisheries). | Transport/ Contractor | Prior to construction |
| | Large woody debris will be retained for creek crossing works where practicable. All large woody debris or snags will be relocated instream by a suitably qualified ecologist. | Contractor | Construction |
| | Underwater piling controls will include (but not be limited too) soft starts. | Contractor | Construction |
| Impacts to aquatic habitat including Key Fish Habitat | Relevant approvals and permits under Part 7 of the *Fisheries Management Act 1994* to be obtained prior to impact of mangroves and or saltmarsh.<br>Transport will consult with DPI (Fisheries) under Part 7 of the FM act on the clearing of saltmarsh and mangroves. | Transport/ Contractor | Prior to construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Temporary obstruction to fish | Temporary obstruction of fish passage may require a NSW Fisheries Permit, subject to assessment by the Department of Planning, Industry and Environment. | Contractor | Construction |
| National Parks | No unauthorised works will be undertaken within land managed by the National Parks and Wildlife. | Contractor | Prior to construction |

### 6.1.5 Biodiversity offsets

Although efforts have been made to avoid, minimise and mitigate potential ecological impacts from the proposal, some residual impacts would occur including the loss of 3.82 hectares of low to good condition vegetation. This biodiversity assessment identifies that the proposal is not likely to have a significant impact on any threatened biodiversity listed under the BC Act or EPBC Act (see Section 5.1.4 and Attachment D of the BAR, refer to **Appendix H**). In this instance, and due to the Commonwealth Strategic Assessment, the EPBC Act environmental offsets policy does not apply.

The proposal would require the removal of the following PCTs:

- Around 1.53 hectares of Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234)
- Around 1.06 hectares of *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)
- Around 0.72 hectares of Grey Mangrove low closed forest (PCT 1747)
- Around 0.51 hectares of Saltmarsh Estuarine Complex (PCT 1746).

In accordance with Transports *Biodiversity Offset Policy* (Roads and Maritime Services, 2016), Transport would provide biodiversity offsets or where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds as detailed in Table 7.1 of the BAR (**Appendix H**).

The clearing totals for this REF area are minor and generally do not reach the thresholds requiring offsets. However, the impact on Coastal Saltmarsh (Threatened Ecological Community – EPBC Act and BC Act) would occur. Proposed offsets for this community are described below. Further to this, the loss of breeding/roosting habitat for the Southern Myotis will require compensatory habitat measures and should be addressed in the MMP.

#### Offsets for impacts to aquatic impacts

There are two PCTs which would be impacted by this proposal that are saline wetland formations and will require offsets:

- Saltmarsh estuarine complex (PCT 1746) (TYPE 1 Key Fish Habitat) – removal of about 0.51 hectares in the REF area
- Grey Mangrove low closed forest (1747) (TYPE 2 Key Fish Habitat) – removal of about 0.72 hectares in the REF area.

NSW DPI enforces a ‘no net loss’ habitat policy as a condition of consent (DPI, 2013). The policy and guidelines for fish habitat conservation and management (DPI, 2013) identifies habitat compensation on a minimum 2:1 basis for all key fish habitat (TYPE1-3). The policy and guidelines (DPIE, 2013) also allow habitat restoration, therefore, efforts to restore areas of KFH in the local area would be in consultation with DPIE Fisheries.

The offset requirements for aquatic communities are described in **Table 6.10**. These are indicative values and offset obligations are to be confirmed in the detailed design and in consultation with DPIE Fisheries.

Table 6.10 Offset contribution option for impacts to aquatic impacts (DPI 2013)

| Key Fish Habitat | Impact | Offset ratio |
|---|---|---|
| Saltmarsh Estuarine Complex (PCT 1746) | 0.51 ha<br>(5,100 $m^2$) | 2:1 |
| Grey Mangrove Low Closed Forest (PCT 1747) | 0.72 ha<br>(7,200 $m^2$) | 2:1 |

## 6.2 Flooding and hydrology

The potential impacts of the proposal on flooding and hydrology are assessed in the *Hexham Straight Widening Flooding and Hydrology Assessment*, refer to **Appendix L**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.2.1 Methodology

#### Overview

The methodology for the flooding and hydrology assessment included:

- Undertaking a desktop assessment – A desktop assessment was carried out to assess the likely and potential impacts of the proposal on flooding and hydrology. The desktop review involved a collation of available literature, databases, aerial photography, topographic mapping and existing land use to aid in interpreting the existing hydrological conditions of waterways and floodplains within the respective study areas. Literature sources included:
  - Soil landscape and hydrological soil group mapping – eSPADE v2.0 interactive NSW Soil and Land Information mapping (DPIE, 2020)
  - Climate and rainfall data from the Bureau of Meteorology (BoM, 2020a, 2020b)
- Identification of sensitive receiving environments (SREs) – SREs are environments that have high conservation or community value, or support ecosystems/human uses of water that are particularly sensitive to changes in quantity of surface water and groundwater such as aquifers, groundwater users, GDE, and wetlands
- Developing detailed flood modelling – Detailed flood modelling was completed to inform the concept design and the environmental impact assessment. The model was developed using a TUFLOW two-dimensional flood hydraulic model of the Lower Hunter River. A detailed summary of the models parameters is provided in Section 3.3.3 of **Appendix L**
- Undertaking stormwater discharge modelling – Potential changes to the rates and volume of stormwater discharged from the proposal during the operational phase were assessed using 12D dynamic hydraulic modelling of the existing and operational phase drainage conditions. Discharges to the receiving environment were quantified at the downstream boundary to assess impacts to downstream drainage systems and natural areas. Where permanent water quality basins form part of the drainage flow path, the basins were conservatively modelled as drainage nodes with no storage capacity being considered in the modelling

- Assess construction flooding impacts – Flooding impacts associated with the construction phase of the proposal was represented and analysed in the TUFLOW model for the 20% and one per cent Annual Exceedance Probability (AEP)
- Assess operational flooding impacts – Flooding impacts due to the operation of the proposal were assessed using TUFLOW modelling by determining the flood level, flood depth, maximum velocities, flood hazard categories, and duration of inundation (hour) above 0.50 metres depth of flooding. Flooding impacts for the operational phase were assessed for the 63.2 per cent, 50 per cent, 20 per cent, 10 per cent, five per cent, two per cent and one per cent AEP and probable maximum flood events.

### Study area

The flooding study area has been identified to assess the potential adverse impacts to flooding from the proposal and covers waterways connected to Hexham Swamp, including Ironbark Creek, and part of Kooragang Island. The flooding study area extends about 0.3 kilometres further north than the proposal, covering part of Purgatory Creek, one kilometre further in the west, covering part of Hexham Swamp, 0.3 kilometres further in the south, covering Sandgate and South Channel Hunter River, and up to three kilometres further in the east to cover North Channel Hunter River and a portion of Kooragang Island including Cobbans Creek.

### Flood design criteria

The flood design criteria adopted for the proposal are outlined below:

- Minimise the increases in flood levels/depths, velocity, hazard and duration of inundation due to temporary and permanent infrastructure where reasonable and feasible during flood events up to an including the one per cent AEP event
- Major roads would not be adversely impacted in flood events up to and including the probable maximum flood.

### Flood management design objectives

The flood management design objectives identified in **Table 6.11** have been adopted as the proposal's quantitative design limits. These objectives apply outside the proposal boundary, for events up to and including the one per cent AEP flood event.

Table 6.11 Quantitative flood management objectives

| Parameter | Location or land use | Quantitative design objective |
|---|---|---|
| Afflux<br><br>i.e. increase in flood level resulting from implementation of the proposal | Above floor flooding of habitable floors | 50 mm |
| | Below flood flooding at habitable buildings | 100 mm |
| | Other urban and recreational | 100 mm |
| | Sensitive infrastructure:<br>• Emergency services (e.g. hospitals, ambulance, fire, police stations)<br>• Electricity substations<br>• Water treatment plants. | 50 mm |
| | Rural and forest | 100 mm |
| | Named roads and railways | Less than 100 mm |

| Parameter | Location or land use | Quantitative design objective |
|---|---|---|
| | | Less than 10% change in length of overtopping |
| Flood hazard<br><br>i.e. increase in flood hazard resulting from implementation of the proposal | All areas outside the proposal | Minimise changes based on an assessment of risk with a focus on land use and flood sensitive receptors |
| Flood duration<br><br>i.e. increase in duration of inundation resulting from implementation of the proposal | All areas outside the proposal | Less than 10% change in duration of inundation for flood depths above 0.5 metres |

### 6.2.2 Existing environment

#### Catchment overview

The proposal is located in the lower portion of the Hunter River catchment in NSW. The Hunter River catchment is one of the largest in NSW covering an area of about 22,000 square kilometres. The Hunter River catchment is east of the Great Dividing Range, bound by the Manning and Karuah catchments to the north, and by the Lake Macquarie and Hawkesbury-Nepean catchments in the south. The catchment drains a total area of about 22,000 square kilometres. The headwaters of the Hunter River are located in the Liverpool Ranges, which flows generally in a south-easterly direction for about 450 kilometres, before reaching the Tasman Sea at Newcastle. Elevations across the catchment vary from over 1500 metres above sea level in the mountain ranges, to less than 50 metres above sea level on the floodplains of the lower valley. Four major rivers discharge into the Hunter River along its length – these are Pages River, Goulburn River, Williams River and Paterson River.

The lower reaches of the Hunter River extend about 64 kilometres inland to its tidal limits at Oakhampton (OEH, 2017). The Hunter Estuary has two main channel arms (identified as the North Channel Hunter River and the South Channel Hunter River) that diverge about 17 kilometres inland and reconverge before flowing to the mouth. The area surrounding the lower estuary is heavily urbanised with significant industrial, commercial and residential development and a major harbour port near the mouth of the estuary.

#### Waterways and wetlands

Key waterways, wetlands and drains within the surface water study area include:

- Hunter River and floodplain
- Ironbark Creek
- Unnamed drainage channel to the south of Ironbark Creek
- Hunter Estuary Wetlands Ramsar sites – Kooragang Nature Reserve and Shortland Wetlands
- Hexham Swamp Nature Reserve
- Unnamed Coastal Wetland (to the north and south of Ironbark Creek)
- Unnamed Coastal Wetland (to the west of the Hunter River and to the north of Millams Road and the Ash Island Bridge)

- Sparkes Creek
- Smithies Creek
- Unnamed Coastal Wetland (to the north of Hexham Bowling Club, between Old Maitland Road and the South Channel Hunter River)
- Unnamed Coastal Wetland (to the west of the Main North Rail Line at the northern end of the proposal)
- Unnamed Coastal Wetland (to the east of the Hunter River in Tomago)
- Mid Site Channel
- Purgatory Creek.

Waterways and drains are shown on **Figure 6.4** and the Coastal Wetlands and Ramsar wetlands are shown in **Figure 1.3**.

### Drainage

Natural drainage on and around the construction area has been disrupted by the rail corridor, fill and the historical industrialisation of the western portion of the Hexham Swamp to the west of the proposal which includes Hexham Swamp Nature Reserve. Drainage of Hexham Swamp principally occurs through Ironbark Creek which discharges to the Hunter River in the southern portion of the REF area. Flood gates are present near the confluence of Ironbark Creek and the Hunter River however these are open to allow tidal flushing and improve water quality for Hexham Swamp Nature Reserve (NCC 2020). These gates are only closed during flood events. Hexham Swamp is also drained by Sparkes Creek and Smithies Creek which drain through culverts under the Main North Rail Line and Maitland Road into the South Channel Hunter River.

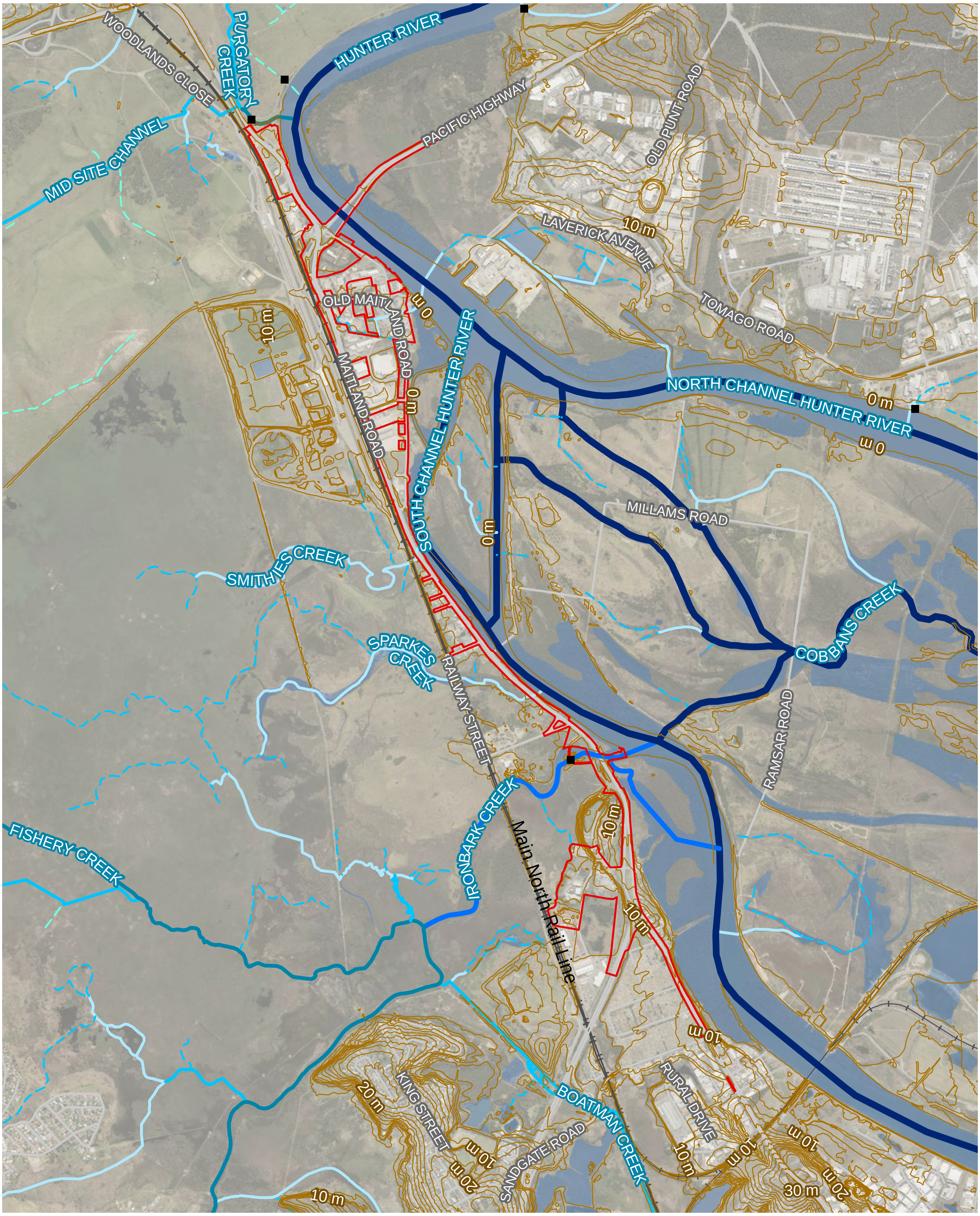
In the north of the proposal, there is also some surface water flow to the east through Mid Site Channel which directs surface water under Woodlands Close, the existing rail corridor and Maitland Road before discharging into Purgatory Creek and then into the Hunter River. In the north of the REF area, there is also some surface water flow to the east through a series of manmade drains which direct surface water via Mid Site Channel under Woodlands Close, the existing rail corridor and Maitland Road before discharging via Purgatory Creek to the Hunter River. Hydrological drainage features that drain stormwater within the REF area are described in **Section 2.2.4**. and shown in **Appendix B**.

### Hydrological flow regimes

The Hunter River is subject to tidal influence as it traverses the flooding study area (as are all other waterways within the Hunter River catchment downstream of any existing floodgates that are in operation). Upstream of the tidally influenced reach, flow in the Hunter River is partially regulated by the operation of the Hunter Regulated Water Source which comprises two large water supply dams (Glennies Creek and Glenbawn).

Where waterways traverse the low-lying Hunter River floodplain a relatively permanent presence of water is found due to lack of streambed gradient, presence of floodgates and channel incision below the surrounding water table. Inflows from the upper catchment are likely to have long residence times resulting in prolonged inundation of the surrounding catchment after flood events.

Above the low-lying floodplain areas, the relatively small tributary catchment areas of Mid Site Channel, Smithies Creek, Sparkes Creek, Purgatory Creek and Ironbark Creek to the west of the study area would typically only generate episodic flows with stream flow recessing relatively quickly and restricted to periods during and immediately after rainfall events.




Date: 9/11/2021 Filename: IA301100_REF_F006_KeyWaterwaysAndDrainage_v2

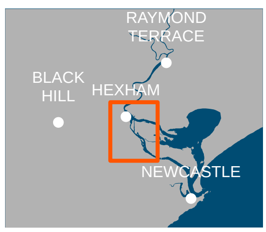
**Legend**

REF area
Contour (2m)
Floodgates

Strahler Stream Order
SSO 0
SSO 1
SSO 2
SSO 3
SSO 4
SSO 5
SSO 9

Railway
Road

0 200 400 m
Scale 1:35,000 at A4
GDA94 MGA56




**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020
DPIE 2020

**Figure 6.4** Key waterways and drainage features

### Flood conditions - existing

Flooding on the Lower Hunter River floodplain is a result of both main-stream flooding from the Hunter River, and local catchment runoff. The floodplain within the REF area varies in width from around 2.5 kilometres between Tarro and Tomago just north of the proposal, to up to 10 kilometres between the western reaches of Hexham Swamp and the North Channel Hunter River.

When the western side levee bank of the Hunter River is overtopped, a substantially large area of low-lying floodplains is inundated. This broad and wide floodplain extends as far as Thornton. To the east of the proposal just past the existing Hexham Bridge, the floodplain is constricted to about 1.5 kilometres wide before branching into the North Channel and South Channel of the Hunter River around Kooragang Island. The North Channel and South Channel of the Hunter River re-join downstream, between Tighes Hill and Stockton, with the main channel of the Hunter River running adjacent to the Newcastle city centre before discharging into the Pacific Ocean through the Port of Newcastle breakwalls.

The behaviour of flood waters from the Hunter River catchment within the REF area is influenced by the geomorphology surrounding the proposal which includes the raised linear features associated with the Main North Rail Line and Maitland Road which act as a levee controlling flood behaviour. During major flooding events, water ponds upstream of the Main North Rail Line in Hexham Swamp and drains to the Hunter River by Ironbark Creek. Under current conditions, sections of the Maitland Road are overtopped in the five per cent AEP flooding event.

### Extent and depth of existing flooding behaviour - existing

The behaviour of floods within the proposal local area are influenced by the flood level in the Hunter River and the local catchment runoff arriving directly from the Hexham Swamp catchment. The extent of existing flood levels within the proposal occurs as a result of raised water levels from the Hunter River and Hexham Swamp. In general, high water depth occurs along and directly next to the Hunter River and Hexham Swamp, then spreads gradually to the floodplains. This can be attributed to the large catchment area of the Hunter River which contributes to high inflow into the main channel of the Hunter River.

Existing flood mapping has been included in Attachment B of the *Hexham Straight Widening Flooding and Hydrology Assessment* (refer to **Appendix L**). During low flood events with a high probability of occurrence (i.e. 63.2 per cent AEP (every year)) the flood extent is limited throughout the proposal and the surrounding road network and the Main North Rail Line are not overtopped. Some areas along Maitland Road may experience localised ponding of water, however the road is not subject to flooding.

A 20 per cent AEP event does not cause any overtopping of roads or railways within or directly next to the proposal. Similar to the 63.2 per cent AEP event, localised flooding occurs along Maitland Road in the 20 per cent AEP event.

During a 10 per cent AEP event, the A1 Pacific Highway is overtopped east of Hexham Bridge, to a depth of about 0.35 metres. The northern sections of Old Maitland Road, Hexham are overtopped by around 0.5 metres leading to pooling next to the road on the eastern edge of the proposal, up to a depth of 0.5 metres. Pooling occurs near Shamrock Street, Hexham resulting in inundation over it up to 0.5 metres. Maitland Road is also overtopped just north of the proposal, with flows from the Hunter River Floodplain north of the proposal entering Hexham Swamp in the area around Purgatory Creek. Modelling results of the existing flood levels indicate that two sections of south bound lanes of the proposal are inundated, while one north bound lane of the proposal is generally free from flooding in the 10 per cent AEP event.

In the five per cent AEP event, Clark Street, Merchant Street and Fenwick Street as well as Shamrock Street, are subject to a flood depth of about 0.7 metres. The Main North Rail Line is overtopped towards the southern extent of the proposal, east of the Newcastle Golf Practice Centre and north of the NICB.

In the two per cent AEP event, much of the existing alignment of Maitland Road throughout the REF area is inundated up to a depth of around 0.5 metres as well as other areas within the proposal. In the one per cent AEP event, most of the area within the proposal is inundated, with maximum depths up to 2.8 metres near the A1 Pacific Highway and Maitland Road intersection at the northern end of the proposal.

In the probable maximum flood (PMF), the proposal is almost completely inundated. During a PMF event, the model results show that the depth of flooding on Maitland Road is about 6.0 metres, and the Main North Rail Line located next to the REF area experiences complete inundation.

### Flow velocity - existing

Flow velocities above 0.5 metres per second are typically confined to the Hunter River, South Channel Hunter River and Ironbark Creek in flood events smaller than 10 per cent AEP. In the 10 per cent AEP event, flow velocities of one metre per second occur during overtopping of the A1 Pacific Highway to the east of Hexham Bridge and Maitland Road to the north of the proposal. In the two per cent AEP event, water begins to flow from Hexham Swamp back into Hunter River south of Hexham Bridge by first overtopping the abandoned Minmi Colliery Railway Line in Hexham Swamp, with velocities up to two metres per second, and then overtopping the Main North Rail Line and Maitland Road from the northern extent of the proposal to Ironbark Creek Bridge. These flows result in velocities of 1.5 metres per second over Maitland Road and 0.7 metres per second over the Main North Rail Line. Velocities do not increase noticeably during the one per cent AEP event. The PMF sees velocities up to four metres per second in Hunter River next to the proposal.

### Flood hazard - existing

Existing flood hazard mapping has been included in Attachment B of the *Hexham Straight Widening Flooding and Hydrology Assessment* (refer to **Appendix L**). In events more frequent than the 10 per cent AEP event, hazard ratings remain low within or next to the REF area. During the 10 per cent AEP event, Maitland Road is overtopped at the northern end of the proposal near Hexham Bridge, and the A1 Pacific Highway is overtopped, east of the Hunter River within the Port Stephens Council LGA, resulting in high flood hazards at both locations across the existing roads. During the five per cent AEP event, these hazards increase further at Maitland Road, north of the proposal near Hexham Bridge, and on the A1 Pacific Highway, across Hexham Bridge within the Port Stephens Council LGA.

Overtopping of the Main North Rail Line near the southern end of the proposal and overtopping of Old Maitland Road north of Hexham Bowling Club result in high hazards. During the two per cent AEP event much of the proposal extent is inundated with high hazards. Overtopping of the A1 Pacific Highway, east of the Hunter River within the Port Stephens Council LGA, and overtopping at Old Maitland Road, just south of Hexham Bridge, results in an increased hazard category.

In the one per cent AEP event, high hazard category occurs within the proposal, including at the following areas:

- Residential properties on Old Maitland Road north of Hexham Bowling Club
- Residential properties located between Clark Street and Shamrock Street
- The rail maintenance facility located to the north-west of the proposal
- Areas near the Hexham Bridge A1 Pacific Highway intersection
- The area around Shamrock Street on Maitland Road.

In the PMF event, much of the proposal extent has a high flood hazard category This excludes an area of high ground at the southern extent of the proposal where the Calvary St Joseph's Retirement Community is located.

### Duration of inundation - existing

Existing flood mapping for duration of inundation has been included in Attachment B of **Appendix L**. Areas within the proposal that experience inundation above 0.5 metres only occur during the 10 per cent AEP event and above. In the 10 per cent AEP event, the A1 Pacific Highway east of Hexham Bridge and the Hunter River is overtopped for a duration of around 12 hours and Maitland Road to the north of the proposal is overtopped for about 48 hours. In the five per cent AEP event, other areas within the proposal are inundated above 0.5 metres and include areas near Shamrock Street and along Old Maitland Road, north of Hexham Bowling Club for durations from zero to 36 hours. For the one per cent and two per cent AEP events, almost all of Maitland Road north of Ironbark Creek is inundated for over 24 hours. In the PMF event, the entire REF area, excluding the high ground at the southern end, is inundated for over 120 hours (5 days).

### Inundation of buildings – existing

Surveyed floor levels of buildings near to the proposal was provided by City of Newcastle and was clipped to the flooding study area so that a total of 333 buildings was used to assess flooding impacts to buildings from the proposal. A summary on the number of buildings flooded above floor and depth of flooding floor is provided in **Table 6.12**. Details on location, floor level and flood level for each building are provided in Attachment J of **Appendix L**.

Table 6.12 Number of buildings flooded above floor in the existing case

| Depth of flooding above floor (m) | 63.2%AEP | 20%AEP | 10%AEP | 5%AEP | 2%AEP | 1%AEP | PMF |
|---|---|---|---|---|---|---|---|
| 0.0 – 0.2 | - | - | 6 | 5 | 15 | 13 | 5 |
| 0.2 – 0.5 | - | - | - | 9 | 37 | 7 | 4 |
| 0.5 – 1.0 | - | - | - | 2 | 30 | 26 | 9 |
| 1.0 – 2.0 | - | - | - | - | 23 | 82 | 22 |
| > 2.0 | - | - | - | - | - | 14 | 204 |
| **Total** | **-** | **-** | **6** | **16** | **105** | **142** | **244** |

### Flood evacuation

Local flood plans applicable for areas within the vicinity of the proposal include the *City of Newcastle Flood Emergency Sub Plan* (SES, 2013a), and *Port Stephens Flood Emergency Sub Plan* (SES, 2013b). Under current conditions there are locations on the major roads, including the New England Highway (Maitland Road) and NICB, which are unlikely to be trafficable during particular AEP events.

During the existing flood behaviours, potential flood impacts may result in access and evacuation routes becoming cut-off more frequently. At the rail maintenance facility, exceedance of a two per cent AEP event is likely to result in significant impacts to all evacuation routes, although a flood warning time of about 24 hours is available which would allow sufficient time to evacuate the facility site.

### 6.2.3 Potential impacts

#### Impacts avoided and minimised

The concept design for the proposal was developed using a multi-disciplinary process that identified and assessed the concept design and options against a range of engineering, environmental, social, land-use and economic criteria.

As a result of proposal development, the bridge over Ironbark Creek has been located to the east of the existing bridge and the overall vertical alignment o Maitland Road remains the same as the existing for the majority of the works. The adoption of this corridor has avoided:

- Adverse flooding impacts to Hexham Swamp and residential receivers between Shamrock Street and Clark Street Hexham
- Erosion and scour directly downstream of the proposal by providing rock transition aprons at the outlet of all culverts that are being upgraded.

#### Construction

#### *Hydrology impacts*

The proposal would potentially impact on the waterways located immediately next to and within the REF area and would include:

- Ironbark Creek
- The South Channel Hunter River alongside the REF area located to the north of EIS Area 2 and extending up to the southern side of EIS Area 2, then from the northern side of EIS Area 2 and extending up to the proposed U-turn facility at Old Maitland Road, Hexham to the north-east of Hexham Bowling Club.
- The Hunter River between Hexham Bridge and Compound 4
- The section of the waterway which receives discharge from the proposal drainage systems in the REF area which includes 31 systems comprised of Systems 3, 7, 10 to 13 and 22 to 46 but does not include the seven systems (1, 2, 4, 5, 6, 15 and 21) in the REF area that drain into CM SEPP areas, refer to **Appendix B**.

*Drainage design impacts*

Construction activities associated with drainage patterns and infrastructure within the REF area that have the potential to impact on sensitive receiving environments include:

- Cleaning of drainage pipes and culverts resulting in increased turbidity and rubbish reducing visual amenity of waterway
- Installation of new drainage pipes and culverts and relining of existing pipes (where required) resulting in a lack of positive drainage leading to an increased risk of flooding
- Temporary drainage resulting in changes in flows and velocities leading to scouring and erosion downstream
- Earthworks, cuttings or stockpiling resulting in erosion and sedimentation altering geomorphology of waterways and leading to algal blooms
- Dewatering resulting in discharges from construction sediment basins, mobilising sediments and contaminants and increase the turbidity of the receiving environments.

*Surface water hydrology*

Key activities during construction of the proposal that may impact the nature of surface water hydrology (volume, rate, timing, duration, velocity, etc.) associated with stormwater discharges include:

- Vegetation clearance (of trees, understorey and ground cover) and reduced infiltration associated with soil compaction and paving within the road corridor
- Temporary dewatering of groundwater ingress to construction excavations
- Temporary and permanent alteration or impedance of existing drainage paths and waterways which have the potential to result in localised increases in flow velocities around in-stream features. In particular:
    - The construction of the new twin bridges at Ironbark Creek including the temporary waterway structures and the permanent piers themselves
    - Demolition of the existing Ironbark Creek Bridge and piers
    - Adjustment of the drainage channel to the south-east of Ironbark Creek as well as temporary and permanent culverts
- Attenuated or delayed discharge of stormwater captured in temporary construction sediment basins and permanent water quality basins
- Reuse of stormwater captured in temporary construction sediment basins and permanent water quality basins.

Potential changes to the rates and volume of stormwater discharged from the proposal during the construction phase have not been assessed quantitatively. However, minor to moderate changes to rates of stormwater discharge, volume and velocity during construction may result as existing drainage infrastructure is cleaned out and new infrastructure is installed. These changes are not expected to result in a material impact to the receiving environment with the implementation of mitigation measures outlined in **Section 6.2.4**.

*Impacts to waterway and riparian processes from changes in flow regime*

The geomorphology of waterways within the study area are typically stable, low energy environments that show little evidence for lateral migration except during flood events and are generally considered low risk from stormwater discharges from the proposal. Unmitigated risks include:

- Reduced bank stability (scouring, undercutting, slumping, etc) immediately downstream of proposal discharge locations as a result of increased streamflow discharge and velocities
- Increased rates of removal and transport of eroded bed and bank material leading to downstream sedimentation and potential infilling of aquatic habitat features such as rocky holes or smothering of aquatic vegetation
- Increased water turbidity due to suspended material and subsequent reduction in light infiltration potentially impacting sensitive aquatic vegetation
- Potential for fish passage obstruction due to increased flow velocities, reduced water levels or physical obstructions caused by the realignment of the unnamed drainage channel to the south-east of Ironbark Creek and the installation of piers for the new Ironbark Creek Bridge.

The proposal seeks to minimise or avoid these impacts with the implementation of erosion and sediment controls, site-specific drainage design for REF areas and temporary and permanent erosion and scour protection as outlined in **Section 3.2.3**.

### *Flooding impacts*

The 20 per cent and one per cent AEP events were assessed and the impacts to flooding for Stage 1, Stage 2 and Stage 3 of the construction phase were reviewed. The proposal is not subject to flooding under the existing condition in the 20 per cent AEP event and consequently no discernible impacts to flooding were identified for all three construction stages. Flood impact maps for the one per cent AEP event are mapped in Attachment C of **Appendix L**.

*Flood levels*

Afflux refers to the predicted change, usually in flood levels, between two scenarios. It is frequently used as a measure of the change in flood levels between an existing scenario and a proposed scenario.

The flood model indicates that three of the construction stages impact on Hexham Swamp, and this includes Hexham Swamp Nature Reserve with Stage 1 of construction having the greatest impact. The afflux in Hexham Swamp is up to 0.03 metres in Stage 1 while in Stage 2 and Stage 3 it is up to 0.02 metres (refer to Figure C-1 in **Appendix L**).

All of the three construction stages show a decrease in flood levels up to 0.05 metres downstream of Ironbark Creek and near Cobbans Creek, south of Ironbark Creek.

The afflux upstream of the Ironbark Creek Bridge and near Sparke Street intersection is about 0.10 metres in all three construction stages, except during Stage 2 when it is about 0.14 metres near Sparke Street intersection.

Surveyed floor levels of buildings provided by City of Newcastle have been used to assess potential flooding impacts to buildings. The properties between Shamrock Street and Clarke Street, Hexham experience an afflux ranging from 0.02 metres to 0.10 metres in Stage 1. The properties around Old Maitland Road, Hexham to the south of Hexham Bridge experience an afflux of about 0.02 metres both in Stage 1 and Stage 2 only. These buildings are currently flood affected.

The properties to the east of Maitland Road at Sandgate and north of the NICB experience an afflux up to 0.05 metres in construction Stage 1 and Stage 2 compared to Stage 3 when afflux is limited to 0.03 metres.

*Flow velocities*

During construction, there are no large areas with substantial changes in flow velocities across the floodplain during the three stages of construction, with the majority of changes in flow velocities being localised around the construction area.

Flow velocities are increased about 1.25 metres per second on the temporary platform in Stage 1 of the construction and flow velocities are decreased by about 0.5 metres per second in Ironbark Creek upstream of the new bridge. Flow velocities through Ironbark Creek are also increased by about 0.3 metres per second in Stage 2 and Stage 3 of the construction. A reduction in velocity, to a maximum of 0.45 metres per second, is observed within the proposal north of Hexham Bridge in Stage 3 (refer to Figure C-2 in **Appendix L**).

The flow velocities change around the Sparke Street intersection, are variable and show increases by 0.3 metres per second in some locations and decreases by 0.1 metres per second in other isolated patches in all three construction stages.

*Flood hazard*

The changes in hazard are expressed in terms of changes between dry, low hazard and high hazard condition, or no change.

The flood hazard changes to dry for areas of new bridges embankments in all three stages (refer to Figure C-3 in **Appendix L**). There are minor areas with changes to flood hazard of dry to low or low to high in all three stages in isolated patches near properties around:

- Old Maitland Road, Hexham to the south of Hexham Bridge
- Sparke Street, Hexham
- To the east of Maitland Road at Sandgate and north of the NICB.

*Duration of inundation*

Figure C-4 in **Appendix L** shows the change in duration inundation for Stage 1, Stage 2 and Stage 3 of the construction phase for the one per cent AEP event. The flood plain between the North Channel and South Channel of the Hunter River has an increase of three per cent in the duration of inundation in general with a maximum increase by about five per cent in isolated patches in all three stages of construction. The duration of inundation increases by a maximum of 10 per cent at the edges of the flood extent in Hexham Swamp with a maximum increase by about 20 per cent in isolated patches.

There is some change to the duration of inundation during Stage 2 of the construction phase. Some areas have a decrease in duration of inundation up to 10 per cent, same localised areas have an increase in duration of inundation. Impacts are lesser in the other two stages of construction.

The majority of properties near Old Maitland Road, Hexham south of Hexham Bridge have an increase in inundation duration of 10 per cent, with increase of more than 20 per cent in isolated patches for all three stages of construction. Sparke Street intersection and north of Sparke Street have an increase of more than 25 per cent in all three stages of construction. The areas around Sandgate Radio Transmission Tower (north of NICB) and Boatman Creek south of Sandgate Road have maximum increase of about 12 per cent for Stage 1 and up to 10 per cent for Stage 2 and Stage 3.

*Flooding impacts to buildings*

Surveyed floor levels of buildings near to the proposal was provided by City of Newcastle and was clipped to the flooding study area so that a total of 333 buildings was used to assess flooding impacts to buildings from the proposal. It is to be noted that the data provided by City of Newcastle does not include floor levels of all buildings located near to proposal.

The afflux was calculated separately for buildings which were flooded above floor and below floor. In addition, buildings newly flooded above or below floor due to the proposal have been identified and addressed separately as part of the discussion around additional number of buildings flooded.

The difference in building impacts between the baseline and construction cases is minimal for the AEPs modelled. The key metrics investigated were the afflux, as well as the change in the number of buildings flooded above and below floor surveyed floor levels. Modelling results have shown that no buildings are flooded above floor in the 20 per cent AEP event during the construction phase. However, buildings near to the proposal are flooded above the floor level during the one per cent AEP event during construction Stage 1, 2 and 3 and the number of buildings impacted for each stage is summarised in **Table 6.13**.

Table 6.13 Number of buildings flooded above floor during the one per cent AEP flood event for Stages 1-3

| Afflux (m) | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|
| 0.01 – 0.02 | 27 | 35 | 51 |

| Afflux (m) | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|
| 0.02 – 0.03 | 6 | 28 | 4 |
| 0.03 – 0.05 | 44 | 11 | 0 |
| 0.05 – 0.08 | 19 | - | 0 |
| **Total** | **96** | **74** | **55** |

In the one per cent AEP event two buildings are newly flooded above floor due to the proposal in construction Stage 1 and one building is newly flooded above floor both in Stage 2 and Stage 3 (refer Attachment J in **Appendix L**). It is to be noted that at all newly flooded buildings above floor is up to 0.04 metres.

Afflux below floor levels for all buildings is lower than 0.01 metres in the 20 per cent AEP event. A summary of afflux below floor levels for all buildings for the three construction stages in the one per cent AEP event is shown in **Table 6.14.**

Table 6.14 Number of buildings flooded below floor during the one per cent AEP flood event for Stages 1-3

| Afflux (m) | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|
| 0.01 – 0.02 | 5 | 6 | 12 |
| 0.02 – 0.03 | - | 6 | - |
| 0.03 – 0.05 | 11 | - | - |
| 0.05 – 0.08 | - | - | - |
| **Total** | **16** | **12** | **12** |

### *Site water balance*

During construction of the proposal key water demands are anticipated for earthworks and dust suppression. Lesser demands are anticipated for potable usage at site offices. For earthworks it is anticipated that water would be required primarily for conditioning of fill material and conditioning of in-situ soils for foundation treatments (ripping and re-compaction).

Indicative estimates of water demands are provided in **Table 6.15** and are based on preliminary construction material estimates. Over the duration of the proposal construction, about 8 megalitres of water would be required, equivalent to an average daily demand of about 9.86 kilolitres (kL) or 0.23 litres per second for a 12 hour working day.

Table 6.15 Estimate of construction water demands

| Water use | Requirements (kL) |
|---|---|
| Earthworks – fill conditioning | 3,250 |
| Earthworks – foundation treatments | 570 |
| Dust suppression | 1,962 |
| Potable | 1,965 |
| **Total** | **7,747** |

Water demand during construction would be met through use of scheme water.

While there may be potential to opportunistically utilise water within sediment retention basins for uses such as dust suppression and fill conditioning. Water availability from the basins is only temporary and cannot be relied on for supply with a requirement to empty the basins within five days following a storm event. It is also noted that key water demands, such as dust suppression and fill conditioning would be reduced during periods of rain when the supply is available following storm events.

There is also potential to opportunistically utilise dewatering discharge produced through temporary construction dewatering for the sediment basins, however in this instance it is noted that dewatering is only likely to occur for a matter of weeks at each basin during construction, and dewatering is not considered to be a viable water source over the duration of the proposal.

Discharge of water from site would only occur from sediment retention ponds at approved discharge points. Discharge will be monitored and managed in accordance with the relevant EPL conditions.

Groundwater produced through temporary construction dewatering for sediment retention basins will be treated as required and discharged to local stormwater drainage system.

### Operation

#### *Hydrology impacts*

An assessment of the impacts of the changes in drainage design and stormwater discharge from the proposal has been completed of the 26 drainage systems that drain to waterways surrounding the proposal and including the Hunter River, South Channel Hunter River and Ironbark Creek.

**Table 6.16** provides a summary of the results of the 26 drainage systems assessed and estimated changes to flow rates and flow velocities, which are summarised as follows:

- Total catchment areas are not proposed to substantially change with a maximum increase of 27 per cent for the catchment (near the intersection of Sparke Street and Maitland Road) and a maximum reduction of -21 per cent for the catchment (near the intersection of Shamrock Street and Maitland Road)
- The relative change in percentage of impervious area within each catchment ranges from zero to five per cent as a result of the road development
- The results indicate that discharge rates would generally increase as a result of the proposal which is consistent with the increase in impervious area within each catchment
- Similarly, discharge volumes are typically predicted to increase as a result of the proposal
- Estimated velocities are also expected to increase.

The drainage modelling indicates that stormwater discharge rates, volumes and velocities are generally expected to increase as a result of the increased percentage of impervious area within each reporting catchment. These changes are not expected to result in a material impact to the receiving environment as:

- Increased discharges of stormwater from the proposal and dewatering of water quality basins would largely be consistent with variations in existing conditions and occur during or following naturally occurring flow events. Changes to the number, timing and duration of flow events in the receiving environment are likely to be minor and not of a material impact
- Where stormwater discharges are made from the proposal, drainage design includes appropriate mitigations including scour protection in the form of rock transition aprons at culvert outlets

- Estimated increases to discharge rates and velocities at the outlets are likely to be reduced as a result of stormwater attenuation provided by the water quality basins that were not included in the drainage modelling.

Table 6.16 Summary of estimated changes to stormwater discharges from the 26 culverts that were assessed

| Storm event | Change | Change | |
|---|---|---|---|
| | | Flow (m3/s) | Velocity (m/s) |
| 50% AEP | Mean | 0.02 | -0.19 |
| | Min | -0.03 | -1.50 |
| | Max | 0.14 | 1.92 |
| 10% AEP | Mean | 0.03 | -0.18 |
| | Min | -0.04 | -1.45 |
| | Max | 0.23 | 1.85 |
| 1% AEP | Mean | 0.04 | -0.08 |
| | Min | -0.12 | -0.77 |
| | Max | 0.34 | 0.62 |

*Drainage design impacts*

The proposal would potentially impact on the waterways located immediately next to and within the REF area and would include:

- Ironbark Creek
- The South Channel Hunter River alongside the REF area located to the north of EIS Area 2 and extending up to the southern side of EIS Area 2, then from the northern side of EIS Area 2 and extending up to the proposed U-turn facility at Old Maitland Road, Hexham to the north-east of Hexham Bowling Club.
- The Hunter River between Hexham Bridge and Compound 4
- The section of the waterway which receives discharge from the proposal drainage systems in the REF area which includes 31 systems comprised of Systems 3, 7, 10 to 13 and 22 to 46 but does not include the seven systems (1, 2, 4, 5, 6, 15 and 21) in the REF area that drain into CM SEPP areas refer to **Appendix B**.

The potential impacts to hydrology during operation of the proposal relate to the increase in impervious surface from introduction of the widening of the road, a change in surface flow paths associated within drainage lines across the proposal and the changes in stormwater discharge due to the frequency and intensity of the storm events.

The drainage design including the cross-drainage culverts and longitudinal drainage pipe systems have been developed to avoid drainage catchment diversion as far as practicable to minimise hydrology impacts. Overall, there is unlikely to be a significant change in hydrology and flow distribution across the broader catchment. However, there is the potential for localised changes in flow from one pavement sub-catchment to the next.

*Culvert upgrades*

The proposal work would require extension of the existing culverts to accommodate the widening of Maitland Road. Upgrade of the size of the existing culverts would also be required where the capacities of the existing culverts are inadequate to cater for flows. The catchment areas to the culverts have not changed, though there are minor changes to the catchment imperviousness. The design methodology adopted has minimised changes to peak flows and velocity as much as practical, and wherever localised changes would still occur, scour protection would be provided to prevent erosion.

Between the southern limit of works and Ironbark Creek, the existing drainage systems that drain the proposal and the upslope catchments on the western side through to the eastern side of Maitland Road, flow from the culvert outlet to intermediate open channels located perpendicular to the edge of the existing road reserve that then discharges water into the low lying swamp areas to the east of Maitland Road. One new reinforced concrete pipe would be provided as part of System 3 that connects System 2 with System 4 via Basin 2 and grassed swale 1 (refer to **Appendix B**), otherwise all the other culverts to the south of Ironbark Creek would not be upgraded, as the existing culverts meet the drainage criteria for the 10 per cent AEP standard and one lane free from inundation in the 10 per cent AEP storm events for the local catchment flows.

All other culverts have a smaller drainage capacity and drain the road pavement runoff from one side of the road to the other side. Where water is drained to the western side of Maitland Road to the north of Ironbark Creek there are some open channels within the road reserve corridor that drain to one of the two major culverts that are described in **Section 2.2.4**. System 10 would be upgraded as part of the proposal and one new reinforced box culvert (2 x 600mm x 300mm) would be provided at System 14 to the southern side of Shamrock Street (refer to **Appendix B**).

Where the existing culverts have been upgraded or extended to suit the new road embankment, scour protection would be provided.

The existing culvert system does not direct flow into the Hexham Swamp Nature Reserve. No adverse impacts to Hexham Swamp and Hexham Swamp Nature Reserve are anticipated from the drainage works that will be implemented as part of the proposal.

*Longitudinal drainage pipe upgrades*

The overall effect of the proposal on longitudinal drainage pipes is considered minor and generally limited to the relocation of the drainage pits on the median and outside lanes as a result of the road design changes.

Existing drainage pipes and the outlets within the proposal area have been retained as much as practical. New drainage pipes and pits (refer to **Appendix B**) have also been provided where required to drain the road surface runoff to the existing outlets in order to meet the proposal drainage design requirements,. System 7 would be removed as part of the removal of Ironbark Creek Bridge and new drainage systems would be constructed at the northern and southern sides of Ironbark Creek Bridge. The southern side of Ironbark Creek Bridge would discharge through Basin 3 and grassed swale 2 and the northern side of the bridge would discharge through Basin 4.

Where new pipes or pipe outlets have been provided, these have been designed with as low gradient as practical and sized to minimise the outlet velocities. Scour protection would be provided at all new pipe outlets to minimise potential risk of erosion.

*Surface water hydrology impacts*

Activities during operation of the proposal that may impact the nature of surface water hydrology (volume, rate, timing, duration, velocity, etc.) associated with stormwater discharges include:

- Road paving and soil compaction leading to reduced or effectively eliminated rates of infiltration
- Alteration or restriction of existing drainage paths and catchments
- Attenuated or delayed discharge of stormwater captured in water quality basins which have been designed to reduce the current annual average pollutant loads.

There would potentially be minor to moderate changes to rates of stormwater discharge, volume and velocity during operation as existing drainage infrastructure is cleaned out and new infrastructure is installed. These changes are not expected to result in a material impact due to the proposed drainage mitigation such as scour protection that will be implemented where required at culverts that will be upgraded for the proposal and permanent water quality basins, refer to **Appendix B**.

*Impacts to waterway and riparian processes*

As identified above, waterways across the study area are generally considered stable, low energy, show little evidence for lateral migration and are hence considered low risk from stormwater discharges from the proposal. However, during operation of the proposal impacts to waterway health and in-stream processes on the Hunter River, the South Channel Hunter River and Ironbark Creek may occur as a result of the increase in impervious surfaces associated with the widening of Maitland Road.

Impacts may extend beyond the immediate discharge location and include:

- Reduced bank stability (scouring, undercutting, slumping, etc) immediately downstream of proposal discharge locations as a result of increased streamflow discharge and velocities and this includes drainage systems that are located on river banks. Within the REF area this includes Systems 10 to 13, 15, 21 and 22 to 24 located on the banks of the South Channel Hunter River and Systems 37-46 located on the banks of the Hunter River
- Increased rates of removal and transport of eroded bed and bank material leading to downstream sedimentation and potential infilling of aquatic habitat features such as rocky holes or smothering of aquatic vegetation
- Increased water turbidity due to suspended material and subsequent reduction in light infiltration potentially impacting sensitive aquatic vegetation.

The proposal seeks to minimise or avoid these impacts by adopting permanent erosion and scour protection at culverts that are upgraded as part of the proposal and the inclusion of five permanent water quality basins , refer to **Appendix B**. The proposal would maintain existing water flow under Maitland Road to Hexham Swamp and no changes are expected from the proposal to the existing surface water hydrology including for sensitive receiving environments such as Hexham Swamp, the surrounding Coastal Wetlands, freshwater wetlands or Ramsar listed wetlands.

#### Flooding impacts

*Impacts of flooding on the proposal*

The majority of the main carriageway alignment, along Maitland Road, is immune to flooding in the five per cent AEP event. Flood mapping is included in the *Hexham Straight Widening Flooding and Hydrology Assessment* (refer to **Appendix L**).

The sections which are overtopped are identified below.

- A section of Maitland Road to the south of Hexham Bridge, next to the A1 Pacific Highway northbound onramp towards Raymond Terrace from Hexham
- A section of Maitland Road at the northern extent of the proposal

- A section of Maitland Road, near Shamrock Road
- A section of Old Maitland Road, Hexham at the northern end of the proposal.

In the two per cent AEP event, the majority the proposal is subject to flooding. Almost the entire proposal is subject to overtopping in the one per cent AEP event aside from the section of Maitland Road and Old Maitland Road, Sandgate next to the Calvary St Joseph's Retirement Community, towards the southern extent of the proposal.

In a PMF event, the proposal would experience complete inundation, aside from areas surrounding the Calvary St Joseph's Retirement Community and the intersection of Maitland Road and NICB.

*Change in flood level*

Figures D-1 to D-4 in **Appendix L** show change in flood levels (afflux) for the five per cent, two per cent and one per cent AEP events and the probable maximum flood event, respectively, for the operational phase. Afflux for the operational phase of the proposal is negligible for flood events smaller than the five per cent AEP event.

Changes in flood for the operational phase in the one per cent AEP event (refer to Figure D-3 in **Appendix L**) are much lower than the construction phase (refer to Figure C-1 in **Appendix L**). Changes in flood levels for the operational phase for the two per cent AEP event are more pronounced than the five per cent AEP, one per cent AEP and the probable maximum flood events.

In the five per cent AEP event, flood level is increased up to 0.25 metres (refer to Figure D-1 in **Appendix L**) at Aurizon Facility along the north-western boundary of the proposal, this is most likely related to the high profile redirective kerb and would be further investigated in detailed design. The localised increase in flood level results in a reduction of flood levels up to 0.10 metres on the southern side of Maitland Road. Changes in flood levels elsewhere are less than 0.01 metres.

In the two per cent AEP event, a localised increase in flood level up to 0.25 metres (refer to Figure D-2 in **Appendix L**) occurs in the vicinity of Smithies Creek along the western boundary of the proposal. The majority of the area located between Shamrock Street and Sparkes Street is subject to 0.1 metres increase in flood level with a maximum localised increase in flood level up to 0.25 metres along the western boundary of the proposal. Flood levels on the floodplain located to the west of the proposal, including Hexham Swamp are increased up to 0.03 metres. Flood levels are lowered up to 0.01 metres along the western boundary of the proposal at the Sparke Street intersection and downstream of the proposed bridge at Ironbark Creek.

Changes in flood levels in the one per cent AEP event (refer to Figure D-3 in **Appendix L**) are less extensive than the two per cent AEP event. A maximum increase in flood level up to 0.25 metres occurs in isolated areas within the proposal. Flood levels on the floodplain located to the west of the proposal are increased up to 0.03 metres due to the proposal.

In the case of the probable maximum flood changes in flood levels are confined to the floodplain located east of the Main North Rail Line as shown in Figure D-4 in **Appendix L**. Increase in flood levels up to 0.25 metres occurs in the vicinity of the new bridge due to the proposal, however this location is currently flood affected.

*Change in flow velocity*

There are no large areas with significant changes in flow velocities across the Hunter River floodplain and Hexham Swamp, and the majority of changes are localised around the operational footprint. Figures D5 to D-8 in **Appendix L** show the change in flow velocities for the five per cent, two per cent and one per cent AEP events and probable maximum flood event for the operational phase. Changes in flow velocities are negligible for flood events smaller than the five per cent AEP event.

In the five per cent AEP event, flow velocity changes show a decrease in velocity in the Hunter River, with changes around the eastern embankment of Hexham Bridge. Increases in velocity of up to 0.3 metres per second occur along Maitland Road, north of Ironbark Creek, near Sparke Street. Furthermore, increases in velocity are expected to occur along the Main North Rail Line next to the rail maintenance facility located at the north-western end of the proposal.

In the two per cent and one per cent AEP events, in addition to impacts similar to the 10 per cent and five per cent AEP events, there are areas of increased velocity of 0.1 to 0.2 metres per second and decreased velocity of 0.1 metres per second in the far northern part of Hexham Swamp. There are also increases of 0.3 metres per second around Clarke Street and Merchant Street, Hexham in addition to increases of 0.3 metres per second at the Sparke Street intersection and within Ironbark Creek adjoining the South Channel Hunter River.

In the probable maximum flood, there are numerous locations where flow velocities both increase and decrease, where the most prominent changes are located around where Ironbark Creek adjoins the South Channel Hunter River and between Shamrock Street and Clark Street, Hexham. Localised increases and decreases of up to 0.5 metres per second occur in these locations.

*Flood hazard*

Figures D-9 to D-12 in **Appendix L** show the change in flood hazard for the five per cent, two per cent and one per cent AEP and probable maximum flood events for the operational phase. Changes in flood hazard are negligible for flood events smaller than the five per cent AEP event. In the case of the other flood events, changes to flood hazard are generally minor and localised.

The one per cent and five per cent AEP events experience minor increases in flood hazard in areas of the northern extent of the proposal, an increase north of Ironbark Creek along Maitland Road to Shamrock Street and decreases directly north of the A1 Pacific Highway along Maitland Road within the REF area. There are not large increases in extent of the high hazard areas, which would indicate a new floodway or flow path being formed as a result of the operational phase.

In the probable maximum flood event, the flood hazard remains unchanged with the proposal.

Overall, the change in flood hazard for the operational phase is localised and as such does not have adverse impacts on flood conveyance, floodways, flow direction and flood storage.

*Flood duration and inundation*

Figures D-13 to D-16 in **Appendix L** show the change in duration in inundation for the five per cent, two per cent and one per cent AEP and probable maximum flood events for the operational phase. Changes in duration of inundation are negligible for flood events smaller than the five per cent AEP event.

In the five per cent AEP event there is a change in duration in inundation located around the rail maintenance facility, located to the north-west of the proposal, increasing in areas for up to 50 hours. Generally, in other areas of the proposal, the duration of inundation is relatively uniform in distribution and typically within +/- five per cent of existing conditions. Downstream of Hexham Bridge there are localised decreases in durations of 10 to 20 per cent where reductions in flood levels are expected.

In the two per cent and one per cent AEP events the changes in duration of inundation are similar to the 10 per cent and five per cent AEP events, with prominent differences around the Hexham Bridge interchange on the southern bank near the railway line, and north of Ironbark Creek to Shamrock Street, with a difference in flooding duration between one and 10 hours.

In the probable maximum flood event, the change in duration of inundation is again typically within +/- five per cent from the existing case across Maitland Road/Pacific Highway (A43) adjacent and just north of the Calvary St Joseph's Retirement Community, with decreases over 30 per cent.

*Flooding impacts to buildings*

Surveyed floor levels of 333 buildings provided by City of Newcastle have been used to assess flooding impacts to buildings. The difference in building impacts between the baseline and operational cases is minimal for the AEPs modelled. The key metrics investigated were the afflux, as well as the change in the number of buildings flooded above and below floor surveyed floor levels.

Details on location, floor level and flood level for each building are provided in Attachment J of **Appendix L**.

Table 6.17 Number of buildings flooded above during operation of the proposal

| Depth of flooding above floor (m) | 63.2%AEP | 20%AEP | 10%AEP | 5%AEP | 2%AEP | 1%AEP | PMF |
|---|---|---|---|---|---|---|---|
| 0.01 – 0.02 | - | - | - | - | 22 | 48 | - |
| 0.02 – 0.03 | - | - | - | - | 23 | 17 | - |
| 0.02 – 0.05 | - | - | - | - | 13 | - | - |
| 0.05 – 0.07 | - | - | - | - | 3 | - | - |
| **Total** | **-** | **-** | **-** | **-** | **61** | **65** | - |

Only one building is newly flooded above floor in the one per cent AEP event, refer to **Appendix L.** It is to be noted that the building is newly flooded 0.01 metres above floor.

Modelling results of the above floor impacts to the 333 buildings located near to the proposal during operation is summarised in **Table 6.18**.

Property surveys would be carried out during detailed design in order to confirm any adverse flooding impacts in consultation with landowners.

Table 6.18 Number of buildings impacted below floor during operation of the proposal

| Depth of flooding above floor (m) | 63.2%AEP | 20%AEP | 10%AEP | 5%AEP | 2%AEP | 1%AEP | PMF |
|---|---|---|---|---|---|---|---|
| 0.01 – 0.02 | - | - | - | - | 22 | 48 | - |
| 0.02 – 0.03 | - | - | - | - | 23 | 17 | - |
| 0.02 – 0.05 | - | - | - | - | 13 | - | - |
| 0.05 – 0.07 | - | - | - | - | 3 | - | - |
| **Total** | **-** | **-** | **-** | **-** | **61** | **65** | - |

*Climate change impacts*

The impact of climate change on flooding during the operational phase was assessed through modelling scenarios that had tidal levels set at expected future heights due to climate change. These expected future heights were for 2050 and 2100. Figure E-1 in **Appendix L** shows increases of flood depths of 0.05 to 0.1 metres in the one per cent AEP event across the entire flood extent within the vicinity of the proposal for the 2050 scenario, with the exception of South Channel Hunter River south of the proposal and an area in Kooragang Island adjacent to this increasing by 0.1 to 0.25 metres. The flood extent has scattered increases on edges of the existing flood extent, except South Channel Hunter River south of Ferry Road, Sandgate where flood extent increases by 130 metres into Kooragang Island.

In the 2100 scenario, flood depths increase by 0.1 to 0.25 metres in the one per cent AEP event (refer to Figure E-2 in **Appendix L**) across the flood extent within the vicinity of the proposal, with the exception of South Channel Hunter River south of Old Maitland Road, Sandgate and the area adjacent in Kooragang Island which increases by 0.25 to 0.4 metres and South Channel Hunter River south of Ferry Road, Sandgate which increases by over 0.4 metres. The flood extent similarly has scattered increases on edges of the existing flood extent with the exception of South Channel Hunter River south of Ferry Road, Sandgate where flood extent increases by 150 metres into Kooragang Island and 50 metres into Sandgate. The flood extent also increases by 350 metres near Kennington Drive.

#### *Site water balance*

There are no ongoing operational water demands for the proposal.

The construction sediment retention basins employed during the proposal construction would be retained as water quality basins during operation.

Discharge of water from site to the environment would only occur from sediment retention ponds at approved discharge points. Discharge will be monitored and managed in accordance with the relevant EPL conditions.

