Part B: **Proposal**

Image: Newell Highway near Edgeroi, NSW

5 Strategic context and need for the proposal

This chapter describes the strategic planning context and the key issues and demands that have influenced the need for, and development of, Inland Rail, and the proposal as part of the wider Inland Rail project. A summary of the need for Inland Rail and the proposal is provided.

5.1 Strategic planning context

5.1.1 The existing situation

There is no direct continuous inland rail link between Melbourne and Brisbane, with interstate rail freight travelling between Melbourne and Sydney via Albury, and then between Sydney and Brisbane, generally along the coast. About 70 per cent of the freight between Melbourne and Brisbane is carried by road, principally the Newell Highway in NSW, and connecting highways in Victoria and Queensland (Transport for NSW, 2015).

The idea for extending the Australian rail network to provide an inland railway between Melbourne and Brisbane has been around for at least one hundred years (Inland Rail Implementation Group, 2015). In the last decade, the concept of an inland railway between Melbourne and Brisbane has been subject to significant analysis for the following reasons (ARTC, 2010):

- The existing north–south coastal railway will reach capacity in the medium term, and additional capacity will be required to service future demands for interstate and regional rail freight.
- The efficiency and service quality associated with the existing coastal route is currently impacting on freight productivity and transport costs.
- Road freight transport has a competitive advantage over rail, making it difficult for rail to increase its market share.
- Road freight is associated with the potential for safety, congestion and environmental costs as a result of the movement of heavy vehicles on roads.
- Rail paths on the coastal route through Sydney are shared between passenger and freight trains, impacting on the reliability of rail freight, and constraining opportunities for the expansion of passenger services.

Two major studies have been undertaken in relation to the development of an inland rail route between Melbourne and Brisbane. The first study, the *North–South Rail Corridor Study* (Department of Transport and Regional Services, 2006) considered potential corridors for the rail line. This study is described in Section 6.1.3. As an outcome of the study the ‘far-western sub-corridor’, via Parkes, Moree and Toowoomba, was identified as the preferred corridor for a Melbourne-Brisbane inland railway.

In 2008, the then Minister for Infrastructure, Transport, Regional Development and Local Government announced a study to determine the optimum alignment, as well as the economic benefits and likely commercial success, of a new standard gauge inland railway between Melbourne and Brisbane. This study, the *Melbourne–Brisbane Inland Rail Alignment Study* (ARTC, 2010) developed the current Inland Rail alignment (as shown in Figure 5.1).

The conclusions of the *Melbourne–Brisbane Inland Rail Alignment Study* include:

- There is demand for an inland railway.
- The route for an inland railway would be more than 100 kilometres shorter than the existing coastal route.
- The preferred alignment could achieve an average Melbourne to Brisbane transit time (terminal to terminal) of less than 24 hours, compared to a transit time on the existing coastal route of about 27 hours and 30 minutes.
- The inland railway would free up rail and road capacity through Sydney.
- The inland railway would achieve a positive economic net present value between 2030 and 2035, and if demand volumes grow more strongly than forecast, viability could be reached sooner.

Figure 5.1 Proposed alignment for Inland Rail

In November 2013, the Minister for Infrastructure and Regional Development announced that the Australian Government had committed $300 million to enable development of Inland Rail to commence, starting with pre-construction activities such as detailed corridor planning, environmental assessments, and community consultation. The Minister also announced that a high-level Implementation Group would be formed to drive the project. The alignment identified by the *Melbourne–Brisbane Inland Rail Alignment Study* (ARTC, 2010) was endorsed by the Implementation Group as the base case for further work (Inland Rail Implementation Group, 2015).

In 2014, the Implementation Group tasked ARTC to develop a business case and a 10-year delivery plan for Inland Rail. Planning and design work for the two projects in NSW is under way:

- Narrabri to North Star (the proposal)
- Parkes to Narromine (subject to a separate application).

ARTC has also commenced planning work on the priority development project in Queensland:

- Gowrie to Helidon – consisting of 26 kilometres of new dual gauge track including a 6.4 kilometre long tunnel.

Further information on the options and alternatives considered is provided in Chapter 6.

5.1.2 Consistency with Australian, State and regional strategic planning

The strategic context of the proposal is influenced by the outcomes of a number of strategic plans for transport, development, and freight that have been prepared at the national, state, and regional levels. Key national and state strategies, policies, and plans have also informed and influenced the vision, objectives, and development of the proposal.

The proposal, as part of Inland Rail, is consistent with the following relevant strategies:

National

- *Australian Infrastructure Plan: Priorities and reforms for our nation's future* (Infrastructure Australia, 2016) (Australian Infrastructure Plan)
- *State of Australia's Cities 2014-2015* (Department of Infrastructure and Regional Development, 2015)
- *Urban Transport Strategy* (Infrastructure Australia, 2013)
- *National Land Freight Strategy: A place for freight* (Standing Council on Transport and Infrastructure, 2013)
- *National Ports Strategy* (Infrastructure Australia, 2011b).

NSW

- State Priorities: NSW Making it Happen – announced by the NSW Premier on 14 September 2015
- *Newell Highway Corridor Strategy* (NSW Government, 2015)
- *Rebuilding NSW – State Infrastructure Strategy* (NSW Government, 2014a)
- *NSW Freight and Ports Strategy* (NSW Government, 2013)
- *NSW Road Safety Strategy 2012-2021* (Transport for NSW, 2012a)
- *NSW Long Term Transport Master Plan* (Transport for NSW, 2012b).

