Transport
for NSW

Hillsborough Road Upgrade

Review of Environmental Factors

November 2022

NSW GOVERNMENT

transport.nsw.gov.au

Acknowledgement of Country

Transport for NSW acknowledges the traditional custodians of the land on which the Hillsborough Road Upgrade is proposed.

We pay our respects to Elders past and present and celebrate the diversity of Aboriginal people and their ongoing cultures and connections to the lands and waters of NSW.

Many of the transport routes we use today – from rail lines, to roads, to water crossings – follow the traditional Songlines, trade routes and ceremonial paths in Country that our nation's First Peoples followed for tens of thousands of years.

Transport for NSW is committed to honouring Aboriginal peoples' cultural and spiritual connections to the land, waters and seas and their rich contribution to society.

Executive summary

The proposal

Transport for NSW ('Transport') proposes to upgrade Hillsborough Road, in the Lake Macquarie suburb of Hillsborough NSW (the proposal). Transport proposes to duplicate Hillsborough Road between the Newcastle Inner City Bypass (NICB) in the east, to west of the Crockett Street intersection, Warners Bay.

Key features of the proposal include:

- Duplication of about 1.8 kilometres of Hillsborough Road from the NICB roundabout west to a tie in point about 300 metres west of Crockett Street
- Two lanes in each direction separated by a raised median with a posted speed limit of 60 km/h
- New traffic lights at Chadwick Street, Barker Avenue and Crockett Street intersections including pedestrian crossings
- Modification of Higham Road intersection to left out only
- Closure of the right turn in and out of the businesses east of the Combined Newcastle Canine Club Showground (CNCC Showground)
- New separated left in only entry and left out only exit for the CNCC Showgrounds located east (entry) and west (exit) of Chadwick Street intersection
- U-turn bay on Barker Avenue
- Provision for on road cyclists within shoulder in both directions
- Off road concrete shared path on the northern side tying into existing footpath
- Upgraded bus stop facilities on Hillsborough Road at Crockett Street intersection, Chadwick Street intersection and on Crockett Street
- Culvert widening at Winding Creek and full replacement of existing culvert between Crockett Street and Barker Avenue
- Minor property acquisition and adjustments including fencing, access and driveway adjustments.

Construction of the proposal is planned to be delivered in stages. The NSW Government has announced $35 million to deliver the first stage of the Hillsborough Road Upgrade. Stage 1 involves upgrading Crockett Street intersection, including installation of traffic lights. Stage 1 is expected to commence construction in 2025 and take about 18 months to complete depending on final staging arrangements. Timing for construction of the remaining stages is subject to project approvals and funding.

Need for the proposal

Hillsborough Road is a sub-arterial road which serves as a connection between Warners Bay and Charlestown. About 36,000 motorists use Hillsborough Road daily with about four per cent being classified as heavy vehicles. The need for the upgrade of Hillsborough Road is driven by a number of existing issues.

Hillsborough Road is at capacity for a single lane in peak periods due to current traffic volumes, with average travel speeds lower than posted speeds between Crockett Street and the NICB. The congestion of Hillsborough Road has led to safety concerns and a high crash rate for this stretch of road. The intersections of Crockett and Chadwick Streets experience lengthy delays and congestion for road users trying to access Hillsborough Road from the suburbs of Cardiff South and Hillsborough.

In addition, within the proposal area there are currently no continuous pedestrian or cycling facilities along the corridor. There are also a number of pinch points for cyclists and only one formal crossing of Hillsborough Road for pedestrians.

The proposal would reduce congestion by providing additional lane capacity, facilitating overtaking and turning movements, and lower capacity related congestion. By installing traffic lights at Crockett and Chadwick Streets, the proposal would improve access to and from the neighbouring suburbs of Hillsborough and Cardiff South.

The upgrades will improve vehicle, cyclist and pedestrian safety. The introduction of traffic lights at Chadwick Street, Crockett Street and Barker Avenue will provide protected turn movements and reduced intersection congestion. The upgrade will provide protected pedestrian crossing options at all three of these intersections. The proposal will remove right hand turn movements into Higham Road to address a crash cluster at this location.

The proposal will provide a central median along Hillsborough Road which will remove right turn movements and reduce the risk of vehicles crossing into an opposing direction lane. A dedicated u-turn facility within Barker Avenue will provide access for road users exiting the CNCC Showground and businesses wanting to return east towards Charlestown.

Active transport would be improved through the provision of an off road shared path as well as on road provision for cyclists within the two metre road shoulder. Upgrades to active transport would improve access to the surrounding suburbs, local schools, shops and recreation areas.

Proposal objectives

The objectives of the proposal include:

- Improve corridor efficiency and reliability for all modes of transport
- Improve road safety for all road users including vulnerable road users
- Improve access to/from the suburbs of Hillsborough and Cardiff South

Options considered

A review of multiple options was considered for the proposal. Options developed included full duplication of Hillsborough Road with different configurations for intersection treatments, active transport, u-turn bays and accessibility arrangements. The review included consideration of strategic designs, cost estimates, traffic modelling and economic analysis for potential options. Consideration was also given to engineering and environmental constraints identified from environmental investigations, engineering studies and site inspections.

The full proposal would provide a dual carriageway solution with two continuous lanes in each direction and improvements to intersections at Crockett Street, Higham Road, Chadwick Street and Barker Avenue including the provision of a u-turn facility within Barker Avenue.

Statutory and planning framework

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

In accordance with Section 5.5 of the EP&A Act, Transport, as the proponent and determining authority, must examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposal.

Community and stakeholder consultation

In June 2021, Transport for NSW sought feedback from the community on the preferred design for the Hillsborough Road Upgrade. Transport published a Community Consultation Report in November 2021, which summarises community feedback and responses to issues raised about the preferred design. During consultation, 108 written submissions were received with most of the feedback supportive of the proposal. The suggestions and key issues raised during this process were considered in the development for the proposal. To address community feedback the following key changes to the design have been included:

- Intersection of Higham Road was updated from a cul-de-sac to allow a left out turning movement
- A u-turn bay was included on Barker Avenue to provide a safe turn around location for road users exiting the local businesses and CNCC Showgrounds and wanting to travel east
- Access to the CNCC Showground was split into two locations, with left in only east of Crockett Street and left out only west of Crockett Street
- Provision made for fauna crossings such as rope ladders along the corridor

During the development of this REF, Transport consulted with potentially affected property owners, community members and relevant government agencies, including Lake Macquarie City Council, NSW Environment Protection Authority (EPA), Awabakal Local Aboriginal Land Council (LALC), NSW Ambulance, Fire and Rescue NSW, Rural Fire Service (RFS), Subsidence Advisory NSW (SA NSW), State Emergency Service (SES) and other stakeholders. Matters raised during consultation included impacts to property and access, pedestrian and cyclist facilities and ecological impacts. Comments received have been considered and addressed in this REF.

The Aboriginal community has been involved throughout the development of the proposal in accordance with the requirements of the Department of Planning and Environment (DPE) Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010) (Consultation Requirements) and Transport 's Procedure for Aboriginal Cultural Heritage Consultation and Investigation (November 2011).

Transport will continue to consult with the community and stakeholders throughout all phases of the proposal.

Environmental impacts

The main environmental impacts of the proposal are summarised below:

Biodiversity

A Biodiversity Assessment Report (BAR) has been prepared to assess the potential biodiversity impacts associated with the proposal.

The proposal would remove 4.1 hectares (ha) of native vegetation and 2.5 ha of non-native vegetation. Within the native vegetation to be removed, 0.2 ha forms part of a listed threatened ecological community (TEC) under the Biodiversity Conservation Act 2016 (BC Act):

- *Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowland* (PCT 1649)

The proposal would remove 2.9 ha of vegetation that provides potential habitat (PCTs 1627 and 1638) for threatened flora Black-eyed Susan (*Tetratheca juncea*) which is listed as vulnerable under the BC Act and EPBC Act. However, there would be no direct loss of individual clumps as part of the proposal. The viable local population of Black-eyed Susan present is unlikely to depend on the habitat that would be removed for its long-term survival.

The study area forms part of an important wildlife corridor. The proposal would increase the existing tree canopy gap from about 30 metres to about 50 metres in some areas. The proposal includes indicative locations for fauna crossings such as rope ladders. As part of the final design, a Fauna Connectivity Strategy would be developed to minimise impacts to threatened fauna connectivity.

Overall, the proposal is not likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the BC Act or *Fisheries Management Act 1994* and therefore a Species Impact Statement or Biodiversity Development Assessment Report is not required.

The proposal is not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth).

The proposal will be required to offset its impacts to biodiversity in accordance with Transport's No Net Loss Guideline (2022) and the Tree and Hollow replacement Guideline (2022).

Hydrology and flooding

The proposal lies within the Winding Creek catchment area. Winding Creek has a catchment area of about 23.3 square kilometres and drains into Lake Macquarie at Cockle Bay. The design for the proposal was incorporated into the *Winding Creek Flood Study* (LMCC, 2017) hydraulic model.

The flood model for the proposal shows a reduction by up to 0.02 metres on the upstream side of Hillsborough Road near the residences in all standard Annual Exceedance Probability (AEP) events. By increasing the height of Hillsborough Road and the creation of the left out only at Higham Road, the proposal has reduced flooding through the residential area on Hillsborough Road in the 20%, 10%, 2% and 1% AEP.

The proposal would result in isolated increases in flood levels on the westbound carriageway of Hillsborough Road near Winding Creek. These increases are generally within the road corridor and would not impact on residential or commercial properties. This increase does not correlate to an increase in overtopping frequency of the roadway at Winding Creek which first overtops in the 1% AEP event the same as in the existing conditions. There would be no substantial changes in the flood hazard or velocity and there would be an overall reduction in the time of inundation of the Hillsborough Road due to the proposal. Mitigation measures have been recommended to further investigate flooding during detail design to reduce impacts of flooding as a result of the proposal where practical.

Noise and vibration

During construction, both daytime and night works would be undertaken, with most expected to be day works during standard construction hours. The construction scenarios with the greatest predicted impacts involve the clearing of vegetation to widen the road corridor and when using concrete saws. These activities have the potential to result in exceedances of residential noise management levels (NMLs).

Noise modelling indicates that several receivers are predicted to exceed the highly noise affected level of 75 dBA during all construction scenarios modelled. These receivers are primarily those located on or close to Hillsborough Road. The modelled predicted noise levels assume worst-case construction noise relative to each sensitive receiver based on all construction machinery and equipment being used together at the one time. These impacts would be managed through the implementation of mitigation measures in a Construction Noise and Vibration Management Plan including consultation and engagement with the affected community.

Operational noise was modelled from 2027 when the proposal is anticipated to be complete and for a further 10 years to 2037. Overall operational noise levels are predicted to decrease at most properties due to the duplication being on the southern side of Hillsborough Road and the traffic moving further away from residential receivers. The modelling indicated that the predicted change in operational traffic noise associated with the proposal would not exceed 2 dB(A), however 17 sensitive receivers would exceed the cumulative noise criteria and are considered eligible for further consideration for noise mitigation treatment. Noise mitigation treatment options are outlined in this REF, and these will be further investigated in the detailed design phase.

Traffic

Access to some properties on Hillsborough Road may be temporarily affected during construction of the proposal. However, most of these impacts would be limited to short term closures. Alternative access arrangements would be provided wherever feasible, and residents and businesses would be notified of any changes well in advance. Access would be maintained for emergency services during construction.

Impacts to traffic on Hillsborough Road during construction would be temporary in nature. Traffic impacts would occur due to reductions in speed limits and the movement of construction and service vehicles along Hillsborough Road. This has the potential to increase travel time for road users. To minimise these impacts some activities would be undertaken as out of hours works outside of standard construction hours.

The proposal is not expected to disrupt public transport. All existing bus movements would be maintained during construction, with potential for minor delays on bus services due to construction speed limits or detours. Some bus stops may need to be temporarily relocated to allow construction to safely occur.

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

With the proposal in operation the assessed intersections were modelled to all perform with a significantly improved Level of Service (LoS) of A or B compared to the current base case which indicated an (F) LoS.

Current average travel times on Hillsborough Road in the morning peak are 7.5 minutes eastbound and three minutes westbound. In the afternoon peak travel times are 2.7 minutes eastbound and 3.1 minutes westbound. These travel times result in an average speed below the posted speed limit. Without the project, travel times will increase by around 40% in 2037. In 2027, the operation of the proposal would reduce journey time on Hillsborough Road by about five minutes during the morning peak and one minute in the afternoon peak. In 2037, travel time savings by the proposal are estimated to be about seven minutes during the morning peak and three minutes in the afternoon peak.

The proposal would improve bus travel time reliability due to reduced congestion and improved intersection performance. The proposal also includes widening and relocating the bus stops to provide safer connectivity and access.

Active transport would also be improved by the addition of a shared path on the northern side of Hillsborough Road which will provide a connection to the exiting shared path network in adjoining suburbs. Pedestrian crossings at the new traffic lights would improve connectivity and provide safer access to bus stops, residential areas as well as recreational facilities such as the CNCC Showgrounds and Charlestown Golf Club.

Once operational some on street parking on the northern side of Hillsborough Road will be removed with the widening and provision of a two metre shoulder. All residential properties along this portion of Hillsborough Road all have off-street parking, with existing on street parking nearby in either Chadwick Street or Higham Road.

Socio-economic

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

Once operational, the proposal would provide improved social infrastructure, reduce travel times and increase economic benefits by increasing traffic capacity though duplication of Hillsborough Road. Amenity and access will be improved from a new shared path and upgraded bus stops. The new traffic lights would include pedestrian crossings making it safer for pedestrians to cross Hillsborough Road. The new traffic lights at Chadwick and Crockett streets as well as Barker Avenue would provide a more reliable access for road users to and from Hillsborough Road.

The proposal would change access for CNCC Showgrounds, Shed Quarters, Whalan's Nursery and a storage facility to left in and left out only from Hillsborough Road. This would require road users to utilise the existing NICB roundabout or the proposed u-turn bay on Barker Avenue. This would provide a safer and more reliable access arrangement for customers and recreational users. The new traffic lights at Barker Avenue would also provide safer and more reliable access to users of the Charlestown Golf Club.

Other issues

This REF also assessed impacts associated with other relevant environmental aspects, including:

- Soils and contamination
- Waste and resource use
- Aboriginal heritages
- Air quality
- Non-Aboriginal heritage
- Hazard and risk
- Property and land use
- Cumulative impacts

The REF finds that the above environmental aspects the construction and operation would be managed by implementation of safeguards and management measures outlined in Section 7.2.

Justification and 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. The proposal, as examined in this REF, would be unlikely to result in a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared or for approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act.

The proposal would not result in any significant impacts upon threatened species or ecological communities and as such a Biodiversity Development Assessment Report or Species Impact Statement is not required. The Proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required. The completed proposal would improve traffic flow and reduce congestion on Hillsborough Road. The new traffic lights at Chadwick Street, Crockett Street and Barker Avenue would improve access and road user safety for all road users. The off road shared path and upgraded footpaths would improve amenity and active transport along the corridor. The proposal would improve access to public transport for the residents of Hillsborough and Cardiff South through upgraded bus stops and footpaths. Construction and operational impacts associated with the proposal are considered acceptable with the implementation of safeguards and management measures outlined in Section 7.2.

Display of the review of environmental factors

This REF is on display for comment between 14 November until 12 December 2022. You can access the documents in the following ways:

Internet

The documents are available as pdf files on the Transport for NSW website at https://roads-waterways.transport.nsw.gov.au/projects/hillsborough-road-hillsborough/index.html

Printed copies

Hard copies are available on request only. You can also view the Hillsborough Road REF and Concept Design at our display portal at: https://hillsboroughrd.ghdengage.com/

How can I make a submission?

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

- Our online submission form at: https://hillsboroughrd.ghdengage.com/
- Submit via email at hillsboroughroad@transport.nsw.gov.au
- Mail a submission to:

  Hillsborough Road Upgrade, Project Manager

  Transport for NSW

  Locked Bag 2030, Newcastle NSW 2300

Submissions must be received by 5pm 12 December 2022. Submissions will be managed in accordance with the *Transport for NSW Privacy Statement*. A copy can be made available upon request.

What happens next?

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

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

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

Table of contents

1 Introduction 18

1.1 Proposal identification 18
1.2 Purpose of the report 22

2 Need and options considered 23

2.1 Strategic need for the proposal 23
2.2 Limitations of existing infrastructure 26
2.3 Proposal objectives and development criteria 27
2.4 Alternatives and options considered 28
2.5 Design refinements 30

3 Description of the proposal 31

3.1 The proposal 31
3.2 Design 37
3.3 Construction activities 47
3.4 Ancillary facilities 53
3.5 Public utility adjustment 56
3.6 Property acquisition 56

4 Statutory and planning framework 59

4.1 Environmental Planning and Assessment Act 1979 59
4.2 Other relevant NSW legislation 64
4.3 Commonwealth legislation 68
4.4 Confirmation of statutory position 68

5 Consultation 70

5.1 Consultation strategy 70
5.2 Community involvement 71
5.3 Aboriginal community involvement 72
5.4 SEPP (Transport and Infrastructure) consultation 72
5.5 Government agency and stakeholder involvement 73
5.6 Ongoing or future consultation 74
5.7 Directly affected property owners (property acquisition and adjustments) 74

6 Environmental assessment 75

6.1 Biodiversity 75
6.2 Hydrology and flooding 98
6.3 Surface water and groundwater 105
6.4 Soils, geology and contamination 113
6.5 Traffic and transport 120
6.6 Air quality 129
6.7 Noise and vibration 136
6.8 Aboriginal cultural heritage 154

6.9 Non-Aboriginal heritage 160
6.10 Landscape character and visual impacts 163
6.11 Property and land use 172
6.12 Socio-economic 175
6.13 Other impacts 182
6.14 Cumulative impacts 185

7 Environmental management 188

7.1 Environmental management plans 188
7.2 Summary of safeguards and management measures 189
7.3 Licensing and approvals 204

8 Conclusion 205

8.1 Justification 205
8.2 Objects of the EP&A Act 207
8.3 Conclusion 210

9 Certification 211

10 EP&A Regulation publication requirement 212

11 References 213

Appendix A - Consideration of section 171 factors and matters of national environmental significance and Commonwealth land 218

Appendix B – Statutory consultation checklists 223

Appendix C – Design Drawings 227

Appendix D – Biodiversity Assessment Report 228

Appendix E – Flooding Assessment Report 229

Appendix F – Surface Groundwater and Soil Report 230

Appendix G – Phase 1 Contamination Report 231

Appendix H – Traffic and Transport Report 232

Appendix I – Air Quality Analysis 233

Appendix J – Noise and Vibration Assessment 234

Appendix K – Aboriginal Cultural Heritage Assessment Report 235

Appendix L – Landscape Character and Visual Impact Assessment.....236

Appendix M – Socio-economic Impact Assessment 237

Appendix N – Property acquisition plans.....238

Tables

Table 2.1: Design refinements 30
Table 3.1: Design criteria 37
Table 3.2: Bus stop arrangement 46
Table 3.3: Design refinements 46
Table 3.4: Proposed construction work methodology 48
Table 3.5: Indicative plant and equipment for the proposal 50
Table 3.6: Vehicle movements during construction of the proposal 52
Table 3.7: Public utility adjustment related to the proposal 56
Table 3.8: Proposed property acquisition 56
Table 4.1: LEP 2014 zoning and provision details 61
Table 4.2: Summary of licensing and approval required 69
Table 5.1: Summary of issues raised by the community 71
Table 5.2: Summary of Transport's Procedure for Aboriginal Cultural Heritage Consultation and Investigation 72
Table 5.3: Issues raised through SEPP (Transport and Infrastructure) consultation 72
Table 5.4: Issues raised through stakeholder consultation 73
Table 6.1: Plant community types 77
Table 6.2: Threatened flora 79
Table 6.3: Threatened fauna 80
Table 6.4: Summary of direct impacts to native vegetation 86
Table 6.5: Summary of direct impacts to threatened fauna habitat 87
Table 6.6: Summary of direct impacts to threatened fauna habitat 89
Table 6.7: Biodiversity safeguards and management measures 93
Table 6.8: Offset Thresholds (Transport No Net Loss Guidelines) 95
Table 6.9: Assessment of vegetation impacts against thresholds 96
Table 6.10: Credit calculations 97
Table 6.11: Construction ancillary facilities flooding potential 99
Table 6.12: Proposal flooding impacts at key locations 101
Table 6.13: Hydrology and Flooding safeguards and management measures 104
Table 6.14: Results of NSW bore database search – bores within 1 km of the Project 106
Table 6.15: Surface water and groundwater safeguards and management measures 111
Table 6.16: Summary of stratigraphic units 114
Table 6.17: Soils, geology and contamination safeguards and management measures 119
Table 6.18: Existing level of service for key intersections in 2021 121
Table 6.19: Recorded crashes on Hillsborough Road NICB to Crockett St: 2016 – 2021 121
Table 6.20: Existing travel time and travel speed on Hillsborough Road in 2021 122
Table 6.21: Average weekday volumes on Hillsborough Road in 2027 and 2037 124
Table 6.22: Level of service for key intersections in 2027 124

Table 6.23: Level of service for key intersections in 2037 125
Table 6.24: Travel time savings on Hillsborough Road in 2027 125
Table 6.25: Travel time savings on Hillsborough Road in 2037 126
Table 6.26: Traffic and transport safeguards and management measures 128
Table 6.27: Air quality impact assessment criteria 129
Table 6.28: 2021 monitoring data 130
Table 6.29: Size and scale of construction activities 132
Table 6.30: Sensitivity of areas of concern for all construction activities 132
Table 6.31: Risk matrix for dust impacts during construction 133
Table 6.32: Overview of modelling scenarios assessed 133
Table 6.33: Predicted pollutant concentration 10 metres from the Hillsborough Road kerb 134
Table 6.34: Air quality safeguards and management measures 135
Table 6.35: Number of modelled noise sensitive receivers 138
Table 6.36: Background and ambient noise levels 138
Table 6.37: Proposal specific residential receiver noise management levels 140
Table 6.38: Noise criteria for non-residential land uses. 141
Table 6.39: Guideline values for short term vibration on structures – DIN 4150-3 141
Table 6.40: Vibration guide values for underground services – BS 5228 142
Table 6.41: Guideline values for vibration on buried pipework – DIN 4150-3 142
Table 6.42: Guideline values for underground assets 142
Table 6.43: Proposal specific operational noise criteria – residential land uses 143
Table 6.44: Proposal specific operational noise criteria – non-residential land uses 143
Table 6.45: Construction Scenarios 144
Table 6.46: Predicted no-mitigation construction noise level range, dBA 144
Table 6.47: Number of exceedances during standard construction hours (day) 145
Table 6.48: Number of exceedances during standard construction hours (evening) 145
Table 6.49: Number of exceedances during standard construction hours (night) 145
Table 6.50: Construction traffic noise prediction 146
Table 6.51: Existing maximum noise level events 147
Table 6.52: Future maximum noise level events 149
Table 6.53: Noise and vibration safeguards and management measures 152
Table 6.54: Frequency of site features from AHIMS data 155
Table 6.55: Field investigations results 156
Table 6.56: Test excavation results summary 156
Table 6.57: Summary of scientific values 157
Table 6.58: Summary of potential impacts 157
Table 6.59: Aboriginal heritage safeguards and management measures 159
Table 6.60: Non-Aboriginal heritage safeguards and management measures 162
Table 6.61: Landscape character and visual impact assessment matrix 164
Table 6.62: Landscape character zones description 164

Table 6.63: Visual Impacts at the proposal viewpoint locations 168
Table 6.64: Visual impacts to landscape character zones 169
Table 6.65: Landscape character and visual safeguards and management measures 171
Table 6.66: Land use zones impacted by the proposal 173
Table 6.67: Property and land use safeguards and management measures 174
Table 6.68: Lake Macquarie LGA demographic summary 176
Table 6.69: Socio economic safeguards and management measures 180
Table 6.70: Other impact safeguards and management measures 184
Table 6.71: Past, present and future projects 185
Table 7.1: Summary of safeguards and management measures 189
Table 7.2: Summary of licensing and approvals required 204
Table 8.1: Objects of the Environmental Planning and Assessment Act 1979 207
Table 10.1: EP&A Regulation publication requirement 212
Table 11.1: Terms and acronyms used in this REF 215

Figures

Figure 1.1: Location of the proposal 20
Figure 1.2: The proposal 21
Figure 3.1: Key features of the proposal 33
Figure 3.2: Cross section – NICB to Higham Road 39
Figure 3.3: Cross section – Winding Creek 40
Figure 3.4: Cross section – Barker Ave to Crockett St 41
Figure 3.5: Cross section – Crockett Street to western limit of works 42
Figure 3.6: Construction ancillary facilities 55
Figure 3.7: Proposed property acquisition 58
Figure 4.1: Land zoning 63
Figure 6.1: Vegetation communities 84
Figure 6.2: Threatened fauna and flora 85
Figure 6.3: Indicative wildlife crossings 91
Figure 6.4: Flood level – 1% annual exceedance probability 103
Figure 6.5: Surface water catchment areas 107
Figure 6.6: Topographical Contours 115
Figure 6.7: Five year wind rose for BoM Newcastle AWS 131
Figure 6.8: Sensitive receivers 139
Figure 6.9: Receivers eligible for consideration of additional mitigation 148
Figure 6.10: Operational noise – day 150
Figure 6.11: Operational noise – night 151
Figure 6.12: Non-Aboriginal heritage items 161
Figure 6.13: Landscape character zones of the proposal 166
Figure 6.14: Viewpoints of the proposal 167

1 Introduction

1.1 Proposal identification

Transport for NSW (Transport) proposes to duplicate a 1.8 kilometre section of Hillsborough Road between the Newcastle Inner City Bypass (NICB) in the east and the duplicated section of Hillsborough Road about 300 metres west of the intersection with Crockett Street in Warners Bay (the proposal) (see Figure 1.1 and Figure 1.2). The proposal is located within the Lake Macquarie City Council (LMCC) local government area (LGA). The proposal is located within the LMCC local government area (LGA) within the Greater Newcastle Region.

Hillsborough Road forms part of the Charlestown to Warners Bay Road corridor (B57 road) and serves as the primary link between the urban centre of Charlestown (south of Newcastle) and Warners Bay, as well as providing access to and from the NICB. Between the NICB and Crockett Street, Hillsborough Road is predominantly a two lane, undivided road. The proposal would improve traffic flow, safety and accessibility for all road users along this section of Hillsborough Road and associated connecting roads.

The main land uses surrounding the proposal include the residential area of Hillsborough, Combined Northern Canine Committee Showgrounds (CNCC), Charlestown Golf Club, and Charlestown Recreation Reserve.

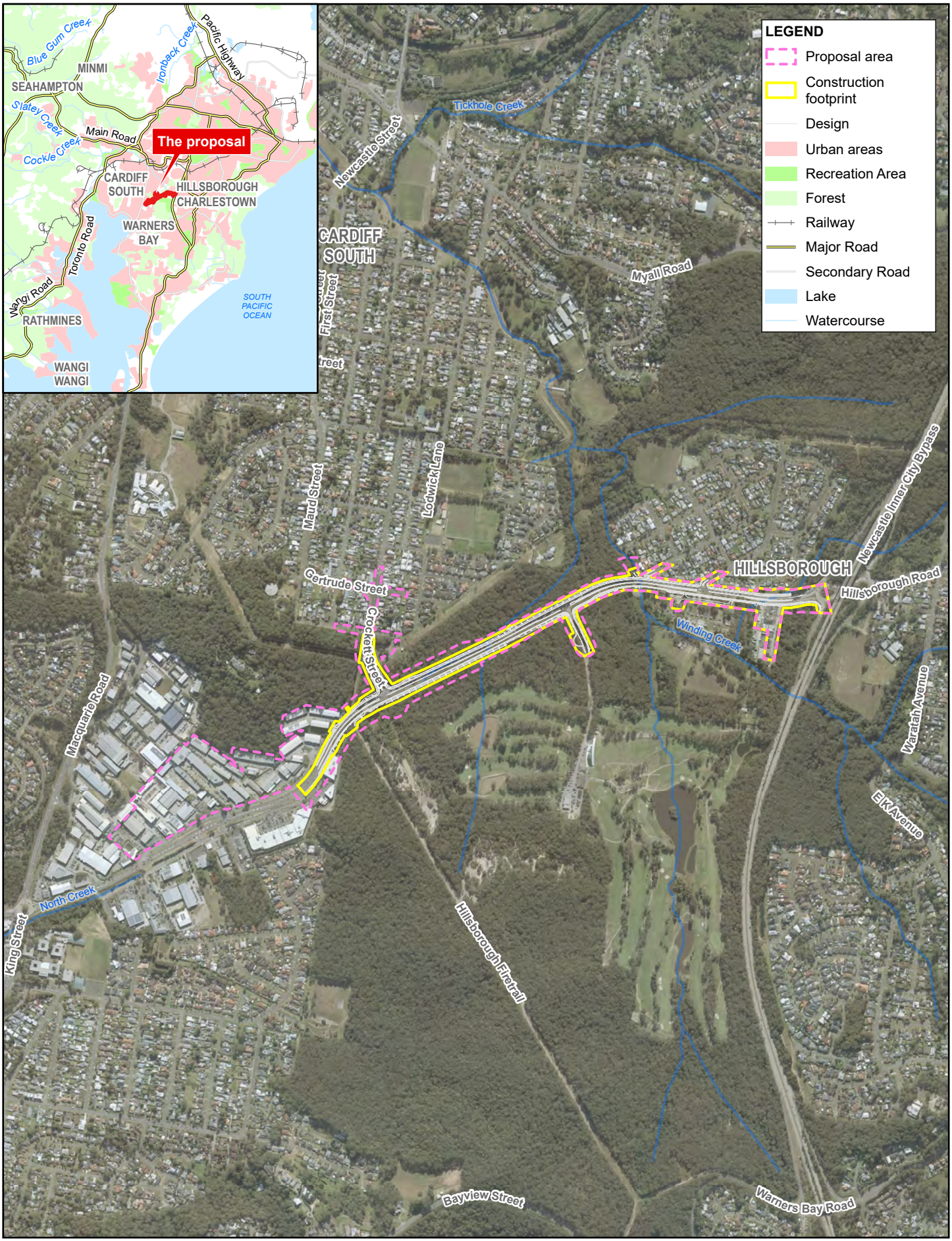
Key features of the proposal include:

- Duplication of about 1.8 kilometres of Hillsborough Road from the NICB roundabout west to a tie in point about 300 metres west of Crockett Street.
- Two lanes each a minimum 3.3 metre wide each way with a solid central median barrier.
- Posted speed of 60 km/h.
- New traffic lights at the Chadwick Street intersection including pedestrian crossings.
- Modification of Higham Road intersection.
- New traffic lights at the Barker Avenue intersection including pedestrian crossing.
- U-turn facility on Barker Avenue.
- Access gates to be relocated beyond U-turn facility.
- New traffic lights at the Crockett Street intersection including pedestrian crossings.
- Provision for on-road cyclists within shoulder in both directions.
- Off-road concrete shared path on the northern side tying into existing path.
- Upgraded bus stop facilities on Hillsborough Road at Crockett Street intersection, Chadwick Street intersection and on Crockett Street. All bus stops are to have shelters with the exception of the southbound bus lay over on Crockett Street.
- Culvert widening on Winding Creek both up stream and down stream of existing culvert structure.
- Culvert widening and full replacement of existing culvert between Crockett Street and Barker Avenue.
- New separated left in only entry and left out only exit for the CNCC Showgrounds located east (entry) and west (exit) of Chadwick Street intersection.
- Maintained access to the Hillsborough Road fire trail opposite Crockett Street.
- Left in / left out only access from existing businesses fronting Hillsborough Road, east of the CNCC Showgrounds.
- Left in / left out only access to residences on Hillsborough Road, east of CNCC Showgrounds.
- Relocation of utilities including, telecommunications, water, power, street lighting and minor adjustments to sewer infrastructure.
- New as well as upgraded street lighting on Hillsborough Road.
- Reinforced concrete retaining walls including facing panels.

- Site investigations, including but not limited to geotechnical investigations.
- Installation of fauna connectivity structures, such as rope crossings.
- Minor property acquisition and adjustments including fencing, access and driveway adjustments.
- Site preparation works, including establishing ancillary facilities, vegetation clearing, site fencing, temporary drainage measures, and implementation of environmental management measures.
- Temporary construction facilities, including site compounds and stockpile sites at the Whalan's Nurseries site– Hillsborough Road, and at vacant commercial buildings within the Warners Bay Commercial Centre – Accessed by northern commercial access road of Hillsborough Road.

An overview of the proposal is shown in Figure 1.2 and the concept design drawings are included in Appendix C. Chapter 3 describes the proposal in more detail.

Construction of the proposal is planned to be delivered in stages. The NSW Government has announced $35 million to deliver the first stage of the Hillsborough Road upgrade. Stage 1 involves upgrading Crockett Street intersection, including installation of traffic lights. Stage 1 is expected to commence construction in 2025 and take about 18 months to complete depending on final staging arrangements. Timing for construction of the remaining stages is subject to project approvals and funding.



Paper Size ISO A4

0 0.1 0.2 0.3 0.4 0.5

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

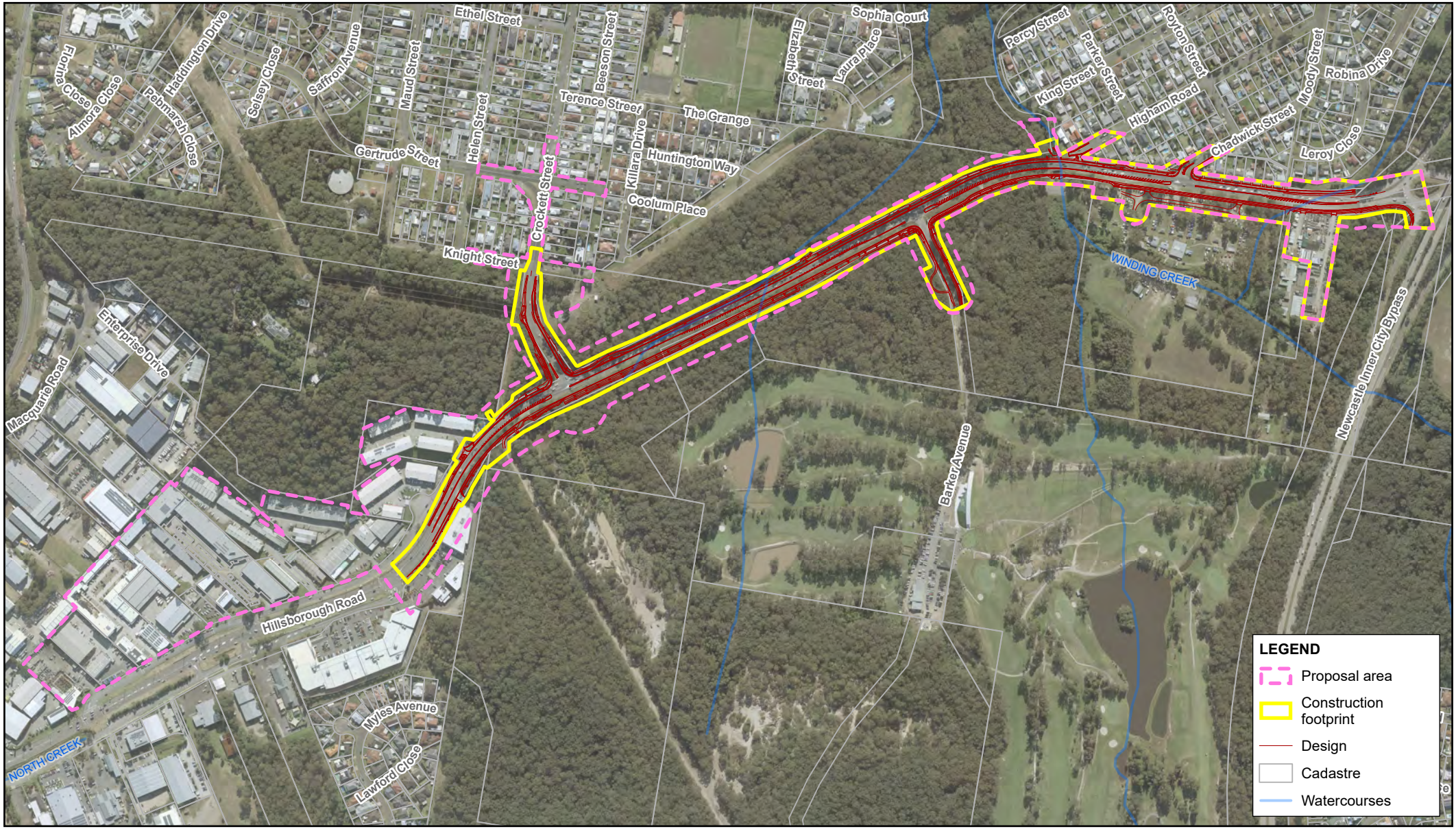
Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

Location of the proposal

FIGURE 1.1

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:25

Data source: Commonwealth of Australia (Geoscience Australia): 250K Topographic Data Series 3, 2006. Metromap Tile Service: .
Created by: tmorton



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

The proposal

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

FIGURE 1.2

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:14

Data source: Metromap Tile Service: - Imagery (Date extracted: 11/10/2022); Roads, Cadastre, Watercourses - LPI, 2017; Created by: tmorton

1.2 Purpose of the report

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

The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail 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 171 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 take into account, to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.
- The strategic assessment approval granted by the Commonwealth Government under the EPBC Act in September 2015, with respect to the impacts of Transport road activities on nationally listed threatened species, ecological communities and migratory species.

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval sought from the Minister for Planning under Division 5.2 of the EP&A Act.
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report.
- The significance of any impact on nationally-listed biodiversity matters under the EPBC Act (view EPBC Act here), including whether there is a real possibility that the activity may threaten long-term survival of these matters, and if offsets are required and able to be secured.

The potential for the proposal to significantly impact any other matters of national environmental significance or Commonwealth land and the need, subject to the EPBC Act strategic assessment approval, to make a referral to the Australian Department of Climate Change, Energy, the Environment and Water for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

2 Need and options considered

2.1 Strategic need for the proposal

Hillsborough Road is a sub-arterial road which serves as a connection between Warners Bay and Charlestown. About 36,000 motorists use Hillsborough Road daily with about four per cent being classified as heavy vehicles The need for the upgrade of Hillsborough Road is driven by the road's safety history, congestion, and delays that are currently experienced.

Recorded crash statistics from March 2012 to March 2017 indicate that 24 crashes were reported during this period. Of all crashes reported nine occurred at Crockett Street, three occurred at Chadwick Street with another 12 occurring along the subject section of Hillsborough Road. The severity of crashes ranged from fatality through to non-casualty (tow away). Of the incidents at Crockett Street 56 per cent (five crashes) resulted in injury and 44 per cent (four crashes) resulted in non-casualty. At Chadwick Street 33 per cent (one crash) resulted in injury whilst 67 per cent (two crashes) were non-casualty incidents. For the remainder of the Hillsborough Road excluding Crockett Street and Chadwick Street eight per cent (one crash) resulted in a fatality, 50 per cent (six crashes) resulted in injury and 42 per cent (five crashes) were non-casualty.

Since this reporting the Transport Centre for Road Safety statistics data indicates that an additional nine crashes occurred between 2017 and 2020, four additional crashes occurred at Crockett Street which were all non-casualty crashes. One additional crash occurred at Chadwick Street which was reported as moderate injury and three at Barker Avenue, two which were classified as non-casualty and one which as classified as moderate injury. In this period one additional crash was recorded along Hillsborough Road just west of Barker Avenue that was reported to be of a serious injury due to a head on accident. From the above data it can be seen that over the eight year period from 2018 to 2020 the majority of crashes have occurred at either intersections or due to head on accidents where there is no divided carriageway. It is considered that the proposal will reduce these incidents by controlling intersections, increasing the number of travel lanes and dividing the carriageways and reducing the speed for the entire 1.8 km section to 60 km/hr.

Congestion and delays are due to a number of pinch points along the alignment. This includes congestion of morning and afternoon peak traffic along Hillsborough Road at the Chadwick Street and Crockett Street intersections. For residents in the suburb of Hillsborough there are no alternative access routes. These issues are likely to worsen in the future, due to the increase in population and traffic movements. Further information regarding population increases is provided in the social impact assessment as summarised in Section 6.12. In addition, there are no shared paths along Hillsborough Road, with pedestrians using the grassed verge. Pedestrians are more susceptible to danger as there are no pedestrian crossings in locations where traffic movement is heavy.

The proposal is expected to improve traffic flow, reduce travel times and improve safety through the corridor, which would meet the proposal objectives as outlined in Section 2.3.

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

- Staying Ahead: State Infrastructure Strategy 2022-2042 (Infrastructure NSW, 2022) (Section 2.1.1)
- Future Transport Strategy 2056 (Transport, 2018a) (Section 2.1.2)
- 2026 Road Safety Action Plan (Transport, 2022a) (Section 2.1.3)
- NSW Freight and Ports Plan 2018 – 2023 and NSW Freight and Ports Strategy (Transport, 2018b) (Section 2.1.4)
- Walking and Cycling Program 2022-2023 (Transport 2021a) (Section 2.1.6)
- Hunter Regional Plan 2036 (DPE, 2016) (Section 2.1.7)
- Greater Newcastle Metropolitan Plan 2036 (DPE, 2018a) (Section 2.1.9)
- Greater Newcastle Future Transport Plan (Transport, 2018c) (Section 2.1.10)
- Shaping the Future: Lake Macquarie City Local Strategic Planning Statement (LMCC, 2020) (Section 2.1.11)
- Walking, Cycling and Better Streets Strategy 2031 (LMCC, 2021) (Section 2.1.12).

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

2.1.1 Staying Ahead: State Infrastructure Strategy 2022-2042

Staying Ahead: State Infrastructure Strategy 2022-2042 (Infrastructure NSW, 2022) builds on the NSW Government's major long-term infrastructure plans over the last seven years from the 2012 State Infrastructure Strategy and Long Term Transport Master Plan. Staying Ahead: State Infrastructure Strategy 2022-2042 is the fourth edition since the initial 2012 State Infrastructure Strategy.

Staying Ahead: State Infrastructure Strategy 2022-2042 sets out Infrastructure NSW's advice on the infrastructure needs and priorities of NSW for the next 20 years, and beyond. Based on the proposal's scope of works (Section 3) and objectives (Section 2.3), the proposal specifically supports relevant objectives, including:

- Boost economy-wide productivity and competitiveness: Supporting the strategic direction to deliver efficient transport networks to support thriving cities, businesses and communities
- Service growing communities: Supporting the strategic direction to improve access to efficient, quality services through better use of assets and a better mix of physical infrastructure and technology-enabled solutions
- Embed reliability and resilience: Supporting the strategic direction to establish a rigorous and funded program to identify and remedy assets most likely to cause service failure
- Integrate infrastructure, land use and service planning: Supporting the strategic direction to coordinate infrastructure, land use and service planning to meet housing, employment, industry and community needs.

2.1.2 Future Transport Strategy 2056

The NSW Future Transport Strategy 2056 (Transport, 2018a) outlines a clear framework to address transport challenges in NSW over the next 40 years and is an update of the NSW Long Term Transport Master Plan released in 2012. It integrates planning for roads, freight and all other modes of transport and sets out initiatives, solutions and actions to meet NSW transport challenges.

The proposal supports the existing and future development of the area and aligns with the following Future Transport Strategy 2056 visions:

- Liveability, amenity and economic success of communities and places are enhanced by transport
- Every customer enjoys safe travel, regardless of transport mode or location, across a high-performing, integrated and efficient network
- Transport enables everyone to get the most out of life, wherever they live an whatever their age, ability or personal circumstances

Specifically, the proposal is consistent with the Future Transport Strategy 2056 by:

- Providing road upgrades to facilitate safer and more efficient connections
- Providing additional active transport infrastructure that improves liveability and provides improved local and sub-regional connections

2.1.3 2026 Road Safety Action Plan

The 2026 Road Safety Action Plan (Transport, 2022a) builds on the Road Safety Plan 2021 (Transport, 2018d) and supports the Future Transport Strategy 2056, working towards the goal of zero trauma on the NSW transport network. It features new targets to halve deaths and reduce serious injuries by 30 per cent on NSW roads by 2030.

The proposal is consistent with the directions set out in 2026 Road Safety Action Plan as it would provide a safer speed limit, better standard of road with improved safety design and provision of improved intersections and active transport links as well as separation of vulnerable road users.

2.1.4 Freight and Ports Plan 2018-2023 and NSW Freight and Port Strategy 2013

The Freight and Ports Plan 2018-2023 (Transport, 2018b) sets the NSW governments priorities for the sector for the next five years. The plan is a supporting plan to the Future Transport Strategy 2056 and is a continuation of the NSW Freight and Port Strategy 2013 (Transport, 2013). The plan has the objectives of:

- Economic growth
- Efficiency, connectivity and access
- Capacity
- Safety
- Sustainability

Hillsborough Road has previously been identified as a tertiary freight route as part of the *NSW Freight and Ports Strategy 2013*. Tertiary freight routes provide connections from the local road network to the primary and secondary freight routes. Hillsborough Road provides an important freight link off the primary freight corridors of M1 Pacific Motorway and Pacific Highway to business and residents in the Lake Macquarie and Newcastle LGAs.

By reducing congestion through this section of Hillsborough Road the proposal will support the overall aims and objectives of the *NSW Freight and Ports Strategy*.

2.1.5 Walking and Cycling Program 2022-2023

The NSW Government is committed to encouraging people to walk or cycle as part of their everyday travel via the *Walking and Cycling Program 2022-2023* (Transport, 2021a).

Walking and cycling for commuting and short trips relieve pressure on our roads and public transport networks and are part of a healthy lifestyle for our communities.

The Walking and Cycling Program's strategic objectives are aimed at:

- Improving bike riding to and within centres, neighbourhoods and to key destinations
- Improving walkability in centres, neighbourhoods and at key destinations
- Enable vibrant centres and liveable neighbourhoods through the creation of street environments that prioritise walking and cycling.

The proposal helps address these objectives by providing additional active transport infrastructure that improves liveability and provides improves local and sub-regional connections.

2.1.6 Hunter Regional Plan 2036

The *Hunter Regional Plan 2036* (DPE, 2016) includes a direction to enhance interregional linkages to support economic growth and identifies Warners Bay as a centre of local significance.

This includes improvements to transport corridors needed to maintain efficiencies in the network, particularly for freight, and to allow for future growth. Planning is under way to extend the M1 Pacific Motorway to Raymond Terrace and to complete the NICB.

The proposal will support the economic growth of Warners Bay, with the accessibility to the NICB improved on Hillsborough Road.

2.1.7 Greater Newcastle Metropolitan Plan 2036

The *Greater Newcastle Metropolitan Plan 2036* (DPE, 2018a) aims to set out strategies and actions that will drive sustainable growth across Cessnock City, Lake Macquarie City, Maitland City, Newcastle City and Port Stephens communities.

The proposal will help achieve the plan's goal of a connected community by providing improved access between key areas including, the identified strategic centres of Charlestown and Cardiff.

2.1.8 Greater Newcastle Future Transport Plan

The *Greater Newcastle Future Transport Plan* (Transport, 2018c) identifies key transport policy, service and infrastructure initiatives for investigation within the Global Gateway City of Greater Newcastle, comprising the five LGAs of Cessnock, Lake Macquarie, Maitland, Newcastle and Port Stephens.

The *Greater Newcastle Future Transport Plan* provides the overarching strategic transport network and vision that will guide future transport planning for the Greater Newcastle area.

The proposal addresses key initiatives of the *Greater Newcastle Future Transport Plan*, including:

- Addressing pinch points in the road network and informing the program of road network optimisation improvements
- Further development of active transport networks

2.1.9 Shaping the Future (Lake Macquarie)

Lake Macquarie's strategic document, *Shaping the Future: Lake Macquarie City Local Strategic Planning Statement* (LMCC, 2020), Identifies the area from Charlestown to Belmont will offer opportunities for significant growth. The economic centres of Charlestown, Belmont, Mount Hutton and Warners Bay will continue to evolve and intensify, providing a wide range of housing, employment and services.

The improvement of Hillsborough Road will allow for a stronger connectivity between these growth areas.

2.1.10 Walking, Cycling and Better Streets Strategy 2031

Developed in consultation with community representatives from LMCC's Active Transport Advisory Group, the *Walking, Cycling and Better Streets Strategy 2031* (LMCC, 2021) sets out LMCC's vision for enhancing active transportation uptake in the LGA. The proposal is consistent with this strategy by the provision of improved shared paths as part of the proposal that will provide safer off road options for pedestrians and cyclists that connect into the LGA's wider active transport network.

2.2 Limitations of existing infrastructure

Hillsborough Road passes through Warners Bay, Cardiff South, and Hillsborough, forming the main road access to Hillsborough. Within the proposal area Hillsborough Road currently has a single lane in each direction, with a posted speed limit of 70 km/h between the western extent of the proposal and Barker Avenue and a posted speed limit of 60 km/h between Barker Avenue and the NICB and has heavy congestion during peak hours.

Other roads within the proposal area or immediate vicinity include:

- **Newcastle Inner City Bypass:** A key regional road providing a north-south route to connect the Pacific Highway between Bennett's Green and Sandgate. Hillsborough Road at this location consists of a four lane, two way road. A grade separated interchange with dual lane roundabout (shaped like a peanut) provides a connection to and from Hillsborough Road to the NICB in all directions.
- **Chadwick Street:** A local street providing access to residential areas in Hillsborough which connects into Hillsborough Road via an unsignalised intersection. Access from both directions of Hillsborough Road is provided via short turning lanes, with westbound traffic turning right across eastbound traffic. Access from Chadwick Street onto Hillsborough Road is provided via short merging lanes, with westbound traffic turning right across eastbound traffic.
- **Combined Newcastle Canine Club Showgrounds access:** An uncontrolled intersection directly opposite the Chadwick Street intersection, providing access to the CNCC Showgrounds. Access is left in (from Hillsborough Road) and left out (from the access road) only, with no allowance for turning or merging lanes.
- **Higham Road:** An unsignalised intersection with Hillsborough Road. A local street providing access to residential areas in Hillsborough. Access from both directions of Hillsborough Road is allowed; however, there is no current allowance for turning lanes and westbound traffic turning right across eastbound traffic. While left and right turns are currently allowed onto Hillsborough Road, there are no merging lanes provided for access from Higham Road. Instead, access is straight onto the east or west bound lanes of Hillsborough Road.

- **Crockett Street:** An unsignalised intersection with Hillsborough Road. A local street providing access to residential areas in Cardiff South. Access from both directions of Hillsborough Road is provided via short turning lanes, with westbound traffic turning right across eastbound traffic. Access from Crockett Street onto Hillsborough Road is provided via short merging lanes, with westbound traffic turning right across eastbound traffic
- **Barker Avenue:** An unsignalised intersection with Hillsborough Road. A local street providing access from Hillsborough Road to the Charlestown Golf Club. Access from both directions of Hillsborough Road is provided via short turning lanes, with eastbound traffic turning right across westbound traffic. Access from Barker Avenue onto Hillsborough Road is provided via short merging lanes, with eastbound traffic turning right across westbound traffic.

There is only one formal un-controlled pedestrian crossing point within the proposal area, this crossing point is via an uncontrolled pedestrian refuge adjacent to the existing eastbound and westbound bus stops located between Higham Road and Chadwick Street.

Existing infrastructure within the construction footprint includes five local bus stops, which are positioned along the proposal site. Existing utilities within the construction footprint include overhead and underground electricity, water, sewage, telecommunications and stormwater services (further detailed in Section 3.5).

2.3 Proposal objectives and development criteria

2.3.1 Proposal-specific objectives

The proposal-specific objectives are as follows:

- Improve corridor efficiency and reliability for all modes of transport
- Improve road safety for all road users including vulnerable road users
- Improve access to/from the suburbs of Hillsborough and Cardiff South

2.3.2 Development criteria

The following considerations have informed the design:

- Improve journey time and journey time reliability for road users travelling along the corridor
- Ease traffic congestion
- Consideration of road function, local land use activity and access needs
- Consideration of potential environmental impacts
- Improve connectivity to the wider road network for all road users and improve amenity
- Improve safety for all road users
- Achieve a positive urban design outcome through the development and application of appropriate urban design objectives and principles
- Fit for purpose design to meet the required design life for the identified need and that maximises the project “value for money”
- Design that meets workplace health and safety (WHS) legislation and in particular is safe, efficient and practical for workers and those in the vicinity during temporary traffic arrangements
- Managing construction and design risk

The design criteria are provided in further detail in Section 3.2.

2.3.3 Urban design objectives

Urban design objectives for the proposal include:

- Ensure the Hillsborough Road corridor upgrade sits sensitively within its varied setting from the Warners Bay employment lands through the enclosed forest canopy to the open residential area

- Ensure the proposal responds to its adjoining land uses
- Ensure better connectivity and improved safety for pedestrian/cycle connections
- Maintain and enhance Hillsborough Road as the key connector between NICB and Warners Bay
- Design with consideration for the ongoing maintenance needs of the asset

The design criteria are provided in further detail in Section 3.2.

2.4 Alternatives and options considered

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

2.4.1 Options considered

In 2018, Transport carried out a review of multiple options for the fixed route, including consideration of strategic designs, cost estimates, traffic modelling and economic analysis for potential route options as well as constraints analysis identified from preliminary environmental investigations, desktop studies and site inspections.

The result of this review was the *MR674 Hillsborough Road Hillsborough Corridor Assessment at Hillsborough* (Transport, 2018e) report and two primary options:

- **Do Nothing:** This option would result in Hillsborough Road from Hillsborough to Cardiff South continuing to function in its current state. There would be no improvement in traffic flow, travel times and safety through Hillsborough.
- **Hillsborough Road Duplication:** A dual carriageway option intended to provide two continuous lanes in each direction and improved intersection treatments at Crockett Street, Higham Road and Chadwick Street for improved traffic efficiency and safety.

The 'do nothing' option was not considered a feasible alternative as it is inconsistent with NSW Government objectives and would not help ease the congestion and improve safety for the community. The Hillsborough Road Duplication would also include an off-road shared path, with some allowance for accommodation of on-road cyclists in one or both directions subject to further refinement during concept design.

In 2021, GHD was engaged by Transport to carry out a review of the 2018 Strategic Design and present alternate design options to be assessed for preferred option selection, with consideration to key constraints identified as requiring additional investigation and optioneering. The following key constraints were identified:

1 Road-cross-section of Hillsborough Road in front of residential properties, including consideration of on-street parking, on-road cycling, shared path width and lane widening
2 Access at Higham Road
3 Winding Creek culvert extension options
4 U-turn facilities

Through the completion a number of collaborative workshops, options were identified and considered in the selection of a preferred option to form the final strategic design for further development during the concept design phase.

- Options within Items one to four (see Section 2.4.1) were compared with reference to fulfilling the fundamental and proposal-specific objectives (see Section 2.3). A description of the preferred option (GHD, 2022a) is provided in Section 3, while design refinements made to the preferred option (GHD, 2022b) are discussed in Section 2.5.
- These key design options from the Hillsborough Road Duplication Strategic Options Report (GHD, 2022a) are discussed in Sections 2.4.1.1 to 2.4.1.4.