### 6.2.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise hydrology and flooding impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.19.**

Table 6.19 Safeguards and management measures – hydrology and flooding

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Potential changes to flood impacts resulting from detailed design | Further flood investigations and detailed hydrological and hydraulic modelling will be carried out during detailed design to ensure the design objectives and performance criteria for the proposal are met. | Contractor | Detailed design |
| Flooding impacts on property | Landowners will continue to be consulted regarding any changes to flooding and hydrology impacts and mitigation measures in relation to individual properties. | Transport/ Contractor | Detailed design |
| Flooding impacts during construction | A Flood Management Plan (FMP) will be prepared as part of the CEMP for the proposal and will include:<br>• Details on the processes for flood preparedness, materials management, weather monitoring, site management and flood incident management<br>• Responsibilities for flood response (preparation of site upon receipt of flood warning, evacuation of site personnel) during and recovery following a flood event | Transport/ Contractor | Prior to construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| | • Detailed construction planning such that construction phase traffic management and other construction area arrangements do not impact on flood evacuation route traffic capacity. | | |
| Flooding impacts of bridges and culverts | Where possible, culvert and bridge design will be further developed to minimise upstream and downstream impacts to wetlands and other sensitive environments. | Contractor | Detailed design |
| | Where possible, detailed construction staging plans will be developed during detailed design so that bridges and culverts are constructed in a way that minimises flood risk. | Contractor | Detailed design |
| Impacts on existing drainage systems | Activities that may affect existing drainage systems during construction will be carried out so that existing hydraulic capacity of these systems is maintained where practicable. This will continue to be undertaken through appropriate design methodologies and considerations during detailed design.<br><br>Drainage systems that are upgraded and require scour protection would also consider Roads and Maritime Services (2017) *Water Sensitive Urban Design Guideline* as part of detailed design. | Contractor | Construction |
| Impacts to riverbanks downstream of proposal discharge locations during construction | As part of the Construction Soils and Water Management Plan a measure will be included to monitor waterways (channels and banks) immediately downstream of proposal discharge locations during the construction phase to identify potential downstream impacts (e.g. sedimentation, scour, etc.). If impacts are identified, relevant corrective actions will be implemented to ensure stabilisation as part of the erosion and sediment control plan.<br><br>Further to this, the requirement for remediative and additional preventative actions will be assessed. Physical controls to ensure the stabilisation and continuing integrity of watercourse geomorphic properties will be considered where reasonable and feasible. | Contractor | Construction |
| Unforeseen impact to surface water hydrology | A surface water and groundwater monitoring program will be implemented that includes the collection of baseline data and detailed monitoring during construction. Should unforeseen impacts arise that are not already addressed by the environmental management measures outlined in this table, appropriate responses and management measures will be developed in consultation with the relevant authority. | Transport | Construction |

## 6.3 Surface water

The potential impacts of the proposal on surface water are assessed in the *Hexham Straight Widening Surface Water and Groundwater Assessment*, refer to **Appendix N**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.3.1 Methodology

The methodology for the surface water impact assessment involved the following:

- A desktop assessment including a review of the existing surface water conditions across the study area to assess the likely and potential impacts of the proposal on surface water quality during construction and operation of the REF area. The review of information has included review of available literature, water data, background information and land use to aid in interpreting the existing conditions
- Data analysis of water quality data from a variety of stakeholders including the former Office of Environment and Heritage (OEH) (now DPIE), ARTC and Transport. Each organisation has its own monitoring objectives for their monitoring and as such, data is variable throughout the catchment, spatially and temporarily and also vary in the types of indicators that are monitored
- Identification of SRE such as key fish habitats, threatened species habitats, aquatic habitats, classified waterways, groundwater and surface water dependent communities, drinking water catchments, protected areas such as Ramsar listed wetlands, and recreational swimming areas
- Identification of water quality criteria and objectives for waterways within the surface water and groundwater study area using the *NSW Water Quality Objectives* (DECCW, 2006).
- Assessment of construction and operational impacts, including:
  - Identifying unmitigated risks to surface water and groundwater quality from various construction activities and the operation of the proposal
  - Identifying potential impacts to downstream waterways and SREs
  - Assessing potential impacts to the nominated water quality objectives (WQOs) of aquatic ecosystems, visual amenity, primary and secondary contact recreation and aquatic foods (cooked) with consideration to the Australian and New Zealand Guidelines (ANZG) (2018) *Water Quality Guidelines*
  - Identifying water quality treatment measures to mitigate the impacts of construction in accordance with the *Blue Book – Managing Urban Stormwater: Soils and Construction* (Landcom 2004)
  - Assessment of increased pollutant loading at each of the SREs or downstream waterways by considering the increase in impervious surfaces within each of their catchments
  - Modelling proposed discharges from the proposal. Pollutant loads of proposed discharges from stormwater runoff were modelled using the eWater Model for Urban Stormwater Improvement Conceptualisation (MUSIC model). The MUSIC model was used to determine surface water pollutant loading from proposal roads, with a focus on three key indicators: TSS, TP and TN
  - Identifying water quality controls to treat proposal runoff. An iterative process using the MUSIC model was used to identify the water quality controls needed to achieve the required water quality treatment for the proposal during operation. A combination of permanent operational water quality basins and swales were identified
  - Identification of appropriate treatment measures to mitigate the residual impact of the operational phase.

### 6.3.2 Existing environment

An overview of the existing catchment, drainage network, waterways and wetlands is provided in **Section 6.2.2**.

### Existing surface water quality

**Table 6.20** provides a summary of the existing surface water quality of waterways with the potential to be impacted by the REF area. Water quality data was obtained OEH/DPIE, ARTC and Transport and was collected at varying frequencies between 2011 and 2021. The existing water quality is discussed in relation to the ANZG (2018) *Water Quality Guidelines default guideline values for the WQO protection of aquatic ecosystems*.

The existing environment does not currently meet WQOs and water quality could be considered poor due to elevated nutrients, low dissolved oxygen and often elevated metal concentrations. The WQO's for aquatic ecosystems is currently not being achieved at any site, nor are the values of visual amenity, primary and secondary contact recreation and aquatic foods (cooked) at the majority of sites.

Table 6.20 Existing surface water quality of key waterways, wetlands and drains

| Watercourse | Description |
|---|---|
| Hunter River (main-stream) | • Generally poor water quality<br>• Elevated nutrient and chlorophyll a concentrations and turbidity<br>• Metal concentrations are generally low with elevated copper and zinc concentrations<br>• Oil sheen and frothing observed<br>• Assigned WQO aquatic food (cooked) – generally (>75%) compliant with guidelines except total suspended solids (TSS) and zinc. |
| North Channel Hunter River | • Elevated nutrient concentrations particularly upstream<br>• Median oxidised nitrogen and total nitrogen concentrations exceed guidelines<br>• Median phosphorus and chlorophyll a were above guidelines upstream<br>• Nominated WQOs of aquatic ecosystems, visual amenity, primary and secondary contact recreation and at areas not impacted by urban development aquatic foods (cooked). |
| Ironbark Creek (and tributary) | • Low dissolved oxygen levels which may not be viable for many aquatic organisms<br>• Turbidity, oxidised nitrogen are above guidelines<br>• Metal concentrations are below guidelines or not detected with the exception of copper and zinc<br>• Nominated WQOs of aquatic ecosystems, visual amenity, primary and secondary contact recreation. |
| Unnamed Coastal Wetland (to the north and south of Ironbark Creek) | • Median concentrations of dissolved oxygen indicate the wetland is poorly oxygenated<br>• Water quality could be considered poor due to elevated metal concentrations with median concentrations of copper, zinc, lead and chromium exceeding guidelines<br>• WQOs for the wetland are protection of estuarine aquatic ecosystems and visual amenity. |
| Unnamed Coastal Wetland (to the east of the Hunter River) | • Water quality of the wetland could be considered poor and generally did not meet the guidelines for dissolved oxygen, turbidity, nutrients and some metals (zinc)<br>• WQOs for the wetland are protection of estuarine aquatic ecosystems and visual amenity. |
| South Channel Hunter River | • Water quality is generally poor, frequently failing to meet the recommended guidelines for numerous indicators including pH, turbidity, nutrients, oxidised nitrogen and total phosphorus<br>• Nominated WQOs of aquatic ecosystems, visual amenity, primary and |

| Watercourse | Description |
|---|---|
| | secondary contact recreation and aquatic foods (cooked). |
| Hexham Swamp Nature Reserve | • Limited water quality data with pH and dissolved oxygen being above guidelines<br>• Nutrient concentrations including ammonia, total nitrogen, total phosphorus and filterable reactive phosphorus exceeded the guideline<br>• Nominated WQOs for the reserve for protection include aquatic ecosystems, visual amenity and primary and secondary contact recreation. |
| Purgatory Creek | • Water quality of Purgatory Creek is very poor and fails to meet the guidelines with elevated nutrients and turbidity<br>• Nominated WQOs for Purgatory Creek are protection of aquatic ecosystems, visual amenity, primary and secondary contact recreation and aquatic foods (cooked). |
| Mid Site Channel | • Very low compliance with guidelines due to elevated nutrients and turbidity.<br>• Metal concentrations are generally low with the exception of zinc, nickel and copper<br>• Nominated WQOs for the channel include protection of aquatic ecosystems, visual amenity, primary and secondary recreation and aquatic foods (cooked). |

### Sensitive receiving environments

Several waterways and wetlands within the proposal local area have been classified as SREs including:

- Groundwater users in the construction area
- Hunter River and floodplain
- Ironbark Creek
- Unnamed drainage channel to the south of Ironbark Creek
- Unnamed Coastal Wetland (CM SEPP) located to the north and south of Ironbark Creek
- Unnamed Coastal Wetland (CM SEPP), located on the western bank of the Hunter River to the north of Millams Road and the Ash Island Bridge
- Unnamed Coastal Wetland (to the north of Hexham Bowling Club, between Old Maitland Road and the South Channel Hunter River)
- Unnamed Coastal Wetland (to the west of the Main North Rail Line at the northern end of the proposal)
- Unnamed Coastal Wetland (CM SEPP), located east of the Hunter River
- Hunter Estuary Wetlands Ramsar site at Kooragang Island (Kooragang Nature Reserve)
- Hunter Estuary Wetlands Ramsar site at Shortland (Shortland Wetlands and includes Hunter Wetlands Centre Australia)
- Hexham Swamp Nature Reserve including Sparkes Creek and Smithies Creek.

## 6.3.3 Potential impacts

### Construction

#### *Erosion and sedimentation*

There is the potential for the subsoil to contain highly erodible soils within the proposal's construction footprint and therefore there is the risk of erosion and sedimentation from the following activities:

- Movement and use of heavy vehicles across exposed earth
- Cut and fill earthworks
- Excavations
- Transportation of materials to and from site
- Stockpiling of excavated material
- Relocation of utilities
- Site restoration
- Vegetation clearing and work within waterways (comprising bridge work, drainage work and waterway adjustments).

Where soil is exposed during these activities there is the potential for offsite sedimentation, particularly during high wind or rainfall events.

#### *Tannin leachate*

Tannin leachate from clearing and mulching of vegetation can enter downstream waterways. Tannins can result in dark coloured water being discharged from construction areas into downstream waterways. This affects the visual amenity of the waterway, can alter the pH and reduce visibility and light penetration. Additionally, tannins can increase biochemical oxygen demand, thereby decreasing available dissolved oxygen which can impact on aquatic ecosystems and lead to fish kills. As vegetation is required throughout the construction area, all waterways are at risk of impacts from tannin leachate.

#### *Disturbance of ASS or contaminated soils*

The majority of construction area is classed as Class 2 ASS, with Class 1 ASS existing around the northern and central portion of construction area, adjacent to Hunter River and around Ironbark Creek Bridge. Direct disturbance through excavation, vegetation clearing, dredging and piling or lowering of the groundwater table in areas containing ASS may result in the production of acidic water which may in turn have water quality impacts.

All waterways are at risk of water quality impacts from exposure of ASS. However, the waterway of Ironbark Creek which drains to the South Channel Hunter River and the unnamed drainage channel to the southeast of Ironbark Creek that drains Hunter Wetlands National Park is most at risk of being impacted by disturbance of ASS. This is due to the excavation and disturbance required for bridge construction and removal of the existing bridge as well as the relocation of the unnamed drainage channel to the southeast of Ironbark Creek.

#### *Release of concrete waste*

Concrete works are required for building roads, drainage infrastructure and the bridge over Ironbark Creek, along includes batching, pre-casting and in-situ pouring. Concreting works generate concrete waste in the form of concrete dust, concrete slurries or washout water which can be discharged to downstream waterways during construction. The impact to water quality is an increase in alkalinity and pH which can be harmful to aquatic life and an increase in chromium concentrations which can accumulate in the gills of fish affecting the health of aquatic animals.

The waterways at most risk from potential mobilisation of concrete waste are in the REF area and in close proximity to ancillary facilities such as the Hunter River, South Channel Hunter River, Coastal Wetlands Proximity Area (south east of Old Punt Road and Old Maitland Road intersection and west of Old Maitland Road) where concrete batch plants and precast facilities would be located. Ironbark Creek is also at risk due to construction of a new bridge.

### *Release of oils and fuels*

Leakage or spills of oils, fuels and other toxicants from construction machinery, plant equipment, refuelling and vehicles travelling to and from site may lead to the introduction of hydrocarbons and heavy metals into the waterways. This can result in oily films on surface water reducing visual amenity and decreased biodiversity, loss of habitat and fish kills from increased concentrations of toxicants which may be harmful to aquatic life and could reduce visual amenity. All waterways within the REF area are at risk.

The demolition of Ironbark Creek Bridge could result in disturbance of sediments that could be contaminated with lead based paint, metals and contaminants from runoff from heavy industrial activities that have occurred historically in the area, including land reclamation on foreshore of Ironbark Creek. There are known areas of imported fill near Sparke Street and Ironbark Creek, which could be disturbed during construction of the bridge abutments. This could result in contaminants such as PAH, heavy metals, pesticides and herbicides being transported downstream to Ironbark Creek and the South Channel Hunter River.

### *Herbicides*

Frequent herbicide application has occurred in the construction area and herbicides are likely bound to the sediments of waterways, which if disturbed could impact on water quality, increase toxicity and impact on aquatic life. The waterway at most risk is Ironbark Creek which would be disturbed during construction of the new bridge and demolition of the existing bridge as this would include work within the new waterway to construct new bridge piers and a temporary work platform and demolish the existing bridge piers.

### *Dust and litter*

Dust generated from concrete work may contain heavy metals which could be harmful to aquatic life. Dust associated with demolition of Ironbark Creek Bridge may contain contaminants such as concrete, asbestos, lead or other pollutants which may be harmful to aquatic ecosystems if mobilised to downstream environments.

Mobilisation of litter to waterways may lead to the introduction of gross pollutants, hydrocarbons and heavy metals into the waterways which may be harmful to aquatic life and reduce visual amenity.

### *Impacts to wetlands*

A key risk of the REF area is the potential impacts to wetlands including:

- Important Coastal Wetlands classified under the CM SEPP
- Wetland nature reserves which are DPIE managed conservation estate, including:
- Hunter Wetlands National Park
- Hexham Swamp Nature Reserve (which is part of Hunter Wetlands National Park estate)
- Kooragang Nature Reserve (which is part of the Ramsar listed Hunter Estuary Wetlands and Hunter Wetlands National Park estate)
- Shortland Wetlands including Hunter Wetland Centre Australia (which is part of the Ramsar listed Hunter Estuary Wetlands).

The proposal is also expected to directly impact three Coastal Wetland areas which define the EIS areas of the proposal. These impacts are considered further in the EIS.

### *Summary*

As discussed in **Section 6.3.2**, the WQOs are currently not being met and water quality could be considered poor due to elevated nutrients, low dissolved oxygen and often elevated metal concentrations. Construction of the proposal is not expected to further deteriorate water quality provided there is proper and adequate implementation of Erosion and Sediment Control Plans and the requirements of the Blue Book (Soils and Construction) during the construction phase.

## Operation

### *Surface water impacts*

During operational all roads and bridges would be sealed, cleared areas would be landscaped and scour protection would be installed. There would be no exposed topsoil and therefore little or no risk of soil erosion and subsequent transport of sediment into receiving waterways.

Further, following the implementation of the proposed operational water quality strategy modelling show that there was a slight reduction on the annual average pollutant loads of TSS, TP and TN by around two to five per cent such that operational impacts would be slightly better than existing conditions.

As such, water quality risks during the operation would instead be associated with:

- **Stormwater runoff** – Involving untreated stormwater from impervious surfaces which are not conveyed to treatment systems. This may result in large volumes of surface runoff and may result in erosion and sedimentation of downstream receiving environments or may contain elevated levels of pollutants from new impervious surfaces which are not conveyed to treatment systems. Increased sediment loads and increased turbidity can reduce light penetration through the water column and can smother aquatic flora and fauna.
- **Accidental spills** – Involving discharge of spill directly into waterways (should spill event happen on a bridge) or via runoff into the drainage system. Spills may include heavy metals, oils and/or fuels. This may result in transportation of dust, litter, or poor-quality runoff to downstream receiving environments from road use by vehicles or from car crashes. Increased concentrations of heavy metals and hydrocarbons (either directly transported into a waterway or attached to sediment) which are toxic to aquatic biota
- **Operational basin discharges** – Involving overflow discharges from water quality basins following a rainfall event.

All waterways and wetlands in the study area have the potential to be impacted by stormwater runoff, accidental spills and operational basin discharges.

### *Impacts to wetlands*

The operation of the proposal has the potential to directly and indirectly impact on water quality of Coastal Wetlands that are within the construction area and the surface water study area more broadly. These potential impacts would be related to increased stormwater runoff associated with increased impervious surfaces, potential spills and leaks caused by vehicle crashes, potential transportation of contaminants and gross pollutants from road use, and operational water quality basin overflows during or following a rainfall event.

It is expected that in drainage catchments where water quality treatment controls are proposed, runoff that would reach waterways would be of a quality that is slightly better than existing as there is currently no water quality controls in place. Therefore, the proposal is not expected to result in long-term impacts or changes to water quality in the wetland environments surrounding the proposal. This includes Hexham Swamp Nature Reserve, Hunter Estuary Wetlands (Shortland Wetlands and Kooragang Nature Reserve) and other SRE and Coastal Wetlands identified in **Section 6.3.2**.

The permanent clearance of the REF area of the proposal is not expected to significantly impact on the functionality or visual amenity of the surrounding wetlands more than what is already occurring, as Maitland Road currently borders and sometimes traverses existing areas of the Coastal Wetlands.

### 6.3.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise surface water impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.21.**

Table 6.21 Safeguards and management measures – surface water

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| General | 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 will include but not be limited to:<br>• Measures to minimise/manage erosion and sediment transport both within the construction area 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<br>• 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)<br>• 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, 2015d) to minimise the potential for mobilisation and transport of dust and sediment in runoff<br>• Concrete waste management procedures<br>• Measures to manage potential tannin leachate, accidental spills (including the requirement to maintain materials such as spill kits) and potential saline soils<br>• A surface water quality monitoring program to monitor the performance of management measures<br>• Controls for sensitive receiving environments including Coastal Wetlands (CM SEPP) which may include but not be limited to:<br>– Designation of 'no go' zones for construction plant and equipment<br>– Creation of catch/diversion drains and sediment fences at the downstream boundary of construction activities where practicable to ensure containment of sediment-laden runoff and diversion toward | Transport / Contractor | Prior to construction / construction/ operation |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| | sediment sump treatment areas (not sediment basins) to prevent flow of runoff to the Coastal Wetland. | | |
| Erosion, sediment and water quality controls | A soil conservation specialist will be engaged for the duration of construction of the REF area 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 |
| Spills and leaks | The CSWMP will outline site specific control measures and required procedures to ensure containment of accidental spills and leaks. This will include:<br>• All fuels, chemicals and liquids will be stored on level ground at least 20 metres away from waterways (including existing stormwater drainage system) and will be stored in a sealed bunded area within ancillary facilities<br>• An emergency spill response procedure will be prepared in accordance with Transport protocols to minimise the impact of accidental spills of fuels, chemicals and fluids during construction<br>• Regular visual water quality checks (for hydrocarbon spills, turbid plumes and other water quality issues) will be carried out when working near any waterways. | Transport / Contractor | Prior to construction/ construction |
| Surface water quality impacts | A construction water quality monitoring program will be developed in accordance with the *Guidelines for Construction Water Quality Monitoring* (Roads and Traffic Authority, 2003b) and the A*ustralian Guidelines for Water Quality Monitoring and Reporting* (ANZECC/ARMCANZ, 2000b), and will be included in the CSWMP for the REF area to establish baseline conditions prior to commencement of construction, observe the environmental performance and any changes in surface water and groundwater during construction, and inform appropriate management responses.<br>Should the results of monitoring identify that the water quality management measures are not effective in adequately mitigating water quality impacts, additional management measures will be identified and implemented as required. | Transport / Contractor | Prior to construction/ construction |
| Dewatering | A dewatering management protocol will be prepared as a sub plan of the Construction Soil and Water Management Plan which would outline:<br>• The methodology for excavation dewatering, dewatering waterways and wetlands, as well as discharges from temporary construction sediment basins<br>• Monitoring of groundwater level responses to dewatering<br>• Supervision requirements<br>• Staff responsibilities and training<br>• Approvals required before any dewatering activity commences. | Transport / Contractor | Prior to construction/ construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| | The protocol would be developed in accordance with the *RTA Technical Guideline: Environmental management of construction site dewatering* (Roads and Traffic Authority, 2011b). | | |

## 6.4 Groundwater

The potential impacts of the proposal on groundwater are assessed in the *Hexham Straight Widening Surface Water and Groundwater Assessment* provided in **Appendix N**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.4.1 Methodology

The methodology for the groundwater impact assessment involved the following:

- Characterising the existing environmental setting including climate, topography, geology, and groundwater occurrence, quality and use, including groundwater dependent ecosystems (GDEs)
- Dedicated field investigations undertaken by Transport contractors, including groundwater level and quality monitoring undertaken at four proposal groundwater monitoring bores, and groundwater level monitoring at an additional three proposal groundwater monitoring bores
- Qualitative assessment of the potential for the proposal to interact with the water table. This was undertaken by assessing the proposal's design levels and comparing these to monitored water table levels and groundwater levels in public domain online databases, and by considering the duration proposal excavations below the water table would be unlined
- Quantitative assessment through numerical groundwater modelling of:
  - The potential for the proposal to reduce groundwater levels due to temporary construction dewatering
  - Groundwater inflow rates into excavations required to construct water quality treatment basins
- Qualitative assessment of the potential for the proposal to impact surface water drainage system baseflow
- Assessment of potential groundwater impacts in areas of GDEs
- Assessment of potential groundwater related impacts against the minimal impact considerations of the *NSW Aquifer Interference Policy* (DPI, 2012)
- Providing recommendations for monitoring and management of identified potential impacts and risks, including management measures as appropriate.

### 6.4.2 Existing environment

#### Groundwater systems and surface water interactions

The following distinct groundwater systems are present in the study area:

- Hunter Alluvium
- Hunter Coastal Sands
- Tomago Coal Measures.

In general, the Hunter Alluvium and Hunter Coastal Sands groundwater systems occur beneath the low-lying floodplains of the Hunter River. Water levels are typically shallow and often express at, or above, or close to, the ground surface level where ground surface elevations drop below one metre Australian Height Datum (AHD), either seasonally or after high rainfall. The groundwater surface water interaction is generally one of groundwater discharge to surface water systems, such as Ironbark Creek, the Hunter River and its tributaries and wetlands.

Direct groundwater flow from the Tomago Coal Measures groundwater system to surface water systems is anticipated to be limited. There are no significant water courses in the portion of the study area where the Tomago Coal Measures outcrop. Some indirect contribution to surface water systems is anticipated to occur as groundwater from the Tomago Coal Measures groundwater system discharges to overlying Hunter Alluvium and Hunter Coastal Sands groundwater systems.

### Groundwater levels

**Table 6.22** provides a summary of the groundwater levels at seven groundwater monitoring bores along the length REF area. BH1 to BH4 were continuously monitored using a logger for one year. D-PZ-SA1, D-PZ-SA3, and D-PZ-R6 did not have loggers installed so were manually measured once using a dip.

Based on the data, groundwater elevations are low, and the water table is shallow with respect to existing ground level. The range in groundwater levels is low (i.e. little variation between maximum and minimum levels).

Table 6.22 Groundwater levels at monitoring bores

| Monitoring bore | Groundwater level (mAHD) | | | |
|---|---|---|---|---|
| | Min | Average | Max | Manual dip (19/01/21) |
| BH1 | 1.64 (2.21 mBGL) | 2.12 (1.73 mBGL) | 3.14 (0.71 mBGL) | - |
| BH2 | 0.16 (1.78 mBGL) | 0.85 (1.09 mBGL) | 1.61 (0.33 mBGL) | - |
| BH3 | 0.22 (1.37 mBGL) | 0.76 (0.83 mBGL) | 1.63 (-0.04 mBGL) | - |
| BH4 | 0.19 (2.21 mBGL) | 0.75 (1.65 mBGL) | 1.54 (0.86 mBGL) | - |
| D-PZ-SA1 | - | - | - | 0.36 (0.54 mBGL) |
| D-PZ-SA3 | - | - | - | 0.44 (0.50 mBGL) |
| D-PZ-R6 | - | - | - | 0.27 (1.24 mBGL) |

### Groundwater flow direction

Groundwater levels from the proposal’s monitoring bores and registered bores from the Water NSW (2021) online bore database were contoured to convey groundwater levels and flow directions. Twenty-eight groundwater level locations and 301 additional control points were used to generate the contours.

The groundwater level contours generally suggest that groundwater flows from areas of relatively high elevation towards areas of relatively low elevation, before discharging to the Hunter River and associated wetland to the east of the proposal, or to low lying areas of wetland to the west of the proposal.

### Hydraulic conductivity

A total of 22 pore pressure dissipation tests were completed during cone penetration tests at seven locations in soft soil layers along the proposal. The testing comprised stopping penetration and recording the decay in pore pressure with time. Except for a single test completed in clayey sand material, all the tests were completed in clayey material. The estimated hydraulic conductivity values are low, as expected for clayey material.

### Groundwater recharge and discharge

Groundwater recharge in the study area is conceptualised to primarily occur through rainfall recharge. Groundwater discharge is conceptualised to occur as outflow to the Hunter River and its tributaries, and through evapotranspiration at wetlands. Both the wetlands and Hunter River and its tributaries are considered to be groundwater sinks.

### Groundwater dependent ecosystems

Existing groundwater dependent ecosystems are discussed in detail in **Section 6.1.2**.

### Groundwater quality

Groundwater monitoring bores BH1, BH2, BH3 and BH4 were sampled in five monitoring rounds between September 2020 and January 2021. The results of the sampling are outlined in **Table 6.23**.

Table 6.23 Groundwater quality

| Parameter | Description |
|---|---|
| pH and conductivity | • The pH is generally slightly acidic to slightly alkaline, with BH1 relatively more acidic than other locations<br>• The average EC values at BH1 and BH2 are representative of 'fresh' water. The average values are representative of 'brackish' water. |
| Cations and anions | • Cations have no dominant type at BH2 and BH3 and are sodium dominant at BH1 and BH4<br>• Anions are bicarbonate dominant at BH2 and BH4 and chloride dominant at BH1 and BH3<br>• Water type is sodium chloride at BH1 and BH3. At BH2 and BH4 the overall water type is calcium bicarbonate. |
| Nutrients | • Ammonia was above the ANZG (2018) marine water 95% protection level (0.91 milligrams per litre) for all samples at BH2 and three samples at BH4<br>• The majority of total nitrogen samples were above the ANZECC 2000 Marine Aquaculture guideline level of 1 milligram per litre. The maximum value was 2.56 milligrams per litre<br>• The majority of total phosphorus samples were above the ANZECC 2000 lowland river stressor level of 0.025 milligrams per litre. The maximum value was 1.1 milligrams per litre. |
| Dissolved heavy metals | • Dissolved heavy metals were compared to the ANZG (2018) marine water 95% protection level and are summarised as follows:<br>• Arsenic: two samples at BH3 (0.013 and 0.014 milligrams per litre) were above the guideline level of 0.013 milligrams per litre<br>• Copper: the majority of samples were above the guideline level of 0.0013 milligrams per litre<br>• Lead: one sample at BH1 (0.005 milligrams per litre) was above the guideline level of 0.0044 milligrams per litre<br>• Zinc: the majority of samples were above the guideline level of 0.0013 milligrams |

| Parameter | Description |
|---|---|
| | per litre. |
| BTEX and hydrocarbons | • BTEX was below the laboratory limit of reporting.<br>• At all bores, at least one sampling round had detections of hydrocarbons. |

### 6.4.3 Potential impacts

#### Construction

##### *Changes to groundwater levels and flow direction*

The proposal has limited potential to alter groundwater levels and flow directions during the construction period. This is because there are no mechanisms to cause large changes in groundwater levels. Changes to groundwater levels could occur but would be small and localised.

Predicted reductions to groundwater levels due to temporary dewatering to permit construction of the proposal's water quality treatment basins indicate the maximum groundwater level reduction is about 1.5 metres at water quality basin (B3), near Ironbark Creek (refer to **Figure 3.3**). The groundwater level reductions are anticipated to occur for a short duration of about one month before commencement of groundwater level recovery. This reduction is not anticipated to impact the groundwater contributions to Ironbark Creek baseflow.

##### *Impacts to Groundwater Dependent Ecosystems*

Impacts to GDEs have been considered in **Section 6.1.3**.

##### *Impacts to registered bores*

There are no registered bores other than monitoring bores that are near the construction area. As such, impacts to bores used for a purpose other than monitoring would not occur. There is a potential that some monitoring bores may require decommissioning if located in areas disturbed by construction.

##### *Impacts to groundwater quality*

Changes to groundwater quality during the construction period could occur as follows:

- Groundwater systems could become contaminated if accidental spills or leaks of hazardous materials (such as fuels, lubricants and hydraulic oils) occur during construction or operation
- If potential acid sulfate soils are excavated and oxidised or if actual acid sulfate soils are excavated and mobilised, some acidification could occur. Acidification could also occur due to oxidisation as a result of lowered groundwater levels. The acidification could also potentially mobilise heavy metals.
- Groundwater salinity could be increased if groundwater levels increase and salts are mobilised that have natural accumulated in the soil.

This risk of the above occurring is considered low.

##### *Groundwater take*

Impacts to groundwater in the REF area is restricted to the dewatering required for basin construction, which would only occur for a period of about one month. The groundwater model predicts a total dewatering volume for basin construction of about two megalitres. Changes to groundwater levels are anticipated to be negligible.

### Operation

The proposal has limited potential to alter groundwater levels and flow directions during the operation period. This is because there are no mechanisms to cause large changes in groundwater levels. Changes to groundwater levels could occur but would be small and localised.

The contribution of groundwater to surface water systems is not anticipated to be impacted during operation of the proposal. This is because material changes to groundwater levels and flows during the operation period are not expected.

GDEs are not anticipated to be impacted by changes to groundwater levels, flows or quality during the operation period.

There are no registered bores other than monitoring bores that are near the construction area. Impacts to existing bores during the operation period are not anticipated.

Groundwater quality could potentially change during operation if accidental spills occur. Salinity and acid sulfate soils could also impact groundwater quality though these risks are more likely during construction.

### 6.4.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise groundwater impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.24.**

Table 6.24 Safeguards and management measures – groundwater

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Groundwater monitoring | Prior to commencement of construction, a groundwater quality sampling round will be undertaken at proposal groundwater monitoring bores.<br><br>Should the results of monitoring identify that the water quality management measures are not effective in adequately mitigating water quality impacts, additional management measures will be identified and implemented as required. | Transport/ Contractor | Prior to construction/ construction |

## 6.5 Coastal processes

The potential impacts of the proposal on coastal processes are assessed in the *Hexham Straight Widening Coastal Processes Assessment* provided in **Appendix O**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.5.1 Methodology

The methodology for the coastal processes assessment involved a desktop study comprising of the following components:

- Conduct a desktop review of available literature, databases, aerial photography and topographic mapping to develop an understanding of the existing coastal processes and hazard within the study area
- Assess the design documentation of the proposal to characterise the features of the proposal

- Determine flood conditions across the construction area due to coastal inundation events and assess the vulnerability of the proposal to coastal inundation and coastal erosion hazards
- Perform a desktop study to assess the likely impacts of the proposal on coastal processes and identify mitigation measures required to mitigate undesirable impacts on coastal processes.

### 6.5.2 Existing environment

#### Hunter Estuary

The proposal is located next to the Hunter Estuary which includes the main channel of the Hunter River and the South Channel Hunter River. The Hunter Estuary is part of the Hunter River catchment, refer to **Section 6.2.2** and extends from the river mouth at the Port of Newcastle to a location in the vicinity of Oakhampton, about 64 kilometres upstream.

Ironbark Creek is a tributary of the Hunter Estuary catchment is the primary watercourse into and out of Hexham Swamp, flowing through the hills in the south of the catchment, through the suburb of Wallsend, and floodplains of Hexham Swamp before entering the Hunter River at Sandgate. Ironbark Creek receives tidal flows.

#### Coastal processes

The study area is affected by a range of coastal processes. The major physical processes that determine the shape of the Hunter River near the construction area include tidal hydrodynamics, flood hydrodynamics and sediment transport. Geology of the region also plays an important role in the estuary's morphology (refer to **Section 6.12.2** for a description of the existing geology).

##### *Tidal hydrodynamics*

The tidal inflows are by far the largest contributor to the water exchange of the estuary. The tidal inflow at the river mouth of the Hunter Estuary is estimated to be about 18,250 gigalitres per year, around 10 times larger than the catchment runoff into the estuary. As a result, tide action is the dominant factor in the overall hydrodynamics of the lower estuary during most environmental conditions except flood events. Further upstream, the significance of tidal inflows diminishes.

The tide in the Hunter Estuary is predominantly semi diurnal with significant diurnal inequality (i.e. there are generally two high tides and two low tides per day and the tidal range between consecutive tidal cycles varies significantly).

As the tide propagates throughout the estuary, the tidal range gradually reduces in an upstream direction. At Hexham Bridge, the mean tidal range is around 96 per cent of the tidal range at the river mouth. The tidal prism at a particular location is the volume of water that passes this location during the rise or fall of a typical tide. The tidal prism decreases from a maximum at the mouth of the river to zero at the limit of tidal propagation. At Hexham Bridge, the tidal prism is about 21 per cent of the tidal prism at the river mouth.

The tide reaches Hexham Bridge via two channel systems which are separated by Kooragang Island, namely North Channel and South Channel. The majority of the tidal flows (around 80 per cent) are conveyed through the North Channel, where water depths are generally greater than five metres. This contrasts with the South Channel where depths upstream of the Port of Newcastle are generally significantly smaller.

Tidal peak flow velocities within the South Channel Hunter River and throughout Ironbark Creek are smaller than those at most other locations with the channel system of the estuary. Flow velocities in the South Channel Hunter River are likely to be in the order of 0.4 to 0.5 metres per second during a typical flood tide and up to about 0.3 metres per second during a typical ebb tide.

### *Flood hydrodynamics*

In response to the historical flood events, significant flood mitigation works have been constructed across the catchment to reduce the frequency of flooding across the floodplain, including flood levees and spillways, floodplain drainage infrastructure, floodgates and riverbank protection works.

The extensive flood mitigation works have significantly changed the nature of flooding in the Hunter River catchment. During small to moderate, the flow is contained within the river's banks and levees and hardly any flow occurs across the floodplain. However, during severe floods, these banks and levees are often overtopped, and flood water becomes stored and/or conveyed across the floodplain.

Flood modelling undertaken indicates that flow velocities in the main river channels are generally well above 1.5 metres per second during major flood events. Flood depths on the Hunter River floodplain, upstream of the proposal, on the rural and environmental conservation areas, are typically 0.3 to 0.5 metres in a 20 per cent AEP event, two to 2.5 metres in the five per cent AEP event and three to 4.5 metres in the one per cent AEP event. During the probable maximum flood depths on the floodplain are seven to eight metres. Flood depths on the Hunter River floodplain downstream of the proposal, including parts of Tomago, Hexham and Kooragang Island, are typically 0.5 to one metres in a 20 per cent AEP event, one to 1.5 metres in the five per cent AEP event and 1.5 to three metres in the one per cent AEP event. During the probable maximum flood depths on the floodplain are five to seven metres.

### *Waves*

The construction area is not exposed to waves from the Pacific Ocean, and due to short fetches across the water bodies located next to Maitland Road, the exposure of the site to locally generated waves is minimal.

### *Erosion and sedimentation*

The transport of sediments within the Hunter Estuary is a complex process that is influenced by both tidal and fluvial hydrodynamics. Fluvial processes dominate the sediment transport within the upper estuary, whereas tidal hydrodynamics and episodic flood events are the dominant factors in the lower estuary (downstream of Hexham Bridge).

Floods result in the bed material becoming dynamic for a short period of time (a matter of days), producing a markedly different distribution of sediment depending on the size of the flood. The sediment transport during a major flood can overwhelm the transport occurring during ambient (low flow) conditions and have an impact which equates to years or decades of tide-driven transport. During floods the trapping capacity of the estuary is significantly reduced, and flood-borne sediment is transported to the lower reaches of the estuary where it may be deposited or exported to the ocean. Only extreme flood events have the capacity to deposit significant quantities of sediment on the floodplains, partly due to the construction of flood protection works along the river.

Tides play a key role in the redistribution of sediment throughout the estuary. However, due to the typically lower velocities involved, the rate of change is much more gradual, with the time frame being in the order of months to years.

In the vicinity of structures or other hard features in the Hunter River, South Channel Hunter River and Ironbark Creek, the sediment transport capacity may be affected by local accelerations and decelerations in the flow currents and the generation of vortices. This could result in local scour around these existing structures.

The upper catchment is the main source of sediment into the estuary. The vast majority of the sediment supplied to the lower estuary is mud sized with limited coarse sediments reaching the lower estuary. Fine sediments supplied to the lower estuary either accumulates in low energy areas or is transported into the ocean where it deposits in large mud deposits offshore of the river mouth.

### *Climate change effects*

Key climate processes that are likely to influence estuaries under climate change include:

- Sea level rise
- Rainfall
- Surface heat budget (i.e. temperature, evaporation, solar radiation)
- Wind
- Ocean acidification.

Rising sea levels are expected to have the most significant impact on the coastal processes within the lower Hunter Estuary. Rising sea levels may inundate low-lying areas, displace wetlands and alter the tidal regime in the estuary. Changes in the tidal regime are in turn likely to result in morphologic changes, as well as impact on the water quality of the estuary.

With respect to the proposal, it should be recognised that coastal inundation levels are likely to rise and the riverbanks would likely become more susceptible to erosion without bank protection.

### *Coastal inundation*

Coastal inundation is defined as the flooding of coastal and estuarine land by ocean waters as a result of elevated sea water levels. During storm tide events, elevated sea water levels would propagate into lower estuary and potentially inundate low-lying areas.

To assess the exposure of the proposal to coastal inundation hazards, the proposed ground elevations across the proposal were compared against the design storm tide levels. The lowest parts of the proposal are situated around the intersection of Shamrock Street and Maitland Road where sections of the proposed road surface have an elevation of about 1.6 metres AHD. This means that under present-day climate conditions, the proposed road within the construction area would not be affected by a one per cent AEP design storm tide event.

As sea levels continue to rise during the design life of the proposal, Maitland Road would become more susceptibility to coastal inundation. Up until mean sea levels at the site have risen by 0.4 metres, the coastal inundation risk of the proposal is considered low and the residual risks can be appropriately managed by incorporating the proposal in existing flood warning systems for the Newcastle region and providing appropriate road signage to relay warnings to road users.

### *Shoreline erosion*

Bank erosion due to episodic flood events has been a significant issue along many reaches of the Hunter River since early European settlement. Changes to flood patterns together with clearance of riparian vegetation along the banks of the estuary following European settlement have led to riverbank destabilisation and substantial bank erosion.

An assessment of the bank stability of the Hunter River and found that sections of the riverbank adjacent to the construction area were showing signs of instability, particularly the section of the South Channel Hunter River between the Ash Island Bridge and the Ironbark Creek Bridge (WRL, 2003). Climate change effects, such as rising sea levels, are likely to exacerbate existing bank stability issues.

### 6.5.3 Potential impacts

#### Construction impacts on coastal processes

##### *Direct impacts on coastal processes*

Construction activities within the REF area that would have direct impacts to coastal processes include:

- Bridge works at Ironbark Creek, including construction of piers in the main channel of the creek and demolition of the existing bridge, which includes the removal of drainage System 7. A temporary bridge, or works platform/crane pad would be installed in Ironbark Creek to complete the work
- Modification and maintenance of existing drainage pits, pipes and culverts that are located on the banks of waterways and includes 20 of the 46 drainage systems located along the proposal within the REF area. Of these, one system discharges to Ironbark Creek (System 7) however this system is being removed as part of the proposal, nine discharge to South Channel Hunter River (Systems –10 to 13, 15 and 21 to 24) and 10 discharge to the Hunter River (Systems 37-46). Further details on drainage systems are provided in **Appendix B** and **Appendix O**.

During construction, direct impacts on the waterways located immediately next to and within the REF areas, including:

- Ironbark Creek
- The South Channel Hunter River to the north of EIS Area 2 and extending up to the southern side of EIS Area 2, then from the northern side of EIS Area 2 and extending up to the proposed U-turn facility at Old Maitland Road, Hexham to the north-east of Hexham Bowling Club.
- The Hunter River between Hexham Bridge and Construction Compound 4.

Impacts associated with each construction activity with potential to have direct impacts on coastal processes are discussed in **Table 6.25**.

Table 6.25 Potential direct impacts on coastal processes associated with the REF area

| Construction activity | Potential direct impact |
|---|---|
| Construction of new Ironbark Creek Bridge | Impacts associated with the construction of the new Ironbark Creek Bridge would generally be restricted to Ironbark Creek and would result in temporary impacts on hydrodynamic processes associated with changes in water flow. As discussed in **Section 6.1.4**, temporary waterway crossings would be designed to be in accordance with the relevant guidelines in order to ensure conditions for fish passage are maintained (where required) |
| Demolition of the existing Ironbark Creek Bridge | Impacts to the surrounding coastal morphology may result as the existing piers form obstacles in the waterway and water would be required to flow around the structures. The removal of these structures would change water flow and direction such that instead of it flowing around the obstacle and creating an eddy (or a counter flow current where water velocity slows and sedimentation occurs) on the downstream side of the pier it would instead flow straight through the area where the structure was previously placed. This would potentially cause changes to the bank and bed morphology of Ironbark Creek immediately upstream and downstream of the structures potentially causing bank erosion and scour of the channel bed. Impacts would potentially be greater on the outside bend of Ironbark Creek where water velocities are higher however impacts are anticipated to be minor and over time the waterway dynamics would stabilise. |

| Construction activity | Potential direct impact |
|---|---|
| Installation of a temporary work platform in Ironbark Creek | The required temporary works are not expected to have a significant impact on the overall sediment transport regime of the Hunter Estuary or the tidal water exchange of the Hexham Swamp area, however the installation of the temporary work platform in Ironbark Creek could result in local erosion and accretion effects in Ironbark Creek, particularly if a severe Ironbark Creek flood event would occur during the construction phase. |
| Construction of the reclaim areas, including the abutments of the proposed Ironbark Creek Bridges | Potential to generate some turbidity, but this would be naturally mitigated to a large extent by the intertidal nature of the waterway in this location. Furthermore, the mangrove fringe located in front and to the sides of the abutment areas would act to trap fine sediments and provide a natural silt barrier for low turbidity concentrations associated with the construction process. Sediment run-off can also be managed through silt screens or similar. |
| Modification and maintenance of existing drainage systems specifically culvert outlets located on the banks of Ironbark Creek, South Channel Hunter River and the Hunter River | Localised impacts on hydrodynamic processes from changes in water flow and velocity during rain events may result, potentially causing erosion, turbidity, and sedimentation, but these would be limited to river and creek areas within 25 metres of the proposed work. |

### *Indirect impacts on coastal processes*

Construction activities that have the potential to indirectly impact on coastal processes during construction include works within 10 metres of the river banks of the Hunter River, South Channel Hunter River and Ironbark Creek. These activities include:

- Construction of the bridge abutments, retaining walls and approaches on either side of Ironbark Creek that are located on the banks of the Ironbark Creek
- Modification and maintenance of seven drainage systems (1, 2, 4, 5, 6, 15 and 21) that drain into sensitive CM SEPP Coastal Wetland areas
- The use of Construction Compounds 2 and 4 located at the northern end of the proposal, refer to **Figure 1.2**
- Temporary erosion and sedimentation controls located on the banks of the Hunter River, South Channel Hunter River and Ironbark Creek.

Localised impacts on hydrodynamic processes from changes in water flow and velocity during rain events may result, potentially causing erosion, turbidity, and sedimentation impacts however these would be limited to river and creek areas within 25 metres of the proposed work.

### Operation impacts on coastal processes

Operation of the proposal is expected to have minimal impacts on coastal processes, with minimal impact to the overall current and wave conditions within the Hunter Estuary. This includes the sections of Ironbark Creek, South Channel Hunter River and Hunter River within the REF area. The new bridges over Ironbark Creek feature abutments that are set back from the banks of Ironbark Creek and would include the installation of slender bridge piers to minimise impacts on tidal and flood flows through Ironbark Creek. There is however potential for scour around the new piers caused from localised changes in flow currents and turbulence around this section of Ironbark Creek. Scour due to the new bridges is expected to be localised in nature and confined to areas in the direct vicinity of the flood flow-exposed piers.

Tidal waterway blockage caused by the new bridge is smaller (less than one per cent of the unrestricted waterway area) when compared with the existing bridge. The area of the encroachment into the tidal waterway is about 0.85 hectares and would result in a loss of tidal storage of about 6,900 metres cubed. This loss of tidal waterway storage represents a very small percentage of the tidal prism of the river; less than 0.1 per cent of the Hunter Estuary tidal prism at Hexham Bridge. Furthermore, the areas where the abutments are proposed to be located are areas of low sediment transport activity due to their landform (ground elevations are generally above the highest average level spring tides reach) and the presence of a mangrove forest.

The proposal would impact on a small area of Mangrove Forest (about 1.58 hectares) however this equates to a very small portion of the total area of Mangrove Forests in the area and is not anticipated to cause changes in the existing sediment transport regime of the Hunter Estuary where the proposal is located.

In other areas of the Hunter Estuary, where the operation of the REF area interacts with coastal processes (i.e. the 20 drainage systems within the REF area) there is potential for localised impacts immediately downstream of the modified drainage systems. Impacts may include changes in water flow and velocity during rain events, potentially causing erosion, turbidity, and sedimentation impacts but these would be limited to river and creek areas within 25 metres of the proposed work.

There is not expected to be any material change in water levels or wave conditions operation of the REF area of the proposal. Furthermore the modification of the drainage infrastructure is not expected to significantly alter the flow current within the main river system, and the protective function of existing landforms and riparian vegetation would be maintained or enhanced.

Sections of the riverbank adjacent to the construction area may be subject to bank instabilities, particularly the section between the Ash Island Bridge and the Ironbark Creek Bridge. Scour caused by the new bridges is expected to localised in nature and confined to areas in the direct vicinity of the flood flow-exposed piers.

#### Impact of coastal hazards on the proposal

The REF area of the proposal is not considered to significantly impact on the coastal inundation hazard exposure of surrounding properties as it would not materially alter the overall propagation of storm tides within the Hunter Estuary and the impact of the REF areas of the proposal on floodwater storage during storm tide events is minimal.

### 6.5.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise coastal process impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.26**.

Table 6.26 Safeguards and management measures – coastal processes

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Bank instability during construction and operation of the proposal | Develop and review bank stability risks to the proposal as part of the detailed design. This will include planning for the management of potential scour effects in Ironbark Creek caused by the new bridges and from the modification of drainage infrastructure within the tidal waterways during construction and operation of the proposal. | Transport | Detailed design |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Coastal process impacts from in-stream construction works in Ironbark Creek | Develop and implement a Construction Coastal Impacts Management Plan to manage potential coastal process impacts resulting from temporary in-stream works in Ironbark Creek. | Transport | Prior to construction |
| Coastal process impacts from in-stream construction works in Ironbark Creek | If the design and construction methodology changes at Ironbark Creek, a consistency assessment of the coastal process impacts will be undertaken to ensure that unacceptable impacts to the value of the creek and its surroundings, resulting from the proposal are avoided. | Transport | Prior to construction |

## 6.6 Traffic and transport

The potential impacts of the proposal on traffic and transport are assessed in the *Hexham Straight Widening Traffic and Transport Assessment* provided in **Appendix P**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.6.1 Methodology

#### Overview

The traffic and transport assessment evaluates the construction and operational impacts arising from the REF area and includes consideration of the surrounding road network. Assessment of the transport and traffic impact of the proposal includes consideration of the following aspects of the transport network both during construction and operation:

- Review of the existing traffic and transport network and activity in the study area through a suite of traffic surveys
- Analysis of crash data for the study area for the most recent five-year period
- Traffic model development:
    - Forecasts for population and employment growth and inter-regional traffic growth for future years 2028 (the proposal opening year), 2038 (10 years after opening) and 2048 (20 years after opening) to develop future trip matrices
    - Develop future 'Do minimum' traffic models at opening (2028) and in future years (2038 and 2048), by developing a microsimulation traffic model which includes other network enhancements unrelated to the proposals that are already committed too or recognised as likely to be committed to
    - Develop future traffic models at opening (2028) and in future years (2038 and 2048), by developing a microsimulation traffic model which includes the proposal
- Identification of construction staging, compound locations and associated construction traffic impact were assessed
- Assessment of impact on pedestrians, cyclists and local access during construction
- Assessment of operational benefits and impact through
    - Traffic modelling to assess the broad operational traffic benefits of the proposal.
    - Qualitative and quantitative assessment of the operational impact on transport services by mode and local access

- Assessment of cumulative impact as a result of the construction and operation activities of the proposal based on the most current and publicly available information, a qualitative assessment was undertaken on approved and proposed projects in the study area.

### Road traffic assessment methodology

The modelling for the proposal was undertaken by using the pre-existing VISSIM microsimulation model developed as part of the Outer Newcastle Study and M1 Motorway extension to Raymond Terrace project. The Hexham Straight model pivots off the pre-existing model to ensure the scenarios run are specific to the proposal.

To determine a reasonable growth rate for traffic passing through the study area, forecasting of traffic growth was undertaken on a first-principles basis by relating growth in population and employment to traffic growth in the study area.

The operation of the modelled road network provides an overview of the performance of the road network and is used to identify the impact of the proposal. This impact can be seen either across the network or at individual locations (i.e. an intersection). The assessment of the REF area focuses on average network travel speed, intersection performance and queues.

The performance of an intersection and its LoS is determined by the average delay per vehicle. The performance criteria for intersections is shown in **Table 6.27**. LoS D is the target performance level generally accepted and if the performance of an intersection.

Table 6.27 LoS of service criteria

| LoS | Average delay (seconds per vehicle) | Traffic signals and roundabout operations |
|---|---|---|
| A | Less than 14 | Good operation |
| B | 15 to 28 | Good with acceptable delays and spare capacity |
| C | 29 to 42 | Satisfactory |
| D | 43 to 56 | Operating near capacity |
| E | 57 to 70 | At capacity, at signals incidents will cause excessive delays |
| F | Greater than 70 | Exceeds capacity roundabouts require other control mode |

A more detailed description of the process of traffic modelling is presented in Attachment B of **Appendix P**, including an overview of the steps undertaken, the assumptions used, and how data is passed between each stage in the traffic modelling process.

## 6.6.2 Existing environment

### Existing road network

The key state roads in the construction area include:

- Maitland Road, in the study area is about six kilometres long starting around 290 metres to the south of the intersection with the NICB at Sandgate and extending to around 760 metres north of Hexham Bridge at Hexham. The section of Maitland Road to the east of the A1 Pacific Highway intersection that is located to the south of the Hunter River and Hexham Bridge is also recognised as the Pacific Highway (A43). The section of Maitland Road to the northwest of the Maitland Road and A1 Pacific Highway intersection (south of the Hunter River and

Hexham Bridge) is also recognised as the New England Highway (A43) and the A1 Pacific Highway. The sections of Maitland Road within the construction area is generally comprised of two lanes in each direction and an 80 kilometres per hour speed limit

- NICB is located at the southern end of the proposal and provides an orbital road within Newcastle's road network to connect the Pacific Highway at Bennetts Green with the A1 Pacific Highway at Sandgate. In the study area, it is generally comprised of two travel lanes in each direction and has a speed limit of 90 kilometres per hour
- A1 Pacific Highway is located at the northern end of the proposal and includes a small section to the east of the Hunter River, the bridges over the Hunter River for northbound and southbound traffic (recognised as Hexham Bridge), the on ramps and off ramp for the A1 Pacific Highway at the intersection with Maitland Road and the section of Maitland Road to the north of Hexham Bridge. In the study area, the A1 Pacific Highway is generally comprised of two travel lanes in each direction with a speed limit of 80 kilometres per hour except for the southbound approach to Hexham Bridge where the speed drops to 60 kilometres per hour.

Key local roads in the construction area include:

- Old Maitland Road, Sandgate is a two-way, no through road that intersects with Maitland Road about 320 metres north of the NICB and Maitland Road intersection. The road has a speed limit of 50 kilometres per hour and provides access to a number of land uses including industrial properties and the Calvary St Joseph's Retirement Community at Sandgate
- Sparke Street is a two-way, no through road that intersects with Maitland Road about 300 metres north of Ironbark Creek Bridge. The road has a speed limit of 50 kilometres per hour and provides access to heavy industrial properties including a recycling centre
- Millams Road is a narrow two-way located about 110 metres to the south of Shamrock Street, Hexham on the eastern side of Maitland Road. Millams Road provides access to Kooragang Island, the Hunter Wetlands National Park and Schoolbox Road via Millams Road and a narrow bridge identified as the Ash island Bridge over the South Channel Hunter River
- Shamrock Street is a two-way road that intersects with Maitland Road in Hexham. Shamrock Street provides access to a variety of land uses including residential properties, commercial (McDonalds) and a truck port. At the end of Shamrock Street there is a railway level crossing that provides access to the rail corridor and western side of the rail tracks
- Fenwick Street is a no through road that intersects with Maitland Road about 300 metres north of the Maitland Road and Shamrock Street intersection. The road is about 100 metres long, has posted speed limit of 50 kilometres per hour and provides access to about 10 residential properties
- Merchant Street is a no through road that intersects with Maitland Road about 370 metres north of the Shamrock Street and Maitland Road intersection. The intersection only allows vehicles to turn left into and out of Merchant Street. The road is about 100 metres long, has no posted speed limit and provides access to about 10 residential properties
- Clark Street is an unpaved, no through road that intersects with Maitland Road about 500 metres north of the Shamrock Street and Maitland Road intersection. The intersection only allows vehicles to turn left into and out of Clark Street. The road provides access to a single residential property
- Old Maitland Road, Hexham is a 1.7 kilometre two-way, ring road which intersects Maitland Road at two locations in Hexham to the north and south of the Hexham Industrial Estate. The southern intersection of Old Maitland Road and Maitland Road is located to the south of Hexham Bowling Club. The northern intersection of Old Maitland Road at Maitland Road is to the north of Hexham Railway Station. The road provides access to both residential and heavy industrial properties

- Old Punt Road in Hexham is a two way 250 metre paved road without shoulders. It intersects with Old Maitland Road and provides access to a few industrial properties and the Hunter River.

Further description of the local roads along the proposal and existing intersection configuration is included in **Section 2.2.1**.

### Road safety and crash history

A total of 178 crashes were recorded along the road corridor between Maitland Road and Wallsend intersection and Maitland Road and the A1 Pacific Highway between October 2013 and September 2018. Fifteen per cent of those crashes being fatal or serious injury crashes. The most prevalent crash movement type in the corridor was found to be rear-end crashes (65 per cent). The majority of crashes involved a motor vehicle, accounting for 88 per cent of all crashes. Location which exhibit a high number of crashes include:

- A1 Pacific Highway and Maitland Road intersection (eight per cent of crashes)
- Old Maitland Road (north) and Maitland Road intersection (seven per cent of crashes)
- Midblock road section between the intersections on Maitland Road with the A1 Pacific Highway and Old Maitland Road (south) (eight per cent of crashes).

### Road traffic volumes and patterns

Traffic surveys were undertaken between 10 October 2017 and 23 October 2017 at various locations in the study area to gain an understanding of daily traffic volumes and traffic composition. The average daily traffic volumes observed on key routes throughout the network are presented in **Figure 6.5**.

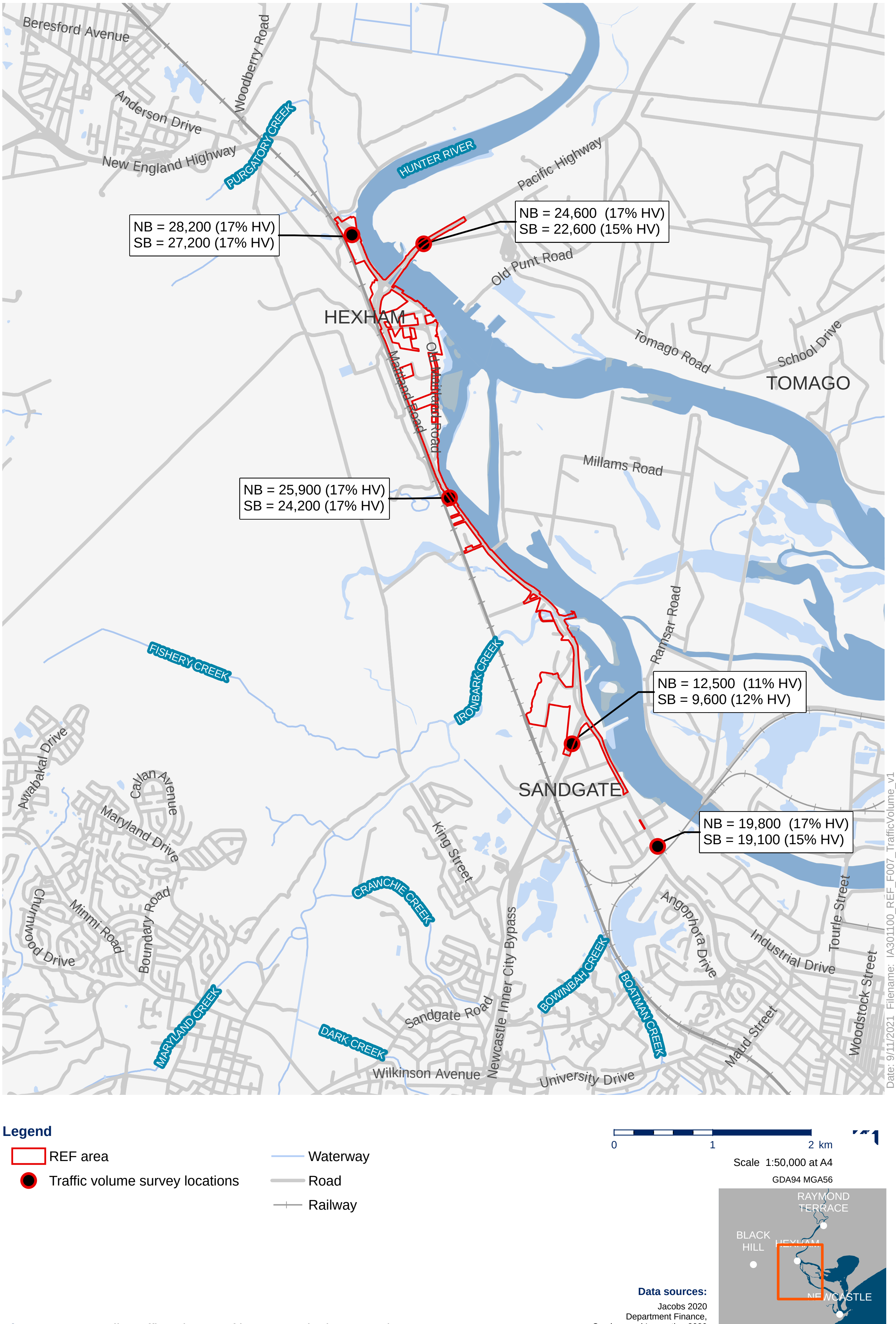



**Figure 6.5** Daily traffic volumes of key routes in the network

### Intersection performance

Intersection delays and LoS for existing intersections within the study area for the morning and afternoon peak periods are provided in **Table 6.28**. These results are based on modelled average delay for the morning and evening peak hour in the VISSIM model.