Regional/local

- *New England North West Regional Plan 2036* (Department of Planning and Environment, 2017)
- *Economic Development Strategy for Regional NSW* (Department of Trade and Investment, Regional Infrastructure and Services, 2015)
- *A Plan for Growing Sydney* (NSW Government, 2014b)
- *NSW Central West Regional Transport Plan* and the *New England North West Transport Plan* (Transport for NSW, 2013a and b)
- *NSW Central West Freight Study* (Regional Development Australia Central West, 2014)
- *Strategic Regional Land Use Plan New England North West* (Department of Planning and Infrastructure, 2012).

Further information on these strategies and their relationship to Inland Rail and the proposal in provided in Appendix E.

5.2 Summary of key issues and demands

A summary of the key issues and demands relevant to the development of, and need for, Inland Rail (including the current proposal) is provided below. A detailed analysis of the issues and project drivers is provided in the Programme Business Case (ARTC, 2015) and in the *Inland Rail Implementation Group Report* (Inland Rail Implementation Group, 2015).

5.2.1 Growth in freight demand

In 2011, the domestic rail freight task totalled 261.4 billion tonne kilometres, accounting for approximately 46 per cent of total domestic freight. This represents an increase of 91 per cent since 2000–01 (Infrastructure Australia, 2015).

The *Australian Infrastructure Audit* (Infrastructure Australia, 2015) notes that:

- The national land freight task is expected to grow by 80 per cent between 2011 and 2031.
- Demand for freight rail infrastructure is projected to grow, in particular for resource bulk commodity haulage in WA, Queensland and NSW.
- Freight rail will need to play a growing role in the movement of goods between ports and inland freight terminals, and in the movement of containerised and general freight over longer distances.

The Melbourne to Brisbane corridor is one of the most important general freight routes in Australia, supporting key population and employment precincts along the east coast and inland NSW. The non-bulk and complementary volumes moving within the corridor are currently estimated at 21 million tonnes per annum. This is expected to grow to over 40 million tonnes per annum by 2050 (Infrastructure Australia, 2016a).

The eastern states of Australia comprise 18 million residents (79 per cent of Australia's population), nine million jobs (78 per cent of Australia's national employment) and contributes $1.1 trillion in gross state product (75 per cent of gross domestic product). Interstate freight transport is projected to increase by 70 per cent between 2015 and 2030, to 140 billion tonne kilometres. The Melbourne to Brisbane corridor already supports 17 per cent of these interstate movements (ARTC, 2015).

With the population of the eastern states forecast to increase by 60 per cent over the next 40 years, the need for efficient and effective freight transport will continue to increase. Strong forecast population growth, accompanied by comparable growth in employment, is likely to place significant pressure on existing infrastructure and services (ARTC, 2015).

Without the increased use of rail, the growth in freight demand is likely to result in increasing pressure on the road network and associated issues, increased freight costs, and a loss of economic opportunity.

5.2.2 Existing freight capacity and infrastructure issues

As the demand for regional and interstate freight transport grows, rail and road infrastructure in the north–south corridor will face progressive challenges in meeting future demand. There will be increasing pressure on freight capacity between capital cities and from the regions to export ports and urban freight destinations.

Freight trains travelling along the Melbourne to Brisbane corridor currently travel through the Sydney metropolitan rail network, often experiencing significant delays. Travel time reliability is poor, as a result of the priority given to passenger services, freight transit curfews in the Sydney metropolitan area, and substandard rail alignments elsewhere. Limited capacity during morning and afternoon passenger peaks restricts freight movements at these times (NSW Government, 2013).

The Australian Infrastructure Plan (Infrastructure Australia, 2016) notes that the existing north–south rail corridor between Melbourne and Brisbane does not provide a service offering that is competitive with road transport. This is largely the result of 19th century alignments leading to low travel speeds and reliability, and major bottlenecks, most notably in the Sydney metropolitan area.

Infrastructure Australia (2016) notes that the demand for urban transport infrastructure is projected to increase significantly. Without action, the cost to the wider community of congestion on urban roads could rise to more than $50 billion each year by 2031. Demand for many key urban road and rail corridors is projected to significantly exceed current capacity by 2031.

The *National Land Freight Strategy* identifies a number of existing challenges facing road and rail freight in general, including:

- Congestion from increasing numbers of passenger vehicles, and the priority given to passenger vehicles over freight vehicles in urban transport, can adversely impact on the efficiency of freight vehicle movement.
- The encroachment of urban development on freight routes and precincts as cities grow in size and density leads to an increased potential for amenity, environmental and interface issues.

The *Melbourne–Brisbane Inland Rail Alignment Study* (ARTC, 2010) indicated that:

- There are likely to be capacity constraints on the existing coastal railway unless significant capital works are undertaken.
- The coastal railway between Sydney and Brisbane would reach capacity around 2052.

The issues associated with the existing regional rail systems also include the fact that much of the infrastructure is old and has maintenance and renewal issues. Poor maintenance of rail lines leads to more freight being transported by road, imposing additional maintenance burdens on the affected councils (Infrastructure Australia, 2015).