2.4.1.1 Hillsborough Road cross section (Newcastle Inner City Bypass to Winding Creek)

The 2018 strategic design specified a two metre shoulder (provision for on-road cyclists), no on-street parking and two and a half metre shared path. Review of the desirable shared path width, consideration for on-street parking and review of safe access to residential properties were undertaken as part of the 2022 concept design.

Design criteria considerations were based on retaining existing facilities as well as improving the efficiency and safety for road users. The preferred option retains existing overhead power poles and provides the following facilities:

- Three metre shared path
- Two metre shoulder (with provision for on-road cyclists in shoulder)
- No on-street parking

All residents within the assessment area have off-street parking facilities (driveway/garage). By removing on-street parking, it was determined that residents or visitors can park either within the property or in nearby side streets to access their properties. This work also reduces the width of land acquisition required with the CNCC Showgrounds.

The final shared path width of three metres was adopted as this was the current minimum standard width adopted within Lake Macquarie LGA along with the provision of an on-road cycle-lane facility.

By retaining the existing overhead power poles and providing a three metre shared path, the safety of access into residential properties was improved from the strategic design arrangement by providing increased distance between property fences and the shared path. This improves site distance for residents exiting their property to both the shared path and Hillsborough Road traffic lanes.

2.4.1.2 Access at Higham Road

Higham Road intersection with Hillsborough Road currently provides a left and right turn in/out movement. This will no longer be possible with a new raised central median and lane duplication. Some form of road termination would be required to prevent access and redirect access/egress through the subdivision via the new Chadwick Street traffic signals.

The 2018 strategic design provided a cul-de-sac turning head suitable for a light vehicle only. Residential property acquisition would be required to construct this new cul-de-sac head.

During the 2021 options assessment, consideration was given to allowing left-out only access from Higham Road to allow residential properties (between Higham Road and Chadwick Street) access to their property frontage via the new Chadwick Street traffic light when travelling westbound. This would mitigate the need to travel west to a U-turn facility and then return east.

Addressing community concerns and providing a secondary emergency access from the subdivision was also considered.

The preferred option was to provide left-out only vehicle access and a raised shared path across a concrete crossing, with priority access to pedestrians and cyclists.

2.4.1.3 Winding Creek culvert extension

The Winding Creek culvert requires modification due to the Hillsborough Road duplication. The following options were considered:

- Extension of the existing culverts upstream and downstream
- Extension of the culverts upstream with a pedestrian bridge on the downstream side
- Full replacement of the existing culverts

Based on the available information related to the existing culverts, full replacement was not considered to be required. The assessment then concluded that the preferred option was to extend the culvert on both the upstream and downstream side based on geometric issues and the existing downstream headwall requiring significant work for it to be retained.

2.4.1.4 U-turn facilities

The Hillsborough Road lane duplication and introduction of a solid median barrier along Hillsborough Road removes the ability for commercial and light vehicles to turn right (eastbound) onto Hillsborough Road from the commercial premises (Whalan's Nurseries and Shed Quarters), CNCC Showground and the Charlestown Golf Club at Barker Avenue.

While larger vehicles (i.e. vehicles over 12.5 metre rigid) would find an alternate route to return eastbound, options for light vehicles, trailers/caravans and service vehicles (up to a 12.5 metre rigid vehicle and car and caravan up to 19 metre) to turn around and travel eastbound were investigated.

The following options were considered as part of the options workshops and again throughout the completion of the concept design:

- **Existing road network at Warners Bay commercial area:** This "do nothing" option relies on utilising the existing commercial areas on both sides of Hillsborough Road beyond the western extents of the project.
- **Crockett Street Intersection:** This U-turn facility would require the addition of a fourth intersection leg on the southern side.
- **Along Crockett Street:** Two potential locations for inclusion of a roundabout on Crockett Street at either Gertrude Street or King Street.
- **Barker Avenue Intersection:** This option involves a fourth leg to the Barker Avenue intersection on the northern side, and would also require adding traffic lights to the intersection.
- **Along Barker Avenue:** This option involves a u-turn facility along Barker Avenue and adding traffic lights to the Hillsborough Road and Barker Avenue intersection to allow right turn out of Barker Avenue.

The options were assessed taking into consideration:

- Traffic impact and travel time saving
- Safety (vehicles, cyclist and pedestrians)
- Location compatibility if project is to be delivered in a staged approach
- Environmental and Socio-economic impacts (including potential impact on local residents)
- Cost
- Practicality of use

The outcome of the assessment was that the U-turn facility along Barker Avenue (including traffic lights on the Barker Avenue intersection) was the preferred option.

2.5 Design refinements

Following the confirmation of the preferred options a number of design refinements have occurred during the concept design phase. Key design refinements are summarised in Table 2.1.

Table 2.1: Design refinements

Proposal element	Design refinement	Description / Reason
Retaining walls	Reduction in number of retaining walls	Removal of retaining walls on Hillsborough Road eastbound at Western tie in, at Crockett Street and on Hillsborough Road east of Barker Avenue and replacement with batters to minimise cost and reduce maintenance.
Pavement	Changes to proposed pavement	Pavements were amended to retain existing pavements using overlays where existing pavement is sound to minimise cost and retain recently installed pavement overlays.
U-Turn facility	Relocation of U-Turn facility from Crockett Street intersection to Barker Avenue	Following submission of the 20% per cent concept design which nominated the U-turn facility to be located at the Crockett Street intersection, assessment of intersection performance and compatibility with construction staging was assessed that the U-turn facility should be relocated to Barker Avenue for the 80per cent concept design.
On road cyclist	Addition of cyclist headstart at Chadwick Street	Increases safety of cyclists at new traffic lights giving cyclists a head start against left turning traffic into Chadwick Street.
CNCC Showground access	Splitting of entry and exit to and from Canine showground	Entry and exit to and from Canine show ground has been split into two separate access points allowing for the entry and exit of larger vehicles.
Cross Drainage	Replacement of existing cross culvert west of Barker Avenue	The existing culvert under Hillsborough Road west of Barker Avenue was found to be undersized and is now proposed to be replaced rather than lengthened as proposed in the strategic design.

3 Description of the proposal

3.1 The proposal

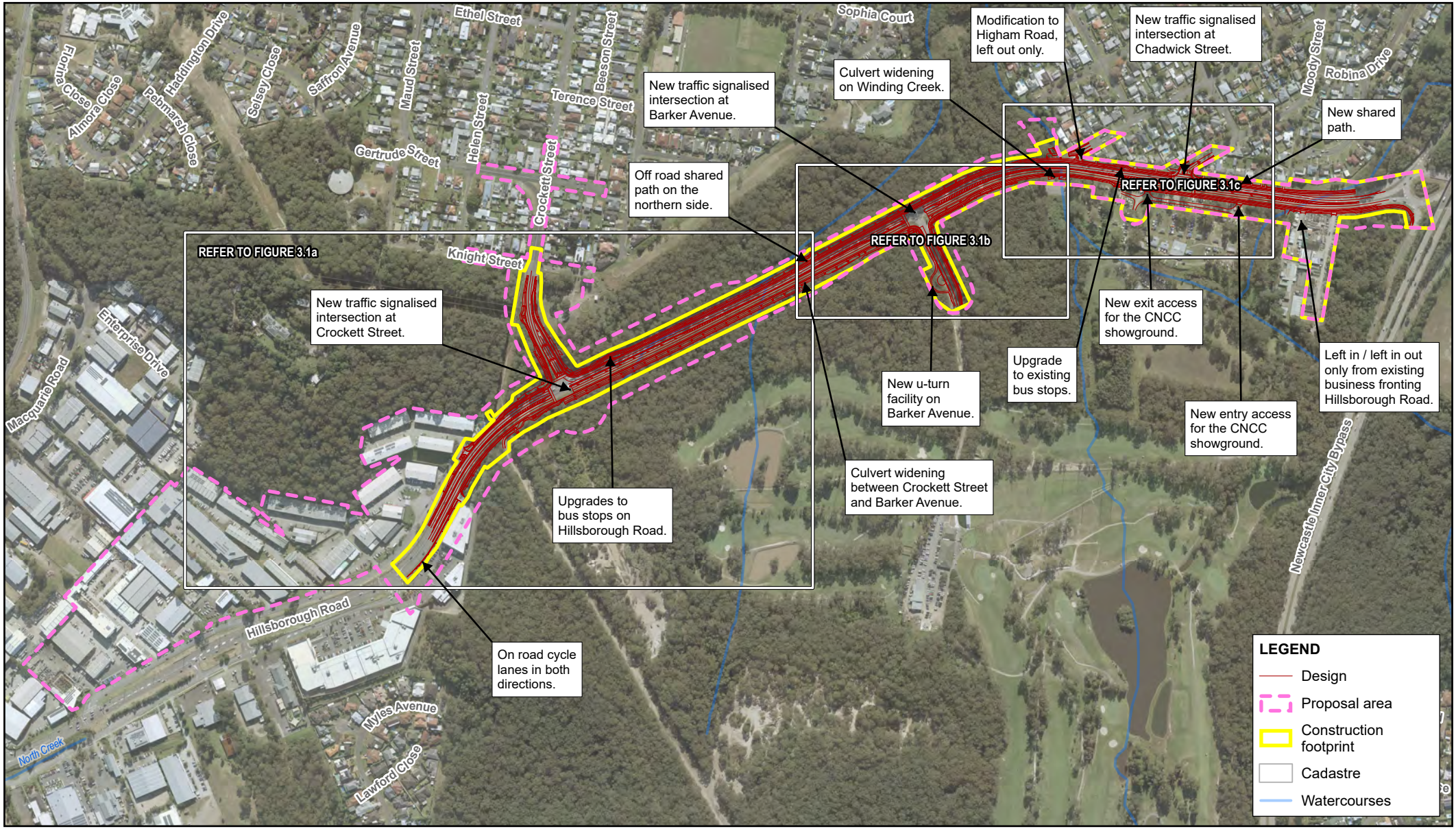
Transport proposes to duplicate Hillsborough Road between the NICB in the east, to west of the Crockett Street intersction. The proposal is shown in Figure 3.1 with detail design drawings attached in Appendix C.

Key features of the proposal include:

- Duplication of about 1.8 kilometres of Hillsborough Road from the NICB roundabout west to a tie in point about 300 metres west of Crockett Street.
- Two lanes each a minimum 3.3 metre wide each way with a solid central median barrier.
- Closure of the right in and right out access for businesses to the east of CNCC Showgrounds on Hillsborough Road.
- Posted speed of 60 km/h.
- New traffic lights at the Chadwick Street intersection including pedestrian crossings.
- Modification of Higham Road intersection.
- New traffic lights at the Barker Avenue intersection including pedestrian crossing.
- U-turn facility on Barker Avenue.
- Access gates to be relocated beyond U-turn facility.
- New traffic lights at the Crockett Street intersection including pedestrian crossings.
- Provision for on-road cyclists within shoulder in both directions.
- Off-road concrete shared path on the northern side tying into existing path.
- Upgraded bus stop facilities on Hillsborough Road at Crockett Street intersection, Chadwick Street intersection and on Crockett Street. All bus stops are to have shelters with the exception of the southbound bus lay over on Crockett Street.
- Culvert widening on Winding Creek both up stream and down stream of existing culvert structure.
- Culvert widening and full replacement of existing culvert between Crockett Street and Barker Avenue.
- New separated left in only entry and left out only exit for the CNCC Showgrounds located east (entry) and west (exit) of Chadwick Street intersection.
- Maintained access to the Hillsborough Road fire trail opposite Crockett Street.
- Left in / left out only access from existing businesses fronting Hillsborough Road, east of the CNCC Showgrounds.
- Left in / left out only access to residences on Hillsborough Road, east of CNCC Showgrounds.
- Relocation of utilities including, telecommunications, water, power, street lighting and minor adjustments to sewer infrastructure.
- New as well as upgraded street lighting on Hillsborough Road.
- Reinforced concrete retaining walls including facing panels.
- Site investigations, including but not limited to geotechnical investigations.
- Installation of fauna connectivity structures, such as rope crossings.
- Minor property acquisition and adjustments including fencing, access and driveway adjustments.

- Site preparation works, including establishing ancillary facilities, vegetation clearing, site fencing, temporary drainage measures, and implementation of environmental management measures.
- Temporary construction facilities, including site compounds and stockpile sites at the Whalan's Nurseries site – Hillsborough Road, and at vacant commercial buildings within the Warners Bay Commercial Centre – Accessed by northern commercial access road of Hillsborough Road.

Construction of the proposal is planned to be delivered in stages. The NSW Government has announced $35 million to deliver the first stage of the Hillsborough Road upgrade. Stage 1 involves upgrading Crockett Street intersection, including installation of traffic lights. Stage 1 is expected to commence construction in 2025 and take about 18 months to complete depending on final staging arrangements. Timing for construction of the remaining stages is subject to project approvals and funding.



Paper Size ISO A4

0 50 100 150 200

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

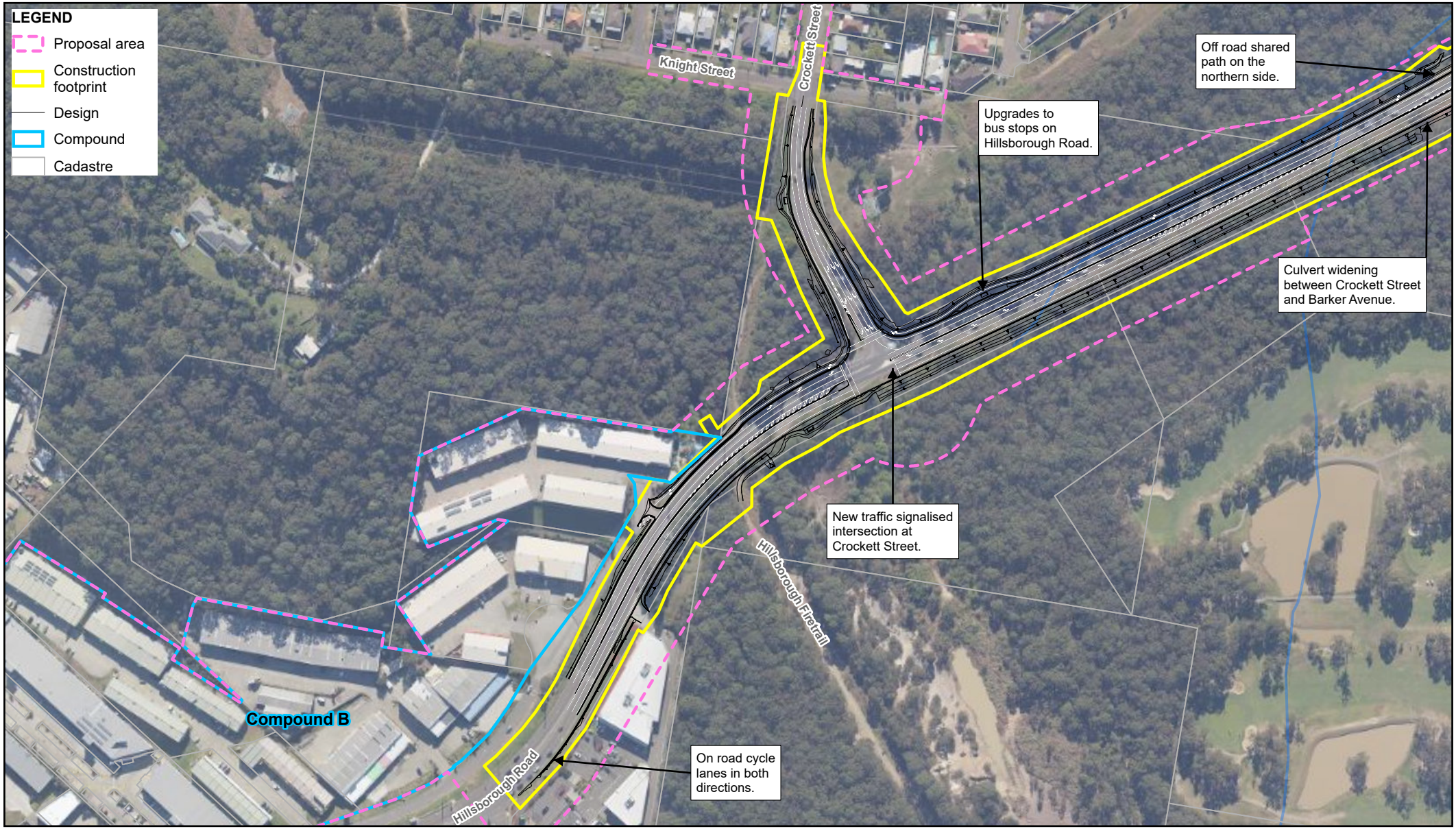
Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

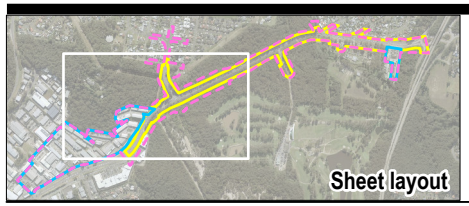
Key features of the proposal

FIGURE 3.1

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:24

Data source: Metromap Tile Service: - Imagery (Date extracted: 11/10/2022); Roads, Cadastre, Watercourses - LPI, 2017; Created by: tmorton





Paper Size ISO A4

0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

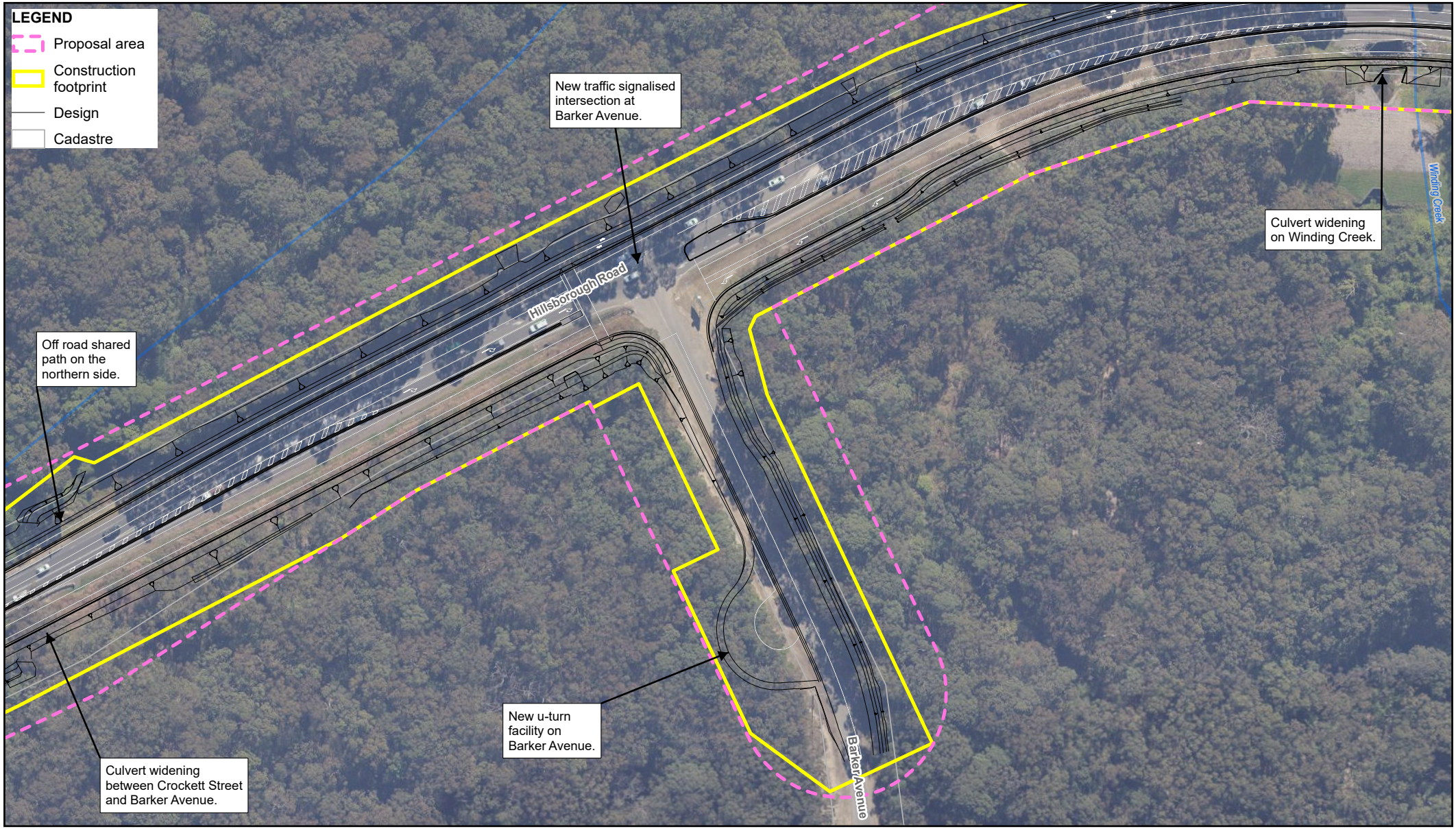
Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Key features of the proposal Crockett Street

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

FIGURE 3.1a

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:20



Paper Size ISO A4

0 10 20 30 40

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

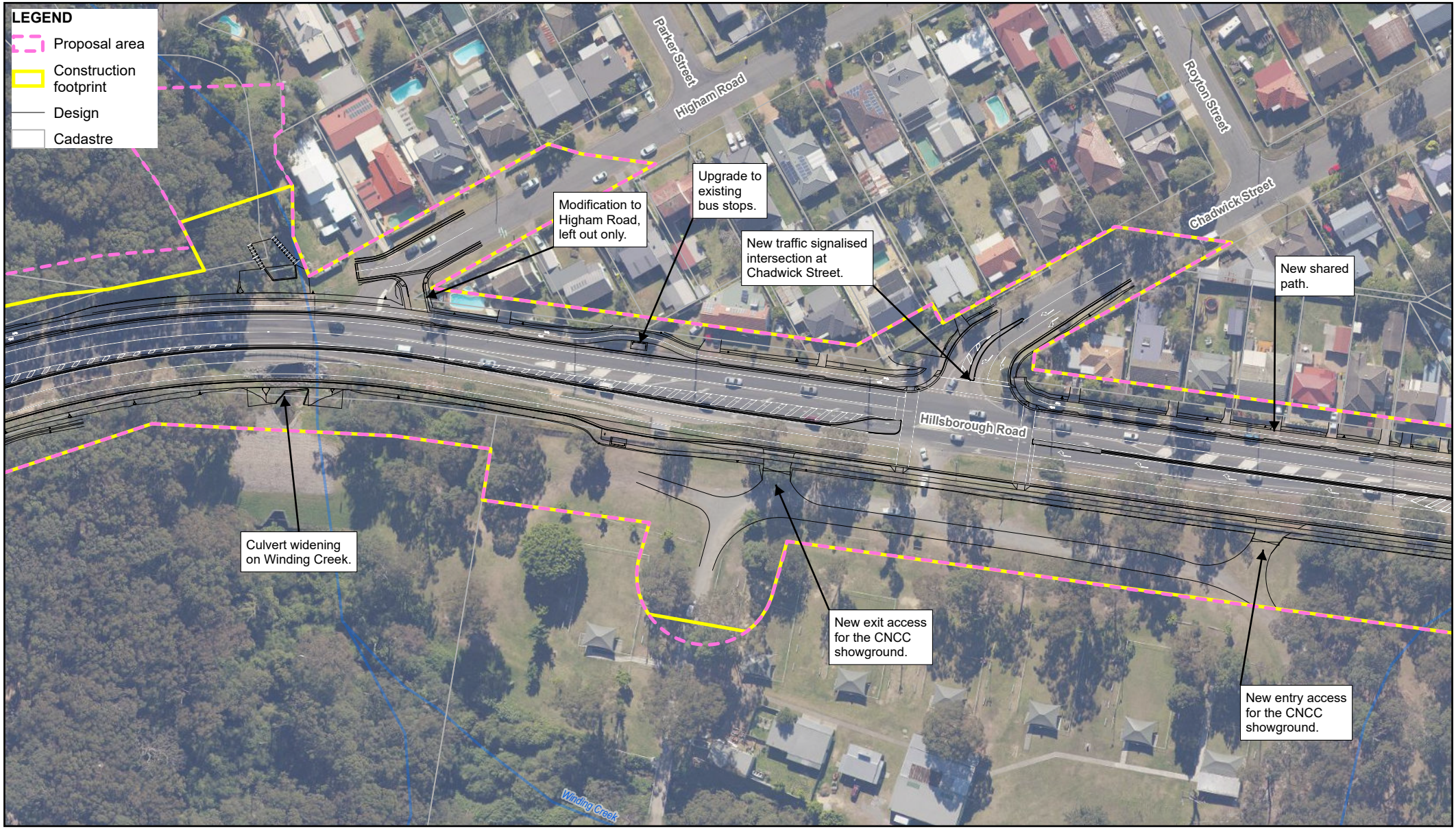
Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

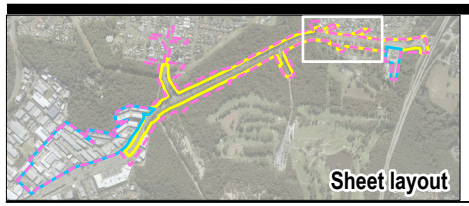
Key features of the proposal
Barker Avenue

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

FIGURE 3.1b

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:20





Paper Size ISO A4

0 10 20 30 40

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Key features of the proposal Higham Road and Chadwick Street

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

FIGURE 3.1c

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:20

3.2 Design

The concept design for the proposal is described below and would be further refined in subsequent design phases as a result of ongoing design investigation and consideration of the environmental safeguards discussed in Chapter 6 (Environmental assessment).

3.2.1 Design criteria

The design criteria and reference documents that have been applied to the concept design of the proposal include the following:

- Austroads Guide to Road Design (Austroads, 2009) and associated Transport supplements to Austroads Guide to Road Design Set
- Australian Standards and associated Transport supplements
- Transport Technical Directions
- Australian Rainfall and Runoff
- Standards Australia Handbooks
- Local Government Standards (where applicable)

The following considerations have informed the concept design:

- The proposal objectives, as detailed in Section 2.3
- Minimising adverse environmental impacts
- Planning temporary arrangements that minimise disruption to local and through traffic
- Maintaining access to nearby properties during construction
- Minimising land acquisition

The road design criteria for the proposal are summarised in Table 3.1 and Figure 3.2 to Figure 3.5 shows a section view of the proposal along Hillsborough Road.

Table 3.1: Design criteria

Key element	Description
Posted speed	60 km/h – Hillsborough Road
	50 km/h – Side Road
	50 km/h– Barker Avenue
Design speed	70 km/h – Hillsborough Road
	60 km/h – Side Road
	60 km/h – Barker Avenue
Lane widths	3.3 metre minimum + widening kerb side – Hillsborough Road
	3.3 metre minimum – Crockett Street
	4.5 metre and variable – Barker Avenue
	4.5 metre and variable – Higham Road
	3.3 metre minimum – Chadwick Street
Left and right turn auxiliary lane widths	3.3 to 3.8 metre depending on design vehicle
Median widths	1.6 metre minimum including High Profile Re-directive Kerb (HPRK)

Key element	Description
Footpath width	1.5 metre minimum
Shared path width	3 metre
Road grade	0.5% to 7% - Hillsborough Road
	Up to 8% matching existing – Crockett Street
	Up to 6% - Barker Avenue
	0.5% matching existing – termination of Higham Road
	Up to 5.7% - Left out driveway from Higham Road
	0.25 to 0.5% matching existing – Chadwick Street
Drainage	Pit and pipe system to road carriageways 1:10 year minor 1:100 year major, annual recurrence probability (ARI)
	Pipe and box culvert cross drainage under carriageways, maintain existing capacity with design check for 1:100 year ARI

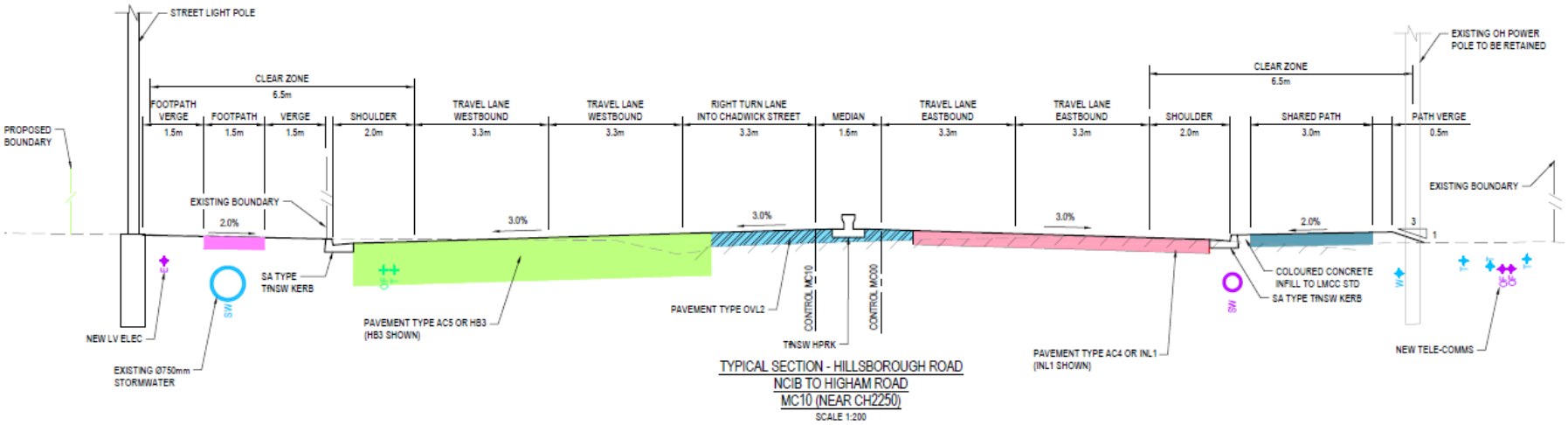


Figure 3.2: Cross section – NICB to Higham Road

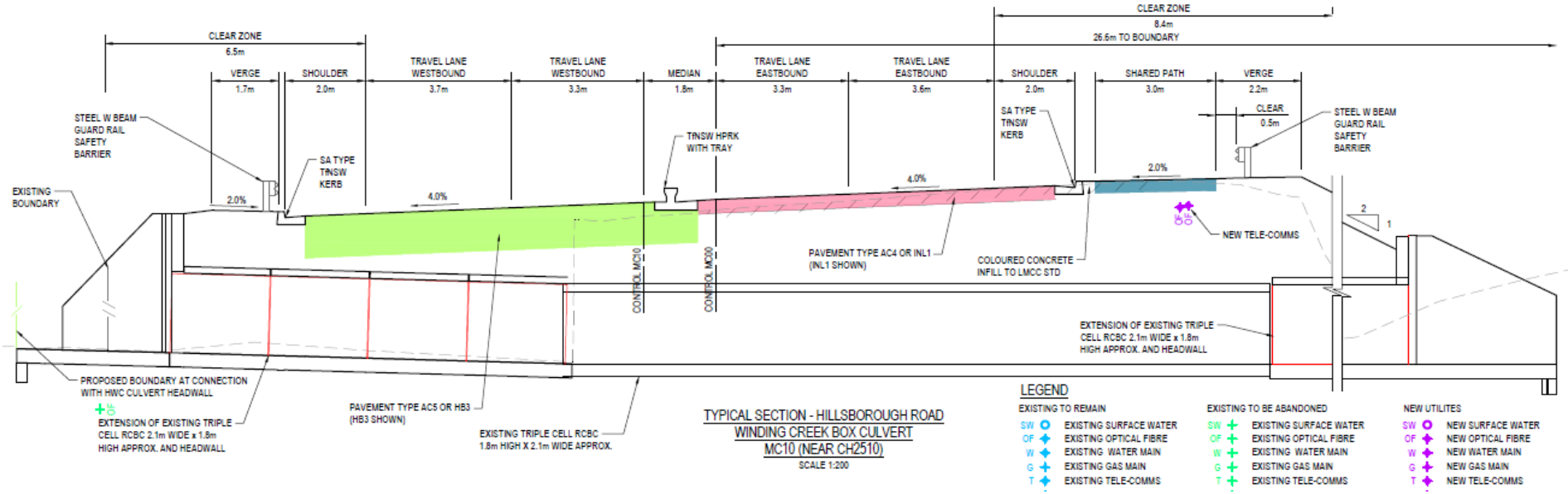


Figure 3.3: Cross section – Winding Creek

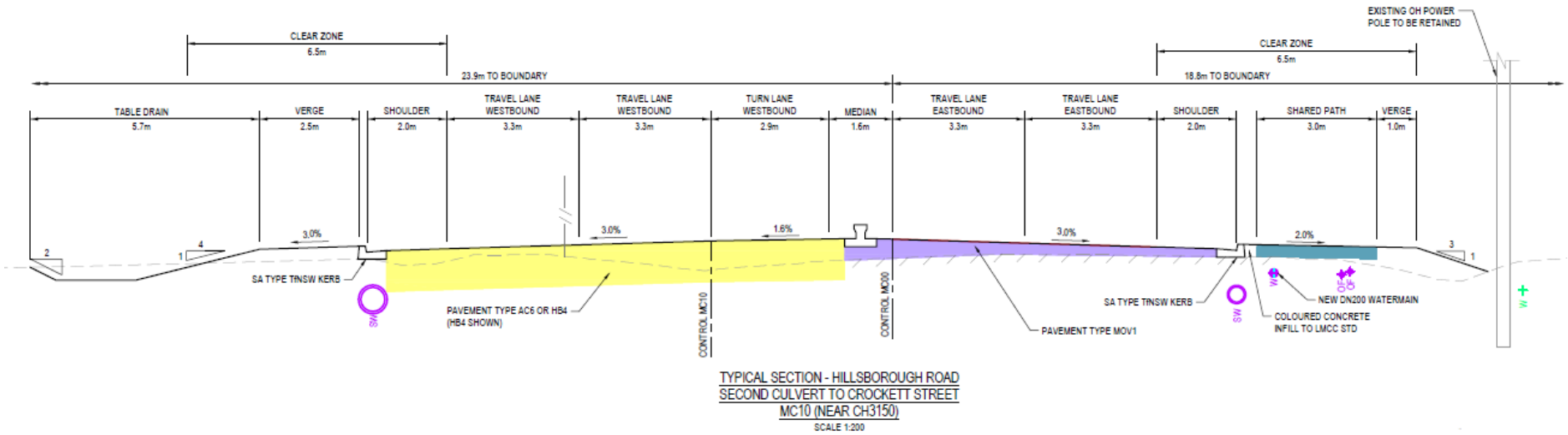


Figure 3.4: Cross section – Barker Ave to Crockett St

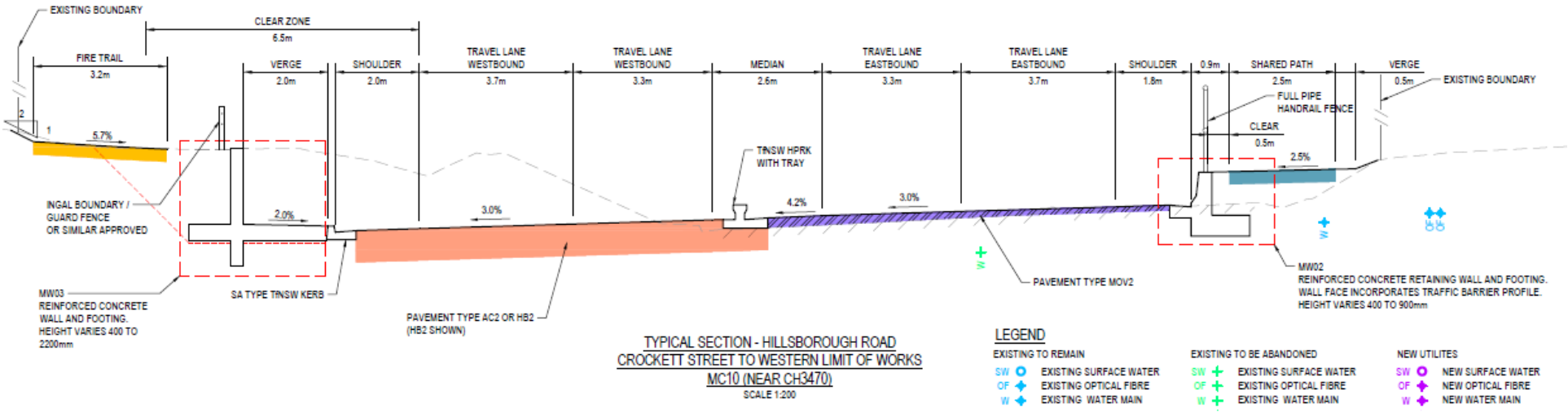


Figure 3.5: Cross section – Crockett Street to western limit of works

3.2.2 Engineering and land use constraints

The key constraints to the development of the proposal include:

- The need to minimise property acquisition, adjustment and access impacts to residents, businesses and recreational areas.
- Land between business park and Crockett Street which is zoned as Environmental Conservation and/or owned by the relevant Local Aboriginal Land Council (LALC).
- Power poles with overhead power lines within about one metre of the existing edge line.
- Water and sewer mains both crossing and parallel to Hillsborough Road.
- Optic fibre and copper communications cables.
- Minimising impacts to Aboriginal heritage.
- Minimise impacts to sensitive biodiversity values, such as threatened species or ecological communities.
- Vertical and horizontal sight distance constraints where tying into existing road formations.
- There is a cutting between the service road intersection and the fire trail at the western end of the Proposal. The cutting is about 2.1 metres high with batter slope about 2:1.
- There is a fire trail which runs north-south accessing an unsealed access from Hillsborough Road on the inside of the curve.
- Winding Creek passes under the roadway in a triple cell culvert.
- Maintaining the existing flooding regime of Winding Creek and minimising flooding impacts associated with the proposal.
- Maintaining traffic flow during construction along Hillsborough Road and adjoining side streets.

3.2.3 Major design features

The major design features of the proposal are shown in Figure 3.1 and described in the following sections. These features have been developed to concept design level and would be further refined subject to detailed design development and innovation.

3.2.3.1 Duplication of Hillsborough Road

The existing Hillsborough Road between the NICB roundabout west to a tie in point about 300 metres west of Crockett Street would be duplicated from two lanes to four lanes. This would provide two lanes in each direction with a minimum 3.3 metre width and a solid central median barrier to separate east-bound and west-bound traffic. The proposal would remove the right in/right out access, and hence provide a left in/left out only access for businesses on the southern portion of Hillsborough Road. The travel lanes would have a posted speed of 60 km/h.

3.2.3.2 New Chadwick Street traffic lights

Chadwick Street is currently an uncontrolled intersection with protected right turn in and left turn out lanes. The intersection will be upgraded to a new traffic light arrangement with a new right turn lane and left turn lane into Chadwick Street. The new signalised intersection has the following arrangement:

- Dedicated right turn lane into Chadwick Street westbound from Hillsborough Road
- Single dedicated right turn lane into Hillsborough Road from Chadwick Street
- Single dedicated left turn lane into Hillsborough Road from Chadwick Street
- On-road cycle provision on northern side of Hillsborough Road
- Provision for shared pathway crossing on Chadwick Street east-west leg
- Provision for pedestrian crossing on both east and western legs of intersection
- Provision for 1.5 metre wide concrete path on southern side of Hillsborough Road to access upgraded bus stop west of intersection

3.2.3.3 Higham Road intersection

Higham Road currently is an uncontrolled four-way movement intersection with Hillsborough Road that is proposed to be partially closed to vehicle access. The Higham Road intersection modification includes the following arrangement:

- Terminated turning head to allow service vehicle to perform a u-Turn in Higham Road
- Concrete access with give-way to shared path users for left-out only access to Hillsborough Road via driveway layback
- Shared path on northern side of Hillsborough Road with priority crossing Higham Road left out access

3.2.3.4 Cross drainage

The Winding Creek culvert requires extension on both the upstream and downstream sides due to the Hillsborough Road duplication. Several culvert options have been discussed in detail in Section 2.4.

Modifications and maintenance to existing drainage structures including pits, pipes, headwalls and culverts to suit the road widening and to maintain capacity as well as new drainage features at the following locations:

- Along both sides of Hillsborough Road and within medians as required for the extents of Hillsborough Road works discharging into Winding Creek and existing drainage network at the western end of works
- Along the southern side of Chadwick Street for the extent of Chadwick Street works connecting into the existing drainage network in Chadwick Street
- Along the southern side of Higham Road for the extent of works in Higham Road discharging into Winding Creek
- At the northern end of Barker Avenue discharging into Winding Creek
- At the southern end of Crockett Street discharging into upper reaches of Winding Creek

3.2.3.5 New Barker Avenue traffic lights

The Barker Avenue intersection currently has left and right turn in lanes and left and right turn out lanes without traffic lights. The proposed design includes a new traffic light arrangement with the following arrangement:

- Dedicated right turn lane into Barker Avenue from Hillsborough Road eastbound
- Dedicated left turn lane into Barker Avenue from Hillsborough Road westbound
- Dedicated cycle provision between westbound through lane and westbound left turn into Barker Avenue
- Single lane exiting Barker Avenue for both left and right turning traffic into Hillsborough Road
- Provision for pedestrian crossing on western leg of intersection only
- Shared path on northern side of Hillsborough Road
- 1.5 metre wide path from western leg pedestrian crossing terminating in Barker Avenue
- Relocation of private access gates to Charlestown Golf Club (in consultation with business)

3.2.3.6 U-turn facility

In response to community consultation, Transport has included a u-turn facility as part of the proposal following a Multi Criteria Analysis (MCA) options assessment process to determine the most appropriate location within the project. The u--turn facility will cater for vehicles wishing to travel east from the commercial businesses, and CNCC Showground where right turn access is now removed due to the raised central median. The u-turn facility has been included along Barker Avenue and would utilise the traffic lights at the intersection of Barker Avenue and Hillsborough Road. The geometry is designed to cater for large, rigid vehicles (12.5 metre) and the caravans that frequent the CNCC Showgrounds.

3.2.3.7 New Crockett Street traffic lights

Crockett Street is currently an uncontrolled intersection with protected right turn in and left turn out lanes to be upgraded to a new traffic light arrangement. The new signalised intersection has the following arrangement:

- Dedicated right and left turn lanes into Crockett Street from Hillsborough Road
- Right turn lane into Hillsborough Road from Crockett Street
- Dual left turn lanes into Hillsborough Road from Crockett Street
- Provision for shared path crossing on the northern east-west leg
- Provision for pedestrian crossing on western leg of the intersection only
- Provision for 1.5 metre wide concrete path on southern side of the intersection connecting the pedestrian crossing to new bus stop west of intersection

3.2.3.8 Retaining walls

There are two minor retaining walls required within the project to limit the road batters spilling into adjacent property boundaries, or to retain the existing ground levels at road cut and fill locations. The type of wall construction will generally consist of a concrete wall and footing solution. In addition to these two walls a road side barrier wall is required to retain the shared path on the northern side of Hillsborough Road.

3.2.3.9 Cyclist and pedestrian facilities

Allowance for cyclists and pedestrians within the project limits has been provided within the following infrastructure:

- On-road cycling provision within the two metre wide shoulder eastbound and westbound
- Three metre wide off-road shared path has been provided on the northern side of Hillsborough Road
- Signalised pedestrian crossings at new Crockett Street, Barker Avenue and Chadwick Street traffic lights
- 1.5 metre footpath between the northbound NICB offload ramp at Hillsborough Road and the westbound bus stop west of Chadwick Street, at the south western corner of the intersection of Hillsborough Road with Barker Avenue, and on the southern side of Hillsborough Road between the intersection of Hillsborough Road with Crockett Street and the westbound bus stop located west of Crockett Street

Dedicated pedestrian crossings at traffic signals and median islands are provided across most legs of the upgraded intersections, substantially improving the accessibility and safety of the intersection.

Pedestrian fencing requirements will be investigated during subsequent design stages.

There is a localised reduced path width from three metres to 2.5 metres on the western end of the proposal area. The reduced width is required to minimise power pole impacts and property acquisition. Reduction in path width will be reviewed in the subsequent design stages and adjusted as necessary.

3.2.3.10 Bus facilities

There are currently three formal bus stop locations on Hillsborough Road and two on Crockett Street within the project limits. It is proposed to retain these existing bus stops and add a new bus stop west of Crockett Street, however the location may be adjusted during detailed design in consultation with the bus companies to determine the most appropriate location relative to traffic lights.

These bus stops have varying degrees of street furniture. The use of floating bus shelters will improve the safety for cyclists on Hillsborough Road. Both LMCC and NSW State Bus Infrastructure have standard drawings for bus stop facilities. The revised strategic design has noted the bus stop arrangements as shown below in Table 3.2.

Table 3.2: Bus stop arrangement

Location	Existing layout	Proposed layout	Proposed furniture
Eastern end of Hillsborough Road **eastbound**	Indented bus stop with standard bus shelter	Kerbside (two metre shoulder)	Floating bus shelter
Eastern end of Hillsborough Road **westbound**	Kerbside in shoulder with seat only	Indented bus bay	Bus shelter
Western end of Hillsborough Road **eastbound**	Kerbside in shoulder with seat only	Kerbside (Indented + 2 metre shoulder)	Floating bus shelter
Western end of Hillsborough Road **Westbound**	No facility	Indented bus bay relocated west	Bus shelter
Crockett Street **Southbound**	Indented sealed shoulder, no seat or shelter	Reseal but retain existing	None
Crockett Street **Northbound**	Indented sealed shoulder, no seat or shelter	Indented bus bay	Bus Shelter

3.2.3.11 Property adjustments

The proposal requires physical works within the boundary of 20 private properties as listed in Table 3.3. This includes adjustments to private and business driveway accesses, relocated drainage, relocated utility connections and boundary fencing were affected by the proposal. Any adjustments to properties required for the proposal would be carried out in consultation with the property owner.

Table 3.3: Design refinements

Location	Reason for adjustment
Lot 132 PD624727	Property acquisition for road alignment
Lot 131 DP624727	Property acquisition for road alignment
Lot 308 DP755233	Property acquisition for road alignment
Lot 1 DP508106	Property acquisition for road alignment
Lot 2071 DP172365	Required due to road alignment
Lot 10 DP1151070	Required due to road alignment
Lot 25 DP234483	Required due to road alignment
Lot 26 DP234483	Required due to road alignment
Lot 6 DP508106	Required due to road alignment
Lot 5 DP508106	Required due to road alignment
Lot 4 DP508106	Required due to road alignment
Lot 3 DP508106	Required due to road alignment
Lot 2 DP508106	Required due to road alignment

Location	Reason for adjustment
Lot 14 DP204385	Required due to road alignment
Lot 13 DP204385	Required due to road alignment
Lot 12 DP204385	Required due to road alignment
Lot 11 DP204385	Required due to road alignment
Lot 10 DP204385	Required due to road alignment
Lot 9 DP204385	Required due to road alignment
Lot 501 DP1178962	Required due to road alignment

3.2.3.12 Public utilities and lighting

There are a number of public utilities within the proposal site that would require adjustment or relocation as part of the proposal. The exact location and nature of these utility relocations would be developed throughout the detailed design phase Refer to Section 6.11 for further details.

Along the length of the proposal there would be upgrades to existing as we as new street lighting to accommodate the widened carriageway.

3.2.3.13 Landscaping

A landscape strategy has been developed for the proposal, this strategy forms part of the overall Urban and Landscape Design Strategy as described in Section 6.10 and Appendix L. 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.

3.3 Construction activities

The indicative methodology, staging, work hours, and plant and equipment to construct the proposal are described in this section. Subject to approval, construction of Stage 1 is expected to commence in 2025 and take around 18 months to complete depending on final staging to be determined during detailed design and potential impacts due to wet weather.

The construction methodology would be further developed by the nominated contractor during the detailed design of the proposal in consultation with Transport.

The actual construction work methods may vary from the description assessed in this REF due to the identification of additional constraints before work starts, ongoing detailed design refinements, feedback from community and stakeholder consultation, and contractor requirements/limitations.

The proposal would be built under Transport construction specifications under a construction environmental management plan (CEMP). The specifications would cover environmental performance and management including vegetation removal, stockpile management and erosion and sediment control.

The proposed construction activities for the proposal are identified in Table 3.4. This staging and the activities undertaken within each stage is indicative and is based on the current concept design and subject to change once the detailed design methodology is finalised.

Table 3.4: Proposed construction work methodology

Proposed works
Establishment work
Site establishment works may include, but not be limited to, the following: • Installation of fencing and sediment and erosion control works • Installation of architectural noise treatment to eligible properties • Property adjustment works including relocating fences and boundary features • Minor earthworks to establish temporary construction roads, level areas for site compounds • Minor vegetation clearing and grubbing works • Utility relocation and connection works • Establishment of construction compounds • Minor road works to establish access points
Early works
Removal where required of existing medians and pedestrian islands and provision of any temporary pavement on Hillsborough to allow Stage 1 works to be completed.
Removal of existing pavement marking and provision of temporary pavement marking and delineation.
Placement of temporary traffic barriers to delineate trafficable lanes from construction area.
Utilities identification, relocation and install on new services.
Site investigations including but not limited to geotechnical investigations.
Installation of fauna connectivity structures, such as rope crossings.
Minor property acquisition and adjustments including fencing, access and driveway adjustments.
Construction phase 1
Construction works will occur on the southern side of Hillsborough Road. The scope of works will include: • Finalise utility relocation work • Clearing and grubbing • Earthworks • Pavement works • Drainage and kerb work • Culvert extension work • Concrete work including medians, footpaths and property accesses
Chadwick Street construction will occur on the eastern side while through traffic travels on the western side on the existing road. Construction activities on Chadwick Street will include earthworks, pavement, kerbs, medians, drainage and utility relocations.
Barker Avenue is to be constructed in halves so that through traffic can be maintained. Work activities to complete on Barker Avenue include kerbs, drainage, earthworks and pavement work.
Crockett Street will be widened to the western side. Stage 1 construction works will include completing the construction of the extended western side of Crockett Street including all earthworks, drainage, utilities and pavement works.
Traffic adjustments to switch live traffic (Traffic moved to newly constructed pavement) including: • Pavement completion • Temporary line marking and delineation • Installation of temporary signage and barriers • Traffic switch

Proposed works
Construction phase 2
Construction works will occur on the northern side of Hillsborough Road until Crockett Street intersection. The indicative scope of works includes: • Utility relocation works • Earthworks • Pavement works • Drainage and kerb work • Culvert extension work • Concrete works including medians, footpaths and property accesses
Chadwick Street construction will occur on the western side while through traffic travels on the eastern side on the newly constructed road.
Higham Road will be under construction most likely without any major staging.
The eastern side of Crockett Street will be reconstructed. Stage 2 construction works will include all earthworks, drainage, utilities, pavement works and other works to complete the construction of Crockett Street.
West of the intersection with Crockett Street construction works will be undertaken on the centre section of Hillsborough Road. This will include earthworks; pavement works and medians. Temporary works to the medians and pavement at the western end of the proposal will be made to allow for the Stage 3 traffic arrangements.
Construction phase 3
Construction of full depth pavement on remaining section of Hillsborough Road at the intersections of Chadwick Street and Crockett Street.
Central pavement and median work on Hillsborough Road between Chadwick Street and Crockett Street.
Asphalt overlay pavement work on the northern side of Hillsborough Road from Crockett Street to the western extent of the proposal work.
Finishing work to the median and traffic island on the approach to the NICB Interchange at the eastern extent of the proposal.
Construction phase 4
Construction activities will include works to complete the central medians at the Chadwick Street and Crockett Street intersections and at the western extent of the proposal.
Completion of all finishing works including pavement wearing course to be completed during this Stage.
Demobilisation
Demobilise construction compounds and rehabilitate disturbed areas in accordance with the management measures detailed in Section 7.

3.3.1 Construction workforce

The construction workforce would fluctuate, depending on the stage of construction and associated activities. The workforce would be expected to be between about 35 and 40 personnel at any given time during the construction period. The final number of construction workers would be identified by the construction contractor.

3.3.2 Construction hours and duration

Construction would be carried out where possible during standard construction working hours as defined by the Interim Construction Noise Guideline (DECC, 2009):

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm

- Sundays and public holidays: generally no work

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

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

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

- Delivery of construction materials such as precast culvert sections for Winding Creek
- Installation and adjustment of barriers and signage for construction zones during each construction stage
- Intersection and tie-in activities to the existing road network
- Activities that may impact access to businesses during business hours
- Operation of construction compounds to support the above work

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.

3.3.3 Plant and equipment

An indicative list of plant and equipment that would be required to construct the proposal is provided in Table 3.5. Additional plant and equipment likely to be used would be identified during detailed design by the nominated contractor.

Table 3.5: Indicative plant and equipment for the proposal

Plant / equipment	
Small drill rig	Small hand-held tools
Small and large excavators	Dumper
Excavator mulch head	Offset boom excavator with rock saw, hammer and bucket attachments
Small and large tipper trucks	Asphalt plant and machinery including milling machines
Small front end tipper all terrain vehicle	Small and franna crane
Franna cranes	Elevated work platform and telehandler
Concreting equipment	Road line marking truck
Small vibratory roller	Concreting equipment including pump, saw, and agitator
Truck with cantilever platform	Traffic control equipment including signage
Hydromulching equipment	Generator and lighting towers
Light vehicles	Trucks and semi trailers

3.3.4 Earthworks

The proposal would result in about 14,000 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.

The proposal would also require about 4,500 cubic metres of fill material to construct ground treatments. The final earthwork requirements and source of materials would be confirmed during detail design.

The proposal would involve excavation of material from existing batters and foundations, trenching and backfill, as well as placement and compaction of site-won and imported fill. Excavated material would be reused on-site where possible or managed in accordance with relevant legislative requirements. This includes the removal and recycling of road pavement where possible.

Any remaining surplus material would be managed and stored (stockpiled) in a suitable location for future use by Transport on future projects or disposed of in accordance with the mitigation measures outlined in this report, and subject to testing and classification in accordance with the Waste Classification Guideline.

Allowance would be made at the proposed compounds for initial stockpiling or surplus material, either for re use elsewhere on the proposal, or prior to its disposal. Sufficient space exists across the proposed compounds to accommodate material stockpiles, and these would be managed in accordance with the contractor's CEMP.

3.3.5 Source of materials

Materials would be sourced from local areas where practicable. The ability to reuse the material would depend on its physical and chemical properties. Material unsuitable for construction would be managed in accordance with resource management hierarchy principles, including (in order of preference):

- Reused as engineered fill onsite
- Transferred:
  - To another Transport project for reuse in accordance with the NSW Environment Protection Authority (EPA) Excavated Public Road Material resource recovery exemption.
  - To an approved Transport stockpile site for future re-use, only if a specific project has been identified before stockpiling and the *Protection of the Environment Operations Act 1997* (POEO Act) waste regulatory requirements have been met. If a project cannot be identified the material would not be stockpiled within the proposal.
  - Off site for reuse by a third party in accordance with a relevant EPA Excavated Public Road Material resource recovery exemption or relevant planning approval.
  - To a licensed waste recovery site.
  - For disposal at a licensed facility.
  - As otherwise provided for by the relevant waste legislation.