The worst performing intersection is Maitland Road/NICB intersection which operates at a LoS D and contributes to increased travel times and reduced travel speeds in the segment of Maitland Road between the section of the road located 290 metres south of the NICB and extending to Sparke Street. Overall, the intersection delay and LoS for all intersections in the study area are satisfactory operating at LoS D or better in 2017 during the peak hours.

Table 6.28 Performance of modelled intersections in 2017

| Intersection | Morning peak (8-9am) | | Evening peak (5-6pm) | |
|---|---|---|---|---|
| | Avg delay (sec) | LoS | Avg delay (sec) | LoS |
| Maitland Road and NICB | 36 | D | 50 | D |
| Maitland Road and Old Maitland Road (north of NICB) | 21 | C | 44 | D |
| Maitland Road and Sparke Street | 8 | A | 15 | B |
| Maitland Road and Shamrock Street | 16 | B | 13 | B |
| Maitland Road and Old Maitland Road (south) | 8 | A | 7 | A |
| Maitland Road and Old Maitland Road (north) | 10 | B | 8 | A |
| Maitland Road and A1 Pacific Highway | 22 | C | 7 | A |

### Public transport

A summary of the existing public transport services within the study area of the REF area is provided in **Table 6.29**.

Table 6.29 Existing public transport services

| Public transport mode | Description |
|---|---|
| Rail | • Main North Rail Line with access from two stations; Hexham and Sandgate<br>• NSW TrainLink Hunter Line between Hamilton and Scone/Dungog<br>• NSW TrainLink regional services between Sydney and Morree |
| Bus | • Route 47, which operates between Jesmond and Marketown, via Warabrook<br>• Route 140, which connects Newcastle Interchange and Raymond Terrace, via Maitland Road and the Pacific Highway<br>• Route 150[1], which connects Taree to Newcastle via Forster, Hawks Nest and Tea Gardens<br>• Route 151[1], which connects Taree to Newcastle via Forster and The Rock<br>• Route 152[1], which connects Hawks Nest and Newcastle<br>• Route 160, which connects Newcastle and Cessnock via the NICB, Maitland |

| Public transport mode | Description |
| --- | --- |
| | Road, New England Highway and John Renshaw Drive<br>• Maitland Road within the study area is also used by 22 school bus routes that provide access for students in Raymond Terrace, Maitland, Clarence Town, Woodberry and Beresfield to schools and educational facilities in Newcastle, Raymond Terrace and Maitland. |

Note 1: Routes 150, 151 and 152 do not service bus stops in the study area.

#### *Pedestrian and cycle links*

The pedestrian network in the study area is limited to the following facilities:

- On the western side of Maitland Road between the NICB and 100 metres south of the Maitland Road and NICB intersection
- The eastern side of Maitland Road between Hexham Bridge and Old Maitland Road (north).

The cycle network in the construction area is facilitated by Maitland Road shoulders which provided dedicated on road bike baths for most of the study area.

### 6.6.3 Potential impacts

#### Construction

#### *Construction staging*

Indicative construction staging plans have been developed to ensure the capacity of the roadway is maximised, and that existing capacity is not diminished where possible. Six stages have been developed for the construction works and are described in **Section 3.3.2** and shown in **Appendix D**.

#### *Construction traffic and haulage routes*

Construction related traffic would use the surrounding road network to:

- Provide access for the workforce to the ancillary sites and construction access locations
- Haul construction related materials to and from the construction access locations
- Carry equipment and materials from one area of the construction area to another.

Construction haulage routes would use Maitland Road to the north and south of the proposal or the A1 Pacific Highway to the east of the proposal or the NICB to the south-west of the proposal (refer to **Figure 6.6**). These major highways are sufficient to cater for heavy construction vehicles without imparting significant road user delay to other vehicles. Vehicles would transport materials to the four construction ancillary facilities identified in **Figure 1.2.**

Where possible, materials for the proposal would be sourced from local suppliers and it is assumed that the majority of building materials would originate from the north of the proposal from Maitland Road or the A1 Pacific Highway, which offers potential sources of fill material.

Heavy machinery would need to be transported to and from site during off peak hours to minimise road user delays due to turning movements. Oversize and overmass vehicles are likely to be escorted and travel at slower speeds than other vehicles on the existing road network and would park in the OSOM parking areas located at the southern and northern ends of the proposal, refer to **Figure 1.2**.

There are about 400 daily vehicle in and out movements expected as part of construction activities. This includes about 300 daily heavy vehicle movements and 106 construction workforce (light vehicle) movements. On average there are about 30 heavy vehicle movements and 10 construction workforce (light vehicle) in and out movements during the peak hour across the four ancillary facilities. When compared to traffic volumes along Maitland Road without construction, additional traffic volumes generated are relatively minor (refer to **Table 6.30**).

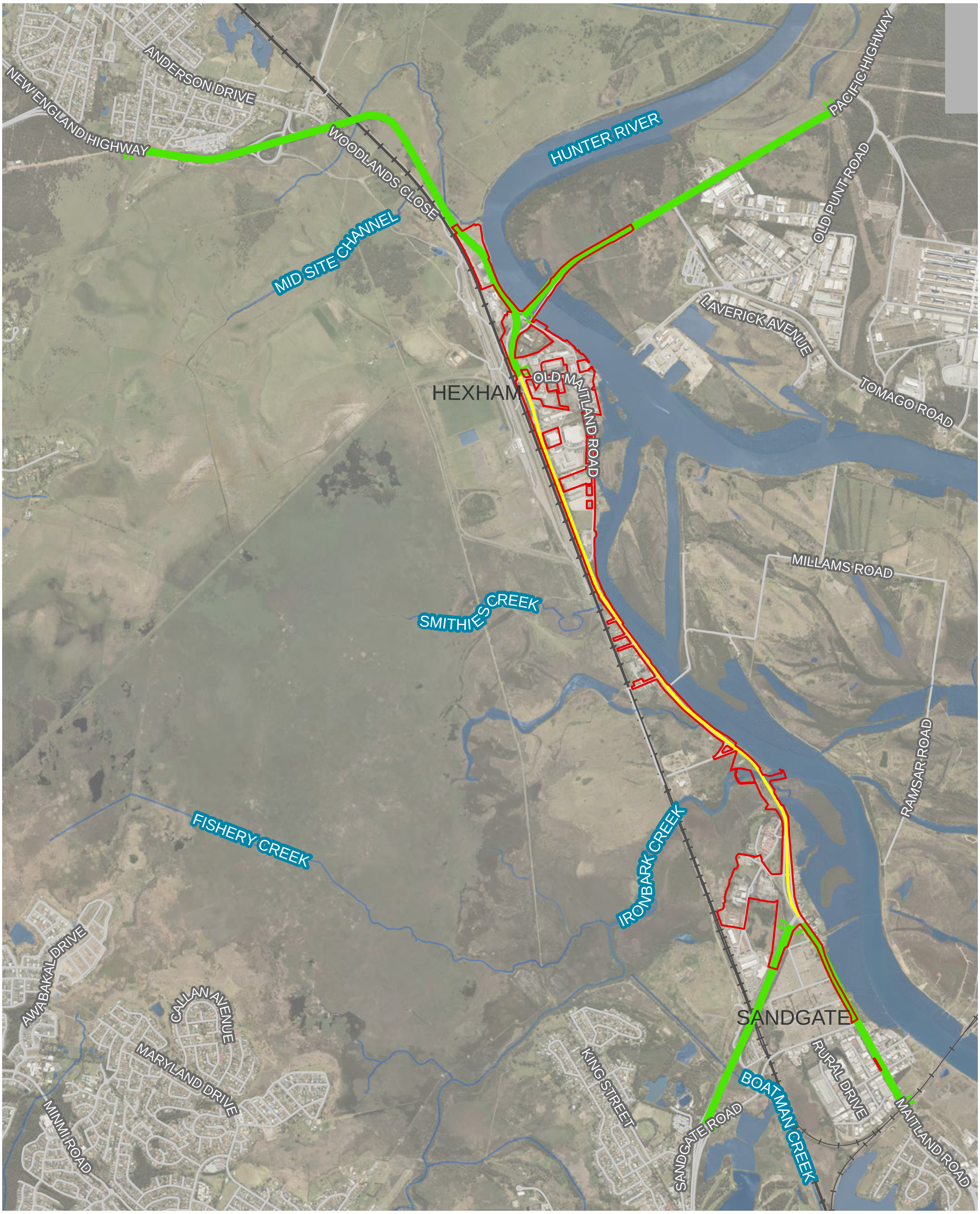
Table 6.30 Daily construction traffic movements

| Compound | Additional vehicle movements | | | |
|---|---|---|---|---|
| | Heavy vehicles | Light vehicles | Total vehicles | Peak hour vehicles |
| C1 | 121 | 42 | 162 | 16 |
| C2 | 91 | 32 | 122 | 12 |
| C3 | 45 | 16 | 61 | 6 |
| C4 | 45 | 16 | 61 | 6 |
| **Total** | **302** | **106** | **406** | **40** |

### *Travel time*

To quantify the impact upon traffic conditions on the existing road network that arise from construction activities, traffic modelling was undertaken using VISSIM to compare construction traffic models to a future base model in 2025. The models assessed a worst-case scenario, with two lanes operational in each direction throughout the construction corridor and a reduced speed limit of 60 kilometres per hour in both the morning peak and evening peak traffic conditions.

Travel time results indicate delays are to be expected under worst-case scenarios developed when compared to future base conditions in 2025. The impacts are most notable in the northbound direction in the evening peak traffic period, with the reduction from three lanes to two at the southern approach to A1 Pacific Highway and Maitland Road intersection the most significant cause of potential delays. The construction phase results display a travel time improvement for a segment of the southbound carriageway due to the reduction in lanes for construction that removes any three lanes to two merging issues. However, vehicles experience increased delays at the approach to the construction zone, which is not captured in this analysis. Vehicles may therefore be able to travel this portion of the corridor quicker in the construction phase, but they would experience lengthier delays at the approach to Hexham Straight. In the southbound direction in the evening peak and both directions during the morning peak, expected travel time delays across the extent of the proposal are within 60 seconds.



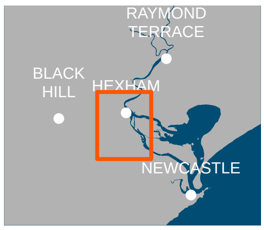

**Legend**

- REF area
- Haulage route
- Pacific Highway/Maitland Road (A43) Study Corridor
- Railway
- Road
- Waterway

0 0.5 1 km

Scale 1:40,000 at A4

GDA94 MGA56




**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.6** Construction haulage routes

Hexham Straight Widening

### *Impact on property access*

Maitland Road would remain open in both directions during the extent of construction and all movements would be maintained. All major movements at key intersections would be maintained. Some minor impacts to breaks in the median at Fenwick Street, Millams Road (Ash Island Bridge and Hunter Wetlands National Park) and at the access to Gilbert & Roach would occur during construction.

Existing pedestrian access to residential and commercial properties fronting Maitland Road would be maintained throughout the construction works.

Access to properties near the proposal would be maintained during construction, although temporary access changes may be required for some properties that have a frontage to Maitland Road. Alteration to access arrangements is likely to be required during pavement widening works being undertaken immediately in front of a driveway. This would be for a duration of one shift. Where possible, pavement widening works being undertaken immediately in front of a driveway would be completed outside of business hours to minimise impacts. In addition, local residents and businesses will be consulted prior to the commencement of the works and would be kept informed of the construction progress works and alternative routes to minimise any impacts. Traffic control personnel would be in attendance at the working area to assist with local access and egress throughout the construction works.

### *Impact on public transport*

There would be minimal impact on the function of the Main North Rail Line and rail maintenance facility during the proposal's construction. Access to Hexham Railway Station and ARTC assets via Maitland Road would be affected by road closures during the concrete and asphalt pouring for road surfacing, however, temporary measures would be adopted by the construction contractor to provide alternative commuter access points. Where this is not possible, activities would need to take place during evening and night-time periods ('out-of-hours work') to minimise disruption to rail users.

Construction staging would ensure movements are maintained in both directions along Maitland Road, therefore there would not be an impact on any of the bus routes. However, impacts to travel time can be expected.

Access to existing bus stops would be temporarily impacted during the concrete and asphalt pouring. If bus stops are required to be relocated to maintain access, bus stops would be located as close as possible to the original bus stop locations, and pedestrian pathways would be provided.

### *Impact on freight*

Construction staging would ensure that freight movements are enabled in both directions along the Maitland Road, including heavy vehicle movements. Freight vehicles users can maintain use of this major transport corridor, however, the travel reductions are also valid for freight vehicles. Overall, the provision of traffic management measures is expected to minimise the impact on the freight network.

Roadworks are not expected to impact rail freight operations on the Main North Rail Line, with road access to loading areas maintained throughout staged works and no temporary closures of rail operations required.

### *Impact on the pedestrian and cycle network*

During construction, access would be maintained for cyclists and pedestrians in both direction.

Impacts on the pedestrian and cycle network is likely to occur during construction of the proposal where alternate lanes are set up to facilitate traffic movement. Where construction activities impact pedestrian and cyclist movements, temporary measures would be adopted by the construction contractor to minimise impacts including the provision of facilities such as bridges and ramps to separate pedestrians and cyclists from proposed works and maintain safety. The provision of traffic control staff during construction hours to manage pedestrian and cyclist movements through the construction area may also be mandated during all stages of construction.

#### Impact on maritime network

Although the proposal involves the replacement of the bridge which spans Ironbark Creek with new twin bridges, impact to maritime operations from the construction of the proposal is expected to be negligible, as there is no major maritime traffic along Ironbark Creek aside for some occasional recreational vessels.

### Operation

#### *Network statistics*

A comparison of network statistics between the ‘Do minimum’ and ‘With proposal’ scenarios are provided in **Table 6.31** for 2028, **Table 6.32** for 2038 and **Table 6.33** for 2048.

Comparison of the ‘Do minimum’ and ‘With proposal’ scenarios for the 2028 horizon year shows the following:

- Substantial increase in average network speed, particularly during the evening peak period. Forecast average network speed is likely to increase by 13 per cent
- Minimal variance in total vehicle kilometres travelled (VKT) across the ‘Do minimum’ and ‘With proposal’ options. However, there is a substantial reduction in total vehicle hours travelled (VHT) of up to 12 per cent. These improvements, coupled with the constant total throughput between the ‘Do minimum’ and ‘With proposal’ models, indicate vehicles can complete the same quantity of trips but in a faster manner
- Substantial reduction in stops by up to 80 per cent, indicating traffic is smoother and not subject to flow breakdown, which means trips can complete their journey with less interruption
- During the evening period, the latent demand has decreased by about 1,000 vehicles in the ‘With proposal’ model in comparison to the ‘Do minimum’ model. All unreleased trips in 2028 are associated with the south approach at Maitland Road.

Table 6.31 Network statistics (2028)

| Network statistics | 2028 morning peak | | 2028 evening peak | |
|---|---|---|---|---|
| | Do minimum | With proposal | Do minimum | With proposal |
| Total throughput | 42,187 | 42,933 | 46,742 | 48,078 |
| VHT | 8,558 | 7,530 | 9,629 | 8,702 |
| VKT | 482,785 | 485,787 | 522,185 | 535,372 |
| Network speed (km/h) | 57 | 65 | 54 | 62 |
| Total stops | 451,083 | 88,488 | 333,762 | 142,666 |
| Latent demand | 2 | 1 | 1,549 | 534 |

Comparison of the ‘Do minimum’ and ‘With proposal’ scenarios for the 2038 horizon year shows the following:

- Substantial improvement in the operational performance of the road network is likely, up to an additional 9 per cent of vehicles can complete their trips within the modelled period. The forecasted average network speed is likely to increase by 12 per cent in the morning peak and 22 per cent in the evening peak
- VKT is likely to increase by up to 9 per cent due to more released traffic on the network compared to ‘Do minimum’ and the proposal would likely lead to a substantial reduction in VHT of up to 14 per cent
- Substantial reduction in stops of up to 78 per cent, indicating traffic is smoother and not subject to flow breakdown, which means trips can complete their journey with less interruption
- The ‘With proposal’ scenario would also relieve substantial congestion at the edge of the study area during the morning and evening peaks. Up to 2,300 vehicles, which previously were unable to enter the study area, can now enter as a result of network improvements that occur due to the proposal.

Table 6.32 Network statistics (2038)

| Network statistics | 2038 morning peak | | 2038 evening peak | |
|---|---|---|---|---|
| | Do minimum | With proposal | Do minimum | With proposal |
| Total throughput | 46,194 | 50,481 | 52,796 | 55,939 |
| VHT | 12,055 | 10,867 | 15,117 | 13,103 |
| VKT | 535,374 | 584,407 | 591,989 | 645,481 |
| Network speed (km/h) | 48 | 54 | 41 | 49 |
| Total stops | 1,335,331 | 306,039 | 1,299,529 | 616,118 |
| Latent demand | 20 | 9 | 3,546 | 1,189 |

Comparison of the ‘Do minimum’ and ‘With proposal’ scenarios for the 2048 horizon year shows the following:

- Substantial improvement in the operational performance of the road network is likely, particularly during the evening peak period. Forecast average network speed is likely to increase by up to 24 per cent in the peak periods
- VKT is likely to increase by up to 14 per cent due to more released traffic on the network compared to ‘Do minimum’ and a substantial reduction in VHT of up to 20 per cent is anticipated
- Substantial reduction in stops of up to 71 per cent in the morning peak period, indicating traffic is free flowing and not subject to congestion, meaning trips can complete their journey with less interruption
- In the ‘do minimum’ models latent demand significantly increase in 2048, this is evidence the network cannot cater for the expected volumes without proposal upgrades. While ‘Do minimum’ upgrades were implemented to reduce latent demand and provide a comparable network, levels of latent demand could not be significantly reduced without implementing the proposal itself. Overall, the proposals significantly reduce latent demand and improves throughput across the network which is supporting the strategic need for the proposal

- The ‘With proposal’ scenario would also relieve congestion at the edge of the study area, with up to 40 per cent fewer vehicles waiting to enter the network at the edge of the model during the peak periods.

Table 6.33 Network statistics (2048)

| Network statistics | 2048 morning peak | | 2048 evening peak | |
|---|---|---|---|---|
| | Do minimum | With proposal | Do minimum | With proposal |
| Total throughput | 48,161 | 53,408 | 54,147 | 58,281 |
| VHT | 18,231 | 14,612 | 19,486 | 18,051 |
| VKT | 545,367 | 620,906 | 604,784 | 678,631 |
| Network speed (km/h) | 35 | 42 | 33 | 38 |
| Total stops | 3,041,822 | 916,940 | 3,127,789 | 1,747,518 |
| Latent demand | 6,402 | 2,090 | 11,646 | 4,721 |

### *Travel time*

A comparison between the travel times from ‘Do minimum’ and ‘With proposal’ scenarios for the years 2028, 2038 and 2048 was undertaken. The proposal results in faster travel times along the Maitland Road corridor in both the northbound and southbound directions in all modelled scenarios when compared with the ‘Do minimum’ scenario. Overall, the proposal would reduce travel times on Maitland Road in the study area by about 34 per cent in 2028, about 31 per cent in 2038 and by about 27 per cent in 2048.

In the southbound direction, the most significant reduction in travel times occurs between the northern extent of the upgrades and Old Maitland Road (north). In this road section, travel time is reduced by about 60 per cent. This occurs due to the reduction in delays at Maitland Road intersection.

In the direction of peak traffic flow (southbound in the morning peak and northbound in the evening peak), travel times increase in the section of road between Old Maitland Road (north) and the southern extent of the proposed road upgrades. This is a result of increased volumes on Maitland Road that occur due to the removal of network pinch points at the northern and southern ends of the study area.

In the northbound direction in 2048, there is a slight increase in travel times. This can be attributed to an increase in northbound traffic as a greater proportion of vehicle are released from the NICB due to the provision of the third turn lane.

### *Intersection performance*

The operational performance at key intersections within the network is presented in **Table 6.34**. Analysis of the modelled intersections shows that the key differences in intersection performance are primarily at the following locations:

- A1 Pacific Highway and Maitland Road intersection located at the northern end of the proposal to the south of the Hunter River and Hexham Bridge: The proposal would substantially improve the performance of this intersection in both peak periods across all modelled years. The lane configuration from the east approach includes three left turn and two right turn lanes that operate under traffic signals. This new lane configuration is enabled by the construction of the M1 Motorway Extension to Raymond Terrace, which reduces the number of east to north traffic moments at this intersection as vehicles divert to the new motorway. Overall, the new lane configuration is designed to meet traffic demands for each approach to the intersection. This reduces the signal green time allocated to the east approach leading to increased signal green time for north-south movements on Maitland Road, resulting in greater north-south capacity and reduced delays at the intersection.

- Old Maitland Road (north) and Maitland Road intersection: The proposal includes an additional northbound and southbound lane on Maitland Road. This increases the capacity of the intersection leading to a significant reduction in delays at this intersection.
- NICB intersection and Maitland Road: The proposal provides an additional lane in the northbound and eastbound direction, adding capacity to the intersection which results in a reduction in delays and improved LoS. The provision of an additional left turn lane from the NICB leads to significant improvements in the delays and LoS for the eastbound approach.
- Shamrock Street and Maitland Road intersection and Sparke Street and Maitland Road intersection: In 2038 and 2048 the delays at these two intersections increase as a result of the proposal. This increase in delays can be attributed to an increase in traffic volume that occurs due to the release of additional trips and the change in traffic flow patterns. Furthermore, the shockwave that is formed in the southbound direction in the AM peak due to increased volumes, which is responsible for the increase in delays at these intersections. This originates just to the south of the Maitland Road and NICB intersection, where the Maitland Road and Wallsend intersection acts as a pinch point on the network.
- Traffic counts were undertaken in March 2021 at the Shamrock Street and Maitland Road intersection. Extrapolating growth from 2017 to 2021, it was found the model overestimates trips using Shamrock Street by about 20 per cent, thus the model results for Shamrock Street can be viewed as conservative. The real-world performance of the intersection is expected to be better in future years than the traffic model predicts.

All modelled intersections in 2028, 2038 and 2048 operate at a satisfactory LoS (LoS D or better) when modelled with the proposal. The proposal improves the capacity between the A1 Pacific Highway and Maitland Road intersection and the NICB and Maitland Road intersection which currently act as a pinch point. These improvements increase the traffic volume on Maitland Road leading to a slight increase in delays at the Maitland Road and Shamrock Street and the Maitland Road and Sparke Street intersection for through traffic. The approaches of minor roads such as Sparke Street, Shamrock Street and Old Maitland Road to Maitland Road do not experience lengthy delays and have suitable capacity at the traffic signals to cater for demand. Despite some increases in intersection delays, travel times over the entire length of the corridor decrease.

Table 6.34 Performance of modelled intersections with and without the proposal in 2028, 2038 and 2058

| Intersection | Year | Do minimum | | | | With proposal | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 8-9am | | 5-6pm | | 8-9am | | 5-6pm | |
| | | Avg delay (s) | LoS | Avg delay (s) | LoS | Avg delay (s) | LoS | Avg delay (s) | LoS |
| NICB and Maitland Road | 2028 | 24 | C | 62 | E | 23 | C | 33 | C |
| | 2038 | 54 | D | 72 | E | 41 | D | 27 | C |
| | 2048 | 72 | E | 58 | E | 40 | D | 32 | C |

| Intersection | Year | Do minimum | | | | With proposal | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 8-9am | | 5-6pm | | 8-9am | | 5-6pm | |
| | | Avg delay (s) | LoS | Avg delay (s) | LoS | Avg delay (s) | LoS | Avg delay (s) | LoS |
| Sparke Street and Maitland Road | 2028 | 9 | A | 21 | C | 7 | A | 7 | A |
| | 2038 | 26 | C | 20 | C | 46 | D | 7 | A |
| | 2048 | 29 | C | 22 | C | 42 | D | 20 | B |
| Shamrock Street and Maitland Road | 2028 | 22 | C | 22 | C | 11 | B | 11 | B |
| | 2038 | 27 | C | 22 | C | 38 | D | 11 | B |
| | 2048 | 28 | C | 19 | B | 39 | D | 20 | B |
| Old Maitland Road (south) and Maitland Road | 2028 | 11 | B | 11 | B | 5 | A | 8 | A |
| | 2038 | 10 | A | 17 | B | 16 | B | 8 | A |
| | 2048 | 10 | A | 14 | B | 17 | B | 16 | B |
| Old Maitland Road (north) and Maitland Road | 2028 | 45 | D | 34 | C | 5 | A | 9 | A |
| | 2038 | 44 | D | 46 | D | 5 | A | 9 | B |
| | 2048 | 44 | D | 48 | D | 10 | A | 15 | B |
| A1 Pacific Highway and Maitland Road | 2028 | 60 | E | 40 | D | 18 | B | 21 | C |
| | 2038 | 63 | E | 79 | E | 23 | C | 22 | C |
| | 2048 | 72 | E | 78 | E | 30 | C | 33 | C |

### *Impact on property access*

The proposal would impact access to a few informal locations and private properties through the closure of the median at four locations and minor changes in access arrangements. Locations with impacted accesses include:

- Closure of the median along Maitland Road at Millams Road would impact access to and from Ash Island Bridge and Hunter Wetlands National Park. Millams Road access would be left-in and left out only. Vehicles accessing Millams Road from the south would be required to travel an additional 470 metres to use the U-turn facility in Shamrock Street to access Millams Road from the north. Vehicles departing Millams Road to the north would be required to travel an additional 1.7 kilometres to the south to use the U-turn facility in Sparke Street
- The informal service road located on the western side of Maitland Road at the approach to Shamrock Street would be removed. Access to three properties (15 to 19) on Maitland Road would be maintained via new driveways constructed off Maitland Road via the shoulder
- The median on Maitland Road at Fenwick Street would be closed and the right turn into and out of Fenwick Street would be removed. Access to Fenwick Street would be left in and left out only. Vehicles accessing Fenwick Street from the north, would be required to travel an additional 840 metres and turn right at the Shamrock Street and Maitland Road intersection in order to use the new U-turn facility that would be provided on the western end of Shamrock Street. Vehicles departing Fenwick Street to travel south would be required to travel an additional 1.4 kilometres turning right at the Old Maitland Road and Maitland Road intersection

to the south of the Hexham Bowling Club and then using the new U-turn facility located about 220 metres to the north-east of the intersection. The closure of the median at Fenwick Street would impact all residential properties located to the west of Maitland Road and north of the service station

- The closure of the median on Maitland Road north of Shamrock Street and the subsequent rerouting of vehicles to the U-turn facility on Shamrock Street would result in additional vehicles on Shamrock Street. Analysis found that the closure of the medians expected to lead to about 45 additional vehicles traveling on Shamrock Street daily. Traffic counts undertaken in March 2021 indicate about 2,150 vehicles currently use Shamrock Street daily, therefore the closure of the median is expected to lead to a two per cent increase in traffic movement which is not considered significant. The Shamrock Street and Maitland Road intersection would continue to operate at a satisfactory level of service
- Closure of the median and the right-turn facility at Gilbert & Roach trucks would mean drivers would have to make a detour when accessing the facility form the south. Two options are available and include:
    - Accessing the rear of the property from Galleghan Street via Old Maitland Road (south). This would be an increase of between 200 metres but would only be available for light vehicles
    - Using the existing U-turn facility at the northern end of the proposal opposite the Oak Factory access road (heavy and light vehicles permitted) which would be increase in 2.4 kilometres. Vehicles could access the front access on Maitland Road
- Closure of the right-turn facility at Gilbert & Roach trucks would mean drivers of light vehicles accessing Industrial Galvanizers Corporation from the south are unable to perform U-turns on Maitland Road and would be required to access the property from the entrance at Old Maitland Road, or alternatively use detours proposed for Gilbert & Roach trucks discussed above
- Access to the Hexham Railway Station for northbound vehicles would be modified to include a new left slip lane about 150 metres to the south of the existing access road. For southbound vehicles travelling to the Hexham Railway Station the closure of the U-turn facility on Maitland Road opposite Truckline Newcastle would require vehicles to use Old Maitland Road (either north or south) at Hexham to access the station. A new access road has been added to the western side of the intersection of Old Maitland Road (north) and Maitland Road to Hexham Railway Station
- Closure of the median and the U-turn facility on Maitland Road opposite Truckline Newcastle at Hexham would mean drivers of light vehicles exiting the Ampol Hexham Diesel Stop and Truckline Newcastle to head north to Beresfield would be required to use turn around at the intersection of Old Maitland Road (south) and Maitland Road, increasing travel distance by up to 2.7 kilometres. Heavy vehicles would need to continue south to use the U-turn facility at Sparke Street, increasing travel distance by up to six kilometres
- Access to the Oak Factory to the north of the A1 Pacific Highway and Maitland Road intersection would be upgraded to a short left-turn slip lane from Maitland Road to provide safer access. Access southbound to this site would be via the existing right turn lane at the signalised intersection. The uncontrolled right turn 150 metres to the north of this would be removed as a solid median barrier would be in place
- Closure of the median at Brancourts Dairy along with the right in and right out movements. Access to Brancourts Dairy northbound would be maintained as left in and left out only. Access for southbound traffic would be via the existing signalised intersection of the Oak Factory southern access road. Vehicles exiting the site and travelling south would use the existing southern access signalised intersection to turn right onto Maitland Road.

No property has been identified as requiring a permanent property adjustment. All impacted driveway accesses would be reinstated following the completion of the proposal. Transport would continue to consult with affected landowners regarding access during detailed design.

### *Impact on public transport*

Widening of the existing lanes for the proposal would not affect current bus routes. The proposal would improve bus travel time reliability due to decreased congestion and improved intersection performance within the study area. Some bus stops would be relocated to provide safer connectivity and access (refer to Section 5.3.2 of **Appendix P**).

There would be no impact to the function of the Main North Rail Line and rail maintenance facility during the proposal's operation. Vehicular access to the Hexham Railway Station for northbound vehicles would be modified to include a new left slip lane about 150 metres to the south of the existing access road. For southbound vehicles travelling to the Hexham Railway Station the closure of the U-turn facility on Maitland Road opposite Truckline Newcastle would require vehicles to use Old Maitland Road (either north or south) at Hexham to access the station. A new access road has been added to the western side of the intersection of Old Maitland Road (north) and Maitland Road to Hexham Railway Station.

### *Impact on pedestrian and cycle links*

The proposal includes upgraded pedestrian crossing facilities at some of the signalised intersections along Maitland Road and including:

- Across the eastbound and westbound lanes of the NICB and across the northbound travel lanes of Maitland Road
- Across the north bound and southbound Maitland Road travel lanes to the north of the U-turn crossing near Calvary St Joseph's Retirement Community entrance
- Across the northbound access road into Sparke Street
- At Shamrock Street intersection across the northbound and southbound Maitland Road travel lanes and across the eastbound and westbound Shamrock Street travel lanes
- At Old Maitland Road (south) intersection across the northbound and southbound Maitland Road travel lanes
- At the A1 Pacific Highway intersection across the northbound and southbound Maitland Road travel lanes and across the A1 Pacific Highway travel lanes into Newcastle
- At the Oak Factory access road, two signalised pedestrian crossings are proposed and includes one across the northbound access road into the Oak Factory and one across the eastbound and westbound travel lanes of the Oak Factory access road and the Maitland Road intersection.

These changes to the pedestrian network would improve connectivity, improve desire lines and provide safer access to bus stops, Hexham Railway Station and adjacent commercial and industrial properties.

The proposal includes a dedicated two metre-wide shoulders for cyclist which would improve cycle connectivity through the study area and encourage an increased mode share to cycle.

The proposal also includes changes to the cycling network in the following locations:

- The short cycle lane at the east approach to the A1 Pacific Highway and Maitland Road intersection would be removed. This would be replaced with off-road provisions at the intersection which would connect to the off-road shared path located on the eastern side of Maitland Road between the A1 Pacific Highway and Maitland Road intersection and the Old Maitland Road (north), the rail access maintenance road and Maitland Road intersection

- The dedicated-on road cycle lane at the northern approach to the A1 Pacific Highway intersection and Maitland Road would be removed. A shoulder would be provided at the intersection for southbound cyclists to use
- A new 900 metre shared user path along Maitland Road on the western side of Maitland Road north of the Oak Factory access road and the Maitland Road intersection A new 900 metre shared user path along Maitland Road on the western side of Maitland Road north of the Oak Factory access road and Maitland Road intersection.

#### *Impact on freight*

The proposal would substantially improve the operation of road freight within the modelled area by substantially reducing delays and travel times. The proposal would reduce travel times on Maitland Road in the study area for freight by about 30 per cent in future years. Furthermore, the proposal would also reduce the total number of stops made by vehicles in the network, which results in freer flowing traffic and greater efficiency of heavy vehicle operations.

#### *Road safety*

The proposal includes separated travel lanes with a central median with solid barrier, which would improve safety for all road users (including cyclists and pedestrians). The proposal would generally improve road safety by:

- Improving traffic flow, reducing the number of stops vehicles make leading to a decreased risk of rear end crashes
- Removal of the southbound merge to the south of the Old Maitland Road (south) and Maitland Road intersection would decrease lane change crashes
- Improvements to the cycle network at the northern end of the proposal through improved cycling infrastructure would reduce the risk of cyclist crashes in this location
- Removal of uncontrolled U-turn provisions.

### 6.6.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise traffic and transport impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.35**.

Table 6.35 Safeguards and management measures – traffic and transport

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Impacts to traffic during construction | A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the T*raffic Control at Work Sites Manual* (Roads and Traffic Authority, 2010) and *QA Specification G10 Control of Traffic*. The TMP will include:<br>• Confirmation of haulage routes<br>• Measures to maintain access to local roads and properties<br>• Site specific traffic control measures (including signage) to manage and regulate traffic movement<br>• Measures to manage temporary changes to the road network including use of barriers or lane occupancies<br>• Measures to maintain pedestrian and cyclist | Contractor | Prior to construction/ construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| | access (including communication, signage and alternative routes)<br>• Requirements and methods to consult and inform the local community of impacts on the local road network (including for out of hours work)<br>• Access to construction areas including entry and exit locations and measures to prevent construction vehicles queuing on public roads<br>• A response plan for any construction traffic incident<br>• Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic<br>• Any licences or permits required before starting activities<br>• Monitoring, review and amendment mechanisms. | | |
| Property access during construction | Property access will be maintained at all times during construction. Any changes to access arrangements or alternative access required during construction to be done in consultation with the landowner and will provide the same equivalent pre-existing level of access unless agreed to. Consultation with landowners on property access to continue during detailed design and construction. | Transport/ Contractor | Detailed design/ prior to construction/ construction |
| Access | Where any legal access to property is permanently affected, arrangements for appropriate alternative access will be determined in consultation with the affected landowner and local road authority. | Contractor | Post-Construction |
| Pedestrian and cyclist access during construction | Pedestrian and cyclist access will be maintained throughout construction. Where maintaining access is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the local road authority. | Contractor | Construction |
| Access to bus stops and public transport during construction | Access for public transport services, including school bus services, will be maintained where possible. The requirements for any temporary changes will be confirmed following consultation with local bus operators and the community. | Contractor | Prior to construction/ construction |
| Impacts to traffic from construction traffic | Haulage vehicle movements will be planned to minimise movements on the road network during the morning and evening peak periods where practicable. | Contractor | Prior to construction/ construction |
| Road closures, diversions or reconfigurations during construction | During any road closures, diversions or reconfigurations of the road and cycle network relevant consultation will be carried out with Transport, Local Council (where relevant), emergency services and public transport authorities. | Contractor | Prior to construction/ construction |
| Impacts to road users from changed traffic arrangements, | Road users and local communities will be provided with timely, accurate, relevant and accessible | Contractor | Prior to construction/ construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| traffic delays and disruptions during construction | information about changed traffic arrangements and delays due to construction activities. | | |
| Damage or impacts on local road infrastructure during construction | Pre-construction and post construction road condition reports for local roads likely to be used for construction will be prepared. Any damage resulting from construction (not normal wear and tear) will be repaired unless alternative arrangements are made with the relevant road authority. Copies of road condition reports will be provided to the local roads authority. | Contractor | Prior to construction |

## 6.7 Aboriginal heritage

Potential impacts of the proposal on Aboriginal heritage items have been assessed in the *Hexham Straight Widening Aboriginal Archaeological Survey Report*, the *Hexham Straight Widening Aboriginal Cultural Heritage Assessment report* (ACHAR) and the *Hexham Straight Upgrade Aboriginal Cultural Values Assessment Report*. These reports are provided in **Appendix I**. These reports were prepared in accordance with Stage 2 and Stage 3 respectively of the PACHCI. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.7.1 Methodology

#### Desktop assessment

A desktop assessment was undertaken to review online databases and literature sources, including:

- AHIMS database
- Newcastle LEP
- National Native Title Tribunal (NNTT) Register of Native Title Applications, Registration Decisions and Determinations.

#### Survey strategy and recording methodology

The study area is largely comprised of the immediate road verges of Maitland Road, and areas surrounding Hexham Bridge and Ironbark Creek Bridge. Much of the study area exhibits high levels of disturbance.

The survey strategy included two sampling strategies:

- Vehicle traverses: vehicle traverses were utilised to inspect sections of the study area where pedestrian survey was not required due to clearly observable disturbance
- Pedestrian survey: targeted pedestrian survey was undertaken for areas identified as archaeologically sensitive. The survey team comprised four to five people with a survey coverage width of five to ten metres.

The methodology for identifying and recording Aboriginal sites is in accordance with the *Due Diligence Code of Practice* (DECCW, 2010a), with any sites identified to be recorded using a hand-held non-differential GPS unit (MGA94 Zone 56).

Detail regarding the survey methods used at each survey unit (SU) location is provided in Table 4.2 of **Appendix I**.

### Aboriginal consultation

The process of consultation with Aboriginal stakeholders for the proposal has been undertaken in accordance with The *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010c). The stages of consultation and their outcomes include:

- Notification of registered Aboriginal parties
- Presentation of information and gathering cultural information
  - Project information and methodology review
  - Aboriginal focus group meeting
- Review of draft Aboriginal Cultural Heritage Archaeology Report.

### Cultural values assessment

The cultural values assessment has been completed in accordance with the following documents:

- Stage 3 of the PACHCI
- Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (DECCW 2011).

The detailed cultural assessment of the study area included:

- Archival research was undertaken in a range of national, state, and local institutions to provide the historical and ethnographic context for the assessment
- Analysis of the ethnographic literature and historical record was undertaken to provide a contextual understanding to allow for the interpretation and assessment of the cultural information
- Consultation (refer further to **Section 6.7.3**), including:
  - The identification of cultural knowledge holders for the REF area through consultation with RAPs and other stakeholders
  - Consultation with the identified knowledge holders regarding the cultural values of the study area.

## 6.7.2 Existing environment

### Desktop assessment

A search of the AHIMS database was completed on 13 March 2019 (ID 405932) searching an eight kilometre by eight kilometre area centred on the study area (**Appendix I**). The search area was sufficient to define the pattern of previously recorded Aboriginal sites in the landscape. No AHIMS sites are located within the study area.

The study area is located in the City of Newcastle LGA. There are no declared Aboriginal places or archaeological sites listed in Schedule 5 Environmental Heritage of the Newcastle LEP within the study area.

A search of the NNTT Register of Native Title Applications, Registration Decisions and Determinations completed on 13 March 2019 identified no determined native title or land claims over the study area.

The distribution of Aboriginal sites supports environmental and ethnographic data which suggests that whilst the floodplains of the Hexham River and surrounding Hexham Swamp would have representing valuable resource gathering areas, they would have been too wet for camping by Aboriginal people. The prevalence of Aboriginal sites, specifically artefact scatters, on elevated landforms surrounding the riverine and estuarine environments reinforces that well-drained areas overlooking these resource gathering locations, were targeted by Aboriginal people as more suitable for longer term occupation.

### Environmental context

The environmental context of the study area, as evidenced by landform and soil data and historical sources, consisted of tidal channels, tidal flats and mangrove swamps, with more prolonged standing water than at present (Dean-Jones 1992). As a result, poorly drained areas such as the Hunter Floodplain and Hexham Swamp would have been too wet for camping by Aboriginal people. However, these low-lying, riverine and estuarine environments would have provided Aboriginal people with an abundant source of floral and faunal resources, particularly bird and reptile species, which would have been readily exploited (Albrecht 2000; National Parks and Wildlife Service 2008).

Utilisation of tidal channels, flats and swamps by Aboriginal people would inevitably have resulted in some cultural evidence being deposited over time within the study area. However, due to the flow dynamics of such a complex hydrological environment, the study area is situated within a highly active environment which is unlikely to feature any archaeologically significant soil integrity. In combination with the prevalence of Aboriginal objects made from organic materials and highly acidic soils within the proposal local area, the likelihood of Aboriginal sites being preserved within the study area is very limited. More elevated and well-drained areas overlooking these resource gathering locations, which begin to appear outside of the study area, would likely have been targeted by Aboriginal people as more suitable for camping.

High levels of disturbance within the study area would have had a deleterious impact upon the material traces of past Aboriginal land use and has likely removed any significant traceable archaeological material. In addition to construction related activities, disturbance of the study area also includes that associated with the placement of a number of underground utilities within the road corridor, including water, sewer and high-pressure gas mains, as well as communications services, which have been installed at depths of up to three metres.

### Archaeological survey results

On Monday 8 April and Tuesday 9 April 2019, an archaeological survey of the study area was completed. The main aims of the survey were to identify Aboriginal sites if present and characterise the landscape to aid predictions of subsurface archaeological potential.

#### *Aboriginal sites*

No Aboriginal sites were recorded within the REF area as a result of the survey, however one Aboriginal site, Hexham Straight Isolated Find 1 (HS-IF 1), was recorded as a result of the survey in the EIS area. The isolated find was located about 17 metres from the edge of existing pavement on the water edge of the Hunter River. A proposal wide Aboriginal Heritage Impact Permit (AHIP) would be sought for the proposal area, refer further to the Hexham Straight Widening EIS and the ACHAR included as **Appendix I**.

No additional artefacts were identified and disturbance at the location was evident by fill material clearly visible in the area surrounding the artefact including brick and concrete construction items.

#### *Other items*

Areas of shell material were identified within the study area in proximity to the Hunter River and Ironbark Creek, however the areas identified were not considered to be representative of Aboriginal occupation.

Beneath Hexham Bridge, multiple lenses of shell material were visible in an eroded cross section adjacent to the Hunter River within the tidal zone. Shell species were very small averaging less than ten millimetres in diameter, and no artefacts or other cultural material was identified in association. It was clearly observable that the lenses of shell are situated on top of fill used in the area to reclaim floodplain and elevate the landform to enable construction. This stratigraphy demonstrates that the shell material represents naturally occurring shell deposits, common within riverine and estuarine environments, which have formed post-construction and are not Aboriginal midden cultural sites.

A discrete area of low-density shell material was also identified in the northern creek embankment of Ironbark Creek. The shell species were very small (less than ten millimetres in diameter), with no distinct layers of shell material visible and no artefacts or other cultural material identified in association. The shell material is located in a section of Ironbark Creek which has been subjected to very high levels of disturbance associated with the construction of various bridges (refer further to **Section 6.8.2**).

### *Cultural values*

Consultation with the cultural knowledge holders identified the study area as being situated within a rich cultural landscape that holds value and significance to the Aboriginal communities of the region. Consideration of the available ethnographic and historical sources shows that cultural values are located throughout the study area and has identified three key elements that hold cultural value and significance include:

- The Burraghihnbihng Wetlands
- Hunter River and estuary islands
- Water Spirit (Bunyip or Wau-wai, Yaa-hoo or Wowee Wowee).

A description of these three cultural values is included in **Table 6.36** and these cultural values apply across the study area as a whole.

Table 6.36 Summary of Aboriginal cultural values

| Cultural value item | Summary | Description |
|---|---|---|
| Burraghihnbihng Wetlands | A rich traditional cultural resource area that extended across the study area. | Burraghighnbihng is valued as a rich resource area that supported the traditional lifeways of Aboriginal people in the region. The resources of this area are understood as having contributed to supporting the traditional large-scale ceremonial gatherings that brought together people from across the wider region. |
| Hunter River and estuary islands | The Hunter River is a traditional travel route and Songline. The Hunter River and the estuary islands were rich resource areas. | The Hunter River holds cultural value throughout its length as a traditional travel route, the patterns of movement holding cultural value for their association with resource use, community gatherings and ceremonial cycles. The estuary islands of the Hunter River hold cultural value as rich resource areas that were extensively utilised by Aboriginal people. |
| Water Spirit (Bunyip or Wau-wai, Yaa-hoo or Wowee Wowee). | A Spirit Being that lives in waterways and swamps including Burraghihnbihng. | The Bunyip or Wau-wai, Yaa-hoo or Wowee holds cultural value as a Dreaming Spirit Being. |

### 6.7.3 Aboriginal consultation

Aboriginal consultation has been undertaken in accordance with Stage 2 and Stage 3 of the PACHCI. Further details on the methodology and a summary of the issues raised by the Aboriginal community is provided in **Section 6.7.3**.

### 6.7.4 Significance assessment

All Aboriginal objects in NSW are protected under the *National Parks and Wildlife Act 1974*. It is recognised that harm to Aboriginal sites may be necessary to allow other activities or developments to occur. In order for the consent authority to make informed decisions on such matters, an important element of cultural resource management is determining the significance of cultural heritage places and objects to understand what may be lost, and how best it can be mitigated.

Cultural significance is outlined in Article 1.2 of the Burra Charter as ‘aesthetic, historic, scientific, social or spiritual value for past, present or future generations’ (Australia ICOMOS 2013). ‘Non-archaeological Aboriginal heritage values’ refer to places which have meaning in accordance with memory or tradition but are not necessarily associated with cultural objects. These sorts of places are described as ‘intangible sites’ and include any socio-cultural or historic values related to historically important persons, events, phases or activities in the Aboriginal community.

Awabakal LALC and Mindaribba LALC provided the following statements regarding the cultural values (tangible and intangible) of the study area:

> *“Significant spiritual or social areas and significant cultural landscape features are throughout the whole study area. Song lines. Shell middens located under the north bound bridge. Oxidised clay used for ceremony found along the Hunter River banks… A variety of flora and fauna would of been available due to the cultural significance of the landscape”* – Mindaribba LALC)
>
> *“Both the Hexham swamp and the Hunter River are major cultural landscape features to the Awabakal people, because of the heavy occupation by their ancestors, living and surviving on an abundance of natural food and freshwater resources*” – Awabakal LALC.

Aboriginal sites with archaeological evidence are all of value to the Aboriginal community through the tangible connection that they represent with pre-colonial Aboriginal land use.

The proposed proposal impacts would result in minimal cumulative change to the current appearance of the study area and to the identification of intangible cultural values.

### 6.7.5 Potential impacts

It is assessed that the proposal has low potential to impact any additional Aboriginal sites. Due to the high level of disturbance, it is anticipated that there is a low potential for intact archaeological deposits to remain within the study area.

The REF area would not impact on any tangible Aboriginal sites or items but is located within areas identified as having Aboriginal cultural values. This includes the three cultural value identified as the Burraghihnbihng Wetlands, Hunter River and estuary islands, and Water Spirit (Bunyip or Wau-wai, Yaa-hoo or Wowee Wowee) identified in **Table 6.36**. In recognition of these cultural values and their significance the Cultural Values Assessment report recommends

- A project specific Aboriginal cultural heritage interpretation plan be developed in consultation with the RAPs and identified Aboriginal knowledge holders to promote understanding and awareness of the cultural heritage values of the study area. The plan would guide the development of interpretative signage on the cultural values of the area and any additional opportunities for input into (aesthetic) design elements and opportunities for dual naming to reflect the Aboriginal cultural values of the area. It is recommended that the interpretative signage be developed by an interpretative specialist in consultation with an intangible cultural heritage specialist, the identified Aboriginal cultural knowledge holders, and the RAPs.

### 6.7.6 Safeguards and management measures

The environmental management measures that will be implemented to minimise Aboriginal heritage impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.37**.

Table 6.37 Safeguards and management measures –Aboriginal heritage

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Aboriginal heritage | An Aboriginal Heritage Management Plan (AHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Aboriginal heritage. | Contactor | Detailed design/ prior to construction |
| Aboriginal heritage | The *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime Services, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Aboriginal origin are encountered.<br>Work will only re-commence once the requirements of that Procedure have been satisfied. | Contactor | Detailed design/ prior to construction |
| Human skeletal remains | The following protocol must be followed in the event that suspected human remains are identified:<br>• All works in the immediate vicinity must cease and the area protected by suitable curtilage<br>• The remains will be immediately reported to the work supervisor who will immediately advise the Transport Project Manager, Environment Manager and/or other nominated senior staff member<br>• The Transport Project Manager or Environment Manager will promptly notify the NSW Police (as required for all human remains discoveries)<br>• If the remains are identified as Aboriginal ancestral remains, Transport will coordinate consultation with Heritage NSW and RAPs to discuss ongoing care of the remains. | Contractor | Construction |
| AHIP | The AHIP application will be made for the overall proposal area. | Transport | Prior to construction |
| Cultural awareness training | Completion of cultural heritage awareness training will be a requirement of the CEMP for all employees and contractors during project construction. | Contractor | Prior to construction/ construction |
| Aboriginal cultural heritage | The development of an Aboriginal cultural heritage interpretation plan to promote understanding and awareness of the cultural values of the study area, including, but not limited to, development of interpretative signage. | Contractor | Detailed design/ prior to construction |

## 6.8 Non-Aboriginal heritage

Potential impacts of the proposal on non-Aboriginal heritage items have been assessed in the *Hexham Straight Widening Statement of Heritage Impact* (SoHI) which is provided in **Appendix J.** The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.8.1 Methodology

#### Overview

The methodology for undertaking the assessment of non-Aboriginal heritage values for the proposal is described below.

- Undertaking a desktop assessment, including:
    - Reviewing heritage registers and databases including the State Heritage Register, State Heritage Inventory, Local Environmental Plan, Section 170 Registers, Cultural Commonwealth Heritage List, National Heritage List
    - Reviewing primary and secondary sources including parish maps, Transport archives, library, heritage and archaeological databases, community heritage information, previous studies and grey literature
    - Reviewing levels of significance for registered items
    - Identifying any potential heritage items.
- Undertaking a site inspection of study area, including inspecting any potential heritage items
- Preparing and collating data including preparation of site inspection recording forms for each item inspected that describes the physical detail, location, setting, fabric, current use and associated features
- Undertaking a non-Aboriginal (historic) heritage assessment of identified heritage items in accordance with the SEARs for the EIS area. The outcomes are discussed in the EIS
- Completing a high-level impact assessment of identified heritage
- Providing recommendations as to any additional works such as archival photographic recording or heritage approvals or notifications that may be required prior to works commencing
- Providing recommendations that would help to avoid, minimise or mitigate against impacts to the identified cultural heritage values of the heritage item.

### 6.8.2 Existing environment

#### Overview

The area of Hexham has been settled by non-Aboriginal people since the mid-19th century. Although the region was historically agricultural, its importance as a crossing point came with the punt across the Hunter River in 1843. The village became a local commercial centre, with churches, a school, a lock-up and other buildings being constructed. The railway station at Hexham is a testament to its local importance.

Most of the heritage items in Hexham relate to this early period of its history. Most of these buildings were located along the various historical alignments of Maitland Road, indicating that some archaeological potential exists in the vicinity of these alignments, as well as the potential for archaeological works related to the previous road fabric and alignments.

### Listed non-Aboriginal heritage items

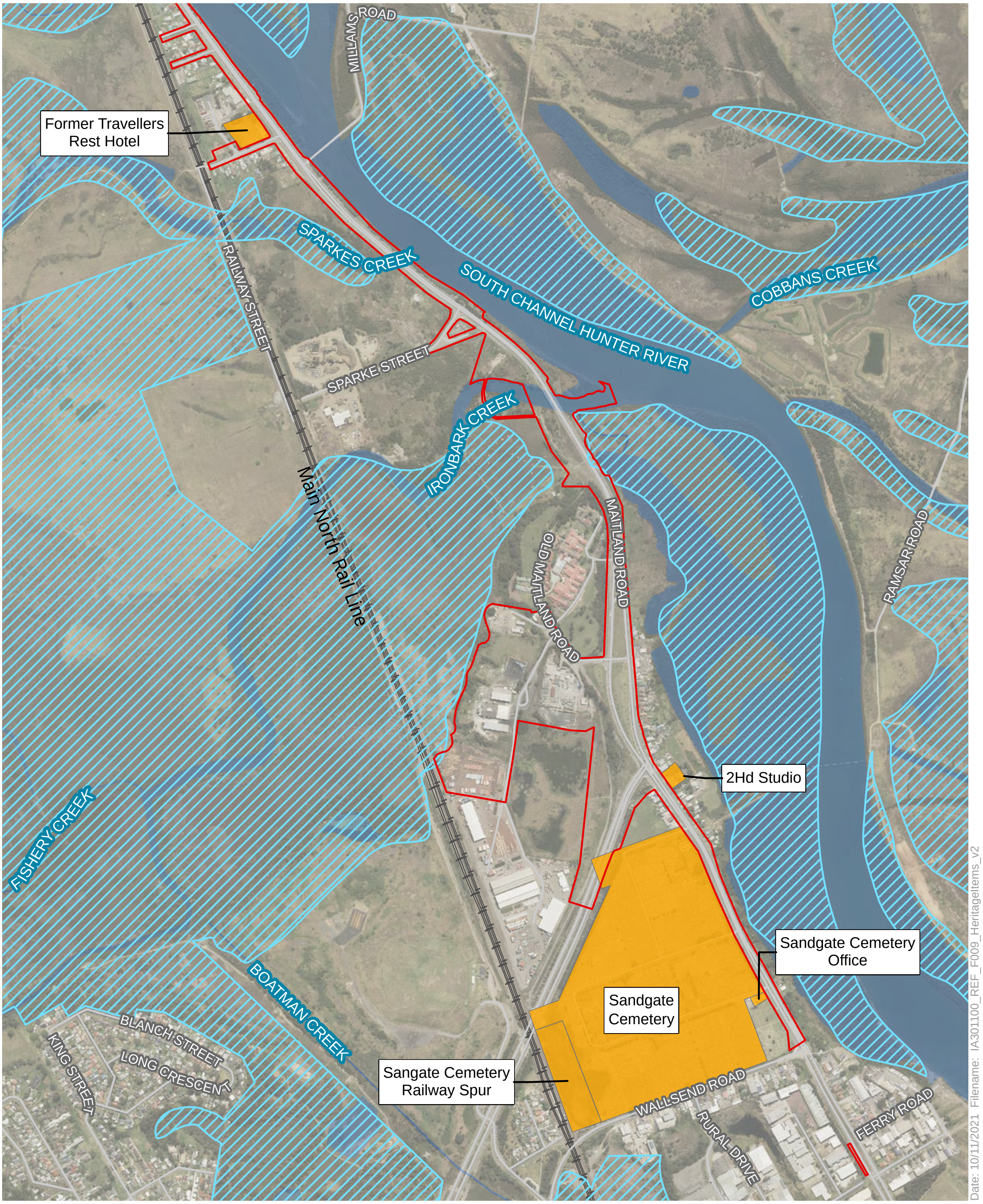
Database searches were completed for the construction area, with a buffer of 500 metres. The results were:

- No World, National and Commonwealth heritage
- No State heritage
- Sixteen items of local heritage within 500 metres of the study area (refer to **Appendix J**) and summarised in **Table 6.38** and shown in **Figure 6.7**.

There is one unlisted non-Aboriginal heritage item within the EIS area with the potential to be impacted, which is identified as the Ironbark Creek crossing point. This item has been assessed as being of local significance.