5.2.3 Assessment of demands for Inland Rail

Continued growth in freight volumes is giving rise to a range of increasingly complex challenges for government, industry and the community. Over the last four decades, the Australian freight task (that is, the amount of freight transport, usually measured in tonnes or tonne-kilometres) has quadrupled, with major increases evident in road and rail transport. Forecasts indicate that the total freight task will continue to grow, and is estimated to nearly double by 2030 based on 2010 levels (Commonwealth of Australia, 2012).

The Programme Business Case (ARTC, 2015) provides a detailed description of the potential demand for Inland Rail. The demand projections have been used to:

- estimate the potential revenue of Inland Rail
- assess the economic benefits arising from mode shift from road and the coastal route to Inland Rail
- determine the appropriate capacity of Inland Rail
- determine appropriate service frequency and the impact of this on capacity utilisation, railway and train operating costs.

The main categories of freight that are expected to comprise the market for Inland Rail are non-bulk manufactured products, including bulk steel, paper, coal and grain. The demand analysis indicates that (ARTC, 2015):

- Inland Rail is expected to increase rail's share of the Melbourne to Brisbane freight market from the current 26 per cent to 62 per cent by 2049-50. Similarly, it is estimated that Inland Rail would increase rail freight's share of the Adelaide to Brisbane market by 28 per cent and Brisbane to Perth's share by seven per cent.
- Better connections to the Port of Brisbane would result in an estimated two million tonnes of freight shifting from road to rail by 2049–50, particularly grain and cotton from New England, as well as grain on both rail and road from the Darling Downs to the Port of Brisbane. In NSW, a significant tonnage of grain (about 7.5 million tonnes) would also use Inland Rail on its way to NSW ports.
- Inland Rail would induce an increase in freight, such as coal in the Surat and Clarence-Moreton Basins, which would increase from the current eight million tonnes to 19.5 million tonnes.

5.3 Need for the proposal

5.3.1 Need for Inland Rail

As noted in the *National Land Freight Strategy* (Standing Council on Transport and Infrastructure, 2013) 'The efficient movement of land freight is crucial for Australia's productivity and competitiveness, and affects the lives of every Australian'. The existing rail mode share of freight between Melbourne and Brisbane (averaging the two directions) varies between approximately 22 to 27 per cent for non-bulk freight, to 60 to 90 per cent for commodities transported in bulk (ARTC, 2010).

The *National Land Freight Strategy* notes that the infrastructure supporting the movement of land freight, such as road, rail and ports, must be sufficient for the significant projected growth in demand for freight transport (described in Section 5.2.1).

Rail is generally the most productive and efficient mode for freight travelling from regional areas to export ports and urban destinations. Rail has traditionally dominated the freight market for mining and agricultural commodities, particularly iron ore, coal, grains, rice, cotton, and sugar for processing or export (ARTC, 2015). As noted by the Minister for Infrastructure and Regional Development (2013), 'an efficient rail freight network is the key to effective supply chains, national productivity and competitiveness'.

Inland Rail is needed to improve the efficiency of freight moving between Melbourne and Brisbane. Inland Rail would bypass the Sydney metropolitan area, it would substantially cut the overall journey time to less than 24 hours, and increase the reliability of services between Melbourne and Brisbane (Infrastructure Australia, 2016). This is expected to increase the competitiveness of rail transport relative to road transport (ARTC, 2015).

As noted by the *Australian Infrastructure Audit* (Infrastructure Australia, 2015) 'Rail offers an alternative to road transport and societal benefits in terms of lower emissions, reduced road congestion and increased safety per tonne kilometre, particularly over longer distances or when carrying heavy goods.'

In summary, Inland Rail is needed to respond to the growth in demand for freight transport (as described in Section 5.2.1), and address existing freight capacity and infrastructure issues (described in Section 5.2.2). The analysis of demand undertaken by ARTC indicated that there would be sufficient demand for Inland Rail (described in Section 5.2.3).

With respect to the need for the proposal, the Inland Rail Implementation Group (2015) found that:

- Without Inland Rail, the amount of freight travelling by road between Melbourne and Brisbane in 2050 will be approximately 7.1 million tonnes, 2.3 million tonnes more than what would be on the road with Inland Rail.
- Key transport links are experiencing increasing capacity constraints and congestion due to inadequate infrastructure.
- Current investment in road and rail is insufficient to address Australia's future freight task.
- Further population and freight growth along the north-south corridor will increase the demand for transport services at a local, state and national level, placing freight corridors under severe pressure and compounding the inefficiencies that already exist.
- If capacity constraints and congestion resulting from inadequate infrastructure are not overcome, national productivity and economic growth will be constrained with environment and safety outcomes also becoming increasingly sub-optimal.

5.3.2 Need for the proposal

Inland Rail consists of 13 geographically based projects, involving:

- building sections of new or 'greenfield' route
- upgrading sections of existing secondary lines to meet Inland Rail's performance specification
- enhancing sections of existing main lines, mainly to improve vertical clearances between infrastructure above the rail corridor and the tracks themselves, to enable trains with double stacked containers to pass safely beneath.

The proposal involves upgrading an existing secondary rail line to meet Inland Rail's performance specification. Development of both the proposal and the Parkes to Narromine project is required to enable implementation of Inland Rail to align with funding availability.