Natural resources required for construction of the proposal would include aggregates and sand for use in concrete. The type of aggregate and sand would be specified by concrete designers during detailed design. Pavement materials may include heavily bound sub-base and asphalt concrete. Manufactured items, including structural steel and precast concrete components would also be required.

Materials would be sourced from appropriately licensed facilities. Wherever possible, materials would be sourced from commercial suppliers in nearby areas or other viable sources such as other nearby infrastructure planning proposals. No materials currently proposed to be used for the proposal are considered to be in short supply.

If additional fill material is required, that cannot be sourced from within the construction footprint, it would be imported from a suitably licensed nearby quarry. Surplus material that cannot be used within the construction footprint would be reused on other projects or disposed of in the order of priority as outlined in Section 6.4.

3.3.6 Traffic management and access

3.3.6.1 Vehicle movements

Traffic generated by construction activities includes construction worker light vehicles, as well as heavy vehicles for periodic delivery and removal of materials, and construction plant and equipment.

The traffic generated as part of the construction works is not expected to exceed 100 light vehicles and 100 heavy vehicles per day during peak construction periods as summarised in Table 3.6.

Table 3.6: Vehicle movements during construction of the proposal

Vehicle type and associated	Vehicle movements		Typical travel patterns and limitations
	Average	Maximum	
Standard hours			
Construction traffic including waste and spoilt vehicles: heavy vehicles up to 40 tonnes	50	100	Regular movements throughout the day (7am to 6pm).
Deliveries: light and heavy commercial vehicles up to 5 tonnes	10	50	Outside of peak periods (10am to 3pm). Parking within the main compound site.
Workers: cars (light vehicles)	50	100	Outside of peak periods (10am to 3pm). Parking within the main compound site.
Out of hours			
Construction traffic: heavy vehicles up to 40 tonnes	20	30	Early evening where possible (6pm to 10pm).

3.3.6.2 Road and lane access

Traffic and transport impacts associated with the proposal are assessed in Section 6.5 of this REF. Traffic delays and access may occur as a result of the proposal's construction and be managed in the Traffic Management Plan (TMP). The potential traffic and access impacts expected during the construction of the proposal include:

- Temporary increased traffic and pedestrian delays from the movement of construction vehicles and hauling of materials.
- Public transport impacts on bus routes 263 (Charlestown to Cameron Park) and 269 (Charlestown to Toronto). Transport has held preliminary discussions with CDC buses who operate these two bus routes along Hillsborough Road.
- School bus transport impacts on bus routes 724 (Highfields to Whitebridge High), 751 (Charlestown to St Josephs Primary), and 1513 (Linuwel School to Macquarie Drive and Glad Gunson Drive).
- Some temporary turning movements at key intersections may be restricted at times, alternate access arrangements would be provided.

The impact of construction worker vehicle parking would be managed through measures identified in the TMP. For the majority of the construction period at least one lane will remain open and intersections will continue to function in their current arrangement. Works with the greatest potential to impact traffic would be scheduled outside of peak times where practical.

Where changes to current access arrangements are required, local residents would be consulted and the wider community notified in advance to allow for alternative travel arrangements to be made and allow commuters to plan for extra travel time if necessary.

3.3.6.3 Local property access management

Property access would be maintained as far as practicable throughout construction. However, there may be temporary disruptions or changes to accesses to private properties, recreational facilities and businesses during construction. The management of property access would be considered by the construction contractor and detailed as part of the final staging plan for the proposal. Commercial and private property access roads would be reinstated and/or relocated as required in consultation with the property owner.

Whalan's Nurseries site is proposed to be used as a Compound A during construction, subject to agreement and relevant lease requirements with the landowner. So, construction access to/from this location would also be covered in the TMP.

3.3.6.4 Traffic management, control and signage

Where possible, construction activities would be programmed to minimise the impact on traffic using the local and regional road network.

Standard traffic management measures would be used to minimise the traffic impact expected during construction. These measures would be identified in a TMP for the proposal and would be developed in accordance with the Transport's *Traffic Control at Work Sites Manual (Roads and Maritime 2018) and Specification G10 - Traffic Management* (Roads and Maritime, 2015).

Detailed construction methods and associated management plans (such as Traffic Control Plans (TCPs)) and a CEMP would also be developed of the proposal to manage potential traffic and access impacts.

3.4 Ancillary facilities

Ancillary facilities would be required throughout construction of the proposal. The preliminary ancillary facilities have been selected based on the following criteria:

- Proximity to the proposal (i.e. reduced distance between the ancillary facilities and the work favourable to reduce construction traffic related impacts)
- Proximity to Transport classified roads which are approved for use by heavy vehicles (i.e. to avoid construction traffic and heavy vehicles on local roads)
- Proximity to sensitive receivers (i.e. larger distances favourable to reduce noise and amenity impacts)
- Low environmental sensitivity (i.e. ideal to avoid existing biodiversity and heritage constraints)
- Existing land use and ownership (i.e. preferable to place in an area with an existing similar use, such as an industrial area or land already owned by Transport)

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

Currently the areas identified for construction compounds are larger than the actual area that would be used (refer Figure 3.6) 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.

Construction compound sites would include portable buildings with amenities such as toilets, secure and bunded storage areas for site materials, including fuel and chemicals, office space for on-site personnel, and associated parking. Sites would be securely fenced with temporary fencing. Signage would be erected advising the general public of access restrictions. Upon completion of construction, the temporary site compound, work areas and stockpiles would be removed, and the site cleared of all rubbish and materials. It would then be rehabilitated.

Two potential construction ancillary facilities assessed in this REF are discussed in Sections 3.4.1 to 3.4.2 and are shown on Figure 3.6. The use of any of the identified ancillary facilities is subject to formal agreement with landowners and availability once construction timing is confirmed.

3.4.1 Main Compound (Compound A): Whalan's Nurseries site

The Whalan's Nurseries site at 68 Hillsborough Road is proposed to be the primary construction compound with safe access provided for eastbound vehicles via the roundabout at the NICB (Figure 3.6).

The site would allow use of existing hardstand areas and utility connections (e.g. communications, water, sewer and electricity). This site would be used for but not limited to:

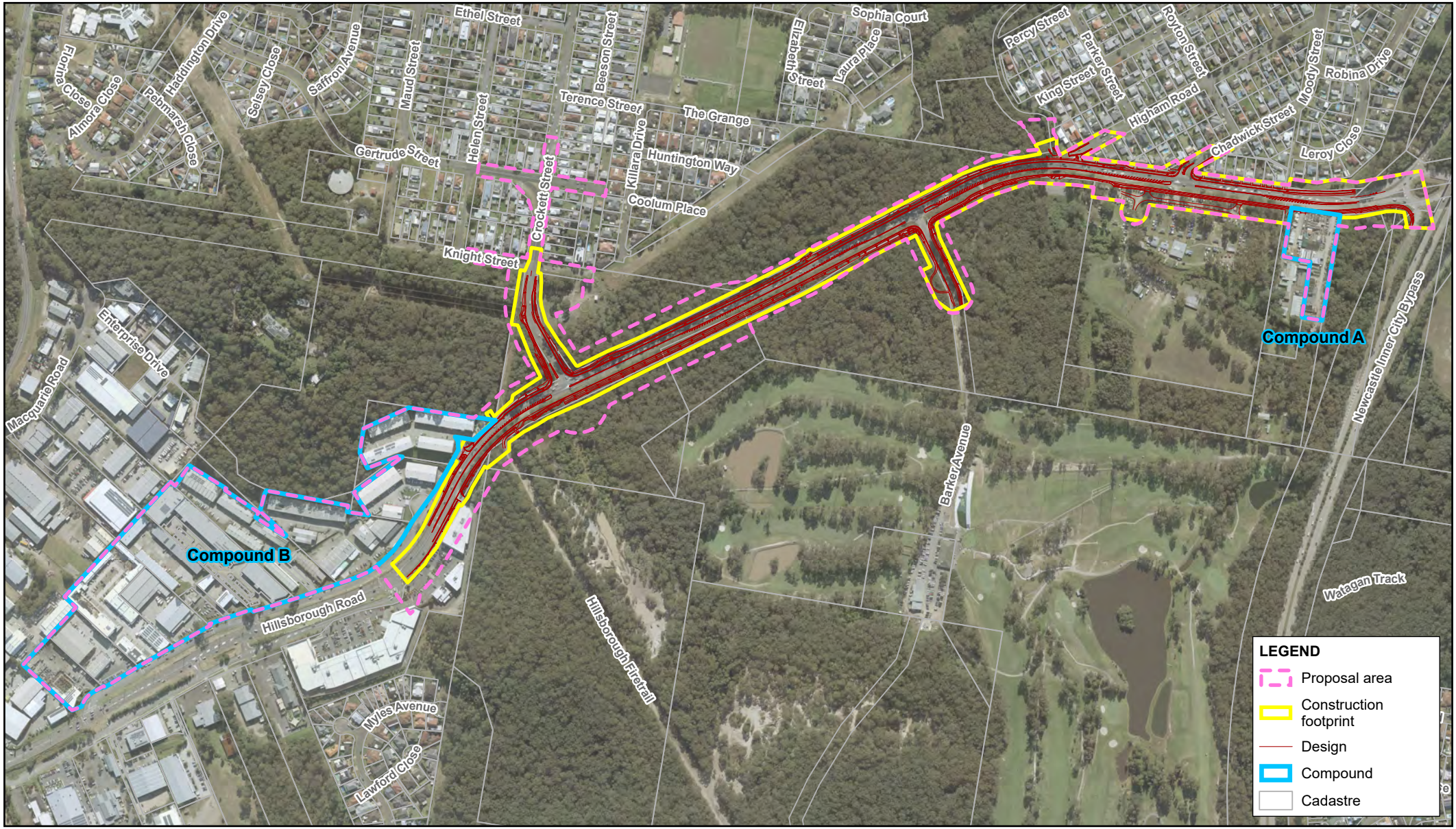
- Site offices
- Plant and equipment storage
- Materials stockpiling
- Staff car parking

The site is privately owned and will require a temporary lease for use during construction. Transport have consulted with the current owner of the property regarding use of the land as site compound.

3.4.2 Minor compound (Compound B): Vacant commercial buildings within Warners Bay commercial centre

Compound B has been identified within the Warners Bay commercial centre (Figure 3.6). The site would be located within a vacant building if available within the commercial centre at the time of construction.

With established connections to utilities, this site would be primarily used for site offices. The use of any commercial building within the Compound B area would be in accordance with any relevant development approval conditions of consent relevant to the buildings proposed to be used.



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

Construction ancillary facilities

FIGURE 3.6

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:14

Data source: Metromap Tile Service: - Imagery (Date extracted: 11/10/2022); Roads, Cadastre - LPI, 2017; Created by: tmorton

3.5 Public utility adjustment

Consultation with public utility authorities has been carried out as part of the development of the concept design to identify and locate existing utilities and incorporate utility authority requirements for relocations and/or adjustments.

Preliminary investigations have indicated that the following existing utilities were found to be within the extents of the proposal and would need relocation or protection in consultation with the relevant authority (see Table 3.7).

The proposal may also impact on the ability of utility providers to access maintenance locations for their utilities and services. Consultation would continue with the public utility authorities during the detailed design phase. This consultation would allow the public utility authorities to provide input into the most appropriate relocation options for the services and utilities.

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

Table 3.7: Public utility adjustment related to the proposal

Utility Service	Asset owner	Details
Communications	Telstra	Relocation and or adjustment
Communications	TPG	Relocation and or adjustment
Street light	Transport	Relocation and or adjustment
Water	HWC	Relocation and or adjustment
Communications	NBN	Relocation and or adjustment
Communications	Optus	Relocation and or adjustment
UG LV	Ausgrid	Relocation and or adjustment
Sewer	HWC	Relocation and or adjustment

3.6 Property acquisition

Based on the concept design and subject to negotiations in accordance with the Land Acquisition (Just Terms Compensation) Act 1991 (NSW) and the reforms announced in October 2016 (NSW Government 2016), the partial and full acquisition of properties listed in Table 3.8 would be required. Table 3.8 lists the property acquisitions, type, area, location and reasons. An overview of these properties in relation to the proposal area is shown in Figure 3.7. Detailed property acquisition plans are provided in Appendix N.

Table 3.8: Proposed property acquisition

Lot Deposited Plan	Acquisition type	Acquisition area (m^2)	Land zoning (LEP)	Use
20 1010980	Partial acquisition	40	RE1	Reserve
132 624727	Partial acquisition	266	RU4	Whalan's Nurseries
131 624727	Partial acquisition	71	RU4	Shed Quarters
308 755233	Partial acquisition	1734	RE1	CNCC Showground

Lot Deposited Plan	Acquisition type	Acquisition area (m^2)	Land zoning (LEP)	Use
1 508106	Partial acquisition	42	R2	Residential
11 204385	Partial acquisition	10	R2	Residential
2061 823731	Partial acquisition	1,388	C2	Bushland
1820 42616	Partial acquisition	2,305	C2	Bushland
47 1029203	Partial acquisition	1,213	C2	Bushland
1 823734	Partial acquisition	941	C2	Bushland
2 823734	Partial acquisition	2,755	C2	Bushland
2071 172365	Partial acquisition	507	C2	Bushland
10 1151070	Partial acquisition	129	B7	Business premises
101 1176697	Full acquisition	2,125	SP2	Bushland

*Areas rounded to the nearest square metre

LEGEND

- Proposal area
- Construction footprint
- Aquisition area
- Lease area
- Proposed property boundary
- Cadastre

Paper Size ISO A4

0 30 60 90 120 150

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Proposed property acquisition Overview

Project No. **12544418**
Revision No. **0**
Date **13/10/2022**

FIGURE 3.7

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 13 Oct 2022 - 11:21

Data source: Metromap Tile Service: - Imagery (Date extracted: 13/10/2022); Roads, Cadastre - LPI, 2017; Created by: tmorton

4 Statutory and planning framework

4.1 Environmental Planning and Assessment Act 1979

The EP&A Act establishes the system of environmental planning and assessment in NSW. This proposal is subject to the environmental impact assessment and planning approval requirements of Division 5.1 of the EP&A Act. Division 5.1 specifies the environmental impact assessment requirements for activities undertaken by public authorities, such as Transport, which do not require development consent under Part 4 of the EP&A Act.

In accordance with Section 5.5 of the EP&A Act, Transport, as the proponent and determining authority, must examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposal.

Clause 171 of the *Environment Planning and Assessment Regulation 2021* (EP&A Regulation) prescribes the minimum factors which must be considered when determining if an activity assessed under Division 5.1 of the EP&A Act has or is likely to have a significant effect on the environment. Chapter 6 of the REF provides an environmental impact assessment of the proposal in accordance with clause 171 and Appendix A specifically responds to the factors for consideration under clause 171.

4.1.1 State Environmental Planning Policies

4.1.1.1 State Environmental Planning Policy (Transport and Infrastructure) 2021

State Environmental Planning Policy (Transport and Infrastructure) 2021 (Transport and Infrastructure SEPP) was announced on 2 December 2021 as part of the NSW Government's reforms, with existing SEPPs and Regional Environmental Plans (REPs) consolidated into 11 new SEPPs. The Transport and Infrastructure SEPP came into effect on 1 March 2022 and consolidated:

- *SEPP (Infrastructure) 2007*
- *SEPP (Educational Establishments and Childcare Facilities) 2017*
- *SEPP (Major Infrastructure Corridors) 2020*
- *SEPP (Three Ports) 2013*

The provisions of the SEPP (Infrastructure) 2007 were adopted into Chapter 2 of the Transport and Infrastructure SEPP. Division 17, Subdivision 1, Clause 2.108 of the Transport and Infrastructure SEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposal is appropriately characterised as development for the purposes of a road or road infrastructure facilities and is to be carried out by or on behalf of Transport, it can be assessed under Part 5, Division 5.1 of the EP&A Act. Development consent is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* (NPW Act) and would avoid land or development regulated by *State Environmental Planning Policy (Resilience and Hazards)* 2021, *State Environmental Planning Policy (Planning Systems) 2021* or *State Environmental Planning Policy (Major Development) 2005*.

Part 2 Division 1 of the Transport and Infrastructure SEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Consultation, including consultation as required by Transport and Infrastructure SEPP (where applicable), is discussed in Chapter 5 of this REF.

Clause 2.7 of the Transport and Infrastructure SEPP identifies that the Transport and Infrastructure SEPP prevails over all other environmental planning instruments, except where there is an inconsistency with *State Environmental Planning Policy (State Significant Precincts) 2005* (now covered in the *State Environmental Planning Policy (Precincts – Regional) 2021* for the proposal location) or certain provisions of the *State Environmental Planning Policy (Coastal Management) 2018* (now covered in the *State Environmental Planning Policy (Resilience and Hazards) 2021*).

As development that may be carried out without the need for development consent, the proposal is subject to assessment under Division 5.1 of the EP&A Act. In accordance with Section 5.3 of the EP&A Act, the determining authority for the assessment (in this REF) is Transport.

4.1.1.2 State Environmental Planning Policy (Resilience and Hazards) 2021

The *SEPP (Resilience and Hazards) 2021* (Resilience and Hazards SEPP) came into effect on 1 March 2022 as part of the NSW Government reforms discussed in Section 4.1.1.1. The Resilience and Hazards SEPP consolidated:

- *SEPP (Coastal Management) 2018*
- *SEPP 33 – Hazardous and Offensive Development*
- *SEPP 55 – Remediation of Land*

The proposal is not located within any land subject to Chapter 2 (Coastal Management) or and is not identified as a development covered by Chapter 3 (Hazardous and Offensive Development) of the Resilience and Hazards SEPP.

Chapter 4 (Remediation of Land) requires consent authorities to consider whether the site is or is likely to be contaminated and determines categories of remediation requiring consent. Consent is not required because the works may be carried out without consent under the Transport and Infrastructure SEPP. However, Section 6.4 contains an assessment of the likelihood of contamination in proposal site.

4.1.1.3 State Environmental Planning Policy (Biodiversity and Conservation) 2021

The *SEPP (Biodiversity and Conservation) 2021* (Biodiversity and Conservation SEPP) came into effect on 1 March 2022 as part of the NSW Government reforms discussed in Section 4.1.1.1. The Biodiversity and Conservation SEPP consolidated a number of SEPPs including:

- *SEPP (Vegetation in Non-Rural Areas) 2017*
- *SEPP (Koala Habitat Protection) 2020*
- *SEPP (Koala Habitat Protection) 2021*
- *SEPP (Bushland in Urban Areas) 2019*

The proposal does not require assessment in accordance with the SEPP as it is an activity being considered under Division 5.1 of the EP&A Act, however the SEPP provides guidance for the identification of koala habitat which was used to inform the assessment for the proposal.

Chapter 2 (Vegetation in Non-Rural Areas) applies as it is in an area listed in Clause 2.3(1)(a) and land within the zones listed in Clause 2.3(1)(b). As the works are permissible without consent under the Transport and Infrastructure SEPP, a permit from LMCC to clear vegetation under this SEPP is not required.

Chapter 3 (Koala Habitat Protection 2020) contains provisions from the Koala SEPP 2020 and, as an interim measure, applies in the NSW core rural zones of RU1, RU2 and RU3, except within the Greater Sydney and Central Coast areas. The proposal is located outside of the Greater Sydney and Central Coast LGA however the proposal does not include any areas zoned as rural zones and therefore it is not applicable.

Chapter 4 (Koala Habitat Protection 2021) aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas. Koala habitat in non-rural lands were previously assessed under the previous SEPP Koala Habitat Protection 2021. The SEPP provides for identification of highly suitable koala habitat. This is not defined in the SEPP however Koala Habitat Protection Guideline for implementing SEPP (Koala Habitat Protection) 2019 (DPIE 2020) provides guidance that highly suitable koala habitat is native vegetation where 15 percent or greater of the total number of trees are regionally relevant koala feed tree species. Regionally relevant koala feed tree species for the proposal are those listed in the Central Coast Koala Management Area.

The aim of Chapter 6 (Bushland in Urban Areas) is to protect and preserve bushland within the urban areas. While Lake Macquarie is identified in Schedule 5 and the proposal would impact land zoned E2 (Environmental Conservation) and RE1 (Public Recreation), pursuant to Clause 6.5(2)(d) consent under Chapter 6 is not required for the purpose of construction or maintaining main roads. However, with consideration to Clause 6.5(4), potential impacts of the proposal on biodiversity have been assessed in Appendix D and summarised in Section 6.1.

4.1.2 Local Environmental Plans

The proposal is permissible without development consent under T&ISEPP and provision of Local Environmental Plans (LEPs) would not formally apply. However, for the purposes of this REF they were included for reference and discussed below.

4.1.2.1 Lake Macquarie Local Environmental Plan 2014

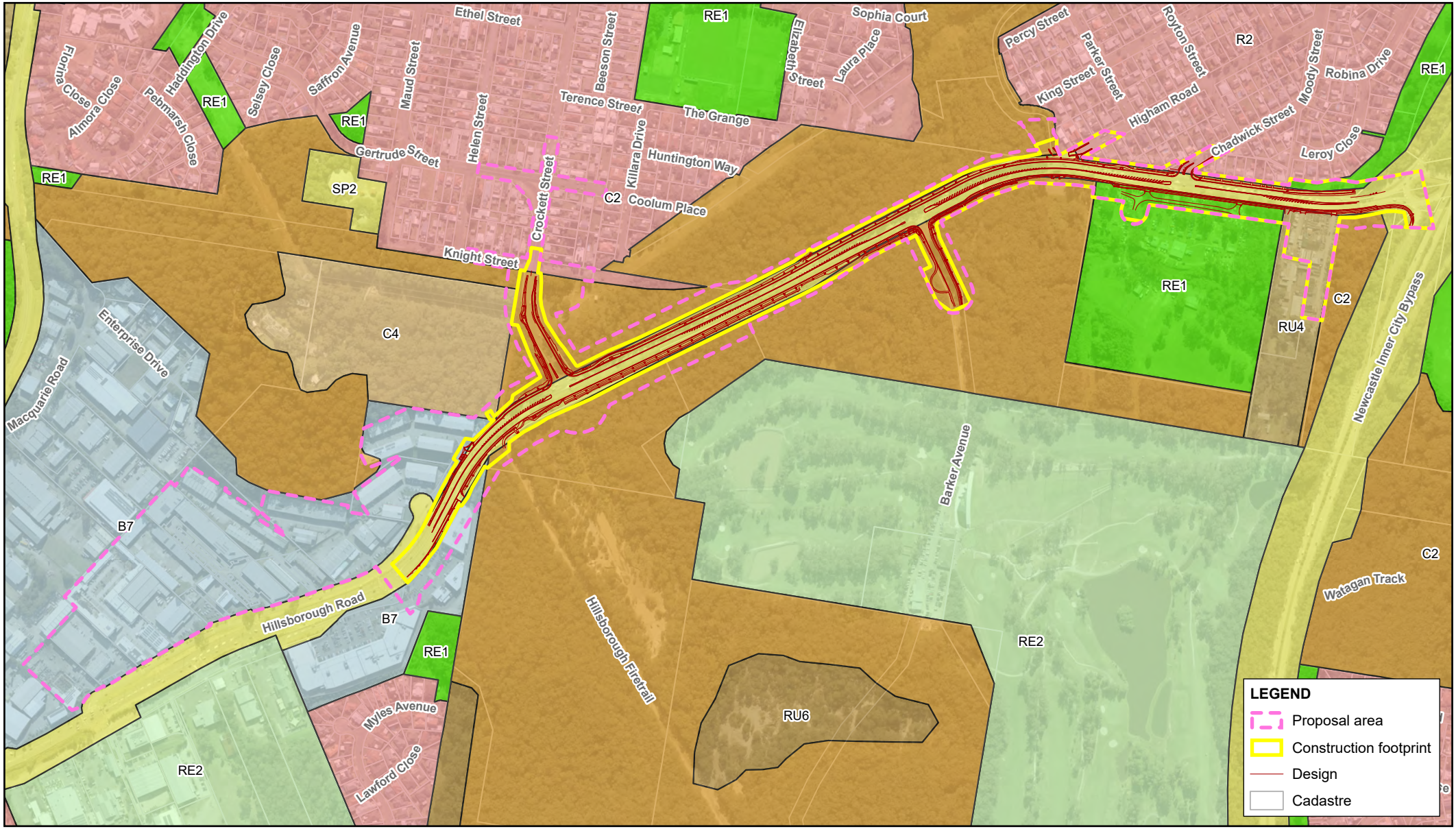
The proposal is located within the Lake Macquarie LGA, with the *Lake Macquarie Local Environmental Plan 2014* (LEP 2014) applying to the proposal site.

The proposal is located primarily within land zoned SP2 Infrastructure, but also occurs within the following land use zones under the LEP 2014, as covered in Table 4.1.

Table 4.1: LEP 2014 zoning and provision details

Zone	Relevant provision details
SP2 Infrastructure	The objectives of zone SP2 include: • To provide for infrastructure and related uses • To prevent development that is not compatible with or that may detract from the provision of infrastructure • To provide land required for the development or expansion of major health, education and community facilities The proposal is consistent with the objectives of zone SP2 as it would provide upgraded road related infrastructure, to improve travel times, safety within the area and improved connectivity.
R2 Low Density Residential	The objectives of zone R2 include: • To provide for the housing needs of the community within a low density residential environment • To enable other land uses that provide facilities or services to meet the day to day needs of residents • To encourage development that is sympathetic to the scenic, aesthetic and cultural heritage qualities of the built and natural environment The proposal is consistent with the objectives of zone R2 as it would provide upgraded road related infrastructure to support the future residential development of the area.
B7 Business Park	The objectives of zone B7 include: • To provide a range of office and light industrial uses • To encourage employment opportunities • To enable other land uses that provide facilities or services to meet the day to day needs of workers in the area • To enable specialised retail premises and commercial uses that do not undermine the function of existing and future urban centres • To provide opportunities for high technology industries, scientific development and research activities The proposal results in impacts on this land zone only during construction, in relation to the use for Compound C (see Section 3.4.2). Therefore, the proposal is considered unlikely to impact on the objectives of zone B7.
C2 Environmental Conservation	The objectives of zone C2 include: • To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values • To prevent development that could destroy, damage or otherwise have an adverse effect on those values • To conserve, enhance and manage corridors to facilitate species movement, dispersal and interchange of genetic material • To encourage activities that meet conservation objectives • To enhance and manage areas affected by coastal processes

Zone	Relevant provision details
	The proposal would not fragment this land zoning and the impact to zone C2 and the associated Lot/DP is considered negligible (see Section 6.11). Proposal design has sought to limit impact on this zone as far as practicable. Therefore, the proposal is considered unlikely to impact on the objectives of zone C2.
C4 Environmental Living	The objectives of zone C4 include: • To provide for low-impact residential development in areas with special ecological, scientific or aesthetic values • To ensure that residential development does not have an adverse effect on those values • To protect, enhance and manage corridors to facilitate species movement, dispersal and interchange of genetic material • To encourage rehabilitation and conservation of environmentally important land The proposal would not fragment this land zoning and the impact to zone C4 and the associated Lot/DP is considered negligible (see Section 6.11). Therefore, the proposal is considered unlikely to impact on the objectives of zone C4.
RE1 Public Recreation	The objectives of zone RE1 include: • To enable land to be used for public open space or recreational purposes • To provide a range of recreational settings and activities and compatible land uses • To protect and enhance the natural environment for recreational purposes • To facilitate the preservation of the environmental qualities of land The proposal would not fragment this land zoning (associated with the CNCC Showground) and the impact to zone RE1 and the associated Lot/DP is considered negligible (see Section 6.11). Therefore, the proposal is considered unlikely to impact on the objectives of zone RE1.
RU4 Primary Production Small Lots	The objectives of zone RU4 include: • To enable sustainable primary industry and other compatible land uses • To encourage and promote diversity and employment opportunities in relation to primary industry enterprises, particularly those that require smaller lots or that are more intensive in nature • To minimise conflict between land uses within this zone and land uses within adjoining zones • To provide for a rural lifestyle and other compatible activities • To maintain or improve the quality of the environment The proposal result in impacts on this land zone only during construction, in relation to the use for Compound A (see Section 3.4.1). Therefore, the proposal is considered unlikely to impact on the objectives of zone RU4.



LEGEND

Land Zoning

- B7
- C2
- C3
- C4
- R2
- RE1
- RE2
- RU4
- RU6
- SP2

Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

Land zoning

FIGURE 4.1

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:21

Data source: Metromap Tile Service: - Imagery (Date extracted: 11/10/2022); Roads, Cadastre - LPI, 2017; Created by: tmorton

4.2 Other relevant NSW legislation

4.2.1 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 Part 3.2 of the POEO Act, the carrying out of scheduled development work as defined in clause 35, Schedule 1 – road construction (meaning the construction or widening of roads) is relevant to the proposal.

Road construction is a scheduled activity under Schedule 1 of the POEO Act 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 and least three kilometres of its length in the metropolitan area. Extractive industries is also a scheduled activity under Schedule 1 of the POEO Act.

While the proposal involves four or more traffic lanes and Hillsborough Road is classified as a main road, the proposal is about 1.8 km in length. The proposal would not result in the extraction of more than 30,000 tonnes of material per year (refer Table 3.5). Therefore, an Environment Protection Licence (EPL) would not be required for the proposal.

4.2.2 Roads Act 1993

Section 138 of the *Roads Act 1993* (Roads Act) requires consent from the relevant road authority for the carrying out of work in, on or over a public road. However, clause 5(1) in Schedule 2 of the Roads Act states that public authorities do not require approval for works on unclassified roads.

The proposal would involve work on Hillsborough Road which is a classified road under the Roads Act. The proposal also includes work on local roads including Crockett Street, Barker Avenue, Higham Road and Chadwick Street. A road occupancy licence may be required and obtained under Section 138 of the Roads Act in order to perform works for the proposal. Where works are required that would impact on local roads of the proposal, ongoing consultation with LMCC (see Section 5.5) would occur, as required.

4.2.3 Crown Lands Management Act 2016

The *Crown Lands Management Act 2016* (Crown Lands Act) replaces the Crowns Lands Act 1989 from 1 July 2018.The Crown Lands 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 Act. The Crown Lands Act sets out the conditions under which Crown land is permitted to be occupied, used, sold, leased, licensed or otherwise dealt with.

One parcel of Crown Land located on the eastern end of the alignment would be subject to partial acquisition as a result of the proposal. This parcel of land is associated the CCNC Showgrounds.

Transport have already commenced consultation with DPE – Crown Lands (see Section 5.5), and will continue to do so as the design progresses regarding any licence/lease requirements for construction/operation of the proposal.

4.2.4 Biodiversity Conservation Action 2016

The *Biodiversity Conservation Act 2016* (BC Act) sets out the environmental impact assessment framework for threatened species, threatened ecological communities and Areas of Outstanding Biodiversity Value (formerly critical habitat) for Division 5.1 activities (amongst other types of 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 is assessed using a five-part test. Where a significant impact is likely to occur, a species impact statement (SIS) or Biodiversity Assessment Report (BAR) must be prepared in accordance with the Director-General's requirements.

The biodiversity assessment conducted for this proposal is documented in Appendix D and summarised in Section 6.1. The assessment found that the proposal is unlikely to have a significant impact on any threatened species or communities under the BC Act, therefore an SIS or BDAR is not required for the proposal.

4.2.5 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 D) provides mitigation measures to manage weeds at the construction area. This is discussed further in Section 6.1.

4.2.6 Coal Mine Subsidence Compensation Act 2017

The *Coal Mine Subsidence Compensation Act 2017* (CMSC Act) provides controls for certain development within mine subsidence districts. Clause 21 of the CMSC Act specifies that a person must not carry out work, or cause work to be done, in connection with the erection or alteration of an improvement within a mine subsidence district, except in accordance with the approval of the Chief Executive.

An improvement as defined in Part 1, 4(1) of the CMSC Act to include any building or work erected or constructed on land or infrastructure whether above or below the surface of the land.

The proposal is located within the Lake Macquarie subsidence district and constitutes 'improvements' as it is for the purpose of constructing infrastructure pursuant to Part 1, 4(1) of the CMSC Act.

In consultation with Subsidence Advisory NSW (SA NSW), in accordance with clause 2.15(f) of the Transport and Infrastructure SEPP, it was determined the proposal would have a low risk of being impacted by mine subsidence (see Section 5.4). However, potential impacts and mitigation measures (as relevant) have been considered in Section 6.4.

4.2.7 National Parks and Wildlife Act 1974

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

The nearest National Park estate property to the proposal is the Tingira Heights Nature Reserve which is located about 3.5 kilometres to the south of the proposal. There is no reserved land under the NPW Act within or immediately adjacent to the proposal area.

The harming or desecrating of Aboriginal objects or places is an offence under section 86 of the NPW Act. Under section 90, an Aboriginal heritage impact permit (AHIP) may be issued in relation to a specified Aboriginal object, Aboriginal place, land, activity or person or specified types or classes of Aboriginal objects, Aboriginal places, land, activities or persons. Potential impacts to Aboriginal heritage as a result of the proposal assessed in Appendix K and summarised in Section 6.8. This assessment was completed in accordance with Transport's Procedure for Aboriginal Cultural Heritage Consultation and Investigation (NSW Roads and Maritime Services, 2011) (PACHCI).

An online AHIMS search was completed on the 10 November 2021 to identify registered Aboriginal sites or declared Aboriginal places within or adjacent to the study area. An archaeological survey was then carried out on 22 to 27 August 2022 where no new archaeological sites (AFT)s were identified.

The Aboriginal cultural heritage assessment undertaken for the proposal is summarised in Section 6.8.

4.2.8 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) provides for the conservation of buildings, works, archaeological items, relics and places of heritage value. It principally achieves this by listing, and therefore protecting, heritage values under a number of registers. This includes the State Heritage Register (SHR), the Heritage and Conservation Register (HCR), LEP heritage schedules, public authority heritage and conservation registers, termed section 170 registers, and interim Heritage Orders (IHOs).

The Heritage Act requires Transport to assess the proposal's impact on historic buildings, places, objects, works, relics and archaeological sites, and to ensure their cultural heritage value is protected. The Heritage Act sets out provisions that require a heritage impact assessment to be prepared where the proposal has the potential to impact on any values that are protected under the Heritage Act. Finally, the Heritage Act sets out a process for obtaining permission from the NSW Heritage Council, as administrators of the Heritage Act, to investigate, excavate and/or impact on a heritage-listed item.

No items listed on the State Heritage Register or on a register under section 170 of the Heritage Act were identified within the proposal area. Refer to Section 6.9.

4.2.9 Contaminated Lands Management Act 1997

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

A preliminary contamination site investigation (PSI) (Jacobs, 2022) was prepared for the proposal. This included a search of the NSW POEO Act register and NSW EPA PFAS Investigation Program Database 2 June 2022 indicated there are no sites or PFAS investigation sites within more than four kilometres of the proposal. A summary of the PSI and assessment of potential contamination impacts are discussed further in Section 6.4.

4.2.10 Land Acquisition (Just Terms Compensation) Act 1991

The *Land Acquisition (Just Terms Compensation) Act 1991* (Land Acquisition Act) and the reforms announced in October 2016 (NSW Government 2016) apply to the acquisition of land (by agreement or compulsory process) by a public authority authorised to acquire the land. It provides a guarantee that, when a public authority requires the acquisition of land, the amount of compensation would not be less than the market value of the land.

The Land Acquisition Act would apply to the acquisition of any land required for the proposal. Property acquisition is further discussed in Section 6.11.

4.2.11 Aboriginal Land Rights Act 1983

The *Aboriginal Land Rights Act 1983* (ALR Act) provides for the land rights for Aboriginal persons and for representative Aboriginal Land Councils in New South Wales. Crown Land that is not lawfully being used or occupied, not (likely) needed for residential or essential public purposes and not the subject of a registered native title claim or determination can be claimed under the ALR Act.

One parcel of Crown Land located on the eastern end of the alignment would be subject to partial acquisition as a result of the proposal. This parcel of land is the CCNC Showgrounds and is not subject to any Aboriginal land claims under the ALR Act.

4.2.12 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) applies to all waters in NSW and aims to conserve, develop and share the fisheries resources of the State for the benefit of current and future generations.

The FM Act requires consideration of proposed impacts for works, including dredging or reclamation, and works that block fish passage or harm marine vegetation. Pursuant to section 199 of the FM Act, Transport must give the Minister written notice of the proposed work before carrying out or authorising such works. Transport must consider any matters raised by the Minister within 28 days after the giving of the notice (or such other period as is agreed between the Minister and Transport).

Winding Creek is not mapped as key fish habitat under the FM Act.

4.2.13 Water Management Act 2000

The *Water Management Act 2000* (WM Act) is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. It is also intended to provide formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses as well as to provide for protection of catchment conditions.

From 1 July 2016, the groundwater sources in the vicinity of the proposal are now regulated by the Water Sharing Plan (WSP) for the North Coast Fractured and Porous Rock Groundwater Sources 2016. So, the proposal is located within the Sydney Basin North Coast groundwater source of this WSP. The alluvial and surface water sources in the study area are regulated by the WSP for the Hunter Unregulated and Alluvial Water Sources 2009 (HUA WSP). Under the HUA WSPs, the proposal is located within the North Lake Macquarie Water Source.

Relevant approvals under the Act include water use approvals (section 89), water management work approvals (section 90) and activity approvals (section 91).

An assessment of the potential impacts to surface and groundwater and measures to manage potential impacts is provided in Section 6.3.

Section 89 of the WM Act establishes access licenses for the taking of water within a water management area. Under Clause 18(1) 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.

Water management work approvals

Water management work approvals are required for water supply works, drainage works and flood works.

The proposal does not constitute water supply works. In addition, under Clause 41E(2) of the *Water Management (General) Regulation 2018*, Transport, as a roads authority, is exempt from the need to obtain a water management works (flood works) approval if it constructs or uses a flood work for the purposes of a public road.

Activity approvals

Activity approvals are required when a certain activity is likely to affect waterfront land (controlled activity approval) or interfere with an aquifer (aquifer interference approval).

Clause 38 of the *Water Management (General) Regulation 2018* provides that Transport, as a roads authority, is exempt from requiring controlled activity approval for all controlled activities that it carries out in, on or under waterfront land.

An aquifer interference approval is required if construction requires intersection of a groundwater source. As groundwater is considered unlikely to be intercepted an aquifer interference approval is unlikely to be required for the proposal. However, due to aquifer interference approvals not being 'live' under the Water Management (General) Regulation 2018, relevant licensing for groundwater take would be under the *Water Act 1912*.

4.2.14 Water Act 1912

The *Water Act 1912* has historically been the main legislation for managing water resources in NSW, however, is currently being progressively phased out and replaced by WSPs under the WM Act. Once a WSP commences, existing licences under the *Water Act 1912* are converted to Water Access Licences (WALs) and to water supply works and use approvals under the WM Act.

This licensing framework is transitioning to a new licensing and approval framework under the WM Act. However, the Water Act 1912 still applies to:

- Taking water from a water source outside water sharing plan areas
- Construction and use of water supply works outside water sharing plan areas
- Drainage works in all areas of NSW
- Aquifer interference activities in all areas of NSW

If interception of groundwater and extraction (dewatering) occurs, a licence for aquifer interference activities may be required under Part 5 of the Water Act 1912, depending upon contractor construction methodology.

4.3 Commonwealth legislation

4.3.1 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 matters of national environmental significance or the environment of Commonwealth land. These are considered in Appendix D and chapter 6 of the REF.

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

Potential impacts to these biodiversity matters are also considered as part of chapter 6 of the REF and Appendix D.

4.3.1.1 Findings - matters of national environmental significance

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

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

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

4.3.2 Native Title Act 1993

The *Native Title Act 1993* recognises and protects native title. The Act covers actions affecting native title and the processes for determining whether native title exists and compensation for actions affective native title. It establishes the Native Title Registrar, the National Native Title Tribunal, the Register of Native Title Claims and the Register of Indigenous Land Use Agreements, and the National Native Title Register. Under the Act, a future act includes proposed public infrastructure on land or waters that affects native title rights or interest.

A search of the Native Title Tribunal Native Title Vision website was undertaken, with no Native Title holders/claimants identified.

Transport would provide a notice of the proposal to NTSCORP under section 24KA of the Act and would invite comment on the proposal.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of [a road and/or road infrastructure facilities] and is being carried out by or on behalf of a public authority. Under Clause 2.108 of the T&ISEPP the proposal is permissible without consent. The proposal is not State significant infrastructure or State significant development. The proposal can be assessed under Division 5.1 of the EP&A Act.

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

Table 4.2 lists licences and/or approvals required for the proposal.

Table 4.2: Summary of licensing and approval required

Instrument	Requirement	Timing
Roads Act	A road occupancy licence under Section 138	Prior to works commencing
CL Act	Lease or licence for temporary use of Crown land	Prior to works commencing
FM Act	Notification under the FM Act for dredging or reclamation works as described in Section 4.2.12	Prior to works commencing

5 Consultation

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

5.1 Consultation strategy

Transport has prepared a Community and Stakeholder Engagement Plan (CSEP) to guide communications and consultation activities for the proposal. The CSEP identifies activities for the consultation process involving Transport, other relevant government agencies, organisations, community representatives and residents.

The objective of the plan is to inform key stakeholders, immediate residents and businesses, road users and the broader community of the proposal. A number of communication tools have been used to inform the local and broader community, key stakeholders, local and state government.

The engagement objectives of the CSEP are to:

- Engage and inform key stakeholders and the community about the proposal planning process and timeframes, proposed concept design and environmental impact assessment
- Consult with stakeholders and community during the concept design, environmental assessment and formal exhibition phases of the proposal
- Incorporate local participation into planning decisions and outcomes related to the proposal
- Generate awareness of opportunities for feedback, accessible proposal information and timely problem solving

Methods of engagement with stakeholders and the community include:

- A dedicated project website, telephone and email address
- Meetings and briefings
- Media coverage, including online Facebook advertisements
- Print and digital communication materials such as a 'have your say' survey, flyers, community updates, and postcards provided via post and email notifications
- Direct consultation with affected key stakeholders

The CSEP outlines the relevant stakeholder groups that have been identified for the proposal, as they may have interested or be affected by the proposal. These groups include, but are not limited to:

- State and local government agencies and elected government representatives
- Key organisations such as LMCC, NSW Environmental Protection Authority (EPA), NSW Ambulance, NSW Fire and Rescue, Rural Fire Service, Subsidence Advisory NSW (SA NSW), and NSW State Emergency Services (NSW SES)
- Emergency services
- Utility providers
- Aboriginal groups including Local Aboriginal Land Council (LALC) and Awabakal LALC
- Special interest groups such as transport and heritage groups
- Local residents, businesses and road users

These stakeholder groups would be consulted with on relevant aspects of the proposal using a variety of engagement activities and consultation methods.

5.2 Community involvement

In June 2021, Transport sought feedback from the community on the preferred design for all three stages of the project. Consultation included a project update delivered to 1500 residents, Facebook campaign, media release, project webpage and targeted consultation with key stakeholders, including meetings with impacted businesses.

Transport published a Community Consultation Report, which summarises community feedback and responses to issues raised about the preferred design. During consultation, 108 written submissions were received with the majority of the feedback supportive of the proposal. This feedback helped Transport to understand what is important to the community and deliver the best outcome for the community and motorists who use Hillsborough Road.

Transport has 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 consultation has been carried out to ensure issues and concerns were understood, documented and addressed, and that stakeholders had an opportunity to discuss any aspect of the proposal.

Transport is planning to further consult with the community and key stakeholders about the concept design and Review of Environmental Factors for the full upgrade in late 2022.

Table 5.1 summarises the community engagement activities carried out to date for the proposal, which included a targeted community consultation campaign in 2021. It is noted that the consultation approach for the proposal to date has largely avoided face-to-face consultation activities due to the considered COVID-19 restrictions and social distancing requirements.

Table 5.1: Summary of issues raised by the community

Issue	Detail	Response / where addressed in REF
Property access	• Concern the no right turn out of Charlestown Golf Club would impact on customers • Opposition to banning right turn from Hillsborough Road into Hillsborough businesses • Concerns about where customers and deliveries associated with businesses on Hillsborough Road will turn around.	Section 6.11
Environment	• Suggested for an overpass for wildlife and/or pedestrians.	Section 6.1
Catering for a U-turn	• Concern about the impact the project will have on wildlife and request this is adequately addressed.	Section 6.5
Higham Road	• Objections to the proposed closure of Higham Road.	Section 6.5
Facilities for pedestrians and cyclists	• Support for the proposed closure of Higham Road. • Suggestion for dedicated cycle lane on Hillsborough Road.	Section 6.5

5.3 Aboriginal community involvement

The Aboriginal community has been involved throughout the development of the proposal in accordance with the requirements of the DPIE Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010) (Consultation Requirements) and Transport 's PACHCI. This is a staged process for investigating potential impacts to Aboriginal cultural heritage as a result of Transport Road planning, development, construction and maintenance activities. The four stages of the PACHCI and the Aboriginal community consultation carried out in each stage are shown in Table 5.2. Consultation carried out with the Aboriginal community is further documented in the Hillsborough Road Upgrade Aboriginal Cultural Heritage Report (ACHAR). Table 5.2

Table 5.2: Summary of Transport's Procedure for Aboriginal Cultural Heritage Consultation and Investigation

Stage	Description
Stage 1	Initial assessment by Transport.
Stage 2	Site survey and further assessment
Stage 3	Formal consultation and preparation of a cultural heritage assessment report.
Stage 4	Implement environmental impact assessment recommendations.

Transport will continue to undertake consultation with the Aboriginal community in accordance with the relevant Consultation Requirements of Transport's PACHCI procedure through future stages of the project.

5.4 SEPP (Transport and Infrastructure) consultation

Consultation with councils and other public authorities is provided for by clause 2.10 to 2.15 of the Transport and Infrastructure SEPP. Which applies to development carried out by or on behalf of a public authority that may be carried out without consent. Consultation is required in relation to development that impacts on:

- Council related infrastructure or services (clause 2.10)
- Local heritage (clause 2.11)
- Flood liable land (clauses 2.12 and 2.13 (NSW State Emergency Services (SES))
- Certain land within the coastal zone (clause 2.14)
- Public authorities other than councils (clause 2.15)

The LMCC and NSW SES have been consulted about the proposal as per the requirements of clauses 2.10, 2.12, 2.13, and 2.14. In addition, Subsidence Advisory NSW (SA NSW) has been consulted in accordance with clause 2.15(2)(f) due to works within a mine subsidence district.

Appendix B contains a Transport and Infrastructure SEPP consultation checklist that documents how consultation Transport and Infrastructure SEPP requirements have been considered. In addition, Table 5.3 outlines Transport and Infrastructure SEPP issues raised during consultation undertaken for the proposal.

Table 5.3: Issues raised through SEPP (Transport and Infrastructure) consultation

Group	Issue raised	Response / where addressed in REF
NSW SES	• Response from NSW SES on 22 February 2022 their review of the proposal it would have minimal impact to NSW SES response operations. However, NSW SES did express concern in relation to potential construction impacts on emergency vehicles using Hillsborough Road and requested notification where there are likely to be significant delays during construction.	Section 6.5

Group	Issue raised	Response / where addressed in REF
Mine Subsidence Advisory NSW	• N/A – Response from SA NSW on 22 February 2022 indicated the proposal is at low risk of being impacted by mine subsidence, based on review of their records in relation to the proposal. • Further advice received by email on 19 September 2022 from Subsidence Advisory NSW confirming they consider the proposal is at low risk of being impacted by subsidence such that no subsidence specific design recommendations are required.	NA
LMCC	• No formal response received	NA
NSW Ambulance	• No formal response received	NA
NSW Fire and Rescue	• No formal response received	NA
Rural Fire Service	• No formal response received	NA

5.5 Government agency and stakeholder involvement

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

- Transport (Client)
- LMCC
- NSW EPA
- Awabakal community
- Utility companies
- Bus companies
- CNCC Showground
- Residential and Commercial property owners

Issues that have been raised as a result of consultation with these agencies and stakeholders are outlined below in Table 5.4.

Table 5.4: Issues raised through stakeholder consultation

Agency	Issue raised	Response / where addressed in REF
NSW EPA	The Environment Protection Authority also provided an attachment which included recommended REF requirements and requested Roads and Maritime refer to the relevant guidelines in that attachment. The attachment included guidelines for: • Environmental impacts of the proposal • Licencing requirements • The proposal and premises • Air issues • Noise and Vibration • Water and Soils • Waste • Dangerous goods, chemical storage and bunding • Monitoring programs	Transport has reviewed the attachment and the requirements relevant to this proposal have been addressed in this REF.

Agency	Issue raised	Response / where addressed in REF
Awabakal Local Aboriginal Land Council	Meetings were held between 12th February 2021 – 4th February 2022 with representatives of Awabakal LALC to discuss the following: • Project update • Proposed concept design/traffic • Property acquisition • Aboriginal cultural heritage investigations	These items have been addressed in the following sections of the REF: • Section 6.5 • Section 6.8 • Section 6.11 & • Appendix A Transport will continue to consult with Awabakal LALC throughout the project.

5.6 Ongoing or future consultation

Transport is committed to continuing the engagement with the community and stakeholders throughout the development of the Proposal. The REF would be placed on public display and comments invited.

Consultation activities during this display period include:

- Updates distributed to the community and stakeholders inviting feedback on the proposal
- A digital portal with the ability to make online submissions
- Zoom or Microsoft Teams meetings with key stakeholders, including Lake Macquarie City Council, as required

Further consultation activities (also subject to current/future Covid-19 restrictions) for the proposal may include:

- Door knocking and targeted letterbox drops for property owners, residents and businesses who may be directly impacted by the project (providing they meet Covid-19 requirements)
- Community members and residents affected by potential property acquisition will be encouraged to book a time to speak to the project and properties teams and outline the best way they would prefer to communicate and ask questions
- Proposal notifications and community updates for residents, businesses and stakeholders
- Media releases
- Online meetings, presentations and briefings for stakeholders, businesses and residents
- Letters, emails and targeted correspondence
- Project phone information line and enquiries email
- Transport for NSW project webpage

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

The community would continue to be informed during the development and construction of the proposal, if approved. Transport would also continue to consult with LMCC as well as other relevant stakeholders and government agencies as the proposal develops.

5.7 Directly affected property owners (property acquisition and adjustments)

Consultation has been undertaken with residents and businesses impacted by property acquisition.

Consultation is ongoing with the property owners potentially affected by proposed property acquisition and adjustments. This would continue leading up to and during construction.

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 matters of national environmental significance under the EPBC Act.
- The factors specified in the Guideline for Division 5.1 assessments (DPE 2022) and as required under section 171 of the Environmental Planning and Assessment Regulation 2021 and the Roads and Related Facilities EIS Guideline (DUAP 1996). The factors specified in section 171 of the Environmental Planning and Assessment Regulation 2021 are also considered in Appendix A.
- Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

6.1 Biodiversity

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

The information presented in this section is drawn from the *Hillsborough Road Biodiversity Assessment* (Biosis, 2022) (BAR) (refer to Appendix D).

6.1.1 Methodology

The methodology for the terrestrial and aquatic flora and fauna assessment incorporated the following:

- Background research of relevant databases and online tools
- Vegetation and habitat field assessment
- Targeted fauna and flora surveys
- Aquatic habitat surveys
- Assessment of the potential impacts of the proposal where they can not be avoided, identification of management measures to minimise these impacts and calculation of offsetting requirements for residual impact in accordance with Transport policy requirements

The methodology for each is described below.

6.1.1.1 Background research

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

- Atlas of NSW Wildlife Database within a 10 kilometre radius of the proposal, in March 2022
- Threatened Biodiversity Data Collection (TBDC). Ongoing review during BAR preparation
- BioNet Vegetation Classification Database. Ongoing review during BAR preparation
- DCCEEW Protected Matters Search Tool (PMST) for known/predicted EPBC Act listed TECs within a 10 kilometre radius of the proposal, in March 2022
- DCCEEW Species Profile and Threats Database (SPRAT). Ongoing review during BAR preparation
- Seed Layer Intersection Tool, in March 2022
- The federal Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE), in March 2022
- DPI Fisheries Spatial Data portal, in March 2022

- DCCEEW National Flying-fox monitoring viewer, in March 2022
- State Environmental Planning Policy (SEPP) Resilience and Hazards 2021 Chapter 2 (Coastal Management) coastal area mapping, in March 2022

6.1.1.2 Habitat assessment

A desktop habitat assessment of likelihood of occurrence of threatened species was undertaken using the results of the background research and field surveys. Where background information or targeted survey is lacking, the precautionary principle has been applied and a 'Moderate' rating given to ensure that all threatened entities at risk of being impacted by the proposal were adequately assessed. Complete likelihood of occurrence tables are provided in Appendix D.

6.1.1.3 Field survey

Vegetation surveys

Field surveys of the proposal area were conducted using a plot based full floristic survey in accordance with BAM methodology. Each plant community type identified were stratified into vegetation zones reflecting variation in condition.

Targeted flora surveys

A range of flora surveys were undertaken across the proposal area for threatened fauna with the potential to be impacted by the proposal. A full list of the fauna surveys undertaken for the proposal including target species, timing and level of survey effort undertaken for the proposal is included in Appendix D.

Habitat surveys

Habitat surveys were undertaken where habitat for all threatened flora and fauna species with the potential to be impacted by the proposal was inspected. A full list of the habitat surveys including target species, timing and level of survey effort undertaken for the proposal is included in Appendix D.

Waterway and aquatic surveys were undertaken within Winding Creek, and unnamed tributary of Winding Creek about 200m east of Crockett Street and a shallow artificial wetland mapped as Plant Community Type (PCT) 3959. None of these waterways were mapped a containing Key Fish Habitat or Habitat for threatened species under the FM Act, therefore no aquatic surveys were undertaken.

Targeted fauna surveys

A range of fauna surveys were undertaken across the proposal area for threatened fauna with the potential to be impacted by the proposal. A full list of the fauna surveys undertaken for the proposal including target species, timing and level of survey effort undertaken for the proposal is included in Appendix D.

6.1.1.4 Offsetting

This section considers whether any impacts require the provision of biodiversity offsets, conservation measures or tree and hollow replacement in accordance with Transport:

- Not Net Loss Guidelines (Transport 2020a) and supporting resources
- Tree and Hollow Replacement Guidelines (Transport 2022b) and supporting resources

6.1.2 Existing environment

6.1.2.1 Plant community types

Several PCTs were identified within the construction footprint of the proposal. These are presented in Table 6.1.