Table 6.38 Listed heritage items within the vicinity of the REF area

| Item | Address | Identifier | Distance from REF area |
|---|---|---|---|
| Sandgate Cemetery | 108 Maitland Road, Sandgate | I516 | Intersecting |
| Office – Sandgate cemetery | 116 Maitland Road, Sandgate | I518 | Adjacent |
| Sandgate Cemetery Railway Spur | 108 Maitland Road, Sandgate | I517 | 325 metres southwest |
| 2HD Studio | 173 Maitland Road, Sandgate | I519 | Adjacent |
| Former Travellers Rest Hotel | 23 Maitland Road, Hexham | I177 | Adjacent |
| Former Uniting Church and Hall | 63 Old Maitland Road, Hexham | I182 | Adjacent/encompassed |
| Former Glen Lovett Hall | 187 Maitland Road, Hexham | I184 | Adjacent/encompassed |
| Former Hexham Public School | 227 Old Maitland Road, Hexham | I185 | Adjacent/encompassed |
| J & A Brown's Hexham Workshops | 100 Old Maitland Road, Hexham | I183 | Adjacent/encompassed |
| Goninans Administration Building | 230 Old Maitland Road, Hexham | I186 | Adjacent/encompassed |
| Minmi to Hexham Railway | Minmi to Hexham | I332 | 28 metres west |
| Railway Station | Maitland Road, Hexham | I176 | Intersecting |
| Hexham Bridge | Pacific Highway, Hexham | I187 | Intersecting |
| Oak Factory | 189 Maitland Road, Hexham | I178 | Adjacent |
| Hexham Shipbuilding Yards | 404 Maitland Road, Tarro | I180 | 25 metres north |
| Hannel Family Vault | 398B Maitland Road, Hexham | I179 | Adjacent |




Legend

REF area

Register of the National Estate (RNE)

Hunter Estuary Wetlands

LEP Local Heritage items

Item - General

Road

Waterway

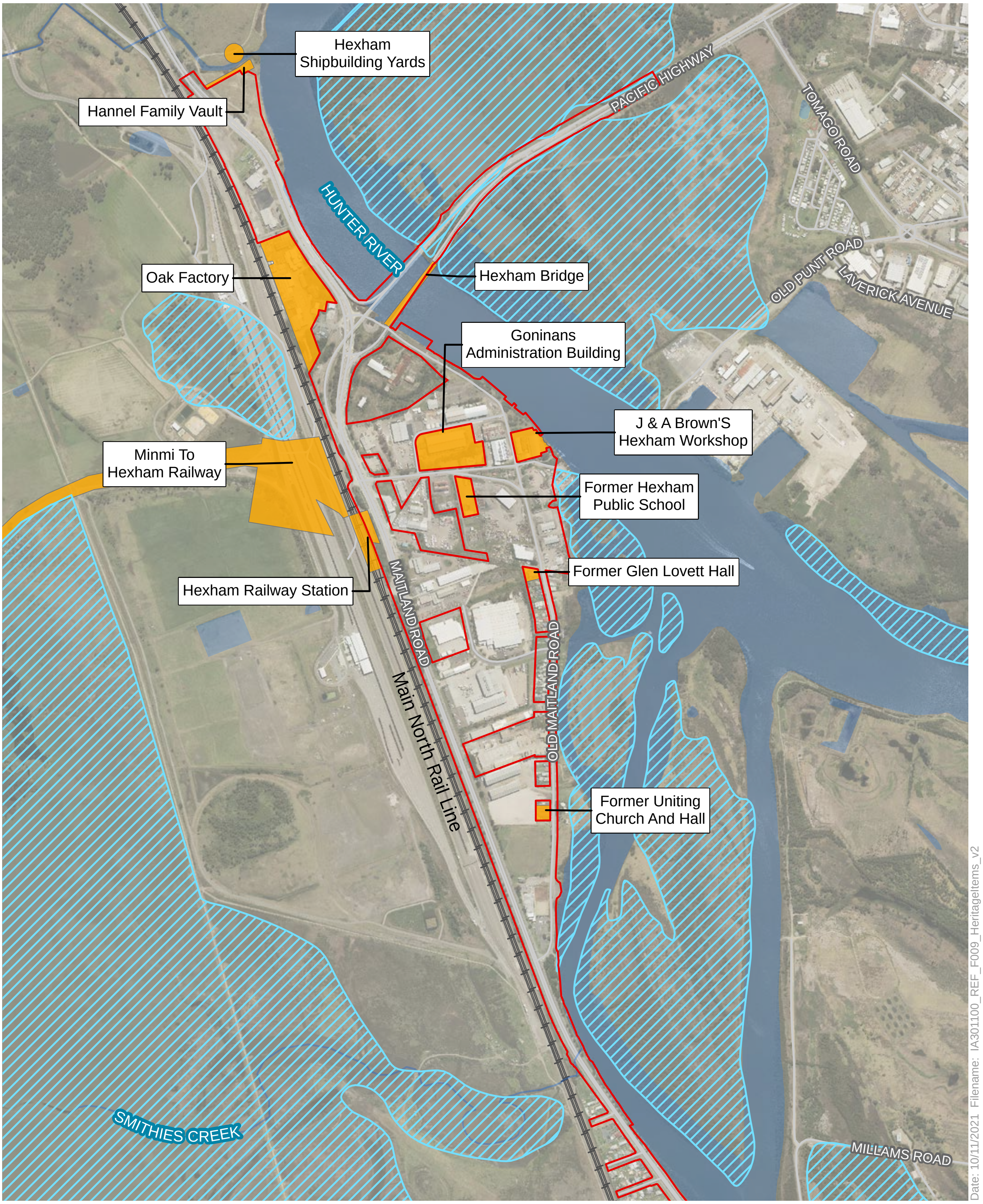
Railway


Scale 1:15,000 at A4

GDA94 MGA56


**Data sources:**
Jacobs 2020
Department of Finance, Services and Innovation 2020

**Figure 6.7a** Items of local heritage significance




**Legend**

REF area

Register of the National Estate (RNE)
Hunter Estuary Wetlands

LEP Local Heritage items
Item - General

Road
Waterway
Railway

0 200 400 m
Scale 1:15,000 at A4
GDA94 MGA56


**Data sources:**
Jacobs 2020
Department of Finance, Services and Innovation 2020

**Figure 6.7b** Items of local heritage significance

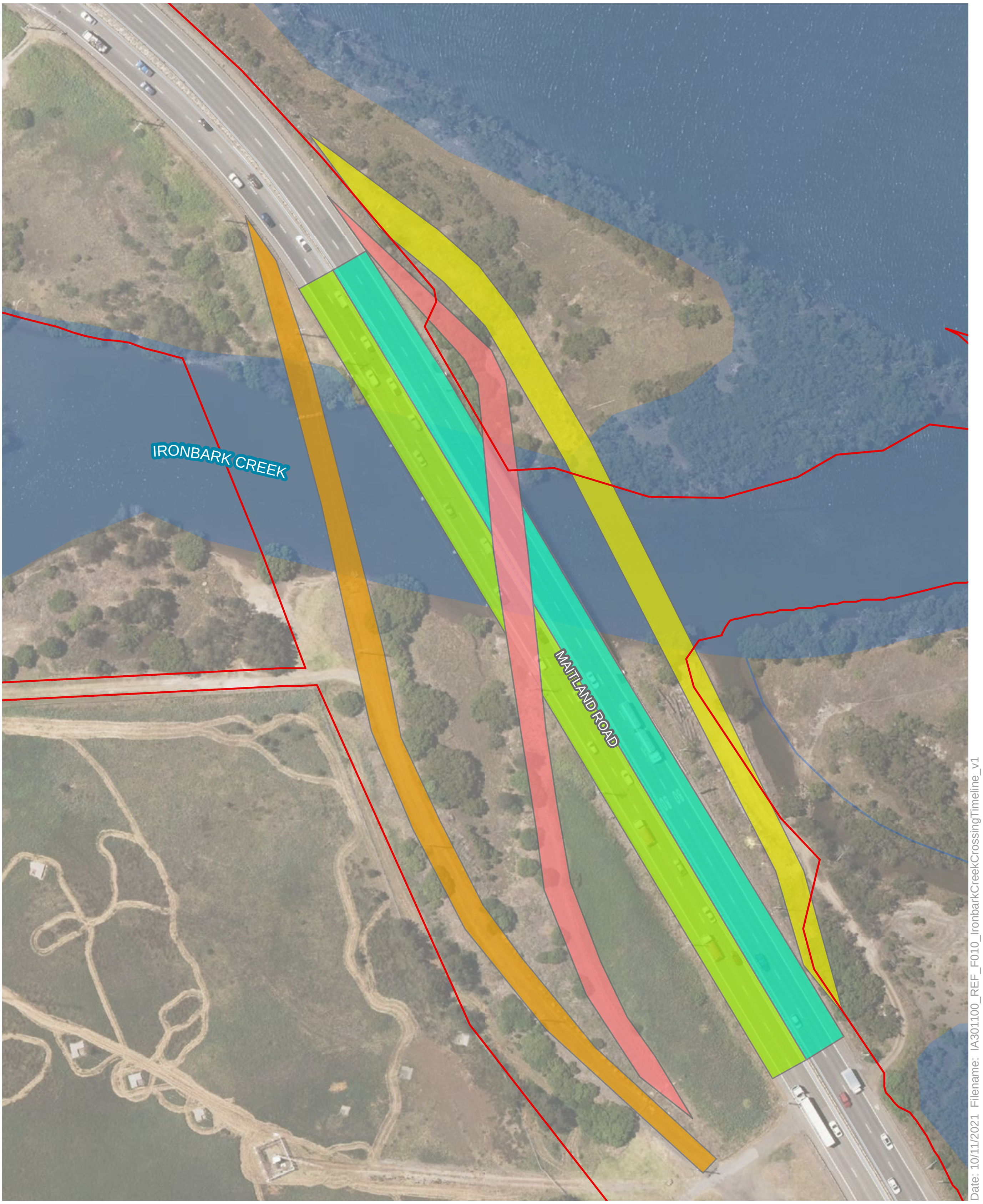
### Archaeological potential

Archaeological potential is generally considered to be low. However, the crossing of Ironbark Creek may contain the remains of earlier bridges. Periodic flooding has required multiple bridges to be constructed, one such bridge famously collapsing in 1955. While the locations of some of these later bridges are known, potential exists for the remains of other, earlier bridges to remain on either side of the Ironbark Creek.

A summary of the historical change to the crossing point is provided in **Table 6.39** and the location of the former bridge alignments is shown in **Figure 6.8**.

Table 6.39 Summary timeline of the Ironbark Creek crossing point

| Year | Crossing details | Summary | Archaeological potential |
|---|---|---|---|
| Pre-1827 | Pre-European arrival, traditional land usage by the traditional inhabitants | Ironbark Creek and the Hexham Swamps would have provided valuable resources by the local Aboriginal people. | No evidence of crossing. |
| 1827-1842 | No formal bridge, corduroy causeway or other informal stabilisation. | Early survey maps show no bridge across Ironbark Creek, most likely a corduroy causeway or other informal crossing. | Timber remnants of a potential corduroy crossing were identified during the field survey. |
| 1873-1875 | Two 28 foot (ft) timber beam approach spans with one 90 ft timber truss span | Timber truss bridge constructed. If there was a bridge prior to this time at the site, it is not shown in the publicly available documentary evidence. | Elements remain of the original piers and earlier road embankment.<br>The northern bank has visible remains of the raised approach road and at least one section of in-situ Telford road base, which may have been constructed contemporary with the original bridge or previously to replace part of a corduroy road. |
| 1938 | Five 40ft steel beam spans | A replacement bridge of concrete and steel was constructed to the west of the original crossing point. | Both bridge approaches remain in situ including original sandstone retaining wall and two bridge pier sets and abutments. |
| 1956 | Two 36 ft approach spans and three 39ft main spans, all steel girder | Following major damage from the Hunter Valley flood of February 1955, the 1938 concrete bridge fully collapsed in February 1956. In order to maintain access across the creek, a temporary Bailey bridge was erected. | Southern timber abutment and approach road were identified during the field survey. |
| 1962 | 320 ft long in total, five 56ft 6in main spans with two approach spans. Carriageway 28 ft wide with a 6 ft footway. | The new bridge opened to traffic. | Existing bridge still in operation. |
| 1962-1966 | Duplication of the 1962 bridge above | The 1962 bridge was duplicated to form a divided carriageway, opening fully to traffic in 1966. | Existing bridge still in operation. |



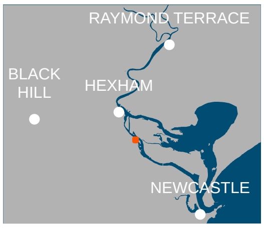

**Legend**

REF area

Previous bridge locations
- 1857
- 1938
- 1956
- Northern 1962
- Southern 1966

Road
Waterway

0 200 400 m
Scale 1:1,500 at A4
GDA94 MGA56




**Data sources:**
Jacobs 2020
Department of Finance, Services and Innovation 2020

**Figure 6.8** Mapping overlay showing the location of the previous bridge alignments

The Ironbark Creek crossing point is an integral part of the road north from Newcastle, facilitating local terrestrial traffic and connecting the port city to the rest of the Hunter Valley, from the earliest time of non-Aboriginal settlement in the early 1820s. The archaeological remains of the series of bridge crossings demonstrates the historical importance of the crossing location, its progressive developments in bridge technology, and of government departmental responses to community requirements.

The Ironbark Creek crossing point has the potential to yield information related to the series of bridge constructions and local adaptations in road construction technology when compared to other NSW locations of the same time period. It is assessed as being of local significance.

Other archaeological items that may be encountered include the remains of structures built on the Maitland Road frontage (including archaeological works such as early culverts or drainage structures) and remains of agricultural structures and/or tools. The significance of such remains, however, would be dependent on their extent and condition.

### 6.8.3 Potential impacts

#### Construction

#### *Built heritage*

Of the 16 listed heritage items listed in **Table 6.38**, eight have the potential to be impacted by the proposal within the REF area. **Table 6.40** discusses both potential direct and indirect construction impacts on listed heritage items.

Table 6.40 Direct and indirect construction impacts on listed heritage items located next to the REF area

| Item | Direct impacts | Indirect impacts |
|---|---|---|
| Sandgate Cemetery | The REF area would be outside the curtilage of the cemetery and would not result in a direct impact. Due to the nature of the road widening works, there would be little to no visual impact to the cemetery. | The works in the vicinity of this item comprise road widening works to Maitland Road. As the works are on the western side of Maitland Road near the curtilage of the item, vibration impacts may occur. |
| 2HD Studio | Activities relating to the road widening are planned within would be about 30 metres from the western curtilage of the item, however as the proposal is confined to the western side of the road it is unlikely that the works would have any impact on the item's heritage significance. In relation to visual impact, it is considered that the item is amenable to change of this kind, considering its long-standing location along a major road. | The works in the vicinity of this item comprise road widening works to Maitland Road. Although the principal works would be on the western side of Maitland Road, the item is still in close enough proximity that impacts through vibration may occur. |
| Former Travellers Rest Hotel | The road widening in this section of Maitland Road would mainly be to the eastern side. Physical impacts to the western side of Maitland Road would therefore be of a minor nature and given the relatively wide verge between the façade of the former hotel and the current road's kerb (currently about eight metres), the works associated with kerbing and similar works would encroach about one to 1.5 metres on the western side. This would | The works in the vicinity of this item comprise road widening works to Maitland Road. These works are proposed within ten metres of the façade of this item. Vibration impacts may therefore occur. |

| Item | Direct impacts | Indirect impacts |
|---|---|---|
| | reduce the distance between the roadside and the former hotel's façade to about 6.5 metres. It is considered unlikely that there would be any physical impact to either the hotel or its setting by the proposal. | |
| Hexham Railway Station | The works in the vicinity of this item comprise road works on an access road from Maitland Road to a hardstand car park to the east of Hexham Railway Station. The termination of these roadworks abuts the car park, which is included in the heritage curtilage of the item. The Hexham Railway Station would not be impacted directly by the works associated with REF area. | Given the proximity of these works, there is some potential for vibration to impact on the item. |
| Hexham Bridge | No ground disturbance works are anticipated near this item. Temporary, portable signage would be erected to directing road changes to users of the bridge during construction. There would be no direct impact to this item. | Vibration impacts unlikely given the bridge is used as an active roadway. |
| Oak Factory | The Oak Factory is located next to the proposal but outside of the heritage items' boundaries. Given its industrial nature, and that the proposal would remain outside its curtilage, there is little potential for direct impact to this item. | None identified. |
| Hexham Shipbuilding Yards | This item is located about 20 metres to the north of the REF area and Compound 4 but is separated by a small waterway. The item is an archaeological site; however, no ground disturbance works would be undertaken in its vicinity. It is therefore unlikely to be directly impacted by the proposal. | None identified |
| Hannel Family Vault | The heritage curtilage of this item is located immediately next to the REF area and Construction Compound 4 (**Figure 6.7**), however the proposal boundaries are located 20 metres from the vault itself. It is therefore not likely to be directly impacted by the proposal. | The works in the vicinity of this item include road works and the location of a proposed construction compound. There is potential for indirect impacts from vibration during construction. |

### *Archaeology*

The new replacement bridge over Ironbark Creek is proposed to be located directly across the alignment of the original 1875 bridge crossing of Ironbark Creek. The excavation and construction work involved in the new bridge construction would result in direct impacts to the 1875 former road alignment, bridge approaches and remnant timbers, and the existing 1960s twin bridges. The removal of these elements would have a direct impact to the heritage values of the Ironbark Creek crossing through the removal of illustrative fabric, and loss of the physical record of the location of the earliest recorded bridge at the site and its most recent. The new bridge construction would not impact the location of the 1938 bridge.

These direct impacts cannot be fully mitigated and would be a major impact to the heritage item; it is recommended that detailed archaeological and archival recording take place prior to construction of the proposal.

Visually, the new bridge would be a modern, concrete construction along the banks of the Hunter River, similar to what currently exists on the site. The introduction of an additional bridge does not represent an indirect impact to the heritage place, due to its historical significance as a point of crossing throughout a long period of time, with successive bridge locations and technologies. A new bridge of the latest technology and construction material is in keeping with this history and value. Although Ironbark Crossing point is directly impacted during construction no indirect impacts associated with vibration are likely as this heritage item is considered an archaeological work.

#### Operation

There are no anticipated direct or indirect impacts to the non-Aboriginal heritage items during operation.

### 6.8.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise non-Aboriginal heritage impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.41**.

Table 6.41 Safeguards and management measures – non-Aboriginal heritage

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Non-Aboriginal heritage | A Non-Aboriginal Heritage Management Plan (NAHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to non-Aboriginal heritage. | Contractor | Detailed design/ prior to construction |
| Non-Aboriginal heritage | The *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime Services, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered.<br>Work will only re-commence once the requirements of that Procedure have been satisfied. | Contractor | Detailed design / prior to construction |
| Site induction | All personnel working on site will receive training to ensure awareness of requirements of the NAHMP and relevant statutory responsibilities. Site-specific training will be given to personnel when working in the vicinity of identified non-Aboriginal heritage items. | Contractor | Prior to construction |
| Non-Aboriginal heritage | Temporary protection zones (TPZ) such as fencing will be placed around the following heritage items:<br>• Sandgate Cemetery<br>• Former Travellers Rest Hotel<br>• Hexham Railway Station<br>• Hannel Family Vault. | Transport | Prior to construction / construction |
| | Archival recording will be completed for the Ironbark Creek crossing point, with particular focus on the location of previous crossings, and original 1875 and 1956 temporary bridges. A report will be prepared in accordance with Transport Heritage Branch's requirements for Archival Recording of | Transport | Detailed design |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| | Heritage Items and, relevant heritage guidelines by a qualified heritage consultant. A copy of the report is to be provided to City of Newcastle Council and Newcastle Libraries. | | |
| Archaeology | Carry out further research and archaeological investigation to confirm the presence of any potential archaeological remains of crossings in use prior to 1875 (such as corduroy crossings) within the construction area of the proposal and confirm the nature and full extent of the bridge and roadway remnants identified in this assessment. Any remains identified during this investigation will be recorded within the archival recording for Ironbark Creek crossing point. Following this investigation, the significance assessment of the item should be reviewed and revised as appropriate. | Transport | Detailed design |
| Archaeology | If unexpected archaeological material or relics are discovered during construction work must stop work immediately and the Heritage Council of NSW contacted, in accordance with section 146 of the *Heritage Act 1977 and* the *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime Services, 2015). The proponent must also inform Transport and the City of Newcastle. | Contractor | Construction |
| Vibration impacts to heritage items | All feasible and reasonable vibration mitigation measures will be implemented to avoid vibration impacts to:<br>• Sandgate Cemetery<br>• 2HD Studios<br>• Former Travellers Rest Hotel<br>• Hexham Railway Station<br>• Hannel Family Vault. | Contractor | Construction |

## 6.9 Noise and vibration

The potential impacts of the proposal on noise and vibration are assessed in the *Hexham Straight Widening Noise and Vibration Assessment* (SLR, 2021) provided in **Appendix M**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.9.1 Methodology

#### Guidelines

The guidelines used to assess construction impacts from the proposal are listed in **Table 6.42**.

Table 6.42 Construction noise and vibration guidelines

| Guideline/Policy name | Where guideline is used |
|---|---|
| ICNG (DECC, 2009) | Assessment of airborne noise impacts on sensitive receivers |
| Road Noise Policy (RNP) (DECCW, 2011) | Assessment of construction traffic impacts |
| BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2, BSI, 1993 | Assessment of vibration impacts (structural damage) to non-heritage sensitive structures |
| DIN 4150: Part 3-2016 Structural vibration – Effects of vibration on structures, Deutsches Institute fur Normung, 1999 | Screening assessment of vibration impacts (structural damage) to heritage sensitive structures, where the structure is found to be unsound |
| Assessing Vibration: a technical guideline (DEC, 2006) | Assessment of vibration impacts on sensitive receivers |
| CNVG (Roads and Maritime Services, 2016) | Assessment and management protocols for airborne noise and vibration impacts for road infrastructure projects |
| RNP (DECCW, 2011) | Operational road traffic noise assessment |
| Noise Criteria Guideline (NCG) (Roads and Maritime Services, 2015) | Defines Roads and Maritime's interpretation of the RNP and details how criteria are applied to sensitive receivers |
| Noise Mitigation Guideline (NMG) (Roads and Maritime Services, 2015) | Details how additional mitigation measures are to be applied to road infrastructure projects |
| Model Validation Guideline (Roads and Maritime Services, 2018b) | Contains procedures for validating operational road traffic noise models |
| Environmental Noise Management Manual (Roads and Traffic Authority, 2001) | Additional information for operational road traffic noise assessment, including maximum noise assessments |
| Preparing an Operational and Construction Noise and Vibration Assessment Report (Roads and Maritime Services, 2016) | Defines how to complete operational road traffic noise and vibration assessments |
| AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors | Provides recommended design sound levels for internal areas of occupied spaces. |
| At-Receiver Noise Treatment Guideline (Roads and Maritime Services, 2017) | Provides an overview and discussion of feasible and reasonable at-receiver noise mitigation measures |

### Noise monitoring

Unattended noise monitoring was completed in the study area during September 2020 (refer to **Figure 6.9**). The measured noise levels have been used to determine the existing noise environment and to set the criteria used to assess the potential impacts from the proposal. All noise monitoring activities were undertaken and processed in accordance with the *Industrial Noise Policy* (EPA 2000). Further details of the noise monitoring methodology are provided in **Appendix M**.

### Construction noise assessment

Noise impacts on sensitive receivers from construction activities during and outside standard construction hours have been assessed. This assessment provides a detailed analysis of the noise levels at each sensitive receiver location and compares them with the relevant noise management level. To assess the impact of construction noise on sensitive receivers, construction scenarios were identified which included the identification of activities, equipment and plant to be used in each of the scenarios and the location of where these activities would occur. This information was used in a noise model to identify maximum construction noise levels experienced at each sensitive receiver for each stage of construction.

The construction scenarios assessed include:

- Early works and utilities – noise intensive works
- Early works and utilities – typical works
- Early works and utilities – Out of Hours Work (OOHWs) noise intensive
- Early works and utilities – OOHWs typical works
- Compounds – establishment
- Vegetation clearing
- Road works – northbound/southbound/ancillary
- Road works – pavement works – noise intensive
- Road works – pavement works – typical
- Bridgeworks – peak
- Bridgeworks – typical
- Bridgeworks – concrete works
- Bridgeworks – demolition
- Finishing works
- Compound activities.

Further details on construction stages is included in **Section 3.3.2** and **Appendix D** and the plant and equipment assumed to be used in each of the noise construction scenarios identified above can be found in **Appendix M**.

The potential impacts from construction traffic on public roads have been predicted using the Calculation of Road Traffic Noise (CoRTN) algorithm.

### Construction vibration assessment

The potential impacts during vibration intensive works have been assessed using the CNVG minimum working distances for cosmetic damage and human response. The assessment identifies structures which are within the minimum working distances assuming a 13 to 18 tonne vibratory roller or a large rockbreaker are used during construction in the appropriate scenarios.

### Operational noise assessment

A noise model of the study area has been used to predict noise levels from the operation of the proposal to the surrounding receivers. Local terrain, receiver buildings and structures were digitised in the noise model to develop a three-dimensional representation of the proposal and surrounding areas.

- The ‘No Build’ scenarios use the existing road alignment geometry, with all existing structures and features within the road corridor included

- The 'Build' scenarios use the proposed design of the proposal, which includes all widening works and changes to existing ground levels such as cuttings and embankments.

To validate the operational road traffic noise model, the 2020 existing scenario was modelled and compared to existing noise measurements in the study area.

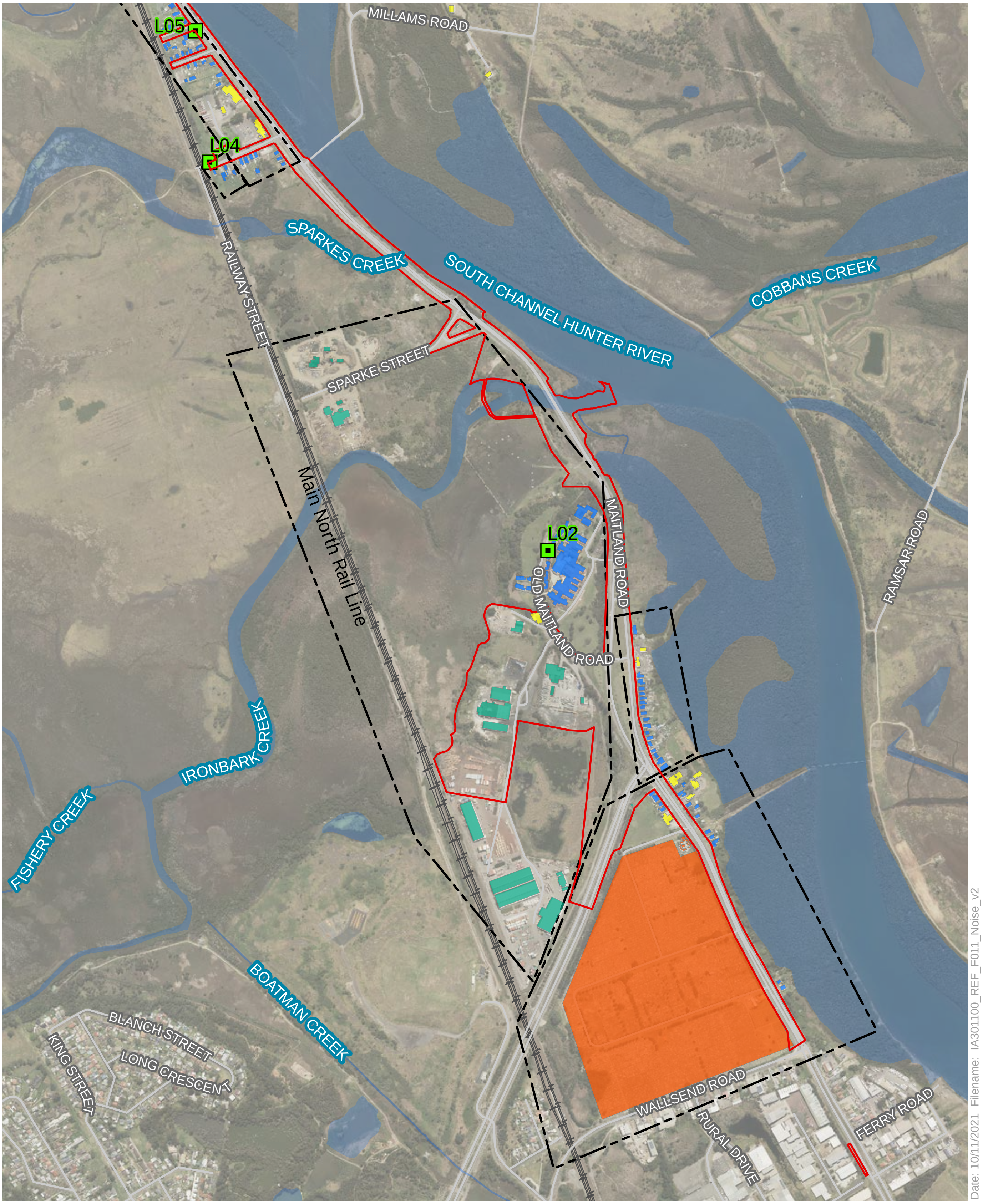
### 6.9.2 Existing environment

The study area surrounding the proposal is characterised by a mix of transport corridors (road and rail), environmental areas including wetlands and waterways, recreational areas both public and private and light and heavy industrial areas. To the east and in some locations next to the proposal is the South Channel Hunter River. The major freight rail line into the Port of Newcastle is located to the west of the proposal and in some locations immediately next to the proposal. There are also commercial and residential receivers.

The assessment uses several Noise Catchment Areas (NCAs) that reflect the land uses in the study area and the existing background noise levels. These are shown in **Figure 6.9** and described in **Table 6.43**.

Table 6.43 NCAs and surrounding land uses

| NCA | Minimum distance (metres) | Descriptions |
|---|---|---|
| NCA01 | 13 | NCA1 covers the construction area south of the NICB. The area consists of residential and commercial receivers fronting Maitland Road. NCA01 also includes Sandgate Cemetery. |
| NCA02 | 12 | NCA2 covers the receivers north of the NICB on the eastern side of construction area to the south of Calvary St Joseph's Retirement Community. |
| NCA03 | 35 | NCA03 covers residential receivers to the west of Old Maitland Road and Calvary St Joseph's Retirement Community. |
| NCA04 | 9 | NCA04 is representative of residential and commercial receivers off Clark Street, Merchant Street, Fenwick Street and Shamrock Street within 100 metres of Maitland Road. |
| NCA05 | 130 | NCA05 is representative of residential and commercial receivers off Shamrock Street more than 130 metres from Maitland Road. |
| NCA06 | 145 | NCA06 is representative of residential receivers off Old Maitland Road in Hexham located to the east of Maitland Road. The area consists mainly of industrial and commercial receivers with scattered residential receivers as well as the Free Church of Tonga, Hexham Bowling Club and Hexham Park Cricket Grounds. NCA06 also includes Hexham Railway Station located to the west of Maitland Road. |
| NCA07 | 11 | NCA07 is representative of the construction area north of Hexham Bridge. The area consists of commercial and residential receivers located to the west of Maitland Road. |




Legend

- REF area
- Logger locations
- NCA_Boundaries
- Receiver types
  - Industrial
  - Residential
  - Commercial
  - Other (Outdoor Passive)
- Waterway
- Road
- Railway

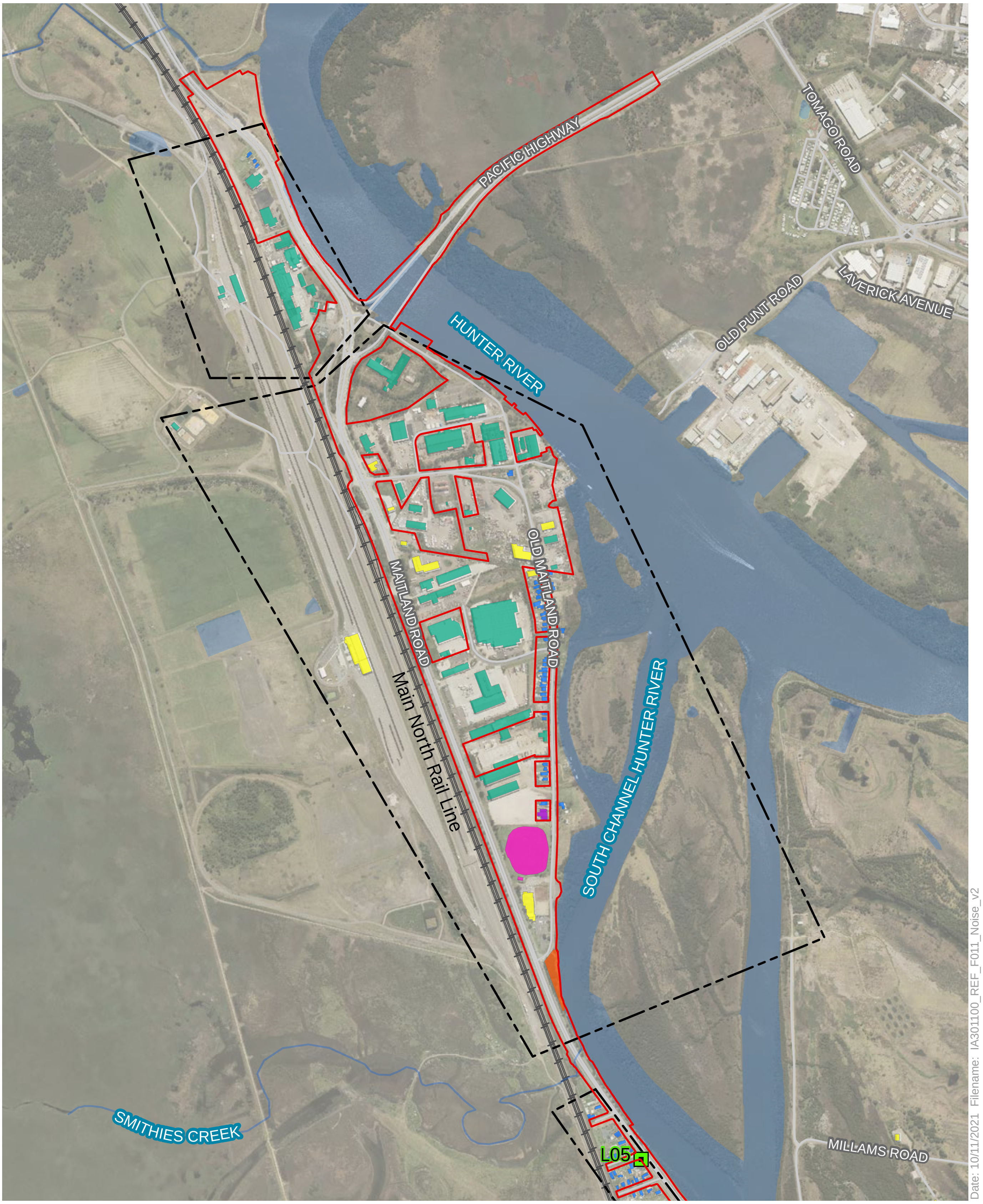
0 200 400 m

Scale 1:15,000 at A4

GDA94 MGA56


**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.9a** Site plan, receivers and noise monitoring locations




**Legend**

REF area
Logger locations
NCA_Boundaries
Receiver types
Industrial
Residential
Commercial
Other (Outdoor Active)
Other (Outdoor Passive)
Other (Place of Worship)
Waterway
Road
Railway

0 200 400 m
Scale 1:15,000 at A4
GDA94 MGA56


**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.9b** Site plan, receivers and noise monitoring locations

The results of noise monitoring for each location identified in **Figure 6.9** is summarised in **Table 6.44**.

Table 6.44 Summary of unattended noise logging results

| ID | Address | Measured noise level (dBA) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Construction[1] | | | | | | Operation[2] | |
| | | Background noise (RBL)[3] | | | Average noise ($L_{Aeq}$) | | | Average noise ($L_{Aeq}$) | |
| | | Day | Eve | Night | Day | Eve | Night | Day | Night |
| L01 | 151 Maitland Road, Sandgate | 56 | 47 | 39 | 68 | 64 | 64 | 67 | 64 |
| L02 | 35 Old Maitland Road, Sandgate | 42 | 40 | 36 | 55 | 49 | 48 | 54[4] | 48[4] |
| L03 | 223 Maitland Road, Sandgate | 60 | 52 | 41 | 76 | 73 | 72 | 75 | 72 |
| L04 | 15 Shamrock Street, Hexham | 47 | 46 | 41 | 66 | 66 | 66 | 66[4] | 66[4] |
| L05 | 2 Merchant Street, Hexham | 64 | 56 | 44 | 75 | 72 | 71 | 74 | 71 |
| L06 | 111 Old Maitland Road, Hexham | 43 | 44 | 42 | 62 | 56 | 55 | 61[4] | 55[4] |
| L07 | 213 Maitland Road, Hexham | 69 | 57 | 46 | 77 | 74 | 73 | 76 | 73 |
| L08[5] | 348 Pacific Highway, Hexham | 65 | 57 | 46 | 74 | 71 | 70 | 73 | 70 |

Note 1: Construction noise is assessed during the daytime which is 7am to 6pm, the evening which is 6pm to 10pm and the night-time which is 10pm to 7am. See the NSW EPA Interim Construction Noise Guideline.

Note 2: Operational road traffic noise is assessed during the daytime which is 7am to 10pm and the night-time which is 10pm to 7am. See the NSW EPA Road Noise Policy.

Note 3: It is noted that the noise monitoring survey was conducted during the COVID-19 Pandemic and traffic volumes in the study area during the noise monitoring survey have the potential to be lower than normal. As background noise levels are generally controlled by traffic on the surrounding road network, and nearby industrial/commercial operations it is possible that the measured RBLs are also lower than may normally be measured in the study area. This would potentially result in a conservative assessment of the construction impacts from the proposal.

Note 4: Influenced by non-traffic noise sources.

Note 5: Local weather station placed at this location.

### 6.9.3 Criteria

#### Construction noise criteria

The construction noise management levels for the proposal have been developed in accordance with the following:

- ICNG
- CNVG.

For work during standard construction hours:

- The 'noise affected level' represents the point above which there may be some community reaction to noise. The noise affected level is calculated by adding 10 decibels (dB(A)) to the rating background level
- The 'highly noise affected level' represents the point above which there may be strong community reaction to noise. The ICNG specifies that the highly noise affected level is 75 dB(A).

For any work outside standard construction hours:

- A strong justification would typically be required for works outside the standard construction hours
- The proponent should apply all feasible and reasonable work practices to meet the noise affected level
- Where all feasible and reasonable practices have been applied and noise is more than five dB(A) above the noise affected level, the proponent should negotiate with the community.

For work outside standard construction hours, the construction noise management level is calculated by adding 5 dB(A) to the rating background level. The noise management level for sleep disturbance is based on a maximum internal noise level of 55 dB(A) $L_{Amax}$ as recommended by the RNP and a 10 dB(A) reduction in noise from outside the building. The RNP acknowledges that one or two noise events per night with maximum external noise levels of 75 to 80 dB(A) are unlikely to substantially affect health and wellbeing. The proposal specific construction noise management levels are provided in **Table 6.45**.

Table 6.45 Specific construction noise management levels - $L_{Aeq(15min)}$ (dBA) - for proposal

| Noise catchment area | Noise monitoring location | Noise management levels $L_{Aeq(15min)}$ (dBA) | | | | Sleep disturbance screening criteria (RBL +15 dB) |
|---|---|---|---|---|---|---|
| | | Standard construction (RBL +10 dB) | Out of hours (RBL +5 dB) | | | |
| | | Day | Day | Evening | Night | |
| NCA01 | L01 | 66 | 61 | 52 | 44 | 54 |
| NCA02 | L02 | 52 | 47 | 45 | 41 | 51 |
| NCA03 | L03 | 70 | 65 | 57 | 46 | 56 |
| NCA04 | L04 | 57 | 52 | 51 | 46 | 56 |
| NCA05 | L05 | 74 | 69 | 61 | 49 | 59 |
| NCA06 | L06 | 53 | 48 | 49 | 47 | 57 |
| NCA07 | L07 | 79 | 74 | 62 | 51 | 61 |

Note 1: Daytime out of hours is 7am to am and 1pm to 6pm on Saturday, and 8am to 6pm on Sunday and public holidays.

## Construction vibration criteria

### *Human comfort*

Human comfort vibration criteria have been determined including consideration of *Assessing Vibration: A Technical Guideline and British Standard (BS) 6472 – 1992, Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* which is recognised by the OEH as the preferred standard for assessing 'human comfort' in relation to potential vibration impacts. Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in **Table 6.46** for sensitive receivers.

Table 6.46 Human comfort intermittent vibration limits (BS6472-1992)

| Receiver type | Period | Intermittent vibration dose value ($m/s^{1.75}$) | |
|---|---|---|---|
| | | Preferred value | Maximum value |
| Residential | Day (7am to 10pm) | 0.2 | 0.4 |
| Residential | Night (10pm to 7am) | 0.13 | 0.26 |
| Offices, schools, educational institutes and places of worship | When in use | 0.4 | 0.8 |

Humans can detect vibration at levels which are well below those that could cause damage to a building. The degrees of perception for humans are shown in **Table 6.47**.

Table 6.47 Guidance on effects of vibration levels for human comfort (BS 5228.2-2009)

| Vibration level | Effect |
|---|---|
| 0.14 mm/s | Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. |
| 0.3 mm/s | Vibration might be just perceptible in residential environments. |
| 1.0 mm/s | It is likely that vibration at this level in residential environments would cause complaints, but can be tolerated if prior warning and explanation has been given to residents |
| 10 mm/s | Vibration is likely to be intolerable for any more than a very brief exposure. |

### *Structural damage*

**Table 6.48** presents the minimum safe levels of vibration at different frequencies for commercial and residential buildings. Based on DIN 4150-3, a measured value exceeding those listed in **Table 6.48**"…does not necessarily lead to damage; should they be significantly exceeded, however, further investigations are necessary."

Table 6.48 Guideline values for short term vibration on structures

| Type of structure | Guideline values for velocity (mm/s) | | |
|---|---|---|---|
| | 1 Hz to 10 Hz | 10 Hz to 50 Hz | 50 Hz to 100 Hz |
| Building used for commercial purposes, industrial buildings, and buildings of similar design | 20 | 20 to 40 | 40 to 50 |
| Dwellings and buildings of similar design and/or occupancy | 5 | 5 to 15 | 15 to 20 |
| Structures that, because of their particular sensitivity to vibration, cannot be classified above and are of great intrinsic value (e.g. listed buildings under preservation order) | 3 | 3 to 8 | 8 to 10 |

Note 1: At frequencies above 100 Hz the values given in this column may be used as minimum values

## Operational noise criteria

### *Road noise policy and noise criteria guidelines*

The RNP is used to assess and manage potential airborne noise impact from new and redeveloped road projects.

This assessment is undertaken with guidance from the NCG which is Roads and Maritime Service's interpretation of the RNP and provides a consistent approach to identifying road noise criteria for infrastructure projects.

The proposal would 'redevelop' Maitland Road. A road is 'redeveloped' where works are in an existing road corridor and the existing road is not substantially realigned, as is the case with this proposal.

The RNP and NCG road traffic noise assessment criteria are presented in **Table 6.49**.

Table 6.49 NCG criteria for residential receivers

| Road category | Type of project/land use | Assessment criteria (dBA) | |
|---|---|---|---|
| | | Daytime (7am – 10pm) | Night-time (10pm – 7am) |
| Freeway/ arterial/ sub-arterial roads | 2. Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads | $L_{Aeq(15\ hour)}$ 60 (external) | $L_{Aeq(9\ hour)}$ 55 (external) |
| | 6. Existing residences affected by increases in traffic noise of 12 dB(A) or more from redevelopment of existing freeway/arterial/sub-arterial roads1 | Between $L_{Aeq(15hour)}$ 42-60 (external) | Between $L_{Aeq(9hour)}$ 42-55 (external) |
| Local roads | 8. Existing residences affected by noise from redevelopment of existing local roads | $L_{Aeq(1\ hour)}$ 55 (external) | $L_{Aeq(1\ hour)}$ 50 (external) |

Several 'other sensitive' non-residential land uses have been identified in the study area. The noise criteria for 'other sensitive' receivers are shown in **Table 6.50**. The NCG does not consider commercial and industrial receivers as being sensitive to operational airborne road traffic noise impacts.

Table 6.50 NCG criteria for other sensitive receivers

| Existing sensitive land use | Assessment criteria (dBA) | |
|---|---|---|
| | Daytime (7am – 10pm) | Night-time (10pm – 7am) |
| School classrooms | $L_{Aeq(1\ hour)}$ 40 (internal)1 | - |
| Hospital wards | $L_{Aeq(1\ hour)}$ 35 (internal) | LAeq(1 hour) 35 (internal) |
| Places of worship | $L_{Aeq(1\ hour)}$ 40 (internal)1 | LAeq(1 hour) 40 (internal)1 |
| Open space (active use) | $L_{Aeq(15\ hour)}$ 60 (external) | - |
| Open space (passive use) | $L_{Aeq(15\ hour)}$ 55 (external) | - |
| Child care facilities | Sleeping rooms $L_{Aeq(1\ hour)}$ 35 (internal)[1]<br>Indoor play areas $L_{Aeq(1\ hour)}$ 40 (internal)[1] | - |

| Existing sensitive land use | Assessment criteria (dBA) | |
|---|---|---|
| | Daytime (7am – 10pm) | Night-time (10pm – 7am) |
| | Outdoor play areas $L_{Aeq(1\ hour)}$ 55 (internal) | |
| Aged care facilities | - | - |

Note 1: The criteria are specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been conservatively assumed that all schools and places of worship have openable windows and external noise levels are 10 dB(A) higher than the corresponding internal level, which is representative of windows being partially open to provide ventilation

#### *Sleep disturbance*

Infrastructure projects often require certain works to be completed during the night-time. Where night works are located close to residential receivers there is potential for sleep disturbance impacts.

The ICNG lists five categories of works that might need to be undertaken outside of standard construction hours:

- The delivery of oversized equipment or structures that require special arrangements to transport on public roads
- Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- Maintenance and repair of public infrastructure where disruption to essential services or considerations of worker safety do not allow work within standard hours
- Public infrastructure works that shorten the length of the project and are supported by the affected community
- Works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

Where construction works are planned to extend over more than two consecutive nights, the ICNG recommends that an assessment of sleep disturbance impacts should be completed. The ICNG refers to the NSW Environmental Criteria for Road Traffic Noise for assessing the potential impacts, which notes that to limit the level of sleep disturbance the $L_{A1(1minute)}$ level (or $L_{Amax}$) should not exceed the existing $L_{A90}$ background noise level by more than 15 dB(A).

### 6.9.4 Potential impacts

#### Construction

#### *Residential receivers*

This section provides an overview of the predicted worst-case noise impacts at the most affected receivers in each NCA for each scenario where construction equipment is at the closest point to each receiver. For most works, the construction noise impacts would frequently be lower than predicted as the worst-case situation is typically only apparent for a relatively short period when noisy equipment is in use nearby.

The following assessment shows the predicted noise impacts based on the exceedance of the NML, as per the categories shown in **Table 6.51** which are taken from the CNVG.

Table 6.51 NML exceedance bands and corresponding subjective response to impacts

| CNVG perception categories | Daytime – standard construction hours | | Out of hours periods | |
|---|---|---|---|---|
| | Symbol | NML exceedance | Symbol | NML exceedance |
| Noticeable | · | -[1] | ♦ | 1 to 5 dB(A) |
| Clearly audible | ● | 1 to 10 dB(A) | ● | 6 to 15 dB(A) |
| Moderately intrusive | ◆ | 11 to 20 dB(A) | ◆ | 16 to 25 dB(A) |
| Highly intrusive | ■ | >20 dB(A) | ■ | >25 dB(A) |

Note 1: Applicable for construction noise levels of 5-10 dB(A) above RBL (see **Table 6.45** ).

The predicted construction noise impacts are presented for the most affected receivers. Receivers which are further away from the works and/or shielded from view would have lower impacts. The assessment is generally considered conservative as the calculations assume several items of construction equipment are in use at the same time within individual scenarios.

A summary of the predicted construction noise impacts in each NCA for residential receivers is shown in **Table 6.52**. The assessment identifies the following:

- The worst-case noise levels and impacts are not confined to any single NCA which is due to residential receivers being relatively close to the construction work throughout the proposal
- Highly intrusive to moderately intrusive worst-case daytime impacts are seen during most scenarios when construction is required to be completed near to receivers
- Highly intrusive worst-case impacts are predicted when noisy construction activities are required to be completed during the night-time near to receivers during the construction work scenarios assessed
- Worst-case night-time noise levels in the region of 90 dBA are predicted in NCA07 when noise intensive equipment, such as a concrete saw or rockbreakers, is being used as part of ‘Early works and utilities – OOHWs noise intensive works’. When noise intensive equipment is not being used as part of these works the noise levels are expected to be substantially reduced with worst-case levels of 83 dBA predicted during ‘Early works and utilities – OOHWs typical works’
- Noise levels from ‘Bridgeworks peak’ are predicted to be results in moderately intrusive impacts in NCA03, which' is mainly due to the use of an impact piling rig. Should an alternative piling methodology be adopted noise from the bridgework would be substantially reduced
- It is noted that for most scenarios, the noisiest works would only be required for a relatively short period of the total proposal duration. Noise levels and impacts at other times works would be much lower than the worst-case levels predicted
- It is noted that the worst-case impacts presented above are based on all equipment working simultaneously and represent a scenario when works are immediately outside each receiver. There would frequently be periods when works are in distant parts of the construction area which would result in construction noise levels being much lower than the worst-case levels predicted. There would also be times when no equipment is in use and no impacts occur.

Table 6.52 Predicted worst-case construction noise exceedances – residential receivers

| Scenario | NCA01 | NCA02 | NCA03 | NCA04 | NCA05 | NCA06 | NCA07 |
|---|---|---|---|---|---|---|---|
| **Daytime** | | | | | | | |
| Early works and utilities – noise intensive works | ■ | ■ | ■ | ◆ | ■ | ◆ | ◆ |
| Early works and utilities – typical works | ◆ | ◆ | ◆ | ● | ◆ | ● | ● |
| Compounds – site establishment | · | · | ◆ | · | · | ■ | · |
| Vegetation clearing | ■ | ■ | ■ | ◆ | ■ | ◆ | ◆ |
| Road works – northbound/southbound/ancillary | ■ | ■ | ■ | ◆ | ■ | ◆ | ◆ |
| Road works – pavement works – noise intensive works | ◆ | ◆ | ◆ | ◆ | ■ | ● | ◆ |
| Road works – pavement works – typical works | ◆ | ◆ | ◆ | ● | ◆ | ● | ● |
| Bridgeworks - peak | · | · | ◆ | · | · | · | · |
| Bridgeworks - typical | · | · | · | · | · | · | · |
| Bridgeworks – concrete works | · | · | · | · | · | · | · |
| Bridgeworks – demolition | · | · | ● | · | · | · | · |
| Finishing Works | ◆ | ◆ | ◆ | ● | ■ | ■ | ● |
| Compound activities | · | · | ● | · | · | ■ | · |
| **Evening** | | | | | | | |
| Early works and utilities – OOHWs noise intensive Works | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Early works and utilities – OOHWs typical works | ◆ | ◆ | ◆ | ◆ | ◆ | ◆ | ◆ |
| Road works – pavement works – noise intensive Works | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Road works – pavement works – typical works | ■ | ■ | ◆ | ◆ | ■ | ■ | ◆ |
| Finishing works | ■ | ■ | ◆ | ◆ | ■ | ■ | ◆ |
| Compound activities | ♦ | ♦ | ● | · | · | ■ | · |
| **Night** | | | | | | | |
| Early works and utilities – OOHWs noise intensive Works | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Early works and utilities – OOHWs typical works | ■ | ■ | ◆ | ■ | ■ | ■ | ■ |
| Compounds – site establishment | ◆ | ◆ | ◆ | · | · | ■ | ◆ |
| Road works – pavement works – noise intensive works | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Road Works – pavement works – typical works | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Finishing works | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Compound – activities | ● | ● | ● | · | · | ■ | ● |

### *Commercial, industrial, and other sensitive receivers*

A summary of the predicted construction noise impacts in each NCA for commercial/industrial and other sensitive receivers is presented in **Table 6.53**. The assessment of commercial/industrial and other sensitive receivers shows that construction noise levels are generally expected exceed the management levels when works are nearby.

Table 6.53 Overview of commercial/industrial and other sensitive receiver NML exceedances

| Scenario | Number of receiver buildings / areas affected | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Place of worship[1] | | | Outdoor areas[2] | | | Commercial / Industrial | | |
| | 1-10 dB | 11-20 dB | >20 dB | 1-10 dB | 11-20 dB | >20 dB | 1-10 dB | 11-20 dB | >20 dB |
| Early works and utilities – noise intensive works | - | 1 | - | 1 | 1 | 1 | 15 | 11 | 4 |
| Early works and utilities – typical works | - | - | - | 1 | 1 | - | 7 | 3 | - |
| Early works and utilities – OOHWs noise intensive works | 1 | - | - | 1 | 1 | 1 | 14 | 6 | 3 |
| Early works and utilities – OOHWs typical works | - | - | - | 1 | 1 | - | 6 | 3 | - |
| Compounds – site establishment | - | - | 1 | - | - | - | 33 | 7 | - |
| Vegetation clearing | - | - | - | - | - | - | - | - | - |
| Road works – northbound/southbound/ancillary | - | 1 | - | 1 | 1 | 1 | 19 | 6 | 4 |
| Road works – pavement works – noise intensive works | 1 | - | - | 2 | - | 1 | 14 | 7 | 1 |
| Road works – pavement works – typical works | 1 | - | - | 1 | 1 | - | 12 | 4 | - |
| Bridgeworks - peak | - | - | - | - | - | - | - | - | - |
| Bridgeworks - typical | - | - | - | - | - | - | - | - | - |
| Bridgeworks – concrete works | - | - | - | - | - | - | - | - | - |
| Bridgeworks – demolition | - | - | - | - | - | - | - | - | - |
| Finishing works | 1 | - | - | 1 | 1 | - | 12 | 4 | - |
| Compound – operation | - | 1 | - | - | - | - | 7 | - | - |

Note 1: 63 Old Maitland Road.

Note 2: Sandgate Cemetery, Hexham Bowling Club, Hexham Park Cricket Grounds, Foreshore Reserve.

### *Sleep disturbance*

Review of the predictions shows that the sleep disturbance screening criterion is likely to be exceeded when night works occur near residential receivers. The receivers which would potentially be affected by sleep disturbance impacts are generally the same receivers where highly intrusive night-time impacts have been predicted (refer to **Table 6.52**).

### *Construction vibration*

The main potential sources of vibration during construction would be from vibratory rollers, rockbreakers and impact piling. The construction scenarios which require vibration intensive equipment are:

- Early works utilities - noise intensive works
- Early works utilities – OOHW noise intensive works
- Road works – northbound/southbound/ancillary
- Road works – pavement works, noise intensive works
- Bridge works – peak.

Impact piling would not be required within 225 metres of any residential or commercial structure and as such vibration levels are predicted to be below the human comfort and cosmetic damage thresholds.

Vibration offset distances for a large rockbreaker have been determined from the CNVG minimum working distances for cosmetic damage and human response. Some buildings are within the minimum safe working distances for a large rockbreaker. Certain receivers in the study area are also within the human comfort minimum working distance and occupants of affected buildings may be able to perceive vibration impacts at times when vibration intensive equipment is in use. Where impacts are perceptible, they would likely only be apparent for relatively short durations when vibration intensive equipment is nearby.

There are five vibration sensitive items that are within the minimum working distances for heritage items (refer to **Table 6.48**) for the use of large rockbreakers and vibratory rollers (i.e. 44 metres), as shown in **Table 6.54**. These heritage items would potentially be impacted by construction of the proposal.

Table 6.54 Construction vibration – heritage items

| Heritage structure | Distance to construction area |
|---|---|
| Hannel Family Vault | 11 m from Construction Compound 4 |
| Hexham Railway Station | 4 m from road work |
| Travellers Rest Hotel (former – now McDonalds) | 8 m from road work |
| 2HD Studios | 22 m from road work |
| Sandgate Cemetery | 13 m from road work |

### *Construction traffic noise*

Construction related traffic has the potential to temporarily increase road traffic noise levels at receivers which are adjacent to construction haulage routes. Construction traffic is proposed to primarily use Maitland Road with Old Maitland Road, Hexham and Old Maitland Road, Sandgate being used where required to access Construction Compound 1 and Old Maitland Road, Hexham being used where required to access Construction Compound 2.

The relatively low numbers of construction traffic compared to the high existing volumes (i.e. significantly more than 50,000 vehicles daily) are not expected to result in any noticeable impacts for receivers on Maitland Road. Road traffic noise levels on these routes are not expected to result in a noticeable change (i.e. the increase is predicted to be less than 2.0 dB) as a result of construction traffic when compared with the no-build scenario.

## Operation

### *Operation airborne noise*

The predicted operational road noise levels at residential receivers are summarised in **Table 6.55** for the 2028 at-opening and 2038 future design scenarios. The table shows the worst-case impacts in each NCA, which are typically for receivers nearest to the proposal. Receivers are generally most affected by the proposal in the night-time period in 2038 with respect to the NCG criteria and NMG triggers. **Figure 6.10** shows the predicted change in noise levels associated with the proposal minus the predicted noise levels that would occur in 2038 if the REF area was not to occur.

The nearest residential receivers to the proposal are subject to relatively high existing road traffic noise impacts which already exceed the NCG criterion in many cases

The proposal would widen and provide minor realignment of Maitland Road. Given that the majority of the proposal widens the road by utilising space within the median, the proposal is not predicted to result in increases road traffic noise levels by more than 2.0 dBA at any residential receiver across the construction area

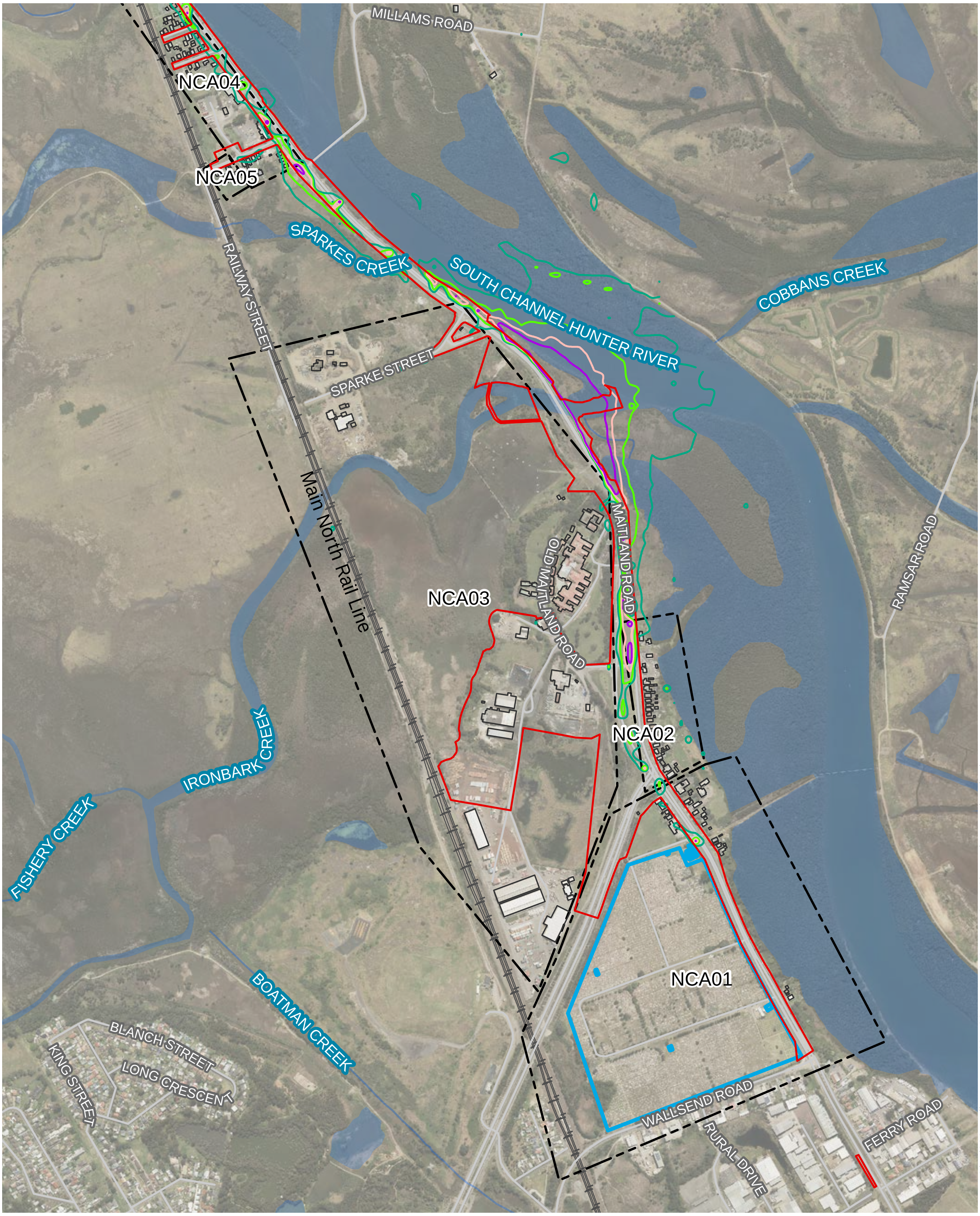
Exceedances of the NCG cumulative limit criteria (i.e. 5 d(A) or more above the NCG controlling criterion) are predicted at residential receivers which are adjacent to the REF area roads in all NCAs.