6. Alternatives and proposal options

This chapter provides a summary of the alternatives that have been considered as part of the development of Inland Rail overall. These included the strategic alternatives to Inland Rail as a whole (including road upgrades, upgrading the east coast railway, and greater use of maritime and air freight), and alternative route locations. The chapter also includes a summary of the main options that were considered during the concept design process for the proposal. Information on how the options were developed and assessed is provided.

6.1 Inland Rail alternatives

6.1.1 Strategic alternatives - alternative freight transport solutions

Alternative freight transport solutions with the potential to address Australia's current and future freight challenges were considered as part of a strategic options assessment set out in the Programme Business Case (ARTC, 2015), and examined in the *Inland Rail Implementation Group Report* (Inland Rail Implementation Group, 2015).

Strategic options assessment

Three options were assessed by the Programme Business Case (ARTC, 2015):

- progressive road upgrades
- upgrading the existing east coast railway
- an inland railway.

These options were subjected to a rigorous assessment consistent with Infrastructure Australia's Reform and Investment Framework Guidelines. The options were assessed against seven equally weighted criteria:

- capacity to serve east coast future inter-capital regional/bulk freight market needs
- foster economic growth through improved freight productivity and service quality (including improved reliability and resilience)
- optimise environmental outcomes
- alleviate urban constraints
- enable regional development
- ease of implementation
- cost-effectiveness.

Overall, constructing an inland railway ranked highest, with an average high likelihood of improving outcomes across all criteria. Progressive road upgrades and upgrading the existing east coast railway both had an average medium overall ranking across all criteria. In relation to individual criteria, progressive road upgrades outranked an inland railway only in relation to ease of implementation, and ranked equally with an inland railway in relation to enabling regional development outcomes. An inland railway was found to be the best option across all other criteria.

Review of alternatives

The following alternatives were reviewed by the Inland Rail Implementation Group:

- maritime freight
- air freight
- road freight
- rail solutions.

The results of the review of alternatives undertaken by the Inland Rail Implementation Group are summarised below:

Maritime shipping

Maritime freight was examined as a potential alternative to Inland Rail based on two types of services:

- a dedicated service between the Melbourne and Brisbane (coastal shipping)
- using spare capacity on vessels calling at Melbourne and Brisbane as part of an international voyage.

The *Inland Rail Implementation Group Report* (Inland Rail Implementation Group, 2015) concluded that:

- Shipping is unlikely to be a strong alternative to Inland Rail, as it does not provide the level of service (transit time and service availability) required by the majority of the Melbourne to Brisbane interstate market.
- Shipping still has a role to play, especially due to its strengths in transporting high volume and long distance cargo around the coast. Shipping must be used in conjunction with other modes such as an inland railway to meet Australia's future transport needs.

Air freight

Domestic air freight accounts for less than 0.01 per cent of total domestic freight movements in Australia by weight. The majority of these movements are comprised of newspapers and parcels between major cities, on either dedicated freight flights or on existing passenger flights. Air freight is highly specialised due to the inherent constraints on aircraft size and the nature of the goods that can be carried. The report concluded that:

- Air freight has a limited role in the transport of bulky or heavy goods on the Melbourne to Brisbane corridor, but will continue to play a crucial role for small, high-value and time-dependant goods.
- Air freight is not a viable alternative for addressing Australia's freight requirements on the Melbourne to Brisbane corridor into the future.

Road freight

The role of road transport was considered as a potential alternative to Inland Rail. While rail carries a larger volume of freight overall, road transport is the main mode of transport for the majority of commodities produced or consumed in Australia. Along the north–south corridor, the main routes for road freight are on the Hume Highway (between Sydney and Melbourne), the Pacific Highway (for coastal transport between Sydney and Brisbane) and the Newell Highway (between Melbourne and Brisbane).

The identified issues and considerations relevant to road freight on these corridors include:

- The north–south road corridor will face significant local and regional capacity constraints for road freight in the medium to longer term.
- The mix of local traffic, private vehicles, and freight vehicles on road transport corridors reduces reliability as a result of the different average travel speeds between cars and heavy vehicles, and increases accident rates.
- Conflicts between local traffic, private vehicles and freight vehicles on these corridors will increase in line with significant forecast growth in population, employment, and demands for freight transport.
- Compared with rail, road freight results in additional environmental costs, including from air pollution, greenhouse gas emissions, and water pollution.
- The cost to freight operators of congestion in urban areas as a result of reduced travel speeds and reliability for freight transport is estimated to be around $60 million per year for Melbourne to Brisbane inter-capital freight alone.
- Australian and State governments are investing in road infrastructure along the north – south corridor. However, this investment will be insufficient to remove all the existing and predicted future issues along the full length of the corridor, leaving trucking productivity exposed to the cumulative effects of the remaining deficiencies.

The report concluded that:

- While road transport will continue to contribute to Australia's freight task, unless substantial additional investment is made, it will be unlikely to meet the longer term needs for Australia's freight task alone.
- Should the Australian Government decide not to proceed with a rail solution, further investigation of road transport is required to determine its capacity to manage the future north–south freight task.

Rail solutions

The two main rail solutions considered were enhancing the existing east coast railway, and constructing a new inland railway.