Table 6.1: Plant community types

Veg. zone	Plant community type (PCT)	Threatened ecological community	Study Area (ha)	Impact Area (ha)
1	PCT 1627: Smooth-barked Apple – Turpentine – Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast (Good) (3621 Sydney Hinterland Turpentine-Apple Gully Forest)	Not a TEC	7.8	2.1
2	PCT 1627: Smooth-barked Apple – Turpentine – Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast (Moderate) (3621 Sydney Hinterland Turpentine-Apple Gully Forest)	Not a TEC	1.7	0.4
3	PCT 1627: Smooth-barked Apple – Turpentine – Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast (Low) (3621 Sydney Hinterland Turpentine-Apple Gully Forest)	Not a TEC	1.6	0.8
4	PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Good) (3582 Hunter Coast Lowland Apple-Bloodwood Forest)	Not a TEC	1	0.2
5	PCT 1638: Smooth-barked Apple – Red Bloodwood – Scribbly Gum grass – shrub woodland on lowlands of the Central Coast (Moderate) (3582 Hunter Coast Lowland Apple-Bloodwood Forest)	Not a TEC	1.7	0.4
6	PCT 1649: Smooth-barked Apple – Red Mahogany – Swamp Mahogany – Melaleuca sieberi heathy swamp woodland of coastal lowlands (Moderate) (3998 Lower North Creekflat Mahogany Swamp Forest)	Endangered (BC Act), does not satisfy EPBC Act listing minimum condition thresholds	1.0	0.2

Veg. zone	Plant community type (PCT)	Threatened ecological community	Study Area (ha)	Impact Area (ha)
7	PCT 1736: Water Couch – Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter (Moderate) (3975 Southern Lower Floodplain Freshwater Wetland)	Not a TEC due to man-made nature	0.1	-
8	Urban/Exotic vegetation	Not a TEC	3.9	2.5
Total native PCT vegetation			14.9	4.1
Total non-native vegetation			3.9	2.5
Total vegetation			18.8	6.6

6.1.2.2 Threatened ecological communities

One PCT present within the study area (Figure 6.2), PCT 1649, is associated with TECs listed under the BC Act and EPBC Act, these being:

- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (Swamp Sclerophyll Forest) (Endangered, BC Act)
- Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland (Swamp Sclerophyll Forest EPBC Act) (Endangered, EPBC Act)

In this instance, PCT 1649 is considered to represent Swamp Sclerophyll Forest (Endangered, BC Act) as:

- 75% (6 of 8) of the native flora species recorded within PCT 1649 are characteristic of this TEC, most notably Swamp Mahogany which is the dominant tree
- The study area is within the Sydney Basin IBRA subregion and Lake Macquarie LGA
- The TEC occurs up to 50 metres elevation, where PCT 1649 occurs is about 30 metres elevation

In contrast to the BC Act listings of TECs, the EPBC Act listings require that more stringent key diagnostics and condition criteria be satisfied. That is, a patch of potential EPBC Act TEC must meet the minimum condition and size thresholds. In this case, non-native species must comprise no more than 80% of the total ground layer vegetation cover. Due to the high level (87.5%) of non-native cover, particularly Small-leaf Privet, recorded within PCT 1649, the minimum condition threshold is not met. Accordingly, PCT 1649 is not considered consistent with Swamp Sclerophyll Forest EPBC Act.

While PCT 1736 is listed as Endangered *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (BC Act), as it is artificial, it's not considered to represent this TEC in accordance with paragraph 4 of the final determination for the TEC.

6.1.2.3 Threatened flora species

A review of NSW BioNet and habitat likelihood of assessment identified six threatened flora species to have a moderate or higher likelihood of occurring prior to targeted survey. All but one, Black-eyed Susan (Vulnerable, BC Act and EPBC Act), were not detected and are considered a low likelihood of occurring. Table 6.2 details the threatened flora species identified during the field surveys and results. Refer to Figure 6.2 which shows the presence of threatened flora species identified within the study area. Details on the level of survey effort undertaken and compliance with the BAM is provided in Appendix D.

Table 6.2: Threatened flora

Species	EPBC Act	BC Act	Identification method (not recorded, assumed, recorded, expert report)	Results
Caladenia tessletata	VU	EN	Not recorded	Habitat present but species not recorded after adequate survey.
Callistemon linearifolius	VU		Not recorded	Habitat present but species not recorded after adequate survey.
Cryptostylis hunteriana	VU	VU	Not recorded	Habitat present but species not recorded after adequate survey.
Diuris praecox	VU	VU	Not recorded	Habitat present but species not recorded after adequate survey.
Grevillea parviflora subsp. P*arviflora*	VU	VU	Not recorded	Habitat present but species not recorded after adequate survey.
Tetratheca juncea	VU	VU	Recorded	77 clumps recorded within study area.

The growth form of Black-eyed Susan within the study area was a diffuse scrambler as is typical for the species were growing under larger shrubs and dense grassy undergrowth, however occasionally occurred as small, dense, multi-stemmed sub-shrubs.

Clumps of Black-eyed Susan were considered readily detectable using the parallel field traverse method, supported by random meanders searches. In areas of optimal habitat, there is a high likelihood that all, or at least the vast majority of individuals occurring in the study area, were detected during the survey. A total of 77 clumps of Black-eyed Susan were recorded within the study area and immediate surrounds.

6.1.2.4 Threatened fauna

A review of NSW BioNet and habitat likelihood of assessment identified 21 threatened fauna species to have a moderate or higher likelihood of occurring prior to targeted survey, with the below exceptions.

Targeted surveys for Dusky Woodswallow, Varied Sittella, Brown Tree-creeper, Scarlet Robin or the Little Lorikeet, are not required under the BAM as they are ecosystem credits only, and therefore assumed to be present. No breeding habitat was identified for cave dwelling microbat species identified in the BioNet search; however foraging habitat is present. Tree-roosting microbat species identified in the BioNet searches are assumed to be present based on foraging habitat available as they are ecosystem credits.

Table 6.3 details the threatened fauna species targeted during the field surveys and results. Refer to Figure 6.2 which shows the presence of threatened fauna species identified within the study area. Details on the level of survey effort undertaken and compliance with the BAM is provided in Appendix D.

Table 6.3: Threatened fauna

Species	EPBC Act	BC Act	Identification method (not recorded, assumed, recorded, expert report)	Results
Barking Owl *Ninox connivens*	N/A	V	Not Recorded	Species/ Ecosystem Credit. The study area contains 14.8 hectares of suitable foraging habitat (PCT 1627, 1638 and 1649). Two potential nest trees were recorded within the study area which provide suitable breeding habitat for the species. These trees were monitored over four nights in August 2022. No sign of usage by owls was observed, with other arboreal fauna utilising one of the hollows.
Masked Owl *Tyto novaehollandiae*	N/A	V	Not Recorded	Species/ Ecosystem Credit. The study area contains 14.8 hectares of suitable foraging habitat (PCT 1627, 1638 and 1649). Two potential nest trees were recorded within the study area which provide suitable breeding habitat for the species. These trees were monitored over four nights in August 2022. No sign of usage by owls was observed, with other arboreal fauna utilising one of the hollows.
Powerful Owl *Ninox strenua*	N/A	V	Not Recorded	Species/ Ecosystem Credit. The study area contains 14.8 hectares of suitable foraging habitat (PCT 1627, 1638 and 1649). Two potential nest trees were recorded within the study area which provide suitable breeding habitat for the species. These trees were monitored over four nights in August 2022. No sign of usage by owls was observed, with other arboreal fauna utilising one of the hollows.
Swift Parrot *Lathamus discolor*	CE	E	Not Recorded	Species/Ecosystem Credit. The study area contains 14.8 hectares of suitable foraging habitat (PCT 1627, 1638 and 1649). Breeding occurs in Tasmania. Species not detected within the study area. The study area does not fall within known areas of important habitat mapping.
Regent honeyeater *Anthochaera phrygia*	CE	CE	Not Recorded	Species/Ecosystem Credit. The study area contains 14.8 hectares of sub optimal foraging habitat (PCT 1627, 1638 and 1649). Species not detected within the study area. The study area does not fall within known areas of important habitat mapping.

Species	EPBC Act	BC Act	Identification method (not recorded, assumed, recorded, expert report)	Results
Squirrel Glider *Petaurus norfolcensis*	N/A	V	Not Recorded (assumed present)	Species Credit. The study area contains 14.8 hectares of suitable foraging habitat (PCT 1627, 1638 and 1649) suitable hollows for nesting. Species was not detected within the study area, however there is a high likelihood of occurrence based on background research and known records in the broader locality.
Glossy Black-Cockatoo *Calyptorhynchus lathami*	V	V	Not Recorded	Species/Ecosystem Credit. The study area contains 14.8 hectares of suitable foraging habitat (PCT 1627, 1638 and 1649). No hollows suitable for breeding are expected to be impacted as a result of the works.
Large-eared Pied Bat *Chalinolobus dwyeri*	N/A	V	Not Recorded (assumed present)	Species Credit. The study area contains 14.8 hectares of suitable foraging habitat (PCT 1627, 1638 and 1649). No breeding habitat is present. There is a moderate likelihood of occurrence for foraging.
Southern Myotis *Myotis Macropus*	N/A	V	Not Recorded (assumed present)	Species Credit. 2 hectares of native vegetation within the study area is identified as potential habitat for Southern Myotis. Five suitable hollows for roosting/breeding area expected to be removed as a result of the works Species was not detected within the study area, however there is a moderate likelihood of occurrence.

6.1.2.5 Wildlife connectivity corridors

The current Hillsborough Road serves as an impediment to movement and a mortality risk to movement for fauna. The current tree canopy gap across is Hillsborough Road is about 30 metres on average (Jacobs 2019) which is within the capabilities of gliding marsupials such as Squirrel Glider. The habitat present within the study area is high quality for Squirrel Glider and LMCC (2016) have mapped important crossing points at four locations between the CNCC Showground in the east and the power easement in the west near Crockett Street. The central crossing point, about half way between Barker Avenue and Crockett Street is considered a Category 6 crossing which is defined as:

Wide interface of bushland (>500 metres) at each side of a crossing point & less than 70 metres in crossing distance. Important areas for fauna movement (LMCC 2016).

6.1.2.6 Groundwater dependent ecosystems

The Atlas of GDEs (Bureau of Meteorology, 2019) identifies areas of the study area associated with Winding Creek and adjoining tributary to the west as high potential GDE's. The study area does not contain any aquatic GDEs and is not located within a floodplain alluvial groundwater source (Jacobs 2019).

While PCT 1649 is considered a high likelihood to be a GDE, this PCT is not obligate (entirely dependent on groundwater). PCT 1649 is not restricted to locations of groundwater discharge or located within aquifers. PCT 1649 is likely to be on opportunistic facultative GDE that depends on the subsurface presence of groundwater in some locations but not in others, particularly where an alternative source of water (i.e. rainfall) cannot be accessed to maintain ecological function.

PCT 1736 only occurs in the study area due to previous disturbance (clearing and excavation) and is not a naturally occurring wetland. This wetland in man-made and exists due to ponding of stormwater. A freshwater wetland would not have naturally occurred in this location, rather PCT 1638 would have. The occurrence of PCT 1736 in the study area is rain fed and is not likely to be a GDE.

6.1.2.7 High Threat Weeds

Several High Threat Weeds were recorded within the vegetation plots. These are:

- Whiskey Grass (*Andropogon virginicus*)
- Asparagus Fern (*Asparagus aethiopicus*)
- Climbing Asparagus Fern (*Asparagus africanus*)
- Balloon Vine (*Cardiospermum grandiflora*)
- Kikuyu (*Cenchrus clandestinus*)
- Camphor laurel (*Cinnamomum camphora*)
- African Love Grass (*Eragrostis curvula*)
- Coolatai Grass (*Hyparrhenia hirta*)
- Morning Glory (*Ipomoea indica*)
- Lantana (*Lantana camara*)
- Large-leaf Privet (*Ligustrum lucidum*)
- Small-leaf Privet (*Ligustrum sinense*)
- Japanese Honeysuckle (*Lonicera japonica*)
- Guinea Grass (*Megathyrsus maximus*)
- Mickey Mouse Plant (*Ochna serrulata*)
- *Paspalum dilatatum*
- Buffalo Grass (*Stenotaphrum secundatum*)

Many of the above species occur as incidental of low coverages within vegetation categorised as good to moderate condition. Within certain zones (PCT 1627 Moderate and PCT 1649 Moderate), woody weeds such as Lantana and Small-leaf Privet are prevalent in disturbed areas.

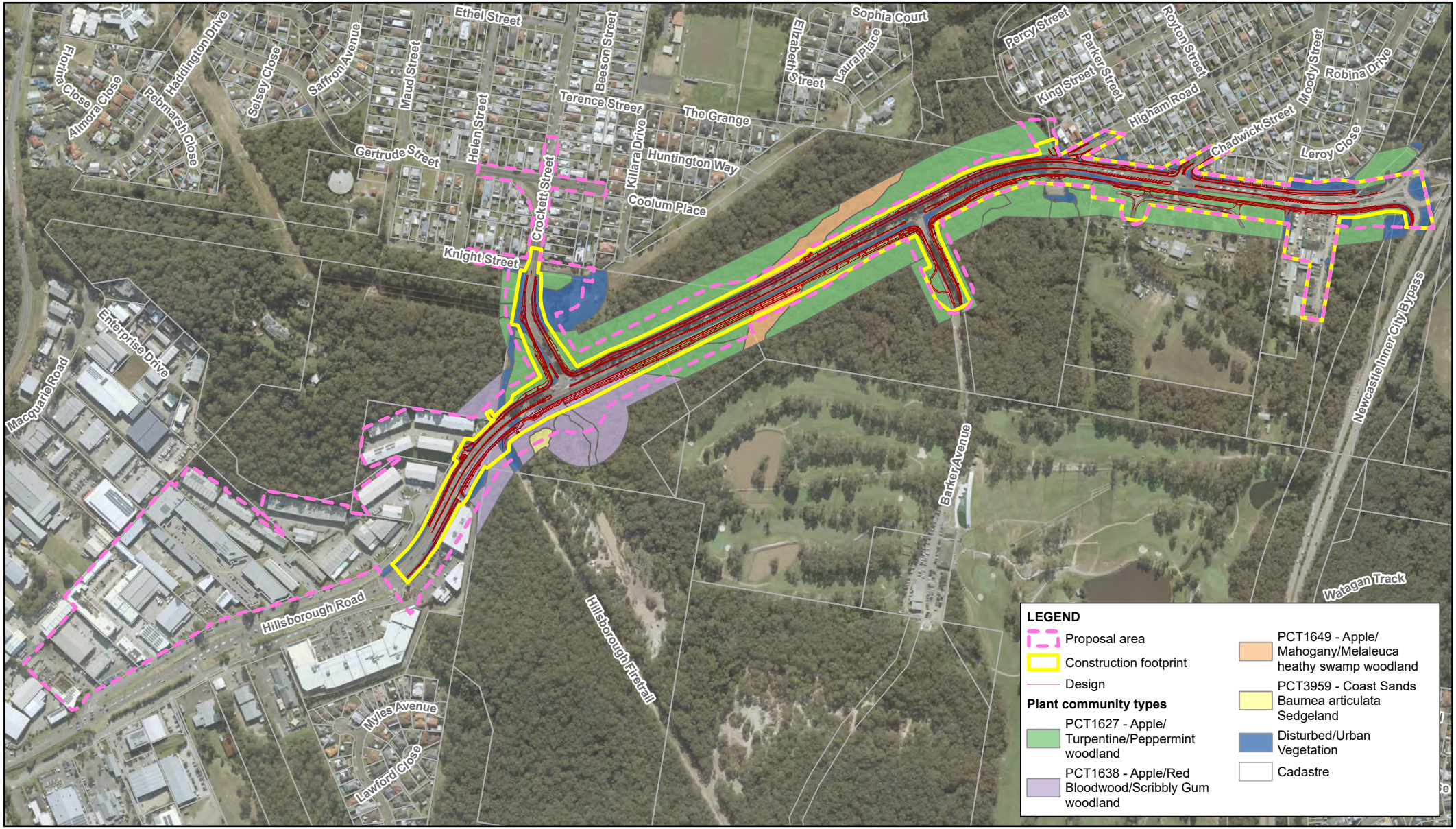
6.1.2.8 Matters of National Environmental Significance

One Matter of National Environmental Significance (MNES), Black-eyed Susan (Vulnerable, EPBC Act) was recorded within the study area. No other flora species listed under the EPBC Act were assessed as having a moderate or higher likelihood of occurrence within the study area. PCT 1649 is associated with the EPBC Act listed TEC Swamp Sclerophyll Forest (Endangered), however does not meet the minimum condition threshold for listing within the study area.

Three threatened fauna species listed under the EPBC Act were assessed as having a moderate or higher likelihood of occurrence within the study area, these include Regent Honeyeater (Critically Endangered), Swift Parrot (Critically Endangered) and Large-eared Pied Bat (Vulnerable).

The nearest wetland of international importance is Hunter Estuary Wetlands, which occurs within 10 km to the north. There is no apparent interaction between the waterways within the study area and Hunter Estuary Wetlands. Winding Creek flows north and east to Cockle Creek, which then flows south into Lake Macquarie.

No migratory species are considered likely to occur within the study area with any regularity.



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

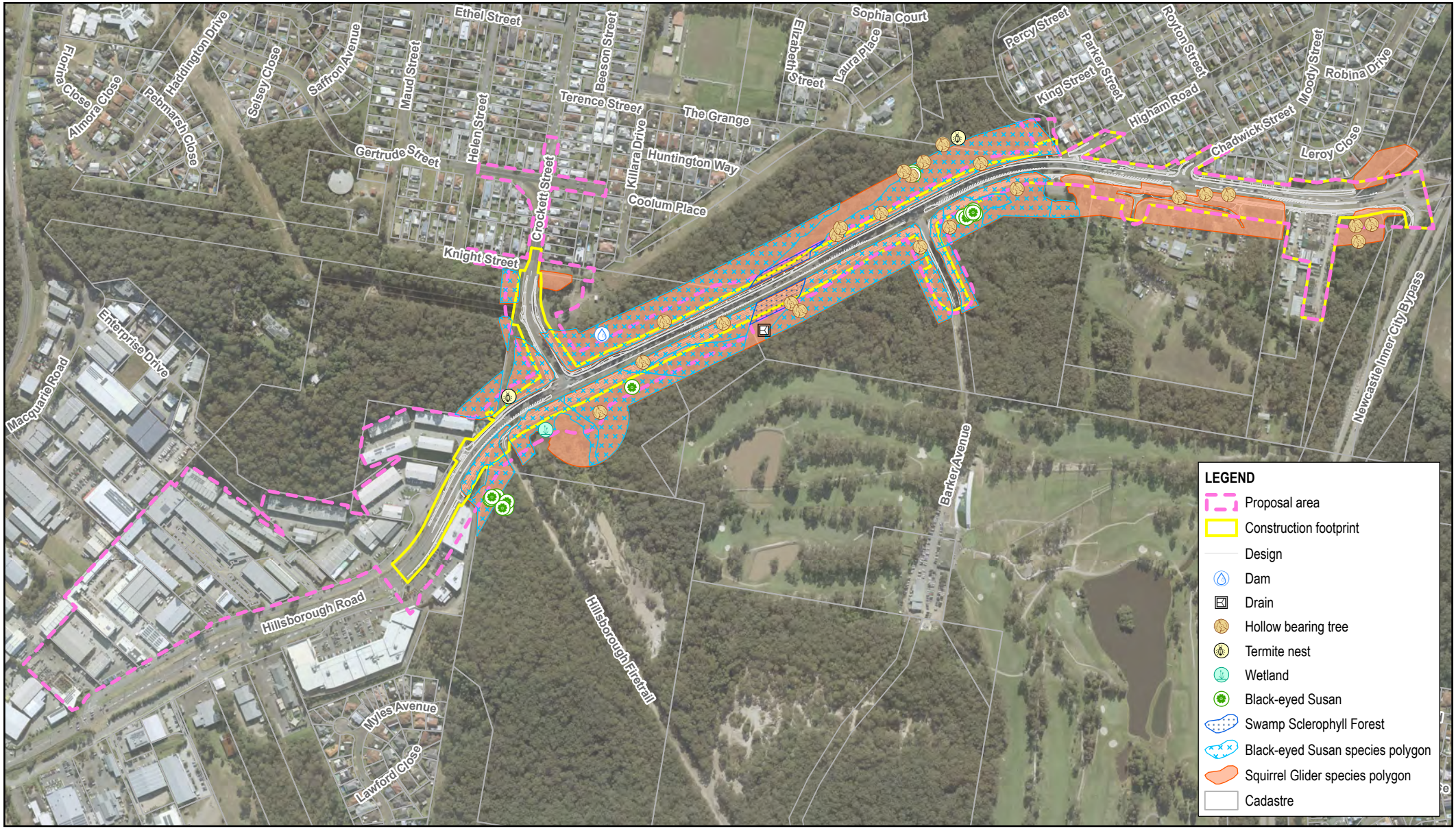
Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

Vegetation communities

FIGURE 6.1

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:21

Data source: Metromap Tile Service: - Imagery (Date extracted: 11/10/2022); Roads, Cadastre - LPI, 2017; Created by: tmorton



Paper Size ISO A4

0 50 100 150 200

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

Threatened flora and fauna

FIGURE 6.2

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:22

Data source: Metromap Tile Service: - Imagery (Date extracted: 11/10/2022); Roads, Cadastre - LPI, 2017; Created by: tmorton

6.1.3 Potential impacts

6.1.3.1 Construction

Native vegetation removal

The proposal would result in the removal of about 4.1 hectare of native vegetation and the removal of 2.5 hectares of non-native vegetation. Within the area of native vegetation to be impacted, 0.2 hectares of one threatened ecological community (TEC) under the Biodiversity Conservation Act 2016 (BC Act) would be impacted (PCT 1649). The proposal will not impact any TEC's which meet the condition requirements to be listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

A summary of the native vegetation to be cleared within each zone is summarised in Table 6.4.

Table 6.4: Summary of direct impacts to native vegetation

Veg zone	PCT	Broad condition class	TEC	Area to be impacted (ha)
1	PCT 1627: Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Good	Not a TEC	2.1
2	PCT 1627: Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Moderate	Not a TEC	0.4
3	PCT 1627: Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Canopy	Not a TEC	0.8
4	PCT 1638: Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast	Good	Not a TEC	0.2
5	PCT 1638: Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast	Moderate	Not a TEC	0.4
6	PCT 1649: Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowland	Moderate	Endangered, BC Act	0.2
Native vegetation to be cleared - Total				4.1

Removal of threatened fauna habitat

The proposal would result in the removal of approximately 4.1 hectare of native vegetation, 3.3 hectares (80%) of which is in good to moderate condition. Foraging resources, for a range of threatened fauna, would be removed. Additionally, five hollow bearing trees, containing one small hollow and four medium hollows, suitable for hollow-dependent small birds, microbats and gliders. The loss of hollow-bearing trees is a key threatening process listed under Schedule 2 of the BC Act. No hollow bearing trees that are suitable habitat for dual credit species such as Powerful Owl (living or dead trees with hollow greater than 20 cm diameter) and Glossy-Black Cockatoo (living or dead trees with hollows greater than 15 centimetres diameter and greater than eight metres above ground) would be removed.

Works to widen both culverts will impact the associated waterways and surrounding vegetation directly. Both culverts are considered unsuitable for roosting microbats given no potential habitat was observed and that they are heavily overgrown which would limit fly-in and fly-out.

Table 6.5 provides a summary of impacts to potential habitat for those species assessed as having a moderate or higher likelihood of occurrence within the study area are presented below.

Table 6.5: Summary of direct impacts to threatened fauna habitat

Species	Credit type	BC Act	EPBC Act	Potential occurrence (Moderate, High, Recorded)	Associated habitat in subject land	Impact (ha)
Regent Honeyeater *Anthochaera phrygia*	Ecosystem/Species	CR	CR	Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1 (foraging only)
Dusky Woodswallow *Artamus cyanopterus cyanopterus*	Ecosystem	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1
Glossy Black-Cockatoo *Calyptorhynchus lathami*	Ecosystem/Species	VU	VU	Moderate	PCT 1627, 1638	3.1 (foraging only)
Large-eared Pied Bat *Chalinolobus dwyeri*	Ecosystem/Species	VU	VU	Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1 (foraging only)
Brown Tree Creeper (eastern subspecies) *Climacteris picumnus victoriae*	Ecosystem	VU		Moderate	PCT 1627, 1638	3.1
Speckled Warbler *Daphoenositta chrysoptera*	Ecosystem	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	Ecosystem	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1
Little Lorikeet *Glossopsitta pusilla*	Ecosystem	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1
Swift Parrot *Lathamus discolor*	Ecosystem/ Species	EN	CR	Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1 (foraging only)
Square-tailed Kite *Lophoictinia isura*	Ecosystem/Species	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1 (foraging only)

Species	Credit type	BC Act	EPBC Act	Potential occurrence (Moderate, High, Recorded)	Associated habitat in subject land	Impact (ha)
Eastern Coastal Free-tailed Bat *Micronomus norfolkensis*	Ecosystem	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1
Little Bent-winged Bat *Miniopterus australis*	Ecosystem/Species	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1 (foraging only)
Large Bent-winged Bat *Miniopterus orianae oceanensis*	Ecosystem/Species	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1 (foraging only)
Southern Myotis *Myotis macropus*	Species	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	0.4
Barking Owl *Ninox connivens*	Ecosystem/Species	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1 (foraging only)
Powerful Owl *Ninox strenua*	Ecosystem/Species	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1 (foraging only)
Squirrel Glider *Petaurus norfolcensis*	Species	VU		High	PCT 1627, 1638 and 1649 (all zones)	4.1
Scarlet Robin *Petroica boodang*	Ecosystem	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1
Grey-headed Flying-fox *Pteropus poliocephalus*	Ecosystem/Species	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1 (foraging only)
Yellow-bellied Sheathtail-Bat *Saccolaimus flaviventris*	Ecosystem	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1
Greater Broad-nosed Bat *Scoteanax rueppellii*	Ecosystem	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1
Eastern Cave Bat *Vespadelus troughtoni*	Species	VU		Moderate	PCT 1627, 1638 and 1649 (all zones)	4.1 (foraging only)

Removal of threatened flora

The proposal would not lead to the direct loss of any individuals of threatened flora species as the Black-eyed Susan recorded are outside the construction footprint. However, there would be the removal of up to 2.9 ha of potential habitat (PCTs 1627 and 1638) for the species as outlined in Table 6.6.

The viable local population of Black-eyed Susan present is unlikely to depend on the habitat that would be removed for its long-term survival as expanses of high quality habitat occur contiguous with the study area to the north and south of Hillsborough Road.

Table 6.6: Summary of direct impacts to threatened fauna habitat

Species	Credit type	BC Act	EPBC Act	Potential occurrence (Moderate, High, Recorded)	Associated habitat in subject land	Impact (ha)
Black-eyed Susan *Tetratheca juncea*	VU	VU	Recorded	PCT 1627 (Zone 1 and 2), PCT 1638 (Zones 5 and 6)	Black-eyed Susan *Tetratheca juncea*	2.9 ha

Aquatic habitats

The most likely aquatic impact from the proposal is introduction of sedimentation downstream from construction, potential erosion of stream banks from physical disturbance and potential bed erosion if the culvert extensions do not have sufficient scour protection. The extensions will also impact upon bed area at Winding Creek and the unnamed waterway.

The hydrology of Winding Creek would be altered to facilitate the flow of water into the culvert at an angle in line with the skew of the existing culvert proposed extension. This is not considered likely to have any lasting detrimental effects on Winding Creek. The culvert works, in conjunction with rehabilitation works, may improve flow and improve aquatic fauna movements above the present condition. Overall, any small change to hydrology is unlikely to be cause a substantial impact to the native vegetation and habitat present in the study area or surrounds post construction.

There is unlikely to be the loss of riparian and/or aquatic habitat such as relocation or removal of snags. Fish passage in Winding Creek was identified as unlikely. Therefore, the proposal would not introduce a new barrier to fish passage. Any obstruction to fish passage would be during construction only and minor.

Discernible change in the hydrology and depth of the unnamed creek is not anticipated.

No threatened aquatic species, populations and communities have been identified within the study area or are considered likely to occur, therefore, would not be impacted.

Injury and mortality

The potential for wildlife injury or death could occur during the construction phase of the proposal, including as a result of the following:

- During construction, when vegetation and habitat are being cleared
- Collision/strike by machinery and plant
- Collision with construction traffic

Groundwater dependent ecosystems

Direct impacts to three GDEs identified in Section 6.1.2 include the clearing of native vegetation and the construction and disturbance footprint required to facilitate the extension of existing culverts. There is not anticipated to be any appreciable change in groundwater flow or depth during construction of the proposal. It should also be noted that these GDEs are not entirely groundwater dependent and are more reliant on the collection of rainwater in these locations.

Indirect impacts

Construction of the proposal would create a temporary barrier to fauna movement, as the presence of plant and construction personnel would deter fauna from the area. Temporary disturbance to wildlife from noise emissions and light spill during construction and night works are predicted to occur within 50-100 m of the construction footprint. Significant long-term impacts are not likely.

During construction, the proposal has the potential to cause both the spread of pathogens, diseases and weeds currently occurring in the study area and surrounds. Pathogens, diseases and weeds have potential to be spread through the introduction and movement of soil. Standard biosecurity hygiene management measures during construction would minimise this risk. Rehabilitation of disturbed areas and ongoing weed management after the completion of construction activities would limit the establishment and spread of weed species during operation.

6.1.3.2 Operation

The study area forms part of an important wildlife corridor, with the existing Hillsborough Road and adjacent existing transmission line already presents a barrier to movement in a north-south direction. It is anticipated that the existing canopy gap would increase form about 30 metres to about 50 metres. The increase in a canopy gap proposed is likely to create a barrier to movement for arboreal fauna such as the Squirrel Glider. Individuals would be deterred from making the crossing and those that do may have an increased chance of vehicle strike.

An increase in operational noise is anticipated with or without the proposal due to cumulative increases in traffic volumes over time. Traffic noise can reduce the distance over which acoustic signals such as song can be detected, an effect known as acoustic interference or masking. Traffic noise could hamper detection of acoustic signals by members of the same species or predator species that use these signals to locate prey. Traffic noise may make it more difficult for fauna to establish and maintain territories, attract mates and maintain pair bonds, and possibly leading to reduced breeding success in noisy roadside habitats.

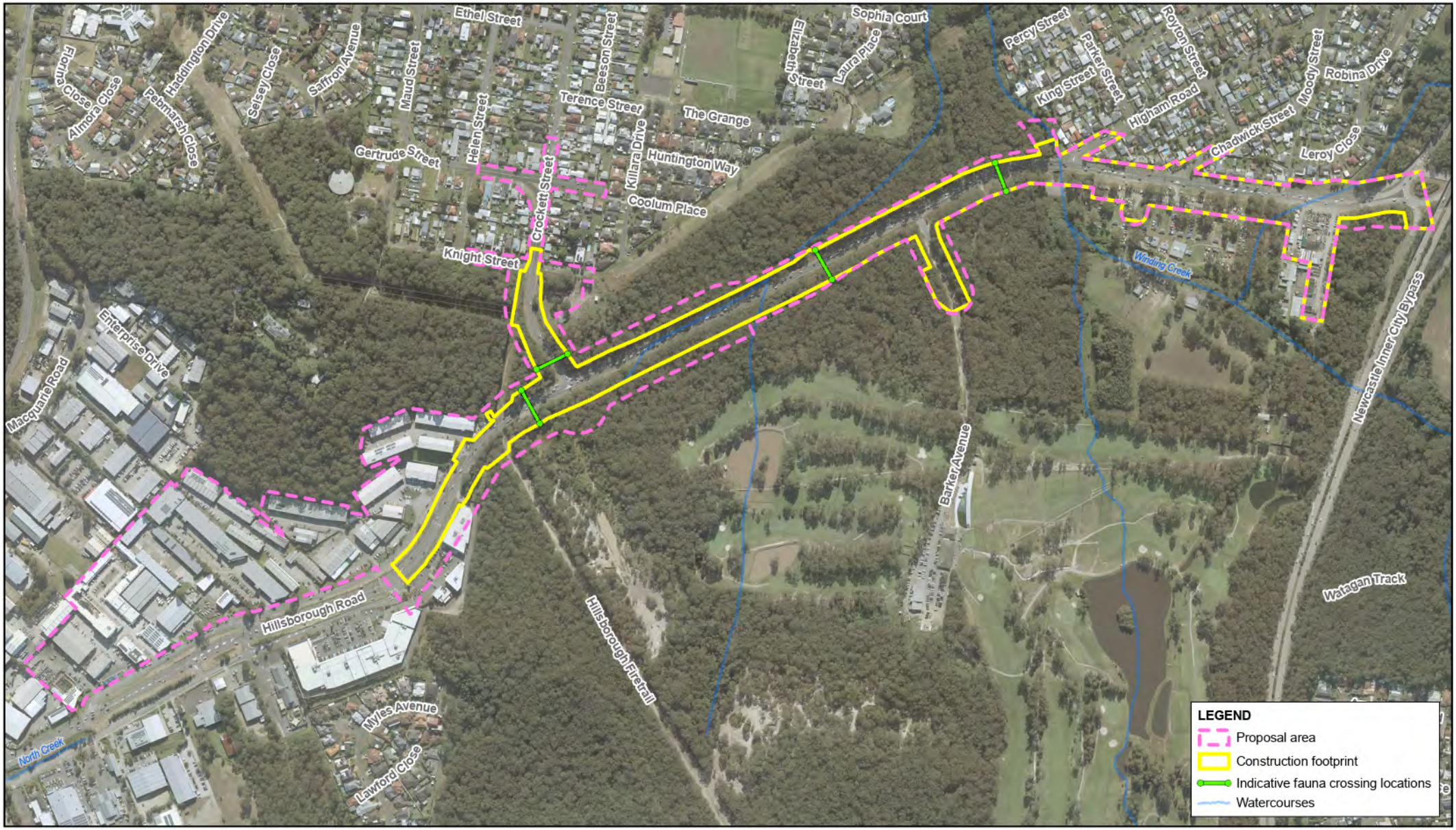
The proposal is likely to create new edge effects in previously undisturbed native vegetation in good-moderate condition, including that adjacent to known locations of Black-eyed Susan. Considering the present edge effects, such as increased opportunity for weed encroachment and exposure within the study area, widening of Hillsborough Road would 'push back' these edge effected areas in the long-term as weeds colonise previously undisturbed areas.

Management measures have been recommended to minimise the impacts, and to maintain wildlife connectivity for threatened fauna species, which would consider existing wildlife corridors. Other ongoing operational impacts to biodiversity as a result of the proposal would be negligible. Indicative wildlife corridor locations are shown on Figure 6.3. The development of a Fauna Connectivity Strategy as part of detailed design is recommended with the aim of reducing the proposal's potential long-term impacts. The number and placement of indicative arboreal fauna crossings (such as rope ladders) will be determined during detailed design.

6.1.3.3 Conclusion on significance of impacts

The proposal is not likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the *Biodiversity Conservation Act 2016* or *Fisheries Management Act 1994* and therefore a Species Impact Statement or Biodiversity Development Assessment Report is not required.

The proposal is not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*.



Paper Size ISO A4

0 100 200 300

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Project No. **12544418**
Revision No. **0**
Date **08/11/2022**

Indicative fauna crossings

FIGURE 6.3

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 08 Nov 2022 - 18:28

Data source: Metromap Tile Service: - Imagery (Date extracted: 8/11/2022); Roads, Cadastre - LPI, 2017; BIOSIS: Wildlife crossings: 2022.
Created by: tmorton

6.1.4 Safeguards and management measures

The measures described in Table 6.7 will be implemented to avoid or minimise potential impacts on biodiversity.

Table 6.7: Biodiversity safeguards and management measures

Impact	Mitigation measure	Timing and duration	Responsibility
Impacts to native flora and fauna	A Flora and Fauna Management Plan will be prepared and implemented as part of the Construction Environmental Management Plan (CEMP). It will address impacts to flora and fauna and include, but not necessarily be limited to: (a) plans for the construction site and adjoining area showing native vegetation, flora and fauna habitat, threatened species and ecological communities (b) plans showing areas to be cleared and areas to be protected, including exclusion zones and protected habitat features (e.g. Hollow-bearing trees), and areas for rehabilitation or re-establishment of native vegetation (c) requirements set out in the RTA Landscape Guideline (d) procedures addressing relevant matters specified in the *Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects*	Prior to construction	Transport/ Contractor
	Development and implementation of a Biodiversity Offset Strategy to facilitate offsetting of impacts that exceed the thresholds within the No Net Loss Guidelines (Transport, 2022b).	Prior to construction	Transport
	Prepare a Tree and Hollow Replacement Plan including the calculation of replacement trees and hollows in accordance with the Tree and Hollow Replacement Guidelines (Transport 2022c). Tree and Hollow replacement Plan will outline requirements for onsite replacement and/or equivalent payment to the Transport Conservation Fund.	Prior to construction	Transport
Removal of native vegetation	Impacts to biodiversity will be minimised through detailed design, where practical and demonstrated within the Detailed Design report	Detailed design	Transport
Fragmentation of identified habitat corridors	A fauna connectivity strategy would be developed during the detailed design stage in accordance with the draft *Roads and Maritime Wildlife Connectivity Guidelines* (Roads and Maritime 2011c). The strategy is to focus on maintaining connectivity through the proposal and is to include, but not be limited to: (a) provision of fauna crossings and locations, particularly where canopy gaps are greater than 50 metres (b) identification of trees suitable for retention (c) consideration of construction footprint requirements (d) consideration of traffic noise and artificial lighting impacts at crossing points	Detailed design, during construction and post construction	Transport/Contractor

Impact	Mitigation measure	Timing and duration	Responsibility
Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Transport/Contractor
Injury and mortality of fauna	Fauna will be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Transport/Contractor

6.1.5 Biodiversity offsets

This section considers whether any impacts require the provision of biodiversity offsets, conservation measures or tree and hollow replacement in accordance with Transport:

- Not Net Loss Guidelines (Transport 2022b) and supporting resources
- Tree and Hollow Replacement Guidelines (Transport 2022c) and supporting resources

Thresholds

Detail the thresholds set out by the No Net Loss Guidelines are demonstrated in Table 6.8.

Table 6.8: Offset Thresholds (Transport No Net Loss Guidelines)

Category	Impact	Threshold
A – Threatened Ecological Communities		
A1	Works involving clearing of a CEEC	Where there is any clearing of an CEEC in 'moderate to good' condition
A2	Works involving clearing of an EEC	Where clearing of an EEC ≥ 2 ha in 'moderate to good' condition
A3	Works involving clearing of a VEC	Where clearing of a VEC ≥ 5 ha in 'moderate to good' condition
B – Threatened fauna habitat		
B1	Works involving clearing of threatened fauna habitat that is also a TEC identified in Category A	No –covered by Category A TEC thresholds
B2	Works involving clearing of any habitat for a known species credit fauna species or clearing of breeding habitat (as defined by the TBDC) for dual-credit fauna species (excluding exotic and planted vegetation that cannot be assigned to a plant community type)	Where clearing ≥ 1 ha in 'moderate to good' condition
C – Threatened flora and habitat		
C1	Works involving removal of known threatened flora species and their habitat	Where loss of individuals is ≥ 10 (species that have a 'count of individuals' as the unit of measure) or where clearing of habitat (in accordance with the BAM) is ≥ 1 ha
D – Key Fish Habitat		
B	Type 1 or Type 2 key fish habitats	Where there is a net loss of habitat
Tree and hollow replacement		
	Any residual biodiversity impact that doesn't require offsets in accordance with the No Net Loss Guideline is to be assessed against the requirements of the Tree and Hollow Replacement Guideline	Any clearing of hollows and/or trees ≥ 5 cm DBH

Table 6.9 details the assessment of direct impacts to native vegetation and habitat against the above thresholds. The category of each threshold that has been triggered is quoted as well as the applicable threatened entity.

Table 6.9: Assessment of vegetation impacts against thresholds

Veg. zone	PCT	Condition	TEC	Impact area (ha)	Threshold triggered
1	PCT 1627: Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Good	Not a TEC	2.1	B2 – Squirrel Glider C1 – Black-eyed Susan
2	PCT 1627: Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Moderate	Not a TEC	0.4	B2 – Squirrel Glider C1 – Black-eyed Susan
3	PCT 1627: Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Canopy	Not a TEC	0.8	B2 – Squirrel Glider.
4	PCT 1638: Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast	Good	Not a TEC	0.2	B2 – Squirrel Glider C1 – Black-eyed Susan
5	PCT 1638: Smooth-barked Apple - Red Bloodwood - Scribbly Gum grass - shrub woodland on lowlands of the Central Coast	Moderate	Not a TEC	0.4	B2 – Squirrel Glider C1 – Black-eyed Susan
6	PCT 1649: Smooth-barked Apple - Red Mahogany - Swamp Mahogany - Melaleuca sieberi heathy swamp woodland of coastal lowland	Moderate	Endangered, BC Act	0.2	B2 – Squirrel Glider
Urban Native/Exotic	NA	NA	NA	2.5	None. Tree and Hollow Replacement Guidelines apply

Preliminary offset calculations

Preliminary calculations of offsets for each threshold category triggered above are provided in Table 6.10. As there is no threshold triggered relating to TECs, only calculations for impacts to species credit species have been calculated. Therefore, no ecosystem credits are required. Biodiversity offset calculations would be confirmed prior to clearing or removal of vegetation.

Table 6.10: Credit calculations

Species name	EPBC Act	BC Act	Impact area (ha)	Species credits
Squirrel Glider *Petaurus norfolcensis*	Not listed	Vulnerable	4.1	105
Black-eyed Susan *Tetratheca juncea*	Vulnerable	Vulnerable	2.9	88
Total species credits				**193**

Biodiversity offset strategy/tree and hollow replacement plan

As biodiversity offsetting thresholds have been triggered under the Transport No Net Loss Guidelines, offsets or conservation measures are required. In accordance with the No Net Loss guidelines, and offsetting thresholds for B2 and C1. A biodiversity offset strategy will be developed prior to the commencement of construction to outline how the proposal will fulfill offsetting obligations.

For impacts to vegetation that would not be otherwise offset via the biodiversity offset strategy, the Tree and Hollow Replacement Guidelines will apply. Namely, this includes 2.5 hectares of areas designated as Disturbed/Urban vegetation. A Tree and Hollow Replacement Plan would be prepared to address the residual impacts prior to the commencement of works. Alternatively, where tree and hollow replacement cannot be accommodated locally or can only be partially accommodated, a payment must be made to the Transport of NSW Conservation Fund prior to the commencement of works in accordance with the Transport for NSW (2022b) Tree and hollow replacement guidelines.

6.2 Hydrology and flooding

This section addresses the hydrology and flooding impacts associated with the proposal and details the safeguards and management measures proposed to mitigate these impacts.

The information presented in this section is drawn from the *Hillsborough Road Flooding Impact Assessment Report* (WMA, 2022) (refer to Appendix E).

6.2.1 Methodology

The methodology for assessing potential impacts to hydrology and flooding included the following:

- Review of background previous studies
- Review of the existing flood conditions
- Review of Winding Creek flood model, topographic data, structures and stormwater infrastructure
- Update to the existing Winding Creek model to incorporate the proposal
- Design conditions and considerations including impact assessment criteria, flood levels and other flood characteristics
- Impact assessment including newly flooded areas and road overtopping locations during specific events
- Recommendations for any additional mitigation measures and controls

6.2.2 Existing environment

The Hillsborough Road Duplication lies within the Winding Creek catchment area. Winding Creek has a catchment area of about 23.3 square kilometres. It drains into Lake Macquarie at Cockle Bay.

About 4.3 square kilometres of the catchment is situated upstream of Hillsborough Road and lies within the boundaries of the City of Lake Macquarie LGA. Flooding of roads and residential areas within the catchment has occurred on several occasions in recent years. The most notable being April 2001, February 1990 and June 2007. Figure 6.1 shows the catchment area of Winding Creek and area reviewed as part of this assessment.

The floodplain within the catchment area includes part of the suburbs of Barnsley, Edgeworth, Argenton, Glendale and Cardiff. The business centre of Cardiff on Winding Creek downstream of the proposal is particularly prone to flooding and the creek system in this reach consists of a wide concrete lined channel.

Upstream of the business centre of Cardiff there are expansive overbank grassed areas of parkland adjoining the lined channel of Winding Creek but through the centre there is development to nearly the boundary of the channel. Significant overbank flooding occurred in February 1990 and June 2007 causing property damage and risk to life.

The western and northern parts of the catchment are heavily vegetated. Urban development in the remaining areas has meant that the pervious coverage has been replaced with impervious surfaces (houses, roads). However, there are large areas of open space including golf courses and parks within the developed areas of the catchment. Of significance is the construction of two retarding basins by Hunter Water in 1993 in the Winding Creek catchment to reduce the peak flows downstream.

The main drainage lines running through the proposal consist of:

- An existing pit and pipe drainage network that collects water from Hillsborough Road and discharges into Winding Creek
- Winding Creek Culvert immediately west of Higham Road
- Cockle Creek culvert between Barker Avenue and Crockett Street
- Various transverse crossings
- Open and grass lined swales along the majority of Hillsborough Road on the northern and southern sides

6.2.3 Potential impacts

6.2.3.1 Construction

Construction flooding and drainage impacts could potentially arise as a result of:

- A temporary increase of runoff volumes and peak flows (e.g. maximum flow rates) across work areas following rainfall events due to an increase in impermeable surfaces from clearing and soil disturbance. This is not expected to be significant as run-off volumes are minor compared to the contribution of the broader catchments and nearby drainage.
- Drainage infrastructure may be temporarily blocked (e.g. by soil, vegetation, waste) or diverted due to construction activities.
- Earthworks during construction could alter or divert overland flow paths, which could direct more flow to some areas. This may temporarily alter local flooding and create ponding around the proposal.

This is particularly important in the following areas of the proposal:

- Culvert extension works at Winding Creek, potential for flows to be impeded and worsen flooding impacts
- Where the proposal is located along a roadside channel that runs along the southern side of Hillsborough Road, where there is potential for construction works to impede flows and worsen flooding impacts

Impacts would be limited and managed by the implementation of the proposed mitigation measures outlined in Section 6.2.4. This includes development of a construction work methodology for drainage structure installation and replacement that includes protection of water quality, staging to maintain existing flows and preparing for significant weather events and flooding.

Table 6.11 provides a brief summary of the flooding and drainage conditions for each of the temporary compounds.

Table 6.11: Construction ancillary facilities flooding potential

Area	Potential for flooding	Potential for works to disrupt drainage or flow paths?
Construction compound A - eastern end	Minor potential for inundation of the northern portion of the compound in a 1% AEP event.	NA. Construction compound A is not located within a flow path. Only subject to backwater flooding.
Compound B - western end	Negligible. Not in a flood zone.	NA

Use of the compounds would result in very small changes in imperviousness. Therefore, due to the small expected changes in imperviousness, it is not expected that the change in land use of these sites would result in a measurable increase in pollutants or peak flows. Impacts from compounds would be limited and managed by the implementation of the proposed mitigation measures outlined in Section 6.2.4, including a compound plan that locates stockpiles and construction facilities so that the existing localised flow paths for the 1% AEP and 5% AEP are not compromised. The potential impacts caused by flooding would be managed in accordance with the measures recommended in Section 6.2.4.

6.2.3.2 Operation

The TUFLOW model created for the Winding Creek Flood Study (LMCC, 2017) has been updated in order to undertake the hydrology and flood impact assessment, including a refinement of the grid size and hydrological modelling following the latest Australian Rainfall and Runoff (Geosciences Australis, 2019) (ARR). The updated model was then used to define the baseline conditions for the 1 Exceedance Year (EY), 20% Annual Exceedance Probability (AEP), 10 per cent AEP, 2 per cent AEP, 1 per cent AEP and 1 in 2000 year storm events. The design for the Hillsborough Road duplication was incorporated into the hydraulic model. The design involves the lane duplication and widening of Hillsborough Road and an extension of the existing culverts along Hillsborough Road.

Impacts are calculated as the change in flood level between the proposal and the existing conditions. Key flooding impacts as a result of the proposal are provided in Table 6.12 and the one per cent are shown in Figure 6.4 along with the mapped flooding assessment locations.

Overall, the proposed duplication causes changes to flood behaviour in the immediate area of Hillsborough Road. Generally the increase in water levels as a result of the project occur in non-residential areas or within or near the road corridor. The proposal would result in a reduction in water levels within downstream residential properties of Hillsborough. There are no significant changes in the flood hazard, velocity and there is an overall reduction in the time of inundation of the Hillsborough Road.

Modelling of flood levels shows a general reduction by up to 20 mm at locations on the upstream side of Hillsborough Road near the residences in all standard AEP events. Increasing the height of Hillsborough Road and the creation of the left out only at Higham Road has reduced flow depths through the residential area on Hillsborough Road in the 10 %, 2 % and 1 % AEP.

At Winding Creek and between Barker Avenue and Crocket Street the southern side of Hillsborough Road the flow depths have been reduced in events up to the 10 % AEP. On the southern side of Hillsborough Road at the Winding Creek culvert crossing the westbound new road formation is lower than the existing Hillsborough Road formation, due to this the new formation shows an increase in flood levels on the westbound lanes of up to 0.42 meters on the most southern lane in the 1% AEP. This inundation is due to the ponded water levels exiting the Hunter Water detention basin in a major event. In the existing condition for the 1% AEP the total flood depth at this location is 3.28 meters, hence an increase of 0.42 meters (about a 12% increase) does not represent a significant change in the magnitude of the impact. A maximum increase of 0.52 meters in the 1% AEP occurs upstream of Hillsborough Road, this increase is contained within the road corridor and between Hillsborough Road and the Basin 3 outlet. Some minor increases in flooding (up to 0.04 meters) occurs on Chadwick Street and Hillsborough Road.

By reducing peak flood levels at most locations within Hillsborough Road, the proposal is predicted to have a positive impact on flooding (i.e. reduction in water levels during inundation) across the adjacent upstream private properties.

As the proposed upgraded pipes across Hillsborough Road allow floodwaters to move faster, the peak flows discharging to the downstream channel discharging to Winding Creek increase and so do the peak flood levels in the downstream channel. Peak flows along this channel can still be contained within the banks of the channel in all events up to and including a 1% AEP event, and localised increased flood levels along this channel do not have an impact on flood levels across private properties further downstream (northwest).

The proposed upgrades to cross drainage structures would improve the hydraulic efficiency, which would also increase peak velocities within culverts and open channels as flow moves faster through them. To protect against these high-velocity flows entering and exiting the cross-drainage structures, scour protection has been included as per section 3.13 in Austroads Part 5B (Austroads, 2021). Minimum rock size and length of apron at the outlet has been checked and would be based upon the pipe diameter at the outlet and the outlet flow velocity as per the hydraulic model. Design of the size of the scour protection required for each outlet would be undertaken in the detailed design stage within the proposal boundary.

Flooding impacts on residential properties

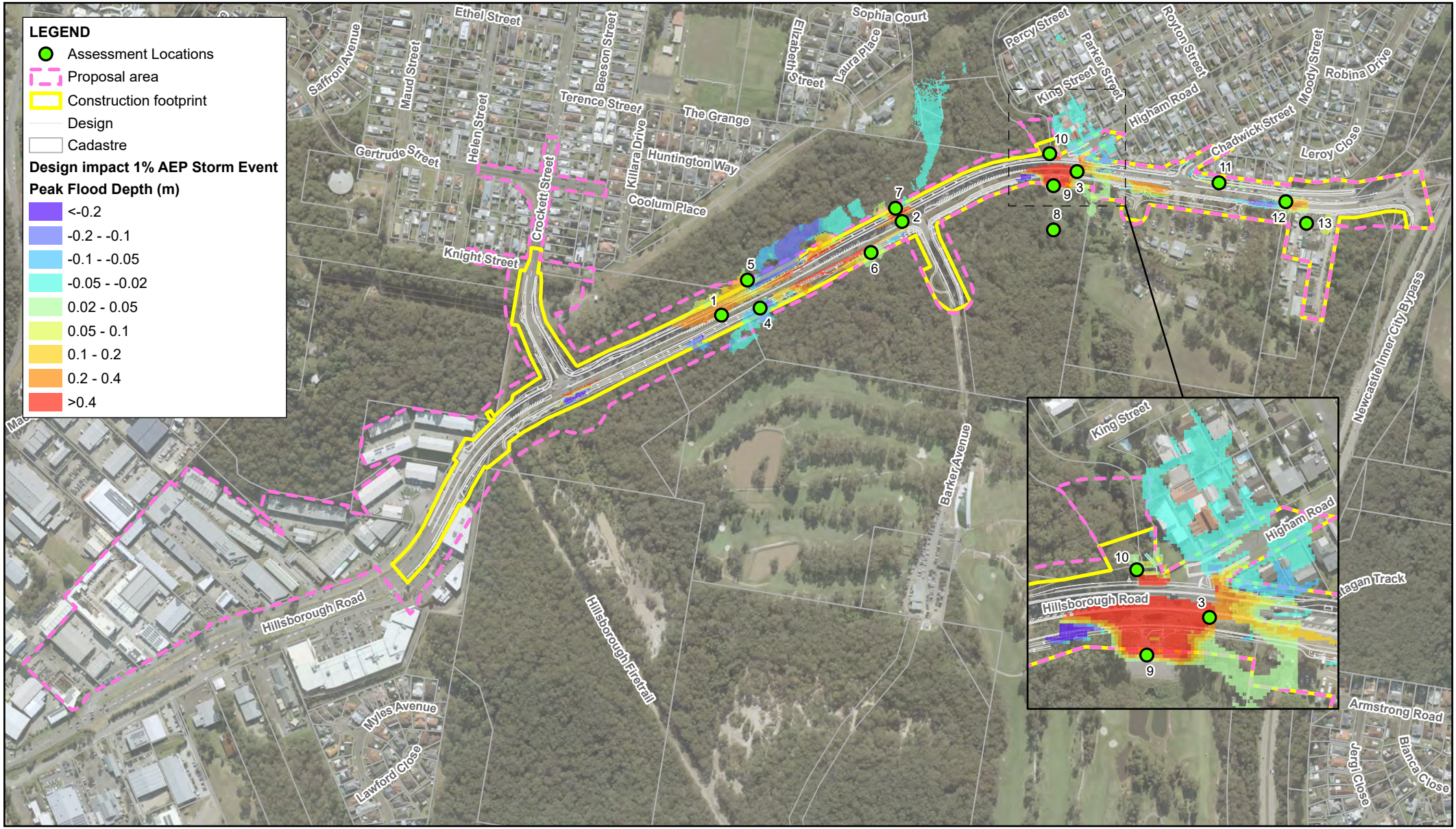
The proposal generally decreases flood levels in the 1% AEP event for already impacted residential properties by up to 0.05 meters. A single residential property (Lot 501, DP 1178962) adjacent to Winding Creek would experience a small area of increased flooding along the south western boundary of up to 0.1 meters but a decrease of 0.05 meters immediately surrounding the building in the 1% AEP event.

Some minor water level reductions (up to 57 mm) occur in Higham Road and King Street with one property no longer flooded.