A total of 70 residential receivers are triggered for consideration of additional noise mitigation as per the NCG operational road traffic noise criteria (refer to Section 6.1 of **Appendix M**).

Table 6.55 Predicted road traffic noise levels at most affected residential receivers in each NCA

| NCA | Predicted noise level (dBA)[1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | At opening (2028) | | | | Future design (2038) | | | |
| | With proposal | | Without proposal | | With proposal | | Without proposal | |
| | Day | Night | Day | Night | Day | Night | Day | Night |
| NCA1 | 78 | 76 | 78 | 77 | 78 | 77 | 78 | 77 |
| NCA2 | 78 | 77 | 78 | 77 | 78 | 77 | 78 | 77 |
| NCA3 | 73 | 71 | 73 | 71 | 73 | 71 | 74 | 71 |
| NCA4 | 79 | 77 | 80 | 78 | 79 | 77 | 81 | 78 |
| NCA5 | 64 | 63 | 64 | 63 | 64 | 63 | 64 | 63 |
| NCA6 | 76 | 77 | 76 | 77 | 76 | 76 | 76 | 77 |
| NCA7 | 81 | 80 | 81 | 79 | 81 | 80 | 81 | 79 |

Note 1: Daytime and night-time are LAeq(15hour) and LAeq(9hour) noise levels, respectively.




Date: 10/11/2021 Filename: IA301100_REF_F012_WorstCaseChangeinoperationalNoise_v1

**Legend**

REF area
Noise levels
0.5
1
1.5
2

Other Sensitive Receivers
Buildings
NCA boundaries

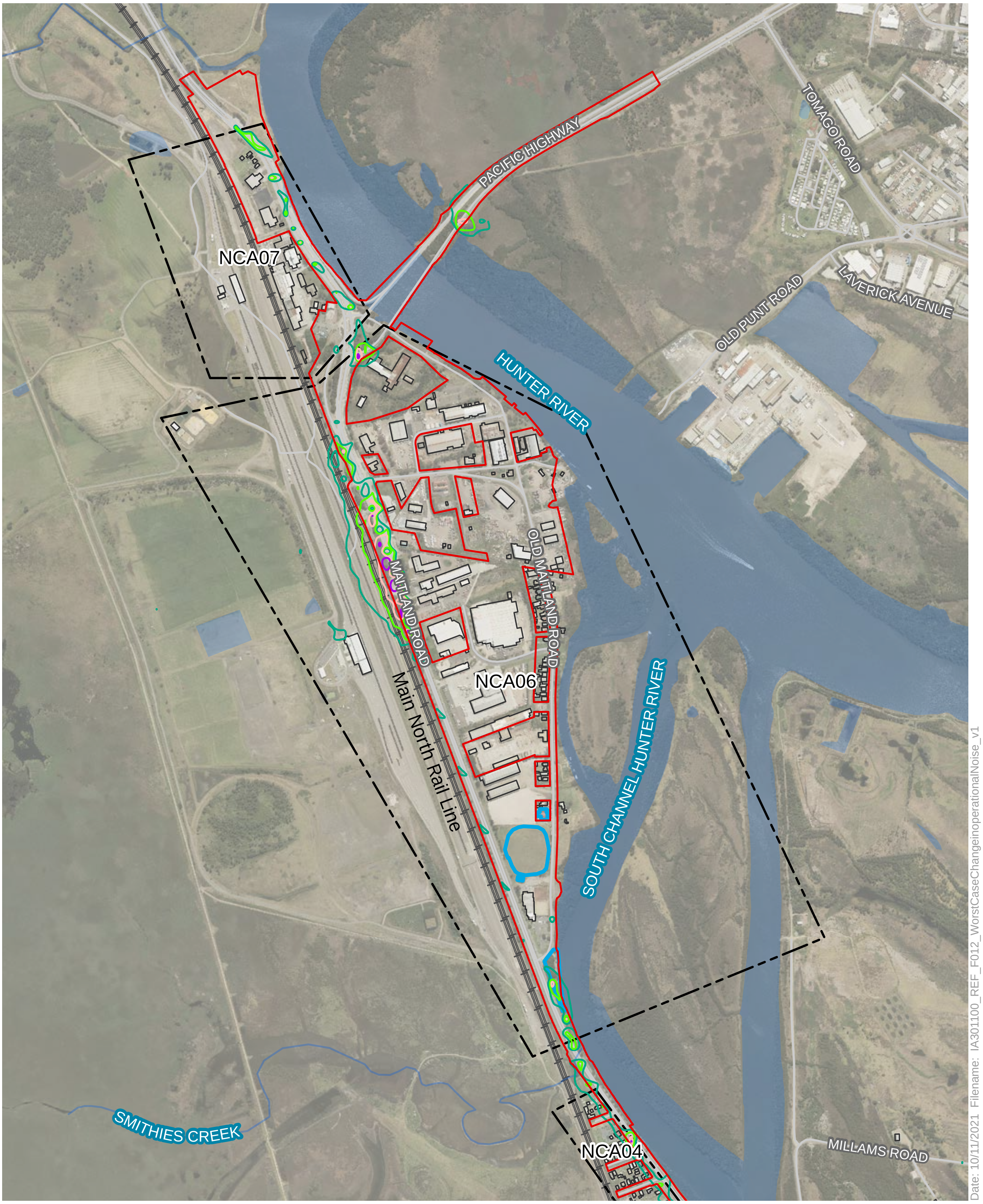
Road
Railway
Waterway

0 200 400 m
Scale 1:15,000 at A4
GDA94 MGA56

RAYMOND TERRACE
BLACK HILL
HEXHAM
NEWCASTLE

Page 1 of 2
**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.10a** Worst-case predicted change in operational noise (2038 night-time, build minus no build)




**Legend**

REF area
Noise levels
0.5
1
1.5
2

Other Sensitive Receivers
Buildings
NCA boundaries

Road
Railway
Waterway

0 200 400 m
Scale 1:15,000 at A4
GDA94 MGA56


Page 2 of 2
**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.10b** Worst-case predicted change in operational noise (2038 night-time, build minus no build)

### *Other sensitive receivers*

A total of four other sensitive receivers that are predicted to have exceedances of the NCG operational road traffic noise criteria, including:

- Sandgate cemetery
- Hexham cricket grounds
- Free Church of Tonga
- Hexham Foreshore Reserve.

### *Receivers eligible for consideration of additional noise mitigation*

A total of 74 sensitive receiver buildings/locations are predicted to have exceedances of the NCG operational road traffic noise criteria and are therefore eligible for consideration of 'additional noise mitigation'. The receivers which have been identified as eligible for consideration of 'additional noise mitigation' (i.e. triggered receivers) are summarised in **Table 6.56**. The locations of these receivers are shown in Section 6.3 of **Appendix M**.

Table 6.56 Receivers eligible for consideration for 'additional noise mitigation'

| NCA | Number of triggered buildings | |
|---|---|---|
| | Residential | Other sensitive |
| NCA01 | 12 | 1 |
| NCA02 | 18 | - |
| NCA03 | 4 | - |
| NCA04 | 32 | - |
| NCA05 | 1 | - |
| NCA06 | - | 3 |
| NCA07 | 3 | - |
| **Total** | **70** | **4** |

## 6.9.5 Safeguards and management measures

The environmental management measures that will be implemented to minimise noise and vibration impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.57**.

Table 6.57 Safeguards and management measures – noise and vibration

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| General construction noise and vibration | A Construction Noise and Vibration Management Plan (CNVMP) will be prepared for the proposal to mitigate and manage noise and vibration impacts during construction and will form part of the CEMP. The CNVMP will be implemented for the duration of construction of the proposal and will:<br>Identify nearby sensitive receivers<br>• Include a description of the construction equipment and working hours | Contractor | Prior to construction/ construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| | • Identify relevant noise and vibration performance criteria for the REF area and license and approval conditions<br>• Identify relevant sleep disturbance screening levels<br>• Outline noise and vibration objectives, standard and additional mitigation measures from the CNVG and information about when each will be applied<br>• Outline requirements for noise and vibration monitoring that will be carried out to monitor REF area performance associated with the noise and vibration criteria<br>• Describe community consultation and complaints handling procedures in accordance with the Community Communication Strategy to be developed for the REF area<br>• Outline measures to manage sleep disturbance during night time work<br>• Outline measures to manage noise impacts associated with construction heavy vehicle movements both on and off site.<br>• All personnel working on site will receive training to ensure awareness of requirements of the CNVMP. Site-specific training will be given to personnel when working in the vicinity of sensitive receivers. | | |
| General vibration | Where works are within the minimum working distances for vibration intensive equipment and considered likely to exceed the cosmetic damage objectives in the CNVG at adjacent receivers, construction work will not proceed unless:<br>• A different construction method with lower source vibration levels is used, where feasible<br>• Attended vibration measurements are carried out to determine any exceedances and if further mitigation is required. | Contractor | Prior construction/ construction |
| Vibration impacts to buried utilities | Where works are within 25 metres of potentially impacted utilities:<br>• Consultation will be carried out with the relevant utility authorities<br>• A detailed assessment of potential vibration impacts to any buried utilities will be conducted once detailed construction methodologies have been developed<br>• In-situ vibration monitoring may be considered when vibration intensive plant and equipment are to be used on site near buried utilities to establish site specific mitigation measures (e.g. safe working distances). | Contractor | Construction |
| Vibration impacts to heritage structures | Heritage listed buildings / structures within 50 metres from vibration intensive work are to be considered on a case by case basis to determine the structural integrity (i.e. structurally sound or unsound) of all | Contractor | Prior to construction/ construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| | potentially affected structures and to identify reasonable and feasible mitigation measures. | | |
| Vibration impact to existing structures | Prior to commencing the activity, a detailed inspection will be undertaken and a written and photographic report prepared to document the condition of buildings and structures where required. A copy of the report will be provided to the relevant land owner or land manager. | Contractor | Prior to construction |
| Operational road traffic noise impacts | Operational noise and vibration mitigation measures will be confirmed during detailed design as part of the Operational Noise and Vibration Review (ONVR) in accordance with the *Noise Mitigation Guideline* (NMG) (Roads and Maritime Services, 2015). | Transport/ Contractor | Detailed design |
| Operational road traffic noise impacts | Where feasible and reasonable, implementation of operational noise mitigation will be carried out within 12 months of construction activities commencing. | Contractor | Prior to construction |
| Operational road traffic noise impacts | Within the first year of operation, monitoring of operational noise levels would be compared to predicted noise levels to verify the predictions and to determine the effectiveness of the noise mitigation measures.<br><br>Additional feasible and reasonable mitigation will be considered at eligible receivers where measured noise levels are found to be significantly different from the predictions. | Transport/ Contractor | Operation |

## 6.10 Socio-economic, property and land use

The potential impacts of the proposal on socio-economic values including property and land use are assessed in the *Hexham Straight Widening Land Use, Property And Socio-Economic Assessment* provided in **Appendix Q**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.10.1 Methodology

This assessment has been developed in accordance with the *Environmental Impact Assessment Practice Note – Socio-economic Assessment* (Transport, 2020). Key steps in the assessment process included:

- Scoping the likely range of potential socio-economic, land use and property issues and identifying communities potentially affected by the proposal's construction and operation
- Review of relevant NSW Government and Council plans, polices and strategies relevant to the proposal and land use, property and the socio-economic environment of the study area
- Description of existing land use, property and socio-economic characteristics, conditions, and values in the study area, based on the review and analysis of existing population, land use, social infrastructure, business and features, to provide a baseline from which potential impacts and benefits of the proposal can be assessed
- Identifying, assessing, and evaluating potential impacts and benefits to land use, property and socio-economic values from the proposal's construction and operation
- Identifying measures to avoid, manage or mitigate negative impacts and potential benefits.

### 6.10.2 Existing environment

#### Land use

Land uses in the study area comprise mainly industrial and environmental uses, with a small number of residential uses, community facilities and commercial uses.

Industrial uses in the study area comprise a mix of general industry, heavy industry and major manufacturing uses within in discrete locations at Hexham and Sandgate.

In addition to industrial uses, some commercials are scattered throughout the study area, including service stations at Hexham and Sandgate, restaurants and takeaway food outlets at Hexham, and small-scale commercial uses at Maitland Road, Sandgate.

Residential uses in the study area are limited and mainly located:

- Along Maitland Road at Sandgate next to the proposal, including on the western side between Sandgate Cemetery and the NICB, and on the eastern side of Maitland Road opposite Sandgate Cemetery and extending to the southbound Maitland Road access to Old Maitland Road and the Calvary St Joseph's Retirement Community
- Along Old Maitland Road, within the Calvary St Joseph's Retirement Community at Sandgate, with the closest residential unit about 165 metres from the proposal at Maitland Road and about 50 metres from the construction area
- Within an area between Maitland Road and the Main North Rail Line at Hexham and include Clarke Street, Merchant Street, Fenwick Street and Shamrock Street, next to the proposal at Maitland Road
- On the western side of Old Maitland Road, north of the Hexham Bowling Club, with the closest residential property being about 145 metres from the proposal at Maitland Road and adjoining the construction area.

Community uses in the study area are generally limited and include sport and recreation uses such as Hexham Oval and Hexham Bowling Club, Calvary St Joseph's Retirement Community, and Sandgate Cemetery.

Parts of the study area are within the Hunter Wetlands National Park, including Hexham Swamp Nature Reserve to the west of the proposal, Hexham Island, Ash Island and Kooragang Island to the east of the proposal, and parts of the Hunter River floodplain at Hexham. Other important environmental features within the study area include the Hunter River, Hunter River South Channel, and Ironbark Creek.

The REF area is mainly located on land zoned SP2 Special Activities within the existing Maitland Road corridor. The purpose of this zoning is to provide for infrastructure and related uses, and to prevent development that is not compatible with or that may detract from the provision of infrastructure. Land within the Sandgate Cemetery and Main North Rail Line corridor is also zoned SP2 Special Activities. Other land use zones surrounding the proposal comprise environmental protection zones, industrial zones and recreation uses.

#### Land tenure

Property within the study area comprises privately owned property, land owned by the City of Newcastle, State owned land (rail and road corridors) and Crown Land.

#### Population and demographics

**Table 6.58** provides a summary of the community profile.

Table 6.58 Community profile (*Source: ABS 2016 Census*)

| Profile | Description |
|---|---|
| Population growth and motility | • At the 2016 Census, there were 435 people in the study area of which 305 people lived in Sandgate and 130 people lived in Hexham<br>• The study area generally had higher levels of population mobility compared to NSW, with lower proportions of people living at the same address both one year and five years prior to the 2016 Census |
| Age profile | • The study area had an older population compared to NSW, with a higher median age, lower proportion of children aged 14 years or younger, and higher proportion of older people aged 65 years or older. |
| Cultural diversity | • The study area had a high proportion of Aboriginal and/or Torres Strait Islander people (7.8 per cent) compared to NSW (2.9 per cent).<br>• The study area generally had lower levels of diversity in relation to overseas born and non-English speaking people |
| Households and family | • There were 120 households within the study area of which 54.2 per cent comprised family households<br>• Young families with children aged under 15 years represented about 41.4 per cent of total families in the study area<br>• The study area had relatively high proportions of lone person households |
| Housing | • There was a total of 151 dwellings in the study area of which 120 dwellings (79.5 per cent) were occupied<br>• Housing in the study area mainly comprises separate houses, with this dwelling type accounting for 95.8 per cent of occupied dwellings<br>• The study area had relatively high levels of rental housing compared to the City of Newcastle and NSW<br>• Housing costs in the study area were generally below the City of Newcastle and NSW in relation to both mortgage costs and rental costs |
| Disadvantage and need for assistance | • Communities in the study area generally displayed higher levels of relative disadvantage<br>• The study area has a high proportion of people (37.9 per cent) reporting a need for assistance, with this well above the proportion of this group in the City of Newcastle LGA and NSW. |
| Travel behaviour | • Residents in the study area had proportions of people who travel to work by car, as either driver or passenger, well above NSW, although this was similar to the proportions of this group in the City of Newcastle<br>• Households in the study area generally had a high level of access to private vehicle with low proportions of households without a vehicle |

## Economic profile

Communities in the study area have lower incomes compared to the City of Newcastle and NSW, lower household and personal incomes, higher proportions of low income households (that is, households earning less than $650 per week), and lower proportions of high income households (that is, households earning more than $2500 per week).

In 2016, there were 108 people aged 15 years and over in the study area who were either working or looking for work, representing a labour force participation rate of 28.1 per cent. This is substantially lower than the labour force participation rate in the City of Newcastle and NSW.

### Local business and industry

A range of businesses at Sandgate and Hexham that have potential to experience impacts from the proposal's construction and operation due to their location near the proposal. They include businesses that service the needs of communities within and surrounding the study area, wider Hunter region and motorists using Maitland Road, such as:

- Large scale manufacturing and heavy industrial uses
- Automotive retailers, including used car sales and truck sales
- Services related businesses, such as automotive repairs and servicing, transport and freight forwarding and auction house
- Service stations, which also include facilities for truck operators (for example, truck refuelling and parking areas)
- Eateries such as cafes, restaurants and takeaway
- Sport and recreation related businesses, including sporting club and golf driving range.

### Community values

Values and features likely to be important to communities in the study area for quality of life and wellbeing, based on existing literature, understanding of key features in the study area, and feedback received through consultation for the proposal include:

- Environmental and natural features such as the Hunter Wetlands National Park, Hexham Swamp Nature Reserve and Hunter River offer environmental, education, recreation and landscape amenity values
- Major industrial and manufacturing which contribute to the local and regional economy and providing employment for residents
- Existing recreation areas, particularly the Hexham Bowling Club, although these are currently affected by noise from major arterial roads such as Maitland Road and rail operations from the Main North Rail Line
- Maintaining road safety and provision of a safe, reliable and efficient road network within the study area and surrounding areas.

A desktop internet search identified three roadside tributes located along the proposal including:

- A cross and flowers attached to a power pole, located on the eastern side of the NICB and Maitland Road intersection alongside the southbound lanes of Maitland Road (refer to **Plate 6.3**)
- A free standing cross and flowers, located on the western side of the northbound lanes of Maitland Road, north of the Old Maitland Road, Sandgate intersection near the Calvary St Joseph's Retirement Community (refer to **Plate 6.4**)
- A cross attached to a tree, located on the eastern side of the southbound lanes of Maitland Road opposite the Sparke Street intersection (refer to **Plate 6.5**).


Source: Google Earth Pro, viewed 4 September 2021

Plate 6.3 Roadside tribute located at the NICB and Maitland Road intersection, view looking southeast

Source: Google Earth Pro, viewed 4 September 2021

Plate 6.4 Roadside tribute located to the north of the Old Maitland Road, Sandgate intersection near the Calvary St Joseph's Retirement Community, view looking northwest


Source: Google Earth Pro, viewed 4 September 2021

Plate 6.5 Roadside tribute located on the eastern side of Maitland Road opposite the Sparke Street intersection, view looking east

### Social infrastructure

The study area accommodates a small number of community facilities and services, including sport and recreational facilities, aged care, and cultural facilities (refer to **Table 6.59**). These cater for residents from surrounding areas within the City of Newcastle LGA and adjoining LGAs.

Table 6.59 Social infrastructure

| Type | Facility | Location |
|---|---|---|
| Sports, recreation and leisure | Newcastle Golf Practice | Off Astra Street, Shortland |
| | Foreshore Reserve | Old Maitland Road, Hexham |
| | Hexham Bowling Club | Old Maitland Road, Hexham |
| | Hexham Park | Old Maitland Road, Hexham |
| | Rainforest Walk to Riverside Park | Wetlands Place, Shortland |
| | Kooragang Wetlands Information Centre | Schoolhouse Road, Newcastle |

| Type | Facility | Location |
|---|---|---|
| Other facilities | Free Church of Tonga | Old Maitland Road, Hexham |
| | The Hub Preschool | Rural Drive, Sandgate |
| | Calvary St Joseph’s Retirement Community | Old Maitland Road, Sandgate |
| | Sandgate Cemetery | Maitland Road, Sandgate |

#### Access and connectivity

A description of the key transport infrastructure and facilities in the study area including roads, rail, bus services, pedestrian and cycle access are discussed in **Section 6.6.2**.

### 6.10.3 Potential impacts

#### Construction

##### *Property*

Temporary leases would be required over some properties for temporary construction facilities such as site compounds and stockpile sites. Four locations have been identified for proposed temporary construction facilities, and these are described in **Section 1.1.1** and shown in **Figure 1.2**.

The exact sites would be confirmed through the detailed design phase. Use of sites within these areas for temporary construction facilities would generally be consistent with surrounding industrial land uses.

Affected properties would be leased by Transport during the construction phase. Following construction, land occupied by construction works, but not required for ongoing operation of the proposal would be reinstated to its preconstruction use.

Access to private properties near to construction works would also be maintained. Where temporary changes are required to driveway accesses during construction, suitable access arrangements would be implemented in consultation with affected property and business owners. The presence of construction works, changes to local road conditions (for example, lane closures), and increased traffic on local streets during night-time diversion periods may influence perceptions of road safety for local communities and some motorists, pedestrians and cyclists.

##### *Land use*

During construction, potential impacts on land use would mainly result from temporary use of land for construction facilities such as site compounds and stockpiles and changes in amenity for some uses near to construction works and temporary construction facilities.

Areas identified for temporary construction facilities include existing industrial land within industrial areas of Hexham and Sandgate, or vacant land. The use of industrial land would be consistent with the existing land uses and is not expected to impact on industrial land in the study area.

There is a section of vacant land at Sandgate proposed to be used as part of Compound 1 that is zoned SP2 and is within an area of road corridor that is owned by Transport. This area is located at the southern end of the compound area to the north-west of the NICB and Maitland Road intersection and was previously used for the construction of the NICB. Use of this section of land for construction is consistent with its current land use zoning.

Vacant land at Hexham identified for Compound 4 includes an area of cleared land owned by Transport between Maitland Road and the Hunter River and zoned E2 for environmental conservation in the Newcastle LEP. This land is generally highly disturbed and has no or limited vegetation and an existing access track provides access from Maitland Road to grazing land north of Purgatory Creek. Following construction, this land would be rehabilitated to its existing use and temporary use of this site is not expected to impact on the future use of this land for environmental conservation.

#### *Population and demographics*

The proposal would not require the acquisition of any residential properties within the study area.

Construction of the proposal is not expected to change population and demography in the study area, including age and gender profiles.

#### *Economic*

At its peak, the proposal would create direct employment for about 500 workers, including construction workers and professional and administrative staff. As the construction workforce is expected to be sourced from across the Hunter, where possible, these benefits are likely to be realised by local and regional communities.

The proposal would also support indirect employment opportunities in local, regional and national businesses and industries that support the construction of the proposal, for example businesses that provide goods and services to support the needs of the construction workforce, suppliers of construction materials and equipment, and transport operators.

The implementation of the NSW Government's Aboriginal Participation in Construction policy would provide employment and training opportunities for Aboriginal people.

#### *Local business and industry*

During construction, potential impacts on local businesses may result from:

- Increased expenditure by construction workers on local goods and services
- Traffic disruptions and local access changes due to road works
- Increase noise, dust and construction traffic impacting on business amenity.

The construction phase may have a positive effect on some businesses within the study area and surrounding suburbs through increased customers and trade in response to the day-to-day needs of construction workers. This includes businesses such as service stations and food outlets near to construction works. Businesses supplying goods and services to construction, for example transport operators and equipment hire, may also experience benefits from increased construction activities locally.

Access to businesses near the proposal would be maintained during construction, although temporary access changes may be required for some businesses that have a frontage to Maitland Road. Generally, any temporary access changes are generally not expected to impact on decisions of customers to visit specific businesses. Where temporary changes are required, these would be determined in consultation with the affected businesses to ensure that any potential impacts on the business are appropriately managed.

Disruptions for motorists and road users during construction due to temporary lane changes and reduced speed limits have potential to cause delays for customers, staff and deliveries accessing businesses in the study area. This may be an inconvenience for some people accessing businesses near the proposal, although this is unlikely to impact on their decision to use a particular business given the nature of businesses in the study area (that is, ‘destination businesses’ access for specific goods or services).

During construction, increased noise and dust from construction activities may impact on the amenity of some businesses near the proposal. The effect of this impact would depend on such things as the nature and type of business but could impact on ability to interact with customers and changes to general ambience. Businesses in the study area mainly include heavy industry and manufacturing uses that are likely to be less sensitive to amenity changes, although there are some businesses such as café/restaurants and sports clubs that have outdoor areas used by customers and may be more sensitive to amenity impacts.

### *Community values*

During construction, potential impacts on community values would mainly be associated with adverse changes to local amenity due to such things as increase noise, dust and traffic from construction activities and changes to local access and connectivity due to works within the road corridor.

Temporary changes to local amenity would mainly occur for occupants of residential and commercial properties, and users of community facilities near to construction works for road widening, new U-turn facilities and intersection upgrades and temporary construction facilities. This may temporarily impact on individuals’ use and enjoyment of these properties, particularly within outdoor areas such as at Hexham Bowling Club, front and back yards of residential uses, and gardens and open space areas within the Calvary St Joseph’s Retirement Community.

It is expected that some work would need to be carried out during the evening and at night to minimise potential impacts on regional road networks. Noise and light spill from these works have potential to affect the night-time amenity at residential properties closest to these works. Noise and light impacts are discussed further in **Section 6.9** and **Section 6.11**.

Given the number of sensitive receivers near to construction works (for example, houses, residential care home, commercial uses and sporting facilities) there is potential for short-term health effects due to dust from construction activities. Any effects are likely to be appropriately managed with the implementation of dust mitigation measures. Dust and air quality impacts are discussed further in **Section 6.13**

An increase in construction traffic and heavy vehicles on roads within the study area and changes to local traffic and pedestrian and cycle access during construction may impact on community perceptions relating to road safety. Traffic impacts are discussed further in **Section 6.6**.

Three roadside tributes were identified through desktop research along Maitland Road within the REF area and which are immediately next to or within the construction area of the proposal. The northern most tribute located opposite Sparke Street would be directly impacted, the other two may be impacted by the proposal. A review would be conducted prior to construction to identify the presence of any additional roadside memorials potentially affected by the proposal. Relocation or removal of these roadside tributes would be required, and would be carried out in accordance with *Roads and Maritime Roadside Tribute Guidelines* (Roads and Maritime Services, 2016).

The proposal would not result in any direct impacts on the Hunter Wetlands National Park, Hexham Swamp Nature Reserve, Kooragang Nature Reserve or Shortland Wetlands, although there is potential for indirect impacts on these natural features.

### *Social infrastructure*

Potential impacts on community facilities and services during construction would mainly result from:

- Increased noise, dust and construction traffic impacting on amenity for users and staff of the community services and facilities
- Changes to local access and traffic disruptions and delays, due to road works.

These impacts would mainly affect social infrastructure located closest to construction activities and temporary construction facilities.

Hexham Bowling Club would be impacted by noise, dust and construction traffic associated with the construction of the U-turn facility at Old Maitland Road to the east of the club which would impact amenity. There is potential for temporary disruptions to weekly competitions, particularly if they coincide with construction activities that cause high levels of noise and dust. Access to the bowling club's car parking areas would be maintained during construction, although road works at Maitland Road and Old Maitland Road may temporarily impact on the availability of roadside parking.

Calvary St Joseph's Retirement Community would experience increased noise, vibration, dust and construction traffic from construction works for the widening of Maitland Road and the operation of a temporary construction facility at Sandgate (Construction Compound 1). This may temporarily impact on the use and enjoyment of some areas within the retirement community, such as outdoor areas and gardens used as meeting or gathering places or areas used for quiet relaxation. Noise from night works have potential to result in adverse changes to the night-time amenity and disruptions to sleeping patterns for some residents of the retirement community. Access to the retirement community, including to independent living units at Old Maitland Road, would be maintained during construction

A detailed summary of the potential impacts of the REF area on specific social infrastructure is provided in Table 6.1 of **Appendix Q**.

### *Emergency services*

During construction, potential impacts on emergency services would mainly be associated with temporary road changes including lane closures, speed restrictions and night works through the REF area. The nearest emergency services near the proposal include NSW Fire and Rescue at Mayfield West and Tarro, and NSW Ambulance at Wallsend and Beresfield.

## Operation

### *Land use*

The proposal would mainly be located within the existing road corridor for Maitland Road and is not expected to directly impact on land use in the study area. Adjustments would be required to three existing driveway accesses at some properties located next to the proposal These adjustments would occur within the road corridor and would be finalised in consultation with the affected property owners and are not anticipated to impact on the ongoing use and functioning of existing land uses. Further discussion provided below and in **Section 6.6.3**.

The proposal is recognised in the Greater Newcastle Metropolitan Plan and would support future land use and development within the study area and surrounding suburbs. The proposal would also support improved connectivity between strategic centres and growth areas within the City of Newcastle and adjoining LGAs, supporting efficiencies in freight movements and future growth, and making it easier for people to get to work, recreation facilities and services.

### *Property acquisition*

The proposal would mainly be within the existing road corridor for Maitland Road, with direct property impacts requiring property acquisition (refer to **Section 3.6**) that is limited to partial property impacts on:

- About 424 square metres of private land (Lot 1, DP623278) located on Shamrock Street, which forms part of the larger Shell service station property and is used for commercial uses
- About 628 square metres of vacant Crown land (Lot 7002, DP1052280) located to the east of Old Maitland Road to the north of the Hexham Bowling Club.

In addition, the proposal would impact on land within the Main North Rail Line corridor owned by Transport and maintained by ARTC (Lot 1013, DP1193512), and vacant land owned by Transport next to the A1 Pacific Highway and Maitland Road intersection to the west of Hexham Bridge (Lot 100, DP1034798).

The two properties requiring acquisition for the proposal would be acquired by Transport prior to construction in accordance with the provisions of the *NSW Land Acquisition (Just Terms Compensation) Act 1991* and the Land Acquisition Reform 2016 process (https://www.propertyacquisition.nsw.gov.au/). The Act provides the basis for an appropriate valuation process and the fair assessment of compensation.

Where private property is only partly affected by the proposal, Transport would carry out a partial acquisition of the directly affected portion. The partial acquisition of the one private property that is used for commercial uses would not impact on the operation of the business.

### *Other property impacts*

The proposal would not require the demolition of any buildings or structures on directly impacted properties. The proposal would not require any property adjustments and any driveway accesses affected by the proposal would be reinstated. Access to three properties at (15 to 19) Maitland Road, Hexham to the south of Shamrock Street, is currently provided via an informal side road that runs parallel to Maitland Road. This would be changed as part of the proposal so that the driveways to each of the three properties connect directly to Maitland Road (refer further to **Section 6.6.3**). Any adjustments to properties required for the proposal would be carried out in consultation with the property owner.

Potential impacts may occur for properties near to the proposal due to changes in local amenity and road traffic noise. These issues are discussed in more detail in **Section 6.11** and **Section 6.9** respectively.

### *Population and demographics*

The proposal would not require the removal of any dwellings or relocation of residents within the study area and consequently would not directly cause changes to population and demography in the study area. Indirectly, operation of the proposal would support future population growth of strategic centres and growth areas within the study area and wider Hunter region.

### *Economic*

Operation of the proposal would not result in any direct impacts on employment and training. Indirectly, the proposal would support improved access, travel times and connectivity to key employment areas in the study area and Hunter region, including at Hexham, Thornton, Beresfield, Black Hill, Tomago, Raymond Terrace and Port of Newcastle.

### *Local business and industry*

The partial acquisition of one private commercial property would not directly impact any commercial functions or change existing commercial operations on this property.

The proposal would improve road safety and accessibility, including through reduced congestion, travel time savings and improved travel reliability for staff, customers and deliveries. This would impact positively on businesses, supporting general improvements to local business and industry within the study area and surrounding suburbs. Changes to existing U-turn facilities and removal of some right turn movements would require changes in access routes for staff, customers and deliveries of some businesses, increasing the distance required for some people to travel.

A summary of potential impacts on specific businesses near the proposal from the operation of the proposal are outlined in Table 6.2 of **Appendix Q**.

### *Community values*

The proposal would support improved travel and accessibility to work, business and leisure activities in the study area and surrounding suburbs. More efficient travel and connectivity for motorists and public transport users provided by the proposal would have positive impacts on community cohesion. Improved access and connectivity to employment areas in the study area and surrounding LGAs would also support enhanced access to employment opportunities.

Potential adverse impacts of the proposal's operation on community values would mainly be associated with changes in traffic noise and increased traffic on local roads such as Shamrock Street at Hexham. Elsewhere, operation of the proposal is not expected to adversely impact on community values, although the proposal would require changes to local access routes. Further details on the impacts of changes to local access routes is provided in **Section 6.6**.

### *Social infrastructure*

The proposal would contribute to improved access and connectivity to services and facilities such as the University of Newcastle, schools, sport and recreation facilities, and cultural uses that service residents in the study are and surrounding suburbs. This would have long-term positive impacts for local and regional communities.

Access routes for most social infrastructure in the study area would remain the same as those currently used. However, access changes would be required for facilities on Ash Island (for example, the Rainforest Walk to Riverside Park and Kooragang Wetlands Information Centre) due to the closure of the central median and right turn from Maitland Road (northbound) onto Millams Road and the Ash Island bridge. Users of these facilities would be required to use the new U-turn facilities at Shamrock Street and Sparke Street.

## 6.10.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise socio-economic, land use and property impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.60**.

Table 6.60 Safeguards and management measures – socio-economic, land use and property impacts

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Community consultation | A Community Communication Strategy (CCS) will be prepared for the REF area to facilitate communication with the local community including relevant Government agencies, | Transport/ Contractor | Prior to construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| | Councils, adjoining affected landowners and businesses, residents, motorists and other relevant stakeholders that may be affected by the proposal. The strategy will:<br>• Identify people, businesses and organisations to be consulted during the delivery of the proposal<br>• Set out procedures and mechanisms for the regular engagement with local businesses and organisations (for example, around local events) and distribution of information about the proposal<br>• Outline mechanisms to keep relevant stakeholders updated on site construction activities, schedules and milestones<br>• 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<br>• Outline a process to resolve complaints and issues raised. | | |
| Property acquisition | 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 |
| | Property adjustments will be completed in consultation with property owners/business managers. | Transport/ contractor | Prior to construction/ construction |
| Business impacts | Access will be maintained to local businesses near to construction work. Where temporary access changes are proposed, these will be agreed with the affected business owner. | Contractor | Construction |
| Social infrastructure | Communication will be undertaken with local communities and recreational fishers about changes to the area near Ironbark Creek that is used informally for recreational fishing, including temporary restrictions during construction and permanent removal of the informal vehicle access road. | Transport | Prior to construction |
| Emergency vehicle access | 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 |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Roadside tributes | A review will be undertaken of the corridor prior to construction to confirm the presence of roadside memorials. | Contractor | Prior to construction |
| | Relocation or removal of roadside tributes will be carried out in accordance with Roads and Maritime *Roadside Tribute Guidelines* (September 2016). | Contractor | Construction |

## 6.11 Urban design, landscape character and visual impacts

The potential impacts of the proposal on urban design, landscape character and visual amenity are assessed in the *Hexham Straight Widening Urban Design, Landscape Character and Visual Impact Assessment* provided in **Appendix C**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.11.1 Methodology

The methodology used to undertake the study is summarised as follows:

- A review of relevant guidelines, planning documents and policies
- A desktop review of existing conditions to allow for contextual analysis
- Site inspections in September 2020 to ground-truth the study area, landscape character and views
- Identification of landscape character zones and assessment of construction and operation landscape character
- Assessment of visual impacts during operation
- Assessment of cumulative landscape character and visual impacts
- Development of a mitigation strategy to address landscape character and visual impacts.

The assessment was undertaken in accordance with the following Transport guidelines:

- *Beyond the Pavement 2020: Urban design approach and procedure for road and maritime infrastructure planning, design and construction* (Transport, 2020)
- *NSW Sustainable Design Guidelines Version 3.0* (Transport, 2013)
- *Crime Prevention through Environmental Design* (Queensland Government, 2007)
- *Urban Green Cover in NSW, Technical Guidelines* (Office of Environment and Heritage, 2015)
- *Healthy Urban Development Checklist* (NSW Health, 2009).

Based on the concept design, a visual and landscape character impact assessment has been undertaken based on relevant Transport guidelines. The landscape character impact is based on the aggregate of an area's built, natural and cultural character and sense of place. In this regard, it is measured by the combination of the area's sensitivity and the magnitude (scale, character and distance). The magnitude of impact refers to the type of proposal and its compatibility with the existing landscape character. Factors such as visual contrast, scale, location or setting all influence the magnitude that the proposal may have on its surroundings. The magnitude impact rating also considers whether the proposal has a positive or negative impact on the landscape character. For example, a proposal may be of a large scale, yet could positively impact how an area functions or improve its sense of place, providing beneficial outcomes.

Key viewpoints of the existing environment proposal were also identified, and the same assessment methodology was used to assess the impacts on the proposal in views.

**Table 6.61** below shows how the level of sensitivity and magnitude are combined to achieve an overall level of impact for both the landscape character impact and the visual impact.

Table 6.61 Visual and landscape character impacts rating matrix

| Sensitivity of landscape / view | Magnitude of change | | | |
|---|---|---|---|---|
| | High | Moderate | Low | Negligible |
| High | High | High - moderate | Moderate | Negligible |
| Moderate | High - moderate | Moderate | Moderate - low | Negligible |
| Low | Moderate | Moderate - low | Low | Negligible |
| Negligible | Negligible | Negligible | Negligible | Negligible |

### 6.11.2 Existing environment

The landform of the study area is characterised by its position next to the Hunter River and the flat landscape of its wide alluvial floodplains and swamps on either side of the Hunter River. The flat, low-lying and open landscape of the floodplain provides long-distance views across the broader area.

Local amenity and character in the study area is mainly influenced by:

- Major industrial and manufacturing uses at Hexham and Sandgate
- Major transport infrastructure such as Maitland Road, the A1 Pacific Highway, the New England Highway and the Main North Rail Line
- Natural features such as the Hunter Wetlands National Park, Hexham Swamp Nature Reserve and waterways including the Hunter River, South Channel Hunter River and Ironbark Creek.

#### Landscape character zones

A total of nine landscape character zones have been identified along the proposal corridor and these are shown in **Figure 6.11** and described in **Table 6.62**.

Table 6.62 Summary of landscape character zones

| Landscape character zones | Description |
|---|---|
| LCZ1 – Waterways | Located next to the north eastern end of the REF area and is dominated by the Hunter River which immediately adjoins the road corridor to the east with uninterrupted water views. |
| LCZ2 – Industrial | This industrial precinct marks the transition from floodplain pasture lands to developed lands and the interchange of the Hexham Bridge. The former Oak Factory site is located in this landscape character zone. |
| LCZ3 – Interchange | This location comprises a combination of elevated road infrastructure and native landscape plantings. The plantings assist in grounding the structures and softening the overall impact of the infrastructure by reducing its scale. |

| Landscape character zones | Description |
|---|---|
| LCZ4 – Industrial (central) | Located south of the interchange of Hexham Bridge and east of the proposal. This area consists of large industrial uses, comprising large warehouse scale buildings and hardstands with minimal canopy cover. |
| LCZ5 – Vegetation screening | Comprises well established corridor of tree plantings creating a buffer between road and rail corridor. |
| LCZ6 – Railway siding | Comprises multiple rail lines between the floodplain and low grasslands. |
| LCZ7 – Riverfront/floodplain | Comprises riverfront floorplan landscape on either side of the proposal. The eastern side of this landscape character zone is dominated by mangrove forest and saltmarsh and western side contains mangroves and freshwater wetlands with a more open character. |
| LCZ8 – Residential / commercial | Three distinct residential and commercial areas comprising workers cottages, houses and some commercial properties. |
| LCZ9 – Gateway | This landscape character zone identifies the suburban limits of Newcastle. The character is defined by earth mounding and Norfolk Island Pines. |

### Key viewpoints

A total of twelve representative viewpoints have been identified along the construction area (refer to **Figure 6.12)** and includes:

- VP1 – NICB. Located at the NICB and Maitland Road intersection looking north-west
- VP2 – Gateway precinct: Located at the start of the Gateway precinct at the southern end of the proposal to the north of the NICB and looking south
- VP3 – Located at Old Maitland Road, Sandgate to the south of the Calvary St Joseph's Retirement Community looking north
- VP4 – Located at the entrance to Calvary St Joseph's Retirement Community looking north
- VP5 – Located at Ironbark Creek Bridge looking east
- VP6 – Located at the Fenwick Street and Maitland Road intersection looking south
- VP7 – Located at the Merchant Street and Maitland Road intersection looking south
- VP8 – Located at the Clark Street and Maitland Road intersection looking north
- VP9 – Located at Old Maitland Road (north), Hexham to the north of the Hexham Bowling Club, looking west
- VP10 – Located on Maitland Road, Hexham at the start of the commercial and industrial precinct, looking north
- VP11 – Located on Maitland Road next to Hexham Railway Station looking north
- VP12 – Located at the northern end of the proposal on Maitland Road towards the eastern end of the New England Highway looking south.

These viewpoints have been identified at key viewpoints along the REF area and reflect views from both private properties and public vantages.


Date: 10/11/2021 Filename: IA301100_REF_F013_LCZ_v3

**Legend**

REF area

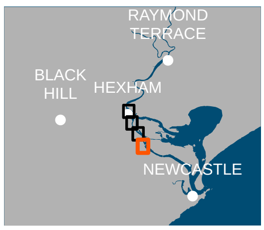
Road

Railway

0 200 400 m

Scale 1:8,000 at A4

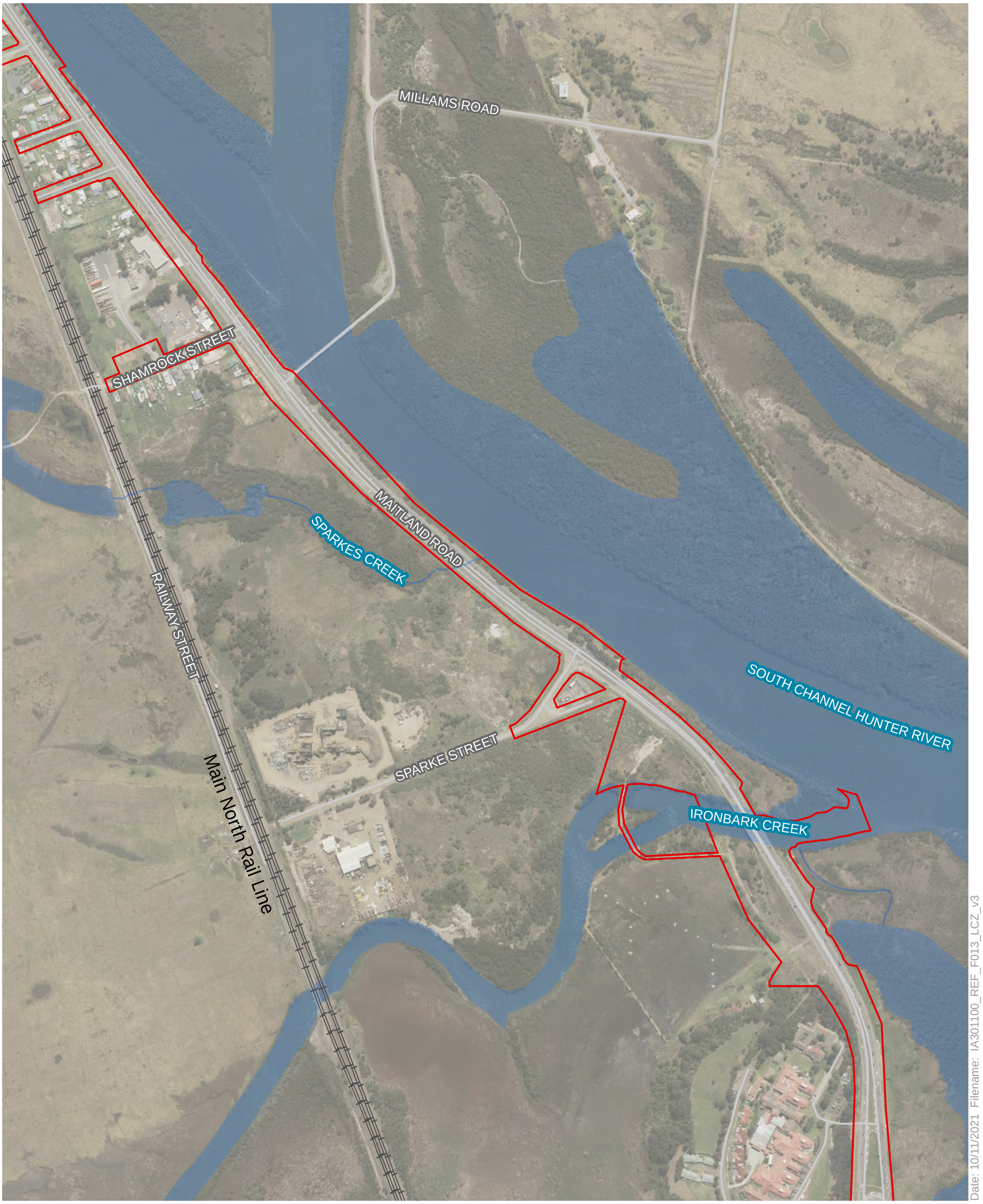
GDA94 MGA56




Page 1 of 4

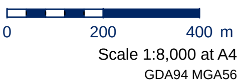
**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

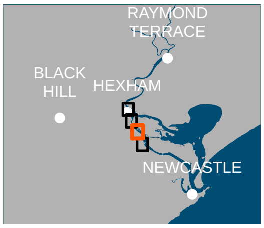
**Figure 6.11a** Landscape character zones




**Legend**

REF area
Road
Railway

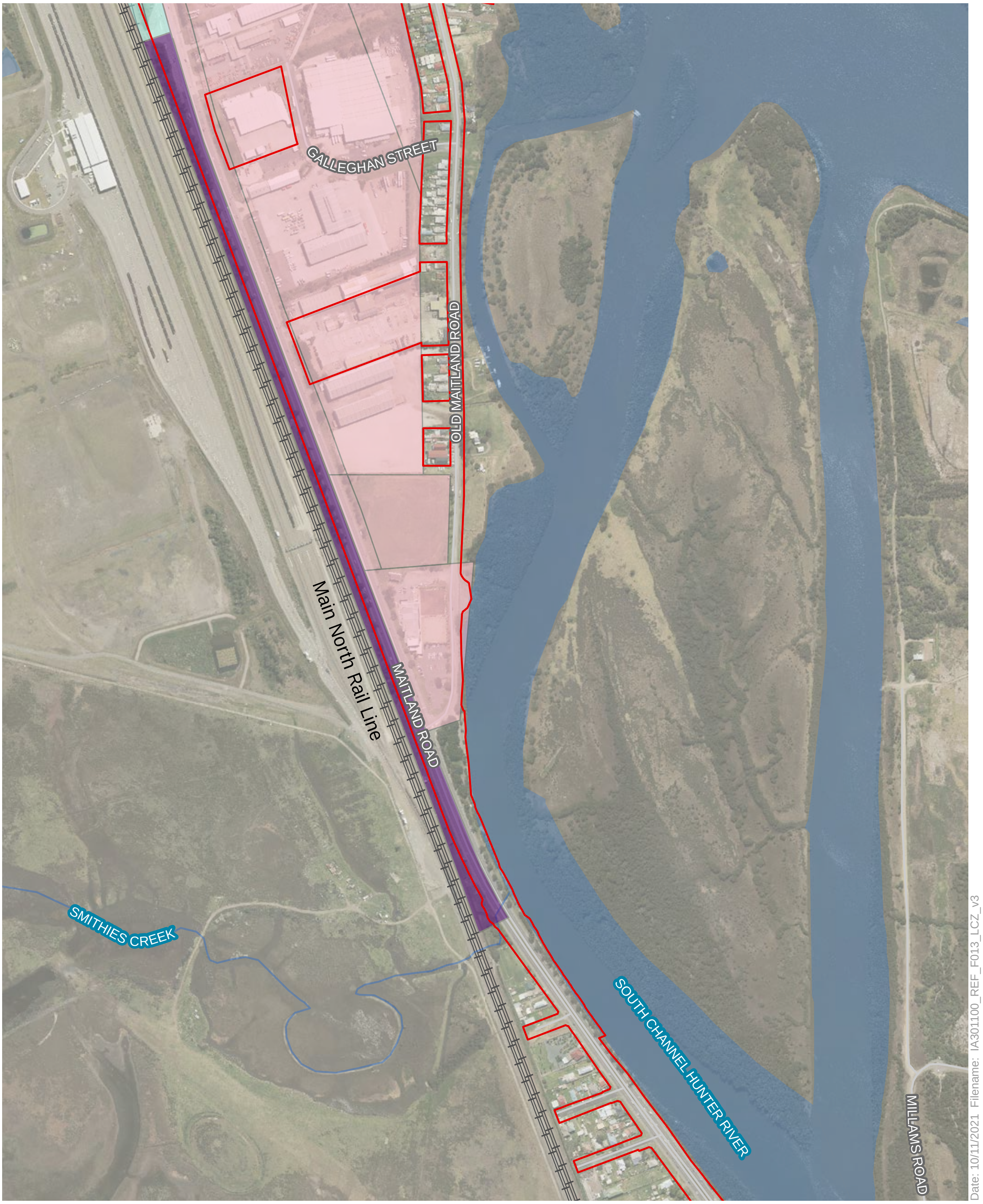



Page 2 of 4

**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.11b** Landscape character zones



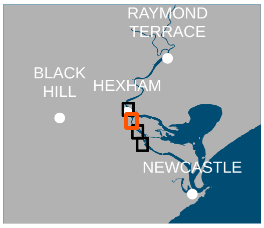

**Legend**

REF area

Landscape character zone
- LCZ4 - Industrial (Central)
- LCZ5 - Vegetation screening
- LCZ6 - Railway siding

Road
Railway

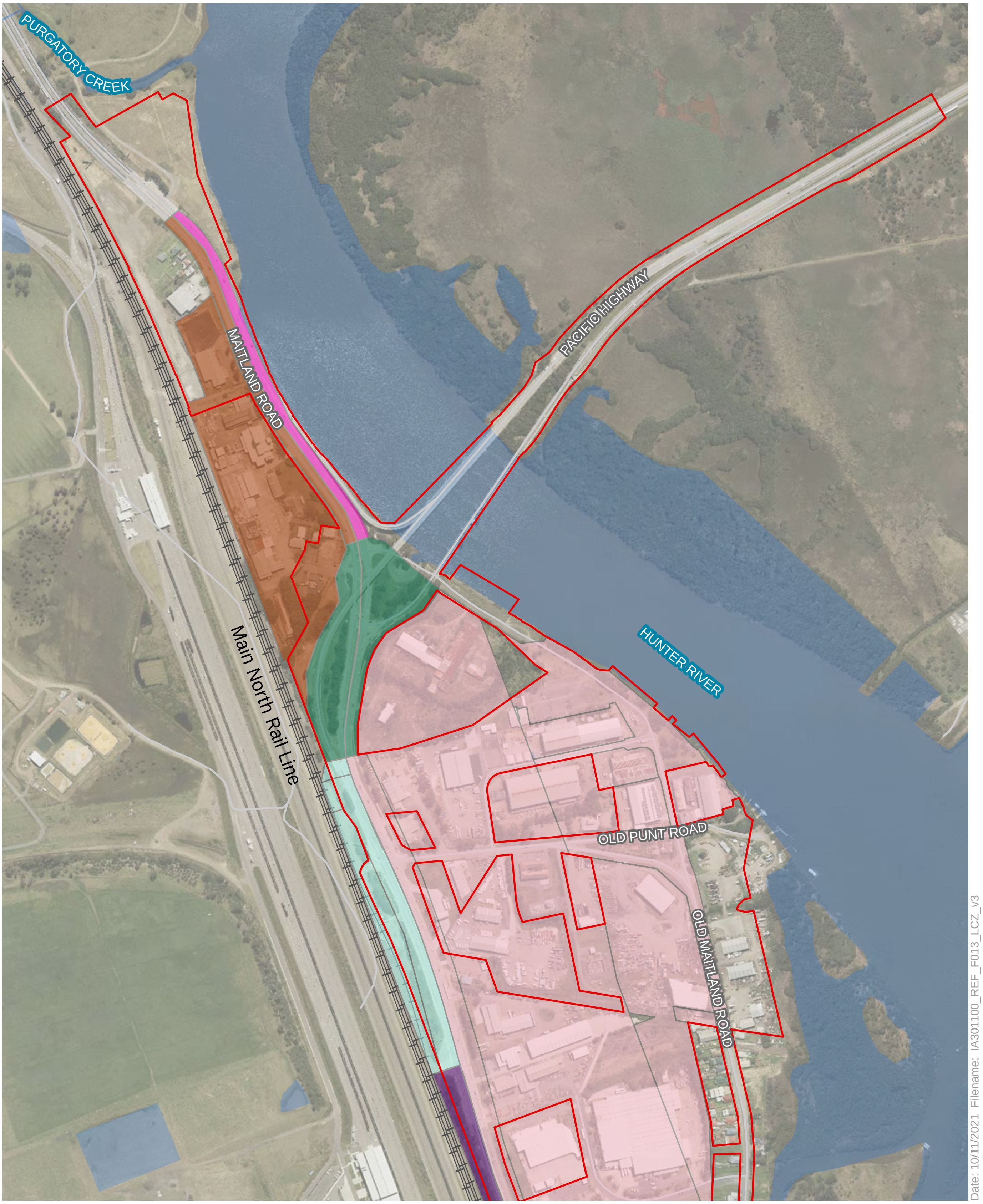
0 200 400 m
Scale 1:8,000 at A4
GDA94 MGA56




Page 3 of 4

**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.11c** Landscape character zones



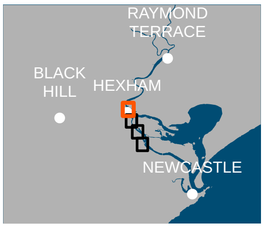

**Legend**

REF area

Landscape character zone
LCZ1 - Waterway
LCZ2 - Industrial
LCZ3 - Interchange
LCZ4 - Industrial (Central)
LCZ5 - Vegetation screening
LCZ6 - Railway siding

Road
Railway

0 200 400 m
Scale 1:8,000 at A4
GDA94 MGA56






**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.11d** Landscape character zones


Date: 10/11/2021 Filename: IA301100_REF_F014_Viewpoints_v1

**Legend**

- REF area
- View point
- Railway
- Road
- Waterway

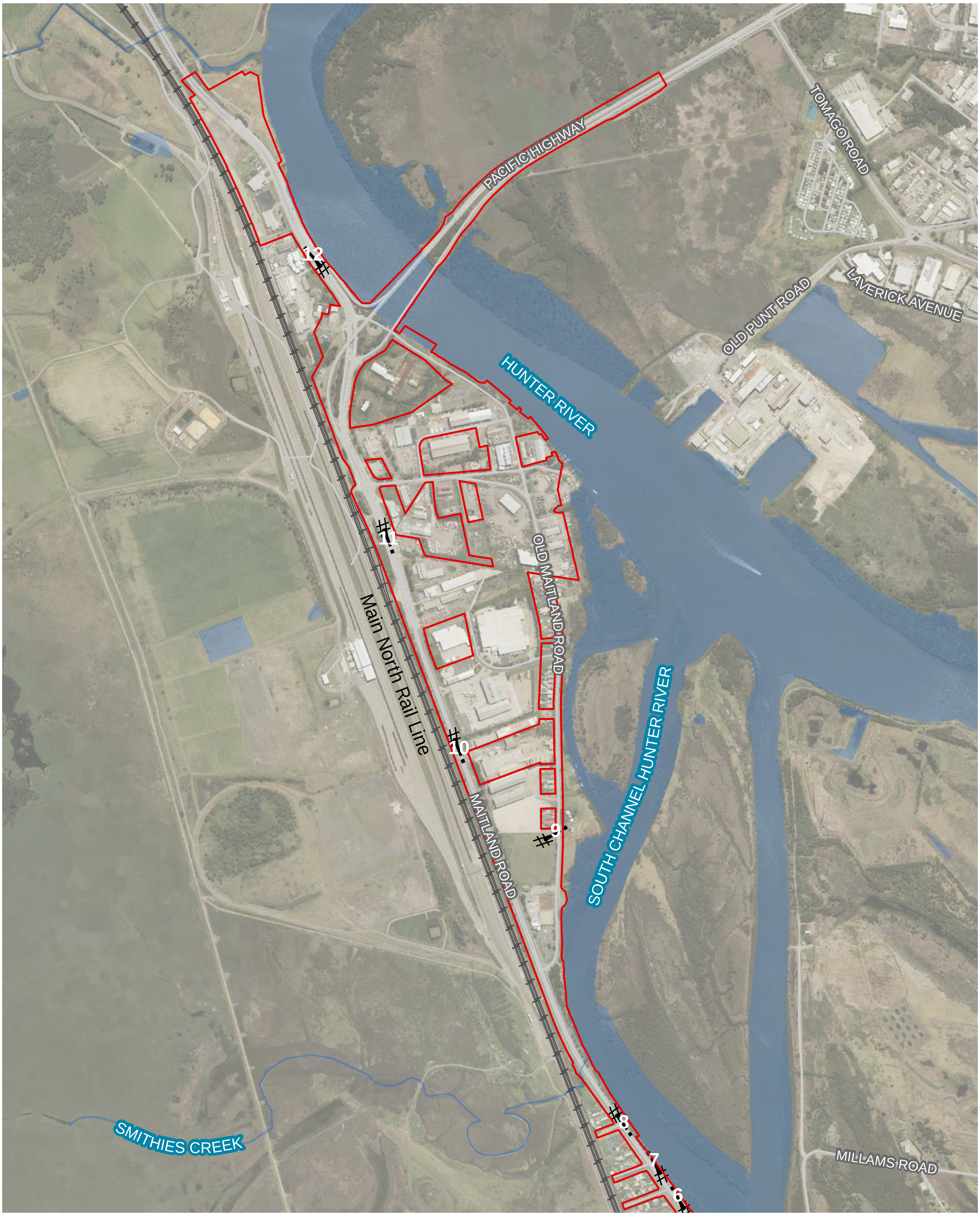
0 200 400 m
Scale 1:15,000 at A4
GDA94 MGA56




**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.12a** Key viewpoints

Hexham Straight Widening




**Legend**

REF area
View point
Railway
Road
Waterway

0 200 400 m
Scale 1:15,000 at A4
GDA94 MGA56


Page 2 of 2

**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.12b** Key viewpoints

### 6.11.3 Potential impacts

#### Construction

Visual impacts during construction of the REF area would be experienced due to vegetation clearance and the introduction of construction areas, construction plant and equipment. Impacts on landscape character and visual amenity would be present throughout construction but would be temporary in nature. Safeguards and management measures would be implemented to minimise any visual impacts during construction.