The report noted that there are a number of capacity, reliability, and performance issues associated with the existing east coast railway, mainly relating to constraints associated with moving freight trains through the Sydney metropolitan rail network.

As a sub-option of enhancing the existing east coast railway, the report noted that the proposed new Outer Sydney Orbital corridor would provide opportunities for a rail route that could ease freight congestion on Sydney freight networks. However, the main role of this corridor would be to address freight capacity constraints on other routes, such as those for intrastate and export freight. In addition, this option would not provide significant transit time savings for Melbourne to Brisbane freight, as the missing link between north-west NSW and southern Queensland would still be required, or the existing coastal line would need to be upgraded. The report concluded that use of the Outer Sydney Orbital corridor would complement, but not replace, Inland Rail.

The report concluded that:

- For Melbourne to Brisbane freight, the existing east coast railway would not be competitive with road in terms of cost or time, even with significant further investment, and it is not a viable alternative to Inland Rail.
- Inland Rail would meet Australia's future freight challenge, and bring significant and positive national benefits by boosting national productivity and economic growth, while promoting better safety and environmental outcomes.

Summary of findings

Overall, in relation to the various alternatives to Inland Rail, the Inland Rail Implementation Group (2015) concluded that:

- while shipping and air will continue to play a role in the interstate freight market, they are not viable alternatives to rail
- without Inland Rail, road is the only mode capable of addressing the majority of the future freight task, with associated direct and indirect costs.

6.1.2 The 'do nothing' alternative

Not developing Inland Rail would result in continued growth in the use of road for freight transport between Melbourne and Brisbane, particularly along the Newell Highway. The issues associated with using road transport alone to address Australia's freight needs into the future are considered in Section 6.1.1. In addition, road transport will be unlikely to meet the longer term needs for Australia's freight task alone unless substantial additional investment is made (Inland Rail Implementation Group, 2015).

6.1.3 Alternative locations/route options for Inland Rail

Alternative routes for Inland Rail have been considered by the following two studies:

- *North–South Rail Corridor Study* (Department of Transport and Regional Services, 2006)
- *Melbourne–Brisbane Inland Rail Alignment Study* (ARTC, 2010).

The results of the studies are summarised below.

North–South Rail Corridor Study

The *North–South Rail Corridor Study* (Department of Transport and Regional Services, 2006) considered potential corridors for the rail line to determine which route would deliver the best economic and financial outcome.

Options identified

Potential options were identified within a 'north–south rail corridor', which comprises an elliptically-shaped area defined by the standard gauge rail line along the NSW coast, and a broad arc west of Shepparton, Jerilderie, Coonamble, Burren Junction, Goondiwindi and Toowoomba. This area covers all sections of the existing rail network in Victoria, NSW, and Queensland that currently form, or could potentially form, part of a freight route between Melbourne and Brisbane.

Within this corridor, four sub-corridors were identified for comparative analysis, each of which could be combined with alternative routes between Melbourne and Junee, via Shepparton or via Albury. The four sub-corridors comprised:

- Far-western sub-corridor - linking Junee to Brisbane via Parkes, Dubbo and/or Narromine, Coonamble, Burren Junction, Narrabri and/or Moree, North Star, Goondiwindi, Warwick and/or Toowoomba
- Central inland sub-corridor – linking Junee to Brisbane via any inland route that includes the Werris Creek to Armidale to Tenterfield rail links
- Coastal sub-corridor – following the existing coastal route between Junee and Brisbane (via Goulburn), through Sydney
- Hybrid sub-corridor – combining elements of an inland and coastal route, linking Junee to Brisbane via Muswellbrook and Maitland.

Within each of these sub-corridors, the feasibility of 136 possible route options was investigated. These options involved different amounts of new track and/or upgrading existing sections of track.

Analysis of options

The route options were compared using an optimisation model specifically developed for the study, based on the following criteria:

- operating efficiency
- infrastructure requirements
- market demand
- environmental constraints
- financial and economic viability.

The study identified potential demand, financial issues, environmental issues, and infrastructure costs relevant to the four sub-corridors. The analysis undertaken for the study concluded that the far-western sub-corridor was markedly superior to the other alternatives.

Melbourne–Brisbane Inland Rail Alignment Study

The purpose of the *Melbourne–Brisbane Inland Rail Alignment Study* (ARTC, 2010) was to determine the optimum alignment as well as the economic benefits and likely commercial success of a new standard gauge inland railway between Melbourne and Brisbane. The terms of reference for the study required it to develop a detailed route alignment, generally following the far western sub-corridor identified by the *North-South Rail Corridor Study*.

Options identified

The *Melbourne–Brisbane Inland Rail Alignment Study* short-listed and analysed a number of route options. The stages of route analysis involved:

- Identification of the route – evaluation of the route options and preliminary analysis for the three main areas: Melbourne to Parkes; Parkes to Moree; and Moree to Brisbane.
- Analysis of the route – the route was analysed in terms of capital cost, environmental impacts and journey time, as well as its preliminary economic and financial viability.
- Development of the preferred alignment – the alignment was developed considering environmental and engineering factors.