Table 6.12: Proposal flooding impacts at key locations

No.	Location	Ground Level (mAHD)	Peak Flood Level (mAHD)						Impact (m)					
			1EY	20% AEP	10% AEP	2% AEP	1% AEP	1 in 2000 year	1EY	20% AEP	10% AEP	2% AEP	1% AEP	1 in 2000 year
1	Hillsborough Road (Between Barker Avenue & Crockett Street)	28.85	N/A	N/A	N/A	N/A	28.82	28.82	Wet now Dry	Wet now Dry	Wet now Dry	Wet now Dry	0.21	0.16
2	Hillsborough Road (Near Barker Avenue)	25.34	N/A	N/A	N/A	N/A	N/A	25.36	<0.01	Wet now Dry	Wet now Dry	Wet now Dry	Wet now Dry	0.16
3	Hillsborough Road (D/S of Basin 3)	24.21	N/A	N/A	N/A	24.49	24.64	24.94	<0.01	<0.01	<0.01	0.01	0.09	0.16
4	U/S of Hillsborough Road (320m East of Crockett Street)	27.22	27.50	27.71	27.81	27.89	27.92	28.08	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
5	D/S of Hillsborough Road (320m East of Crockett Street)	26.89	27.17	27.25	27.29	27.36	27.40	27.45	0.04	0.03	0.05	0.01	0.01	<0.01
6	U/S of Hillsborough Road (510m East of Crockett Street)	24.94	25.04	25.15	25.18	25.36	25.42	25.70	<0.01	<0.01	<0.01	0.01	0.06	0.25
7	D/S of Hillsborough Road (25m West of Barker Avenue)	23.89	24.01	24.06	24.08	24.15	24.17	24.27	<0.01	<0.01	<0.01	<0.01	0.01	0.06
8	Basin 3	21.16	24.90	24.90	25.17	25.64	25.69	25.84	<0.01	<0.01	0.14	0.02	0.02	<0.01
9	U/S of Hillsborough Road (Basin 3/ Winding Creek)	20.78	22.34	22.35	22.61	24.11	24.61	24.96	0.14	0.13	0.24	0.44	0.42	0.15
10	D/S of Hillsborough Road (Basin 3/ Winding Creek)	19.89	21.97	21.99	22.17	22.92	23.12	23.64	<0.01	<0.01	0.04	0.10	0.09	0.08

No.	Location	Ground Level (mAHD)	Peak Flood Level (mAHD)					Impact (m)					
			1EY	20% AEP	10% AEP	2% AEP	1% AEP	1 in 2000 year	1EY	20% AEP	10% AEP	2% AEP	1% AEP	1 in 2000 year
11	U/S of Hillsborough Road (60m East of Chadwick Street)	25.52	N/A	25.58	25.59	25.63	25.64	25.68	<0.01	<0.01	<0.01	0.01	0.01	0.01
12	Hillsborough Road (Near Whalan's Nurseries)	26.86	N/A	27.00	27.00	27.00	27.00	27.00	Wet now dry	0.10	0.10	0.08	0.08	0.06
13	D/S of Hillsborough Road (Whalan's Nurseries)	28.01	27.99	28.00	28.00	28.00	28.01	28.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Flood level
1% annual exceedance probability

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

FIGURE 6.4

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:21

Data source: Metromap Tile Service: - Imagery (Date extracted: 11/10/2022); Roads, Cadastre - LPI, 2017; Created by: tmorton

6.2.4 Safeguards and management measures

A number of mitigation measures have been built into the design of the proposal, these include:

- Changes to the stormwater network for flood mitigation particularly close to Barker Avenue and Whalan's Nurseries including pits and connections to the existing 750 mm pipe. A standard sag pit flow curve, which was converted to a stage-flow curve for input in TUFLOW, based on the road geometry.
- Upgrade of the culvert near Barker Avenue.
- An open drain arrangement along the southern side of Hillsborough Road and to the West of Barker Avenue to convey and direct flow towards the culverts.
- Modification to the terrain near Higham Road to reduce the flow into the area.

In addition to the above, despite the minor impact the proposal will have on flooding, the measures described in Table 6.13 will be implemented to avoid or minimise potential residual impacts on existing flooding.

Table 6.13: Hydrology and Flooding safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Flood Mitigation	Detailed design of Winding Creek culvert extensions to further minimise flooding impacts to flood depths on the west bound travel lane, where practical.	Transport/Contractor	Detailed design, Construction, Operation
Flood Management Plan	A Construction Flood management plan to be prepared as part of the CEMP. The FMP will address but not necessarily be limited to: • Processes for monitoring and mitigating flood risk during construction • Monitoring of weather and rainfall conditions • Steps to be taken in the event of a flood warning/ very high rainfall including stop work periods	Transport/Contractor	Detailed design, Construction, Operation
Construction methodology	Construction methodology is to be developed that maintains the existing capacity of drainage within the proposal area.	Transport/Contractor	Detailed design, Construction, Operation

6.3 Surface water and groundwater

This section addresses the surface water and groundwater impacts associated with the proposal and details the safeguards and management measures proposed to mitigate these impacts.

The information presented in this section is drawn from the *Hillsborough Road Soils, Surface and Groundwater Assessment Report* (SGWAR) (GHD, 2022) (refer to Appendix F).

6.3.1 Methodology

The methodology for assessing potential impacts to surface and groundwater included the following:

- Consideration of the location of the proposal area in the context of surrounding and upstream catchment areas and potential influence on downstream waterways
- Identification of construction activities likely to impact on surface water quality and groundwater
- Review of the reference design and activities likely to cause an impact on water quality and groundwater
- The surface water quality assessment has included:
  - A desktop review of available information (e.g. soils, rainfall, existing drainage lines and watercourses, downstream sensitive receiving environments, historic data, previous assessments)
  - Identification and assessment of impacts on water quality against the water quality objectives, both at the construction stage and during operation
  - Identification of the relevant water quality objectives, based on the NWQMS guidelines and guidelines stipulated by LMCC management plans
  - An assessment of the potential impacts of the proposal on the surrounding water quality during construction and operational phases, against the water quality objectives
  - Identification of mitigation measures, including erosion and sediment controls (including consideration of the requirement for sediment basins: as per the Blue Book) that would be required during construction and operational phases
  - Conclusion identifying residual impacts and any further required studies
  - Typical scour protection measures at culvert outlets
- The groundwater assessment has included:
  - Estimation of groundwater inflows for construction elements that may intercept groundwater using the analytical equations and approach outlined in Marinelli and Niccoli (2000)
  - Assessment of potential groundwater impacts, including development of a conceptual groundwater model, against the criteria specified in the NSW Aquifer Interference Policy (Department of Primary Industries, 2012) (AIP)
- Identification of mitigation measures to reduce potential adverse impacts on surface water and groundwater environments during construction and operation, including:
  - Identification of measures and controls to mitigate impacts on surface water quality
  - Identification of measures and controls to mitigate impacts on groundwater quality and quantity
- Assessment of the expected residual impacts on surface water following the implementation of measures and controls

6.3.2 Existing environment

6.3.2.1 Surface water

As shown in Figure 6.5 most of the proposal is within the catchment of Winding Creek; however, the western portion of the proposal is within the catchment of North Creek.

Winding Creek is a mixture of natural and semi-natural channels, as well as a concrete-lined channel. Winding Creek is within the Cockle Creek catchment. Winding Creek drains towards the north west of the proposal to then joins with Brush Creek, about 4.5 kilometres downstream of the proposal area. Brush Creek is a tributary of Cockle Creek. Cockle Creek drains into Lake Macquarie at Boolaroo.

North Creek flows into Lake Macquarie in Warners Bay about 1.8 kilometres south-west of the proposal.

Lake Macquarie - Freshwater Catchment Ecosystem Health data (LMCC, 2022) reports on the freshwater waterway health of Lake Macquarie's main catchments including Winding Creek and North Creek. As part of the assessment three components of waterway health (water quality, stream pollution and riparian evaluation) are assessed and graded. Water quality is graded on an 'A to F' scale.

Over the period 2011 to 2021, water quality at Winding Creek was graded A to B while overall site grade has been graded as C to D. For North Creek, between 2011 and 2021 water quality has generally been graded at D to F; however, in 2021 water quality was graded as B. Overall site grade at North Creek has generally been between D and E.

As noted in Section 6.2.2, flooding along Winding Creek and to a lesser extent along Cockle Creek has been recorded since the 1930's. Two retarding basins were constructed by Hunter Water in 1993 on Winding Creek to reduce flows downstream. One of these basins is located immediately upstream of the proposal while another basin is located about 500 metres downstream of the proposal area.

6.3.2.2 Groundwater

Search of the NSW Groundwater Bore Database (BoM, 2022) was carried out on 4 May 2022 to identify registered bores within a three kilometres radius of the proposal, which identified 81 bores within the search area. The majority of identified bores (63 bores) were registered as monitoring bores. The remaining bores were registered as stock, domestic, farming or irrigation purposes (12 bores), environmental rehabilitation (three bores), industrial (one bore), drainage (one bore) or recreation purposes (one bore).

The closest bores to the Project include:

- GW047633 registered for dewatering and located within 100 metres of the proposal
- GW078258 registered for irrigation and located 1.1 kilometres north of the proposal
- GW058977 registered for water supply and located 1.3 kilometres north of the proposal

Details of GW047633, the only bore within one kilometre of the site are outlined in Table 6.14. All other registered bores are located over 1.5 kilometres from the site.

Groundwater has been observed in a number of test pits in the Winding Creek alluvium during investigations dating back as early as 2014 at levels between 1.2 metres below ground level (metres bgl) up to 10.61 metres bgl.

This indicates groundwater levels at the site are likely to vary over time due to rainfall conditions. Due to the immediate upstream presence of the retarding basin water infiltration is likely to occur in the construction footprint. The shallow alluvial groundwater in the vicinity of Winding Creek likely discharges to the lower reaches of Winding Creek as baseflow.

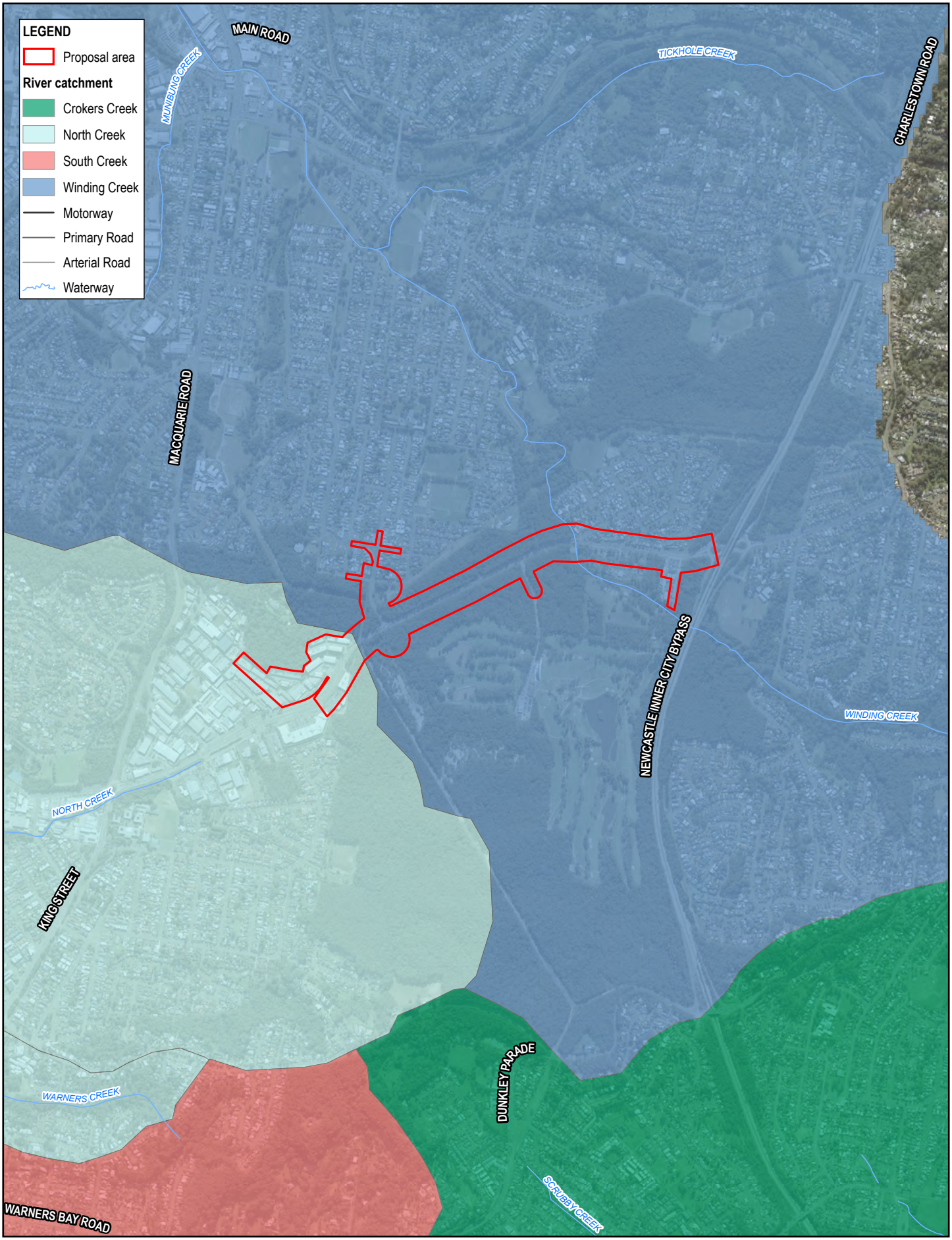
Table 6.14: Results of NSW bore database search – bores within 1 km of the Project

Bore ID	Easting	Northing	Authorised use	Depth (m)	Yield (L/s)	Geology description
GW047633	374666	6351909	Dewatering	27.7	-	Overburden (3 m thick) overlayed 20 m thickness shale and coal seam

Groundwater dependent ecosystems

As detailed in Section 6.1 the Atlas of GDEs identifies areas of the study area associated with Winding Creek and adjoining tributary to the west as high potential GDE's. The study area however does not contain any aquatic GDEs and is not located within a floodplain alluvial groundwater source (Jacobs 2019).

Further details in relation to GDEs is provided in the biodiversity assessment in Section 6.1.



Paper Size ISO A4

0 140 280 420 560

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

Catchments areas

FIGURE 6.5

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:24

Data source: Metromap Tile Service: . Created by: tmorton

6.3.3 Potential impacts

6.3.3.1 Construction

Surface water

Construction and drainage activities increase risks associated with sediment-laden water, with increased turbidity and nutrient loading, draining from unprotected areas during periods of heavy rainfall and major surface runoff events. During construction, there is potential for a range of pollutants to enter waterways, particularly during high rain events. These include sediment laden water and soil nutrients resulting from the following construction activities:

- Removal of vegetation currently stabilising soils and increasing the risk of erosion and sedimentation through the exposure of soils to weathering processes
- Cut/fill excavation works for road construction
- Reinstatement of work areas following completion of construction
- Mobilisation of fine sediment within Winding Creek during movement of plant and equipment associated with culvert widening works at this waterway
- Deposition of dust during construction activities
- Construction waste
- Fuels, hydraulic and lubricating oil spilled or leaked from plant and equipment, particularly when operating within proximity to waterways
- Fuels leaking during refuelling of plant and equipment
- Water from washing down of plant and equipment
- Water containing biological contaminants such as nutrients and bacteria from site toilets and taps associated with the site compound
- Disturbance of contaminated soils and/or PASS, which may adversely affect water chemistry including pH and dissolved solids (refer to Section 6.4)
- If flood waters were to affect any areas where chemicals and fuels have been stored, this could lead to chemical pollution of the local stormwater network and downstream receiving environment (refer to Section 6.2)
- Introduction of new drainage network elements into the water ways in addition to the risk of working on an 'online' drainage network has the potential to impact water quality, by disrupting existing flow paths and runoff velocities, which can cause an additional disturbance to soils

The potential impacts of the construction activities relate to soil disturbance, which represent a risk to surface water quality, and run-off during construction. Potential impacts on surface water during the construction phase of the proposal include:

- Impacts of typical surface water pollutants on Winding Creek and increased nutrient loads associated with sedimentation on Lake Macquarie, in excess of the water quality guidelines
- Increased nutrient loads within Winding Creek and Lake Macquarie
- Increased pollutant loads within stormwater catchment, resulting in decreased treatment effectiveness

The impact of construction activities on the quality of runoff discharging to the receiving drainage lines would be minimised by implementing an effective construction soil and water management plan. Impacts on water quality during construction can be minimised effectively through implementation of the mitigation measures detailed in Section 6.3.4.

Aquatic Habitats

No KFH or habitat for threatened aquatic species, populations or ecological communities listed under the FM Act is present. No such threatened entities are considered to have a moderate or higher likelihood of occurring. Further detail in relation to aquatic habitats is provided in the biodiversity assessment in Section 6.1.

Groundwater

The NSW AIP requires that potential impacts on groundwater sources, including their users and groundwater dependant ecosystems, be assessed against the minimal impact considerations outlined in the policy. If the predicted impacts are less than the Level 1 minimal impact considerations for less productive alluvial and fractured rock groundwater sources, then the potential groundwater impacts of the proposal are acceptable.

The depth of excavation for the proposal is not anticipated to intercept groundwater and dewatering of groundwater is unlikely to be required for the proposal. Groundwater level measurements closest to the culvert were taken at 1.9 metre (DP-BH01) and three metre (DP-BH02). The anticipated depth needed to construct the widened culvert would not intercept at these depths and is therefore unlikely to encounter groundwater. Groundwater impacts are less than the Level 1 minimal impact considerations.

If the proposal intercepted groundwater, volumes are expected to be minimal. Analytical equations have been developed to estimate the rate of groundwater inflow and associated radius of influence for conservatively high groundwater levels as a conservative estimate for the construction phase of the proposal.

Dewatering of excavations may occur at times during construction and would be carried out in accordance with dewatering plan prepared in accordance with the *Technical Guideline for Dewatering (Roads and Maritime, 2011)*. Any dewatered groundwater may be used on-site for dust suppression or irrigation, with excess water potentially discharged in accordance with the dewatering procedure. If water is to be discharged, then water quality testing will be undertaken, as recommended in Section 6.3.4.

6.3.3.2 Operation

Surface water

Potential impacts to surface water quality during operation would include pollutants and contaminants from the surface of the road being conveyed during runoff events to receiving waters. Contaminants could include:

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

The impact of the proposal on the hydrology or water quality of runoff from the Winding Creek catchment was estimated by assessing the increase in imperviousness likely to result from the additional pavement areas created by the proposal. During operation, a greater impervious area could result in increased surface runoff by a small amount. However, the increase in impervious areas is minor relative to the size of the overall Winding Creek catchment. This small change in total impervious area of the catchment is unlikely to result in any measurable changes in the hydrology or pollutant loads discharged to the receiving environment.

Opportunities for stormwater treatment were considered during the concept design process. Stormwater and drainage has been developed for the proposal aims to maintain existing drainage patterns as much as possible and implement water sensitive urban design features where practical.

The proposal corridor is highly constrained, and based on site design constraints, minimal opportunities for basins and gross pollutant traps are able to be incorporated into the design. Some water quality treatment can be achieved for the above areas where runoff is directed to informal landscaped or vegetated swales. Vegetated swales would assist in pollutant load reduction but not to the level of pollutant removal normally achieved by the larger measures. This is commensurate with the low risk of water quality impacts identified above.

Despite this, in detailed design, Transport would further investigate locations and incorporate where feasible, opportunities for surface flows (stormwater run-off) from the proposal to be directed towards and contained within drainage infrastructure such as smaller vegetated swales and shallow informal filter beds. In other cases, uncontained surface run-off would be directed to flow through grassed and landscaped areas before entering the stormwater system.

Groundwater

The introduction of hard road surface areas may increase runoff and decrease groundwater recharge, due to the loss of permeability. The decrease in recharge rates would however be minor, given the small road surface of the proposal compared to the remainder of the catchment.

Road runoff could contain pollutants associated with vehicular movements, leaks, spills and crashes, which could lead to the contamination of groundwater. The contaminants could include hydrocarbons (petrol, diesel and oils), metals and suspended solids. Measures to minimise surface water impacts (as described in Section 6.4.4) would contain the risk to groundwater quality.

Under normal operating conditions, the proposal is not expected to result in any changes to the quality of groundwater in the local or regional aquifers. Similarly, impacts to groundwater availability would be negligible as the proposal does not require any significant groundwater extraction or inhibit recharge.

6.3.4 Safeguards and management measures

The measures described in Table 6.15 will be implemented to avoid or minimise potential impacts on surface water and groundwater.

Table 6.15: Surface water and groundwater safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Soil & Water	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction. The SWMP will include monitoring required for the proposal.	Contractor	Detailed design / pre-construction	Section 2.1 of QA G38 *Soil and Water Management*
	A site-specific Progressive Erosion and Sediment Control Plan/s will be prepared and implemented as part of the Soil and Water Management Plan. Erosion and sediment control measures are to be designed, implemented and maintained in accordance with the Blue Book (DECC 2008). The Plan will include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Detailed design / pre-construction	Section 2.2 of QA G38 *Soil and Water Management*
Disturbance of creek beds and banks	A detailed Environmental Work Method Statement (EWMS) will be prepared and implemented as part of the SWMP for all works undertaken within waterways. The EWMS will detail measures to avoid or minimise risks from erosion and sedimentation to water quality and biodiversity. It will be prepared in accordance with relevant guidelines including, but not limited to: • RMS Biodiversity Guidelines – Protecting and managing biodiversity on RTA projects • Construction staging and consideration of temporary drainage and diversions to maintain capacity The EWMS will consider any temporary access points required to be installed for construction access to waterways for construction works.	Contractor	Pre-construction	SW13
	Batters will be designed and constructed to minimise risk or exposure, instability and erosion, and to support long-term, on-going best practice management, in accordance with the RMS Guideline for Batter Stabilisation Using Vegetation (April 2015). Includes consideration of both temporary and operational batters	Contractor, Transport	Pre-construction, Construction	SW15

Impact	Environmental safeguards	Responsibility	Timing	Reference
Chemical or hydrocarbon spills	Prepare a spill emergency management plan that would be included in the SWMP. Including: • Storage of hazardous goods and refuelling activities to take place in bunded areas. • Parking of vehicles and storage of plant/equipment is to occur on existing paved areas. Where this is not possible, vehicles and plant/equipment are to be kept away from environmentally sensitive areas and outside the dripline of trees. • Open drainage channels provided through construction areas will be protected by appropriate spill management measures such as bunding to prevent any spills and leaks to stormwater drainage networks. • Monitor spill management measures at specified intervals during the construction period. These include checks of the location of stored materials and of the condition of containers and bunding.	Contractor	Pre-construction, Construction	QA G38 Soil and Water Management SW3
Dewatering	A detailed Environmental Work Method Statement (EWMS) will be prepared and implemented as part of the SWMP for all dewatering activities. The EWMS will detail measures to avoid or minimise risks from potential offsite water quality impacts. Any dewatering activities will be undertaken in accordance with the RTA Technical Guideline: Environmental management of construction site dewatering in a manner that prevents pollution of waters.	Contractor	Pre-construction, Construction	G38 3.4 SW10
	If groundwater is encountered during excavations potential adverse impacts would be minimized through the implementation of the measures identified in the RTA Technical Guideline: Environmental management of construction site dewatering, where applicable.	Contractor	Pre-construction, Construction	Additional measure
Soil stabilisation and restoration	The rehabilitation of disturbed areas will be undertaken progressively as construction stages are completed, and in accordance with: • Landcom's Managing Urban Stormwater: Soils and Construction series • RTA Landscape Guideline • RMS Guideline for Batter Stabilisation Using Vegetation (draft June 2014)	Contractor	Construction	SW15

6.4 Soils, geology and contamination

This section addresses the soils, geology and contamination impacts associated with the proposal and details the safeguards and management measures proposed to mitigate these impacts.

Soils and geology information presented in this section is drawn from the SGWAR (GHD, 2022) (refer to Appendix F), the Mine Subsidence Phase 1 review (GHD, 2022) and the Phase 1 Contamination Assessment (Jacobs 2022) (refer to Appendix G).

6.4.1 Methodology

Soils and geology information was reviewed and assessed in the SWGAR. The SWGAR included a review of:

- Soils
- Topographic information
- Climate and rainfall
- Acid sulphate soils / potential acid sulphate soils
- Potential sensitive receiving environments downstream of the proposal

The assessment included a discussion of construction methodologies and operational impacts in terms of the relevant legislation and guidelines.

An additional Phase 1 Contamination Assessment report (Jacobs, 2022) and Mine Subsidence – Phase 1 Report (GHD, 2022) have been prepared for the proposal and information presented within these reports is also summarised below.

6.4.2 Existing environment

Topography

The proposal sites surface levels generally fall gently east from a high of about RL 40 metres Australian Height Datum (mAHD) (near Crocket Street at the western end of the alignment) to near Barker Avenue where they flatten at about RL 25 mAHD. East of Barker Avenue and across Winding Creek the proposal site remains relatively flat before rising gently to about RL 30 mAHD in the eastern end of the alignment. Topographic contours are shown in Figure 6.6.

Geology and soils

Based on the 1:100,000 scale Newcastle Coalfield Regional Geology Map (Department of Mineral Resources, 1994), about 200 metres of the eastern section of the proposal site is underlain by the Permian aged Newcastle Coal Measures. These typically comprise conglomerate, sandstone, siltstone, coal and tuff. As the proposal site heads west it transitions to a section of Quaternary aged alluvium associated with Winding Creek for about 300 metres. The remainder of the alignment is underlain by the Permian aged Newcastle Coal Measures.

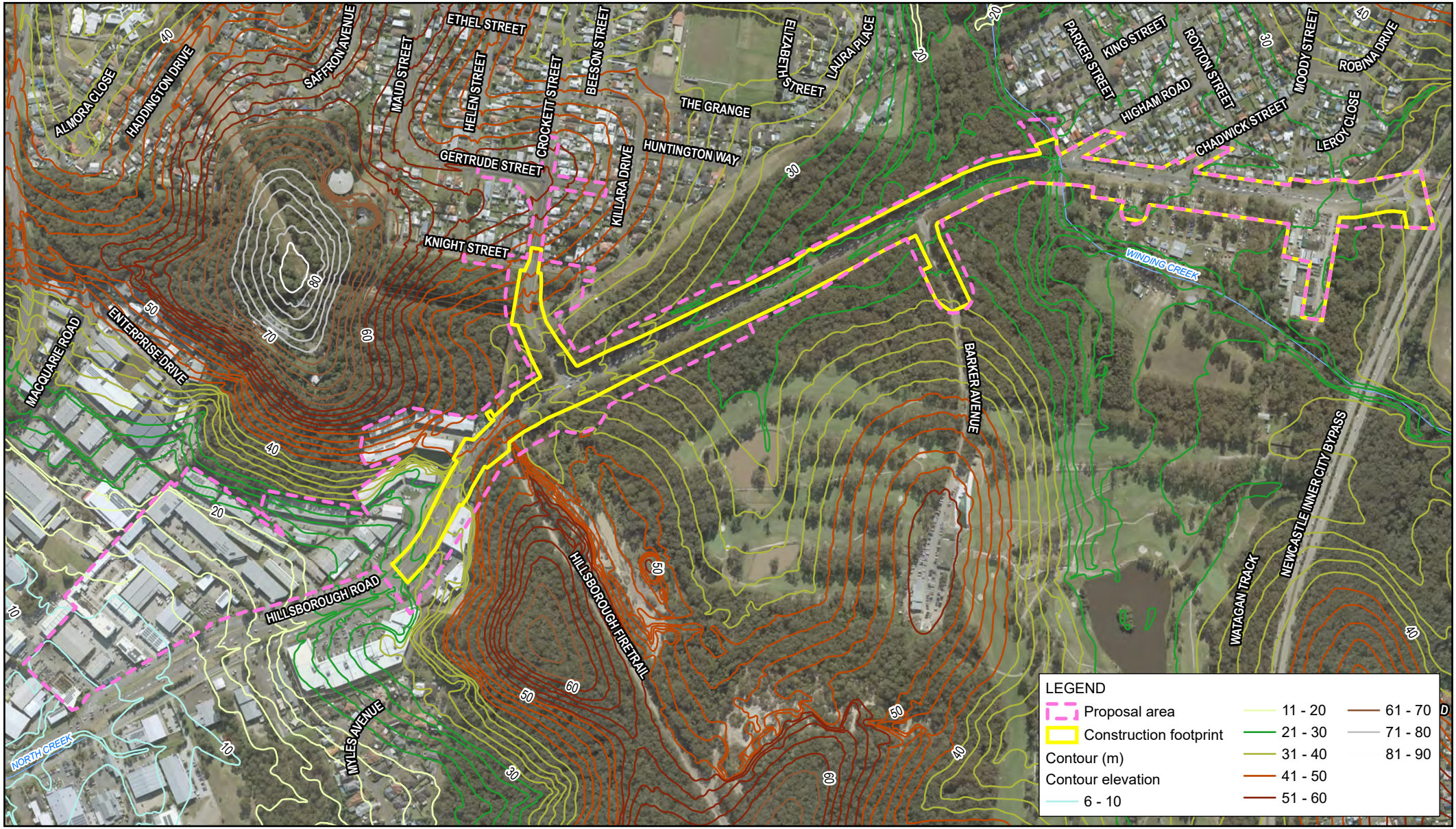
Based on the Newcastle 1:100,000 scale Soil Landscape Series Sheet (9232) (Department of Land and Water Conservation 1995), the proposal site contains three soil landscape, including:

- 'Warners Bay' ('wa') residual unit mapped west of the Winding Creek. The dominant soils include silt and sandy clay topsoils underlain by silts and clays. Landscape limitations include foundation hazard, localised steep slopes, mass movement hazard on steep slopes, high water erosion hazard, seasonal waterlogging, high run-on and mine subsidence.
- 'Cockle Creek' ('cc') alluvial unit mapped in the vicinity of Winding Creek. The typical soil profile consists of a brownish black sandy loam to brown sandy clay loam topsoil overlying a clay or sandy clay subsoil. Limitations within this unit are reported to include flood hazard, waterlogging, permanently high water tables, acid sulfate potential, high run-on, foundation hazard and mine subsidence.

- 'Gateshead' ('ga') erosional unit mapped east of Winding Creek. Dominant soil materials are typically moderately well to imperfectly drained and include sandy to clayey loams underlain by clays and sandy clays. Noted landscape limitations include localized localised steep slopes, localized localised seasonal waterlogging on lower slopes and a potential water erosion and high run-on hazards.
- Geotechnical investigations were carried out for the proposal to identify subsurface materials in the proposal site. A description of these subsurface units is provided in Table 6.16 below.

Table 6.16: Summary of stratigraphic units

Unit	Descriptor	Sub-unit	General description
1	Pavement, topsoil and general fill	1A	Asphalt
		1B	Bound pavement
		1C	Unbound pavement
		1D	Topsoil
		1E	General fill
2	Alluvial soils	2A	Soft cohesive material
		2B	Firm cohesive material
		2C	Stiff to very stiff or hard cohesive material
		2D	Loose non-cohesive material
		2E	Medium dense or dense non-cohesive material
3	Residual soils	3A	Firm cohesive material
		3B	Stiff to very stiff or hard cohesive material
4	Rock	4A	Extremely low strength sandstone
		4B	Medium to high strength tuffaceous sandstone
		4C	Coal/predominantly carbonaceous material
		4D	Extremely low strength tuffaceous siltstone or claystone
		4E	Medium strength siltstone



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

Topography contours

FIGURE 6.6

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:23

Data source: Metromap Tile Service: - Imagery (Date extracted: 11/10/2022); Roads, Cadastre - LPI, 2017; Created by: tmorton

Acid sulfate soils

Reference to the Wallsend 1:25,000 scale Acid Sulfate Soil Risk Map (Edition 2) shows that no acid sulfate soil (ASS) risk zones are mapped within the vicinity of the proposal site. The closest mapped occurrences are located about 1 km south-west of the proposal site.

A total of 16 ASS field indicator tests and chromium reducible sulfur tests were conducted as part of the 2020 investigations undertaken by Transport. None of the 16 tested samples recorded field pH values indicative of actual ASS, but most samples did show a significant reduction in oxidised pH, which may be indicative of potential ASS (PASS).

Impacts from exposure of acid sulfate are possible where:

- Excavation is more than 1 m below the natural ground surface, or
- Earthworks and drainage work have the potential to lower the water table more than one metre below the natural ground surface.

An Acid Sulphate Soil Management Plan would be required if greater than 1,000 tonnes of potential acid sulfate soil were disturbed during construction, based on comparison of the results to the action criteria in the ASSMAC (1998) guidelines.

Abandoned coal mining and mine subsidence

Historical mining records held by SA NSW indicate shallow abandoned coal mine workings exist west of Crockett Street and beneath Hillsborough Road in the Australasian Seam (Cardiff Borehole Colliery, Record Tracing 339, discontinued 1932). Abandoned workings in the Hartley Hill Seam to the north of Hillsborough Road are also recorded (Camden Colliery, Record Tracing 642, abandoned 1923).

Contamination

Jacobs (2022) prepared a Preliminary Site Investigation (PSI) to evaluate the potential for contamination to be present within the proposal area. This is attached in full at Appendix G. As part of the PSI searches were undertaken in September 2022 of EPA, Geoscience Australia and Lake Macquarie Council registers and databases to identify any sites known to contain. This search did not identify and known contaminated sites within or immediately adjacent to the proposal area.

A search of the *Protection of the Environment Operations Act 1997* register and NSW EPA PFAS Investigation Program Database 2 June 2022 indicated there are no sites or PFAS investigation sites within more than 4 kilometres of the proposal.

A review of historical aerial photography was also undertaken to identify sites or previous land uses which may have had the potential to result in legacy contamination issues not otherwise identified by the register and database searches. No significant sources of contamination have been identified as part of the historical land use reviews however the presence of a nursery and of unidentified stockpiled materials that coincide with surrounding land development are noted. Further to this a site inspection identified illegal disposal of waste material such as tyres and household rubbish and fill materials within the bushland adjoining Hillsborough Road.

6.4.3 Potential impacts

6.4.3.1 Construction

Soil disturbance

The proposal would result in impacts to soils and landscapes primarily through earthworks during the construction phase. These earthworks would include:

- Removal of vegetated groundcover currently stabilising soils and increasing the risk of erosion and sedimentation through the exposure of soils to weathering processes
- Stockpiling of excavated and imported materials
- Reinstatement of work areas following completion of works

Areas of high risk surrounding the proposal include the southwest cut embankments along the Hillsborough Road, works within and adjacent Winding Creek and the areas disturbed in and around new and existing swale drains including the large drain along Hillsborough Road west of Barker Avenue.

The proposal would involve removal of topsoil, earthworks detailed above and stockpiling of spoil for reuse in rehabilitation works. If not adequately managed, earthworks, stockpiling and transportation of materials could potentially have the following impacts:

- Increased sedimentation and elevated turbidity levels of nearby drainage structures and channels from exposed soil during site disturbance and movement of construction vehicles, particularly following rainfall events
- Increased levels of nutrients, metals and other pollutants, transported via sediment to the adjacent Winding Creek
- Erosion of exposed soil and stockpiled materials
- Instability and scouring of cuttings
- Sedimentation of neighbouring private properties and drainage structures
- Loss of soil quality impacts through any accidental spills cause by leaks and drips from poor maintenance of vehicles used during the construction phase and the temporary of storage and management of spoil and waste leading to leachate generation

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

The compaction of soils within the proposal site may also occur as a result of materials and soil stockpiling and parking and machinery movements, potentially impacting soil stability and the regeneration of groundcover.

Stabilisation and rehabilitation would be carried out progressively and as soon as practicable following disturbance during construction. Topsoil would be reused where possible to encourage natural regeneration and future vegetative growth. A rehabilitation plan would be developed for the proposal to ensure disturbed areas are stabilised and identify further management actions, as necessary. During construction, erosion and sediment controls would be installed in accordance with the Landcom/Department of Housing *Managing Urban Stormwater, Soils and Construction Guidelines* (the Blue Book) (Landcom, 2004) to minimise erosion from disturbed areas and prevent sediment entering the waterway. In addition, a detailed site-specific SWMP would be prepared for construction of the proposal to manage potential construction-related impacts (refer to Section 6.3.4).

Acid sulfate soils

The results of the geotechnical interpretive and design assessment indicate that PASS may be present in the vicinity of Winding Creek.

Disturbance or poor management of ASS has the potential to result in generation of low pH waters (surface and groundwater) which may result in the following impacts:

- Sulfuric acid generation leading to heavy metal leaching both of which have terrestrial and aquatic ecological impacts, including disturbance to aquatic species, disturbance to water plant communities and secondary effects on water quality
- Reduced land and soil conditions, potentially inhibiting growth of vegetation and land quality degradation
- Soil structure degradation and loss
- Loss of infrastructure integrity (such as corrosion)

With reference to the *Acid Sulfate Soils Assessment Guidelines* (ASSMAC, 1998), for disturbances of less than 1000 tonnes, six of the 16 samples meet or exceed the action criteria trigger levels. These include ASS samples from Transport TP2, TP13, TP16, TP17, BH3 (sample 'C') and BH2 (sample 'D').

As a result, ground disturbance works in the vicinity of Winding Creek culvert, would require development of an acid sulfate soil management plan (ASSMP) for the proposal.

Mine subsidence

An area of the former South Wallsend Colliery workings are shown to underlie Hillsborough Road (refer to the *Hillsborough Road Concept Design Mine Subsidence Report – Phase 1* by GHD). The outcrop of the Australasian Seam is to the east of Waratah No. 7 bore. As such, this bore should have intersected the southwest dipping Australasian Seam. However, contemporary geological mapping (NSW Seamless Geology– MinView) indicates the Australasian Seam outcrops west of the Waratah No. 7 bore where no intersection of the Australasian Seam would be possible.

Consultation with Subsidence Advisory has been undertaken and the advice received indicates the workings present minimal risk to the proposal due to their depth and proximity to the works (refer to Section 5.4). Further consultation would be undertaken with Subsidence Advisory during the detailed design phase of the project.

Contamination

Although there is considered to be minimal potential for widespread contamination to occur in the proposal site, there is always the potential to encounter previously unknown contamination during construction. This is most likely to be due to illegal dumping of waste within the immediate bushland adjacent to Hillsborough Road which may include items containing asbestos or other hazardous goods. An unexpected finds procedure would be included in the CEMP.

The proposal has the potential to result in soil contamination which may impede natural regeneration. Soil contamination has the potential to occur as a result of accidental spills or leaks of fuels, oils and other chemicals from equipment and vehicles during construction. To avoid this potential impact, fuels and chemicals would be managed in accordance with the management measures provided in Section 6.4.4.

Fill material imported from off-site would be sourced from certified suppliers to avoid the potential for contaminated fill. Surplus or unsuitable material that cannot be used on-site (for example as part of reinstatement and landscaping) would be classified in accordance with the Waste Classification Guidelines (EPA, 2014) and disposed of appropriately.

6.4.3.2 Operation

During the operation of the proposal, the risk of soil erosion would be minor as all areas affected by construction would be sealed, rehabilitated and/or landscaped to prevent soil erosion from occurring. There are minor contamination risks associated with the operation of the proposal, including:

- Spills from industrial heavy vehicles such as oil tankers.
- Accidents from general motorists causing oil and petrol spills. These risks would be similar to the existing situation, although the risk of accidents may be reduced with the proposed safety improvements such as the reduced speed and median barrier. Spills and other contamination sources during operation would be appropriately managed by implementing standard emergency spill environmental safeguards. It should be noted that the proposal is not a dangerous goods route and therefore has no increased risk of spills that most other arterial roads.

6.4.4 Safeguards and management measures

Table 6.17: Soils, geology and contamination safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Stockpiles	Stockpiles will be designed, established, operated and decommissioned in accordance with the RTA Stockpile Site Management Guideline 2011.	Contractor	Construction
Topsoil Management	Topsoil will be stockpiled in cleared in existing disturbed areas and managed in accordance with the RTA Stockpile Site Management Guideline until: • If not suitable or not required for use in future rehabilitation or revegetation works – it is removed from the construction site and disposed of an appropriately licensed facility, OR • If suitable and required for future use – it is re-used • Beneficial re-use under waste exemption or DA	Contractor	Construction
ASSMP	Acid Sulfate Materials Management Plan will be prepared and implemented as part of the CEMP, if greater than 1000 tonnes of potential acid sulphate soil material is to be disturbed. The Plan will be prepared in accordance with the RTA Guidelines for the Management of Acid Sulfate Materials.	Contractor	Pre-construction, Construction
Illegal dumping	The CEMP will include an unexpected finds protocol for potentially contaminated material encountered during construction work.	Contractor	Pre-construction, Construction
Rehabilitation	A rehabilitation plan will be prepared covering all areas disturbed as part of the proposal and will include the following: • Progressive stabilisation and rehabilitation of construction areas back to the original condition or re-vegetated with appropriate native species, as soon as practicable. • Rehabilitation of riparian areas (i.e. within 40 m from the highest bank on relevant waterways) and meets the requirements of Guidelines for Controlled Activities on Waterfront Land; Guidelines for Riparian Corridors on Waterfront Land. This may include fencing of riparian areas being rehabilitated. • Monitoring to meet clear targets in relation to vegetation establishment and stabilisation of disturbed areas.	Contractor	Pre-construction, construction and post-construction
Pre / Post Construction Land Condition Assessment	Land condition assessments will be completed for each compound area intended to be leased.	Transport	Pre-construction, construction and post-construction

6.5 Traffic and transport

This section addresses the traffic and transport impacts associated with the proposal and details the safeguards and management measures proposed to mitigate these impacts.

The operational traffic information presented in this section is drawn from the *Hillsborough Road Traffic and Transport Assessment Report* (TTAR) (Arcadis, 2022) (refer to Appendix H).

6.5.1 Methodology

The methodology for the traffic and transport assessment has been undertaken via the following process:

- Review of the existing traffic and transport conditions.
- Review of relevant government policy, guidelines and strategies.
- Review of current and future performance of roads and intersections associated with the proposal.
- Completion of operational traffic and transport modelling utilising the following assumptions:
  - The base year VISSIM model represents 2021 traffic conditions.
  - The proposal refers to 80 per cent concept design developed by GHD. At the time of undertaking traffic modelling for 80 per cent concept design, future years were assumed to be 2024 and 2034. Following completion of 80 per cent concept design, future years were amended to 2027 and 2037.
  - Proposal opening year is assumed to be 2027.
  - Traffic performance is assessed for opening year in 2027 and 10 years after opening in 2037.
  - The future base case 'Do Minimum' network is the 'existing condition' network for the base year 2021.
- Assessment of the traffic and transport impacts as a result of the proposal by:
  - Reviewing the project objectives to develop an optimal solution for the proposal adopting traffic engineering and planning techniques.
  - Gaining an appreciation of the current operating conditions in the area surrounding the proposal for all transport modes.
  - Assessing the immediate road network impacts with and without the proposal for opening day and 10 year horizon year scenarios.

Further details on the methodology for the TTAR are outlined in Appendix H.

6.5.2 Existing environment

6.5.2.1 Road network

Hillsborough Road is a major road corridor in the Lake Macquarie LGA. Hillsborough Road carries large volumes of regional and local traffic volumes, providing an important connection between Warners Bay, Cardiff and NICB. The posted speed limit on the Hillsborough Road at this location is both 60 and 70 kilometres per hour with the speed zone change occurring just west of Barker Avenue.

On an average weekday, Hillsborough Road between Crockett Street and NICB carries about 34,500 to 38,100 vehicles per day. Hillsborough Road is a designated B-double route for trucks up to 26 metres long and 4.6 metres in height. The heavy vehicles proportion on the Hillsborough Road between Crockett Street and NICB is about three to four per cent of total traffic on an average weekday.

6.5.2.2 Key intersections

The proposal area includes four key intersections on Hillsborough Road with Crockett Street, Barker Avenue, Higham Road, and Chadwick Street:

- Hillsborough Road / Crockett Street intersection allows for sign controlled T-Intersection movement. All movements are permitted with turning bays provided for both left and right turn in and out movements.

- Hillsborough Road / Barker Avenue intersection allows for uncontrolled T-Intersection movement. All movements are permitted with turning bays provided for both left and right turn in and out movements.
- Hillsborough Road / Higham Road intersection is currently uncontrolled T-Intersection intersection allowing all movements.
- Hillsborough Road / Chadwick Street intersection is currently sign controlled T-Intersection. All movements are permitted. Right turn in and out turning bays are provided on Hillsborough Road. Chadwick Street also aligns with the entrance to the CNCC Showground on the southern side of the road, a major access point during the weekend. Right turn from Hillsborough Road (eastbound) to CNCC Showground is banned.

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

Table 6.18 details the existing LoS for intersections in the proposal area. With the exception of the Barker Avenue during the morning peak, all intersections are operating unsatisfactorily.

Table 6.18: Existing level of service for key intersections in 2021

Intersection	Control type	AM Delay (seconds)	LoS	PM Delay (seconds)	LoS
Crockett Street / Hillsborough Road	Sign controlled	171	F	163	F
Barker Avenue / Hillsborough Road	Uncontrolled	23	B	96	F
Higham Road / Hillsborough Road	Uncontrolled	594	F	71	F
Chadwick Street / Hillsborough Road	Sign controlled	449	F	83	F

6.5.2.3 Crash data

Five years of crash data was obtained from Transport for the years 2016 to 2021 between the Hillsborough Road and Crockett Street intersection, and the NICB. Table 6.19 summarises the five year crash data.

Table 6.19: Recorded crashes on Hillsborough Road NICB to Crockett St: 2016 – 2021

Type	Casualty				Non-Casualty	Total
	Fatal	Serious injury	Moderate injury	Minor / other injury		
Intersection	0	2	2	1	7	12
Non-intersection	0	3	0	0	0	3
Total	0	5	2	1	7	15
	0	33%	13%	7%	47%	100%

6.5.2.4 Travel times

Table 6.20 show the base year (2021) travel time and travel speed on Hillsborough Road and also shows the travel speed relative to the posted speed on Hillsborough Road. As can be seen a large percentage of travel speeds are lower than the posted speed particularly the AM eastbound during peak times.

Table 6.20: Existing travel time and travel speed on Hillsborough Road in 2021

Peak period	Direction	Average travel time (minutes	Average travel speed (km/h)	% travel speed lower than posted speed
AM peak	Eastbound	7.5	18	70%
	Westbound	3.0	45	25%
PM Peak	Eastbound	2.7	50	16%
	Westbound	3.1	45	26%

6.5.2.5 Parking

There is currently on-street parking available on small sections of Hillsborough Road east of Chadwick Street. The reminder of the residential area along Hillsborough Road is designated as bus zones or no stopping zone. The remainder of the proposal predominantly has unsealed shoulders of varying width used for informal parking within the unformed footpath area.

6.5.2.6 Public transport

The proposal study area is serviced by two bus routes including routes 269 and 263. During the weekday AM peak between 7am and 9am, there are about two services for each route, equivalent to about an hour for each bus. During the PM peak two hours between 4pm and 6pm, there are about two services for each route, equivalent to about an hour for each bus. This is the same for the weekday PM peak between 4pm-6pm.

Currently, there are two bus stops westbound and two bus stops eastbound on Hillsborough Road between Crockett Street and NICB. Of these, three are bus bays and one is in-lane bus stop. There is no bus stop sign and bus bay at the stop on the westbound direction near Crockett Street. In addition to the public buses, a number of School buses operate in the corridor servicing Biddabah Public School, St Mary's Primary School, Warners Bay Primary School, Warners Bay High School and Hillsborough Public School.

6.5.2.7 Active transport

Hillsborough and Cardiff South are residential areas comprising low density housing and supporting services such as open space. Offroad cycleways and pathways are incorporated in the residential areas linking to the on-road cycleway on Hillsborough Road.

Currently, there is no formal footpath provided along Hillsborough Road between Crockett Street and NICB. One pedestrian refuge is provided for crossing the road near the bus stops at Higham Road. Key destinations within the proposal area include the suburbs of Hillsborough and Cardiff South, Charlestown Golf Club, Warners Bay commercial area, Hillsborough Public school and Cardiff Public school.

On-road bicycle lanes are currently provided along Hillsborough Road between Crockett Street and NICB either eastbound or westbound. The cyclists can cross Hillsborough Road at the pedestrian refuge near Higham Road.

6.5.3 Potential impacts

6.5.3.1 Construction impacts

Construction traffic impacts

Construction vehicles would access the site via arterial roads wherever possible. Indicative construction traffic access points are shown on Figure 3.6 in Chapter 3 and would generally be via Hillsborough Road.

Indicative heavy vehicle haulage routes have been identified for the movement of spoil between different areas of the proposal. The routes to and from the Hillsborough Road are via NICB. The haulage routes have been designed to avoid use of local roads, where possible. Both the NICB and Hillsborough Road are classified as B-double routes.

The number of construction vehicle movements has been estimated to be up to 40 light and 50 heavy vehicles per day (up to 5 per hour) during peak construction periods across all compounds. Heavy vehicle movements, which are likely to have the largest impact, would mainly be related to earthworks or spoil movement, but would also include other movements including girder delivery and plant delivery. The estimated 50 heavy vehicle movements described above includes movements associated with material and plant delivery, which are anticipated to be limited to around 10 per cent (5 movements per day) of the total daily heavy vehicle movements.

As noted, heavy vehicles would only access construction sites from approved heavy vehicle routes, primarily the NICB. Existing traffic flows on the NICB are substantially greater than the proposed construction traffic numbers and include heavy vehicles. The existing traffic flows on Hillsborough Road are about 1,200 heavy vehicles each day. Therefore, construction traffic, including earthworks truck movement, is likely to have a minor impact on existing traffic operations.

Most construction works would be carried out adjacent to the existing road network, during standard working hours and night works in order to minimise impact to traffic operations. It is expected certain construction works would be undertaken outside of standard working hours under a Road Occupancy Licence (ROL) to avoid impacts during peak traffic periods. Timing of works is further discussed in Section 3.3.

The existing lane arrangement of Hillsborough Road would be preserved where possible during construction to assist in maintaining traffic flow. There is likely to be some short term disruption of some turning movements and lanes at the intersections during the works to install median islands and commission traffic lights. Works within and adjacent to the road would be planned and undertaken in a manner that seeks to limit impacts upon traffic as far as practicable. This would include scheduling of certain works as off-peak day or night works, noting that some short-term works such a utility connections and drainage cutovers impacting on traffic flows within standard construction hours would be unavoidable.

Impacts to traffic on the Hillsborough Road during construction would be temporary in nature. Traffic impacts would occur due to the movement of construction and service vehicles along Hillsborough Road and access roads, for the haulage of construction materials. As described above, construction sites would be primarily accessed via approved heavy vehicle routes. Impacts to residential side streets would be minimised as far as practicable.

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

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

Measures to manage potential construction traffic impacts are listed in Section 6.5.4.

Public transport

The proposal is not expected to disrupt public transport. All existing bus movements would be maintained during construction, with potential for minor delays on bus services due to construction speed limits or detours. Bus stops may be subject to some temporary relocation within the proposal area, during the reconstruction of the surrounding footpaths, utilities and drainage.

Bus Stop ID: 2282197 may be temporarily closed and relocated during construction to enable widening, drainage and utility works on the southern side of Hillsborough Road, in consultation with bus operators. The temporary location would be about 300 meters further east of the current location. Upon completion, bus stop 2282197 would be reinstated in its original location with improved connectivity to the Crockett Street traffic lights and pedestrian crossing.

New signage for the relocated stop would be provided and changes would be communicated to potentially affected customers in advance. Traffic and access associated with the relocated bus stop, including bus stopping and departing and pedestrian access would be managed by the CTMP.

School bus services would be affected in a similar manner to the local bus services described above. All existing school bus services would be maintained during construction, however there is potential for some bus stop relocations.

Through the implementation of the community engagement plan, the community, including public transport operators, would be informed of upcoming activities that may affect the operation of public transport. Access to existing bus stops on Hillsborough Road will be maintained during construction.

Parking availability

Sufficient parking would be provided within compounds for both light and heavy construction vehicles. All roadside parking for general traffic throughout the proposal area would be removed permanently during construction, as this is an intended requirement for the road in operation to allow width for the shared path, drainage and pedestrian footpaths.

Roadside parking is currently restricted around the eastern extent of Hillsborough Road with limited on road spaces available. Roadside parking in this location is therefore unlikely to be affected by the proposal. There may however be temporary disruption to some parking around the CNCC Showground access to allow for utility, road widening and access relocation works.

Parking on side streets of Higham Road and Chadwick Street may also experience temporary disruption.

Active transport

The existing pedestrian facilities at the eastern end of the proposal near Chadwick Street would be temporarily affected during construction. Diversions around the proposal area, such as alternative crossings, would be provided where possible to ensure safe passage for both pedestrians and cyclists. This would include maintenance of access to any bus stops relocated during construction.

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

6.5.3.2 Operational impacts

Traffic impacts

Traffic volumes on Hillsborough Road will continue to grow due to population and employment growth. The average weekday traffic volumes on Hillsborough Road between Crockett Street and NICB are predicted to grow from 34,500-38,100 vehicles per day in 2021 to 37,400- 41,300 vehicles per day in 2027.

In 2037, traffic volumes on Hillsborough Road are predicted to increase to 42,300-46,700 vehicles per day, equivalent to about 130 per cent of 2021 traffic volumes. Table 6.21 shows predicted daily traffic volumes on Hillsborough Road in 2027 and 2037.

Table 6.21: Average weekday volumes on Hillsborough Road in 2027 and 2037

Hillsborough Road section	Average weekday volumes (vehicles per day)		
Year	2021	**2027**	**2037**
West of Crockett Street	38,100	41,300	46,700
West of Higham Road	37,000	40,100	45,400
West of Chadwick Street	34,500	37,400	42,300

Intersection performance

Utilising the future year of opening and 10 year forecast traffic growth, intersection performance was modelled factoring in the proposal having been constructed and in operation. Table 6.22 and Table 6.23 show the intersection performance with the proposal in place for 2027 and 2037 respectively. As can be seen, with the proposal in operation the modelled intersection will all perform with an LoS of A or B compared to the current base case in the earlier Table 6.18, which indicated an unacceptable LoS of F.

Table 6.22: Level of service for key intersections in 2027

Intersection	Control type	AM Delay (seconds)	LoS	PM Delay (seconds)	LoS
Crockett Street / Hillsborough Road	New traffic lights	16	B	20	B
Barker Avenue / Hillsborough Road	New traffic lights	15	B	12	A

Intersection	Control type	AM Delay (seconds)	LoS	PM Delay (seconds)	LoS
Higham Road / Hillsborough Road	Left out only	16	B	12	A
Chadwick Street / Hillsborough Road	New traffic lights	12	A	8	A

Table 6.23: Level of service for key intersections in 2037

Intersection	Control type	AM Delay (seconds)	LoS	PM Delay (seconds)	LoS
Crockett Street / Hillsborough Road	New traffic lights	20	B	23	B
Barker Avenue / Hillsborough Road	New traffic lights	17	B	14	A
Higham Road / Hillsborough Road	Left out only	30	B	17	B
Chadwick Street / Hillsborough Road	New traffic lights	16	B	10	A

Travel time

Table 6.24 and Table 6.25 show average travel times (minutes) for the base case (without proposal) and the project case (with proposal) in 2027 and 2037.