#### Operation

##### *Landscape character*

**Table 6.63** provides a summary of the landscape character impacts on the nine landscape character zones.

The sensitivity of the landscape character varies along the length of the REF area with the majority of the works being within the existing road corridor. As a result, much of the REF area would result in a negligible impact to landscape character.

Landscape character zones that would experience moderate or higher impact to landscape character during operation include:

- LCZ7 – Riverfront/floodplain would experience a high magnitude of change associated with the removal of the existing bridge over Ironbark Creek and construction of a new structure requiring the removal of some vegetation along Ironbark Creek. This would result in a moderate to high impact to landscape character.
- LCZ8 – Residential / commercial would experience a moderate impact to landscape character
- LCZ9 – Gateway would experience a moderate impact to landscape character.

##### *Visual impacts*

**Table 6.64** provides a summary of the visual impacts from the twelve representative viewpoints identified along the proposal. The visual impacts of the proposal have been assessed as predominately low reflecting the proposed works mostly occurring within the existing road corridor.

Nine of the twelve viewpoints are within the REF area. Viewpoints that would experience moderate or higher impact to visual amenity during operation include:

- VP1 – NICB looking northwest would experience a moderate impact associated with the removal of vegetation which currently provides screening
- VP11 – Hexham Railway Station would experience a moderate impact associated with the removal of vegetation which currently provides screening.

Table 6.63 Impacts on landscape character zones

| Zone and sensitivity | Magnitude of change | Landscape character impact |
|---|---|---|
| LCZ1 – Waterways<br><br>High: Highly visible scenic outlook which is regarded as highly sensitive to change. | Negligible: The upgrade reconfigures the lane arrangements with limited impact on the overall footprint of the corridor and the river's edge. Given the presence of the existing infrastructure its impact is considered negligible. | Negligible: Overall impact has been assessed as negligible reflecting the scale of the REF area. This impact would increase if the proposal shifted east reflecting the highly sensitive rating at this location. |
| LCZ2 – Industrial<br><br>Low: The view presents an industrial context in which large scale built forms dominate a flat landscape. It is a built landscape of crude proportions. | Negligible: The proposal largely keeps the road design within the existing corridor through the adjustment of lane widths and alignment. The majority of landscape planting is within the adjoining properties which would not be impacted. | Negligible: The scale of intervention proposed and industrial context of the landscape result in the impact having been assessed as negligible. |
| LCZ3 – Interchange<br><br>Moderate: The interchange presents a highly structured context moderated by landscaping comprising a number of ramps passing over the road alignment and contained within a canopy of trees. | Negligible: The proposal does not impact the overall structure of the intersection; expansion is focused within the median section of the alignment with the footprint largely maintained within the existing pavement area. | Negligible: Whilst the setting of the intersection is sensitive to change the nature of the changes are minimal, so an overall impact is considered negligible. |
| LCZ4 – Industrial (central)<br><br>Low: The presence of industrial uses separated by a grass verge and adjoining a major road presents a hard-urban industrial context that has a low sensitivity to changes. | Negligible: The presence of the existing road infrastructure and relatively low scale of expansion proposed by the reconfiguration of lanes and minor increases in pavement and formation width are considered to pose minimal change in character. | Negligible: The scale of intervention proposed and industrial context of the landscape result in the impact having been assessed as negligible. |
| LCZ5 – Vegetation screening<br><br>High: A vegetated edge provides a sense of enclosure and scale which if impacted would alter the overall feel and scale of the road corridor. | Negligible: The proposed works stays substantially within the existing road alignment through the reconfiguration of lane widths and the verge and minimises impacts to the adjoining vegetation. | Negligible: The scale of intervention proposed and minimisation of impacts on adjoining vegetation result in the impact having been assessed as negligible. |
| LCZ6 – Railway siding<br><br>Moderate: This presents an industrial scene of rail infrastructure associated with the Main North Rail Line | Low: The proposal in LCZ6 largely fits within the existing travel lanes formation with only minor widening. The corridor would become increasingly paved removing the grass median. | Moderate to low: While the view is of moderate sensitivity the scale of the proposal is considered low resulting in an intensification of paved surfaces within the present footprint. |

| Zone and sensitivity | Magnitude of change | Landscape character impact |
|---|---|---|
| with multiple sidings visible in the foreground of a view across the floodplain. | | |
| LCZ7 – Riverfront/floodplain<br><br>Moderate: This natural setting presents a largely intact and homogenous appearance comprising listed vegetation communities. The overall appearance from the road is degraded by being interrupted by overhead services and weeds at its margins. There are some transient views of the Hunter River from the southbound lanes of Maitland Road at the northern end of the proposal and of the South Channel Hunter River on the approach to ironbark Creek. There are also some water views of Ironbark Creek from Ironbark Creek Bridge however these views are transitory. | High: The proposal stays within the existing road alignment however the construction of new bridges at Ironbark Creek moves the road to the east impacting some of the vegetation and introducing an elevated formation. | Moderate to high: This is a natural setting of strong consistency and the proposed new bridge on a new alignment has the potential to have an elevate form in what is otherwise a flat landscape. |
| LCZ8 – Residential / commercial<br><br>High: As residential cottages, they are sensitive to change associated with the road. Although already impacted the potential movement of the road corridor closer to the property would be considered to be of high impact. | Low: Scale of works largely fits within the existing confines of the road corridor. Impacts on verge are variable but are kept to a minimum. The impact is considered low as the scale of change would not be readily perceive and the treatments are the same as the existing context. | Moderate: Impacts are considered moderate due to the proximity of residential and commercial properties to the road corridor and the scale of change proposed. |
| LCZ9 – Gateway<br><br>Moderate: The intersection marks the transition into Newcastle's outer suburbs and provides a framework for this to be experienced. Its composition is important in the comprehension of the road and its operation as part of the broader road network. | Moderate: The intersection is reconfigured to address the additional lanes. A slight increase in pavement sees changes in the median width which impacts the existing trees adjoining the north bound travel lanes. Redevelopment of the landscape treatment would be required to minimise impacts. | Moderate: The sensitivity of the environment as a transition into Newcastle's outer suburbs and the magnitude of the change with increased pavement and removal of trees would result in a moderate impact. |

Table 6.64 Impacts on viewpoints

| Viewpoint | Nature of impact | Visual sensitivity | Magnitude of change | Overall visual impact rating |
|---|---|---|---|---|
| VP1 – NICB looking northwest | Adverse | Moderate – Residential receivers located nearby. | Moderate – Additional lane being constructed would reduce vegetation which currently providing some visual screening to residential receivers. | Moderate |
| VP2 – Gateway precinct | Adverse | Moderate – Set within the road corridor the view includes residential and commercial properties overlooking. | Low - Proposed works would largely be contained within existing road alignment. | Moderate to Low |
| VP3 – Old Maitland Road to the south of the Calvary St Joseph's Retirement Community | Adverse | Low – Views from Calvary St Joseph's Retirement Community are restricted by vegetation within the properties boundary. | Low – The addition of a lane would be contained within the existing road corridor with the grassed verge being largely unaffected. | Low |
| VP4 – Calvary St Joseph's Retirement Community entrance | Adverse | Low – View from this location is limited to road users with short term glances. | Low – The additional lane would see the median narrowed. | Low |
| VP5 – Ironbark Creek Bridge | Adverse | Moderate – Sensitivity of the view is determined based on a transitory view from the existing bridge. | High – Removal of vegetation and the existing bridge structure plus the addition of a new larger bridge structure | Moderate to high |
| VP6 – Fenwick Street | Adverse | Moderate – Sensitivity of the view is based on a transitory view of a vehicle turning onto Maitland Road or a resident on Fenwick Street. | Low – Additional lane would see the median narrowed. | Moderate to low |
| VP7 – Merchant Street | Adverse | Moderate - Sensitivity of the view is based on a transitory view of a vehicle turning onto Maitland Road or a resident on Merchant Street. | Low – Expansion of the Maitland Road alignment in both directions, the median would be removed and replaced with a barrier to divide the traffic lanes. | Moderate to low |
| VP8 – Clark Street | Adverse | Low - Sensitivity of the view is based on a transitory view of a cyclist or vehicle heading north along Maitland Road. | Moderate– Grassed median would be removed and replaced with additional lanes. | Moderate to low |

| Viewpoint | Nature of impact | Visual sensitivity | Magnitude of change | Overall visual impact rating |
|---|---|---|---|---|
| VP9 – Old Maitland Road (Hexham) | Adverse | Low – Sensitivity of the view is based on a transitory view from a vehicle. Open park space with scattered trees screens residential properties from Maitland Road | Negligible – Majority of the changes would be contained within the existing road corridor but would include the removal of a grassed median. | Negligible |
| VP10 – Maitland Road commercial and industrial precinct | Adverse | Low – Sensitivity of the view is based on a transitory view of a cyclist or vehicle heading north along Maitland Road. | Low – Grassed median would be replaced with a narrow, raised concrete median. | Low |
| VP11 – Hexham Railway Station | Adverse | Moderate – Sensitivity of the view is based on a transitory view of a vehicle heading north along Maitland Road. | Moderate – Upgrade of this intersection would see the removal of much of the screen plantings, exposing the rail corridor and increasing the sense of infrastructure. | Moderate |
| VP12 – New England Highway | Adverse | Low – Sensitivity of the view is based on a transitory view of a vehicle heading south along New England Highway. | Low – Grassed median would be removed and replaced with additional lanes. | Low |

### 6.11.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise landscape character and visual impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.65**.

Table 6.65 Safeguards and management measures – urban design, landscape character and visual impacts

| Impact | Environmental safeguard | Responsibility | Timing |
|---|---|---|---|
| General design integration | The proposal will follow Transports integrated project development process, including the requirement for urban designers to be part of the project team. | Transport | Detailed design |
| | Transport's Urban Design Policy (*Beyond the Pavement*) and *Transport's Urban Design Guidelines* will be used to guide future design development of the proposal.<br>The urban design objectives, principles and concept design strategy presented in the urban design report for the proposal will form the basis for future design development and consultation with stakeholders.<br>This will consider:<br>• Integrating appropriate grades with adjoining landform, avoiding sharp transition in profile, and blending the formation into its context<br>• Minimising clearance extent where possible and clearly defining clearance limits and exclusion zones to protect vegetation cover<br>• Progressively implementing revegetation works to limit erosion and to establish vegetation<br>• Utilising cleared material as part of revegetation works<br>• Providing minimum signage requirements and limit structural elements to provide an open and permeable setting.<br>• Looking for opportunities to minimise designed signage. Signage to be set out in accordance with Australian Standards.<br>• Limiting the extent of lighting and potential for light spill. Lighting to be set out in accordance with Australian Standards<br>• Providing visual screening within the road corridor to limit the visual impact of the proposal in areas identified as moderate or high impact.<br>• Providing a sense of space and openness associated with the flat open character of the floodplain landscape. | Transport | Detailed design |
| Earthworks | Stabilisation and revegetation will be undertaken progressively during construction to limit erosion and visual impacts through early integration with surrounding vegetation | Contractor | Construction |
| Revegetation | Selection of vegetation communities that reflect the existing communities and landscape character. Landscaping to utilise local material where possible. | Transport | Construction |

| Impact | Environmental safeguard | Responsibility | Timing |
|---|---|---|---|
| Drainage | Utilise local sedgeland species where appropriate to aid in the filtration of stormwater and to provide a level of biodiversity within the corridor | Contractor | Construction |
| Lighting | Lighting towers to be positioned away from residences where possible. | Contractor | Construction |
| Ancillary facilities | Maintain compound in a tidy and well-presented manner. Provide and maintain screening and fencing. Works to be carried out in accordance with *Roads and Maritime EIA-N04 Guideline for Landscape Character and Visual Impact Assessment*. | Contractor | Construction |
| | Progressively throughout the work, where feasible and reasonable, the ancillary facility sites will be returned to at least their pre-construction state, unless otherwise detailed in the design once construction activities are complete or will be progressively remediated throughout the construction program where possible. | Contractor | Construction |

## 6.12 Soils and contamination

The potential impacts of the proposal associated with soils and contamination are assessed in the *Hexham Straight Widening Phase 1 Soils and Contamination Assessment* provided in **Appendix K**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.12.1 Methodology

The assessment of soils and contamination involved the following:

- Collation of existing information from databases, websites, reports and other sources of information
- Undertaking a site inspection to ground truth the desktop assessment
- Development of description of existing environment
- Construction and operational impact assessment
- Development of management measures and safeguards.

### 6.12.2 Existing environment

#### Topography

Topography data depicts land surrounding the construction area as broad, generally flat, low lying floodplains. Elevation varies from two metres Australian Height Datum (AHD) in the north and 12 metres AHD in the south. The low-lying floodplains in the area appear to receive tidal flows from the Hunter River via a number of creeks. Hexham Swamp located to the west of Maitland Roads is generally below five metres AHD.

#### Hydrogeology

The NSW Department of Primary Industries – Office of Water registered groundwater bore database indicated that there were 33 registered groundwater bores located onsite or within 500 metres of the proposal in April and June 2020.

The proposal is situated on the Hunter Alluvium, Hawkesbury to Hunter Coastal Sands Aquifer and the Sydney Sandstone Central Coast Aquifer. The Hunter subregion hosts alluvial and non-alluvial aquifers and groundwater extraction from these aquifers is used for a range of purposes including domestic, irrigation, stock, town water supply and industrial purposes. Estuarine sediments next to the Hunter River and within the proposal are unlikely to contain any aquifers suitable for human uses generally due to the high salinity of the groundwater from the estuarine influences.

### Geology

A review of the Newcastle 1:250 000 Geological Sheet SI/56-02 (Geological Survey of New South Wales, 1996) indicates the majority of the proposal is underlain by undifferentiated Quaternary alluvial (Qa) deposits of sand, silt, clay and gravels along with some residual and colluvial deposits. This includes channel, levee, lacustrine, floodplain and swamp deposits with the potential for some higher-level Tertiary terraces. The southern portion of the site is underlain by Tomago Coal Measures (Pt) comprising primarily of siltstone, sandstone, coal, tuff, claystone, conglomerate and minor clay. A review of the Bohena 1: 250 000 Geological Sheet in June 2020 indicates there is a concealed fault north east of Hexham Bridge running in a north east to south west direction.

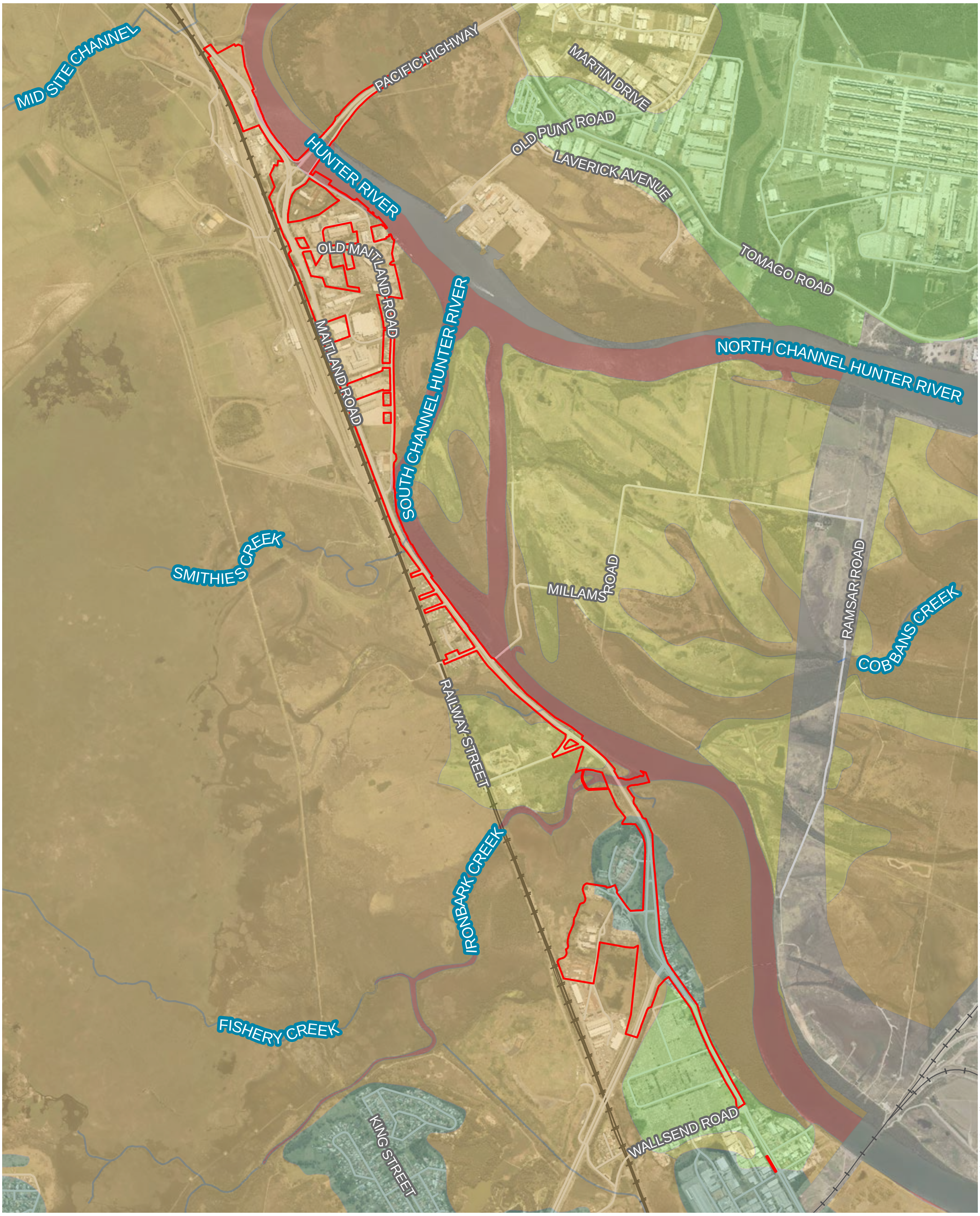
### Soils

A review of the Newcastle 1:100,000 soil landscape sheet 9232 (Soil Conservation Service of NSW, 1995) indicates that the construction area traverses six soil landscapes. It is expected that the majority of the construction area would comprise the Millers Forest (ESmf), Disturbed Terrain (DTxx), Fullerton Cove (ESfc), Hexham Swamp (SWhs) soil units and that the southern portion would also include small areas of the Beresfield (REbe) and Hamilton (Rehm) soil units. Disturbed terrain occurs across a number of sections of the construction area and is often associated with cutting and filling activities and the potential presence of imported fill material of unknown origin.

### Acid sulfate soils

Acid sulfate soils (ASS) are the common name given to naturally occurring sediments and soils containing iron sulfides. The exposure of the sulfide in these soils to oxygen by drainage or excavation leads to the generation of sulfuric acid.

ASS Risk Maps from the CSIRO Australian Soil Resource Information System (ASRIS) database indicates the majority of the proposal is located on Class 2 ASS (high probability of occurrence). There are small areas in the northern and central portion of the proposal, adjacent to the Hunter River and around Ironbark Creek Bridge, considered to have very high ASS risk (Class 1 ASS). The proposal also covers Class 3 (moderate risk ASS) and Class 4 (low risk ASS) soils, refer to **Figure 6.13**.



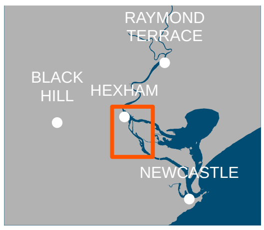

Date: 10/11/2021 Filename: IA301100_REF_F021_AcidSulfateSoils_v1

**Legend**

REF area
Railway
Waterway

Acid Sulphate Soil Risk
Class 1 - Any works
Class 2 - Works below the natural ground surface
Class 3 - Works more than 1m below the natural ground surface
Class 4 - Works more than 2m below the natural ground surface
Class 5 - Works within 500 m of Class 1, 2, 3, 4 that is below 5m AHD and by which the water table is likely to be lowered below 1 m AHD on adjacent Class 1, 2, 3 or 4 land

0 250 500 m
Scale 1:30,000 at A4
GDA94 MGA56




**Data sources:**
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.13** Acid sulfate soils

## Contamination

Areas within and directly surrounding the proposal have increasingly commercial/industrial land use since the 1950s. The area has experienced historical high rail usage over at least the last 50 years and a variety of industrial land uses across the majority of the proposal.

A review of EPA Public Register under section 308 of the POEO Act identified a total of 20 premises within the construction area or within 500 metres of the proposal which are either currently licensed or have historically been licensed by the EPA. These include railway systems activities, Onesteel Recycling, Industrial Galvanizers Corporation, Brancourts Manufacturing and Processing, Hexham Bowling Club, Hexham Engineering, Slattery Auctions Australia, CBP Contractors, Hexham Train Support Facility, Crei Industrial Nominees No 2 Pty Ltd, McDonald's, Sibelco Australia, NICB construction, Cummins South Pacific, Tomago Site, the Newcastle Wallsend Coal Co and four activities relating to herbicide use.

A search of the list of contaminated sites notified to the NSW EPA and the NSW EPA record of notices identified 13 sites within the construction area or within 500 metres of the proposal. These sites may pose a risk to construction and construction area workers.

In total, there are nine AEIs located within or near to the REF area that may present a low to high contamination or soil management risk to the proposed construction activities and/or temporary construction facilities. These include:

- Within the REF area and include:
    - AEI 1: Potential herbicide application in waterways that transect or run adjacent to the REF area (drainage lines, Ironbark Creek and Hunter River)
    - AEI 3: Imported fill and discarded waste along the eastern verge of Maitland Road, opposite McDonald's in the central portion of the site and around the bridge abutments of Ironbark Creek Bridge; Imported fill and discarded waste (including fragments of potential asbestos containing material) west of Maitland Road, on the land between Sparke Street and Ironbark Creek
    - AEI 4: Class 1 and 2 ASS
    - AEI 5: Potential contaminants associated with Ironbark Creek Bridge and its demolition
    - AEI 7: Historical and current commercial/industrial premises east and west of the alignment where temporary construction facilities are proposed.
- Less than 150 metres from the REF area and include:
    - AEI 2: Railway corridor
    - AEI 6: Service stations: BP Service Station, 366 Maitland Road, Hexham; Shell Coles Express Hexham, 25-27 Maitland Road, Hexham; Ampol Diesel Stop, 360 Maitland Road, Hexham; Caltex Sandgate, 162-164 Maitland Road, Hexham
    - AEI 8: Historical and current commercial/industrial premises west of the alignment
    - AEI 9: Potential groundwater and surface water contamination.

The location of AEIs within proximity to the construction area are identified in **Figure 6.14**, with the exception of AEI 4 – ASS which is shown in **Figure 6.13**.

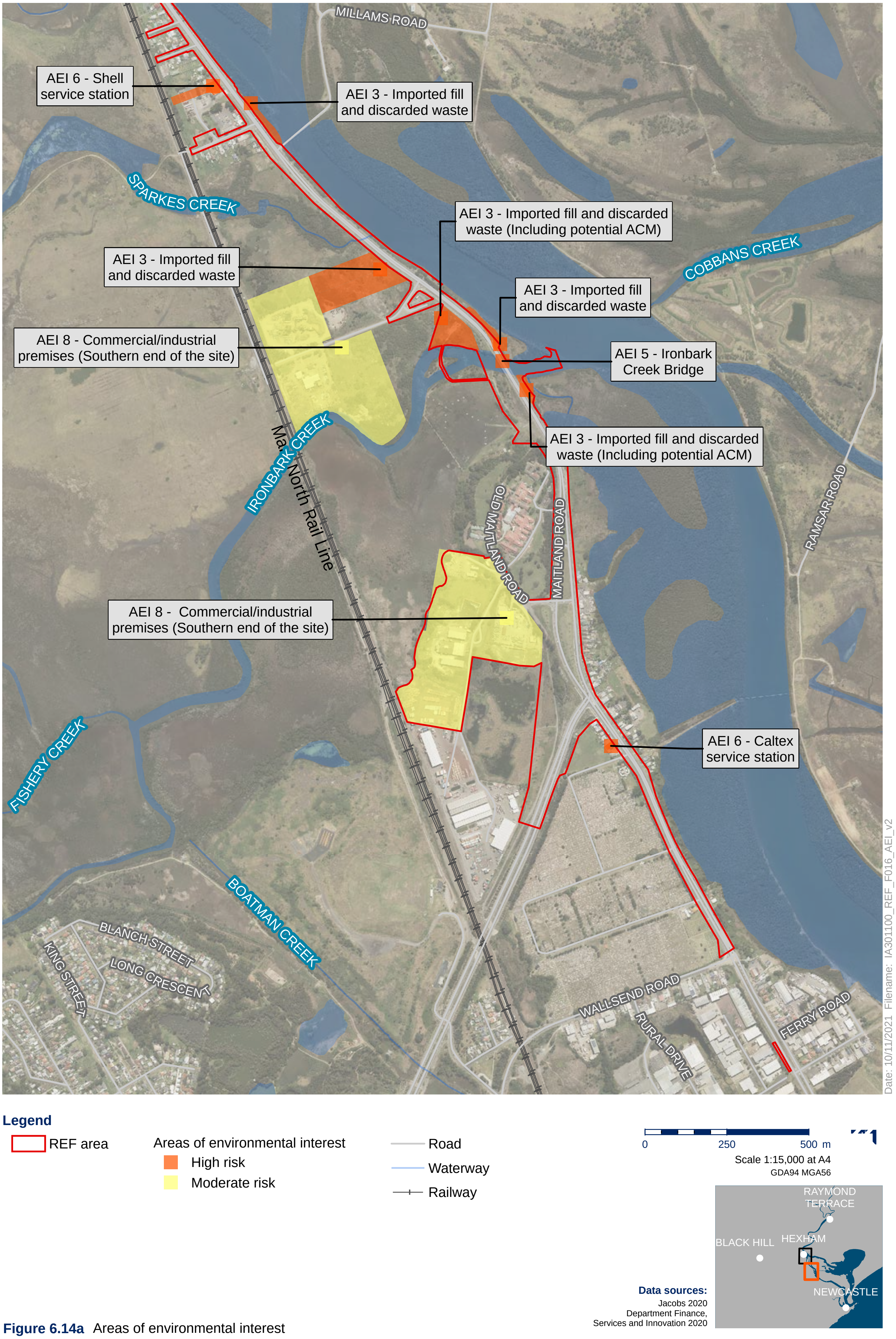
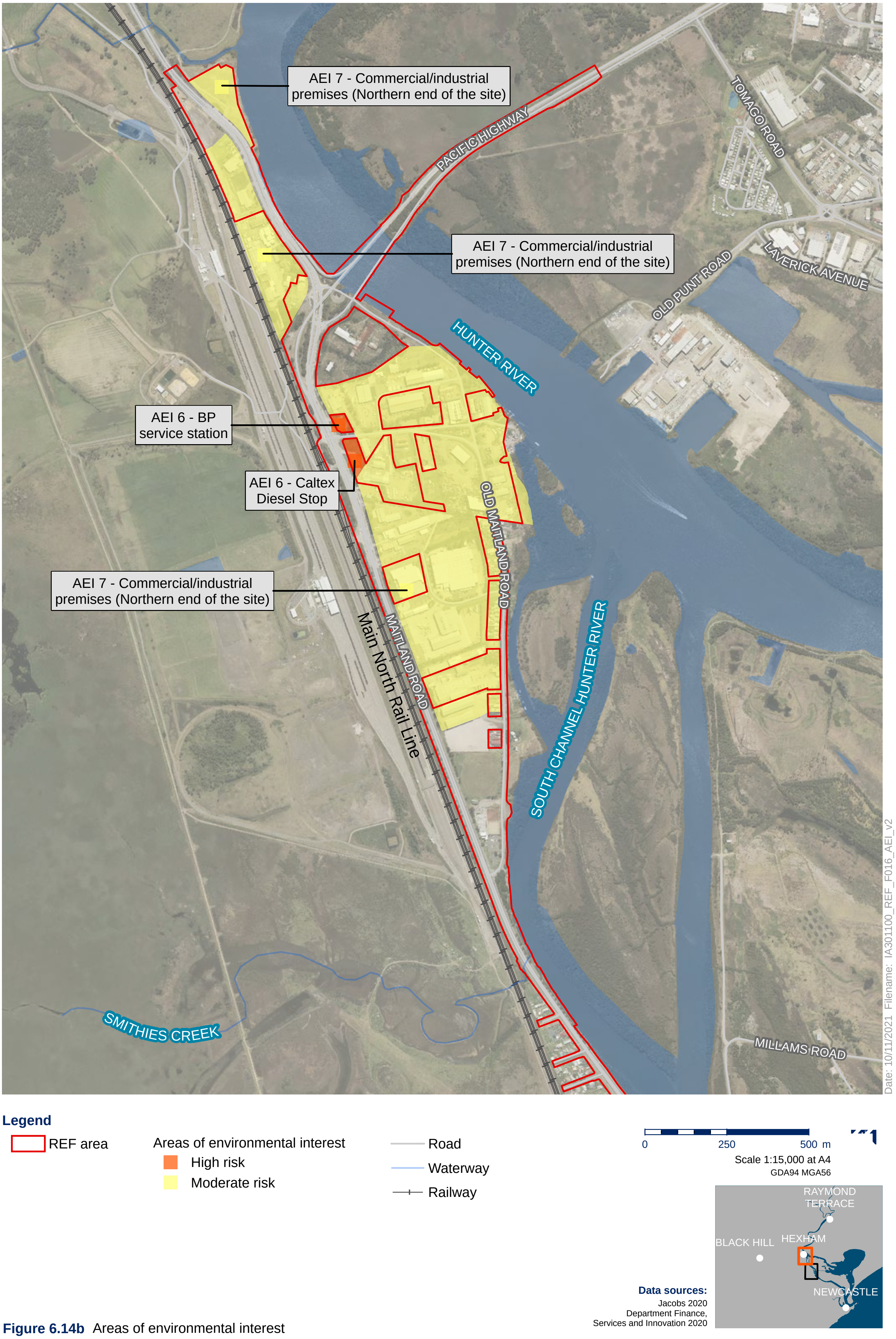



**Figure 6.14a** Areas of environmental interest




Data sources:
Jacobs 2020
Department Finance, Services and Innovation 2020

**Figure 6.14b** Areas of environmental interest

### 6.12.3 Potential impacts

#### Construction

Exposure or disturbance of contaminated land and groundwater during construction of the REF area could result in the following impacts:

- Mobilisation of surface and subsurface contaminants during construction (impacting groundwater, surface water and soils)
- Migration of potential contaminants into surrounding areas (impacting groundwater, surface water and soils) via leaching, overland flow and/or subsurface flow (water and/or vapour)
- Mobilising potential groundwater and/or surface water contamination
- Risk of exposure to site workers, site users and site visitors
- Risk of exposure to surrounding environmental receptors (i.e. flora, fauna, surrounding ecosystems including groundwater dependent ecosystems).

#### Operation

Vehicle or plant and equipment leakages or a vehicle crash may cause spills of oils, lubricants, hydraulic fluids and chemicals during the operation of the REF area. Spills and leakages within the REF area have the potential to result in contamination. The severity of the potential impact would depend on the magnitude and/or location of the spill in relation to sensitive receivers, emergency response procedures and/or environmental management measures implemented on site and the nature of the receiving environment. Further, operational water quality basins which have been proposed will capture and treat runoff.

### 6.12.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise soils and contamination impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.66**.

Table 6.66 Safeguards and management measures – soils and contamination

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Contaminated land | A detailed site investigation (Phase 2) will be undertaken in areas of potential contamination identified during the preliminary site investigation (Phase 1), in accordance with the *Roads and Maritime Services (2013) Guideline for the Management of Contamination*.<br><br>An in-situ waste classification will be undertaken for any materials which are proposed to be excavated and removed from the proposal as part of a Phase 2 investigation. | Transport | Detailed design/ prior to construction |
| Contaminated land | A Contaminated Land Management Plan will be prepared in accordance with the *Guideline for the Management of Contamination* (Roads and Maritime Services, 2013) and implemented as part of the CEMP. The plan will include, but not be limited to:<br>• Capture and management of any surface runoff contaminated by exposure to the contaminated land<br>• Further investigations required to determine the | Transport/ Contractor | Detailed design/ prior to construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| | extent, concentration and type of contamination, as identified in the detailed site investigation (Phase 2)<br>• Acid sulfate soils management plan<br>• Management of the remediation and subsequent validation of the contaminated land, including any certification required<br>• Measures to ensure the safety of site personnel and local communities during construction. | | |
| Contaminated land – temporary construction compounds | A pre and post lease condition assessment be conducted for all temporary construction facilities proposed within sealed areas. | Contractor | Prior to construction/ post construction |
| Contaminated land | If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other work that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Transport Environment Manager and/or EPA. | Contractor | Detailed design/ prior to construction |
| Accidental spill | A site specific emergency spill plan will be developed and include spill management measures in accordance with the Transport *Code of Practice for Water Management* (Roads and Traffic Authority, 1999) and relevant legislation and guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities. | Contractor | Detailed design/ prior to construction |

## 6.13 Air quality

The potential impacts of the proposal on air quality are assessed in the *Hexham Straight Widening Air Quality Assessment* provided in **Appendix R**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.13.1 Methodology

Air quality issues can arise when emissions from an industry or activity lead to a deterioration in the ambient air quality. Construction of the proposal could lead to emissions to air from a variety of activities including land clearing, earthworks, material handling, and material transport. Emissions may also arise from wind erosion of exposed areas. These construction-related emissions would mainly comprise of particulate matter in the form of:

- Total suspended particles (TSP), typically where particles are less than 30 microns in equivalent aerodynamic diameter
- Particulate matter $(PM)_{10}$, representing particulate matter with equivalent aerodynamic diameter of 10 microns or less
- $PM_{2.5}$, representing particulate matter with equivalent aerodynamic diameter of 2.5 microns or less.

There are relatively minor emissions (i.e. smaller quantities) from construction machinery exhausts such as carbon monoxide (CO), oxides of nitrogen (NOx), $PM_{10}$, $PM_{2.5}$, some hydrocarbons, and to a lesser extent sulfur dioxide ($SO_2$). Odour and other volatile organic compounds also have the potential to be generated from the handling of potentially contaminated soils associated with historical land uses.

Operation of the proposal would lead to emissions to air from vehicles using both the existing and modified road network. There are a variety of air pollutants associated with road vehicles with the most significant pollutants, in terms of potential impacts to health, being:

- CO
- NOx, representing the total of nitric oxide (NO) and Nitrogen Dioxide ($NO_2$)
- Particulate matter as $PM_{10}$ and $PM_{2.5}$
- Hydrocarbons (HC).

These pollutants are generated from the combustion of fuel and emitted via the exhaust system. Particulate matter emissions are also generated from brake and tyre wear, as well as re-suspended road dust.

### 6.13.2 Existing environment

The DPIE has established a network of monitoring stations across NSW to understand current air quality conditions and impacts, and to help identify programs to improve air quality. The closest DPIE air quality monitoring sites to the REF area are located at Beresford and Newcastle. Data from these stations have been examined and compared to relevant impact assessment criteria in order to understand the existing meteorological and air quality conditions for the key pollutants that are relevant to the proposal. **Table 6.67** identifies the parameters measured at each site.

Table 6.67 Measured parameters at nearby DPIE monitoring stations

| Station | Distance from proposal | Measured parameters |
|---|---|---|
| DPIE Beresfield | Four kilometres | Meteorology, $NO_2$, $PM_{10}$, $PM_{2.5}$ |
| DPIE Newcastle | Nine kilometres | Meteorology, CO, $NO_2$, $PM_{10}$, $PM_{2.5}$ |

Meteorological data collected over five recent years (2015 to 2019 inclusive) from DPIE's Beresfield monitoring station. Hourly records of wind speed and wind direction were examined and the data showed that the wind speed statistics do not vary significantly from year to year. Wind patterns in the vicinity of the proposal are characteristic of the Lower Hunter Valley, with the prevailing winds being from the west-northwest.

**Table 6.68** shows the assumed background levels that apply in the vicinity of the proposal. The justification for these background levels is also provided, with conservative approaches adopted in most instances.

Table 6.68 Assumed background levels in the vicinity of the proposal.

| Pollutant | Averaging time | Assumed background level | Notes |
|---|---|---|---|
| CO | 1-hour | 2,400 micrograms per cubic metre (µg/m$^{3}$) | Maximum 1-hour concentration from Newcastle (2015 to 2019) |
| | 8-hour | 1,700 µg/m$^3$ | Maximum 8-hour concentration from Newcastle (2015 to 2019) |
| $NO_2$ | 1-hour | 105 µg/m$^3$ | Maximum 1-hour concentration from Beresfield (2015 to 2019) |
| | Annual | 17 µg/m$^3$ | Highest annual concentration from Beresfield (2015 to 2019) |
| $PM_{10}$ | 24-hour | 48 µg/m$^3$ | Maximum 24-hour average in 2016 (2017 to 2019 were excluded due to drought, dust storms and bushfires) |
| | Annual | 22 µg/m$^3$ | Highest annual concentration from Beresfield (2015 to 2018) |
| $PM_{2.5}$ | 24-hour | 28 µg/m$^3$ | Maximum 24-hour average in 2016 (2017 to 2019 were excluded due to drought, dust storms and bushfires) |
| | Annual | 8.7 µg/m$^3$ | Highest annual concentration from Beresfield (2015 to 2018) |

### 6.13.3 Potential impacts

#### Construction

The key air quality issue during construction of the proposal would be dust. Dust emissions from construction works have the potential to cause nuisance impacts if not properly managed. Air quality impacts during construction would largely result from vegetation clearing, topsoil stripping, lime stabilisation of soils and lime neutralisation of acid sulphate soils, demolition of redundant assets, stockpiling of soil, and general material handling.

The total amount of dust generated would depend on the quantities of material handled, silt and moisture content of the soil, the types of operations being carried out, exposed areas, frequency of water spraying and speed of vehicles and machinery operating on unpaved roads and areas.

The proposal was determined to present a ‘high’ risk of dust impacts during construction and measures commensurate to this level of risk have been recommended.

In addition to construction dust, there are a range of other potential air quality issues. These include exhaust emission from the combustion of fossil fuels generated by equipment and construction plant, odours arising from uncovered contaminated and/or hazardous materials, and other airborne hazardous materials, which may be generated during demolition and excavation activities. Potential impacts from construction plant and equipment exhaust emissions are not anticipated, owing to the expected intensity of construction operations, setback distances from surrounding sensitive receivers, and the linear nature of the proposal. There is potential for odours and impacts from airborne hazardous materials during demolition activities. These risks may also be present during excavation works, noting the presence of potentially contaminated soils and areas of illegal dumping within the construction study area.

With the implementation of the safeguards and management measures outlined in **Section 6.13.4**, significant air quality impacts associated with dust, exhaust emissions, odours, and airborne hazardous materials are not anticipated.

### Operation

The potential operational impacts of the proposal have been quantified using dispersion modelling. Results from the modelling have been assessed by examining the spatial differences between with and without proposal scenarios, and also in terms of the potential for the proposal to cause exceedances of the EPA air quality impact assessment criteria at sensitive receivers.

#### *Carbon monoxide*

Modelling indicates that in 2028, changes in maximum 1-hour and 8-hour CO concentrations between the with and without the proposal scenarios were less than 10 per cent. These changes would be greater at some receivers in 2038. Regardless, the maximum predicted 1-hour and 8-hour averaged contributions from the proposal were predicted be low equating to around three and eight per cent of the EPA's respective cumulative 30,000 µg/m$^3$ and 10,000 µg/m$^3$ impact assessment criteria.

Considering the limited changes in road emissions between corresponding with and without proposal assessment scenarios and that the resulting cumulative levels remained below the EPA's impact assessment criteria, it was concluded that changes in CO emissions as a result of the proposal were unlikely to result in unacceptable impacts.

#### *Nitrogen dioxide*

Modelling indicates that in 2028, changes in maximum 1-hour and annually averaged $NO_2$ concentrations between the with and without the proposal scenarios were 10 per cent or less. In 2038 increases of up to around 23 per cent in road contributions with the proposal were predicted compared with the no proposal scenario.

The maximum predicted 1-hour $NO_2$ proposal contribution (85 µg/m$^3$) equates to around 35 per cent of the EPA's cumulative 1-hour averaged $NO_2$ criterion (246 µg/m$^3$) whereas the maximum annually averaged with REF area contribution equalled around 65 per cent of the 62 µg/m$^3$ EPA annual criterion.

Considering the limited changes in road contributions between corresponding with and without proposal assessment scenarios and that the resulting cumulative levels remained below the EPA's impact assessment criteria, it was concluded that changes in $NO_2$ emissions as a result of the proposal were unlikely to result in unacceptable impacts.

#### *Particulate matter ($PM_{10}$)*

Modelling indicates that changes in maximum 24-hour and annually averaged $PM_{10}$ concentrations between the with and without the proposal scenarios for 2028 and 2038 were 4 per cent or less. Annually averaged $PM_{10}$ contributions with the proposal were predicted to be around 13 to 33 per cent higher than the corresponding no proposal scenario. The maximum predicted 24-hour $PM_{10}$ proposal contribution (22 µg/m$^3$) equates to around 44 per cent of the EPA's cumulative 24-hour averaged $PM_{10}$ criterion (50 µg/m$^3$) whereas the maximum annually averaged with REF area contribution equalled around 31 per cent of the 25 µg/m$^3$ EPA annual criterion.

While the resulting maximum cumulative concentrations with the proposal were predicted to exceed the EPA's 50 µg/m$^3$ and 25 µg/m$^3$ 24-hour and annually averaged cumulative criteria, this was also the case for the no proposal assessment scenarios. In 2028 the increase between the cumulative 24-hour and annually averaged $PM_{10}$ concentrations with and without the proposal was less than one percent. In 2038, the estimated with REF area cumulative 24-hour and annually averaged concentrations were up to four per cent higher than the 2038 without proposal scenario. Considering the magnitude of these changes, it is not considered that the proposal would result in unacceptable changes in local air quality with regards to $PM_{10}$.

#### *Particulate matter ($PM_{2.5}$)*

Modelling indicates that changes in maximum 24-hour and annually averaged $PM_{2.5}$ concentrations between the with and without the proposal scenarios for 2028 and 2038 were 4 per cent or less. Annually averaged $PM_{2.5}$ contributions with the proposal were similarly predicted to be around 13 to 33 per cent higher than the corresponding no proposal scenario. The maximum predicted 24-hour $PM_{2.5}$ proposal contribution (22 µg/m$^3$) equates to around 88 per cent of the EPA's cumulative 24-hour averaged $PM_{2.5}$ criterion (25 µg/m$^3$) whereas the maximum annually averaged with REF area contribution (7.8 µg/m$^3$) equalled around 98 per cent of the 8 µg/m$^3$ EPA annual criterion.

While the maximum cumulative concentrations with the proposal were predicted to exceed the EPA's 25 µg/m$^3$ and 8 µg/m$^3$ 24-hour and annually averaged cumulative criteria at some receivers, this was also the case for the no proposal assessment scenarios. In 2028 the increase between the cumulative 24-hour and annually averaged $PM_{10}$ concentrations with and without the proposal was less than two percent. In 2038, the estimated with REF area cumulative 24-hour and annually averaged concentrations were up to 12 per cent higher than the 2038 without proposal scenario.

Changes in $PM_{2.5}$ concentrations are as a result of the proposal are not expected result in a risk to human health.

#### *Air toxics*

Five priority air toxics (benzene, formaldehyde, toluene, xylenes and PAHs as benzo(a)pyrene) identified by the NEPM were assessed for selected sensitive receivers and local communities located near main roads along the proposed route. The results indicate the concentrations of the air toxics would not exceed NSW EPA air quality impact assessment criteria. Lower concentrations would be expected at locations further from main roads. It is therefore concluded that the proposal would not lead to adverse air quality impacts with regards to air toxics.

### 6.13.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise air quality impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.69**.

Table 6.69 Safeguards and management measures – air quality

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Risks to air quality during construction | Preparation and implementation of an Air Quality Management Plan (AQMP) to minimise risks to air quality. The AQMP will identify:<br>• Potential sources of air pollution (including odours unexpected finds and dust) during construction | Contractor | Prior to construction/ construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| | • Air quality management objectives consistent with relevant published guidelines<br>• Identification of all dust and odour sensitive receivers<br>• Measures to manage air quality impacts<br>• Community notification and complaint handling, monitoring and incident response procedures. | | |

## 6.14 Climate change

The potential impacts of the proposal on climate change and sustainability are assessed in the *Hexham Straight Widening Climate Change Assessment* provided in **Appendix S**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.14.1 Methodology

#### Climate change

The methodology for conducting this climate change risk assessment is based on the Australian Standard AS 5334-2013 Climate change adaptation for settlements and infrastructure – A risk-based approach. The risk assessment is intended to form part of a risk management process which involves communication and consultation with the design team, relevant stakeholders such as transport departments as well as regular monitoring and review of the risk assessment plan.

### 6.14.2 Existing environment

The Southern Hunter has a highly variable climate. Annual and season rainfall and temperatures vary over a wide range. The area is periodically subject to extreme weather and climatic events which may disrupt the community, threaten health and safety and damage infrastructure and the environment. The Southern Hunter's climate is also changing, with signs evident in records of temperature. Those and other changes are projected to continue as increasing atmospheric concentrations of greenhouse gases drive warming and other changes in the climate system.

**Table 6.70** shows the projected climate change within near future (2030, 2050 and 2090) for the Southern Hunter region.

Table 6.70 Current and projected climate change in the Southern Hunter region in the near future (2030, 2050 and 2090)

| Parameter | Measure | Projected climate change | | |
|---|---|---|---|---|
| | | 2030 | 2050 | 2090 |
| Annual change in rainfall | Maximum | 0 | -16 mm | 45 mm |
| | Mean | -59 mm | -69 mm | -94 mm |
| | Minimum | -49 mm | -62 mm | -93 mm |
| Annual change in temperatures | Maximum | 0.6ºC warmer | 1.4ºC warmer | 3.4ºC warmer |
| | Mean | 1.2ºC warmer | 2.0ºC warmer | 4.0ºC warmer |
| | Minimum | 1.5ºC warmer | 2.3ºC warmer | 3.5ºC warmer |

| Parameter | Measure | Projected climate change | | |
|---|---|---|---|---|
| | | 2030 | 2050 | 2090 |
| Increase in days over 35 degrees Celsius | Days | 5.1 | 9.2 | 21.3 |
| Increase in heatwaves days | Days | 22 | 42 | 93 |

Over the course of the 21st century, the Southern Hunter's climate is expected to become:

- Warmer: with increased average and extreme high temperatures, but fewer extreme cold temperatures
- Drier: rainfall is projected to decline. Reduced annual rainfall and increased evaporation is anticipated to result in drier soil conditions, less run-off in water supply catchments and reduced average river flows and groundwater recharge
- More susceptible to coastal flooding and coastal erosion due to higher sea levels
- Subject to more extreme weather conditions: hydrological cycles are projected to intensify with atmospheric warming, leading to more intense rainfall events. Heatwaves would become more frequent, intense and prolonged. While extreme weather conditions may become more extreme, they may become less frequent.

Projected changes in climate over the course of the 21st century may be disruptive to the operations of the proposal and users of the Southern Hunter road network, increase operation and maintenance costs and shorten its operating life. While climate change projections are uncertain, the opportunity exists to assess its implications for the proposal and to incorporate appropriate, proportional measures to help ensure its resilience under the climate it would experience over its operating life.

Sustainability goals for the proposal include implementing climate change resilience through planning and delivering transport infrastructure and operations that are resilient to the effects of climate change. The expected reduction in vehicle emissions due to the proposal would contribute to reducing greenhouse gas emissions.

### Transport Climate Change Plan

To address the impacts of climate change, Transport has developed a Climate Change Plan which includes actions to:

- Reduce Transport's carbon footprint
- Help reduce the carbon footprint of NSW road transport
- Adapt the road transport system to the impacts of climate change
- Manage Transport's transition to a low carbon economy.

Transport also reports its greenhouse gas emissions and direct energy consumption annually to the OEH in accordance with the NSW Government Sustainability Policy. The annual report includes information on greenhouse gas emissions from energy usage associated with the operation of Transport properties, street lighting, traffic signals, and vehicles.

### 6.14.3 Potential impacts

#### Impacts of climate change on the REF area

Planning for construction of the proposal would have to consider the current climate, including more recent extremes of rainfall and bushfires which have been experienced. However, the climate change assessment is focused on longer term shifts in the climate based on projections for the middle and end of the 22nd century and as such does not assess potential construction impacts

Climate change is anticipated to have direct (climate event impact on the asset) and indirect impacts (such as impacts elsewhere affecting how the asset is used) on the proposal.

The combined direct and indirect impacts of climate change may contribute to:

- Accelerated infrastructure deterioration and increased maintenance requirement
- Safety incidents
- Increased frequency and/or duration of road closures
- Adverse road user experience due to climate (not as a result of service disruption)
- Infrastructure impact (total loss, partial damage / loss of function as a result of a severe weather event).

The key climate change risks to the REF area that have been identified as having a medium to high risk rating include:

- Impacts to revegetated areas due to droughts and heatwaves resulting in vegetation being unable to survive. This would reduce visual amenity and could result in bank instability and drainage channels requiring increased maintenance
- Flooding damage to road and road infrastructure (including electrical infrastructure) which could temporarily close the road and severely delay traffic
- Flooding and /or standing water causes crashes for road users resulting in safety incidents
- Increased rainfall leading to culverts and drainage channels being overwhelmed causing increased flooding on the up flow side of the culverts, and increased scour at the outflows. This results in increased road closures, and increased maintenance or rectification costs and diverted water leading to increased flooding at existing properties
- Increased local bushfires cause decreased visibility due to smoke effects
- Sea level rise, exacerbated by the proposal, resulting in wetlands between Maitland Road and the Hunter River becoming permanently inundated resulting in total or partial loss of the ecosystem.

A detailed list of climate change risks is provided in Table 5.3 of **Appendix S**.

#### Construction impacts on climate change

Construction of the REF area would result in greenhouse gas emissions, including:

- Release of stored carbon dioxide from vegetation removal (decomposition of cleared vegetation)
- Release of stored carbon within sediments during the removal of wetland vegetation
- Carbon dioxide and nitrous oxide from liquid fuel use in plant, barges and vehicles (diesel, petrol) during construction, disposal and transport of materials
- Use of materials such as concrete that have high embodied energy content

- Methane from landfilling any carbon based waste, and possible fugitive emissions from the use of natural gas
- On-site electricity usage.

Construction materials and the operation of construction equipment would be the main emissions sources during construction. Vegetation removal can result in an increase in carbon dioxide in the atmosphere as the carbon would no longer be stored within plants and their soil as they would no longer be able to carry out carbon sequestration. Carbon stored within sediments located within wetland areas are also sources of carbon and if released into waterways can eventually contribute to the acidification of oceans.

#### Operation impacts on climate change

During operation, the proposal may result in decreased vehicle emissions through increased efficiency of the road network and reduced congestion and travel times. Predicted traffic growth may result in an increase in vehicle emissions, however this increase would occur regardless whether the proposal proceeds. Minimal emissions would be generated during road and bridge maintenance activities.

### 6.14.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise climate change impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.71**.

Table 6.71 Safeguards and management measures – climate change impacts

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Climate change risk | Detailed design should incorporate the full range of temperature projections, as well as expected life of bridge components, when materials are specified. | Transport / Contractor | Detailed design |
| Climate change risk | Ensure that revegetation and landscaping design:<br>• Considers climate change projections in the selection of species (both in and outside the floodplain)<br>• Considers how vegetation will contribute to or support the structural integrity of soils in a changing climate<br>• Ensures plant/tree species selection (and location of trees) caters for potential impacts if burnt (e.g. falling onto the roadway). | Transport / Contractor | Detailed design |
| | A material durability report will be prepared and actioned which will specifically review the potential impacts of climate change on concrete durability, including depth of cover over reinforcement. | Transport/ Contractor | Detailed design |
| Flood risk/ sea level rise | The climate change scenarios presented in the *Hexham Straight Widening Flooding and Hydrology Assessment* will be reviewed to confirm whether any design changes are required to provide ongoing resilience to the asset, or to minimise any impact on the surrounding area. | Transport/ Contractor | Detailed design |

## 6.15 Sustainability

The potential impacts of the proposal on sustainability are assessed in the *Hexham Straight Widening Sustainability Assessment* provided in **Appendix T**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

### 6.15.1 Methodology

#### Sustainability

Sustainability, or sustainable development, can be defined in different ways depending on the application and context in which it is being applied.

The term 'sustainable development' has gained widespread acknowledgement and use since the release of Our Common Future, commonly referred to as the Brundtland Report (World Commission on Environment and Development, 1987). The Brundtland Report's definition of sustainable development is commonly adopted in Australia, and a similar interpretation is adopted in the *National Strategy for Ecologically Sustainable Development* (Council of Australian Governments, 1992). It defines sustainable development as 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'.

The sustainability assessment for the REF area of the proposal broadly involved:

- Defining the sustainability context for the proposal within the broader context of NSW's objective of improving transport efficiency, and the relevant Transport policies and guidelines
- Reviewing the sustainability focus areas, associated objectives from the Environmental Sustainability Strategy and responding to how these focus areas apply to the proposal
- Identifying requirements for managing sustainability during detailed design, construction and operation.

The assessment considered whole of life mitigation in response to the focus areas and objectives.

### 6.15.2 Existing environment

The Roads and Maritime Services *Environmental Sustainability Strategy 2019-2023* (2019) (Environmental Sustainability Strategy) has been developed in context of NSW legislation and policies/guidelines. The Environmental Sustainability Strategy identifies 10 focus areas to embed sustainability into the delivery of Roads and Maritime infrastructure and services. It defines objectives and targets for sustainability in the context of Transport projects. **Section 6.15.3** discusses the objectives of the Environmental Sustainability Strategy and how the proposal responds to those objectives.

The Environmental Sustainability Strategy also defines the sustainability delivery model and targets in the context of Transport projects. It also establishes focus areas, targets and initiatives for Transport (formerly Roads and Maritime Services) projects and operation activities. Sustainability goals for the proposal include implementing climate change resilience through planning and delivering transport infrastructure and operations that are resilient to the effects of climate change. The expected reduction in vehicle emissions due to the proposal would contribute to reducing greenhouse gas emissions.

### 6.15.3 Potential impacts

#### Sustainability

This section assesses the REF area against the key sustainability guidance document, the Environmental Sustainability Strategy. **Table 6.72** provides a summary of the proposal response to the objectives of the focus areas. The majority of the sustainability focus areas have been considered in separate sections of this REF. A detailed assessment is provided in Table 4.1 of **Appendix T**.

Table 6.72 Sustainability focus areas that relate to key environmental constraints for the proposal

| Sustainability focus area | Proposal response |
|---|---|
| Energy and carbon management | The proposal would allow a greater volume of traffic to travel through the road network which would facilitate an increase in energy use and greenhouse gas emissions associated with road travel. The reduction in congestion would mean that the traffic transits the area more efficiently than if the proposal were not constructed. |
| Resource use and waste management | A procurement strategy to minimise unnecessary consumption of materials and waste generation in accordance with relevant legislation and guidelines would be prepared. A water reuse strategy would be prepared for both construction and operational phases of the proposal, to reduce reliance on potable water. |
| Climate change resilience | A climate change risk assessment has been carried out and measures proposed in **Section 6.14** to manage the impacts expected from climate change. Key residual risks identified in the climate change risk assessment relate to flooding impacts coupled with sea level rise. Detailed design would review modelling results of flood level sensitivities to climate change and confirm appropriate environmental management measures for the proposal to respond to each of these risks. Further flood modelling is to be undertaken during the detailed design stage. |
| Air quality | The proposal would minimise the air quality impacts aimed at reducing transport related air emissions (refer to **Section 6.13**). Measures have been proposed to in **Section 6.13.4** to address any air quality and dust impacts. |
| Pollution control, resource use and waste management | Potential proposal pollution risks during construction and operation are detailed in **Section 6.3** (Surface water), **Section 6.4** (Groundwater), **Section 6.12** (Soils and contamination) and **Section 6.9** (Noise and vibration). These sections have also developed environmental management measures to respond to, and control the risks identified. |
| Biodiversity | The proposal has sought to improve outcomes for biodiversity by avoiding, mitigating or offsetting the proposal's potential impacts on threatened species (flora and fauna), populations and ecological communities (refer to **Section 6.1**). |
| Heritage – Aboriginal and non-Aboriginal heritage | Aboriginal (refer to **Section 6.7**) and non-Aboriginal heritage (refer to **Section 6.8**) impacts have been considered and assessed. These impacts have been minimised, avoided and mitigated where practicable and management measures to be implemented throughout construction of the proposal have been provided. |
| Liveable communities | The proposal has sought to deliver urban design outcomes that contribute to community sustainability and liveability with the urban design vision (refer to **Section 2.3.3** and **Appendix C**). Transport would continue to develop the design in accordance with the urban design objectives and principles during future proposal phases and the design |

| Sustainability focus area | Proposal response |
|---|---|
| | development would follow the landscape and visual amenity objectives developed for the proposal. |
| Sustainable procurement | The proposal would seek to drive sustainable procurement for the goods and services required to deliver the proposal; and contribute value to the environmental, social and economic wellbeing of the community, in alignment with the requirements in the NSW Government Procurement Policy Framework. |

### 6.15.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise sustainability impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.73**.

Table 6.73 Safeguards and management measures –sustainability impacts

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Sustainability | A Sustainability Management Plan for the proposal will be developed and implemented during detailed design and construction, detailing measures to meet the proposal's sustainability objectives and targets. The sustainability management plan will:<br>• Demonstrate leadership and commitments to sustainability<br>• Adopt relevant sustainability performance targets in accordance with the Transport sustainability strategy.<br>• Establish the roles, responsibilities and resourcing requirements<br>• Sustainable procurement measures to prioritise efficient use of resources and conservation of natural resources, and inform the proposal's sustainable procurement requirements from legislation, industry's policies/guidelines, and Transports' corporate requirements<br>• Document the process for the identification, assessment and implementation of sustainability initiatives and opportunities<br>• Identifies sustainability training and awareness requirements<br>• Document the process to be used to monitor and review of sustainability performance against achieving the proposal's sustainability targets<br>• Outline the documentation and reporting requirements for sustainability on the proposal. | Transport/ Contractor | Prior to construction/ construction |

## 6.16 Waste management

Transport is committed to ensuring the responsible management of unavoidable waste and promotes the reuse of such waste in accordance with the resource management hierarchy principles outlined in the *Waste Avoidance and Resource Recovery Act 2001*. These resource management hierarchy principles, in order of priority are:

- Avoidance of unnecessary resource consumption in operations, maintenance, construction and management
- Resource recovery (including reuse, reprocessing, recycling and energy recovery)
- Disposal.