The study noted that with the combination of numerous route options and sections, there were over 50,000 possible options for the route between Melbourne and Brisbane. As it was not feasible to analyse each option, two key criteria (capital cost and journey time) were used to establish a shortlist of route options in each of the three main areas. The shortlist included:

- Melbourne to Parkes – two main options:
  - Via Albury, using existing track from Melbourne to Parkes (with a possible new direct line from Junee or Illabo to Stockinbingal by-passing Cootamundra).
  - Via Shepparton, using the existing broad gauge Mangalore–Tocumwal line via Shepparton, the disused standard gauge line to Narrandera, and a new direct connection through to near Caragabal, before rejoining the existing line to Parkes.

- Parkes to Moree – four main options:
  - Parkes to Moree via Werris Creek, using existing track (with a new section of track at Binnaway and Werris Creek to avoid reversals).
  - Parkes to Moree via Binnaway and Narrabri, using existing track to Binnaway, and then a new section connecting to the existing track near Emerald Hill or Baan Baa.
  - Parkes to Moree via Curban, Gwabegar and Narrabri, using existing track to Narromine, predominately new track between Narromine and Narrabri, and existing track from Narrabri to Moree.
  - Parkes to Moree via Burren Junction, using existing track to Narromine, and predominately new track via Coonamble and Burren Junction to Moree.
- Moree to Brisbane - two main options:
  - The Warwick route – a new 'greenfield' route via Warwick to the existing standard gauge Sydney–Brisbane line.
  - The Toowoomba route – a new corridor direct from Inglewood to Millmerran and Oakey, near Toowoomba, and then a new alignment down the Toowoomba range, and use of the proposed Southern Freight Rail Corridor from Rosewood to Kagaru.

Analysis of options

The shortlist of route options was subjected to more detailed technical, financial and economic assessment. The option involving use of existing track towards Werris Creek was chosen to represent the option with the lowest capital expenditure meeting the performance specification. This option had a length of about 1,880 kilometres. The option involving the more direct route between Narromine and Narrabri had the fastest transit time for a reasonable capital expenditure. This option, which had a length of about 1,731 kilometres, became the focus for more detailed route, demand, economic and financial analysis.

Refining the proposed alignment involved an iterative process, with evaluation of the following:

- environmental and land issues
- railway operations considerations
- engineering assessments
- capital cost estimates.

The final preferred alignment, between South Dynon in Melbourne and Acacia Ridge in Brisbane, incorporated:

- Melbourne to Parkes – 670 kilometres of existing track and 37 kilometres of new track on a greenfield alignment from Illabo to Stockinbingal, bypassing Cootamundra and the Bethungra spiral.
- Parkes to North Star – 307 kilometres of upgraded track, and 291 kilometres of new track on a greenfield alignment from Narromine to Narrabri.
- North Star to Acacia Ridge – 271 kilometres of new track on a greenfield alignment, 119 kilometres of existing track upgraded from narrow gauge to dual gauge, and 36 kilometres of the existing coastal route.

6.2 Proposal option development

6.2.1 Approach to the option development and design process

Option development has been an integral part of the overall design process for the proposal. An iterative process of option selection, design development, and evaluation has been undertaken to define the proposal to date. Further to the strategic and initial planning studies for Inland Rail, as described in Section 5.1, the design process for the proposal involves the following general phases:

- phase 1 – concept design
- phase 2 – feasibility design
- phase 3 – detailed design.

The proposal as described in this EIS is based on the outcomes of the feasibility design. The detailed design would take into account the outcomes of the feasibility design phase; the findings of this EIS, including the mitigation measures detailed in Chapters 9 to 26 (and summarised in Chapter 27); and any conditions of approval (if the proposal is approved).

The design has, and will continue to, evolve over these phases as a result of engineering, traffic, financial, economic and environmental considerations. The option selection and design process has also taken into account issue raised during consultation with relevant stakeholders (refer to Chapter 4) and the findings of preliminary environmental investigations.

6.2.2 Option assessment process

Options assessments have been undertaken for the following features of the proposal:

- track upgrading
- crossing loops
- bridges over Croppa Creek and the Gwydir and Mehi rivers
- level crossings
- Newell Highway overbridge
- Camurra hairpin curve upgrade
- Moree options.

A summary of the outcomes of the options assessments for these features is provided in the following sections.

In general, the assessments involved the following steps:

- Task 1 – confirming requirements
- Task 2 – identifying options to be assessed
- Task 3 – reviewing potential impacts, constraints, risks and opportunities associated with each option
- Task 4 – agreeing on evaluation criteria
- Task 5 – assessing the options against the criteria using a multi-criteria analysis
- Task 6 – identifying the preferred option
- Task 7 – reporting.

6.3 Options considered for proposal features

6.3.1 Track upgrading

Within the existing rail corridor, the existing track and formation needs to be upgraded/replaced to meet the operational requirements for Inland Rail, in particular, for the types and speeds of trains that would use Inland Rail.

Options considered

The track consists of the rails, fasteners, sleepers and ballast. The formation consists of the foundation material beneath the ballast and above the sub-grade. It is comprised of structural fill but may also include a capping layer. Three options for upgrading the track and/or formation were considered:

- track reconstruction – replacing the existing track and formation
- skim reconditioning – using the existing track ballast and sub-ballast as structural capping on the existing consolidated subgrade
- skim plus reconditioning – a combination of skim reconditioning and track reconstruction.