In 2027, the proposal would reduce journey time on the Hillsborough Road by up to 4.8 minutes during peak periods. In 2037, travel time savings by the proposal are estimated to be up to 7.2 minutes during peak periods.

Table 6.24: Travel time savings on Hillsborough Road in 2027

Peak period	Direction	Base case (without proposal)	Base case (without proposal)	Change / savings
AM peak	Eastbound	8.3	3.5	-4.8
	Westbound	4.2	3.2	-1.0
PM Peak	Eastbound	3.6	3.2	-0.4
	Westbound	4.7	3.9	-0.9

Table 6.25: Travel time savings on Hillsborough Road in 2037

Peak period	Direction	Base case (without proposal) (min)	Base case (without proposal) (min)	Change / savings (min)
AM peak	Eastbound	10.8	3.6	-7.2
	Westbound	5.6	3.3	-2.3
PM Peak	Eastbound	5.7	3.5	-2.2
	Westbound	8.0	4.7	-3.3

Public transport

The proposal would not impact current bus routes. The proposal would improve bus travel time reliability due to reduced congestion and improved intersection performance. The proposal also includes widening and relocating the bus stops to provide safer connectivity and access. These changes include:

- Two bus stops on Hillsborough Road near Crockett Street will be widened and relocated close to new traffic signals and upgraded pedestrian crossing facilities at Crockett Street.
- Two bus stops on Hillsborough Road near Chadwick Street will be widened and relocated close to new traffic signals and upgraded pedestrian crossing facilities at Crockett Street.

Active transport

The proposal is expected to result in an overall positive impact for active transport users in this area. This includes upgrade and extension of the existing pedestrian network, as well as substantially improved facilities for cyclists and other non-motorised users. This includes:

- A new three meter wide shared path along Hillsborough Road on the northern side between Crockett Street and the NICB. The path begins after the eastbound exit onto Hillsborough Road from the Hillsborough commercial area and stops at the NCIB. From there pedestrians and cyclists will have to return to using the existing verges and shoulders as they currently do. Signalised pedestrian crossings will be provided on the northbound and westbound approaches at Crockett Street intersection.
- A signalised pedestrian crossing is provided on Hillsborough Road western approach at Barker Avenue intersection.
- Signalised pedestrian crossings will be provided on all approaches at Chadwick Street intersection.
- A 1.5 m wide footpath along the southern extent of Hillsborough Road between the NICB northbound offload ramp and the westbound bus stop.
- A 1.5 m wide footpath on south western side of Barker Avenue intersection with Hillsborough Road terminating at Barker Avenue.
- A 1.5 m wide footpath from Crockett Street Intersection with Hillsborough Road signalised pedestrian crossing to new bus stop facility west of Crockett Street.

In addition to the shared path, the proposal will provide a two metre wide shoulder for on road cyclists in both directions.

These changes to the pedestrian network would improve connectivity, improve desire lines and provide safer access to bus stops, schools and recreational facilities.

Parking

Once operational some formal on street parking on the northern side of Hillsborough Road between Chadwick Street and the NICB will be removed with the widening of Hillsborough Road and provision of a two metre shoulder and shared path. These residential properties on Hillsborough Road all have off street parking, with additional on street parking nearby in either Chadwick Street or Higham Road. There will be a minor parking loss on the side street of Higham Road and Chadwick Streets as a result of intersection works.

Access

All properties affected by changed access arrangements as a result of the proposal would be provided with restored or new permanent access arrangements during operation. As the proposal includes dividing the traffic lanes with a solid median barrier, right turns into adjacent properties on the northern side of Hillsborough Road from the westbound carriageway would not be possible.

The proposal would result in four lanes across Hillsborough Road with a central median barrier, this would remove the right in/right out access, and hence provide a left in/left out only access for businesses on the southern portion of Hillsborough Road, this would provide safer access to these properties as well as all road users. Road users coming from the eastbound direction wanting to access these businesses would continue straight and turn right around the NICB roundabout to return to Hillsborough Road. From there employees and customers would turn left into the businesses. This would add about 600 meters to the trip, however provide a safer and more reliable access.

A new U-turn facility would be provided within Barker Avenue, accessed via the new traffic lights. This will allow westbound vehicles to turn around to head back in an easterly direction towards the NICB.

6.5.4 Safeguards and management measures

The measures described in Table 6.26 will be implemented to avoid or minimise potential traffic impacts.

Table 6.26: Traffic and transport safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Construction traffic	A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the RMS Traffic Control at Work Sites Manual and the worksite manual RMS Specification G10. The TMP will include but is not limited to: • Community notification in accordance with the RTA's Community Involvement and Communications Resource Manual • 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 maintain pedestrian and cyclist access • Requirements and methods to consult and inform the local community of impacts on the local road network • Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads • A response plan for any construction traffic incident • Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • Monitoring, review and amendment mechanisms	Transport / Contractor	Preconstruction, Construction
Property Access	Requirements for any changes to local access arrangements will be confirmed during detailed design in consultation with the local road authority and any affected landowners.	Transport	Pre construction
Impacts to bus services	Consult with bus companies regarding the relocation and temporary closure of bus stops and temporary access arrangements.	Transport	Detailed design
Impacts on Emergency Services	Undertake consultation with emergency services prior to and during construction to confirm any diversions and any operational road network changes.	Transport	Pre construction, Construction
Pedestrian and cyclist access	Safe pedestrian access to bus stops and cyclist access through Hillsborough Road will be maintained throughout construction.	Transport/ Contractor	Pre construction, Construction
Access to properties	Disruptions to property access and traffic will be notified to landowners prior to changes to access in accordance with the relevant Transport Project Construction community consultation processes outlined in the Traffic Management Plan (TMP).	Contractor	Construction

6.6 Air quality

This section provides the results of an air quality impact assessment of the proposal.

The information presented in this section is supported by air quality modelling outputs attached at to Appendix I.

6.6.1 Methodology

The air quality assessment involved the following tasks:

- Review of existing information – a review of all relevant information in the local area was undertaken including NSW Department of Planning and Environment air quality monitoring data. Background air quality data was sourced from the nearest monitoring sites to the proposal at Wallsend and Newcastle.
- Selection of criteria – the relevant criteria relating to air quality was identified in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (Approved Methods) (EPA, 2016) and the *National Environmental Protection (Ambient Air Quality) Measure* (NEPC, 2021) (NEPM AAQ).
- Assessment of impacts:
  - A qualitative construction assessment using the Institute of Air Quality Management (IAQM) method was undertaken based on typical construction activities and management measures.
  - A quantitative operational air quality assessment was undertaken using the Transport assessment Tool for Roadside Air Quality (TRAQ). The assessment estimated pollution emission rates and concentrations due to road traffic on Hillsborough Road.
- Identification of mitigations measures required to appropriately manage the impacts identified during both construction and operational phases.

Criteria

The Approved Methods outlines impact assessment criteria which are concentration levels to be met at all 'existing' or 'future' off-site sensitive receptors. The criteria are shown in Table 6.27, and relate to cumulative impacts (proposal plus background). In order to assess the total air quality impact, the predicted impact of the proposal (incremental) is added to the existing levels (background).

The NEPM AAQ was updated in May 2021 and included revised air quality objectives for key pollutants, including those relevant to this proposal, including particulate matter with a diameter of 2.5 micrometres or smaller (PM2.5) and Nitrogen Dioxide (NO2).

Table 6.27: Air quality impact assessment criteria

Pollutant	Averaging period	Criteria/goals (µg/m³)	
		Approved Methods	NEPM AAQ
PM_{10}	Annual	25	25
	24 hours	50	50
$PM_{2.5}$*	Annual	8	7
	24 hours	25	20
Nitrogen dioxide (NO_2)	Annual	62	31
	1 hour	246	164
Carbon monoxide (CO)	8 hours	10,000	10,000
	1 hour	30,000	-
Note: NEPM AAQ goals for $PM_{2.5}$ are those presented in Table 2 'Goal for Particles as $PM_{2.5}$ from 2025'			

6.6.2 Existing environment

Ambient air quality

The existing air quality within and surrounding the study area is typical of an urban environment in close proximity to major transport corridors. The air quality in the study area would be heavily influenced by emissions from motor vehicles using the road network. Other local sources of air emissions would include residential and commercial land uses. No significant emitters or air pollutants are located within the vicinity of the study area.

The nearest monitoring station with available long-term data is located at Wallsend, about seven kilometres north of the study area. Monitoring data shows that background concentrations of common pollutants such as CO and NO2 are all consistently below the respective national standards in most areas of NSW. Concentrations of some pollutants, including particulate matter (PM10 and PM2.5) can exceed national standards, in both rural and urban areas (EPA, 2016).

Carbon monoxide levels are not recorded at this station and have been sourced from the Newcastle station, eight kilometres east of the study area. Monitoring data for 2021 is provided in Table 6.28 and shows a slightly elevated annual average background PM2.5 concentration (5.9 µg/m3) when compared to the objectives outlined in Table 6.28. Levels of all other pollutants are notably lower than the respective assessment criteria.

Table 6.28: 2021 monitoring data

Pollutant	Averaging period	Criteria level	Measured level (µg/m^3)
PM10	Annual	25	14
	24 hours	50	21
PM2.5	Annual	7	5.9
	24 hours	20	9.8
Nitrogen dioxide (NO2)	Annual	31	0.52
	1 hour	164	1.2
Carbon monoxide (CO)	8 hours	10,000	295
	1 hour	30,000	306

Existing meteorology

Figure 6.7 shows a wind rose for five years (2017 – 2021) of data from the Bureau of Meteorology's (BoM) Newcastle Nobbys Signal Station Automatic Weather Station (AWS) (SN: 061055). The wind rose shows the mean wind speed is 5.2 m/s and prevailing winds from the north west.

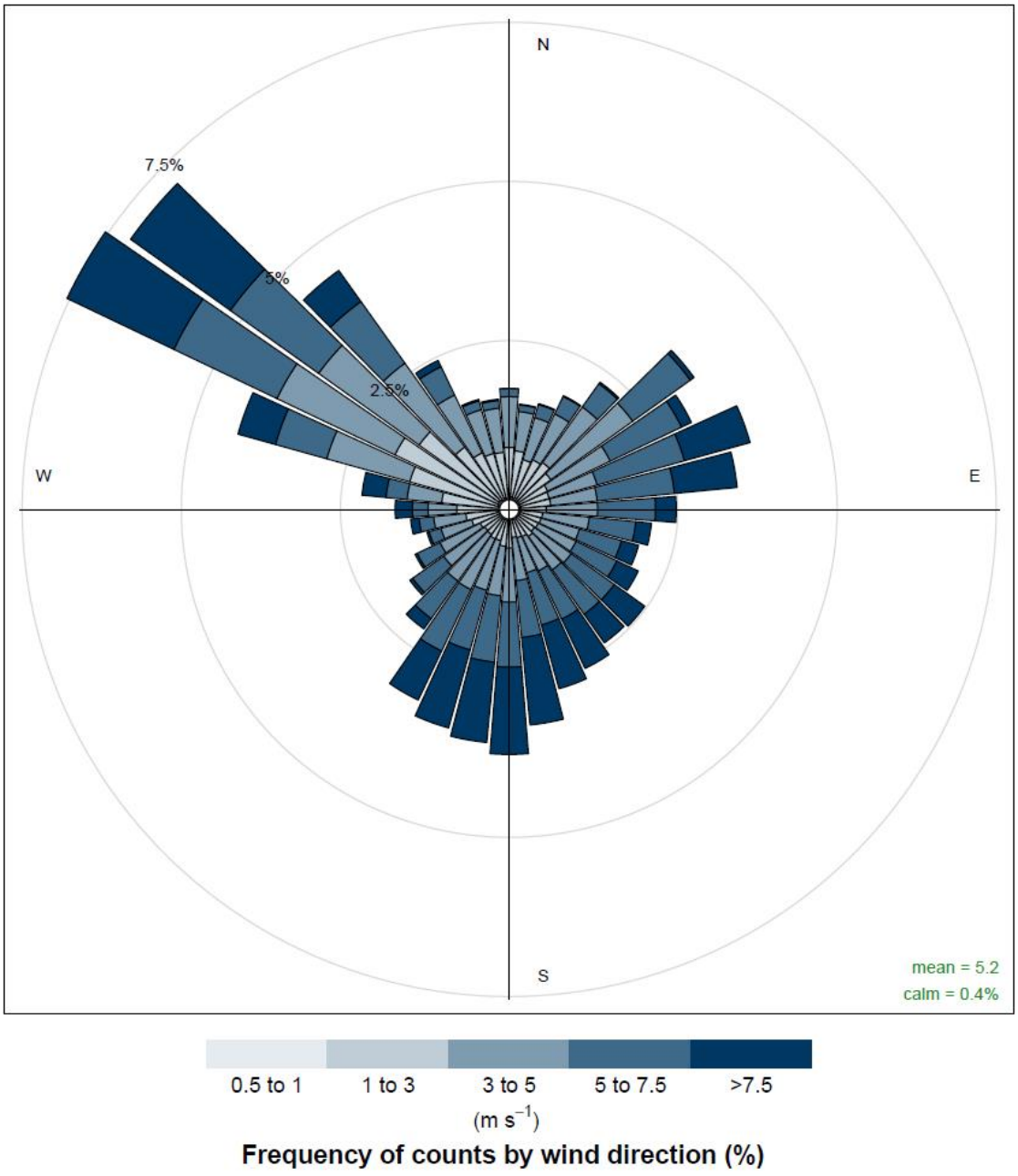


Figure 6.7: Five year wind rose for BoM Newcastle AWS

6.6.3 Potential impacts

Construction impacts

A qualitative assessment of construction works has been undertaken in accordance with the IAQM guidance, a copy of the guidance is provided in Appendix I. For the purposes of the construction air quality assessment, the construction program has been divided into three activity groups that have potential to cause dust emissions. These activities are:

- Earthworks: including the activities to reform the road for widening
- Construction: including paving and profiling of the road
- Track-out: including transportation actives associated with all stages of the construction

In order to identify the risk of dust impact from each stage of the construction the size and scale of each activity must be determined as well as the sensitivity of the surrounding environment.

Size and scale

The size and scale of the activities are determined by not only the physical size of the proposal but other factors that are likely to increase or decrease the amount of dust created during each construction activity. Table 6.29 outlines these factors for each activity and the resulting size and scale descriptor as defined in Section 7.2 of the IAQM Guidance. A description of the works required in each activity is provided and is based on the example definitions from the guidance.

Table 6.29: Size and scale of construction activities

Activity	Description of project	Size and scale descriptor
Earthworks	• Area requiring earthworks is > 54,000 m^2 • Significant leveling of earth required prior to construction of the road • Earth required to be loosened and stockpiled	Large (> than 10,000 m^2 is considered large)
Construction	• Construction of roadway, including mixing and pouring asphalt • Profiling of roadway	Large (volume >100, 000 m^3, on site concrete batching, sandblasting)
Track-out	• Estimated that there will be >100 vehicle movements per day • Vehicle movements along paved roads	Large (> than 50 heavy vehicle movements a day is considered large)

Sensitivity

The sensitivity of the surrounding environment is determined by the number of high risk, medium risk and low risk receptors within a certain proximity of the construction footprint. High sensitivity receptors include dwellings, educational institutions, and medical facilities. Medium sensitivity receptors include commercial, and industrial premises. Low sensitivity receptors include farmland, recreational parklands, and other public spaces.

There are a number of residential properties (>10) facing Hillsborough Road between Higham Road and the on ramp for the NICB. This creates a high sensitivity rating as per Section 7.3 of the IAQM Guidance in this area for dust soiling. Due to the relatively low annual PM10 average, 21 µg/m3, the sensitivity to human health impacts is low.

The sensitivity is determined for three areas of concern, these are:

- Sensitivities of people to the effects of dust soiling, the build-up of deposited dust on surfaces
- Sensitivities of people to the health effects of PM10
- Sensitivities of receptors to ecological effects

The sensitivities for each area for all construction activities are outlines in Table 6.30.

Table 6.30: Sensitivity of areas of concern for all construction activities

Activity	Description	Sensitivity
Sensitivities of people to dust soiling effects	• More than 10 highly sensitive receptors within 20 m of the construction activity	High
Sensitivities of people to the health effects of PM_{10}\	• Ambient PM_{10} levels <24 µg/m^3 have been used • More than 10 highly sensitive receptors within 20 m of the construction activity	Low
Sensitivities of receptors to ecological effects	• No high or medium sensitive ecological features within 50 m of the construction activity	Low

Risk summary

The risk matrix uses the sensitivity and scale to determine the risk of dust impacts on the surrounding receptors. Table 6.31 outlines the risk matrix determined for the construction of the proposal from the guidance provided in the IAQM guidance. The risk identified for all construction activities is High Risk for dust soiling however, Low Risk for human health and ecological impacts. Proposed specific mitigation measures and residual impacts are provided in Section 6.6.4 to further minimise the risk of dust impacts at receptor locations during construction works.

Table 6.31: Risk matrix for dust impacts during construction

Impact	Risk		
	Earthworks	Construction	Track-out
Dust soiling	High risk	High risk	High risk
Human health	Low risk	Low risk	Low risk
Ecological	Low risk	Low risk	Low risk

Operational impacts

A qualitative assessment using the Transport TRAQ tool was undertaken to assess potential operational impacts of the proposal. TRAQ assesses the potential impacts on air quality from vehicles using a new or existing road. TRAQ is a first pass screening assessment to estimate pollutant emission rates due to road traffic and subsequently, pollutant ground level concentrations at a selected distance from the road.

The following model scenarios (S) were completed:

- S1 - 2021 current – existing traffic on existing roads within network.
- S2 - 2037 no-build – expected traffic in 2037 within network where the proposal is not built.
- S3 - 2037 build – expected traffic in 2037 within network where the proposal is built.
- The TRAQ model is completed for each Hillsborough scenario, using the segment with the highest predicted traffic volumes for each and therefore represents the worst-case scenario. The TRAQ spreadsheets for each of the assessed scenarios are attached to this letter for reference.

The vehicle fleet databases used were 2021 for S1 and 2037 for S2-S3. The traffic make-up for each scenario was based on the default for an arterial road. The assessment tool uses the worst-case weather conditions occurring all year, which is considered a conservative approach.

Table 6.32 includes the modelling scenarios used in the TRAQ assessment, and the respective worst-case segment as well as daily traffic volumes.

Table 6.32: Overview of modelling scenarios assessed

	Scenario	Section	Daily traffic volume	Speed/
S1	Existing scenario (2021 current)	Hillsborough Road between King Street and NICB	36,000 (total) 50% directional split	60 km/h
S2	2037 no build	Hillsborough Road between King Street and NICB	42,700 (total) 50% directional split	60 km/h
S3	2037 build	Hillsborough Road between King Street and NICB	43,100 (total) 50% directional split	60 km/h

The TRAQ model predicts CO, NO2 and PM10 concentrations. PM2.5 has been determined using a 1:2 ratio based on background measurements undertaken near an arterial road.

Predicted pollutant concentrations at 10 metres from the kerb for the three assessed scenarios are summarised in Table 6.33 and TRAQ outputs are provided in Appendix I. Since no receptors are within 10 metres of the kerb, predicted levels are indicative of maximum receptor concentrations.

Table 6.33: Predicted pollutant concentration 10 metres from the Hillsborough Road kerb

Pollutant and averaging period				Assessment criteria1
Scenario	1	2	3	
Maximum 8 hour average CO (mg/m3)	0.49	0.49	0.49	10
Maximum 1 hour average NO2 (ug/m3)	18	12	12	164
Annual average NO2 (ug/m3)	3.9	2.6	2.7	31
Maximum 24 hour average PM10 (ug/m3)	30	30	30	50
Annual average PM10 (ug/m3)	18	18	18	25
Maximum 24 hour average PM2.5 (ug/m3)	14	15	15	20 (25)
Annual average PM2.5 (ug/m3)	7.72	7.8	7.8	7 (8)

Note:
1. The assessment criteria are the most stringent of those presented in Table 6.27.
2. Assessment of $PM_{2.5}$ for Scenario 1 is against the current Approved Methods objectives as the future NEPM is not in place until 2025.

Due to the relative similarity in the traffic volumes during the build and no-build scenarios, the difference between predicted concentrations of all pollutants is negligible.

The predicted concentrations of pollutants for each of the scenarios remain below the assessment criteria with the exception of the annual average PM2.5 concentration which is predicted to be above the 7 µg/m3 2025 NEPM criteria for all future scenarios.

When considering cumulative impacts for all assessed scenarios, PM2.5 is predicted to be the limiting (worst-case) pollutant. This is largely due to the annual average background PM2.5 concentration measured at Wallsend air quality monitoring station (5.9 µg/m3). The predicted results for all assessed pollutants are the same for both future no-build and build scenarios, meaning there is no additional impact from the proposed road duplication.

The TRAQ assessment methodology assumes that worst-case daily traffic emissions, and meteorological conditions occur for all days of the year which is considered to lead to a highly conservative estimate of air quality impacts from traffic impacts. Consequently, the exceedance of the PM2.5 criteria on an annual average basis is not considered to be a true representation of the air quality risk associated with the operation of the proposal.

It is expected that predicted impact would be reduced where a sophisticated air quality impact assessment methodology is applied. Results comply with the current NSW EPA annual PM2.5 criteria of 8 µg/m3.

6.6.4 Safeguards and management measures

The measures described in Table 6.34 will be implemented to avoid or minimise potential impacts on air quality.

Table 6.34: Air quality safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
General air quality impacts	An Air Quality Management Plan will be prepared and implemented as part of the CEMP. The Plan will identify: • Potential sources of air pollution (such as dust, vehicles transporting waste, plant and equipment) during construction • Air quality management objectives consistent with any relevant published EPA and/or OEH guidelines • Mitigation and suppression measures to be implemented, such as spraying or covering exposed surfaces, provision of vehicle clean down areas, covering of loads, street cleaning, use of dust screens, maintenance of plant in accordance with manufacturer's instructions • Methods to manage works during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces • Roles and responsibilities • A monitoring program to record whether the air quality mitigation, suppression and management measures have been applied; and assess the effectiveness of the applied measures • Community notification and complaint handling procedures	Contractor	Pre- Construction, Construction

6.7 Noise and vibration

This section addressed the potential noise and vibration impacts associated with the proposal and detailed the management measures proposed to mitigate these impacts.

The information presented in this section is drawn from the *Hillsborough Road Noise and Vibration Impact Assessment Report* (NVIA) (GHD, 2022) (refer to Appendix J).

6.7.1 Methodology

The noise and vibration assessment has been undertaken with reference to the following guidelines:

Construction noise:

- Construction Noise and Vibration Guideline (CNVG) (Roads and Maritime 2016)
- Interim Construction Noise Guideline (ICNG) (DECC 2009)
- Code of Practice for Noise and Vibration Control on Construction and Open Sites (British Standard (BS) 5228-1: 2009 + A1:2014)
- Guide to noise and vibration control on construction, demolition and maintenance sites (AS2436) (Australian Standard (AS) 2436-2010)

Construction vibration:

- Assessing Vibration: a technical guideline (AVTG) (NSW Department of Environment and Conservation (DEC) 2006a)
- DIN 4150:Part 2-2016 Structural vibration – Effects of vibration on structures (Deutsches Institut für Normung 2016)
- DIN 4150:Part 3-2016 Structural vibration – Effects of vibration on structures (Deutsches Institut für Normung 2016)
- Evaluation and Measurement for Vibration in Buildings Part 2, (British Standard (BS) 7385:Part 2-1993) (BS 7385)

Operational traffic noise:

- NSW Road Noise Policy (RNP) (DECCW 2011)
- Noise Criteria Guideline (NCG) (Roads and Maritime 2015a)
- Noise Mitigation Guideline (NMG) (Roads and Maritime 20022)
- Noise Model Validation Guideline (Roads and Maritime 2018)
- Application Notes – Noise Criteria Guideline (Roads and Maritime 2015a)
- Environmental Noise Management Manual (ENMM) (Roads and Maritime 2001)
- Procedure for Preparing an Operational Noise and Vibration Assessment (Roads and Maritime 2011b)
- Draft At-Receiver Treatment Guideline (ARTG) (Roads and Maritime 2017)

Sleep disturbance during construction:

- NSW Road Noise Policy (RNP) (DECCW 2011)
- Noise Policy for Industry (Npfl) (NSW Environment Protection Authority (NSW EPA) 2017)

Noise and vibration attended monitoring

The following key tasks were undertaken in the assessment of potential noise and vibration impacts:

Field Investigations:

- Site inspection/ground truthing – Identify noise sensitive receivers and suitable construction noise catchment areas
- Ambient noise measurements – Complete measurements of existing road traffic noise levels and background noise levels for the assessment of construction and operational noise

Noise logging was undertaken at the following locations:

- Residential receiver 16 Higham Road, Hillsborough
- Residential receiver 13 Leroy Close, Hillsborough
- Residential receiver 117 Hillsborough Road, Hillsborough
- Residential receiver 7 Coolum Place, Cardiff South

An operator attended measurement was undertaken at each logging location at the time of their deployment to assist in identification and quantification of noise sources present. The ambient noise monitoring consisted of continuous, unattended noise logging and operator attended noise surveys. The operator attended noise surveys help to define noise sources and the character of noise in the area and are, therefore, used to qualify unattended noise logging results. Monitoring was undertaken from Monday 29 November 2021 to Wednesday 15 December 2021.

Simultaneous traffic counts were undertaken in close proximity to the noise loggers for the purposes of model calibration and validation.

Construction noise and vibration assessment report:

The construction noise and vibration assessment has been undertaken based on the following methodology:

- The Rating Background Levels (RBLs) (calculated in accordance with the NpfI) for the proposal were calculated from the noise monitoring data obtained at the noise monitoring locations. The RBLs were used to establish construction Noise Management Levels (NMLs) with consideration of the ICNG.
- A list of likely construction activities and machinery were determined in consultation with Transport. Representative sound power levels and vibration levels for the selected plant were obtained from data provided in *CNVG, AS 2436* and *BS 5228*.
- Noise associated with construction works were predicted using noise modelling software. This modelling includes ground topography, buildings and representative construction noise sources in accordance with ISO9613. The results of this modelling was then assessed against the construction noise management levels for the proposal.
- Construction traffic was assessed with consideration to the RNP for assessment of construction traffic on public roads.
- Vibration levels from vibration-intensive construction plant and equipment were predicted and assessed.

Road Traffic Noise Assessment:

- Road traffic noise criteria - Appropriate criteria for each receiver was identified using the RNP and NCG.
- Maximum road traffic noise level assessment – An assessment of existing maximum noise events and impact of the proposal on these events was assessed, in accordance with Transport's *Environmental Noise Management Manual*.
- Calculation of road traffic noise – road traffic noise levels predicted using the CoRTN noise algorithm implemented within SoundPLAN software. The existing road traffic noise model was validated with monitoring data.
- Noise mitigation strategies – feasible and reasonable noise mitigation measures identified.

6.7.2 Existing environment

Noise sensitive receivers

Proposal specific noise catchment areas (NCAs) have been identified as:

- NCA01 is all sensitive receivers east of Barker Avenue where the dominant road traffic noise source is Hillsborough Road and rating background levels are not impacted by the NICB.
- NCA02 is all sensitive receivers west of Barker Avenue where the road traffic noise is a mixture of Hillsborough Road and the NICB. Rating background levels are impacted by both Hillsborough Road and the NICB.

The NCAs and noise study area are shown on Figure 6.6. The noise study area is 600 metres from the centre line of the outermost traffic lane either side of the Hillsborough Road (the proposal). Sensitive land uses with the potential to be affected by noise from the operation of the proposal include both residential and non-residential land uses.

Existing residential land uses are located mostly to the north of the proposal. Receivers included in this assessment are based on building data obtained from Geoscape Australia on 16 December 2021.

Sensitive non-residential receivers including schools, places of worship (churches) and outdoor recreation areas have specific noise criteria for construction and operational noise. Non-residential receivers identified in the study area include commercial premises, Charlestown Golf Club, Hillsborough Public School and Newcastle Junior School. These receivers are in close proximity to the proposal area and have the potential to be noise impacted by operational road traffic or construction noise.

An overview of the number of modelled receivers is provided in Table 6.35 and shown in Figure 6.8.

Table 6.35: Number of modelled noise sensitive receivers

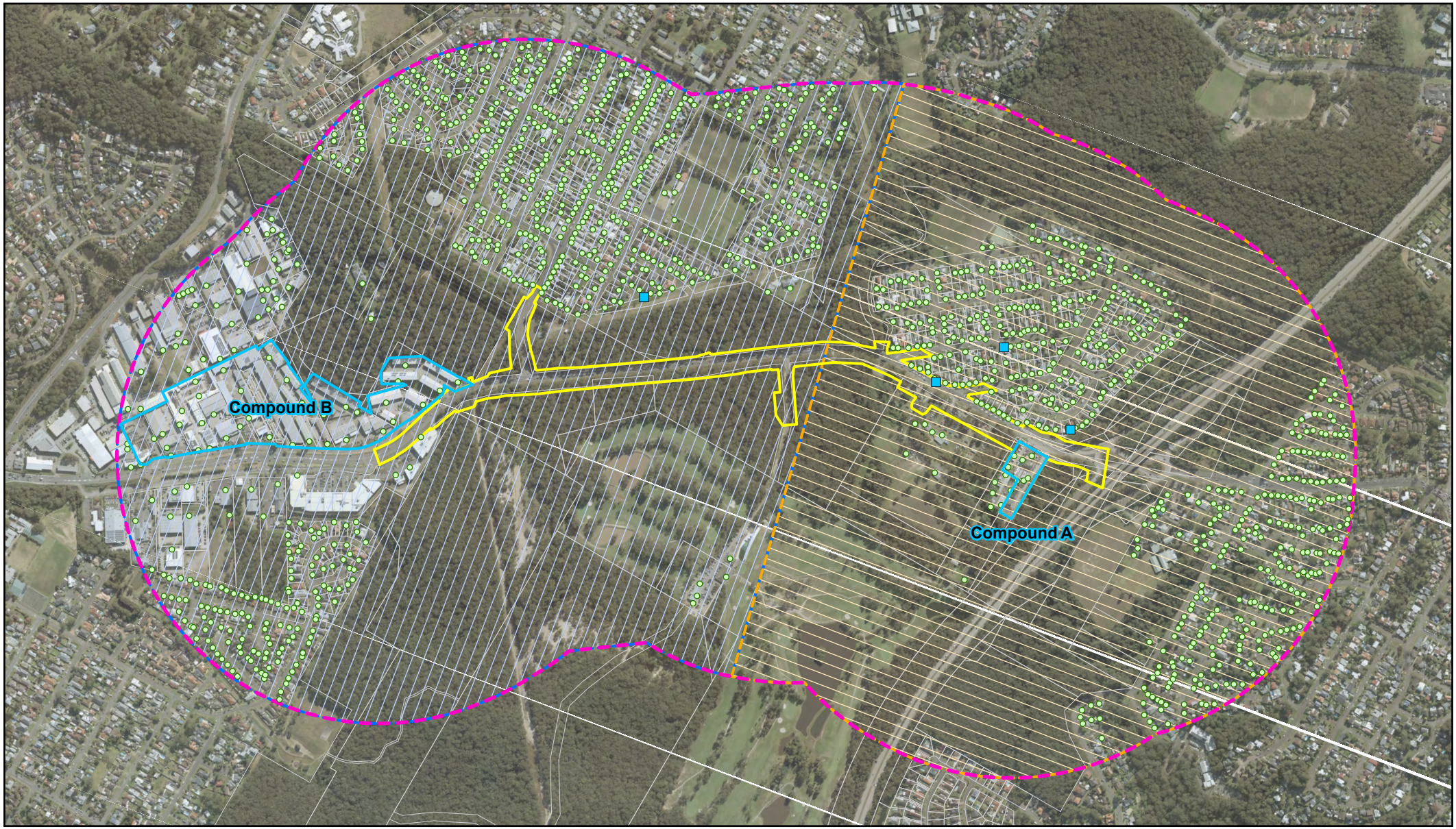
Receiver type	Number of modelled receivers		Total
	NCA01	NCA02	
Active recreation	11	12	23
Commercial	105	14	119
Educational institute	12	14	26
Place of worship	1	0	1
Residential	922	787	1709
Total	**1051**	**827**	**1878**

Background noise levels

A summary of the background noise monitoring results are provided in Table 6.36. These noise levels were used to define appropriate construction noise management levels.

Table 6.36: Background and ambient noise levels

Location	Background noise descriptors $L_{A90(Period)}$			Ambient noise descriptors $L_{Aeq(period)}$		
	Day	**Evening**	**Night**	**Day**	**Evening**	**Night**
M1 – 13 Leroy Close	55	50	36	66	57	52
M2 – 16 Higham Road	43	41	28	53	50	45
M3 – 117 Hillsborough Road	65	54	32	72	69	65
M4 – 7 Coolum Place	48	47	37	60	55	48



LEGEND

- Study area
- Construction footprint
- Compound
- NCA1
- NCA2
- Sensitive receivers
- Monitoring locations
- Cadastre

Paper Size ISO A4

0 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

Sensitive receivers

FIGURE 6.8

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:13

Data source: Metromap Tile Service: - Imagery (Date extracted: 11/10/2022); Roads, Cadastre - LPI, 2017; Created by: tmorton

6.7.3 Criteria

6.7.3.1 Proposal specific noise management levels

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

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

The proposed construction activities are expected to generally occur during standard construction hours, however some activities would be required to be carried out outside of standard hours.

Construction noise management levels (NMLs) have been developed for standard construction hours (day) and outside of standard hours of working (OOHW) (day, evening and night). The NML represents the point above which there may be some community reaction to noise.

A summary of the proposal construction noise management levels for each identified residential receiver noise catchment area is provided in Table 6.37.

Table 6.37: Proposal specific residential receiver noise management levels

Residential receiver NCA	Time of day	Management level, dBA
NCA01 M4 – 7 Coolum Place	Recommended standard hours	58
	OOHW – Day	53
	OOHW – Evening	52
	OOHW – Night	41
NCA02 M2 – 16 Higham Road	Recommended standard hours	53
	OOHW – Day	48
	OOHW – Evening	46
	OOHW – Night	351

6.7.3.2 Construction traffic noise criteria

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

Based on the RNP it is considered that where road traffic noise levels already exceed the assessment criteria, an increase of less than 2 dB represents a minor impact that is barely perceptible to the average person. Where the predicted noise increase is 2 dB or less, then no further assessment is required. However, where the predicted noise level increase is greater than 2 dB, further assessment is required using Roads and Maritime's Noise Criteria Guideline.

Non-residential receiver noise criteria are presented in Table 6.38.

Table 6.38: Noise criteria for non-residential land uses.

Existing sensitive land use	Assessment criteria - dBA		Additional considerations
	Day (7 am to 10 pm)	Night (10 pm to 7 am)	
School classrooms	L_{Aeq} (1hr) 40 (internal) When in use	-	In the case of buildings used for education or health care, noise level criteria for spaces other than classrooms and wards may be obtained by interpolation from the 'maximum' levels shown in Australian/New Zealand Standard 2107:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors.
Places of worship	L_{Aeq} (1hr) 40 (internal) When in use	L_{Aeq} (1hr) 40 (internal) When in use	The criteria are internal. Areas outside the place of worship, such as a churchyard or cemetery may also be a place of worship. Compliance with internal criteria inside the church may be sufficient; however for external areas passive recreation criteria (see item 5) may also be applied.
Open space (active use)	L_{Aeq} (15hr) 60 (external) When in use	-	Active recreation is characterised by sporting activities and activities which generate their own noise or focus for participants making them less sensitive to external noise intrusion.
Aged care facilities	-	-	Assessed as residential receivers.

6.7.3.3 Structural damage due to vibration

For the Proposal, the DIN criteria in Table 6.39 has been adopted for structural damage to heritage buildings. Note that the closest heritage building is 700 meters from the proposal.

Table 6.39: Guideline values for short term vibration on structures – DIN 4150-3

Type of structure	Guideline values for velocity, vi(t) (1) [mm/s]		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20-40	40-50
Dwellings and buildings of similar design and/or occupancy	5	5-15	15-20
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (for example listed buildings under preservation order)	3	3-8	8-10

Source: German Standard DIN 4150-3: 2016-02 Structural Vibration – Part 3: Effects of vibration on structures

Notes:

1. The term vi refers to vibration levels in any of the x, y or z axes.
2. At frequencies above 100 Hz the values given in this column may be used as minimum values.
3. Due to the nature of the proposal construction activities no continuous vibration criteria are deemed necessary.

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

6.7.3.4 Vibration damage to utilities

The British Standard BS 5228-2:2009 Code of Practice for noise and vibration control on construction and open sites and the German Standard 4150-3: 2016-12 Structural Vibration – Part 3: Effects of vibration on structures, provide information on the vulnerability of ground-related services and structures to vibration. Table 6.40 and Table 6.41 present the vibration guideline values in the British Standard (BS) and German Standard (DIN), respectively.

For this assessment, the BS criteria (the more conservative criteria) has been adopted for damage to underground services due to vibration and can be summarised as 30 mm/s for intermittent or transient vibrations (excavators, pile driving, trucks etc.) and 15 mm/s for continuous vibrations (compactors and rollers).

Table 6.40: Vibration guide values for underground services – BS 5228

Type of Utility	Guideline maximum values for velocity measured on the pipe (mm/s)	
	Intermittent or transient vibrations	Continuous vibrations
Underground services	30	15

Table 6.41: Guideline values for vibration on buried pipework – DIN 4150-3

Line	Type of Utility	Guideline values for velocity measured on the pipe (mm/s)
1	Steel (including welded pipes)	100
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with and without flange)	80
3	Masonry, plastic	50

The criteria shown in Table 6.42 for underground assets has been developed based on discussions GHD has had with underground asset owners.

Table 6.42: Guideline values for underground assets

Type of Utility	Guideline values for velocity measured on the pipe (mm/s)
Telstra (and other comms agencies by proxy)	50[1]
Energex (other electricity providers by proxy)	25
APA (gas pipelines)	20[2]

Notes:

1. Telstra generally anticipate that when construction activities comply with a minimum vibration limit / peak particle velocity of 50 mm/s there would be no damage or disruption to telecommunication assets (in particular, light transmitting in the fibre networks).
2. Vibration levels shall be monitored during the installation of the pile/pile sleeve if installed by way of a vibration driver or by impact hammer. The ground vibration at the pipeline shall be monitored and the vibration levels controlled to less than 20 mm/s. Works shall cease if levels exceed 20 mm/s and new method of installation sought.

6.7.3.5 Sleep disturbance, traffic noise

The RNP provides a literature review for the assessment of sleep arousal due to traffic noise however does not set a sleep disturbance assessment criterion. Sleep disturbance impacts are likely to be dependent on the following:

- Maximum noise level of an event
- Number of occurrences
- Duration of the event
- Level above background or ambient noise levels

For continuous rather than intermittent traffic flow, the Transport guidance recommends LAmax noise pass-by events should not exceed LAeq (1hr) noise levels by more than 15 dBA. The Environmental Noise Management Manual (RTA, 2001) advises that maximum noise levels can be used as a tool to prioritise and rank mitigation strategies but should not be applied as a decisive criterion in itself.

At locations where road traffic is continuous rather than intermittent, the LAeq(9hour) criteria for operational noise assessment should sufficiently account for sleep disturbance impacts. However, where the emergence of LAmax over the ambient LAeq(1hr) is equal to or greater than 15 dBA, the LAeq(9hour) criteria may not sufficiently account for sleep disturbance impacts and a detailed assessment may be required.

The NSW Road Noise Policy (RNP 2011) concludes that:

- Maximum internal noise levels below 50 – 55 dBA are unlikely to awaken people from sleep
- One or two noise events per night, with maximum internal noise levels of 65 – 70 dBA, are not likely to affect health and wellbeing significantly

6.7.3.6 Proposal specific operational noise criteria

A summary of the proposal specific operational criteria is presented in Table 6.43 and Table 6.44.

Table 6.43: Proposal specific operational noise criteria – residential land uses

Road category	Type of proposal / land use	Assessment criteria - dBA	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway / arterial / sub-arterial roads	2. Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads. 3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments.	$L_{Aeq\ (15hr)}$ 60 (external)	$L_{Aeq\ (9hr)}$ 55 (external)

Table 6.44: Proposal specific operational noise criteria – non-residential land uses

Existing sensitive land use	Assessment criteria - dBA		Additional considerations
	Day (7 am to 10 pm)	Night (10 pm to 7 am)	
1. School classrooms	$L_{Aeq\ (1hr)}$ 40 (internal) When in use	-	In the case of buildings used for education or health care, noise level criteria for spaces other than classrooms and wards may be obtained by interpolation from the 'maximum' levels shown in Australian/New Zealand Standard 2107:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors.
2. Open space (active use)	$L_{Aeq\ (15hr)}$ 60 (external) When in use	-	Active recreation is characterised by sporting activities and activities which generate their own noise or focus for participants making them less sensitive to external noise intrusion.
3. Open space (passive use)	$L_{Aeq\ (15hr)}$ 55 (external) When in use	-	Passive recreation is characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion e.g. playing chess, reading.

6.7.4 Potential impacts

6.7.4.1 Construction

Construction scenarios have been created based on construction equipment likely to be operating simultaneously at any given time and located in the location creating the maximum received noise level. Although this is unlikely to occur, the modelling assumes the 'worst-case' scenario to identify where noise impacts could be a concern and require mitigation.

The construction scenarios used for this assessment are outlined in Table 6.45.

Table 6.45: Construction Scenarios

Scenario ID	Phase	Area	Std. hours	Out-of-standard hours		
				Day	Eve	Night
CS01	Mobilisation and site establishment	Existing road corridor	X	X	X	X
CS02	Utility, property, services adjustment	Existing road corridor	X	X	X	X
CS03	Corridor clearing	Existing road corridor	X	-	-	-
CS04	Bulk earthworks	Existing road corridor	X	-	-	-
CS05	Drainage infrastructure	Existing road corridor	X	-	-	-
CS06	Paving / Asphalting	Existing road corridor	X	X	X	X
CS07	Concrete Saw	Existing road corridor	X	-	-	-
CS08	Road furniture installation	Existing road corridor	X	X	X	X
CS09	Site clean up	Existing road corridor	X	-	-	-
CS10	Compounds	Whalan's Nurseries	X	X	X	X

The timing for the above construction is indicative and subject to change based on construction methodology and traffic and safety consideration. In addition, the predictions use the shortest separation distance to each sensitive receiver, however in reality separation distances would vary between plant and sensitive receivers. For 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.

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

The predicted levels are based on construction works occurring at the worst-case location relative to each receiver. The actual exceedance during construction would generally be lower and maximum noise level impacts would only be experienced for limited periods where equipment is operating at their maximum capacity. At most times, construction equipment would produce lower noise levels than those considered in this assessment.

A summary of the predicted noise level range within each noise catchment area are presented in Table 6.46.

Table 6.46: Predicted no-mitigation construction noise level range, dBA

Noise catchment area	Construction scenario (dBA)									
	CS 01	CS 02	CS 03	CS 04	CS 05	CS 06	CS 07	CS 08	CS 09	CS 10
NCA01	12-66	25-79	29-83	26-80	25-79	26-80	29-83	19-73	12-66	24-82
NCA02	22-85	35-98	39-102	36-99	35-98	36-99	39-102	29-92	22-85	35-75
Non-residential	24-79	37-92	41-96	38-93	37-92	38-93	41-96	31-86	24-79	29-94

6.7.4.2 Construction impacts outside of standard working hours

In the event that out of hours work is undertaken, although not anticipated, the number of exceedances under exceedances for outside of standard hours are outlined in Table 6.47 to Table 6.49.

Table 6.47: Number of exceedances during standard construction hours (day)

(day)Noise catchment area	Construction scenario and number of predicted exceedances									
	CS 01	CS 02	CS 03	CS 04	CS 05	CS 06	CS 07	CS 08	CS 09	CS 10
NCA01	14	128	190	142	128	142	190	44	14	65
NCA02	87	340	672	410	340	410	672	204	87	363
Non-residential	2	18	34	22	18	22	34	7	2	14

Table 6.48: Number of exceedances during standard construction hours (evening)

(day)Noise catchment area	Construction scenario and number of predicted exceedances									
	CS 01	CS 02	CS 03	CS 04	CS 05	CS 06	CS 07	CS 08	CS 09	CS 10
NCA01	15	142	228	151	142	151	228	56	15	71
NCA02	109	490	772	583	490	583	772	247	109	568
Non-residential	2	18	34	22	18	22	34	7	2	14

Table 6.49: Number of exceedances during standard construction hours (night)

(day)Noise catchment area	Construction scenario and number of predicted exceedances									
	CS 01	CS 02	CS 03	CS 04	CS 05	CS 06	CS 07	CS 08	CS 09	CS 10
NCA01	118	710	819	734	710	734	819	293	118	494
NCA02	340	786	787	787	786	787	787	777	340	785
Non-residential	2	18	34	22	18	22	34	7	2	14

The highest predicted noise levels are located at receivers located in NCA02 during corridor cleaning works and use of concrete saws. These receivers are predicted to experience exceedances of the highly noise affected level of 75 dBA with predicted levels up to 102 dBA.

The construction scenarios with the greatest predicted impacts are scenario three and seven, which involve the clearing of vegetation to widen the road corridor and using concrete saws. Construction equipment expected to be used includes a petrol chainsaw, 30-ton excavator, tub grinder, dump trucks and concrete saws. The equipment is modelled to produce an adjusted sound power level of 118 dB and a total of 418 residential exceedances of the relevant NMLs are expected.

The detailed construction noise results presented in Appendix J indicate that several receivers are predicted to exceed the highly noise affected level of 75 dBA during all construction scenarios modelled. These receivers are primarily those located on or close to Hillsborough Road.

The predicted noise levels are considered conservative as they assume worst-case operations relative to each receiver. The construction will not be occurring along the entire length of the corridor simultaneously and will instead move along the corridor. This means that the number of exceedances provided for each construction scenario is greater than what would occur during any one time and is best considered a cumulative total value.

There are several non-residential exceedances predicted, located at the CNCC Showgrounds and Hillsborough Public School. Exceedances of up to 6 dBA at the Public School and 8 dBA at the Showground during the vegetation clearing construction and concrete sawing construction scenarios are predicted at these receivers.

Construction traffic noise impacts

All construction traffic is expected to access site via the existing road network. To increase the road traffic noise of these roads by 2 dB, traffic would have to increase significantly. The TfNSW Construction and Maintenance Noise Estimator Road Traffic Noise Estimator worksheet has been used to calculate additional vehicles required to achieve a 2 dB increase. This is listed below in Table 6.50.

Table 6.50: Construction traffic noise prediction

Road Section	Existing light vehicles per day	Existing heavy vehicles per day	Additional vehicles required for a 2 dB increase	Change in noise level (dB)
Hillsborough Road – East of NICB	20,8971	1,3381	10,000 LV + 1,000 HV	+ 2.0
Hillsborough Road – West of NICB	26,6801	1,7091	12,000 LV + 1,400 HV	+ 2.0

Although actual construction traffic movements are not known, there is no reasonable possibility that there would be enough additional traffic as a result of the construction activities to exceed the Road Noise Policy recommendation of a maximum of a 2 dB increase to total road traffic noise. Therefore, construction traffic noise impacts are not anticipated.

Construction structural vibration impacts

Using the DIN 4150-3:1999-02 Structural Vibration – Part 3: Effects of vibration on structures criteria, structural vibration impacts are summarised as follows:

For worst case vibration generating works within the construction footprint (vibratory roller activities):

- Heritage structures or buildings of similar construction may be affected by vibration within a maximum of 42 metres of the works. 42 residential receivers have been identified within this distance. There are no heritage structures in close proximity to the proposal.
- Standard dwellings or buildings of similar construction may be affected by vibration within a maximum of 18 metres of the works. 21 residential receivers have been identified within this distance.

Construction would progress along the construction area and vibration impacts would be experienced for short times at most locations.

Construction human comfort vibration impacts

Human comfort impacts are summarised as follows:

- For vibration generating works within the construction footprint (vibratory roller activities) residential receivers may be affected by vibration within a maximum of 128 metres of the work. 141 residential receivers were identified within this distance. Nine commercial premises may be affected within 54 metres of the works. No other non-residential sensitive receivers were identified within this buffer distance.

Using the BS 5228-2.2009 criteria:

- For vibration generating works within the construction footprint (vibratory roller activities) receivers may be affected by vibration within a maximum of 140 metres of the work. 156 residential receivers were identified within this distance. 23 commercial premises and four active recreation buildings may be affected within 54 metres of the works. No other non-residential sensitive receivers were identified within this buffer distance.

Construction would progress along the construction area and vibration impacts would be experienced for relatively short times at most locations. Construction vibration impacts would be avoided through maintaining minimum distances between plant and the nearest receivers as detailed in Appendix J.

6.7.4.3 Operation

Operational road traffic noise

The RNP requires the assessment of road traffic noise at the year of opening (2027 indicative) and at the design year (2037 indicative) for daytime and night time periods. The operational noise scenarios which have been assessed therefore include:

- No build (2027 and 2037), representing the year of opening and the design year and incorporates the existing alignment and traffic flows for the applicable year
- Build (2027 and 2037), incorporating the proposal including any existing major arterial roads

During both scenarios, noise levels are not predicted to increase by more than 2 dB at any receiver as a result of the proposal, but some receivers are predicted to exceed the cumulative limit once the proposal is built. That is, the affected properties are already subject to substantial noise from the existing road, with the proposal only contributing a marginal increase. It is noted that road traffic noise levels at these receivers are predicted to reduce as a result of the proposal being constructed.

Noise modelling results indicated that road traffic noise criteria may be exceeded at several residential receivers. The results for receivers eligible for consideration of mitigation are presented in Appendix J. The noise modelling results indicated:

- 17 individual residential receiver dwellings are identified to be considered for noise mitigation
- The cumulative limit is exceeded at each of the 17 residential receiver floors during the day and at 14 during the night
- Noise levels are predicted to be acute at each of the 17 residential receiver floors during the day and at 14 during the night

Receivers that have been identified to be considered for noise mitigation are shown graphically in Figure 6.9. Operational noise contours for the day and night time at the year of opening are presented in Figure 6.10 and Figure 6.11 respectively. Receivers that have been identified to be considered for noise mitigation are presented in Appendix J. These mitigation recommendations would be re-evaluated at the detailed design phase and are subject to change. This may result in more or less sensitive receivers qualifying for consideration of at-receiver noise mitigation. This will take into account any changes to the design and would involve consultation with affected residents.

Where properties have been identified for at-receiver noise treatment and would also be impacted by noise from construction works, Transport would consult with those property owners about bringing forward the installation of treatments to provide noise mitigation during the construction of the proposal, where feasible.

Maximum noise level assessment

Existing maximum noise levels

Existing maximum noise levels were measured during the unattended noise logging. A summary of the data is presented below in Table 6.51.

Table 6.51: Existing maximum noise level events

Location	No. of events	Measured maximum noise levels (dBA LAmax)	
		Range	Median
M1 – 13 Leroy Close	100	65 – 80	68
M2 – 16 Higham Road	85	65 – 87	70
M3 – 117 Hillsborough Road	2662	65 – 89	72
M4 – 7 Coolum Place	30	65 – 73	67

Table 6.51 indicated that maximum noise level events are a regular feature at location M1 to M3 and range from 65 to 89 dBA. The significantly higher number of measured events at M3 is due to the proximity of the location to Hillsborough Road. Maximum noise level events at the high end of the range are most likely due to heavy vehicles passing by the noise monitor while light vehicles passing by will be at the lower end of the range.

LEGEND

- Study area
- Construction footprint
- Compound
- Design
- Sensitive receivers
- Cadastre

Paper Size ISO A4

0 10 20 30 40

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Receivers eligible for consideration of additional mitigation

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

FIGURE 6.9

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:13

Data source: Metromap Tile Service: - Imagery (Date extracted: 11/10/2022); Roads, Cadastre - LPI, 2017; Created by: tmorton

Future maximum noise levels

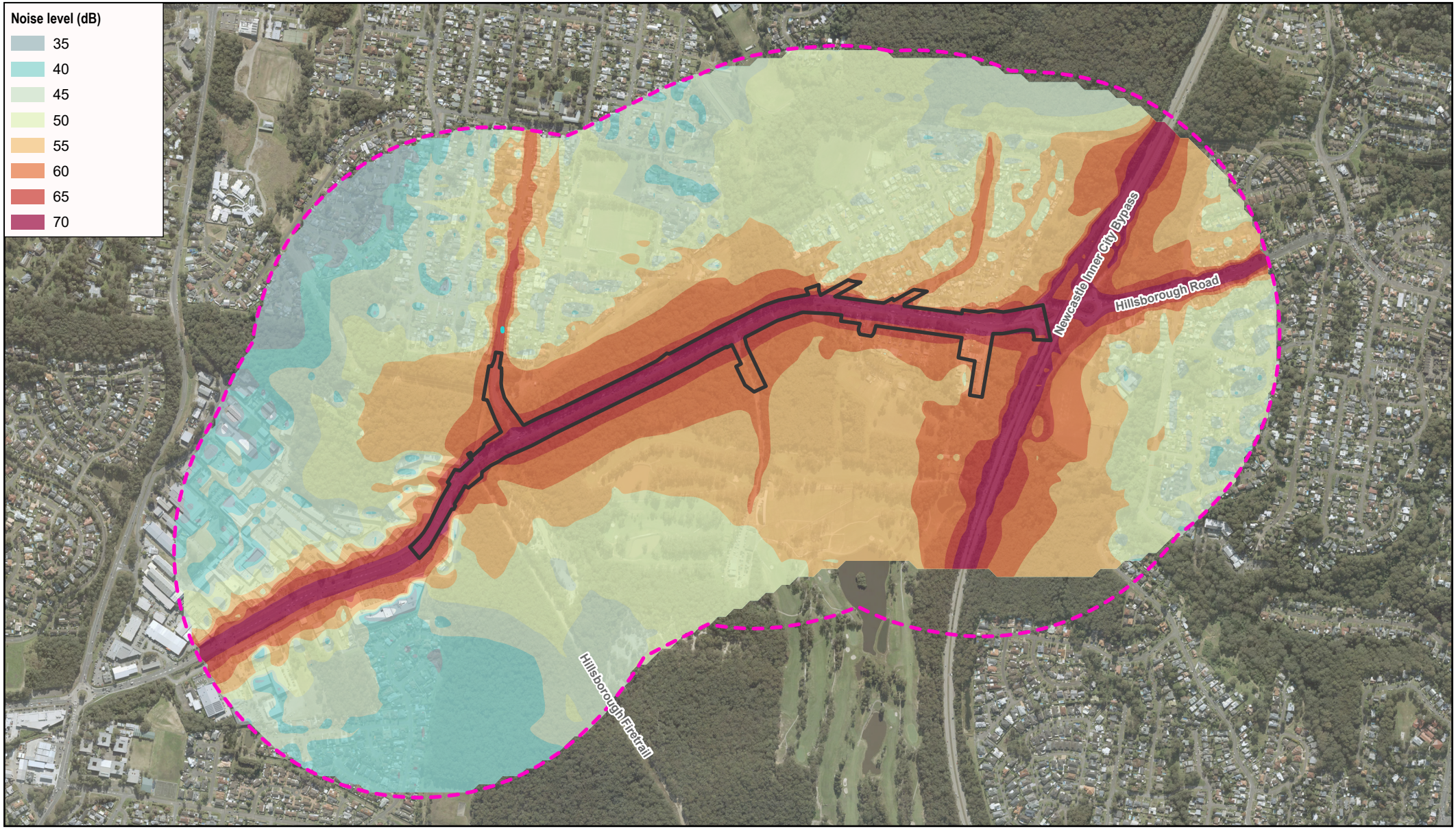
The duplication of Hillsborough Road and the addition of a signalised intersection at Chadwick Street has the potential to change maximum noise level events in the area. A summary of the predicted changes is presented in Table 6.52.