By adopting the above principles, Transport aims to efficiently reduce resource use, reduce costs, and reduce environmental harm in accordance with the principles of ecologically sustainable development.

### 6.16.1 Potential impacts

The REF area has the potential to generate waste from the following activities:

- Vegetation clearance including native, exotic and noxious species
- Earthworks for constructing the bridge approaches including removal of rock and soil for road widening and realignment
- Structural works for the bridge and abutments
- Utility adjustments
- Materials from the demolition of the bridge.

Waste streams likely to be generated during construction of the REF area include:

- Excess spoil – all material generated by the REF area would be reused on site in areas of fill with the exception of any unsuitable material. The only spoil which would be removed from site is material which is deemed unsuitable for reuse on site
- Green waste as a result of vegetation clearing. Noxious weed material would be separated from native green waste. Green waste would either be mulched and reused on site or sent to a composting facility
- Excess material used in the construction of the bridge and other elements of the proposal that cannot be reused – e.g. form work, small quantities of concrete
- Roadside materials (fencing, guide posts, guard rails etc.)
- Packaging and general waste from staff (lunch packaging, portable toilets etc.)
- Chemicals and oils
- Waste water from wash-down and bunded areas
- Redundant erosion and sediment controls
- Demolition waste such as concrete, steel, asphalt and electrical material from the removal of the existing bridge and sections of highway
- Building demolition waste from the demolition of the motel, private residence and other smaller structures.

Apart from demolition, the activities above would generate relatively low quantities of waste materials and would be managed, reused and disposed of in accordance with the relevant guidelines and standard practices.

Demolition activities would generate substantial quantities of potential waste material. Estimated quantities and potential reuse opportunities for the demolition of the existing bridge are presented in **Table 6.74**.

Table 6.74 Waste quantities and reuse potential from demolition of the existing bridge

| Material | Quantity (potential reuse percentage) | Recycling and disposal location |
|---|---|---|
| Concrete | 2,478 tonnes | Concrete waste to be transported to a licenced facility for recycling and disposal |
| Steel | 261 tonnes | Steel waste to be transported to a licenced facility for recycling and disposal |

The potential to reuse all materials would be further investigated during detailed design and construction planning. Unsuitable fill material and all other wastes would be classified in accordance with the *NSW EPA Waste Classification Guidelines* (EPA, 2014) and disposed of at an appropriately licenced facility. Final waste classification is required once the volumes of waste requiring offsite disposal during construction are confirmed.

### 6.16.2 Safeguards and management measures

The environmental management measures that will be implemented to minimise waste impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.75**.

Table 6.75 Safeguards and management measures – waste management

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Waste management general | A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to:<br>• Measures to avoid and minimise waste associated with the proposal<br>• Classification of wastes and management options (re-use, recycle, stockpile, disposal)<br>• Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions<br>• Procedures for storage, transport and disposal<br>• Monitoring, record keeping and reporting.<br>The WMP will be prepared considering the *Environmental Procedure - Management of Wastes on Roads and Maritime Services Land* (Roads and Maritime Services, 2014) and relevant Roads and Maritime Waste Fact Sheets. | Contractor | Prior to construction/ construction |
| Waste management general | Unsuitable fill material and all other wastes will be classified in accordance with the *NSW EPA Waste Classification Guidelines* (EPA, 2014) and disposed of at an appropriately licenced facility. | Contractor | Construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Waste management general | All wastes will be managed and disposed of in accordance with the POEO Act. | Contractor | Construction |

## 6.17 Other impacts

### 6.17.1 Existing environment and potential impacts

This section provides an assessment of the proposal's potential impacts for other minor environmental factors not identified as key issues in **Section 6.1** to **Section 6.16**. A summary of these potential impacts are provided in **Table 6.76**.

Table 6.76 Summary of existing environment and potential impacts for other minor environmental factors

| Environmental factor | Existing environment | Potential impacts |
|---|---|---|
| Utilities | A summary of the existing utilities that would need to be relocated or adjusted for the REF area is provided in **Table 3.8**. | The potential risk associated with utility related hazards would be minimised by carrying out utility checks (such as dial before you dig searches and non-destructive digging) and consulting with the relevant utility providers. Construction methodologies for construction works near high pressure gas or petroleum pipelines would be developed to comply with relevant standards in consultation with utility providers to minimise environmental hazards.<br><br>Damage, rupture and/or failure to shut down, isolate or otherwise appropriately manage underground utilities during construction activities has the potential to result in the following environmental hazards:<br>• Release of untreated sewage and/or gas from a sewer main<br>• Release of natural gas from a gas main<br>• Release of large electrical currents through the ground surface from an underground electricity cable (known as earth potential rise)<br>• Release of high pressure petroleum or gas products from petroleum, gas or oil pipelines.<br>• Key utilities which would present a potential hazard or risk where located close to construction works include:<br>• High voltage power lines (both aboveground and underground)<br>• High pressure gas mains<br>• Gas distribution lines. |
| Hazard and risk management | N/A | Potential hazards during construction would be temporary and associated with:<br>• The on-site storage, use and transport of dangerous goods and hazardous substances<br>• The on-site handling and transport of contaminated soil and hazardous wastes<br>• Potential impacts to utilities<br>• Potential bushfire risks.<br>Construction areas would be planned so that hazardous materials are stored appropriately and at a suitable distance from sensitive receivers, in accordance with the thresholds established under *Applying SEPP 33 guidelines* (Department of Planning, 2011). |

| Environmental factor | Existing environment | Potential impacts |
|---|---|---|
| | | Environmental hazards associated with the on-site storage, use and transport of chemicals, fuels and materials would be managed through standard mitigation measures to be developed as part of the construction environmental management documentation. These measures would include the storage and management of all dangerous goods and hazardous substances in accordance with the Work Health and Safety Act 2011, the Work Health and Safety Regulation 2017, the Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005) and Applying SEPP 33 (Department of Planning, 2011).<br><br>Dangerous goods would be transported to and from construction areas using the routes identified in **Figure 6.6**. Transport of dangerous goods would be in accordance with the *Dangerous Goods (Road and Rail Transport) Act 2008* and Dangerous Goods (Road and Rail Transport) Regulation 2014, and extended routes would avoid areas (such as road tunnels) prohibited by NSW Road Rule 300-2 (carriage of dangerous goods in prohibited areas). |

### 6.17.2 Safeguards and management measures

The environmental management measures that will be implemented to minimise impacts associated with utilities, hazards and risks of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.77**.

Table 6.77 Safeguards and management measures – other minor environmental impacts

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Utilities | Prior to the commencement of work the location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners<br><br>If the scope or location of proposed utility relocation work falls outside of the assessed proposal scope and footprint, further assessment will be undertaken. | Contactor | Detailed design/ prior to construction |
| Hazards and risk management | A Hazard and Risk Management Plan (HRMP) will be prepared and implemented as part of the CEMP. The HRMP will include, but not be limited to:<br>• Details of hazards and risks associated with the activity<br>• Measures to be implemented during construction to minimise these risks<br>• Record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials<br>• A monitoring program to assess performance in managing the identified risks<br>• Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations. | Contactor | Detailed design/ prior to construction |

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| | The HRMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or DPIE publications. | | |

## 6.18 Cumulative impacts

### 6.18.1 The proposal

As outlined in **Section 1.1.1**, the REF area forms part of a larger proposal which involves the widening of about six kilometres of Maitland Road from four lanes to six lanes, from the intersection with the NICB at Sandgate, through to Hexham Bridge, in Hexham, NSW. The proposal includes works located within the EIS area as shown in **Figure 1.3**. The EIS areas are relatively small areas subject to the CM SEPP.

### 6.18.2 Other projects and developments

#### Hexham Straight Widening EIS area

The EIS area is part of the proposal and is comprised of three separate locations within land subject to the CM SEPP, refer to **Section 1.1.2** and **Figure 1.3**.

Key environmental impacts relevant to the EIS area include:

- Direct impacts to 3.28 hectares of mapped CM SEPP Coastal Wetlands within the EIS area and minor indirect impacts outside the EIS area from the upgrade and maintenance of drainage systems that discharge into Coastal Wetlands listed under the CM SEPP
- Destruction of Aboriginal artefact HS-IF 1
- Clearing of about 2.73 hectares of native vegetation comprised of three TECs
- Localised direct impacts on coastal processes from the relocation of an unnamed drainage channel to the southeast of Ironbark Creek
- Removal of the vehicle access track to the fishing spot to the southeast of Ironbark Creek Bridge
- Relocation of the bus stop (ID 2322137) opposite Shamrock Street on Maitland Road would be permanently relocated but access would be maintained during construction.

#### M1 Pacific Motorway extension to Raymond Terrace (in planning)

The M1 Pacific Motorway extension to Raymond Terrace is currently in planning and proposes an additional fifteen kilometres of dual travel lanes motorway with two lanes in each direction, bypassing Hexham and Heatherbrae and connecting the existing M1 Pacific Motorway to Raymond Terrace. The project would also include new interchanges at Black Hill, Tarro, Tomago, and Raymond Terrace.

The project is located about one kilometre north of the proposal and directly alongside the proposal to the east of the Hunter River. The M1 Pacific Motorway extension to Raymond Terrace will also be using Construction Compound 4 which is within the construction area of the proposal. There is potential for consecutive (back to back) construction and concurrent (simultaneous) operation with the REF area.

Key environmental impacts relevant to the REF area include:

- This project would result in the removal of around 171.28 hectares of native vegetation, representing 14 PCTs and six TECs. Native vegetation includes habitat for threatened fauna species. The project also includes removal of 16.4 hectares of Coastal Wetlands.
- The construction of the M1 Pacific Motorway extension will result in additional construction vehicles on Hexham Straight. These construction vehicle volumes are not expected to exceed capacity (including heavy vehicle capacity) of these state roads
- When both projects are operational, the M1 Pacific Motorway between Tarro and Raymond Terrace will reduce traffic at the A1 Pacific Highway and Maitland Road intersection improving traffic performance for Hexham Straight
- There are seven heritage items listed on the LEP located within the investigation area, six areas of heritage potential and one heritage item listed on the Register of National Estate (Hunter Estuary Wetlands) located within the investigation area
- Given the location and distance of the proposal and the M1 Pacific Motorway to Raymond Terrace Upgrade, cumulative noise impacts to sensitive receivers at the north of the proposal would be unlikely to occur during operation of this proposed project but may occur during construction during the shared use of Construction Compound 4
- Traffic changes and increased construction traffic, resulting in extended periods of delays and disruptions for road users
- Construction activities would have benefits for local businesses due to increased demand for goods and services to support construction activities. Positive impacts may also occur for local employment due to an increase in construction related jobs, providing employment opportunities for local people and opportunities for skills development across multiple construction projects

### Lower Hunter Freight Corridor (in planning)

Transport is currently undertaking preliminary investigations to assess options for the Lower Hunter Freight Corridor which would enable a future dedicated freight rail line to be constructed between Fassifern and Hexham; bypassing Newcastle while improving regional and interstate links.

The investigation area includes Hexham at the south east of the project and extends to the M1 Pacific Motorway and Lenaghans Drive at the south west of the proposal.

An environmental assessment has not been completed for this project, so the extent of the environmental impacts are not fully understood.

Likely environmental impacts relevant to the REF area include, the construction of a rail freight corridor that would reduce the demand for road freight in the study area.

### Richmond Vale Rail Trail to Shortland, including Shortland to Tarro cycleway

The Richmond Vale Rail Trail is a proposed 32 kilometre 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. The trail passes through old railway tunnels and over bridges, among wildlife habitats and links to Shortland Wetlands (including Hunter Wetlands Centre Australia).

An environmental assessment has not been completed for this project, so the extent of the environmental impacts are not fully understood.

Likely environmental impacts relevant to the REF area include:

- The Richmond Vale Rail Trail to Shortland would encourage additional pedestrian and cycle links use within the study area
- Pollutant runoff, sedimentation and disturbance of ASS
- During operation increased litter could impact the water quality of the wetlands
- The rail trail utilises the Minmi to Hexham Railway (I332), listed on the Newcastle LEP, and the Richmond Vale Railway (I214), and listed on the Cessnock LEP. A number of other heritage items are located with the projects study area. The project would result in the following heritage impacts:
  - Moderate physical and visual heritage impacts to the Minmi to Hexham Railway
  - Major physical and visual cumulative heritage impacts to the Richmond Vale Railway
  - Minor and moderate visual heritage impacts to the unlisted portions of the former Richmond Vale Railway Line, between the Newcastle and Cessnock LGA boundary and the Lake Macquarie and Cessnock LGA boundary.

### Newcastle Power Station AGL

AGL proposes to construct and operate a dual fuel fast-start peaking power plant with a nominal capacity of 250 megawatt with gas pipelines, electricity transmissions lines, site access and associated ancillary facilities. The project would be located off Old Punt Road in Tomago NSW on the southern side of the Hunter River about one kilometre east of the most eastern extent of the proposal.

Key environmental impacts relevant to the REF area include:

- This project would result in the removal of around 15.5 hectares of native vegetation, three *Eucalyptus parramattensis subsp. decadens*, 0.18 hectares of habitat for Koala and 4.48 hectares of habitat for Squirrel Glider
- Extended periods of exposed, temporarily cleared areas as a result of vegetation removal, temporary hoardings and fencing, increased construction traffic, lighting, plant and equipment would lead to ongoing disruptions to the landscape character
- Permanent land use changes, vegetation removal and changes to built form would impact the landscape character during operation.

### Hunter Gas Pipeline

The Hunter Gas Pipeline is designed to be about 833 kilometres in length, running from Wallumbilla in Queensland to Newcastle in NSW. The Hunter Gas Pipeline is located to the east of the proposal in Tomago and would connect to the Tomago Aluminium Smelter in Tomago.

Key environmental impacts relevant to the REF area include:

- The project would traverse Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion EEC and habitats for a number of threatened fauna species. Minor cumulative impact to biodiversity values is expected in the vicinity of the construction footprint
- Extended periods of exposed, temporarily cleared areas as a result of vegetation removal, temporary hoardings and fencing, increased construction traffic, lighting, plant and equipment would lead to ongoing disruptions to the landscape character
- During operation the pipeline would experience concentrated landscape and visual impacts along the pipeline alignment due to lack of landscaping within the corridor
- Extended periods of temporary hoarding and fencing, increased construction traffic.

### 6.18.3 Potential impacts

**Table 6.78** provides a summary of the cumulative impacts of the REF area for a number of key environmental factors.

Table 6.78 Summary of cumulative impacts

| Environmental factor | Potential cumulative impact | |
|---|---|---|
| | Construction | Operation |
| Biodiversity | Cumulative impacts include the clearing of native vegetation with the M1 Pacific Motorway extension to Raymond Terrace proposal removing 171.28 hectares of native vegetation, representing 14 PCTs and six TECs and the Newcastle Power Station AGL projects removing an additional 40 hectares.<br><br>The removal of this vegetation would impact the habitat of a number of threatened species including *Diuris praecox, Caladenia tessellata, Callistemon linearifolius, Grevillea parviflora subsp. Parviflora, Diuris arenaria,* and *Eucalyptus parramattensis subsp. Decadens*. | Cumulative biodiversity impacts are expected to be minimal. |
| Hydrology and flooding | Cumulative construction hydrology and flooding impacts are expected to be negligible. | Due to increased runoff volumes from the AGL power station site there is expected to be 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. |
| Surface water | Cumulative construction surface water quality impacts would be minimal. Key risks would include transport of materials to and from site and accidental spillages however these could be managed with the implementation of mitigation measures. | Cumulative operation surface water quality impacts would be negligible. |
| Coastal processes | The M1 Pacific Motorway extension to Raymond Terrace would be constructed at different times and so is not expected there would be any cumulative river geomorphology or coastal processes impacts during construction. | It is expected that cumulative impacts to river geomorphology and coastal processes of the Hunter River associated with the M1 Pacific Motorway extension to Raymond Terrace would be negligible as, similar to the proposed project, Transport would employ rehabilitation efforts (in line with relevant guidelines) to ensure the disturbed landscape is stabilised. |
| Traffic and transport | Nearby projects would result in additional construction vehicles on Hexham Straight. These construction vehicle volumes are expected to be minor and not exceed capacity of these state roads. | When both projects are operational, the M1 Pacific Motorway between Tarro and Raymond Terrace will reduce traffic at the A1 Pacific Highway and Maitland Road intersection improving traffic performance for the Hexham Straight proposal.<br><br>The construction of the Lower Hunter Freight Corridor would reduce the demand for road freight in the study area. |

| Environmental factor | Potential cumulative impact | |
|---|---|---|
| | **Construction** | **Operation** |
| Noise and vibration | The M1 Pacific Motorway extension to Raymond Terrace is not expected to result in cumulative noise impacts from construction due to the location and distance of the project.<br><br>Cumulative construction noise associated with the other projects is unknown due to the lack of available information. | The M1 Pacific Motorway extension to Raymond Terrace is not expected to result in cumulative noise impacts during operation due to the location and distance of the project.<br><br>Cumulative construction noise associated with the other projects is unknown due to the lack of available information. |
| Non-Aboriginal heritage | Projects carried out in the vicinity of the REF area have had a negligible impact on non-Aboriginal heritage in the region. The contribution of the project to cumulative impacts on non-Aboriginal heritage in the area is minor, considering the heritage impacts are being addressed and managed through the implementation of a range of environmental management measures including avoidance, dilapidation surveys, noise and vibration controls, barrier fencing, archival photographic recording, archaeological salvage excavation, geophysical survey and archaeological test excavation (if required). | Operational heritage impacts associated with projects in the vicinity of the REF area are expected to be minimal. |
| Urban design, landscape character and visual impacts | Cumulative landscape and visual impacts are expected during construction of nearby projects due to extended periods of exposed, temporarily cleared areas as a result of vegetation removal, temporary hoardings and fencing, increased construction traffic, lighting, plant and equipment | Cumulative operational landscape and visual impacts are expected due to permanent land use changes, vegetation removal and changes to built form. |
| Socio-economic | Construction of the M1 Pacific Motorway extension to Raymond Terrace would mainly result from traffic changes and increased construction traffic, resulting in extended periods of delays and disruptions for road users. Construction activities would have benefits for local businesses due to increased demand for goods and services and increased employment opportunities. | Combined with the REF area, the operation of the M1 Pacific Motorway extension to Raymond Terrace would improve access and connectivity throughout the region. |

### 6.18.4 Safeguards and management measures

The environmental management measures that will be implemented to minimise cumulative impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.79**.

Table 6.79 Safeguards and management measures – cumulative impacts

| Impact | Environmental safeguards | Responsibility | Timing |
|---|---|---|---|
| Cumulative impacts | Ongoing coordination and consultation will be undertaken with nearby projects as required. | Transport/ contractor | Prior to and during construction |
| Cumulative impacts | The CEMP will be revised to consider potential cumulative impacts from surrounding development activities as they become known. | Contractor | Construction |

# 7 Environmental management

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

## 7.1 Environmental management plans (or system)

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

A single CEMP will be prepared to describe the safeguards and management measures identified for this REF and the EIS. The CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation. The CEMP will also provide the roles and responsibilities of key construction personnel and describe how environmental risks associated with the proposal will be managed and be complemented by the various sub-plans included in **Table 7.1** and the EIS.

The CEMP will be prepared prior to construction of the proposal and must be reviewed and approved 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. The CEMP would be developed in accordance with the specifications set out in the QA Specification *G36 – Environmental Protection (Management System)*, QA Specification *G38 – Soil and Water Management (Soil and Water Plan)*, QA Specification *G40 – Clearing and Grubbing*, QA Specification *G10 – Traffic Management.*

Environmental safeguards and management measures outlined in this REF will be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal within the REF area, should it proceed. These safeguards and management measures will minimise any potential adverse impacts arising from the proposed work on the surrounding environment. The safeguards and management measures are summarised in **Table 7.1**.

## 7.2 Summary of safeguards and management measures

This section collates the environmental management measures for the proposal in the REF area that were identified through the impact assessment process (refer to **Chapter 6**). All measures listed in **Table 7.1** would be incorporated into the CEMP and/or the operational framework for the proposal.

Table 7.1 Summary of safeguards and management measures

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| GEN1 | General - minimise environmental impacts during construction | A CEMP will be prepared and submitted for review and endorsement of the Transport Environment Manager prior to commencement of the activity.<br>• As a minimum, the CEMP will address the following:<br>• Any requirements associated with statutory approvals<br>• Details of how the project will implement the identified safeguards outlined in the REF and EIS<br>• Issue-specific environmental management plans<br>• Roles and responsibilities<br>• Communication requirements<br>• Induction and training requirements<br>• Procedures for monitoring and evaluating environmental performance, and for corrective action<br>• Reporting requirements and record-keeping<br>• Procedures for emergency and incident management<br>• Procedures for audit and review.<br>• The endorsed CEMP will be implemented during the undertaking of the activity. | Transport/ Contractor | Prior to construction/ detailed design | - |
| GEN2 | General - notification | All businesses, residential properties and other key stakeholders (e.g. schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity. | Transport/ Contractor | Prior to construction | - |
| GEN3 | General – environmental awareness | All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project. This will include up-front site induction and regular ‘toolbox’ style briefings. | Transport/ Contractor | Prior to construction/ detailed design | - |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | | Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include:<br>• Areas of Aboriginal heritage sensitivity<br>• Threatened species habitat<br>• Coastal Wetlands areas<br>• Adjoining residential areas requiring particular noise management measures. | | | |
| B1 | Impact to surrounding vegetation and threatened ecological communities | A Flora and Fauna Management Plan will be prepared in accordance with the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (Roads and Traffic Authority, 2011a) and implemented as part of the CEMP. The FFMP will provide specific management for flora and fauna species (including threatened species) that will include but not limited to:<br>• Construction personnel are to be informed of the environmentally sensitive aspects of the site<br>• Construction crews will be made aware that any native fauna species encountered must be allowed to leave site without being harassed and a local wildlife rescue organisation must be called for assistance where necessary<br>• Delineation of work zones, areas for parking and turning of vehicles and plant equipment prior to commencement of works<br>• Establishment of exclusion zones around high-quality vegetation<br>• Materials, plant, equipment, work vehicles and stockpiles will be placed to avoid damage to surrounding vegetation and will be outside tree drip-lines.<br>• Periodic monitoring will be undertaken to ensure all controls are in place and no inadvertent impacts are occurring.<br>• If any damage occurs to vegetation outside of the nominated work area, Transport will be notified so that appropriate remediation strategies can be developed. | Contractor | Prior to construction | **Appendix H** |
| B2 | Impact to native plants and animals including | A pre-clearing inspection will be carried out in accordance with *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (Guide 1: Pre-clearing process) (Roads and Traffic Authority, 2011a).<br>A post clearance report, including any relevant Geographical Information System files, would also be produced that validates the type and area of | Contractor | Construction | **Appendix H** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | threatened species | vegetation cleared including confirmation of the number of hollows impacted and the corresponding nest box requirements to offset these impacts. | | | |
| B3 | | Clearing of vegetation would follow the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (Guide 1: Pre-clearing process) (Roads and Traffic Authority, 2011a). | Contractor | Construction | **Appendix H** |
| B4 | | Where possible, hollows would be cut out of hollow-bearing trees and re-established in large trees to mitigate the loss of hollow habitat on fauna. Re-establishing existing hollows into trees is more likely to encourage uptake than use of artificial nest boxes. | Contractor | Construction | **Appendix H** |
| B5 | | The unexpected species find procedure under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects* (Roads and Traffic Authority, 2011a) will be implemented if TECs or threatened fauna, not assessed in the biodiversity assessment, are identified in the construction area of the proposal. | Contractor | Construction | **Appendix H** |
| B6 | Impacts to the Southern Myotis | Microbat Management Plan (MMP) will be prepared as part of the FFMP. The MMP will outline specific mitigation measures to be undertaken during construction of the proposal to minimise impacts on threatened microbat species including:<br>• Details on timing of construction and demolition activities that are likely to impact. The proposed works likely to impact must occur outside of the Southern Myotis breeding season (September- December) and will also avoid winter months when bats may be in torpor due to cold conditions<br>• Roost exclusion and/or translocation methodology<br>• Ecological supervision and survey<br>• Compensatory roost installation in suitable location in the immediate surrounds and/or within the new proposed structure as compensation for the loss of existing roosting habitat<br>• Reporting and monitoring. | Transport | Prior to construction | **Appendix H** |
| B7 | Impacts from introduction and spread of weeds | Weed species will be managed in accordance with *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (Roads and Traffic Authority, 2011a) (Guide 6: Weed management) and the *Biosecurity Act 2015* | Contractor | Construction | **Appendix H** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| B8 | Impacts from introduction and spread of plant pathogens and amphibian chytrid fungus | A hygiene protocol to be included as part of the FFMP for construction vehicles and equipment to prevent the spread or introduction of weeds, pest and pathogens. | Contractor | Construction | **Appendix H** |
| B9 | Impacts to aquatic habitat including Key Fish Habitat | 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* (NSW Roads and Traffic Authority 2011a) and Section 3.3.2 Standard precautions and mitigation measures of the *Policy and guidelines for fish habitat conservation and management Update 2013* (Department of Primary Industries 2013). | Contractor | Construction | **Appendix H** |
| B10 | | A Biodiversity Offset Strategy (BOS) will be prepared in accordance with the *Policy and guidelines for fish habitat conservation and management* (DPI, 2013), for impacts to key fish habitat, in consultation with DPI (Fisheries). | Transport/ Contractor | Prior to construction | **Appendix H** |
| B11 | | Large woody debris will be retained for creek crossing works where practicable. All large woody debris or snags will be relocated instream by a suitably qualified ecologist. | Contractor | Construction | **Appendix H** |
| B12 | | Underwater piling controls will include (but not be limited too) soft starts. | Contractor | Construction | **Appendix H** |
| B13 | Impacts to aquatic habitat including Key Fish Habitat | Relevant approvals and permits under Part 7 of the *Fisheries Management Act 1994* to be obtained prior to impact of mangroves and or saltmarsh.<br>Transport will consult with DPI (Fisheries) under Part 7 of the FM act on the clearing of saltmarsh and mangroves | Transport/ Contractor | Prior to construction | **Appendix H** |
| B14 | Temporary obstruction to fish | Temporary obstruction of fish passage may require a NSW Fisheries Permit, subject to assessment by the Department of Planning, Industry and Environment. | Contractor | Construction | **Appendix H** |
| B15 | National Parks | No unauthorised works will be undertaken within land managed by the National Parks and Wildlife. | Contractor | Prior to construction | **Appendix H** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| FL1 | Potential changes to flood impacts resulting from detailed design | Further flood investigations and detailed hydrological and hydraulic modelling will be carried out during detailed design to ensure the design objectives and performance criteria for the proposal are met. | Contractor | Detailed design | **Appendix L** |
| FL2 | Flooding impacts on property | Landowners will continue to be consulted regarding any changes to flooding and hydrology impacts and mitigation measures in relation to individual properties. | Transport/ Contractor | Detailed design | **Appendix L** |
| FL3 | Flooding impacts during construction | Flood Management Plan (FMP) will be prepared as part of the CEMP for the proposal and will include:<br>• Details on the processes for flood preparedness, materials management, weather monitoring, site management and flood incident management<br>• Responsibilities for flood response (preparation of site upon receipt of flood warning, evacuation of site personnel) during and recovery following a flood event<br>• Detailed construction planning such that construction phase traffic management and other construction area arrangements do not impact on flood evacuation route traffic capacity | Transport/ Contractor | Prior to construction | **Appendix L** |
| FL4 | Flooding impacts of bridges and culverts | Where possible, culvert and bridge design will be further developed to minimise upstream and downstream impacts to wetlands and other sensitive environments. | Contractor | Detailed design | **Appendix L** |
| FL5 | | Where possible, detailed construction staging plans will be developed during detailed design so that bridges and culverts are constructed in a way that minimises flood risk. | Contractor | Detailed design | **Appendix L** |
| FL6 | Impacts on existing drainage systems | Activities that may affect existing drainage systems during construction will be carried out so that existing hydraulic capacity of these systems is maintained where practicable. This will continue to be undertaken through appropriate design methodologies and considerations during detailed design.<br>Drainage systems that are upgraded and require scour protection would also consider Roads and Maritime Services (2017) *Water Sensitive Urban Design Guideline* as part of detailed design. | Contractor | Construction | **Appendix L** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| FL7 | Impacts to river banks downstream of proposal discharge locations during construction | As part of the Construction Soils and Water Management Plan a measure will be included to monitor waterways (channels and banks) immediately downstream of proposal discharge locations during the construction phase indicate potential downstream impacts (e.g. sedimentation, scour, etc.) then in the first instance relevant corrective actions outlined in the erosion and sediment control plan (to be developed as part of the CSWMP will be employed.<br><br>Further to this, the requirement for remediative and additional preventative actions will be assessed. Physical controls to ensure the stabilisation and continuing integrity of watercourse geomorphic properties will be considered where reasonable and feasible. | Contractor | Construction | **Appendix L** |
| FL8 | Unforeseen impact to surface water hydrology | A surface water and groundwater monitoring program will be implemented that includes the collection of baseline data and detailed monitoring during construction. Should unforeseen impacts arise that are not already addressed by the environmental management measures outlined in this table, appropriate responses and management measures will be developed in consultation with the relevant authority. | Transport | Construction | **Appendix L** |
| SW1 | General | A Construction Soils and Water Management Plan (CSWMP) will 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 will include but not be limited to:<br><br>• Measures to minimise/manage erosion and sediment transport both within the construction area 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<br>• 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)<br>• 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, 2015d) to minimise the potential for mobilisation and transport of dust and sediment in runoff | Transport/ Contractor | Prior to construction/ construction/ operation | **Appendix N** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | | • Concrete waste management procedures<br>• Measures to manage potential tannin leachate, accidental spills (including the requirement to maintain materials such as spill kits) and potential saline soils<br>• A surface water quality monitoring program to monitor the performance of management measures<br>• Controls for sensitive receiving environments including Coastal Wetlands (CM SEPP) which may include but not be limited to:<br>– Designation of 'no go' zones for construction plant and equipment<br>– Creation of catch/diversion drains and sediment fences at the downstream boundary of construction activities where practicable to ensure containment of sediment-laden runoff and diversion toward sediment sump treatment areas (not sediment basins) to prevent flow of runoff to the Coastal Wetland. | | | |
| SW2 | Erosion, sediment and water quality controls | A soil conservation specialist will be engaged for the duration of construction of the REF area 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 | **Appendix B** |
| SW3 | Spills and leaks | The CSWMP will outline site specific control measures and required procedures to ensure containment of accidental spills and leaks. This will include:<br>• All fuels, chemicals and liquids will be stored on level ground at least 20 metres away from waterways (including existing stormwater drainage system) and will be stored in a sealed bunded area within ancillary facilities<br>• An emergency spill response procedure will be prepared in accordance with Transport protocols to minimise the impact of accidental spills of fuels, chemicals and fluids during construction<br>• Regular visual water quality checks (for hydrocarbon spills, turbid plumes and other water quality issues) will be carried out when working near any waterways. | Transport/ Contractor | Prior to construction/ construction | **Appendix B** |
| SW4 | Surface water quality impacts | A construction water quality monitoring program will be developed in accordance with the *Guidelines for Construction Water Quality Monitoring* (Roads and Traffic Authority, 2003b) and the *Australian Guidelines for Water* | Transport/ Contractor | Prior to construction/ construction | **Appendix B** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | | *Quality Monitoring and Reporting* (ANZECC/ARMCANZ, 2000b), and will be included in the CSWMP for the REF area to establish baseline conditions prior to commencement of construction, observe the environmental performance and any changes in surface water and groundwater during construction, and inform appropriate management responses.<br>Should the results of monitoring identify that the water quality management measures are not effective in adequately mitigating water quality impacts, additional management measures will be identified and implemented as required. | | | |
| SW5 | Dewatering | A dewatering management protocol will be prepared as a sub plan of the Construction Soil and Water Management Plan which would outline:<br>• The methodology for excavation dewatering, dewatering waterways and wetlands, as well as discharges from temporary construction sediment basins<br>• Monitoring of groundwater level responses to dewatering<br>• Supervision requirements<br>• Staff responsibilities and training<br>• Approvals required before any dewatering activity commences.<br>The protocol would be developed in accordance with the *RTA Technical Guideline: Environmental management of construction site dewatering* (Roads and Traffic Authority, 2011b). | Transport / Contractor | Prior to construction/ construction | **Appendix B** |
| GW1 | Groundwater monitoring | Prior to construction, a groundwater quality sampling round will be undertaken at proposal groundwater monitoring bores.<br>Should the results of monitoring identify that the water quality management measures are not effective in adequately mitigating water quality impacts, additional management measures will be identified and implemented as required. | Transport/ Contractor | Prior to construction/ construction | **Appendix B** |
| CP1 | Bank instability during construction and operation of the proposal | Develop and review bank stability risks to the proposal as part of the detailed design. This will include planning for the management of potential scour effects in Ironbark Creek caused by the new bridges and from the modification of drainage infrastructure within the tidal waterways during construction and operation of the proposal. | Transport | Detailed design | **Appendix B** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| CP2 | Coastal process impacts from in-stream construction works in Ironbark Creek | Develop and implement a Construction Coastal Impacts Management Plan to manage potential coastal process impacts resulting from temporary in-stream works in Ironbark Creek. | Transport | Prior to construction | **Appendix O** |
| CP3 | Coastal process impacts from in-stream construction works in Ironbark Creek | If the design and construction methodology changes at Ironbark Creek, a consistency assessment of the coastal process impacts will be undertaken to ensure that unacceptable impacts to the value of the creek and its surroundings, resulting from the proposal are avoided. | Transport | Prior to construction | **Appendix O** |
| TT1 | Impacts to traffic during construction | A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the *Traffic Control at Work Sites Manual* (Roads and Traffic Authority, 2010) and *QA Specification G10 Control of Traffic.* The TMP will include:<br>• Confirmation of haulage routes<br>• Measures to maintain access to local roads and properties<br>• Site specific traffic control measures (including signage) to manage and regulate traffic movement<br>• Measures to manage temporary changes to the road network including use of barriers or lane occupancies<br>• Measures to maintain pedestrian and cyclist access (including communication, signage and alternative routes)<br>• Requirements and methods to consult and inform the local community of impacts on the local road network (including for out of hours work)<br>• Access to construction areas including entry and exit locations and measures to prevent construction vehicles queuing on public roads<br>• A response plan for any construction traffic incident<br>• Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic<br>• Any licences or permits required before starting activities | Contractor | Prior to construction/ construction | **Appendix P** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | | • Monitoring, review and amendment mechanisms. | | | |
| TT2 | Property access during construction | Property access will be maintained at all times during construction. Any changes to access arrangements or alternative access required during construction to be done in consultation with the landowner and will provide the same equivalent pre-existing level of access unless agreed to. Consultation with landowners on property access to continue during detailed design and construction. | Transport/ Contractor | Detailed design/ prior to construction/ construction | **Appendix P** |
| TT3 | Access | Where any legal access to property is permanently affected, arrangements for appropriate alternative access will be determined in consultation with the affected landowner and local road authority. | Contractor | Post-Construction | **Appendix P** |
| TT4 | Pedestrian and cyclist access during construction | Pedestrian and cyclist access will be maintained throughout construction. Where maintaining access is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the local road authority. | Contractor | Construction | **Appendix P** |
| TT5 | Access to bus stops and public transport during construction | Access for public transport services, including school bus services, will be maintained where possible. The requirements for any temporary changes will be confirmed following consultation with local bus operators and the community. | Contractor | Prior to construction/ construction | **Appendix P** |
| TT6 | Impacts to traffic from construction traffic | Haulage vehicle movements will be planned to minimise movements on the road network during the morning and evening peak periods where practicable. | Contractor | Prior to construction/ construction | **Appendix P** |
| TT7 | Road closures, diversions or reconfigurations during construction | During any road closures, diversions or reconfigurations of the road and cycle network relevant consultation will be carried out with Transport, Local Council (where relevant), emergency services and public transport authorities. | Contractor | Prior to construction/ construction | **Appendix P** |
| TT8 | Impacts to road users from changed traffic arrangements, traffic delays and disruptions | Road users and local communities will be provided with timely, accurate, relevant and accessible information about changed traffic arrangements and delays due to construction activities. | Contractor | Prior to construction/ construction | **Appendix P** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | during construction | | | | |
| TT9 | Damage or impacts on local road infrastructure during construction | Pre-construction and post construction road condition reports for local roads likely to be used for construction will be prepared. Any damage resulting from construction (not normal wear and tear) will be repaired unless alternative arrangements are made with the relevant road authority. Copies of road condition reports will be provided to the local roads authority | Contractor | Prior to construction | **Appendix P** |
| AH1 | Aboriginal heritage | An Aboriginal Heritage Management Plan (AHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Aboriginal heritage | Contactor | Detailed design/ prior to construction | Section 4.10 of QA G36 Environment Protection |
| AH2 | Aboriginal heritage | The *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime Services, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Aboriginal origin are encountered.<br><br>Work will only re-commence once the requirements of that Procedure have been satisfied. | Contactor | Detailed design/ prior to construction | Section 4.10 of QA G36 Environment Protection |
| AH3 | Human skeletal remains | The following protocol must be followed in the event that suspected human remains are identified:<br>• All works in the immediate vicinity must cease and the area protected by suitable curtilage<br>• The remains will be immediately reported to the work supervisor who will immediately advise the Transport Project Manager, Environment Manager and/or other nominated senior staff member<br>• The Transport Project Manager or Environment Manager will promptly notify the NSW Police (as required for all human remains discoveries)<br>• If the remains are identified as Aboriginal ancestral remains, Transport will coordinate consultation with Heritage NSW and RAPs to discuss ongoing care of the remains. | Contractor | Construction | **Appendix I** |
| AH4 | AHIP | An AHIP application will be made for the overall proposal area. | Transport | Prior to construction | **Appendix I** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| AH5 | Cultural awareness training | Completion of cultural heritage awareness training will be a requirement of the CEMP for all employees and contractors during project construction. | Contractor | Prior to construction/ construction | **Appendix I** |
| AH6 | Aboriginal cultural heritage | The development of an Aboriginal cultural heritage interpretation plan to promote understanding and awareness of the cultural values of the study area, including, but not limited to, development of interpretative signage. | Contractor | Detailed design/ prior to construction | **Appendix I** |
| NH1 | Non-Aboriginal heritage | A Non-Aboriginal Heritage Management Plan (NAHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to non-Aboriginal heritage. | Contractor | Detailed design/ prior to construction | **Appendix J** |
| NH2 | Non-Aboriginal heritage | The *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime Services, 2015) will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered.<br>Work will only re-commence once the requirements of that Procedure have been satisfied. | Contractor | Detailed design / prior to construction | **Appendix J** |
| NH3 | Site induction | All personnel working on site will receive training to ensure awareness of requirements of the NAHMP and relevant statutory responsibilities. Site-specific training will be given to personnel when working in the vicinity of identified non-Aboriginal heritage items. | Contractor | Prior to construction | **Appendix J** |
| NH4 | Non-Aboriginal heritage | Temporary protection zones (TPZ) such as fencing will be placed around the following heritage items:<br>• Sandgate Cemetery<br>• Former Travellers Rest Hotel<br>• Hexham Railway Station<br>• Hannel Family Vault. | Transport | Prior to construction/ construction | **Appendix J** |
| NH5 | | Archival recording will be completed for the Ironbark Creek crossing point, with particular focus on the location of previous crossings, and original 1875 and 1956 temporary bridges. A report will be prepared in accordance with Transport Heritage Branch's requirements for Archival Recording of Heritage Items and, relevant heritage guidelines by a qualified heritage consultant. A | Transport | Detailed design | **Appendix J** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | | copy of the report is to be provided to City of Newcastle Council and Newcastle Libraries. | | | |
| NH6 | Archaeology | Carry out further research and archaeological investigation to confirm the presence of any potential archaeological remains of crossings in use prior to 1875 (such as corduroy crossings) within the construction area of the proposal and confirm the nature and full extent of the bridge and roadway remnants identified in this assessment. Any remains identified during this investigation will be recorded within the archival recording for Ironbark Creek crossing point. Following this investigation, the significance assessment of the item should be reviewed and revised as appropriate. | Transport | Detailed design | **Appendix J** |
| NH7 | Archaeology | If unexpected archaeological material or relics are discovered during construction work must stop work immediately and the Heritage Council of NSW contacted, in accordance with section 146 of the *Heritage Act 1977 and* the *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime Services, 2015). The proponent must also inform Transport and the City of Newcastle. | Contractor | Construction | **Appendix J** |
| NH8 | Vibration impacts to heritage items | All feasible and reasonable vibration mitigation measures will be implemented to avoid vibration impacts to:<br>• Sandgate Cemetery<br>• 2HD Studios<br>• Former Travellers Rest Hotel<br>• Hexham Railway Station<br>• Hannel Family Vault. | Contractor | Construction | **Appendix J** |
| NV1 | General construction noise and vibration | A Construction Noise and Vibration Management Plan (CNVMP) will be prepared for the proposal to mitigate and manage noise and vibration impacts during construction and will form part of the CEMP. The CNVMP will be implemented for the duration of construction of the proposal and will:<br>• Identify nearby sensitive receivers<br>• Include a description of the construction equipment and working hours<br>• Identify relevant noise and vibration performance criteria for the REF area and license and approval conditions<br>• Identify relevant sleep disturbance screening levels | Contractor | Prior to construction/ construction | **Appendix M** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | | • Outline noise and vibration objectives, standard and additional mitigation measures from the CNVG and information about when each will be applied<br>• Outline requirements for noise and vibration monitoring that will be carried out to monitor REF area performance associated with the noise and vibration criteria<br>• Describe community consultation and complaints handling procedures in accordance with the Community Communication Strategy to be developed for the REF area<br>• Outline measures to manage sleep disturbance during night time work<br>• Outline measures to manage noise impacts associated with construction heavy vehicle movements both on and off site.<br>• All personnel working on site will receive training to ensure awareness of requirements of the CNVMP. Site-specific training will be given to personnel when working in the vicinity of sensitive receivers. | | | |
| NV2 | General vibration | Where works are within the minimum working distances for vibration intensive equipment and considered likely to exceed the cosmetic damage objectives in the CNVG at adjacent receivers, construction work will not proceed unless:<br>• A different construction method with lower source vibration levels is used, where feasible<br>• Attended vibration measurements are carried out to determine any exceedances and if further mitigation is required. | Contractor | Prior construction/ construction | **Appendix M** |
| NV3 | Vibration impacts to buried utilities | Where works are within 25 metres of potentially impacted utilities:<br>• Consultation will be carried out with the relevant utility authorities<br>• A detailed assessment of potential vibration impacts to any buried utilities will be conducted once detailed construction methodologies have been developed<br>• In-situ vibration monitoring may be considered when vibration intensive plant and equipment are to be used on site near buried utilities to establish site specific mitigation measures (e.g. safe working distances). | Contractor | Construction | **Appendix M** |
| NV4 | Vibration impacts to | Heritage listed buildings / structures within 50 metres from vibration intensive work are to be considered on a case by case basis to determine the structural | Contractor | Prior to construction/ construction | **Appendix M** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | heritage structures | integrity (i.e. structurally sound or unsound) of all potentially affected structures and to identify reasonable and feasible mitigation measures. | | | |
| NV5 | Vibration impact to existing structures | Prior to commencing the activity, a detailed inspection will be undertaken and a written and photographic report prepared to document the condition of buildings and structures where required. A copy of the report will be provided to the relevant land owner or land manager. | Contractor | Prior to construction | **Appendix M** |
| NV6 | Operational road traffic noise impacts | Operational noise and vibration mitigation measures will be confirmed during detailed design as part of the Operational Noise and Vibration Review (ONVR) in accordance with the *Noise Mitigation Guideline* (NMG) (Roads and Maritime Services, 2015). | Transport/ Contractor | Detailed design | **Appendix M** |
| NV7 | Operational road traffic noise impacts | Where feasible and reasonable, implementation of operational noise mitigation will be carried out within 12 months of construction activities commencing. | Contractor | Prior to construction | **Appendix M** |
| NV8 | Operational road traffic noise impacts | Within the first year of operation, monitoring of operational noise levels would be compared to predicted noise levels to verify the predictions and to determine the effectiveness of the noise mitigation measures.<br><br>Additional feasible and reasonable mitigation will be considered at eligible receivers where measured noise levels are found to be significantly different from the predictions. | Transport/ Contractor | Operation | **Appendix M** |
| SE1 | Community consultation | A Community Communication Strategy (CCS) will be prepared for the REF area to facilitate communication with the local community including relevant Government agencies, Councils, adjoining affected landowners and businesses, residents, motorists and other relevant stakeholders that may be affected by the proposal. The strategy will:<br>• Identify people, businesses and organisations to be consulted during the delivery of the proposal<br>• Set out procedures and mechanisms for the regular engagement with local businesses and organisations (for example, around local events) and distribution of information about the proposal<br>• Outline mechanisms to keep relevant stakeholders updated on site construction activities, schedules and milestones<br>• Outline avenues for the community to provide feedback (including a 24- | Transport/ Contractor | Prior to construction | **Appendix Q** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | | hour, toll free project information and complaints line) or to register complaints and through which Transport will respond to community feedback<br>• Outline a process to resolve complaints and issues raised. | | | |
| SE2 | Property acquisition | 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 | **Appendix Q** |
| SE3 | | Property adjustments will be completed in consultation with property owners/business managers. | Transport/ Contractor | Prior to construction/ construction | **Appendix Q** |
| SE4 | Business impacts | Access will be maintained to local businesses near to construction work. Where temporary access changes are proposed, these will be agreed with the affected business owner. | Contractor | Construction | **Appendix Q** |
| SE5 | Social infrastructure | Communication will be undertaken with local communities and recreational fishers about changes to the area near Ironbark Creek that is used informally for recreational fishing, including temporary restrictions during construction and permanent removal of the informal vehicle access road. | Transport | Prior to construction | **Appendix Q** |
| SE6 | Emergency vehicle access | 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 | **Appendix Q** |
| SE7 | Roadside tributes | A review will be undertaken of the corridor prior to construction to confirm the presence of roadside memorials. | Contractor | Prior to construction | **Appendix Q** |
| SE8 | | Relocation or removal of roadside tributes will be carried out in accordance with Roads and Maritime *Roadside Tribute Guidelines* (September 2016). | Contractor | Construction | **Appendix Q** |
| LV1 | General design integration | The proposal will follow Transports integrated project development process, including the requirement for urban designers to be part of the project team. | Transport | Detailed design | **Appendix C** |
| LV2 | | Transport's Urban Design Policy (*Beyond the Pavement*) and *Transports' Urban Design Guidelines* will be used to guide future design development of the proposal. | Transport | Detailed design | **Appendix C** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | | The urban design objectives, principles and concept design strategy presented in the urban design report for the proposal will form the basis for future design development and consultation with stakeholders.<br>• This will consider:<br>• Integrating appropriate grades with adjoining landform, avoiding sharp transition in profile, and blending the formation into its context<br>• Minimising clearance extent where possible and clearly defining clearance limits and exclusion zones to protect vegetation cover<br>• Progressively implementing revegetation works to limit erosion and to establish vegetation<br>• Utilising cleared material as part of revegetation works<br>• Providing minimum signage requirements and limit structural elements to provide an open and permeable setting.<br>• Looking for opportunities to minimise designed signage. Signage to be set out in accordance with Australian Standards.<br>• Limiting the extent of lighting and potential for light spill. Lighting to be set out in accordance with Australian Standards<br>• Providing visual screening within the road corridor to limit the visual impact of the proposal in areas identified as moderate or high impact.<br>• Providing a sense of space and openness associated with the flat open character of the floodplain landscape. | | | |
| LV3 | Earthworks | Stabilisation and revegetation will be undertaken progressively during construction to limit erosion and visual impacts through early integration with surrounding vegetation | Contractor | Construction | **Appendix C** |
| LV4 | Revegetation | Selection of vegetation communities that reflect the existing communities and landscape character. Landscaping to utilise local material where possible. | Transport | Construction | **Appendix C** |
| LV4 | Drainage | Utilise local sedgeland species where appropriate to aid in the filtration of stormwater and to provide a level of biodiversity within the corridor | Contractor | Construction | **Appendix C** |
| LV5 | Lighting | Lighting towers to be positioned away from residences where possible. | Contractor | Construction | **Appendix B** |
| LV6 | | Maintain compound in a tidy and well-presented manner. Provide and maintain screening and fencing. Works to be carried out in accordance with Roads and | Contractor | Construction | **Appendix C** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | Ancillary facilities | Maritime *EIA-N04 Guideline for Landscape Character and Visual Impact Assessment*. | | | |
| LV7 | | Progressively throughout the work, where feasible and reasonable, the ancillary facility sites will be returned to at least their pre-construction state, unless otherwise detailed in the design once construction activities are complete or will be progressively remediated throughout the construction program where possible. | Contractor | Construction | **Appendix C** |
| SC1 | Contaminated land | A detailed site investigation (Phase 2) will be undertaken in areas of potential contamination identified during the preliminary site investigation (Phase 1), in accordance with the *Roads and Maritime Services (2013) Guideline for the Management of Contamination*.<br>An in-situ waste classification will be undertaken for any materials which are proposed to be excavated and removed from the proposal as part of a Phase 2 investigation. | Transport | Detailed design/ prior to construction | **Appendix K** |
| SC2 | Contaminated land | A Contaminated Land Management Plan will be prepared in accordance with the *Guideline for the Management of Contamination* (Roads and Maritime Services, 2013) and implemented as part of the CEMP. The plan will include, but not be limited to:<br>• Capture and management of any surface runoff contaminated by exposure to the contaminated land<br>• Further investigations required to determine the extent, concentration and type of contamination, as identified in the detailed site investigation (Phase 2)<br>• Acid sulfate soils management plan<br>• Management of the remediation and subsequent validation of the contaminated land, including any certification required<br>• Measures to ensure the safety of site personnel and local communities during construction. | Transport/ Contractor | Detailed design/ prior to construction | Section 4.2 of QA G36 Environment Protection |
| SC3 | Contaminated land – temporary construction compounds | A pre and post lease condition assessment be conducted for all temporary construction facilities proposed within sealed areas. | Contractor | Prior to construction/ post construction | Section 4.15 of QA G36 Environment Protection |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| SC4 | Contaminated land | If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other work that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Transport Environment Manager and/or EPA. | Contractor | Detailed design/ prior to construction | Section 4.2 of QA G36 Environment Protection |
| SC5 | Accidental spill | A site specific emergency spill plan will be developed and include spill management measures in accordance with the Transport *Code of Practice for Water Management* (Roads and Traffic Authority, 1999) and relevant legislation and guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities. | Contractor | Detailed design/ prior to construction | Section 4.3 of QA G36 Environment Protection |
| AQ1 | Risks to air quality during construction | Preparation and implementation of an Air Quality Management Plan (AQMP) to minimise risks to air quality. The AQMP will identify:<br>• Potential sources of air pollution (including odours unexpected finds and dust) during construction<br>• Air quality management objectives consistent with relevant published guidelines<br>• Identification of all dust and odour sensitive receivers<br>• Measures to manage air quality impacts<br>• Community notification and complaint handling, monitoring and incident response procedures. | Contractor | Prior to construction/ construction | **Appendix R** |
| CC1 | Climate change | Detailed design should incorporate the full range of temperature projections, as well as expected life of bridge components, when materials are specified. | Transport/ Contractor | Detailed design | **Appendix S** |
| CC2 | Climate change risk | Ensure that revegetation and landscaping design:<br>• Considers climate change projections in the selection of species (both in and outside the floodplain)<br>• Considers how vegetation will contribute to or support the structural integrity of soils in a changing climate.<br>• Ensures plant/tree species selection (and location of trees) caters for potential impacts if burnt (e.g. falling onto the roadway). | Transport/ Contractor | Detailed design | **Appendix S** |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| CC3 | | A material durability report will be prepared and actioned which will specifically review the potential impacts of climate change on concrete durability, including depth of cover over reinforcement. | Transport/ Contractor | Detailed design | **Appendix S** |
| CC4 | Flood risk / sea level rise | The climate change scenarios presented in the *Hexham Straight Widening Flooding and Hydrology Assessment* will be reviewed to confirm whether any design changes are required to provide ongoing resilience to the asset, or to minimise any impact on the surrounding area. | Transport/ Contractor | Detailed design | **Appendix S** |
| SU1 | Sustainability | A Sustainability Management Plan for the proposal will be developed and implemented during detailed design and construction, detailing measures to meet the proposal's sustainability objectives and targets. The sustainability management plan will:<br>• Demonstrate leadership and commitments to sustainability<br>• Adopt relevant sustainability performance targets in accordance with the Transport sustainability strategy.<br>• Establish the roles, responsibilities and resourcing requirements<br>• Sustainable procurement measures to prioritise efficient use of resources and conservation of natural resources, and inform the proposal's sustainable procurement requirements from legislation, industry's policies/guidelines, and Transports' corporate requirements<br>• Document the process for the identification, assessment and implementation of sustainability initiatives and opportunities<br>• Identifies sustainability training and awareness requirements<br>• Document the process to be used to monitor and review of sustainability performance against achieving the proposal's sustainability targets<br>• Outline the documentation and reporting requirements for sustainability on the proposal. | Transport/ Contractor | Prior to construction/ construction | **Appendix T** |
| WM1 | Waste management general | A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to:<br>• Measures to avoid and minimise waste associated with the proposal<br>• Classification of wastes and management options (re-use, recycle, stockpile, disposal)<br>• Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions | Contractor | Prior to construction/ construction | - |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | | • Procedures for storage, transport and disposal<br>• Monitoring, record keeping and reporting.<br>The WMP will be prepared considering the *Environmental Procedure - Management of Wastes on Roads and Maritime Services Land* (Roads and Maritime Services, 2014) and relevant Roads and Maritime Waste Fact Sheets. | | | |
| WM2 | Waste management general | Unsuitable fill material and all other wastes will be classified in accordance with the *NSW EPA Waste Classification Guidelines* (EPA, 2014) and disposed of at an appropriately licenced facility. | Contractor | Construction | - |
| WM3 | Waste management general | All wastes will be managed and disposed of in accordance with the POEO Act. | Contractor | Construction | - |
| UT1 | Utilities | Prior to the commencement of work:<br>• The location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners<br>• If the scope or location of proposed utility relocation work falls outside of the assessed proposal scope and footprint, further assessment will be undertaken. | Contactor | Detailed design/ prior to construction | - |
| HZ1 | Hazards and risk management | A Hazard and Risk Management Plan (HRMP) will be prepared and implemented as part of the CEMP. The HRMP will include, but not be limited to:<br>• Details of hazards and risks associated with the activity<br>• Measures to be implemented during construction to minimise these risks<br>• Record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials<br>• A monitoring program to assess performance in managing the identified risks<br>• Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations. | Contactor | Detailed design/ prior to construction | - |

| No. | Impact | Environmental safeguards | Responsibility | Timing | Reference |
|---|---|---|---|---|---|
| | | The HRMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or DPIE publications. | | | |
| CU1 | Cumulative impacts | Ongoing coordination and consultation will be undertaken with nearby projects as required. | Transport/ Contractor | Prior to construction/ construction | - |
| CU2 | Cumulative impacts | The CEMP will be revised to consider potential cumulative impacts from surrounding development activities as they become known. | Contractor | Construction | - |

## 7.3 Licensing and approvals

**Table 7.2** summarises the licenses and approvals required for the proposal and outlines the associated legal instrument and the timing of the license or approval.

Table 7.2 Summary of licensing and approvals required

| Instrument | Requirement | Timing |
|---|---|---|
| POEO Act (s43) | EPL for scheduled activities e.g. road construction and possibly extractive activities (to be confirmed in detailed design). | Prior to start of the activity. |
| POEO Act (s43) | EPL for non-scheduled activities for the purposes of regulating water pollution. | Prior to start of the activity. |
| FM Act (s199) | Notification to the Minister for Agriculture and Western NSW prior to any dredging or reclamation work. This notification would be in regard to the construction and removal of a temporary work platform in Ironbark Creek. | A minimum of 28 days prior to the start of work. |
| FM Act (s205) | Permit to harm marine vegetation from the Minister for Agriculture and Western NSW. | Prior to start of the activity. |
| Heritage Act 1977 (s139) | Excavation permit from the Heritage Council of NSW. | Prior to start of the activity. |
| NPWS Act 1974 (s90) | Aboriginal heritage impact permit from Heritage NSW. | Prior to start of the activity. |
| Water Management Act 2000 (s91) | Notification of controlled activity to NSW Office of Water. | 30 days prior to the activity |
| Water Management Act 2000 (s91B) | Water supply work approval from DPI (Water). | Prior to start of the activity. |
| Water Management Act 2000 (s91C) | Drainage work approval from DPI (Water). | Prior to start of the activity. |
| Water Act 1912 (s10/s18F) | Licence and/or permit for construction or use of a 'work' (e.g. changing the course of a river – specifically the unnamed drainage channel to the southeast of Ironbark Creek) for certain purposes from DPI (Water). | Prior to start of the activity |
| Crown Land Act (Division 3.4, 5.5 and 5.6) | Lease or licence to occupy areas of Crown land.<br>Note: Work on Crown land triggers the requirement for a 24KA notice under the Native Title Act 1993. The notice is to be prepared by the legal team and send to NTSCORP. This is required whether there is a claim on the land or not. | Prior to start of the activity |

# 8 Conclusion

This chapter provides the justification for the proposal considering its biophysical, social and economic impacts, the suitability of the site and whether or not the proposal is in the public interest. The proposal is also considered in the context of the objectives of the EP&A Act, including the principles of ecologically sustainable development as defined in Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

## 8.1 Justification

### 8.1.1 Social factors

As outlined in **Section 6.10,** the proposal would have some negative social impacts during the construction phase of the proposal. These would include:

- Disruptions for motorists and road users during construction due to temporary lane changes and reduced speed limits that have potential to cause delays for customers, staff and deliveries accessing businesses in the study area. This would potentially inconvenience some people accessing businesses near the proposal
- Temporary changes to local amenity for occupants of residential and commercial properties, and users of community facilities near to construction works. These temporary changes would possibly impact on individuals' use and enjoyment of these properties, particularly within outdoor areas
- Noise and light spill from night works, potentially impacting night-time amenity at residential properties closest to these works and impacts on health and wellbeing due to sleep disturbance or disruptions to sleeping patterns
- Dust from construction activities, resulting in possible effects on the health and wellbeing of some people near to construction works who may be more sensitive to changes in air quality
- Increased noise, dust and construction traffic and access changes impacting on users and staff of community services and facilities, such as Hexham Bowling Club, Hexham Park, the Free Church of Tonga at Old Maitland Road, and Calvary St Joseph's Retirement Community
- Increased construction traffic on roads within the study area and changes to road conditions, impacting on road users including private and commercial motorists, cyclists and public transport users.