Assessment

Geotechnical investigations were undertaken along the existing rail corridor to provide a preliminary quantification of the extent of each potential treatment option. The results of this investigation were tested against the key parameters for each option.

Preferred option

All three options would be implemented as required, depending on the existing track and formation conditions. The track would be reconstructed in areas where the subgrade strength is inadequate, the existing formation has failed, and/or there is insufficient quality material in the existing track to be retained. Skim reconditioning would be used in areas where the existing ballast and sub-ballast is suitable for reuse. Skim plus reconditioning would be used in areas where there is not enough existing ballast.

6.3.2 Crossing loops

Initial options

A crossing loop is a section of track off to the side of the main track/s that allows a train to move to the side so that another train can pass along the main track. Trains move to the crossing loop via turnouts.

Crossing loops are positioned along a rail line using a network modelling methodology. This identifies locations to provide the maximum number of possible ‘train paths’ on the network. The number of potential train paths on a network represents the capacity of that network. For Inland Rail, a crossing loop is required around every 25 kilometres.

Assessment

A multi-criteria analysis was undertaken to determine the location of crossing loops as part of the proposal, based on network capacity requirements and taking into account local constraints. Considerations included:

- future train lengths
- minimising impacts on level crossings
- existing structures currently recommended to be retained
- distance to a receiver (noise)
- earthwork cut and fill volumes
- access
- geometry.

Preferred option

Based on this assessment, five new crossing loop locations were selected to allow trains to pass safely – at Bobbiwaa, Waterloo Creek, Tycannah Creek, Coolleearllee, and Murgo.

6.3.3 Bridges over Croppa Creek and the Gwydir and Mehi rivers

The existing rail bridges over Croppa Creek and the Gwydir and Mehi rivers are large span steel bridges, ranging in length from 75 to 150 metres, which span over rivers with high and steep river banks. The bridges over the Mehi and Gwydir rivers are listed heritage items on ARTC's Section 170 register and the bridge over Croppa Creek has local heritage significance (described in Chapter 18).

A review of the existing structures with Inland Rail requirements determined that there were a number of issues associated with the existing bridges including:

- the existing steel truss girders are not compatible with Inland Rail vertical clearance requirements
- there are a number of structural defects in the existing bridges associated with timber degradation
- the existing piers would be unable to handle Inland Rail design loadings.

An assessment of the potential options to upgrade the bridges were considered as part of the design process. The following options were identified and assessed:

- Base case – this option would involve a combination of partial demolition and upgrade of the existing structure. A retrofitted ballast top superstructure would be fitted on to the existing piers.
- Option 1 - Offline: this would involve building a new bridge approximately 10 metres to the east of the existing bridge. The rail track would be realigned for a distance of about 250 metres to 280 metres on each side of the bridge, to meet the new bridge approach spans. The existing bridge would be removed once construction and commissioning of the new bridge is complete
- Option 2 - Online: this option would involve building a new bridge in the same location as the existing bridge, and upgrading the rail tracks and formation along the existing alignment. The existing bridge would be removed prior to construction of the new infrastructure. The new bridge would be wider than the existing bridge.

Assessment

A multi-criteria analysis of the options was undertaken. The following criteria were used:

- relative cost
- construction complexity
- property impacts
- environmental impact.

Table 6.1 lists the advantages and disadvantages associated with each option, which provided the basis for assessing the options.

Table 6.1 Advantages and disadvantages of bridge options

Option	Advantages	Disadvantages
Base case	▸ Some level of retention would provide heritage reference. ▸ No property acquisition would be required. ▸ Limited vegetation removal would be required. ▸ The impact on Aboriginal objects/sites would be minimised (Mehi River bridge only - refer to Chapter 17).	▸ The existing piers would require substantial strengthening. ▸ The time for reconstruction of the approach embankments and shutdown of the rail line would be significant, which would also increase the potential for flooding during works. ▸ There would be high design and construction costs. ▸ A unique Super T span would be required to match the pier locations.
Option 1	▸ The new structure would not clash with the existing pier foundations. ▸ The risk to program is the lowest of all options. ▸ Lower risk from a constructability perspective when compared to the base case and option 2. ▸ A standard Super T and rail girder configuration could be utilised.	▸ Some property acquisition and vegetation clearance would be required. ▸ The hydraulics of flood flow would change. This would need to be considered during detailed design. ▸ An increased amount of earthworks would be required, when compared to the other options. ▸ The impact on Aboriginal objects/sites would be increased due to the increase in earthworks (Mehi River bridge only – refer to Chapter 17).
Option 2	▸ No property acquisition and minimal vegetation clearance would be required. ▸ Lower cost and constructability risk when compared to base case. ▸ The potential for impact on Aboriginal objects/sites would be less than option 2. ▸ A standard Super T and rail girder configuration could be utilised.	▸ It may require removal of the existing pier substructure to substantial depth. ▸ The hydraulics of flood flow would change. This would need to be considered during detailed design.

Options 1 and 2 also entail the complete demolition of the existing structures. From an engineering and safety perspective, this was considered necessary because:

- Retention of the existing structures would be a safety risk to the community as the structures continue to degrade with time and could collapse. The risk would be to ARTC personnel or members of the public who seek unauthorised access to the bridge.
- Retention of the existing structures would require ongoing maintenance costs and would increase the potential for vandalism and graffiti.
- If the existing piers were retained (in addition to the construction of new piers), there would be the potential for an increase in local flooding extent and frequency and associated scour issues.
- If the existing piers were retained additional bridge spans would be required which would result in increased costs.