Table 6.52: Future maximum noise level events

Monitoring location	Worst case change (dB)	Discussion
M1 – 13 Leroy Close	0	Due to proximity to NICB as well as Hillsborough Road it is not anticipated that maximum noise levels will change at this location.
M2 – 16 Higham Road	0	Traffic flows are predicted to decrease on Higham Road because of the proposal. Maximum noise levels are not predicted to decrease however the number of events has the potential to decrease.
M3 – 117 Hillsborough Road	+2	Maximum noise levels have the potential to increase at residences along Hillsborough Road due to the introduction of a signalised intersection at Chadwick Street.
M4 – 7 Coolum Place	0	Maximum noise level events associated with road traffic noise are not a significant feature at this location. An increase in maximum noise levels is not predicted.

Although maximum noise levels are not used as a criterion to determine the consideration of additional noise mitigation it is highly recommended that they be considered when feasible and reasonable mitigation measures are considered.

This is especially true for residences that are adjacent to the Hillsborough Road and Chadwick Street intersection where a signalised intersection is to be introduced. The decision to mitigate operational road traffic noise impacts will consider the potential impacts the intersection would have on maximum noise levels, most notably the impact of stop-start traffic. Operational noise management measures are detailed in Section 6.7.5.



LEGEND

- Study area
- Construction footprint

Paper Size ISO A4

0 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

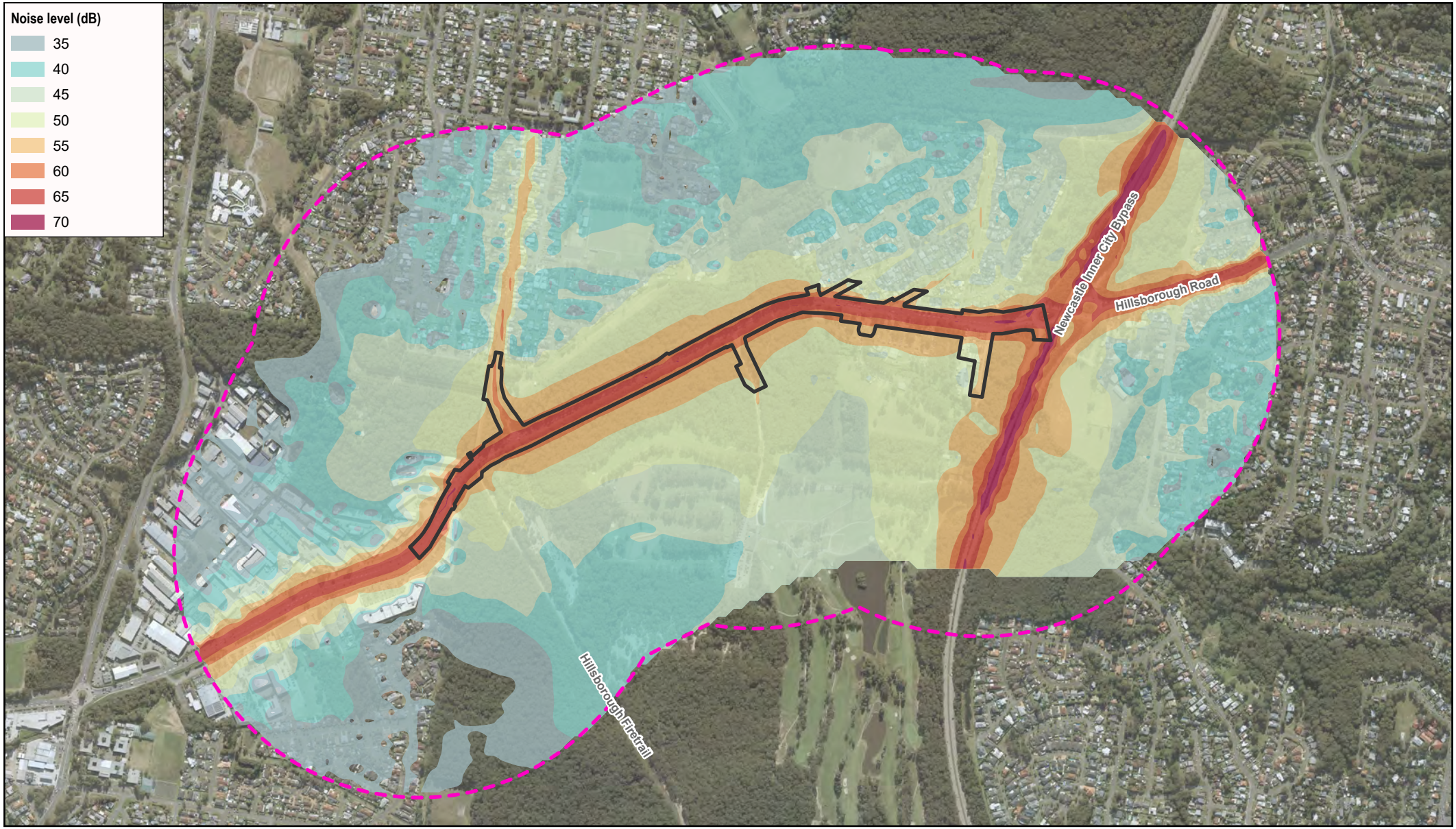
Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

Operational noise - day

FIGURE 6.10

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:14

Data source: Metromap Tile Service: - Imagery (Date extracted: 11/10/2022); Roads, Cadastre - LPI, 2017; Created by: tmorton



LEGEND

- Study area
- Construction footprint

Paper Size ISO A4

0 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

Operational noise - night

FIGURE 6.11

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:14

Data source: Metromap Tile Service: - Imagery (Date extracted: 11/10/2022); Roads, Cadastre - LPI, 2017; Created by: tmorton

6.7.5 Safeguards and management measures

The measures described in Table 6.53 will be implemented to avoid or minimise potential impacts on noise and vibration.

Table 6.53: Noise and vibration safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Noise and vibration	A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in *the Interim Construction Noise Guideline (ICNG) (DECC, 2009*) and identify: • All potential significant noise and vibration generating activities associated with the activity • Feasible and reasonable mitigation measures to be implemented, taking into account *Beyond the Pavement: urban design policy, process and principles* (Transport, 2014) • A monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria	Contractor	Detailed design/pre-construction
Noise and vibration	All sensitive receivers (e.g. schools, local residents) likely to be affected will be notified at least 7 days prior to commencement of any work associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • The proposal • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information	Contractor	Detailed design/ pre-construction
Site Inductions	All personnel working on site will receive awareness training as part of the site induction package for their requirements within the Noise and Vibration Management Plan. The site induction will include reasonable and feasible behavioural practices as identified in the ICNG.	Contractor	Pre-Construction / Construction
Plant and equipment noise	Use quieter and less vibration emitting construction methods where feasible and reasonable.	Contractor	Pre-Construction / Construction

Impact	Environmental safeguards	Responsibility	Timing
Operational Noise	The proposal will consider noise attenuation measures (such as: architectural treatments) for all eligible properties identified as being impacted by operational traffic noise.	Transport	Detailed Design
Vibration impacts to existing buildings	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.	Transport/Contractor	Pre-Construction / Construction
Operational Noise	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. 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

6.8 Aboriginal cultural heritage

This section addresses the Aboriginal heritage impacts associated with the proposal and details the management measures proposed to mitigate these impacts.

The information presented in this section is drawn from the *Hillsborough Road Draft Aboriginal Cultural Heritage Assessment Report* (ACHAR) (Jacobs, 2022) (refer to Appendix K).

6.8.1 Methodology

The Aboriginal archaeological survey report was collated following the guidelines outlined in the *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime, 2011b) and the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010).

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 methodology

The study area is largely comprised of the immediate road verges of Hillsborough Road, and areas surrounding of surrounding bushland along with residential and commercial areas. Much of the study area exhibits high levels of disturbance.

The survey strategy involved targeted pedestrian survey for study area and areas identified as archaeologically sensitive. 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 handheld non-differential GPS unit (MGA94 Zone 56).

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

As part of consultation for the proposal, the RAPs were asked for information regarding potential cultural values and the identification of cultural knowledge holders that may possess specific knowledge to be considered. Consultation regarding cultural values for the proposal were done during meetings and phone calls to individuals.

6.8.2 Existing environment

Overview

The study area is located less than four kilometres from Lake Macquarie and can be characterised as generally flat and surrounded by low to moderate elevated areas, which causes the study area to act as a watershed.

The study area is covered by both unsealed (grassed areas, open space) and sealed areas (roadways), with land use in the study area currently dominated by public roadway, road verges and electrical easements, with industrial and residential development also present. Residential precincts are found at two main locations within the study area at Cardiff South and Hillsborough, and industrial and/or commercial developments border the study area at Warners Bay.

Aboriginal archaeological potential is determined by a combination of environmental factors such as topography, geology and soils and primarily reduced by post-European disturbance. The predictive model for site types developed for the proposal indicates that certain site types are more likely to be prevalent in the landscape, including:

- **Open camp sites (stone artefact scatters):** These are the most likely sites to have survived in the archaeological record. They are scatters of stone artefacts with little associated food residue such as shell and bone. Since larger camp sites would have been associated with permanent water sources, the most likely places for these camp sites would be on terraces or low, flat spurs adjacent to and above swamps or permanent creeks.
- **Natural/mythological/ritual sites:** These sites may not exhibit any physical or archaeological evidence, but their identification is derived from local Aboriginal tradition and oral history. It is unlikely these site types would be identified in a field survey, but instead through consultation with the Aboriginal stakeholders. To date, no information relating to ceremonial sites has been passed on by the traditional knowledge holders during the consultation process.
- **Waterholes or wells:** Waterholes or wells can be any natural or excavated water retaining feature of either historic of prehistoric significance. Waterholes or wells are unlikely to be found within the study area, but if present might potentially be found within the Warners Bay and Cockle Creek soil landscapes.

AHIMS sites

A search of the AHIMS database for the revised study area was undertaken on 10 November 2021 for an area of land at datum GDA, zone 56, eastings 372304 – 378488, northings 6349740 – 6354680 with a buffer of 100 meters. The search area extends 2 km beyond the maximum extent study area in all directions to gain information on the archaeological context of the local area. The revised search was also completed to capture any additional sites which may have been registered since the search which was completed on 2 October 2018 for the 2019 report. No registered AHIMS sites are located within the proposal construction footprint. Full AHIMs the full results of the revised AHIMS searches are presented in Appendix K.

Table 6.54: Frequency of site features from AHIMS data

Site feature	Frequency	Percentage (%)
Artefact	9	64.29
Grinding Groove	2	14.29
Modified Tree (Carved or Scarred)	1	7.14
Habitation Structure	1	7.14
Stone Arrangement	1	7.14
Total	14	100.00

Archaeological survey results

The Archaeological survey for the proposal was undertaken with representatives from Awabakal LALC, Transport and Jacobs Archaeological team on 18 November 2021. The aim of the archaeological surveys was to undertake a comprehensive visual assessment of the study area with Aboriginal stakeholders to identify any archaeological objects, or areas of PAD. On-site consultation with the representative from Awabakal LALC enabled the development management and mitigations measures for potential and actual impacts of the proposal.

An additional survey was completed on 8 March 2022 with representatives from Awabakal LALC, Transport and Jacobs Archaeological team for an area of land on Barker Avenue, between Hillsborough Road and the Charlestown Golf Club. The additional survey was to include a new area proposed for the U-turn facility.

The survey was completed on foot in accordance with the Code of Practice and the PACHCI Stage 2. The overall strategy was to complete a full coverage survey, where possible. All identified surface exposures were inspected for the presence of Aboriginal objects. While scarred trees and grinding grooves are known to be present within the region, no suitable trees or outcrops were encountered for visual inspection.

A handheld Global Positioning System (GPS) was used to track the path of the survey team and record the coordinates of identified features and disturbances. Detailed aerial maps marked with grid coordinates for the survey unit was carried by the survey team. The coordinate system projection used for all data recording was GDA94 MGA 56.

A photographic record was kept during the survey. Photographs were taken to record aspects of each survey unit including disturbance and recorded Aboriginal sites. Scales were used for photographs where appropriate.

Field investigations did not identify any previously unregistered sites during the archaeological survey however the following PAD sites were identified within the proposal and are listed in Table 6.55.

Table 6.55: Field investigations results

Site name (AHIMS ID)	Feature	Landform
HillsboroughRd PAD 2021-03 (AHIMS ID 38-4-2133)	PAD	Flat
HillsboroughRd PAD 2022-01 (AHIMS ID Pending)	PAD	Lower slope
Winding Creek (north of Hillsborough Road)	PAD	Creek bank
Winding Creek (south of Hillsborough Road)	PAD	Creek bank
Cockle Creek (north of Hillsborough Road)	PAD	Creek bank
Cockle Creek (south of Hillsborough Road)	PAD	Creek bank
Crockett Street	PAD	Low rise and creek bank alluvial terrace mid slope
HillsboroughRd PAD 2021-01 (AHIMS ID 38-4-2132)	PAD	Lower slope
HillsboroughRd PAD 2021-02 (AHIMS ID 38-4-2131)	PAD	Lower slope

One registered site (Hillsborough Rd IA 01 - AHIMS ID 38-4-2007) was identified about 50m outside of the proposal boundary.

Archaeological test excavation results

As part of the ACHAR assessment, 7 of the 9 sites identified were subject to test excavation. A total of 24 test pits were ultimately excavated across the proposal area. Details of each area subject to test excavation and the results of excavation are provided below in Table 6.56.

Table 6.56: Test excavation results summary

PAD	Number of Test Pits	Landform	Aboriginal Objects
Cockle Creek (south of Hillsborough Road)	2	Creek Bank	None Area disturbed.
Cockle Creek (north of Hillsborough Road)	3	Creek Bank	None Area disturbed.
HillsboroughRd PAD 2021-03 (AHIMS ID 38-4-2133) and Winding Creek (north of Hillsborough Road)	5	Creek Bank	None Area disturbed.
Winding Creek (south of Hillsborough Road)	2	Creek Bank	None Area disturbed.
HillsboroughRd PAD 2022-01 (AHIMS ID Pending)	8	Lower slope	None Area disturbed.
Crockett Street	4	Low Rise and Creek bank alluvial terrace midslope	None Area disturbed.

Significance assessment

In accordance with the Code of Practice and the PACHCI, an assessment of the scientific value of an Aboriginal object or place is required in order to form the basis of its management. Of the sites which underwent test excavation no archaeological items were recovered therefore no assessment of significance assessment was undertaken. Two sites which were originally identified in the proposal area but have since been avoided by the design of the project did not undergo test excavation and therefore an assessment of the significance of these sites could not be undertaken as outlined in in Table 6.57.

Table 6.57: Summary of scientific values

Site name (AHIMS ID)	Research potential	Representativeness	Rarity	Education potential	Overall significance assessment
Hillsborough Rd PAD 2021-01 (AHIMS ID 38-4-2132)	Unknown	Unknown	Unknown	Unknown	Unknown
Hillsborough Rd PAD 2021-02 (AHIMS ID 38-4-2131)	Unknown	Unknown	Unknown	Unknown	Unknown

6.8.3 Potential impacts

6.8.3.1 Construction

The impact assessment has been revised to no impacts and no loss of value to those sites. A summary of the assessed impacts in accordance with the Code of Practice and the PACHCI is included in Table 6.58.

Table 6.58: Summary of potential impacts

Site name (AHIMS ID)	Type of harm	Degree of harm	Consequence of harm
HillsboroughRd PAD 2021-03 (AHIMS ID 38-4-2133)	None	None	No loss of value
HillsboroughRd PAD 2022-01 (AHIMS ID Pending)	None	None	No loss of value
Winding Creek (north of Hillsborough Road)	None	None	No loss of value
Winding Creek (south of Hillsborough Road)	None	None	No loss of value
Cockle Creek (north of Hillsborough Road)	None	None	No loss of value
Cockle Creek (south of Hillsborough Road)	None	None	No loss of value
Crockett Street	None	None	No loss of value
HillsboroughRd PAD 2021-01 (AHIMS ID 38-4-2132)	None	None	No loss of value
HillsboroughRd PAD 2021-02 (AHIMS ID 38-4-2131)	None	None	No loss of value

The ACHAR found that:

- HillsboroughRd PAD 2021-01 (AHIMS ID 38-4-2132) and HillsboroughRd PAD 2021-02 (AHIMS ID 38-4-2131) will be avoided by the proposed works and will be conserved.
- Hillsborough Rd IA 01 (AHIMS ID 38-4-2007) will not be impacted by the proposed works, therefore there will be no loss of value.
- HillsboroughRd PAD 2021-03 (AHIMS ID 38-4-2133), HillsboroughRd PAD 2022-01 (AHIMS ID Pending), Winding Creek (north of Hillsborough Road), Winding Creek (south of Hillsborough Road), Cockle Creek (north of Hillsborough Road), Cockle Creek (south of Hillsborough Road) and Crockett Street were found not to include Aboriginal cultural material as a result of test excavation. They have been reassessed as not being PADs.

It is therefore recommended that:

- Hillsborough Rd IA 01 (AHIMS ID 38-4-2007), HillsboroughRd PAD 2021-01 (AHIMS ID 38-4-2132) and, HillsboroughRd PAD 2021-02 (AHIMS ID 38-4-2131) are to be conserved during proposed works and should be separated from construction areas during works with high visibility fencing.
- HillsboroughRd PAD 2021-03 (AHIMS ID 38-4-2133), HillsboroughRd PAD 2022-01 (AHIMS ID Pending) status on AHIMS should be updated on AHIMS with the submission of Aboriginal site impact recording forms (ASIRs) detailing the results of the test excavation and their reassessment as not being PADs.

6.8.3.2 Operation

The proposal is not expected to impact on any items of Aboriginal heritage or cultural values.

6.8.4 Safeguards and management measures

The measures described in Table 6.59 will be implemented to avoid or minimise potential impacts on Aboriginal heritage.

Table 6.59: Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) will be prepared in accordance with the Procedure for Aboriginal cultural heritage consultation and investigation (Transport, 2012) and implemented as part of the CEMP. It will provide specific drafting guidance on measures and controls to be implemented for managing and avoiding impacts on Aboriginal heritage.	Contractor	Detailed design / Pre-construction
Aboriginal Heritage	The AHMP must include measures to identify nearby PADs and registered site and/or conserve with high visibility fencing during works for the following: • Hillsborough Rd IA 01 (AHIMS ID 38-4-2007) • Hillsborough Rd PAD 2021-01 (AHIMS ID 38-4-2132) • Hillsborough Rd PAD 2021-02 (AHIMS ID 38-4-2131)	Contractor	Pre-construction
Site induction	All personnel working on site will receive training to ensure awareness of requirements of the Aboriginal Heritage Management Plan and relevant statutory responsibilities. Site-specific training will be given to personnel when working in the vicinity of identified Aboriginal heritage items.	Contractor	Pre-construction
Unexpected finds	The Standard Management Procedure - Unexpected Heritage Items will be followed in the event that a known or potential Aboriginal object(s), including skeletal remains, is found during construction. This applies where RMS does not have approval to disturb the object(s) or where a specific safeguard for managing the disturbance (apart from the Procedure) is not in place. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Pre-construction

6.9 Non-Aboriginal heritage

6.9.1 Methodology

A desktop non-Aboriginal heritage assessment was undertaken by GHD in accordance with the documents *Assessing Heritage Significance* (NSW Heritage Office, 2001) and *Statements of Heritage Impact* (NSW Heritage Office, 2002).

6.9.1.1 Desktop research

Heritage database searches were conducted on 3 June 2022 to identify heritage items located within or in proximity to the construction footprint. The following registers were reviewed during the search:

- World Heritage List
- National Heritage List
- Commonwealth Heritage List
- State Heritage Register
- NSW Section 170 Heritage and Conservation Registers (S170 Registers)
- Lake Macquarie LEP 2014

In addition to the heritage register searches, the desktop assessment also included background research into the historical development of the area. This research was used to determine the historic context of the construction footprint and identify any potential for additional heritage items to be present within or adjacent to the construction footprint.

6.9.2 Existing environment

Searches of relevant historic heritage registers and lists were conducted to identify previously recorded historic heritage items within close proximity to the proposal.

The nearest recorded non-Aboriginal heritage items (locally listed in the Lake Macquarie LEP 2014) to the proposal have been identified as:

- The former Colliery Tramway (local listing 41) located about 700 metres north-west of the proposal
- Miners' Cottages (local listing 59) located about 1.4 kilometres east of the proposal
- South Waratah Colliery (local listing 111) located about 1.5 kilometres north-east of the proposal
- Raspberry Gully Line Railway (local listing 112) located about 1.6 kilometres north-east of the proposal

There are seven state heritage items listed in the Lake Macquarie LGA. The nearest to the proposal is Glenrock early coalmining sites, located about 3.7 kilometres east of the proposal. Figure 6.12 shows the non-Aboriginal heritage items in proximity to the proposal.

6.9.3 Potential impacts

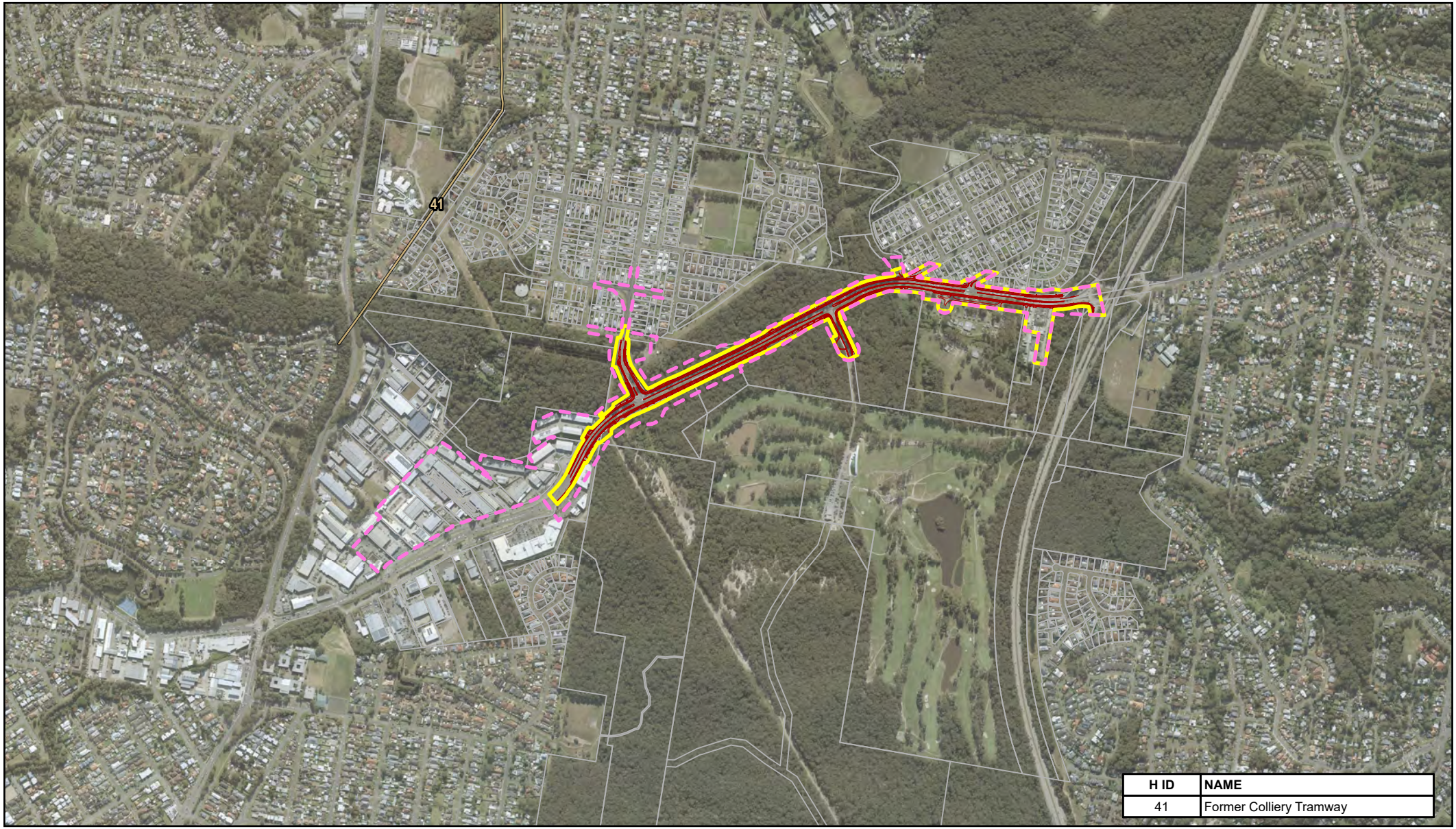
6.9.3.1 Construction

Due to the offset distances between the proposal and the nearest non-Aboriginal heritage items, any direct or indirect impacts to these items during construction is considered highly unlikely.

Should any unexpected archaeological items or remains be identified during construction the Standard Management Procedure - Unexpected Heritage Items (Transport for NSW, 2015d) would be followed.

6.9.3.2 Operation

Potential impacts to non-Aboriginal heritage items during operation not anticipated.



H ID	NAME
41	Former Colliery Tramway

LEGEND

- Proposal area
- Construction footprint
- Design

Heritage

- Item - General
- Cadastre

Paper Size ISO A4

0 110 220 330 440

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

N

GHD

Transport for NSW
Hillsborough Road Upgrade Concept Design
Review of Environmental Factors

Project No. **12544418**
Revision No. **0**
Date **11/10/2022**

Non-Aboriginal heritage items

FIGURE 6.12

G:\22\12544418\GIS\Maps\REF_0.aprx
Print date: 11 Oct 2022 - 13:24

Data source: Metromap Tile Service: - Imagery (Date extracted: 11/10/2022); DPIE: Heritage items, 2022. Roads, Cadastre - LPI, 2017; Created by: tmorton

6.9.4 Safeguards and management measures

The measures described in Table 6.60 will be implemented to avoid or minimise potential impacts on non-Aboriginal heritage.

Table 6.60: Non-Aboriginal heritage safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Non-Aboriginal heritage	Should any heritage items, archaeological remains or potential relics of Non-Aboriginal origin be encountered, then construction work that might affect or damage the material will cease and notification provided to the relevant Transport officer identified in the Transport Standard Management Procedure - Unexpected Archaeological Finds. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contactor	Detailed design/pre-construction

6.10 Landscape character and visual impacts

This section addresses the urban design, visual and landscape impacts associated with the proposal and details the management measures proposed to mitigate these impacts.

The *Urban design strategy - Concept design - MR674 - Hillsborough Road Duplication* (Peter Andrews and Associates Pty Ltd, 2022) included a Landscape Character and Visual Impact Assessment (LCVIA). This section summarises the visual impact assessment provided in full at Appendix L.

6.10.1 Methodology

The visual impact assessment was prepared with reference Transport's Environmental Impacts Assessment Practice Note – Guideline for Landscape Character and Visual Impact Assessment EIA-N04 (Transport, 2020) (LCVIA Practice Note). The LCVIA methods for this proposal include:

- Site visits and photographic record to review the proposal's landscape character and visual qualities
- Desktop review of relevant planning policies and procedures
- Analysis of the surrounding landscape including the built and natural qualities of the area
- Analysis of the proposal's landscape character
- Development of urban design vision and concepts
- Assessment of the potential landscape character impacts of the proposal
- Assessment of the potential visual impacts of the proposal
- Provision of mitigation measures

Landscape character

Landscape character is the combined quality of the built, natural and cultural aspects that make up an area and provide its unique sense of place. Landscape in this context is taken to include all qualities and characteristics of a tract of land, landform, vegetation, built form and infrastructure.

The method to measure impact is based on the combination of sensitivity of the existing area or view to change and magnitude of the proposal on that area or view. Sensitivity and magnitude are defined by the LCVIA Practice Note as:

- Sensitivity – the qualities of an area, the number and type of receivers and how sensitive the existing character of the setting is to the proposed nature of change.
- Magnitude – the type of proposal and its compatibility with the exiting landscape character. The scale of elements, as well as location or setting.

Visual impact assessment

The potential visual impact of the proposal is assessed in relation to a number of key viewpoints. Locations and directions of chosen viewpoints are representative of the range of viewpoints within the visual catchment of the proposal.

Visual sensitivity is dependent on the following:

- Distance between viewer and the proposal
- The category of viewer/receiver (resident, worker, shopper, open space user)
- The elements of the proposal that are visible
- Importance of the view, for example, identified in tourist guides, static or moving viewpoint, do people deliberately seek the view

The magnitude of a proposal refers to the scale, form and character of the proposal. In the case of visual impact assessment it also incorporates how far the proposal is from the viewer.

Table 6.61 shows how the level of sensitivity and magnitude are combined to achieve an overall landscape character and visual impact rating.

Table 6.61: Landscape character and visual impact assessment matrix

		MAGNITUDE			
SENSITIVITY		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

6.10.2 Existing environment

Overview

Hillsborough Road is a connector providing an important transport link between the NICB to the suburbs of Hillsborough, Cardiff South and Warners Bay. Hillsborough Road connects to Warners Bays to the west, which is identified as an economic centre in the Lake Macquarie LGA.

The Warners Bay Economic Centre incorporates a business park and supports large format indoor recreation and entertainment facilities.

Hillsborough and Cardiff South are residential areas comprising low density housing and supporting services such as open space. Offroad cycleways and pathways are incorporated in the residential areas linking to the on-road cycleway on Hillsborough Road.

The residential area of Hillsborough is visible from Hillsborough Road, with some dwellings fronting or backing onto Hillsborough Road. Cardiff South is not visible from Hillsborough Road, being screened by vegetation along the north side of Hillsborough Road.

Other land uses include the CNCC Showgrounds, Whalan's Nurseries and Warners Bay Industrial Area buildings, all of which are visible from Hillsborough Road. The Charlestown Golf Club is accessible from Hillsborough Road but is not visible, being screened by vegetation along the southern side of Hillsborough Road.

Landscape character zones

The four identified LCZs include Warners Bay Industrial and Bulky Goods Retail, Closed Woodland, Showground and Nursery, and Low Density Residential. Table 6.62 describes each of the LCZs and are shown in Figure 6.13.

Table 6.62: Landscape character zones description

LCZ	Description	Sensitivity
LCZ 1 – Warners Bay Industrial and Bulky Goods Retail	Warners Bay is identified by Lake Macquarie Council as an economic centre. The part of Warners Bay that is included in the study area incorporates bulky goods retailing, industrial land uses and large format indoor recreation/entertainment.	Negligible
LCZ 2 – Closed Woodland	The area is generally flat land with some areas being slightly elevated above the road level. This causes rainwater being directed towards the road corridor and the creek lines. There are several creeks located within this LCZ, the most prominent being Winding Creek and its tributary, which crosses the study area before turning north west and continuing into Cockle Creek (and ultimately into Lake Macquarie which is located about two km to the southwest).	Low
LCZ 3 – Showground and Nursery	Land zoned for small lot primary production and recreational land uses. The area incorporates Whalan's Nurseries and the CNCC Showgrounds.	Low

LCZ	Description	Sensitivity
LCZ 4 – Low Density Residential	Hillsborough and Cardiff South are residential areas comprising low density housing and supporting services such as open space. The residential area of Hillsborough is visible from Hillsborough Road with some dwellings fronting or backing onto Hillsborough Road. Cardiff South is not visible from Hillsborough Road as it is located to the north and screened by the extensive vegetation along Hillsborough Road.	Moderate

Viewpoints

There are 16 viewpoints were identified for the assessment of this proposal. These viewpoints are detailed in Figure 6.14.

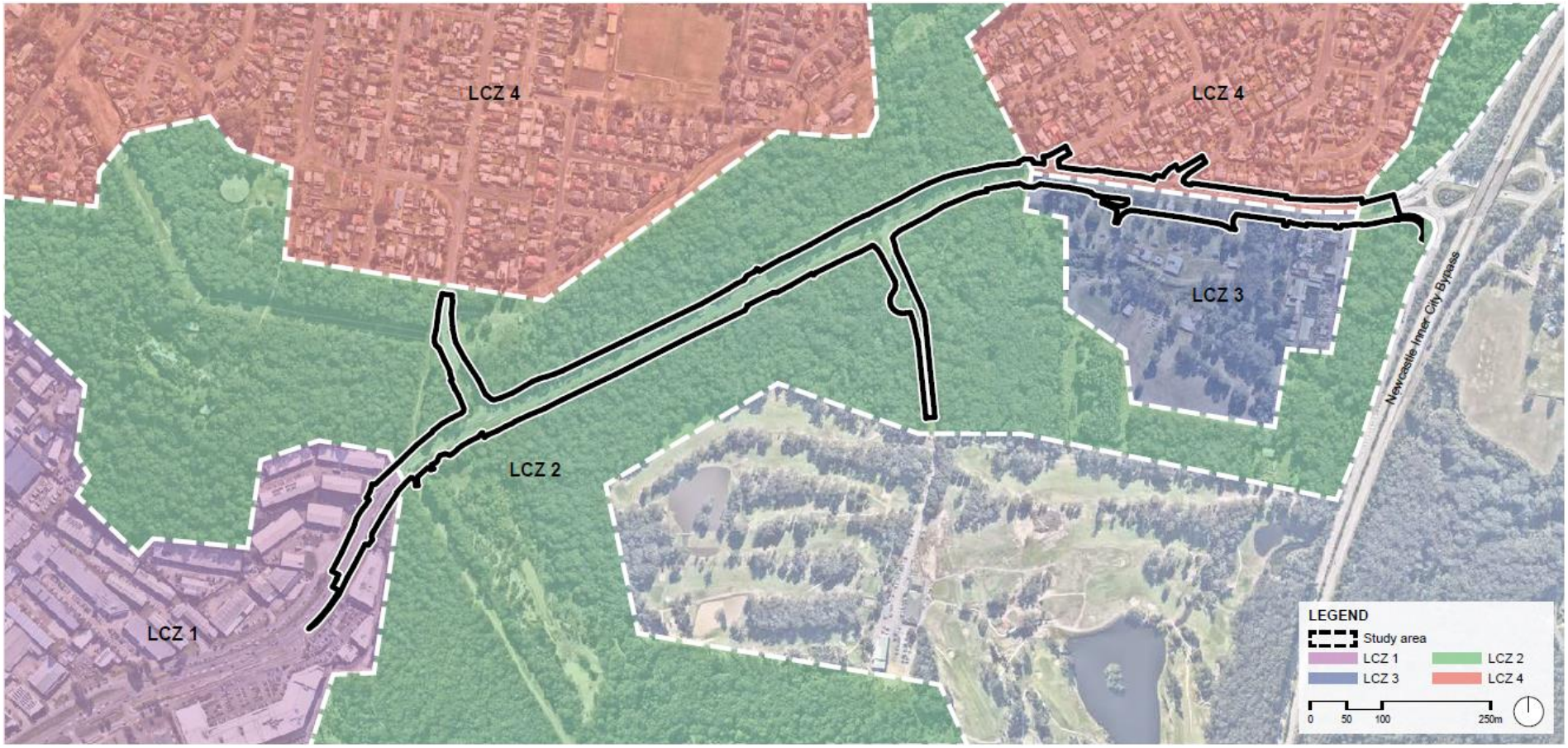


Figure 6.13: Landscape character zones of the proposal

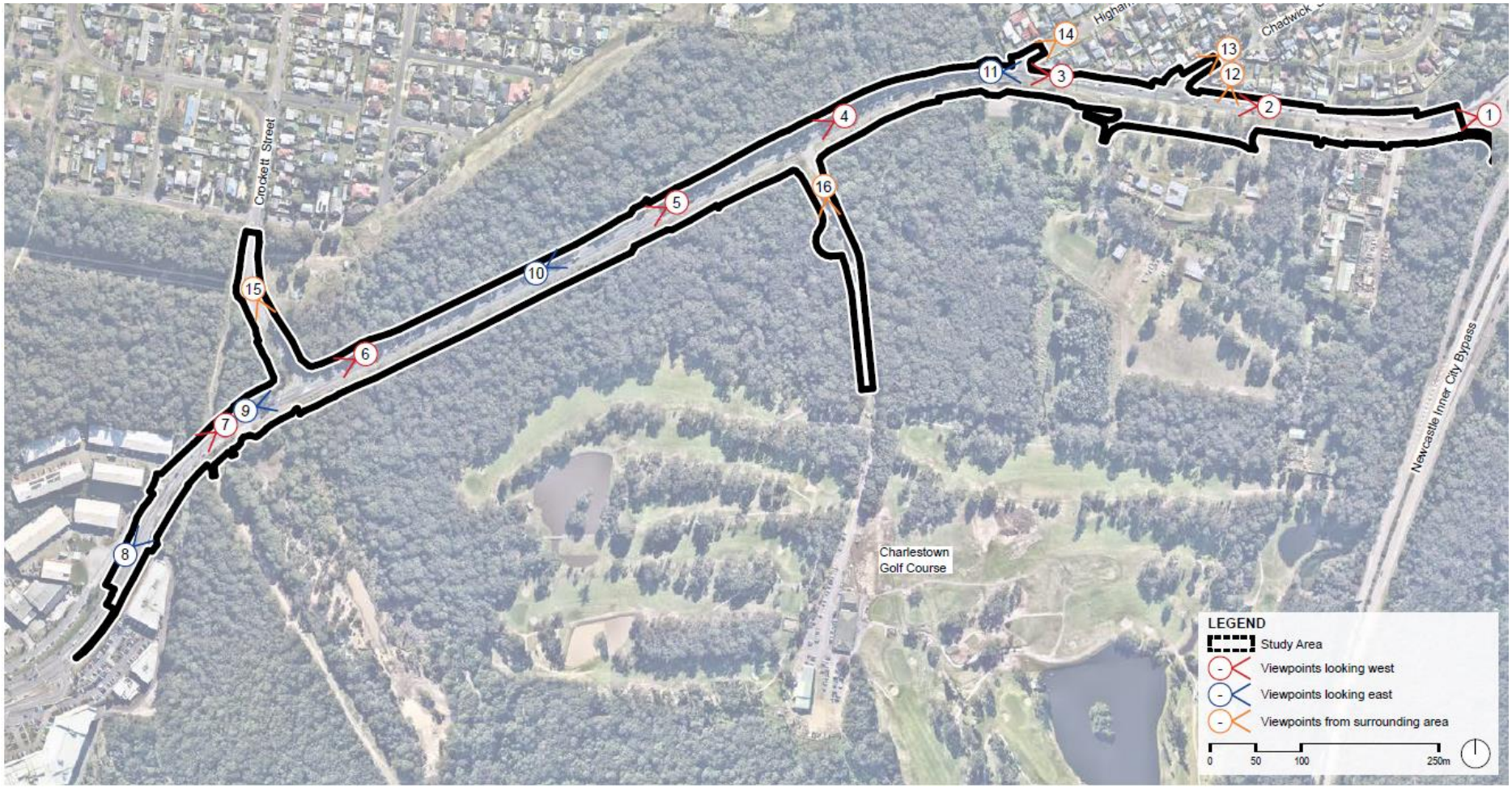


Figure 6.14: Viewpoints of the proposal

6.10.3 Potential impacts

6.10.3.1 Construction

During construction, visible construction elements would be expected to typically include, removal of vegetation, construction of a new widened road formation, construction of retaining walls and drainage infrastructure, construction of new pedestrian infrastructure, re-sheeting of the road corridor and landscaping.

Views to the construction activity would be seen by a high number of passing motorists, a low number of residents from within their homes, and a low number of other community members as they entered and left community facilities (such as CNCC Showground and Charlestown Golf Club).

The high number of passers-by on the roads seeing construction activity would get detailed views to the activity by these views, but these views would be fleeting and make up only a small proportion of their overall journey. These receptors would also be expected to be focused on driving and hence would not be highly sensitive to changes in views.

Compound A would be located within the existing nursery at the eastern end of the proposal. This site is reasonably visually shielded from the road by existing vegetation and fencing. In its current state as a working nursery and soils / landscape products supplier it has a high visitation rate from trucks and utility vehicles delivering and collecting material. There are a small number of potentially sensitive visual receptors that would see the construction activity from their houses, however, the compound would unlikely to be seen beyond the back fences of these properties (and therefore from living areas within these residences) due to fence lines and vegetation along the rear boundaries of these properties. As such there are no highly sensitive visual receptors who would see the construction activity, and the site would be seen for short periods of time as the drivers passed the site.

Compound B is located in the commercial area on the northern side of Hillsborough Road. It would utilise existing buildings within the commercial area and not result in any visual change.

6.10.3.2 Operation

Details of each of the viewpoints and potential visual impacts at each are summarised in Table 6.63 and shown in Figure 6.14. Details of each of the landscape character zone impacts are summarised in Table 6.64 and shown in Figure 6.13.

Table 6.63: Visual Impacts at the proposal viewpoint locations

#	Description	Sensitivity due to	Sensitivity	Magnitude	Impact Rating
1	View of the proposal at its eastern extent, Hillsborough Road looking west from intersection with NICB	Change to road geometry and access arrangements	Negligible	Negligible	Negligible
2	Hillsborough Road looking west approaching intersection with Chadwick Street	New intersection arrangement including traffic	Low	Low	Low
3	Hillsborough Road looking west towards intersection with Higham Road	Change of intersection arrangement and potential loss of vegetation	Low	Negligible	Negligible
4	Hillsborough Road looking south west towards intersection with Barker Avenue (at the creek crossing)	Loss of vegetation and change in intersection arrangement	Low	Negligible	Negligible
5	Hillsborough Road looking south west at unnamed creek crossing	Widening of road network and loss of vegetation	Low	Negligible	Negligible
6	Hillsborough Road looking south west at the intersection with Crockett Street	New intersection arrangement including traffic signals and loss of vegetation	Low	Low	Low
7	Hillsborough Road looking south west towards Warners Bay light industrial and bulky goods retail area	Road network widens and retaining walls to be incorporated replacing grassed and/or landscaped batters	Low	Moderate	Moderate-Low

#	Description	Sensitivity due to	Sensitivity	Magnitude	Impact Rating
8	Hillsborough Road looking north east from the Warners Bay light industrial and bulky goods retail area	Road network widens and loss of vegetation	Low	Moderate	Moderate-Low
9	Hillsborough Road looking north east approaching intersection with Crockett Street	New intersection arrangement including traffic signals and loss of vegetation	Low	Low	Low
10	Hillsborough Road looking east towards intersection with Higham Road	Road network widens and loss of vegetation	Low	Negligible	Negligible
11	Travelling eastbound approaching Higham Road	Change of Intersection arrangement and removal of vegetation	Low	Negligible	Negligible
12	View from residential area on Hillsborough Road looking south	Road network widens and loss of vegetation	Moderate	Low	Moderate-Low
13	View from Chadwick Street looking south west to	The new signalised intersection and potential loss of vegetation	Low	Negligible	Negligible
14	View from Higham Road looking south west to	Part closure of the intersection and rearrangement of Higham Road including separate access to private properties and a left turn in and left out arrangement	Moderate	Moderate	Moderate
15	View from Crockett Street looking south to the intersection with Hillsborough Road.	The new signalised intersection and loss of vegetation	Low	Negligible	Negligible
16	View from Barker Avenue looking south towards the proposed u-turn facility	The new u-turn facility and loss of vegetation	Low	Low	Low

Table 6.64: Visual impacts to landscape character zones

LCZ	Sensitivity	Magnitude	Impact Rating	Comment
1	Negligible	Low	Negligible	The Warners Bay economic centre will want to retain easy access and visual links to the buildings, signage, carparks and the access roads to maximise liveability for this community. Any infrastructure and landscape treatment should retain these sight lines.
2	Low	Moderate	Moderate-low	Removal of vegetation should be minimised where possible. Whilst the road corridor will be widened, the extent of vegetation within the area would still enclose the road corridor. The proposal does however give the opportunity for the removal of weeds and rubbish.

LCZ	Sensitivity	Magnitude	Impact Rating	Comment
3	Low	Low	Low	Retention of access to these land uses should be maintained. It is envisaged that the nursery and sheds facility would require retention of the sight lines with the road corridor to retain the visual links for users of Hillsborough Road. Some vegetation would be removed.
4	Moderate	Low	Moderate-low	The road corridor will be widened throughout this LCZ and be closer to the residential area. Additional infrastructure will be incorporated including a shared pathway along the residential edge. An opportunity exists to provide street trees subject to location of services.

Elements of the proposal that are likely to be the most visually intrusive include the new traffic lights that have replaced sign controlled intersections, the widening of the road corridor including hard structures and paths, the reconfiguration of road lanes at intersections and the removal of vegetation. Vehicle headlights and lighting along the proposal may also cause visual impacts at night.

The visual receptor location at Higham Road was subject to a moderate impact rating. While elements would be added or removed from within the view, the overall effect would result in a replacement of existing road infrastructure with similar elements.

As shown in Table 6.64, four of the 16 visual receptor locations were subject to moderate or moderate to low visual impact arising from the proposal. Given the low quality of existing views and that the scale and character of the proposal would generally be consistent with the existing setting with a moderate to low degree of contrast.

Key receptors would be motorists who would travel past the site as part of a greater journey and some residents north of Hillsborough Road. Parts of the proposal would be seen from relatively close proximity from some residences, however the overall effect would result in a replacement of existing road infrastructure with similar elements.

It is unlikely that the changes would be seen from within the property of the Charlestown Golf Club due to significant amounts of vegetative screening at the boundary of this property.

While the duration of the changes would be long term and with no chance of reversibility, the changes would reduce in visual prominence over time as the landscape matures, particularly any planting along the road edge. Overall, the reconfiguration of the intersections and road leading to the intersection would result in additional road elements within the view, however these changes to views are negligible when compared to existing views from these locations.

The proposal was found to generally have a negligible to moderate-low impact on landscape character and visual amenity. This is largely due to the extent of native vegetation that adjoins both sides of Hillsborough Road. Whilst some vegetation would be removed, the area would still retain a large amount of native vegetation, which still encloses a large part of the road. The proposal would also provide an opportunity to remove the dense weeds within the area and therefore provide opportunities to improve visual amenity.

The most impact was found to be a moderate impact for views from Higham Road looking south-west towards Hillsborough Road. This level of impact was identified due to the change in intersection arrangement removing the previously available left turn into Higham Road from Hillsborough Road. To minimise these impacts it was identified that signage and landscape treatment should be provided to guide road users. Replacement of the grassed and landscaped batters with retaining walls at the western end of the proposal provides an opportunity to improve safety and maintenance along Hillsborough Road.

6.10.4 Safeguards and management measures

The measures described in Table 6.65 will be implemented to avoid or minimise potential impacts on landscape character and visual amenity.

Table 6.65: Landscape character and visual safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Best Practice Urban Design	An Urban Design Plan will be prepared to support the final detailed project design and implemented as part of the CEMP. The Plan will present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan will include design treatments for: • Location and identification of existing vegetation and proposed landscaped areas, including species to be used (cross-referencing any relevant specified biodiversity safeguards) • Design and location of replacement trees • Built elements including retaining walls • Pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings • Street furniture • Details of the staging of landscape works • Procedures for monitoring and maintaining landscaped or rehabilitated areas The Plan will be prepared in accordance with relevant guidelines, including: • *RMS Beyond the Pavement urban design policy, process and principles* • *RMS Landscape Guideline, Bridge Aesthetics, Noise Wall Design Guidelines and Shotcrete Design Guideline*	Contractor	Pre construction
Construction work sites	Project work sites, including construction areas and supporting facilities (such as storage compounds and offices) will be managed to minimise visual impacts, including appropriate storage of equipment, parking, stockpile screening and arrangements for the storage and removal of rubbish and waste materials.	Contractor	Pre construction, construction

6.11 Property and land use

6.11.1 Existing environment

Land zoning and land use

The proposal is located on land zoned as SP2 Infrastructure – Classified Road, R2 Low Density Residential, and C2 Environmental Conservation, as identified in Section 4.1.1.3. Land use zones adjacent to the proposal area include:

- B7 – Business Park
- RE1 – Public Recreation
- RU4 – Primary Production Small Lots
- C4 – Environmental Management

The proposal is located on Hillsborough Road, starting at the NICB and extending west to about 300 metres west of Crockett Street in Warners Bay. The proposal encompasses part of Crockett Street which provides access to residential areas in Cardiff South.

The proposal area travels through a portion of a commercial area and business park in Warners Bay in the east, an area of bushland around Crockett Street in the centre and continuing to a residential area in Hillsborough. The business park contains around 25 commercial and retail businesses. There are a number of residential dwellings located adjacent to the proposal area on the northern side of Hillsborough Road in the suburb of Hillsborough.

The Warners Bay commercial area, Charlestown Golf Club, Shed Quarters, Whalan's Nurseries and the CNCC Showgrounds are located within or adjacent to the proposal area.

Public utilities

Public utilities and associated infrastructure identified within the proposal area includes and is not limited to:

- Electricity supply and street lighting – Ausgrid, Transport for NSW
- Telecommunications – Telstra, NBN, Optus, TPG
- Water and sewer – Hunter Water
- Stormwater – Lake Macquarie City Council, Hunter Water

Details of utilities in the existing environment are provided in Section 3.5.

6.11.2 Potential impacts

6.11.2.1 Construction

Land use and zoning

During construction direct impacts on land use as a result of the proposal would mainly relate to the temporary presence of construction work within the proposal site.

The proposal will result in the partial acquisition of 20 lots, totalling about 11,400 metres squared. Table 6.66 provides a summary of the amount of each land use zoning that would be acquired. The need for property acquisition would be further refined during the detailed design phase.

Temporary leases would be required over some properties for construction activities and temporary construction facilities such as site compounds and stockpile sites. One location has been identified for a proposed temporary construction compound and another for site offices described in Section 3. 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.

This is considered a negligible to minor negative impact on the landowners. The land loss is not expected to impact on the viability of the existing or any future uses of the properties affected in the long-term, with the land to be acquired representing small portions of the overall land holding. Any property leases proposed for use in construction would be done so through agreement and negotiation with landholders and not compulsory.

Changes to land use during construction would be limited to land which is rezoned after acquisition. This would include:

- Land currently zoned as 'low density residential' that would (partially) become part of the SP2 road reserve
- Land currently zoned "environmental conservation" that would (partially) become part of the SP2 road reserve
- Land currently zoned "environmental living" that would (partially) become part of the SP2 road reserve
- Land currently zoned "public recreation" that would (partially) become part of the SP2 road reserve
- Land currently zoned "primary production small lots" that would (partially) become part of the SP2 road reserve

All compounds would be rehabilitated to their pre-existing state upon completion of construction, requiring no permanent changes to land use.

The proposal is unlikely to result in significant change to surrounding land uses, given the relatively minor need for property acquisition is focused on that adjacent Hillsborough Road. All properties affected by changed access arrangements as a result of the proposal would be provided with restored or new permanent access arrangements prior to operation.

Table 6.66: Land use zones impacted by the proposal

Zone	Indicative impacted zone (m^2)*
SP2 Infrastructure	1,767
R2 Low Density Residential	64
C2 Environmental Conservation	8,030
C4 Environmental Living	12
RE1 Public Recreation	1,282
RU4 Primary Production Small Lots	200
B7 Business Park	54

*figures rounded.

Access during construction

Access to residential areas of Cardiff South and Hillsborough, as well as the relevant recreational facilities (i.e. CNCC Showground and Charlestown Golf Club) would be maintained during construction. Where required, temporary property access would be provided. The management of access during construction would be addressed in the TMP required for construction of the proposal.

Whalan's Nurseries site is proposed to be used as a Compound A during construction, subject to agreement and relevant lease requirements with the landowner. Construction access to/from this location would also be addressed in the TMP. The permanent access and egress from the site would be restored to its original state after construction.

Land use and property, including acquisition

The design has identified a number of properties that require partial acquisition to enable the proposal to be constructed. Table 3.8 lists the property acquisitions, type, area, location and reasons. It should be noted that the advice issued in Table 3.8 is preliminary only as the need for property acquisition would be further refined in detailed design.

The acquisition is not expected to impact on the long-term viability of the existing or any future uses of the properties affected, with the land to be acquired representing small portions of the overall land holding.

An overview of property acquisition or adjustments requirements is provided in Section 3.6. Transport would continue to consult with affected landholders before and during construction to minimise the potential for impacts on land use.

Public utilities

Existing utilities would be impacted by the proposal requiring relocation or protection. These are identified in Table 3.7 of Section 3.5.

In addition to relocation or protection, the proposal may also impact on the ability of utility providers to access maintenance locations for their utilities and services. Consultation would allow the public utility authorities to provide input into the most appropriate relocation options for the services and utilities. Consultation with relevant service providers has informed the concept design and would continue with the public utility authorities during the detailed design.

Modifications to the affected utilities would be in accordance with the design and construction methods approved by the relevant utility stakeholder.

Minor property adjustments

The proposal requires physical works within the boundary of 20 private properties, including adjustments to private and business driveway accesses, relocated drainage, relocated utility connections and boundary fencing where affected by the proposal. Any adjustments to properties required for the proposal would be carried out in consultation with the property owner.

6.11.2.2 Operation

The proposal would not result in significant long-term land use impacts. It would require a change of land use for small areas of land to accommodate the proposal, as discussed in construction impacts. Elsewhere, the proposal is located within the road reserve of Hillsborough Road and the local roads of Chadwick Street, Higham Road, Barker Avenue and Crockett Street. These roads would revert to their existing land use during operation.

6.11.3 Safeguards and management measures

The measures described in Table 6.67 will be implemented to avoid or minimise potential impacts on property and land use.

Table 6.67: Property and land use safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Property acquisition	Transport will complete property adjustments including fencing, driveways/accesses and other property infrastructure impacted by the proposal in consultation with affected property owners.	Transport	Detailed design
Property acquisition	All property acquisition will be carried out in consultation with relevant landowner in accordance with the Land Acquisition Information Guide (Roads and Maritime, 2012) and the Land Acquisition (Just Terms Compensation) Act 1991.	Transport	Pre-construction and construction
Utility relocations	Prior to the commencement of works: • The location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners • If the scope or location of proposed utility relocation works falls outside of the assessed proposal scope and footprint, further assessment will be undertaken	Transport	Pre-construction and construction

6.12 Socio-economic

This section summarises the results of the Socio-economic impact assessment (GHD, 2022) (SEIA) that was completed for the proposal by GHD. This section summarises the SEIA which is provided in full at Appendix M.