However, once operational, the proposal would enhance access and connectivity for residents, workers, businesses and freight in the study area and surrounding LGAs, supporting future growth and development of employment areas and strategic centres.

Travel time savings and enhanced travel reliability provided by the proposal would support improved access and connectivity for local and regional communities, business and industry. This would have long-term benefits and support improved access to employment areas and future growth and development of strategic centres in Greater Newcastle.

Locally, the proposal would require changes to local access routes to residential properties, businesses and community facilities. While these changes are likely to be an inconvenience for motorists currently making these movements and require increasing travel distances, these changes would support improved road safety for road users, and on balance it is considered that the impacts associated with increased travel distances and travel time would be outweighed by the improved safety outcomes for motorists and local communities.

### 8.1.2 Biophysical factors

The proposal involves widening an existing main road corridor. The proposal would therefore minimise the amount of land required for its development and the consequential impact on adjoining land uses, watercourses and ecosystems. The proposal would generally follow the existing topography and would thereby minimise the need for earthworks.

The REF area would require the removal of about 3.82 hectares of native vegetation listed under the EPBC Act and BC Act. These include the following PCTs:

- Around 1.53 hectares in the REF area of Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234)
- Around 1.06 hectares in the REF area of *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)
- Around 0.72 hectares in the REF area of Grey Mangrove low closed forest (PCT 1747)
- Around 0.51 hectares in the REF area of Saltmarsh Estuarine Complex (PCT 1746).

Fauna injury or death has the greatest potential to occur during the removal and relocation of the Southern Myotis (*Myotis macropus*) (vulnerable BC Act) found roosting within Ironbark Creek Bridge, and during construction when vegetation clearing would occur, and the extent of this impact would be proportionate to the extent of vegetation that is cleared.

An Assessment of Significance has been conducted for threatened species that have been positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the study area due to the presence of suitable habitat. The conclusion of the assessment indicates that a significant impact is considered unlikely on any threatened species or TECs listed under the BC Act.

Modifications to the existing drainage infrastructure and increases in the area of road pavement may impact stormwater discharges causing some minor increases in rates, volumes and velocity into the existing receiving environments. These changes may result in some impacts to local receiving waterway processes and health, immediately downstream of proposal discharge locations from storm events during construction and operation of the proposal. Impacts potentially include increased erosion and water turbidity, geomorphological impacts including reduced bank stability and minor increases to the duration and depth of inundation for overbank events to areas downstream of stormwater discharge locations being upgraded by the proposal. The proposal design includes appropriate mitigations including scour protection in the form of rock transition aprons at all culvert outlets upgraded as part of the proposal to manage impacts.

During operation, flood levels are expected to increase along the length of the proposal. However, the large majority of existing flood-affected residential, commercial and industrial properties would experience negligible change in flood depth (<0.01 metres change) and flood hazard during operation of the proposal.

The proposal would require excavation, removal of vegetation, disturbance of soil and the construction of road surfaces and drains, which may lead to exposed soils, sediment entering waterways and the degradation of water quality.

The proposal has some long-term negative biophysical impacts that would be managed through implementation of the mitigation measures proposed in **Section 7.2**. However, these impacts of the proposal would be outweighed by the long-term benefits once the proposal is operational through improvements to the transport network in and around the REF area.

### 8.1.3 Economic factors

The proposal would be constructed largely within the existing road corridor, with minimal land acquisition required. The upgrade of the existing road corridor would minimise long-term disruption and economic impacts on residents, businesses and motorists.

The proposal would have positive impacts for local and regional business and industry by supporting improved access and connectivity to key employment and strategic growth areas in the Lower Hunter region, including Black Hill – Beresfield, Tomago, Raymond Terrace, Hexham, the Port of Newcastle and Newcastle central business district. In particular, the proposal would reduce congestion and improve travel time reliability for motorists and freight vehicles.

Locally, the proposal would improve road safety and accessibility, including through reduced congestion, travel time savings and improved travel reliability for staff, customers and deliveries. This would impact positively on businesses, supporting general improvements to local business and industry within the study area and surrounding suburbs.

### 8.1.4 Public interest

The public interest is best served through the equitable distribution of resources, and investment in public infrastructure that fulfils the need of the majority. The proposal represents a cost-efficient investment in public infrastructure that would maximise the long-term social and economic benefits, while minimising the long-term negative impacts on communities and the environment. By improving local and regional transport facilities, the proposal would better enable movement of people, goods and services and improve overall road safety.

The proposal would result in some short-term impacts on amenity, accessibility and transport efficiency during construction. In addition, the clearing of about 3.82 hectares of native vegetation would be required to construct the proposal. Mitigation measures would be implemented to manage and reduce these impacts.

There are a number of Commonwealth and State strategic plans that specifically to improving safety and efficiency of the road network. The proposal is consistent with these plans including the State Infrastructure Strategy and the Future Transport Strategy among others.

## 8.2 Objects of the EP&A Act

**Table 8.1** provides a summary of the REF area against the objectives of the EP&A Act.

Table 8.1 Objects of the EP&A Act

| Object | Comment |
|---|---|
| 1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources. | The proposal would improve the social and economic welfare of the community by improving the road safety within the proposal local area.<br><br>However, during construction the community and businesses in the area would be likely to experience temporary traffic delays, noise and air quality and visual amenity impacts. In addition, the proposal would result in the removal of 3.82 hectares of native vegetation.<br><br>The proposal would require the acquisition of one private property and one property identified as Crown land. The proposal would also impact on land within the Main North Rail Line owned by Transport and on other areas of Crown land along waterways during construction. |

| Object | Comment |
|---|---|
| | The proposal design, impact, safeguard and management measures detailed in this REF allow for the proper management, development and conservation of natural and artificial resources. |
| 1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment. | Ecologically sustainable development is considered in **Section 8.2.1** below and **Chapter 6** of this REF has considered relevant economic, environment and social considerations in decision making about environmental planning and assessment. |
| 1.3(c) To promote the orderly and economic use and development of land. | The proposal has considered anticipated growth within the area and where appropriate included consideration of it in the design. |
| 1.3(d) To promote the delivery and maintenance of affordable housing. | Not relevant to the proposal. |
| 1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats. | The REF area would require the removal of about 3.82 hectares of native vegetation listed under the EPBC Act and BC Act. These include the following PCTs:<br>• Around 1.53 hectares in the REF area of Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234)<br>• Around 1.06 hectares in the REF area of *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)<br>• Around 0.72 hectares in the REF area of Grey Mangrove low closed forest (PCT 1747)<br>• Around 0.51 hectares in the REF area of Saltmarsh Estuarine Complex (PCT 1746).<br>Fauna injury or death has the greatest potential to occur during the removal and relocation of the Southern Myotis (*Myotis macropus*) (vulnerable BC Act) found roosting within Ironbark Creek Bridge, and during construction when vegetation clearing would occur, and the extent of this impact would be proportionate to the extent of vegetation that is cleared.<br>The clearing totals for the proposal are minor and do not exceed the thresholds required to offset according to Transports Biodiversity Offsets policy. However, offsets in the REF area would be required in accordance with the DPI ‘no net loss’ habitat policy for two PCTs that are identified as saline wetland formations which are comprised of saltmarsh and grey mangrove. These areas are also identified as areas of key fish habitat under the FM Act. Further to this, the loss of breeding/roosting habitat for the Southern Myotis habitat in the REF area would require compensatory habitat measures. |
| 1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage). | An assessment of impacts to Aboriginal heritage has been undertaken in accordance with the requirements of PACHCI (refer to **Section 6.7.3**).<br>The proposal within the REF area would not result in impacts to any known AHIMS sites or Aboriginal objects.<br>The proposal will impact on Aboriginal cultural values including the Burraghihnbihng Wetlands, Hunter River and estuary islands, and Water Spirit (Bunyip or Wau-wai, Yaa-hoo or Wowee Wowee). |

| Object | Comment |
| --- | --- |
| 1.3(g) To promote good design and amenity of the built environment. | Not relevant to the proposal. |
| 1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants. | Not relevant to the proposal. |
| 1.3(i) To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State. | Not relevant to the proposal. |
| 1.3(j) To provide increased opportunity for community participation in environmental planning and assessment. | Consultation with the community and relevant government agencies was carried out during the development of the proposal. There would be further opportunities for the public to comment on the proposal during the exhibition of the REF. Details on this consultation can be found in **Chapter 5**. |

An objective of the EP&A Act is to encourage ecologically sustainable development. The principles of ecologically sustainable development have been considered throughout development of the proposal and are considered further below.

### 8.2.1 Ecologically sustainable development

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

#### The precautionary principle

This principle states: “if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation”.

Evaluation and assessment of alternatives and options have aimed to reduce the risk of serious and irreversible impacts on the environment. Stakeholder consultation considered issues raised by stakeholders and a range of specialist studies were carried out for key issues to provide accurate and impartial information to assist in the evaluation of options.

The concept design has sought to minimise impacts on the amenity of the study area while maintaining engineering feasibility and safety for all road users. A number of safeguards are proposed to minimise potential impacts. These safeguards would be implemented during construction and operation of the proposal. No safeguards have been postponed out of any lack of scientific certainty.

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

### Intergenerational equity

The principle states: "the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations".

The proposal would not result in any impacts that are likely to adversely impact on the health, diversity or productivity of the environment for future generations.

The proposal would cater for future population and traffic growth in the region. The proposal would benefit future generations by helping to addressing the future increases in traffic volumes and traffic congestion associated with movement of traffic along Maitland Road. While the proposal would have some adverse impacts, they are not considered to be of a nature or extent that would result in disadvantage to any specific section of the community or to future generations.

Should the proposal not proceed, the principle of intergenerational equity may be compromised, as future generations would experience an increase in travel time on Maitland Road by about 34 per cent in 2028, about 31 per cent in 2038 and by about 27 per cent in 2048.

### Conservation of biological diversity and ecological integrity

This principle states: "the diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival".

The principle of conservation of biological diversity and ecological integrity requires the maintenance and improvement of genes, specie, populations and communities, as well as the ecosystems and habitats to which they belong, to ensure their survival. A thorough assessment of the existing local environment was undertaken to identify and manage any potential impacts of the REF area on local biodiversity (refer to **Section 6.1)**.

The study area is situated in an over-cleared landscape due to historic activities and the road widening would occur on an active and busy section of highway. However, the REF area would require the removal of about 3.82 hectares of native vegetation listed under the EPBC Act and BC Act. These include the following PCTs:

- Around 1.53 hectares in the REF area of Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234)
- Around 1.06 hectares in the REF area of *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)
- Around 0.72 hectares in the REF area of Grey Mangrove low closed forest (PCT 1747)
- Around 0.51 hectares in the REF area of Saltmarsh Estuarine Complex (PCT 1746).

Fauna injury or death has the greatest potential to occur during the removal and relocation of the Southern Myotis (*Myotis macropus*) (vulnerable BC Act) found roosting within Ironbark Creek Bridge, and during construction when vegetation clearing would occur, and the extent of this impact would be proportionate to the extent of vegetation that is cleared.

In accordance with Transports *Biodiversity Offset Policy* (Roads and Maritime Services, 2016) offsets in the REF area will not be required for TECs listed under the BC Act as the clearing totals for the REF area of the proposal are minor and generally do not reach the thresholds requiring offsets. However, offsets in the REF area will be required in accordance with the DPI 'no net loss' habitat policy for two PCTs that are identified as saline wetland formations which are comprised of saltmarsh and grey mangrove. These areas are also identified as areas of key fish habitat under the FM Act. Further to this, the loss of breeding/roosting habitat for the Southern Myotis habitat in the REF area will require compensatory habitat measures. The overall outcome of the Assessments of Significance (BC Act and EPBC Act) indicate that there is a high level of certainty that the impacts to threatened biodiversity are unlikely to be significant. Due to the presence of a breeding population of Southern Myotis associated with the existing Ironbark Creek Bridge, and the proposed demolition of the bridge, it is recommended that a Microbat Management Plan (MMP) be prepared to avoid and minimise impacts to this species.

#### Improved valuation, pricing and incentive mechanisms

This principle is defined as:

*improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as:*

*(i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,*

*(ii) 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,*

*(iii) 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 REF has examined the environmental consequences of the proposal and identified mitigation measures to manage the potential for adverse impacts. The requirement to implement these mitigation measures would result in an economic cost to Transport and would increase the capital and operating costs of the proposal. The costs of the generation and management of waste and pollution would be captured in any waste disposal charges for construction activities. This signifies that environmental resources have been given appropriate valuation.

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

## 8.3 Conclusion

The REF has examined and considered to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration (as relevant) of conservation agreements and plans of management under the NP&W Act, biodiversity stewardship sites under the BC Act, wilderness areas, areas of outstanding value, impacts on threatened species and ecological communities and their habitats and other protected fauna and native plants. It has also considered potential impacts to MNES listed under the EPBC Act.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the proposal objectives but would still result in some impacts including construction noise and vibration, changes to access and traffic delays during construction, land acquisition and property adjustments, visual and landscape changes, loss of around 3.82 hectares of native vegetation and flooding impacts. Safeguards and management measures as detailed in this REF would avoid or minimise these expected impacts. The proposal would also relieve congestion, improve travel times, improve intersection performance and improve road safety. On balance the proposal is considered justified and the following conclusions are made.

### Significance of impact under NSW legislation

The REF area of the proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning and Public Spaces under Division 5.2 of the EP&A Act. A BDAR or Species Impact Statement is not required for the REF area. The REF area of the proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required for the REF area.

### Significance of impact under Australian legislation

The proposal is not likely to have a significant impact on MNES or the environment of Commonwealth land within the meaning of the EPBC Act. A referral to the Australian Government Department of Agriculture, Water and Environment is not required.

# 9 Certification

This REF provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.

Rachel Vazey

Environment Manager

Jacobs

Date: 12 November 2021

I have examined this REF and accept it on behalf of Transport for NSW.

Andrew Thompson

Project Development Manager
Regional Infrastructure Development
Infrastructure & Place
Transport for NSW

Date: 12 November 2021

# 10 References


ANZECC/ARMCANZ. 2000b. *Australian Guidelines for Water Quality Monitoring and Reporting*.

ANZG. 2018. *Water Quality Guidelines*.

Australian Bureau of Statistics. 2016. *Census data.*

Australian Government. 2012. *National Ports Strategy*.

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

Australian Institute for Disaster Resilience. 2007. *Australian Disaster Resilience Handbook 7, Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*

Australian Standards Institute. 2013. *Australian Standard AS 5334-2013 Climate change adaptation for settlements and infrastructure – A risk-based approach.*

Australian Standards Institute. 2016. *AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors.*

Australian Standards Institute. 2017. *AS5100-2017 Bridge Design.*

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

Austroads. 2015. *Guide to Road Design*.

BMT WBM. 2009. *Hunter Estuary Management Study*.

BMT WBM. 2017. *Hunter Estuary Coastal Zone Management Plan*.

British Standards Institute. 1992. *BS 6472 – 1992, Guide to Evaluation of Human Exposure to Vibration in Buildings, BSI.*

British Standards Institute. 1993. *BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2.*

British Standards Institute. 2009. *BS 5228.2-2009 Guidance on effects of vibration levels for human comfort*.

Brundtland, G. 1987. *Report of the World Commission on Environment and Development: Our Common Future*. United Nations General Assembly document A/42/427.

Bureau of Meteorology. 2020. *Climate and rainfall data from the Bureau of Meteorology.*

Bureau of Meteorology. 2021. *Groundwater Dependent Ecosystems Atlas*, accessed February 2021 at http://www.bom.gov.au/water/groundwater/gde/map.shtml.

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

Council of Australian Governments. 1992. *National Strategy for Ecologically Sustainable Development.*

CSIRO. 2009. *Australian Soil and Land Survey Field Book*.

Department of Environment, Climate Change and Water. 2006. *NSW Water Quality Objectives*.

Department of Environment, Climate Change and Water. 2011. *NSW Road Noise Policy*.

Department of Planning, 2011. *Applying SEPP 33 Guidelines*

Department of Planning and Environment (DPE). 2016. *Hunter Regional Plan 2036*, NSW Government.

Deutsches Institute fur Normung. 1999. *DIN 4150:Part 3-2016 Structural vibration – Effects of vibration on structures*.

Environment Protection Authority. 2000. *Industrial Noise Policy*

Environment Protection Authority. 2014. *NSW EPA Waste Classification Guidelines*.

Geological Survey of New South Wales. 1996. *Newcastle 1:250 000 Geological Sheet SI/56-02.*

Greater Sydney LLS. 2019. *Greater Sydney Regional Strategic Weed Management Plan 2017 – 2022*.

Infrastructure Australia. 2016. *Australian Infrastructure Plan. Priorities and reforms for our nation's future*, Commonwealth of Australia.

Infrastructure Australia. 2020. *Infrastructure Priority List: The Priority List - August 2020*, Commonwealth of Australia.

Infrastructure NSW. 2018. *Building momentum: The State Infrastructure Strategy 2018-2038*.

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

NSW Department of Climate Change. 2009. *Interim Construction Noise Guideline*

NSW Department of Conservation. 2006. *Assessing Vibration: a technical guideline*

NSW Department of Environment and Climate Change. 2008. *Managing Urban Stormwater – Soils and Construction, Volume 2D*.

NSW Department of Environment, Climate Change and Water. 2010a. *Aboriginal Consultation Requirements for Proponents*. (PAGE 70)

NSW Department of Environment, Climate Change and Water. 2010b. *Due Diligence Code of Practice*

NSW Department of Environment, Climate Change and Water. 2011a. *Road Noise Policy*

NSW Department of Environment, Climate Change and Water. 2011b. *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW*.

NSW Department of Industry (Water). 2018. *Guidelines for Controlled Activities on Waterfront Land*.

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

NSW Government. 2014. *Hunter Regional Transport Plan*, Transport for NSW, Chippendale.

NSW Government. 2016a. *Hunter Regional Transport Plan Update*, Transport for NSW, Chippendale.

NSW Government. 2016b. *Water Sharing Plan for the North Coast Coastal Sands Groundwater Sources 2016*, accessed February 2021 at https://legislation.nsw.gov.au/view/html/inforce/current/sl-2016-0374.

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

NSW Department of Planning and Environment. 2018. *Greater Newcastle Metropolitan Plan 2036*.

Department of Planning, Industry and Environment. 2020. *Soil landscape and hydrological soil group mapping – eSPADE v2.0 interactive NSW Soil and Land Information mapping*

NSW Department of Primary Industries. 2012. *NSW Aquifer Interference Policy*

NSW Government. 2005. *Floodplain Development Manual*.

NSW Government. 2014. *The Hunter Regional Transport Plan*.

NSW Government. 2016. *Hunter Regional Transport Plan Update*.

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

NSW Government. Undated. *NSW Women's Strategy 2018-2022 – Advancing economic and social equality in NSW*.

NSW Health. 2009. *Healthy Urban Development Checklist*.

NSW Office of Environment and Heritage. 2015. *Urban Green Cover in NSW, Technical Guidelines.*

Queensland Government. 2007. *Crime Prevention through Environmental Design*.

Roads and Maritime Services. 2011. *Procedure for Aboriginal Cultural Heritage Consultation and Investigation*.

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

Roads and Maritime Services. 2014. *Environmental Procedure - Management of Wastes on Roads and Maritime Services Land*.

Roads and Maritime Services. 2015a. *Noise Criteria Guidelines*

Roads and Maritime Services. 2015b. *Noise Mitigation Guideline*

Roads and Maritime Services. 2015c. *Standard Management Procedure - Unexpected Heritage Items*.

Roads and Maritime Services. 2015d. *Stockpile Site Management Guideline*.

Roads and Maritime Services. 2016a. *Construction Noise and Vibration Guideline*.

Roads and Maritime Services. 2016b. *Preparing an Operational and Construction Noise and Vibration Assessment Report.*

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

Roads and Maritime Services. 2018a. *Landscape Design Guideline: Design guideline to improve the quality, safety and cost effectiveness of green infrastructure in road corridors*

Roads and Maritime Services. 2018b. *Model Validation Guideline*

Roads and Maritime Services. 2019. *Environmental Sustainability Strategy 2019-23*.

Roads and Traffic Authority. 1999. *Transport for NSW Code of Practice for Water Management.*

Roads and Traffic Authority. 2001. *Environmental Noise Management Manual.*

Roads and Traffic Authority. 2003. *Guidelines for Construction Water Quality Monitoring*.

Roads and Traffic Authority. 2006. *Roads and Maritime Specification G10 – Control of Traffic*.

Roads and Traffic Authority. 2010. *Traffic Control at Work Sites Manual Version 4*.

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

Roads and Traffic Authority. 2011b. *RTA Technical Guideline: Environmental management of construction site dewatering*

Soil Conservation Service of NSW. 1995. *Soil landscapes of the Newcastle 1:100 000 sheet 9232,* Sydney

Transport and Infrastructure Council. 2019. *National Freight and Supply Chain Strategy*, Commonwealth of Australia.

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

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

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

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

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

Transport for NSW. 2020. *Beyond the Pavement 2020 - Urban design approach and procedures for road and maritime infrastructure planning, design and construction*. Prepared by the Centre for Urban Design for Transport for NSW.

Transport for NSW. 2020b. *Environmental Impact Assessment Practice Note – Socio-economic Assessment*.

WorkCover NSW. 2005. *Storage and Handling of Dangerous Goods Code of Practice*.

WRL (2003), *Hunter Estuary Processes Study*, Report MHL1095, prepared for NSW Department of Commerce, November 2003.

# Terms and acronyms used in this REF

| Term/ Acronym | Description |
|---|---|
| ABS | Australian Bureau of Statistics |
| Aboriginal cultural heritage | The tangible (objects) and intangible (dreaming stories, songlines, places) cultural practices and traditions associated with past and present day Aboriginal communities. |
| Aboriginal object | Any deposit, object or material evidence (not being a handicraft made for sale), including Aboriginal remains, relating to the Aboriginal habitation of NSW. |
| Aboriginal place | Any place declared to be an Aboriginal place under Section 94 of the *National Parks and Wildlife Act 1974*. |
| ACHAR | Aboriginal Cultural Heritage Assessment Report |
| Acid sulfate soils | Naturally acid clays, mud and other sediments usually found in swamps and estuaries. They may become extremely acidic when drained and exposed to oxygen and may produce acidic leachate run-off that can pollute waters and liberate toxins. |
| AEI | Areas of environmental interest |
| AEP | Annual Exceedance Probability<br>The probability of a rainfall or flood event exceeding a nominated level in a year. A 1% AEP is the probability of an event exceeding a nominated level in 100 years. |
| Afflux | An increase in water level resulting from a constriction in the flow path. |
| AFG | Aboriginal focus group |
| AHD | Australian Height Datum<br>The standard reference level used to express the relative height of various features. A height given in metres AHD is essentially the height above sea level. Mean sea level is set as zero elevation. |
| AHIMS | Aboriginal Heritage Information Management System<br>A register of NSW Aboriginal heritage information maintained by DECCW |
| AHIP | Aboriginal Heritage Impact Permit |
| AHMP | Aboriginal Heritage Management Plan |
| ANZECC | Australian and New Zealand Environment and Conservation Council |
| Afflux | An increase in flood level resulting from implementation of the proposal |
| ANZG | Australian and New Zealand Guidelines |
| AQIA | Air quality impact assessment |
| AQMP | Air Quality Management Plan |
| ARI | Average recurrence interval |

| Term/ Acronym | Description |
|---|---|
| | Used to describe the frequency or probability of floods occurring. (For example a 100 year ARI flood is a flood that occurs or is exceeded on average once every 100 years). |
| ARMCANZ | Agriculture and Resource Management Council of Australia and New Zealand |
| ARTC | Australian Rail Track Corporation |
| Arterial road | The main or trunk roads of the State road network that carry predominantly through traffic between regions. |
| ASIRF | Aboriginal Site Impact Recording Form |
| ASRIS | Australian Soil Resource Information System |
| ASS | Acid Sulfate Soils |
| ASSMP | Acid Sulfate Soils Management Plan |
| Aquifer | Geologic formation, group of formations, or part of a formation capable of transmitting and yielding quantities of water. |
| BAM | *Biodiversity Assessment Methodology* (Office of Environment and Heritage, 2017a) |
| BAR | Biodiversity Assessment Report |
| Batter | The constructed slope of road embankments and cuttings, usually expressed as a ratio of x horizontal to 1 vertical. |
| BC Act | *Biodiversity Conservation Act 2016* |
| BDAR | Biodiversity Assessment Development Report |
| BOS | Biodiversity Offset Strategy |
| BTEX | Benzene, toluene, ethylbenzene and xylene |
| CCS | Community Communication Strategy |
| CCTV | Closed-circuit television |
| CEMP | Construction Environmental Management Plan<br><br>A site specific plan developed for the construction phase of a project to ensure that all contractors and sub-contractors comply with the environmental conditions of approval for the project and that environmental risks are properly managed. |
| CLM Act | *Contaminated Land Management Act 1997* |
| CM SEPP | State Environmental Planning Policy (Coastal Management) 2016 |
| CNVG | Construction Noise Vibration Guidelines (Roads and Maritime Services, 2016) |
| CNVMP | Construction Noise and Vibration Management Plan |
| CO | Carbon monoxide |
| CoRTN | Calculation of Road Traffic Noise |
| CM Act | *Coastal Management Act 2016* |

| Term/ Acronym | Description |
|---|---|
| Compound site | Facilities used to support the operation of a construction site including site offices, workshops, delivery areas, storage areas, crib sheds, staff vehicle parking, materials, plant and equipment. |
| Concept design | Initial functional layout design for a road or road system, to establish feasibility, to provide a basis for estimating, and to determine further investigations needed for detailed design. |
| Construction area | The area to be directly impacted by the proposal. This comprises the future construction footprint of the proposed bridge over Ironbark Creek and the upgrade of Maitland Road, including all roadside cut and fill, construction compound areas and parking areas for oversize and overmass vehicles, refer further to Section 1.1.1 |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| CSWMP | Construction Soil and Water Management Plan |
| Cumulative impact | Impacts that, when considered together, lead to a stronger impact than any impact in isolation. |
| dB(A) | Decibels |
| DCP | Development Control Plan<br><br>A subsidiary plan to an environmental planning instrument (most commonly to a local environmental plan) that provides greater detail than the environmental planning instrument. |
| DEC | Department of Environment and Conservation<br><br>Former name for the Department of Environment, Energy and Science |
| DECC | Department of Environment and Climate Change<br><br>Former name for the Department of Environment, Energy and Science |
| DECCW | Department of Environment, Climate Change and Water<br><br>Former name for the Department of Environment, Energy and Science |
| Detailed design | The detailed design details the final project. It includes designs, plans and construction drawings for all elements, including:<br>• Road alignment and geometry<br>• Retaining wall, pavements and traffic signals<br>• Urban design, landscaping and street lighting<br>• Construction staging and traffic management<br>• Drainage and utilities. |
| DPE | Department of Planning and Environment<br><br>Former name for the Department of Planning, Industry and Environment |
| DPI | Department of Primary Industries |
| DPIE | Department of Planning, Industry and Environment |
| Earthworks | All operations involved in loosening, excavating, placing, shaping and compacting soil or rock. |
| EEC | Endangered Ecological Communities<br><br>An ecological community identified by relevant legislation that is likely to become extinct or is in immediate danger of extinction. |

| Term/ Acronym | Description |
|---|---|
| EIS | Environmental Impact Statement<br><br>An environmental impact assessment document prepared in accordance with the requirements of Division 4 of the Environmental Planning and Assessment Regulation 2000. Any application for designated development under Part 4 of the Environmental Planning and Assessment Act or any activity assessed under Part 5 of the Act as being likely to significantly affect the environment must be accompanied by an environmental impact statement. |
| EIS area | The areas of the proposal to be assessed by the EIS and within land subject to the CM SEPP as defined in **Section 1.1.2**. |
| Environment | All aspects of the surroundings of humans, whether affecting any human as an individual or in his or her social groupings (from EP&A Act). |
| EPA | Environment Protection Authority |
| EP&A Act | *Environmental Protection and Assessment Act 1979* |
| EPBC Act | *Environment Protection and Biodiversity Construction Act 1999* |
| EPL | Environment Protection Licence |
| ESCP | Erosion and sediment control plan |
| ESD | Ecologically sustainable development<br><br>As defined by the Protection of the Environment Administration Act 1991, requires the effective integration of economic and environmental considerations in decision making processes including:<br>• The precautionary principle<br>• Inter-generational equity<br>• Conservation of biological diversity and ecological integrity<br>• Improved valuation, pricing and incentive mechanisms (includes polluter pays, full life cycle costs, cost effective pursuit of environmental goals). |
| Estuary | The mouth or lower course of a river in which its current meets the sea's<br><br>tides and is subject to tidal effects. |
| FFMP | Flora and Fauna Management Plan |
| Flood duration | An increase in duration of inundation resulting from implementation of the proposal |
| Flood hazard | An increase in flood hazard as defined by resulting from implementation of the proposal |
| FM Act | *Fisheries Management Act 1994* |
| FMP | Flood Management Plan |
| GDE | Groundwater Dependent Ecosystem |
| GPS | Global Positioning System |
| Greenhouse gases/emissions | Atmospheric gases that enhance the natural greenhouse effect, including carbon dioxide, methane, chlorofluorocarbons, nitrous oxide, ozone and water vapour. |
| Grubbing | The removal of roots or stumps from below ground level. |

| Term/ Acronym | Description |
|---|---|
| Heavy truck / vehicle | A heavy vehicle at least 15 tonnes gross. A heavy vehicle is classified as a Class 3 vehicle (a two axle truck) or larger, in accordance with the Austroads Vehicle Classification System. |
| HECZMP | Hunter Estuary Coastal Zone Management Plan |
| HPGDE | High priority groundwater dependent ecosystem |
| HRMP | Hazard and Risk Management Plan |
| ICOMOS | International Council on Monuments and Sites |
| ICNG | Interim Construction Noise Guideline (DECC, 2009b) |
| ISEPP | State Environmental Planning Policy (Infrastructure) 2007 |
| KFH | Key fish habitat |
| $L_{A10}$ | The noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below LA10 level for 90% of the time. The LA10 is a common noise descriptor for environmental noise and road traffic noise. |
| $L_{A90}$ | The noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below LA90 level for 10% of the time. This measure is commonly referred to as background noise level. |
| $L_{Aeq}$ | The equivalent continuous sound level. This is the energy average of the varying noise over the sample period and is equivalent to the level of constant noise which contains the same energy as the varying noise environment. This measure is a common measure of environmental noise and road traffic noise. |
| $L_{Amax}$ | The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period. |
| LALC | Local Aboriginal Land Council |
| Landscape character | The aggregate of built, natural and cultural aspects that make up an area and provide a sense of place. Includes all aspects of a tract of land – built, planted and natural topographical and ecological features. |
| LCVIA | Landscape Character and Visual Impact Assessment |
| LEP | Local Environment Plan |
| LGA | Local Government Area |
| Local road | Roads that have a low speed limit, have a small footprint, serve local communities and that are generally conducive to walking and cycling. A road or street used primarily for access to abutting properties. |
| LoS | Level of service<br>A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. |
| mAHD | Metres above height datum |
| Midden deposit | A mound consisting of shells of edible molluscs and other refuse, marking the site of prehistoric human habitation. |
| mBGL | Metres below ground level |

| Term/ Acronym | Description |
|---|---|
| MMP | Microbat Management Plan |
| MNES | Matters of national environmental significance |
| MUSIC | eWater Model for Urban Stormwater Improvement Conceptualisation |
| NAHMP | Non-Aboriginal Heritage Management Plan |
| NBN | National Broadband Network |
| NCA | Noise Catchment Area |
| NCG | Noise Criteria Guidelines (Roads and Maritime Services, 2015a) |
| NEPM | National Environmental Protection Measures |
| NICB | Newcastle Inner City Bypass |
| NLTN | National Land Transport Network |
| NMG | Noise Mitigation Guideline (Roads and Maritime Services, 2015b) |
| NML | Noise management level |
| NNTT | National Native Title Tribunal |
| $NO_X$ | Oxides of nitrogen |
| $NO_2$ | Nitrogen dioxide |
| NP&W Act | *National Parks and Wildlife Act 1974* |
| NPWS | National Parks and Wildlife Services |
| NSW | New South Wales |
| OEH | Office of Environment and Heritage |
| ONVR | Operational Noise and Vibration Review |
| OOHW | Out of Hours Works |
| OSOM | Oversize and overmass |
| PACHCI | Procedure for Cultural Heritage Consultation and Investigation |
| PAD | Potential archaeological deposit |
| PAH | Polycyclic Aromatic Hydrocarbon |
| PCT | Plant Community Type |
| PMF | Probable Maximum Flood<br>Largest flood that could theoretically occur at a particular location and defines the extent of flood prone land (the floodplain). |
| PM2.5 | Particulate matter less than 2.5 microns in diameter |
| PM10 | Particulate matter less than 10 microns in diameter. |
| POEO Act | *Protection of the Environment Operations Act 1997* |
| Pollutant | Any measured concentration of solid or liquid matter that is not naturally present in the pristine environment. |

| Term/ Acronym | Description |
|---|---|
| Proposal | The proposed widening of a six kilometre section of the Maitland Road from four lanes to six lanes, starting about 290 metres south of the intersection with the Newcastle Inner City Bypass at Sandgate, and extending through to about 760 metres north of Hexham Bridge, in Hexham, NSW |
| Proposal local area | The area within 10 kilometres of the proposal. |
| Ramsar | An intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. |
| RBL | Rated Background Level<br><br>The median value of the assessment background levels values for the period over all of the days measured. There is therefore an RBL value for each period — daytime, evening and night time. |
| REF | Review of Environmental Factors<br><br>A report that documents the environmental impact assessment process and is prepared to satisfy RMS' obligations under section 111 of the Environmental Planning and Assessment Act 1979. |
| REF area | The areas of the proposal to be assessed by the REF and this covers all other aspects of the proposal included in **Section 1.1.1** that are outside the footprint of the EIS area described in **Section 1.1.2** |
| Riparian | Relating to the banks of a natural waterway. |
| RMS | Roads and Maritime Services |
| RNP | *Road Noise Policy* (DECCW, 2011a) |
| Road furniture | A general term covering all signs, street lights and protective devices for the control, guidance and safety of traffic and convenience of road users. |
| Road reserve | A legally defined area of land within which facilities such as roads, footpaths and associated features may be constructed for public travel. |
| RTA | Roads and Traffic Authority |
| SCEP | Stakeholder and Community Engagement Plan |
| SEARs | Secretary's Environmental Assessment Requirements |
| Sediment basin | An area where runoff water is ponded to allow sediment to be deposited. |
| SEPP | State Environmental Planning Policy |
| SEPP 55 | State Environmental Planning Policy no. 55 – Remediation of Land |
| SES | State Emergency Service |
| SIS | Species Impact Statement |
| $SO_2$ | Sulfur dioxide |
| SoHI | Statement of Heritage Impact |
| SRE | Sensitive receiving environment |
| Study area | The construction area of the proposal and additional areas that are likely to be affected by the proposal, either directly or indirectly |

| Term/ Acronym | Description |
|---|---|
| TEC | Threatened Ecological Community |
| TMP | Traffic Management Plan |
| TPZ | Temporary protection zones |
| TSC Act | *Threatened Species Conservation Act 1995*<br>Now replaced with the BC Act |
| TSP | Total Suspended Particles |
| TSS | Total Suspended Solids |
| Turbidity | A measure of light penetration through a water column containing particles of matter in suspension. |
| Urban design | The process and product of designing human settlements, and their supporting infrastructure, in urban and rural environments. |
| VHT | Vehicle hours travelled |
| VKT | Vehicle kilometres travelled |
| WARR Act | *Waste Avoidance and Resource Recovery Act 2001* |
| Water table | The ‘surface’ of groundwater where the pressure of the water is equal to that of the atmosphere. |
| Waterway | Any flowing stream of water, whether natural or artificially regulated (not necessarily permanent). |
| Wetland | A swamp or marsh in which the soil is frequently or permanently saturated with water, or under water. |
| WM Act | *Water Management Act 2000* |
| WMP | Waste Management Plan |
| WON | Weeds of National Significance |
| WQO | Water Quality Objectives |
| µg/m3 | Micrograms per cubic metre |

# Appendix A

## Concept design and property acquisition drawings

# Appendix B

## Drainage design figures

# Appendix C

## Urban Design, Landscape Character and Visual Impact Assessment

# Appendix D

## Construction staging figures

# Appendix E

## Consideration of clause 228(2) factors and MNES and Commonwealth land

## Clause 228(2) Checklist

In addition to the requirements of the *Is an EIS Required?* Guideline (DUAP 1995/1996) and the *Roads and Related Facilities EIS Guideline* (DUAP 1996) as detailed in the REF, the following factors, listed in clause 228(2) of the Environmental Planning and Assessment Regulation 2000, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

| Factor | Impact |
|---|---|
| a) Any environmental impact on a community? | |
| The REF area would have construction impacts through the generation of noise during construction, potential traffic impacts and potential reductions in air quality and visual amenity impacts. These would be managed through safeguards listed in **Chapter 7**. | Short-term negative |
| The REF area would be likely to improve traffic conditions and congestion, safety and access throughout the region. The REF area (as part of the overall proposal) would result in improved road safety and accessibility, reduce congestion, improve travel times and improve travel reliability. | Long-term positive |
| b) Any transformation of a locality? | |
| The REF area would include the construction of a new bridge and associated approaches as well as the widening of Maitland Road from four lanes to six lanes. Overall, the REF area would be located in a similar corridor to the existing roadway and therefore is not considered to substantially transform the locality. | Nil |
| c) Any environmental impact on the ecosystems of the locality? | |
| The REF area would require the removal of about 3.82 hectares of native vegetation listed under the EPBC Act and BC Act. These include the following PCTs:<br>• Around 1.53 hectares in the REF area of Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234)<br>• Around 1.06 hectares in the REF area of *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)<br>• Around 0.72 hectares in the REF area of Grey Mangrove low closed forest (PCT 1747)<br>• Around 0.51 hectares in the REF area of Saltmarsh Estuarine Complex (PCT 1746).<br><br>Fauna injury or death has the greatest potential to occur during the removal and relocation of the Southern Myotis (*Myotis macropus*) (vulnerable BC Act) found roosting within Ironbark Creek Bridge, and during construction when vegetation clearing would occur, and the extent of this impact would be proportionate to the extent of vegetation that is cleared.<br><br>An Assessment of Significance has been conducted for threatened species that have been positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the study area due to the presence of suitable habitat. The conclusion of the assessment indicates that a significant impact is considered unlikely on any threatened species or TECs listed under the BC Act. | Long-term negative |
| d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality? | |

| Factor | Impact |
|---|---|
| Temporary changes to local amenity would mainly occur for occupants of residential and commercial properties, and users of community facilities near to construction works for road widening, new U-turn facilities and intersection upgrades and temporary construction facilities. This may temporarily impact on individuals' use and enjoyment of these properties, particularly within outdoor areas such as at Hexham Bowling Club, front and back yards of residential uses, and gardens and open space areas within Calvary St Joseph's Retirement Community.<br><br>It is expected that some work would need to be carried out during the evening and at night to minimise potential impacts on regional road networks. Noise and light spill from these works have potential to affect the night-time amenity at residential properties closest to these works.<br><br>The REF area would require the removal of about 3.82 hectares of native vegetation, this would result in a reduction in visual amenity of the area. | Short-term negative<br><br>Long-term negative |
| e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations?<br><br>The proposal would not impact on any known AHIMS sites or Aboriginal objects within the REF area.<br><br>The proposal will impact on Aboriginal cultural values including the Burraghihnbihng Wetlands, Hunter River and estuary islands, and Water Spirit (Bunyip or Wau-wai, Yaa-hoo or Wowee Wowee). | Long-term negative |
| f) Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act 1974)?*<br><br>The REF area would require the removal of about 3.82 hectares of native vegetation listed under the EPBC Act and BC Act.<br><br>Fauna injury or death has the greatest potential to occur during the removal and relocation of the Southern Myotis (*Myotis macropus*) (vulnerable BC Act) found roosting within Ironbark Creek Bridge, and during construction when vegetation clearing would occur, and the extent of this impact would be proportionate to the extent of vegetation that is cleared.<br><br>An Assessment of Significance has been conducted for threatened species that have been positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the study area due to the presence of suitable habitat. The conclusion of the assessment indicates that a significant impact is considered unlikely on any threatened species or TECs listed under the BC Act. | Long-term negative |
| g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?<br><br>The REF area would require the removal of about 3.82 hectares of native vegetation listed under the EPBC Act and BC Act.<br><br>Fauna injury or death has the greatest potential to occur during the removal and relocation of the Southern Myotis (*Myotis macropus*) (vulnerable BC Act) found roosting within Ironbark Creek Bridge, and during construction when vegetation clearing would occur, and the extent of this impact would be proportionate to the extent of vegetation that is cleared. | Long-term negative |

| Factor | Impact |
| --- | --- |
| An Assessment of Significance has been conducted for threatened species that have been positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the study area due to the presence of suitable habitat. The conclusion of the assessment indicates that a significant impact is considered unlikely on any threatened species or TECs listed under the BC Act. | |
| h) Any long-term effects on the environment?<br><br>The REF area would require the removal of about 3.82 hectares of native vegetation listed under the EPBC Act and BC Act. The REF area would also result in noise, visual and air quality impacts during construction. | Long-term negative |
| i) Any degradation of the quality of the environment?<br><br>Landscape and urban design has been considered as part of the development of the design, which would minimise visual degradation of the environment. The REF area has the potential to degrade the quality of the environment via accidental spills and erosion and sedimentation during construction, vegetation removal and during the removal of the existing bridge. The construction area would be rehabilitated as work progresses to minimise impacts. Safeguards and management measures as outlined within **Chapter 7** would be implemented to reduce degradation of the quality of the environment during proposed activities. | Long-term negative |
| j) Any risk to the safety of the environment?<br><br>Operation of the proposal would reduce potential safety risks. All chemicals and fuels used during construction and maintenance activities would be stored within bunded areas to ensure that spills are not released into the environment. | Nil |
| k) Any reduction in the range of beneficial uses of the environment?<br><br>The REF proposal would improve safety for road users, pedestrians and cyclists. | Long-term positive |
| l) Any pollution of the environment?<br><br>There is potential for accidental spills of chemicals during the construction period which could affect surrounding land and waterways. Air quality would be reduced during construction activities. Erosion and sedimentation, if not controlled, would impact water quality.<br><br>There is expected to be minimal change in air quality and noise during operation of the proposal. Stormwater discharge would deliver an annual average pollutant load that is less than pollutant loads for existing conditions. | Short-term negative<br><br>Long-term positive |
| m) Any environmental problems associated with the disposal of waste?<br><br>Waste would be managed in accordance with the resource management hierarchy principles outlined in the *Waste Avoidance and Resource Recovery Act 2001*. It is not anticipated that there would be issues encountered with the disposal of waste. | Nil |
| n) Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply?<br><br>All resources required would not be in short supply and would be readily available. | Nil |

| Factor | Impact |
|---|---|
| o) Any cumulative environmental effect with other existing or likely future activities?<br>Vegetation clearance would also be required for the EIS area and the cumulative impacts of both the EIS and REF area have been considered and appropriate safeguards developed.<br>Cumulative impacts associated with the construction of other projects and developments nearby have been considered and would be generally minor. Potential cumulative impacts would include vegetation removal and minor impacts on travel times for people travelling through multiple project areas. | Short-term negative<br>Short-term negative |
| p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?<br>Based on the coastal processes study undertaken, the REF area would have minor impacts on coastal processes and coastal hazards. Projected climate change conditions were considered both in the design of the REF area and also hydrological and coastal processes studies. | Nil |

### Matters of National Environmental Significance and Commonwealth land

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

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

| Factor | Impact |
|---|---|
| a) Any impact on a World Heritage property?<br><br>There are no World Heritage properties within or near to the REF area. There would be no World Heritage properties impacted by the REF area. | Nil |
| b) Any impact on a National Heritage place?<br><br>There are no National Heritage places within or near to the REF area. There would be no negative impacts to a National Heritage Place by the REF area. | Nil |
| c) Any impact on a wetland of international importance?<br><br>The Hunter Estuary Wetlands are located close the REF area. These areas are identified as sensitive receiving environments in this assessment as these wetlands have the potential to be impacted by changes in surface water and groundwater hydrology and flooding from the proposal. However, due to distance of the REF area from the Hunter Estuary Wetlands Ramsar site areas, no direct or indirect impacts are anticipated from surface water hydrology changes resulting from changes in drainage infrastructure or flooding changes resulting from changes in road levels and proposal infrastructure. | Nil |
| d) Any impact on a listed threatened species or communities?<br><br>The REF area would have an impact on the following EPBC listed ecological communities:<br><br>• Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234)<br>• Saltmarsh Estuarine Complex (PCT 1746).<br><br>A significance assessment concluded that a significant impact is considered unlikely for any Matter of NES and a referral of the proposal would not be required. | Long-term negative |
| e) Any impacts on listed migratory species?<br><br>While some migratory species of bird are likely to use the study area and locality on occasion, the study area is not recognised as an 'important habitat'. The proposal would not substantially modify, destroy or isolate an area of important habitat for a migratory species and it would not seriously disrupt the lifecycle of an ecologically significant proportion of a population of migratory birds. | Nil |
| f) Any impact on a Commonwealth marine area?<br><br>There are no Commonwealth marine areas within or near the REF area. There would be no impact to Commonwealth marine areas by the REF proposal. | Nil |

| Factor | Impact |
| --- | --- |
| g) Does the proposal involve a nuclear action (including uranium mining)?<br><br>The REF area does not involve a nuclear action. | Nil |
| h) Additionally, any impact (direct or indirect) on the environment of Commonwealth land?<br><br>The REF area would impact on Crown Land and would require a permit from the DPIE (Crown land). | Short-term negative |

# Appendix F

## Statutory consultation checklists

## Infrastructure SEPP

### Certain development types

| Development type | Description | Yes/No | If 'yes' consult with | ISEPP clause |
|---|---|---|---|---|
| Car Park | Does the project include a car park intended for the use by commuters using regular bus services? | No | | ISEPP cl. 95A |
| Bus Depots | Does the project propose a bus depot? | No | | ISEPP cl. 95A |
| Permanent road maintenance depot and associated infrastructure | Does the project propose a permanent road maintenance depot or associated infrastructure such as garages, sheds, tool houses, storage yards, training facilities and workers' amenities? | No | | ISEPP cl. 95A |

### Development within the Coastal Zone

| Issue | Description | Yes/No/ NA | If 'yes' consult with | ISEPP clause |
|---|---|---|---|---|
| Development with impacts on certain land within the coastal zone | Is the proposal within a coastal vulnerability area and is inconsistent with a certified coastal management program applying to that land? | No | | ISEPP cl. 15A |

Note: See interactive map here: https://www.planning.nsw.gov.au/policy-and-legislation/coastal-management. Note the coastal vulnerability area has not yet been mapped.

Note: a certified coastal zone management plan is taken to be a certified coastal management program

### Council related infrastructure or services

| Issue | Potential impact | Yes/No | If 'yes' consult with | ISEPP clause |
|---|---|---|---|---|
| Stormwater | Is the work likely to have a substantial impact on the stormwater management services which are provided by council? | Yes | City of Newcastle | ISEPP cl.13(1)(a) |
| Traffic | Is the work likely to generate traffic to an extent that will strain the capacity of the existing road system in a local government area? | No | | ISEPP cl.13(1)(b) |
| Sewerage system | Will the work involve connection to a council owned sewerage | No | | ISEPP |

| Issue | Potential impact | Yes/No | If 'yes' consult with | ISEPP clause |
|---|---|---|---|---|
| | system? If so, will this connection have a substantial impact on the capacity of any part of the system? | | | cl.13(1)(c) |
| Water usage | Would the work involve connection to a council owned water supply system? If so, would this require the use of a substantial volume of water? | No | | ISEPP cl.13(1)(d) |
| Temporary structures | Would the work involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, would this cause more than a minor or inconsequential disruption to pedestrian or vehicular flow? | Yes | City of Newcastle | ISEPP cl.13(1)(e) |
| Road & footpath excavation | Would the work involve more than minor or inconsequential excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance? | Yes | City of Newcastle | ISEPP cl.13(1)(f) |

## Local heritage items

| Issue | Potential impact | Yes/No | If 'yes' consult with | ISEPP clause |
|---|---|---|---|---|
| Local heritage | Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the study area for the work? If yes, does a heritage assessment indicate that the potential impacts to the heritage significance of the item/area are more than minor or inconsequential? | Yes | City of Newcastle | ISEPP cl.14 |

## Flood liable land

| Issue | Potential impact | Yes/No | If 'yes' consult with | ISEPP clause |
|---|---|---|---|---|
| Flood liable land | Is the work located on flood liable land? If so, would the work change flood patterns to more than a minor extent? | Yes | City of Newcastle | ISEPP cl.15 |

| Issue | Potential impact | Yes/No | If ‘yes’ consult with | ISEPP clause |
|---|---|---|---|---|
| Flood liable land | Is the work located on flood liable land? (to any extent). If so, does the work comprise more than minor alterations or additions to, or the demolition of, a building, emergency work or routine maintenance | Yes | State Emergency Services | ISEPP<br>cl.15AA |

Note: Flood liable land means land that is susceptible to flooding by the probable maximum flood event, identified in accordance with the principles set out in the manual entitled *Floodplain Development Manual: the management of flood liable* land published by the New South Wales Government.

## Public authorities other than councils

| Issue | Potential impact | Yes/No | If 'yes' consult with | ISEPP clause |
|---|---|---|---|---|
| National parks and reserves | Is the work adjacent to a national park or nature reserve, or other area reserved under the *National Parks and Wildlife Act 1974*, or on land acquired under that Act? | Yes | Environment, Energy and Science, DPIE | ISEPP cl.16(2)(a) |
| National parks and reserves | Is the work on land in Zone E1 National Parks and Nature Reserves or in a land use zone equivalent to that zone? | Yes | Environment, Energy and Science, DPIE | ISEPP cl. 16(2)(b) |
| Aquatic reserves | Is the work adjacent to an aquatic reserve or a marine park declared under the *Marine Estate Management Act 2014*? | No | | ISEPP cl.16(2)(c) |
| Sydney Harbour foreshore | Is the work in the Sydney Harbour Foreshore Area as defined by the *Place Management NSW Act 1998*? | No | | ISEPP cl.16(2)(d) |
| Bush fire prone land | Is the work for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land? | No | | ISEPP cl.16(2)(f) |
| Artificial light | Would the work increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map? (Note: the dark sky region is within 200 kilometres of the Siding Spring Observatory). | No | | ISEPP cl.16(2)(g) |
| Defence communications buffer land | Is the work on buffer land around the defence communications facility near Morundah? (Note: refer to Defence Communications Facility Buffer Map referred to in clause 5.15 of Lockhardt LEP 2012, Narrandera LEP 2013 and Urana LEP 2011. | No | | ISEPP cl. 16(2)(h) |

| Issue | Potential impact | Yes/No | If ‘yes’ consult with | ISEPP clause |
|---|---|---|---|---|
| Mine subsidence land | Is the work on land in a mine subsidence district within the meaning of the *Mine Subsidence Compensation Act 1961*? | No | | ISEPP<br>cl. 16(2)(i) |

# Coastal Management SEPP

## Clause 11 factors – proximity to Coastal Wetlands areas

| Clause factor | Consideration |
|---|---|
| Clause 11(1) – land in proximity to Coastal Wetlands | |
| (a) the biophysical, hydrological or ecological integrity of the adjacent coastal wetland or littoral rainforest | Modifications to the existing drainage infrastructure and increases in the area of road pavement may impact stormwater discharges causing some minor increases in rates, volumes, and velocity into the existing receiving environments. These changes may result in some impacts to local receiving waterway processes and health, immediately downstream of proposal discharge locations from storm events during construction and operation of the proposal. Impacts potentially include increased erosion and water turbidity, geomorphological impacts including reduced bank stability and minor increases to the duration and depth of inundation for overbank events to areas downstream of stormwater discharge locations being upgraded by the proposal. The proposal design includes appropriate mitigations including scour protection in the form of rock transition aprons at all culvert outlets upgraded as part of the proposal to manage impacts. |
| (b) the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland or littoral rainforest | A key risk of the REF area is the potential impacts to important Coastal Wetlands classified under the CM SEPP 2018, and wetland nature reserves which are DPIE managed conservation estate, including, Hexham Swamp Nature Reserve (Hunter Wetlands National Park estate), Kooragang Nature Reserve (part of the Ramsar listed Hunter Estuary Wetlands and Hunter Wetlands National Park estate) and Shortland Wetlands which includes Hunter Wetland Centre Australia (also part of the Ramsar listed Hunter Estuary Wetlands).<br>The REF area would not impact on the quantity or quality of surface and groundwater flows with the implementation of the mitigation measures outlined in **Section 7.2**. The proposal is expected to directly impact three Coastal Wetland areas which define the EIS area. These impacts are considered further in the EIS. |

## Clause 13 factors – coastal environment areas

| Clause factor | Consideration |
|---|---|
| Clause 13(1) – coastal environment area | |
| (a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment | Modifications to the existing drainage infrastructure and increases in the area of road pavement may impact stormwater discharges causing some minor increases in rates, volumes and velocity into the existing receiving environments. These changes may result in some impacts to local receiving waterway processes and health, immediately downstream of proposal discharge locations from storm events during construction and operation of the proposal. Impacts potentially include increased erosion and water turbidity, geomorphological impacts including reduced bank stability and minor increases to the duration and depth of inundation for overbank events to areas downstream of stormwater discharge locations being upgraded by the proposal. The proposal design includes appropriate mitigations including scour protection in the |

| Clause factor | Consideration |
|---|---|
| | form of rock transition aprons at all culvert outlets upgraded as part of the proposal to manage impacts. |
| (b) coastal environmental values and natural coastal processes | Construction activities such as in-stream works would have the potential to impact on coastal processes. In-stream works can have an impact on hydrodynamic processes which result in morphologic changes in the river, either temporary or longer term. The magnitude of the impacts is dependent on the scale and nature of the works and the prevailing geomorphic processes at that location. While no works are proposed within the main channel system of the Hunter Estuary, works would be required in Ironbark Creek to facilitate the construction of the new bridges and demolition of the existing bridge. |
| (c) the water quality of the marine estate (within the meaning of the *Marine Estate Management Act 2014*), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1 | The REF area would not impact on the water quality of any coastal lakes. |
| (d) marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms | The REF area would require the removal of about 3.82 hectares of native vegetation listed under the EPBC Act and BC Act. These include the following PCTs:<br>• Around 1.53 hectares in the REF area of Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234)<br>• Around 1.06 hectares in the REF area of *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)<br>• Around 0.72 hectares in the REF area of Grey Mangrove low closed forest (PCT 1747)<br>• Around 0.51 hectares in the REF area of Saltmarsh Estuarine Complex (PCT 1746).<br>Fauna injury or death has the greatest potential to occur during the removal and relocation of the Southern Myotis (*Myotis macropus*) (vulnerable BC Act) found roosting within Ironbark Creek Bridge, and during construction when vegetation clearing would occur, and the extent of this impact would be proportionate to the extent of vegetation that is cleared.<br>Assessments of Significance have been conducted for threatened species that have been positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the study area due to the presence of suitable habitat. The conclusion of the assessment indicates that a significant impact is considered unlikely on any threatened species or TECs listed under the BC Act.<br>In accordance with Transports *Biodiversity Offset Policy* (Roads and Maritime Services, 2016) offsets in the REF area will not be required for TECs listed under the BC Act as the clearing totals for the REF area of the proposal are minor and generally do not reach the thresholds requiring offsets. However, offsets in the REF area will be required in accordance with the DPI 'no net loss' habitat policy for two PCTs that are identified as saline wetland formations which are comprised of saltmarsh and grey mangrove. These areas are also identified as areas of key fish habitat under the FM Act. Further to this, the loss of breeding/roosting habitat |

| Clause factor | Consideration |
|---|---|
| | for the Southern Myotis habitat in the REF area would require compensatory habitat measures. |
| (e) existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability | The REF area would not result in a permanent impact on existing public open space. The REF area would not result in any impacts to safe access to and along the foreshore, beach, headland, or rock platform for members of the public, including persons with a disability. |
| (f) Aboriginal cultural heritage, practices and places | The REF area would not impact on any known AHIMS sites or Aboriginal objects.<br>The proposal will impact on Aboriginal cultural values including the Burraghihnbihng Wetlands, Hunter River and estuary islands, and Water Spirit (Bunyip or Wau-wai, Yaa-hoo or Wowee Wowee). |
| (g) the use of the surf zone | The REF area would not impact on the use of the surf zone. |

## Clause 14 factors – coastal use areas

| Clause factor | Consideration |
|---|---|
| Clause 14(1) (a) – coastal use area | |
| (i) existing, safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability | The REF area would not impact on existing, safe access to and along the foreshore, beach, headland, or rock platform for members of the public including persons with a disability. |
| (ii) overshadowing, wind funnelling and the loss of views from public places to foreshores | The REF area would include the construction of a new bridge over Ironbark Creek which would result in some minor overshadowing and would change the visual environment for the public from some locations. |
| (iii) the visual amenity and scenic qualities of the coast, including coastal headland | Visual impacts during construction of the REF area would be experienced due to vegetation clearance and the introduction of construction areas, construction plant and equipment. Impacts on landscape character and visual amenity would be present throughout construction, but would be temporary in nature.<br>Moderate to high visual impacts are expected near Ironbark Creek associated with the removal of the existing bridge, vegetation and the construction of a wider and taller bridge structure. |
| (iv) Aboriginal cultural heritage, practices and places | The REF area would not impact on any known AHIMS sites or Aboriginal objects.<br>The proposal will impact on Aboriginal cultural values including the Burraghihnbihng Wetlands, Hunter River and estuary islands, and Water Spirit (Bunyip or Wau-wai, Yaa-hoo or Wowee Wowee). |
| (v) cultural and built environment heritage | The REF area would not impact on cultural and build environment heritage. |

# Appendix G

## Consultation

# Appendix H

## Biodiversity Assessment Report

# Appendix I

## Aboriginal heritage

# Appendix J

## Statement of Heritage Impact

# Appendix K

## Phase 1 Soils and Contamination Assessment

# Appendix L

## Flooding and Hydrology Assessment

# Appendix M

## Noise and Vibration Assessment

# Appendix N

## Surface Water and Groundwater Assessment

# Appendix O

## Coastal Processes Assessment

# Appendix P

## Traffic and Transport Assessment

# Appendix Q

## Socio-economic, Property and Land Use Assessment

# Appendix R

## Air Quality Assessment

# Appendix S

## Climate Change Assessment

# Appendix T

## Sustainability Assessment