6.12.1 Methodology

The SEIA was completed in accordance with the Environmental Impact Assessment Practice Note – Socio-economic assessment (EIA-N05) (Transport, 2020) (SEIA Practice Note).

The SEIA Practice Note outlines the requirements for establishing the socio-economic baseline and guides the process for assessing socio-economic impacts of Transport activities. In accordance with the Practice Note, the assessment included the following methodology:

- Definition of the SEIA specific study areas being:
  - SEIA local study area: Comprising the suburbs of Hillsborough, Cardiff South and Warners Bay
  - SEIA regional study area: Comprising the Lake Macquarie LGA.
- Desktop assessment including review of background socio-economic impact assessments
- Identification of the appropriate scope of the SEIA. The appropriate level of socio-economic assessment was identified as 'comprehensive'
- Identification and consultation with local communities and stakeholders who could be affected by the proposal
- Development of a baseline profile of the existing socio-economic environment based on information available from the Australian Bureau of Statistics (ABS), relevant local, regional and State policies and plans, as well as the outcomes of consultation carried out for the proposal
- Assessment of the potential construction, operation and cumulative impacts of the proposal on socioeconomic matters, including an assessment of the significance of these impacts
- Identification of management measures for managing and monitoring the potential socio-economic impacts of the proposal.

The assessment of the significance of socio-economic impacts in accordance with the Practice Note includes consideration of the magnitude of the impact and the sensitivity of the receivers. The criteria for assessing each impact was established based on:

- Magnitude of impact which was made up of scale and intensity, spatial extent and duration
- Sensitivity of affected stakeholders which was defined by the susceptibility or vulnerability of people, receivers or receiving environments to adverse changes caused by the impact, or the importance placed on the matter being affected.

Full details of the SEIA assessment methodology are provided in Appendix M.

6.12.2 Existing environment

Located in the Lake Macquarie LGA, the proposal includes a stretch of Hillsborough Road about 10 kilometres southwest of the Newcastle CBD, which traverses the suburbs of Hillsborough, Cardiff South and Warners Bay. Hillsborough and Cardiff South are predominantly residential areas. Warners Bay is a larger suburb, made up of residential, commercial and industrial areas. The proposal area also borders the suburb of Charlestown, which is a strategic centre within the Hunter Region. Hillsborough Road is a key connection between Newcastle LGA and Lake Macquarie LGA, used frequently by motorists, buses and cyclists (SEIA consultation 2022).

The proposal is located on Awabakal Country and is known as 'Biddabah', meaning 'quiet resting place', and was known for its abundance of food (History of Biddabah, 2022). The area was settled by Europeans in the 1820s, with Hillsborough and Cardiff South settled in the 1870s. Hillsborough Road was initially constructed as an access road between Warners Bay and Charlestown, likely during the 1870s when a mine was operating in the area (History of Lake Mac, 2022).

Table 6.68 presents a summary of key socio-economic indicators for Lake Macquarie LGA. Multiple sources of data have been drawn upon cover specific areas of interest in the demographic profile, including recent estimated populations, population projections and economic development indicators. The key indicators for the regional study area and the local study area were found to be similar and therefore the Lake Macquarie LGA indicators are presented here only. Full details of the local study area indicators are provided in Appendix M.

Table 6.68: Lake Macquarie LGA demographic summary

Data type	Key Statistics
Total population	In 2020, the estimated resident population of Lake Macquarie LGA was 207,775 people (REMPLAN, 2022).
Population projection	The population of Lake Macquarie is expected to increase between by 15.0 per cent from 202,350 people in 2016 to 232,700 people in 2041 (NSW Government, 2016).
Indigenous population	At the time of the 2016 Census, the Indigenous population of Lake Macquarie LGA was 8,032, representing 4.1 per cent of the population (ABS, 2016).
Age profile	At the time of the 2016 Census, Lake Macquarie LGA had a median age of 40 which is higher compared to the NSW state average of 38 years. The largest age cohorts in the LGA being the 35 to 49 cohort (41.0 percent) and 50 to 64 (39.7 per cent) (ABS, 2016).
Cultural diversity	At the time of the 2016 Census, there was a significantly lower proportion of people born in non-English speaking countries living in Lake Macquarie LGA (5.5 per cent) compared to NSW (21.1 per cent). There is a significantly lower proportion of the population who speak a language other than English at home in Lake Macquarie LGA (4.4 per cent) compared to NSW (25.2 per cent). Within Lake Macquarie LGA, the most common languages other than English spoken at home are Mandarin (0.3 per cent), Italian (0.3 per cent), Macedonian (0.3 per cent), German (0.2 per cent) and Spanish (0.2 per cent) (ABS, 2016).
Unemployment	Unemployment in Lake Macquarie LGA between September 2018 and March 2020 has been characterised as relatively stable, sitting between 4.2 per cent and 5.0 percent over this time. From June 2020, Lake Macquarie saw a sharp upturn in unemployment rates, which is consistent with rates of unemployment in NSW and nationally. These rates are broadly understood as an impact from COVID-19. As of June 2021, Lake Macquarie LGA's unemployment rates returned to 5.1 percent, consistent with pre-COVID-19 levels (REMPLAN, 2022).
Advantage/disadvantage	Lake Macquarie LGA has an IRSAD1 of decile 7, indicating a lower level of disadvantage (SEIFA, 2016).
Wellbeing	The proportion of residents in Lake Macquarie LGA (54.0 per cent) feel very safe/safe walking alone in the local area after dark was similar to NSW (53.4 per cent). The estimated proportion of adults residents who have high or very high psychological distress was slightly higher in Lake Macquarie LGA (13.5 per cent) compared to NSW (12.4 per cent). The estimated proportion of the population who were modelled to have 'fair' or 'poor' health in Lake Macquarie LGA (13.5 per cent) was consistent with that of NSW (PHIDU, 2022).

The vast majority of people in the Lake Macquarie LGA use a car to travel to work. Of the 61,601 workers in the LGA, 68.1 per cent also live in the area in 2016 (REMPLAN, 2022). The highest portion of workers travelling to work from outside Lake Macquarie LGA came from Newcastle LGA (18.4% of workers). Most workers travelling to Lake Macquarie LGA drove a car (74.1%), with an additional 4.6 per cent as a passenger in a car (REMPLAN, 2022). This indicates that most workers depend on the road network to travel to and from work in Lake Macquarie LGA.

Within Lake Macquarie LGA, there smaller percentages of other forms of active transport to work including cycling (0.2%) and walking (1.8%) (REMPLAN, 2022). This may indicate that currently places of work are not readily connected from homes to public transport hubs or have well connected local and regional active transport routes.

[1] The ABS produces four socio-economic indices for areas (SEIFA) based on Census data, which identify areas of relative advantage and disadvantage. The Index of Relative Socio-Economic Advantage/Disadvantage (IRSAD) was examined for the social locality (SEIFA, 2016).
The IRSAD divides a population into ten equal groups, called a decile. The lowest scoring 10 per cent of these groups are given a decile number of 1, which indicates the highest level of disadvantage, and the highest scoring 10 per cent of areas are given a decile of 10, which indicates the highest level of advantage.

Social infrastructure

Social infrastructure refers to the facilities, structures and services that support the physical, social, cultural or intellectual development or welfare of the community.

This includes a range of physical facilities, as well as the activities and programs that operate within them. Social infrastructure located within 400 metres of the proposal area and the two compounds include:

- CNCC Showgrounds (subject to partial land acquisition)
- Charlestown Golf Club (subject to partial land acquisition)
- Hillsborough Oval and playground (~300 metres)
- Ulinga Oval (~300 metres)
- Great North Walk (~300 metres)
- Newcastle Junior School (~200 metres)
- Hillsborough Public School (~200 metres)
- NSW Ambulance – Cardiff South (~100 metres)

Key baseline information relevant to the SEIA include:

- The proposal area covers a section of Hillsborough Road that includes residential dwellings in Hillsborough, several businesses, and a business park.
- Hillsborough Road provides the only access to the residential area of Hillsborough suburb (via Chadwick Street and Higham Road).
- The Charlestown Golf Club, Shed Quarters and CNCC Showgrounds are located within or adjacent to the proposal area.
- There is bushland immediately south of the proposal area, which includes a section of the Great North Walk and other walking/cycling tracks, parts are owned by the Awabakal LALC. The Hillsborough Firetrail provides RFS access to the conservation area from Hillsborough Road. This area is visited by locals and visitors for bushwalking.
- Cardiff South has a higher level of disadvantage compared to the other suburbs within the study area and the Lake Macquarie LGA.

6.12.3 Potential impacts

6.12.3.1 Construction

Property and land use

The proposal would require partial land acquisition of a very small area at two residential properties along Hillsborough Road, and at non-residential properties, including the CNCC Showgrounds, Shed Quarters, and Warners Bay Home commercial centre. Partial land acquisition would lead to construction activities and road infrastructure moving closer to yards or residences. Residents may experience a loss of amenity in these areas.

For some businesses, this may lead to reduced areas for parking. Some businesses may be less able to adapt due to the specialised requirements for parking (i.e. caravan and trailers at CNCC Showgrounds, and large utility vehicles at Shed Quarters). This may be inconvenient to some visitors and employees at these businesses.

The proposal would also require partial land acquisition of land zoned Environmental Conservation, owned by the Awabakal LALC. This would include removal of native vegetation.

Construction of the proposal would also require temporary leasing of land, or other arrangement for temporary use of land for compounds such as construction compounds. Lease agreements will be done in consultation with the land owner prior to the commencement of construction.

Access and connectivity

During construction, there would be changes to access and connectivity in the area, including:

- Temporary lane closures and speed zone reductions along Hillsborough Road may increase travel time for road users.
- Temporary impact on access to some residential driveways during construction, which may inconvenience some residents.

- Temporary impact to access for businesses along the southern side of Hillsborough Road. Employees, customers, and delivery drivers may experience delays when accessing businesses on the southern side of Hillsborough Road.
- Impact to access to the fire trail access track entrance located on Hillsborough Road just east of Barker Avenue.
- Intersection upgrades at Crockett Street, Higham Road, Barker Avenue and Chadwick Street, upgrades and temporary relocations to bus stops and construction of the shared pathway may lead to increased travel times for pedestrians and cyclists due to narrowing of travel lanes, shoulders and verges.
- Delays to public transport services and school buses due to construction activities such a speed reductions and lane narrowing.

Amenity and character

During construction, potential changes to amenity and character in the area, include but are not limited to the following:

- Increased noise from construction activities may be a nuisance to some residents, and also be disruptive to businesses, and also be a nuisance to customers. Further details on noise impacts are outlined Section 6.7.
- Dust generated from construction activities may impact air quality on nearby residential areas. Vulnerable residents, such as older people, children and people with medical conditions such as asthma, may be more sensitive to dust. Further details on air quality impacts are outlined in Section 6.6.
- Residents on Hillsborough Road would be able to view construction activities. This may lead to some residents reducing use or enjoyment of outdoor areas. Further details on Landscape and visual character impacts are outlined in Section 6.10.
- Residents on Hillsborough Road would experience changes to visual surroundings as a result of vegetation removal. Further details on Landscape and visual character impacts are outlined in Section 6.10.

Economy, employment and business

The following changes may occur as a result of the construction of the proposal:

- Combined changes to parking, traffic, and access from construction activities may reduce amenity and impact customers at businesses along Hillsborough Road
- Potential increase in employment opportunities due to 35 to 40 construction employment opportunities
- Potential demand for local food and beverage and retail services close to the proposal to increase due to construction workers spending their wages.

Summary

During construction, the community and road users are likely to experience temporary traffic delays, temporary construction impacts of minor noise, dust, visual and general amenity impacts. Measures have been proposed in the REF to minimise these impacts. The construction phase of the proposal would create jobs. Once complete, improved connectivity and reduced travel times would contribute to business productivity improvements and enhance business opportunities in the area. Upgrades to active transport would improve access to local schools, shops and recreation areas.

All negative construction related socio-economic changes identified in the SEIA were assessed as ranging from Negligible to Low-Moderate. A number of positive construction related changes were identified also, including job creation and increased opportunities for local businesses.

6.12.3.2 Operation

The new arrangements would allow for safer vehicle movements and remove the potential unsafe turning movements (right turn in and out) across oncoming traffic. The road duplication would provide a safer road for motorists by the provision of overtaking lanes, a traffic light at Crockett and Chadwick streets as well as other road and safety improvements.

All negative operational related socio-economic changes identified in the SEIA were assessed as ranging from negligible with the exception of visual impacts to residents which was assessed low-medium, as it is a permanent change from the existing baseline conditions. A number of positive operation related changes were identified also, including improved travel times, road safety, improved access for businesses and recreational facilities (CNCC Showground and Charlestown Golf Club) and reduced congestion on Hillsborough Road.

Access and connectivity

During operation, the following changes to access and connectivity may occur:

- During operation the proposal will provide additional lane capacity, facilitating overtaking and turning movements, and reduce congestion and may improve travel times. This results in road users gaining better access to essential services, schools and recreation.
- Traffic flow improvements would have the potential to benefit emergency service response times if they are required to travel through the area.
- Traffic at the intersections at Chadwick Street and Crockett Street would provide safer access to Hillsborough Road from the suburbs of Hillsborough and Cardiff South.
- The new road design would remove right in/right out access, and hence provide a left in/left out only access for businesses on the southern portion of Hillsborough Road, this would provide safer access to these properties.
- The Higham Road intersection with Hillsborough Road would be partially closed to provide left out only access to Hillsborough Road, which may slightly increase travel time for some residents.
- Formalised intersections would provide improved pedestrian access to bus stops along Hillsborough and Crockett Street. New facilities at bus stops, such as shelters may provide more comfort for public transport users.
- Improved accessibility for active transport users due to new shared pathways and better cycling network connections.

Amenity and character

The Higham Road intersection with Hillsborough Road would be partially closed to provide left out only access to Hillsborough Road, and remove access from Hillsborough Road directly on to Higham Road, which may reduce numbers of vehicle movements along this street.

Residents on Hillsborough Road would experience changes to visual surroundings as a result of new road infrastructure, in particular those close to the new intersections and where any vegetation removal has occurred. This may alter some views from windows and frontages and may decrease amenity in these areas.

6.12.4 Safeguards and management measures

The measures described in Table 6.69 will be implemented to avoid or minimise potential socio-economic impacts.

Table 6.69: Socio economic safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Communication Plan	A Construction Communication Plan (CCP) will be prepared and implemented as part of the CEMP to ensure provision of timely and accurate information to the community during construction. The CP will include (as a minimum): • Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions • OOHW Protocol • Contact name and number for complaints. The CP will be prepared in accordance with the RMS Community Involvement and Communications Resource Manual.	Transport, Contactor	Detailed design/ pre-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
Impacts to local residents and businesses	A C&SES will be prepared and continue to be updated during the project to ensure the following: • Community and stakeholders have a high level of awareness of all processes and activities • Accurate and accessible information is made available • A timely response is given to issues and concerns raised by the community. Feedback from the community is encouraged • Opportunities for input are provided.	Transport, Contractor	Pre-construction, Construction
Engagement	Ongoing engagement with affected business owners and employees should be undertaken to: • Understand and address specific business impacts • Identify potential changes to customer behaviours resulting from the proposal • Manage potential vehicle access changes. The C&SES would continue to align with the focus area to partner with communities as set out in the Transport Sustainability Plan.	Transport, Contractor	Pre-construction, Construction

Impact	Environmental safeguards	Responsibility	Timing
Property acquisition plan	Consultation will be carried out with each landowner and resident throughout the acquisition process, in accordance with Transport policy and the *Land Acquisition (Just Terms Compensation) Act 1991*.	Transport, Contractor	Pre-construction, Construction
Local and Indigenous employment and procurement	Aligned with Transport's Aboriginal Participation Strategy and Transport's Transport Sustainability Plan Transport has committed to prioritising opportunities for Indigenous workers and procurement in its proposals in line with the NSW's Governments Aboriginal Procurement Policy.	Transport, Contractor	Pre-construction, Construction

6.13 Other impacts

This section summarises the assessment of other impacts for the proposal.

6.13.1 Existing environment and potential impacts

Environmental factor	Existing environment	Potential impacts
Resource use and waste management	The existing operation of Hillsborough Road generates small quantities of waste including roadside litter and excess materials from maintenance activities. The nearest waste disposal locations to the construction footprint are: • Summerhill Waste Management Centre, which is accessed off Minmi Road in Wallsend • Solo Resource Recovery which is located on Oakdale Road in Gateshead, about 4 km south-east of the site.	Section 3.3 describes the resources that would be needed to build the proposal. These resources are common materials, and their use would not result in a resource supply shortage in the region. Waste generated during construction would likely include: • Excess building material (e.g. concrete, asphalt, steel) or excavated natural material. • Packing materials (pallets, crates, plastics). • Food waste and general site waste and litter. • General wastewater from facilities, vehicle wash down and dust suppression. • Wastewater from bridge hydro demolition, bridge washing activities, piling, grouting, geotechnical investigations, and rock drilling activities. This wastewater may potentially be alkaline and contain residual chemicals (oils lubricants, waste fuels, batteries). • Green waste (trees and other vegetation). The waste generated would either be recycled or disposed offsite in accordance with the waste hierarchy and the relevant waste classification. Any impact associated with waste and resource use during operation of the proposal would be negligible and largely consistent with the existing operation of the road.
Utilities	Existing utilities within the construction footprint including optical fibre conduits and electrical infrastructure have been identified and located as part of the concept design (refer to Section 3.5).	The strategy for the protection or relocation of existing utilities within the construction footprint would be carried out in consultation with the relevant utility owner during detailed design to minimise the risk of damaging utilities, which may cause network outages or safety hazards. Access to utilities along Hillsborough Road would be maintained for utility providers during construction. Further discussion on utilities is included in Section 6.11.

Environmental factor	Existing environment	Potential impacts
Hazard and Risk	Hazards and risks relating to the construction of the proposal would include: • Spills or leakage of contaminants such as fuels, chemicals and hazardous substances entering surface and groundwater or contaminating soils • Discharge of turbid run-off, resulting in pollution of waterways • Encountering unexpected utilities or contaminated material during earthworks • Spread of noxious weeds • Flooding during extreme rain events • Fire from offsite or caused as a result of construction activities such as hot works • Changed traffic conditions leading to incidents.	These potential impacts have been addressed in other sections of this REF, including: • Biodiversity (refer Section 6.1) • hydrology and flooding (refer Section 6.2) • Surface water and groundwater (refer Section 6.3) • Soils and contamination (refer Section 6.4) • Traffic and transport (refer Section 6.5). In relation to potential fires during construction these would be managed by restrictions to hot works on site as part of the construction works. No hot works would be undertaken during period of total fire ban. Construction risks would be temporary and managed with the relevant safeguards and management measures outlined in the sections referenced above.

6.13.2 Safeguards and management measures

The measures described in Table 6.70 will be implemented to avoid or minimise potential other impacts.

Table 6.70: Other impact safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Waste	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to: • Measures to avoid and minimise waste associated with the project • Classification of wastes and management options (re-use, recycle, stockpile, disposal) • Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal • Monitoring, record keeping and reporting. The WMP will be prepared taking into account the *Environmental Procedure - Management of Wastes on Roads and Maritime Services Land* (Roads and Maritime, 2014) and relevant Roads and Maritime Waste Fact Sheets.	Contractor	Detailed design/ pre-construction
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 • If the scope or location of proposed utility relocation work falls outside of the assessed proposal scope and footprint, further assessment will be undertaken.	Contractor	Detailed design/ pre-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: • Details of hazards and risks associated with the activity • Measures to be implemented during construction to minimise these risks • Record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials • A monitoring program to assess performance in managing the identified risks • Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations • No hot work during periods of total fire ban (TOBAN). The HRMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or Office of Environment and Heritage publications.	Contractor	Detailed design/ pre-construction
Hazards and risk management	Emergency response plans will be incorporated into the construction environmental management plan (CEMP).	Contractor	Pre-construction, construction

6.14 Cumulative impacts

6.14.1 Study area

Cumulative impacts could be experienced if construction operation of the proposal coincides with construction or operation of other local development, such as other upgrades, public work or private development.

A desktop review of the major project register on the DPE website completed on 1 September 2022 identified major projects within the Lake Macquarie and City of Newcastle LGA which have the potential to contribute to cumulative impact with the proposal. These projects are listed in Table 6.71.

6.14.2 Broader program of work

Construction of the proposal is planned to be delivered in stages. The NSW Government has announced $35 million to deliver the first stage of the Hillsborough Road Upgrade. Stage 1 involves upgrading Crockett Street intersection, including installation of traffic lights. Stage 1 is expected to commence construction in 2025 and take about 18 months to complete depending on final staging arrangements.

Timing for construction of the remaining stages is subject to project approvals and funding.

Refer to Table 6.71 for additional information.

6.14.3 Other projects and developments

Table 6.71 provides a summary of other identified projects in the vicinity of the proposal and their potential to result in cumulative impacts.

Table 6.71: Past, present and future projects

Project	Construction impacts	Operational impacts
Charlestown Private Hospital and Medical Centre (SSD-35241384) Subject to assessment and approval	Construction impacts of the Charlestown Private Hospital may include: • Traffic congestion affecting Smith Street, Fredrick Street, and the Pacific Highway during standard construction hours • Construction noise exceeding the noise criteria for commercial buildings and residences on Smith Street, Fredrick Street, and the Pacific Highway.	Operational impacts of the Charlestown Private Hospital and Medical Centre project may include: • An increase in traffic in the Charlestown area (particularly Smith Street, Fredrick Street, and the Pacific Highway) as well as commute to and from the Charlestown Private Hospital area during operating hours.
Alesco Senior College, Charlestown (SSD-10478). Project has been approved.	Construction impacts of the Alesco Senior College development may include: • Traffic congestion affecting Charlestown Road and the Pacific Highway during standard construction hours • Construction noise exceeding the noise criteria for commercial buildings and residences on Charlestown Road and the Pacific Highway.	Operational impacts of the project may include: • An increase in traffic in the Charlestown area, including commute to and from the Alesco Senior College • Visual impacts of the new buildings.

Project	Construction impacts	Operational impacts
NICB – Rankin Park to Jesmond (SSI – 6888). Approved. Construction underway.	Construction impacts of the NICB Rankin Park to Jesmond Project development may include: • Traffic congestion affecting NICB and potentially Hillsborough Road during standard construction hours • Construction noise exceeding the noise criteria for residences on NICB. Given the distance between the two projects (i.e. about 1.5 km) It is considered unlikely that cumulative construction related impacts will occur in the vicinity of Hillsborough.	Operational impacts of the project may include: • An increase in traffic in Hillsborough Road due to increased use of NICB.
John Hunter Health and Innovation Precinct (SSD-9351535) Approved. Construction underway.	Construction impacts from: • New acute services building • Refurbishment of existing buildings • New hospital entry canopy and drop off zone • Link bridge to the Hunter Medical Research Institute • Landscaping, earth works, mine grouting, road, building services and utilities Given the distance between the two projects (i.e. about 4 km) It is considered unlikely that cumulative construction related impacts will occur in the vicinity of Hillsborough.	Cumulative operational impacts are considered negligible.

6.14.4 Potential impacts

The construction of Stage 1 of proposal is expected to commence 2025 and is anticipated to finish in about 18 months. The extent of potential cumulative impacts can only be assessed in regard to project information and schedules available at the time.

6.14.4.1 Construction

Cumulative impacts could occur where construction of the proposal and other developments are being carried out in parallel. The key cumulative impacts during construction could include:

- Increased construction vehicle traffic on local roads
- Cumulative air and noise impacts associated with multiple construction activities
- Temporary changes to visual amenity.

Potential cumulative impacts would be temporary and environmental safeguards and management measures would be implemented as appropriate.

The severity of potential cumulative impacts would vary between locations and would generally be dependent on the types of work being carried out, the timing and duration of the work relative to each other, the distance between the work and the receivers and sensitivity of the receiver.

The nominated road projects may have the potential to cause cumulative construction traffic delays at other locations on the NICB if they are constructed at the same time as the proposal. With detailed construction traffic management plans in place to manage the cumulative impacts of these projects individually it is considered these impacts would be minor.

6.14.4.2 Operation

The proposal, combined with other approved and proposed road upgrade projects would result in cumulative traffic benefits on the NICB and surrounds through the increased capacity of the road network, improved traffic flow and journey times and improved road safety.

6.14.5 Safeguards and management measures

The majority of cumulative impacts would be mitigated and managed by the safeguards and management measures outlined throughout Section 6 of this REF and summarised in Table 7.1.

7 Environmental management

7.1 Environmental management plans

A number of safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Construction Environmental Management Plan (CEMP) will be prepared to describe the safeguards and management measures identified. The CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The CEMP will be prepared prior to construction of the proposal and must be reviewed and certified by the Transport Environment Officer, Hunter Region, 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 and PEMP would be developed in accordance with the specifications set out in the: QA Specification *G36 – Environmental Protection (Management System)*, QA Specification *G38 – Soil and Water Management (Soil and Water Plan)*, QA Specification *G40 – Clearing and Grubbing*, QA Specification *G10 – Traffic Management.*

7.2 Summary of safeguards and management measures

Environmental safeguards and management measures outlined in this REF will be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards and management measures will minimise any potential adverse impacts arising from the proposed works on the surrounding environment. The safeguards and management measures are summarised in Table 7.1.

Table 7.1: Summary of safeguards and management measures

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity					
1	Impacts to native flora and fauna	A Flora and Fauna Management Plan will be prepared and implemented as part of the Construction Environmental Management Plan (CEMP). It will address impacts to flora and fauna and include, but not necessarily be limited to: (a) plans for the construction site and adjoining area showing native vegetation, flora and fauna habitat, threatened species and ecological communities (b) plans showing areas to be cleared and areas to be protected, including exclusion zones and protected habitat features (e.g. Hollow-bearing trees), and areas for rehabilitation or re-establishment of native vegetation (c) requirements set out in the RTA Landscape Guideline (d) procedures addressing relevant matters specified in the *Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects.*	Transport/Contractor	Prior to construction	B1
2		Development and implementation of a Biodiversity Offset Strategy to facilitate offsetting of impacts that exceed the thresholds within the No Net Loss Guidelines (Transport, 2022b).	Transport	Prior to construction	B6
3		Prepare a Tree and Hollow Replacement Plan including the calculation of replacement trees and hollows in accordance with the Tree and Hollow Replacement Guidelines (Transport 2022c). Tree and Hollow replacement Plan will outline requirements for onsite replacement and/or equivalent payment to the Transport Conservation Fund.	Transport	Prior to construction	B6

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
4	Removal of native vegetation	Impacts to biodiversity will be minimised through detailed design, where practical and demonstrated within the Detailed Design report.	Transport	Detailed design	B3
5	Fragmentation of identified habitat corridors	A fauna connectivity strategy would be developed during the detailed design stage in accordance with the draft Roads and Maritime Wildlife Connectivity Guidelines (Roads and Maritime 2011c). The strategy is to focus on maintaining connectivity through the proposal and is to include, but not be limited to: (a) provision of fauna crossings and locations, particularly where canopy gaps are greater than 50 metres (b) identification of trees suitable for retention (c) consideration of construction footprint requirements (d) consideration of traffic noise and artificial lighting impacts at crossing points.	Transport/Contractor	Detailed design, during construction and post construction	B7
6	Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Transport/Contractor	During construction	B9
7	Injury and mortality of fauna	Fauna will be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Transport/Contractor	During construction	B11
Hydrology and flooding					
8	Flood Mitigation	Detailed design of Winding Creek culvert extensions to further minimise flooding impacts to flood depths on the west bound travel lane, where practical.	Transport	Detailed design, Construction, Operation	Additional Mitigation Measure from Surface and Groundwater Assessment
9	Flood Management Plan	A Construction Flood management plan to be prepared as part of the CEMP. The FMP will address but not necessarily be limited to: • Processes for monitoring and mitigating flood risk during construction • Monitoring of weather and rainfall conditions • Steps to be taken in the event of a flood warning/ very high rainfall including stop work periods.	Transport, construction contractor	Detailed design, Construction, Operation	Additional Mitigation Measure from Surface and Groundwater Assessment

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
10	Construction methodology	Construction methodology is to be developed which maintains the existing capacity of drainage within the proposal area.	Transport	Detailed design, Construction, Operation	Additional Mitigation Measure
Surface and groundwater					
11	Soil & Water	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction. The SWMP will include monitoring required for the proposal.	Contractor	Detailed design / pre-construction	Section 2.1 of QA G38 *Soil and Water Management*
12		A site-specific Progressive Erosion and Sediment Control Plan/s will be prepared and implemented as part of the Soil and Water Management Plan. Erosion and sediment control measures are to be designed, implemented and maintained in accordance with the Blue Book (DECC 2008). The Plan will include arrangements for managing wet weather events, including monitoring of potential high-risk events (such as storms) and specific controls and follow-up measures to be applied in the event of wet weather.	Contractor	Detailed design / pre-construction	Section 2.2 of QA G38 *Soil and Water Management*
13	Disturbance of creek beds and banks	A detailed Environmental Work Method Statement (EWMS) will be prepared and implemented as part of the SWMP for all works undertaken within waterways. The EWMS will detail measures to avoid or minimise risks from erosion and sedimentation to water quality and biodiversity. It will be prepared in accordance with relevant guidelines including, but not limited to: • RMS Biodiversity Guidelines – Protecting and managing biodiversity on RTA projects • Construction staging and consideration of temporary drainage and diversions to maintain capacity. The EWMS will consider any temporary access points required to be installed for construction access to waterways for construction works.	Contractor	Pre-construction	SW13
		Batters will be designed and constructed to minimise risk or exposure, instability and erosion, and to support long-term, on-going best practice management, in accordance with the RMS Guideline for Batter Stabilisation Using Vegetation (April 2015).	Contractor	Pre-construction, Construction	SW15

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
14	Chemical or hydrocarbon spills	Prepare a spill emergency management plan that would be included in the SWMP. Including: • Storage of hazardous goods and refuelling activities to take place in bunded areas. • Parking of vehicles and storage of plant/equipment is to occur on existing paved areas. Where this is not possible, vehicles and plant/equipment are to be kept away from environmentally sensitive areas and outside the dripline of trees. • Open drainage channels provided through construction areas will be protected by appropriate spill management measures such as bunding to prevent any spills and leaks to stormwater drainage networks. • Monitor spill management measures at specified intervals during the construction period. These include checks of the location of stored materials and of the condition of containers and bunding.	Contractor	Pre-construction, Construction	QA G38 Soil and Water Management SW3
15	Dewatering	A detailed Environmental Work Method Statement (EWMS) will be prepared and implemented as part of the SWMP for all dewatering activities. The EWMS will detail measures to avoid or minimise risks from potential offsite water quality impacts. Any dewatering activities will be undertaken in accordance with the RTA Technical Guideline: Environmental management of construction site dewatering in a manner that prevents pollution of waters.	Contractor	Pre-construction, Construction	G38 3.4 SW10
16		If groundwater is encountered during excavations potential adverse impacts would be minimized through the implementation of the measures identified in the RTA Technical Guideline: Environmental management of construction site dewatering, where applicable.	Contractor	Pre-construction, Construction	Additional measure

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
17	Soil stabilisation and restoration	The rehabilitation of disturbed areas will be undertaken progressively as construction stages are completed, and in accordance with: • Landcom's Managing Urban Stormwater: Soils and Construction series • RTA Landscape Guideline • RMS Guideline for Batter Stabilisation Using Vegetation (draft June 2014).	Contractor	Construction	SW15
Soils, geology and contamination					
18	Stockpiles	Stockpiles will be designed, established, operated and decommissioned in accordance with the RTA Stockpile Site Management Guideline 2011.	Contractor	Construction	SW9
19	Topsoil Management	Topsoil will be stockpiled in cleared in existing disturbed areas and managed in accordance with the RTA Stockpile Site Management Guideline until: • If not suitable or not required for use in future rehabilitation or revegetation works – it is removed from the construction site and disposed of an appropriately licensed facility, OR • If suitable and required for future use – it is re-used • Beneficial re-use under waste exemption or DA.	Contractor	Construction	SW14
20	ASSMP	Acid Sulfate Materials Management Plan will be prepared and implemented as part of the CEMP, if greater than 1000 tonnes of potential acid sulphate soil material is to be disturbed. The Plan will be prepared in accordance with the RTA Guidelines for the Management of Acid Sulfate Materials.	Contractor	Pre-construction, Construction	SW4

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
21	Rehabilitation	A rehabilitation plan will be prepared covering all areas disturbed as part of the proposal and will include the following: • Progressive stabilisation and rehabilitation of construction areas back to the original condition or re-vegetated with appropriate native species, as soon as practicable. • Rehabilitation of riparian areas (i.e. within 40 m from the highest bank on relevant waterways) and meets the requirements of Guidelines for Controlled Activities on Waterfront Land; Guidelines for Riparian Corridors on Waterfront Land. This may include fencing of riparian areas being rehabilitated. • Monitoring to meet clear targets in relation to vegetation establishment and stabilisation of disturbed areas.	Contractor	Pre-construction, construction and post-construction	Additional measure
22	Pre / Post Construction Land Condition Assessment	Land condition assessments will be completed for each compound area intended to be leased.	Transport	Pre-construction, construction and post-construction	G36 4.15.2
Traffic and Transport					
23	Construction traffic	A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the RMS Traffic Control at Work Sites Manual and the worksite manual RMS Specification G10. The TMP will include but is not limited to: • Community notification in accordance with the RTA's Community Involvement and Communications Resource Manual • 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 maintain pedestrian and cyclist access • Requirements and methods to consult and inform the local community of impacts on the local road network • Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads • A response plan for any construction traffic incident	Transport / Contractor	Preconstruction, Construction	TT2

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • Monitoring, review and amendment mechanisms.			
24	Property Access	Requirements for any changes to local access arrangements will be confirmed during detailed design in consultation with the local road authority and any affected landowners.	Transport	Pre construction	TT3
25	Impacts to bus services	Consult with bus companies regarding the relocation and temporary closure of bus stops and temporary access arrangements.	Transport	Detailed design	Additional measure
26	Impacts on Emergency Services	Undertake consultation with emergency services prior to and during construction to confirm any diversions during construction and any operational road network changes.	Transport	Pre construction, Construction	Additional measure
27	Pedestrian and cyclist access	Safe pedestrian access to bus stops and cyclist access through Hillsborough Road will be maintained throughout construction.	Transport	Pre construction, Construction	Additional measure
28	Access to properties	Disruptions to property access and traffic will be notified to landowners prior to changes to access in accordance with the relevant Transport Project Construction community consultation processes outlined in Manager the Traffic Management Plan (TMP).	Contractor	Construction	Additional measure

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Air Quality					
29	General air quality impacts	An Air Quality Management Plan will be prepared and implemented as part of the CEMP. The Plan will identify: • Potential sources of air pollution (such as dust, vehicles transporting waste, plant and equipment) during construction • Air quality management objectives consistent with any relevant published EPA and/or OEH guidelines • Mitigation and suppression measures to be implemented, such as spraying or covering exposed surfaces, provision of vehicle clean down areas, covering of loads, street cleaning, use of dust screens, maintenance of plant in accordance with manufacturer's instructions • Methods to manage works during strong winds or other adverse weather conditions • A progressive rehabilitation strategy for exposed surfaces • When the air quality, suppression and management measures need to be applied, who is responsible, and how effectives will be assessed • A monitoring program to record whether the air quality mitigation, suppression and management measures have been applied; and assess the effectiveness of the applied measures • Community notification and complaint handling procedures.	Contractor	Pre- Construction	Section 4.4 of QA G36 Environment Protection AIR1

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Noise and Vibration					
30	Noise and vibration	A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in *the Interim Construction Noise Guideline (ICNG) (DECC, 2009*) and identify: • All potential significant noise and vibration generating activities associated with the activity • Feasible and reasonable mitigation measures to be implemented, taking into account *Beyond the Pavement: urban design policy, process and principles* (Transport, 2014) • A monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.	Contractor	Detailed design/ Pre-construction	Section 4.6 of QA *G36 Environment Protection* NOISE1
31	Noise and vibration	All sensitive receivers (e.g. schools, local residents) likely to be affected will be notified at least 7 days prior to commencement of any work associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • The proposal • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information.	Contractor	Detailed design/ pre-construction	NOISE3
32	Site Inductions	All personnel working on site will receive awareness training as part of the site induction package for their requirements within the Noise and Vibration Management Plan. The site induction will include reasonable and feasible behavioural practices as identified in the ICNG.	Contractor	Pre-Construction / Construction	Additional measure
33	Plant and equipment noise	Use quieter and less vibration emitting construction methods where feasible and reasonable.	Contractor	Pre-Construction / Construction	Additional measure

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
34	Operational noise	The proposal will consider noise attenuation measures (such as: architectural treatments) for all eligible properties identified as being impacted by operational traffic noise.	Transport	Detailed design	Additional measure
35	Vibration impacts to buildings	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.	Transport/Contractor	Pre-Construction / Construction	Additional measure
36	Operational noise	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. 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	Additional measure
Aboriginal Heritage					
37	Aboriginal heritage	An Aboriginal Heritage Management Plan (AHMP) will be prepared in accordance with the Procedure for Aboriginal cultural heritage consultation and investigation (Transport, 2012) and implemented as part of the CEMP. It will provide specific drafting guidance on measures and controls to be implemented for managing and avoiding impacts on Aboriginal heritage.	Contractor	Detailed design / Pre-construction	Section 4.9 of QA *G36 Environment Protection*
38	Aboriginal Heritage	The AHMP must include measures to identify nearby PADs and registered site and/or conserve with high visibility fencing during works for the following; • Hillsborough Rd IA 01 (AHIMS ID 38-4-2007) • Hillsborough Rd PAD 2021-01 (AHIMS ID 38-4-2132) • HillsboroughRd PAD 2021-02 (AHIMS ID 38-4-2131).	Contractor	Pre-construction	Additional measure
39	Site induction	All personnel working on site will receive training to ensure awareness of requirements of the Aboriginal Heritage Management Plan and relevant statutory responsibilities. Site-specific training will be given to personnel when working in the vicinity of identified Aboriginal heritage items.	Contractor	Pre-construction	GEN3

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
40	Unexpected finds	The Standard Management Procedure - Unexpected Heritage Items will be followed in the event that a known or potential Aboriginal object(s), including skeletal remains, is found during construction. This applies where RMS does not have approval to disturb the object(s) or where a specific safeguard for managing the disturbance (apart from the Procedure) is not in place. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contractor	Pre-construction	Section 4.9 of QA *G36 Environment Protection*
Non-Aboriginal Heritage					
41	Non-Aboriginal heritage	Should any heritage items, archaeological remains or potential relics of Non-Aboriginal origin be encountered, then construction work that might affect or damage the material will cease and notification provided to the relevant RMS officer identified in the RMS Standard Management Procedure - Unexpected Archaeological Finds. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contactor	Detailed design/pre-construction	Section 4.10 of QA *G36 Environment Protection*
Landscape Character and Visual Impact					
42	Best Practice Urban Design	An Urban Design Plan will be prepared to support the final detailed project design and implemented as part of the CEMP. The Plan will present an integrated urban design for the project, providing practical detail on the application of design principles and objectives identified in the environmental assessment. The Plan will include design treatments for: • Location and identification of existing vegetation and proposed landscaped areas, including species to be used (cross-referencing any relevant specified biodiversity safeguards) • Design and location of replacement trees • Built elements including retaining walls • Pedestrian and cyclist elements including footpath location, paving types and pedestrian crossings • Street furniture • Details of the staging of landscape works • Procedures for monitoring and maintaining landscaped or rehabilitated areas.	Contractor	Pre construction	UD1

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		The Plan will be prepared in accordance with relevant guidelines, including: • *RMS Beyond the Pavement urban design policy, process and principles* • *RMS Landscape Guideline, Bridge Aesthetics, Noise Wall Design Guidelines and Shotcrete Design Guideline.*			
43	Construction work sites	Project work sites, including construction areas and supporting facilities (such as storage compounds and offices) will be managed to minimise visual impacts, including appropriate storage of equipment, parking, stockpile screening and arrangements for the storage and removal of rubbish and waste materials.	Contractor	Pre construction, construction	UD2
Property and land use					
44	Property acquisition	Transport will complete property adjustments including fencing, driveways/accesses and other property infrastructure impacted by the proposal in consultation with affected property owners.	Transport	Detailed design	Additional measure
45	Property acquisition	All property acquisition will be carried out in accordance with the Land Acquisition Information Guide (Roads and Maritime, 2012) and the Land Acquisition (Just Terms Compensation) Act 1991.	Transport	Pre-construction and construction	Additional measure
46	Utility relocations	Prior to the commencement of works: • The location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners. • If the scope or location of proposed utility relocation works falls outside of the assessed proposal scope and footprint, further assessment will be undertaken.	Transport	Pre-construction and construction	UT1

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
Socio-economic					
47	Communication Plan	A Construction Communication Plan (CCP) will be prepared and implemented as part of the CEMP to ensure provision of timely and accurate information to the community during construction. The CP will include (as a minimum): • Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions • OOHW Protocol • Contact name and number for complaints. The CP will be prepared in accordance with the RMS Community Involvement and Communications Resource Manual.	Transport, Contactor	Detailed design/ pre-construction	SE1
48	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	SE2
49	Impacts to local residents and businesses	A C&SES will be prepared and continue to be updated during the project to ensure the following: • Community and stakeholders have a high level of awareness of all processes and activities • Accurate and accessible information is made available • A timely response is given to issues and concerns raised by the community. Feedback from the community is encouraged • Opportunities for input are provided.	Transport, Contractor	Pre-construction, Construction	Additional measure
50	Engagement	Ongoing engagement with affected business owners and employees should be undertaken to: • Understand and address specific business impacts • Identify potential changes to customer behaviours resulting from the proposal • Manage potential vehicle access changes. The C&SES would continue to align with the focus area to partner with communities as set out in the Transport Sustainability Plan.	Transport, Contractor	Pre-construction, Construction	Additional measure

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
51	Property acquisition plan	Consultation will be carried out with each landowner and resident throughout the acquisition process, in accordance with Transport policy and the *Land Acquisition (Just Terms Compensation) Act 1991*.	Transport, Contractor	Pre-construction, Construction	Additional measure
52	Local and Indigenous employment and procurement	Aligned with Transport's Aboriginal Participation Strategy and Transport's Transport Sustainability Plan Transport has committed to prioritising opportunities for Indigenous workers and procurement in its proposals in line with the NSW's Governments Aboriginal Procurement Policy.	Transport, Contractor	Pre-construction, Construction	Additional measure
Other Impacts					
53	Waste	A Waste Management Plan (WMP) will be prepared and implemented as part of the CEMP. The WMP will include but not be limited to: • Measures to avoid and minimise waste associated with the project • Classification of wastes and management options (re-use, recycle, stockpile, disposal) • Statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • Procedures for storage, transport and disposal • Monitoring, record keeping and reporting. The WMP will be prepared taking into account the *Environmental Procedure - Management of Wastes on Roads and Maritime Services Land* (Roads and Maritime, 2014) and relevant Roads and Maritime Waste Fact Sheets.	Contractor	Detailed design/ pre-construction	Section 4.2 of QA *G36 Environment Protection*
54	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 • If the scope or location of proposed utility relocation work falls outside of the assessed proposal scope and footprint, further assessment will be undertaken.	Contractor	Detailed design/ pre-construction	Additional measure

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
55	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: • Details of hazards and risks associated with the activity • Measures to be implemented during construction to minimise these risks • Record keeping arrangements, including information on the materials present on the site, material safety data sheets, and personnel trained and authorised to use such materials • A monitoring program to assess performance in managing the identified risks • Contingency measures to be implemented in the event of unexpected hazards or risks arising, including emergency situations • No hot work during periods of total fire ban (TOBAN). The HRMP will be prepared in accordance with relevant guidelines and standards, including relevant Safe Work Australia Codes of Practice, and EPA or Office of Environment and Heritage publications.	Contractor	Detailed design/ pre-construction	Additional measure
56	Hazards and risk management	Emergency response plans will be incorporated into the construction environmental management plan (CEMP).	Contractor	Pre-construction, construction	Additional measure

7.3 Licensing and approvals

Table 7.2 provides a summary of the notifications, licences and approvals required by the proposal prior to the start of construction or start of certain activities. These should be reviewed during and following the completion of detailed design to confirm is they are still applicable.

Table 7.2: Summary of licensing and approvals required

Instrument	Requirement	Timing
Fisheries Management Act 1994 (s199)	Notification to the Minister for Lands and Water prior to any dredging or reclamation works	A minimum of 28 days prior to the start of work
Mine Subsidence Compensation Act 1961	Approval to alter or erect improvements or to subdivide land within a mine subsidence district from the Mine Subsidence Board	Prior to start of the activity
Roads Act 1993	Requirement for a Road Occupancy Licence undersection 139	Prior to start of the activity
Crown Lands Act 1989 (s6)	Licence to occupy areas of Crown land	Prior to start of the activity

8 Conclusion

8.1 Justification

Hillsborough Road is a major road corridor in the Lake Macquarie LGA. Hillsborough Road carries around 35,000 vehicles per day providing an important connection between Warners Bay, Cardiff and the NICB. Increasing traffic growth has seen the operation of Hillsborough Road impacted by reduced travel speeds, increased travel times and unacceptable intersection performance for secondary roads connecting to Hillsborough Road through uncontrolled intersections.

The preferred option for the upgrading of Hillsborough Road as outlined in Section 3 has been identified to alleviate the current operational issue on Hillsborough Road. The proposal was found to be consistent with the objectives of the relevant strategic planning documents as outlined in Section 2 as well as meet the project specific objectives which are to:

- Reduce congestion along Hillsborough Road in peak periods
- Reduce travel times and improve accessibility for surrounding suburbs, between the NICB and Warners Bay
- Improve road safety
- Improve active transport connections
- Minimise traffic disruptions on the surrounding road network during construction.

While there would be some environmental impacts as a consequence of the proposal including impacts to biodiversity, flooding, water quality, traffic, noise and vibration, non-Aboriginal heritage, landscape visual and socio-economic they have been avoided or minimised wherever possible through design, standard and site-specific mitigation measures and safeguards. Most impacts would be short term during the construction phase with longer term benefits being realised during the operational phase.

Overall it is considered that the adverse impacts of the proposal would be outweighed by the long-term benefits of improved traffic flow, faster travel times, improved traffic speeds and improved safety for roads users and residents within Hillsborough and surrounds. Therefore the proposal is considered justified.

8.1.1 Social factors

As documented in Section 6.1.2, the proposal would have some social impacts including:

- Acquisition affecting 20 properties.
- Temporary disruptions to private property access.
- 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.
- 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.

The combined effect of construction noise, dust, local access changes, and general disturbance caused by construction activity, construction traffic and machinery movements would result in a general loss of amenity for residents, motorists, workers and others who live near the proposal area and those who visit the proposal area on a regular basis during construction.

However, the long-term effect would be an overall social benefit, through improved safety and efficiency of Hillsborough Road. The need for the upgrade to Hillsborough Road is driven by the road's poor safety, congestion, and delays that are currently experienced.

The proposal is expected to improve traffic flow, travel times and safety through Warners Bay, which would meet the proposal objectives as outlined in Section 2.3.

Compared with the 'do nothing' option where Hillsborough Road is not upgraded; the long-term effect would be an overall social benefit from the proposal.

8.1.2 Biophysical factors

Terrestrial biodiversity

The proposal involves widening the exiting road corridor of Hillsborough Road. This would result in the following disturbance impacts to biodiversity:

- Clearing of up to 4.1 ha of native vegetation including 0.2 ha of Swamp Sclerophyll Forest
- Removal of 2.9 ha of habitat for Black-eyed Susan
- Removal of five hollow bearing trees (four medium hollows and one small hollow) that may be used by smaller hollow-dependent fauna such as microbats and birds
- Increased impacts to an important north-south wildlife corridor for Squirrel Glider and other arboreal fauna by increasing the canopy gap across Hillsborough Road from about 30 metres to about 50 metres.

The proposal is not likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the BC Act or FM Act and therefore a Statement of Significance or BDAR is not required.

The proposal is not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the EPBC Act.

Waterways and hydrology

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 at Winding Creek and west of Barker Avenue. However, these increases are isolated and range between 0.2 to 0.4 meters in the 1% AEP. Flood levels decrease in the residential area of Hillsborough and no residential properties are newly flooded as a result of the proposal.

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 proposal area.

8.1.3 Economic factors

The proposal would result in changes to parking, road, public transport and active transport. Resident and employee journeys may be delayed. Altered bus stops and adjusted footpaths would also occur during construction of the proposal.

Residents and businesses may also experience amenity loss during construction of the proposal due to associated noise, traffic movements, work activities and presence of construction plant and equipment.

The proposal would be constructed largely within the existing corridor. Whilst some acquisition is required it is generally the acquisition of small portions of lots.

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.

The proposal would improve road user safety with improved geometry and a new shared user path on Hillsborough Road. The proposal would improve access to community and recreational facilities and further work to build community values, as well as improved facilities for cyclists and pedestrians.

As a result, the proposal is considered to be in the public interest as the upgrades to road infrastructure fulfil the needs of the majority. The proposal represents a cost-efficient investment in public infrastructure to maximise the long-term social and economic benefits, while minimising the long-term negative impacts on communities and the environment. During the construction phase, the proposal would result in some short-term impacts on visual amenity, traffic and noise.

Compared with the 'do minimum' option, these impacts would be outweighed by the long-term benefits of the proposal. The overall result would be improved safety and traffic efficiency outcomes once the proposal is operational.

8.2 Objects of the EP&A Act

Table 8.1: Objects of the Environmental Planning and Assessment Act 1979

Instrument	Requirement
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 also improve the social and economic welfare of the community by improving the road safety on this section of Hillsborough Road. The proposal design, impact, safeguards 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.	The proposal is considered consistent with the principal of ecologically sustainable development as outlined in Section 8.2.1.
1.3(c) To promote the orderly and economic use and development of land.	The proposal is not expected to impact on the economic use of land. However, the proposal would improve the economic use of the road by improving the traffic flow, travel times, and safety on Hillsborough Road.
1.3(d) To promote the delivery and maintenance of affordable housing.	This clause is 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.	Impacts to native animals and plants, including threatened species, populations and ecological communities and their habitats were considered in Section 6.1. An assessment of significance has been carried out for threatened species and ecological communities that are likely to occur in the proposal area. The assessment found that the proposal is unlikely to have a significant impact on all matters listed under the BC Act. Impacts to biodiversity are discussed in Section 6.1.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The proposal would not result in potential impacts to Aboriginal heritage. No impacts to non-Aboriginal heritage are expected. The management of Aboriginal heritage and non-Aboriginal heritage is considered in Section 6.8 and Section 6.9, respectively.

Instrument	Requirement
1.3(g) To promote good design and amenity of the built environment.	The proposal would promote good design and amenity of the built environment. As noted in Section 3.2.1, the proposal would be constructed in accordance with the following standards: • Guide to Road Design – Austroads (Austroads, 2017) • Guide to Road Safety – Austroads (Austroads, 2009) • Roads and Maritime Austroads Guide Supplement (Roads and Maritime, 2017) • Road Design Guide (Roads and Traffic Authority of NSW (undated)) • Guidelines for Road Safety Audit Practices (Roads and Maritime Services, 2011) • Beyond the Pavement, RTA urban design policy, procedures and design principles (Roads and Traffic of NSW, 2009) • Roads and Maritime Delineation Manual (Roads and Maritime, 2008-2015) • Roads and Maritime Road Technical Directions • NSW Speed Zone Guidelines (Roads and Traffic Authority of NSW, 2011).
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	This clause is 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.	This clause is not relevant to the proposal.
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	The proposal development process has involved the consultation with relevant stakeholders. Consultation carried out and proposed is outlined in Section 5.

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.

8.2.1.1 The precautionary principle

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

This principle was considered during route options development (see Section 2.4). The precautionary principle has guided the assessment of environmental impacts for this REF and the development of mitigation measures.

Conservative 'worst case' scenarios were considered while assessing environmental impact, with specialist studies were undertaken for the following issues to provide accurate and impartial information for the evaluation of options and development of the proposal:

- Traffic and transport
- Noise and vibration
- Hydrology and flooding
- Soils, surface water and groundwater
- Socio-economic

- Landscape character and visual amenity
- Biodiversity
- Aboriginal heritage

In developing the proposal, the best available technical information, environmental standards and measures have been used to minimise environmental risks. The preferred option minimises vegetation clearance, with particular consideration of sensitive areas. The preferred option minimises potential impacts of property acquisition and other existing land uses, while also taking into consideration supporting the future land use and development of the area.

8.2.1.2 Intergenerational equity

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

Intergenerational equity was applied to the proposal in the following ways:

- Minimise the environmental impact such as vegetation clearance and Aboriginal heritage, with water quality and hydrological measures, and fauna connectivity considered in the design to ensure that the impacts on sensitive environments are minimised
- Improve flood immunity to allow the road to be serviceable for future generations
- Improve road safety

8.2.1.3 Conservation of biological diversity and ecological integrity

This principle reinforces the previous two principles in requiring the diversity of genes, species and communities, as well as the ecosystems and habitats to which they belong, be maintained and improved to ensure their survival.

As part of the assessment process, a comprehensive assessment of the existing local environment has been carried out to recognise and manage any potential impacts of the Proposal on local biodiversity. The proposal would not significantly impact biological diversity or ecological integrity. A biodiversity assessment and appropriate site-specific safeguards are provided in Section 6.1.

8.2.1.4 Improved valuation, pricing and incentive mechanisms

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by the carrying out of a project, including air, water, land and living things.

This REF has examined the environmental consequences of the proposal and identified mitigation measures for areas that may possibly experience adverse impacts. Implementation of these mitigation measures would increase the capital costs of the proposal. This shows environmental resources were valued in economic terms during concept design. In addition, the concept design was developed with an objective of minimising potential impacts on the surrounding environment, thereby minimising costs to the environment.

In summary, the proposal is generally in accord with the principles of ESD. The proposal would improve traffic movement and would provide a sustainable balance between environmental and economic objectives. It would also provide better facilities for pedestrians, cyclists and vehicles.

8.3 Conclusion

The proposed Hillsborough Road Upgrade at Hillsborough is subject to assessment under Division 5.1 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration (where relevant) of conservation agreements and plans of management under the NPW Act, biodiversity stewardship sites under the BC Act, wilderness areas, areas of outstanding value, impacts on threatened species and ecological communities and their habitats, and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the EPBC Act.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the project objectives but would still result in some impacts on biodiversity, noise and some minor amenity impacts during construction. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also improve travel times, travel speeds, intersection performance, commuter safety and lead to reduced congestion. Other benefits include improved public transport and active transport infrastructure. On balance the proposal is considered justified and the following conclusions are made.

8.3.1.1 Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. So it is not necessary for an environmental impact statement (EIS) to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report (BDAR) or Species Impact Statement (SIS) is not required. The proposal is subject to assessment under Part 5, Division 5.1 of the EP&A Act. Consent from Council is not required.

8.3.1.2 Significance of impact under Australian legislation

The proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the EPBC Act. A referral to the Australian Government DCCEEW is not required.