Preferred option

The assessment concluded that option 2 (the online option) is the preferred option, as it scored highest as an outcome of the multi-criteria assessment. This option has the benefits noted above, and would involve the complete demolition of the existing structures. With regards to the existing structures ARTC will explore opportunities to reuse the existing truss structures elsewhere on their network.

6.3.4 Level crossings

A total of 86 level crossings are located along the proposal site. Of these, 45 are located on public roads (a number of which are Crown roads providing access to a single property), and 41 crossings are located on private roads or maintenance access tracks.

The majority of level crossings along the proposal site have passive forms of control, consisting of give way or stop signs (82 crossings). The remaining four crossings have active controls (either signage with flashing lights, or signage with flashing lights and boom gates).

Initial options and assessment

ARTC is applying the Inland Rail level crossing strategy for the proposal. The level crossing strategy involves reviewing all crossings along the proposal site to determine the works required to meet relevant crossing standards, guidelines, and Inland Rail operational criteria. The level crossing strategy consists of two stages:

- Stage 1 - identify options for level crossings and the preferred approach.
- Stage 2 - consult with relevant stakeholders (including landowners and road owners) to confirm the preferred treatment, and finalise the strategy.

Stage 1 of the level crossing strategy involved:

- identifying all level crossings across the proposal site
- initial field assessment of crossings
- review existing crossings with regard to Australian and ARTC level crossing design standards
- consulting with stakeholders about the use of crossings
- identifying preferred works and consolidation options for further stakeholder consultation as part of stage 2.

The following options were considered for each level crossing:

- retain existing crossing controls
- upgrade the level of control at the crossing
- construct a gated crossing with administrative controls, such as a requirement to phone train control prior to use
- consider crossing consolidation based on he outcomes of further investigation and stakeholder agreement.

Preferred option

The preferred option for level crossings across the proposal site is listed in Table 6.2.

Table 6.2 Summary of preferred option for level crossings

Action	Number of crossings affected		
	Private	Public	Total
Consider crossing consolidation based on the outcomes of further investigation	2	6	8
Upgrade crossing from existing passive protection (Give Way sign) to Stop sign	3	0	3
Retain existing passive protection (Stop sign)	19	26	45
Upgrade from passive to active pedestrian level crossing	3	0	3
Retain existing active protection (railway crossing flashing signal and boom)	4	0	4
Upgrade from Give Way sign to flashing lights and boom barriers	3	0	3
Upgrade from Stop sign to flashing lights and boom barriers	7	0	7
Construct a gate and require call access to open	0	13	13
Total	**41**	**45**	**86**

The next stage

The next stage in the level crossing strategy involves:

- consulting with stakeholders regarding the preferred option
- reviewing the proposed works for each crossing in detail, taking into account input from stakeholders
- reviewing consolidation options in accordance with the requirements of the *Transport Administration Act 1998*
- preparing detailed designs for works
- stakeholder consultation on the detailed designs
- finalise the detailed designs for each crossing, taking into account the results of consultation.

As noted in Section 3.4.3, any closure of level crossings needs to be undertaken in accordance with the requirements of the *Transport Administration Act 1998*. Private level crossings cannot be closed unless there is an alternative means of legal access to the property. Further information on the requirements of the *Transport Administration Act 1998* in relation to level crossings is provided in Section 3.4.3.

6.3.5 Newell Highway overbridge

Initial options

As described in Chapter 2, the Newell Highway passes over the existing rail corridor via an existing overbridge located about 3 kilometres north of Bellata, near the Tookey Creek rest area (located about 46 kilometres south of Moree). There are a number of issues associated with the existing bridge, including the width of the bridge and its clearance above the rail corridor. An assessment of the potential options to upgrade the existing Newell Highway overbridge were considered as part of the design process.

The objectives of the upgrade are to:

- provide sufficient height to meet the Inland Rail performance requirements and cater for double stacked freight trains to clear the crossing of Newell Highway (at least 7.1 metres from top of rail to base of bridge)
- be consistent with the Newell Highway Corridor Strategy (NSW Government, 2015)
- provide adequate room for any future widening of the rail corridor in this location
- minimise environmental impacts
- minimise property impacts
- minimise disruption to road users.

The following options were identified and assessed:

- Option 1.1 – involves a new 1.5 kilometres long highway deviation to the south, and a new three span bridge.
- Option 1.2 – similar to option 1.1 with a higher embankment.
- Option 2 – involves a new 2 kilometres long highway deviation to the north, and a new single span bridge structure.
- Option 3.1 – is an unmodified base case (that is, the 'do nothing' option).
- Option 3.2 – is an improved base case, which involves lowering the rail track by excavating a distance of 2.5 metres underneath the existing overbridge for a distance of one kilometre.

The location of options 1.1, 1.2 and 2 is shown in Figure 6.1.

Assessment

A multi-criteria analysis of the options was undertaken to assist in weighting the value of various risks and opportunities associated with each of the options. The following criteria were used for the assessment:

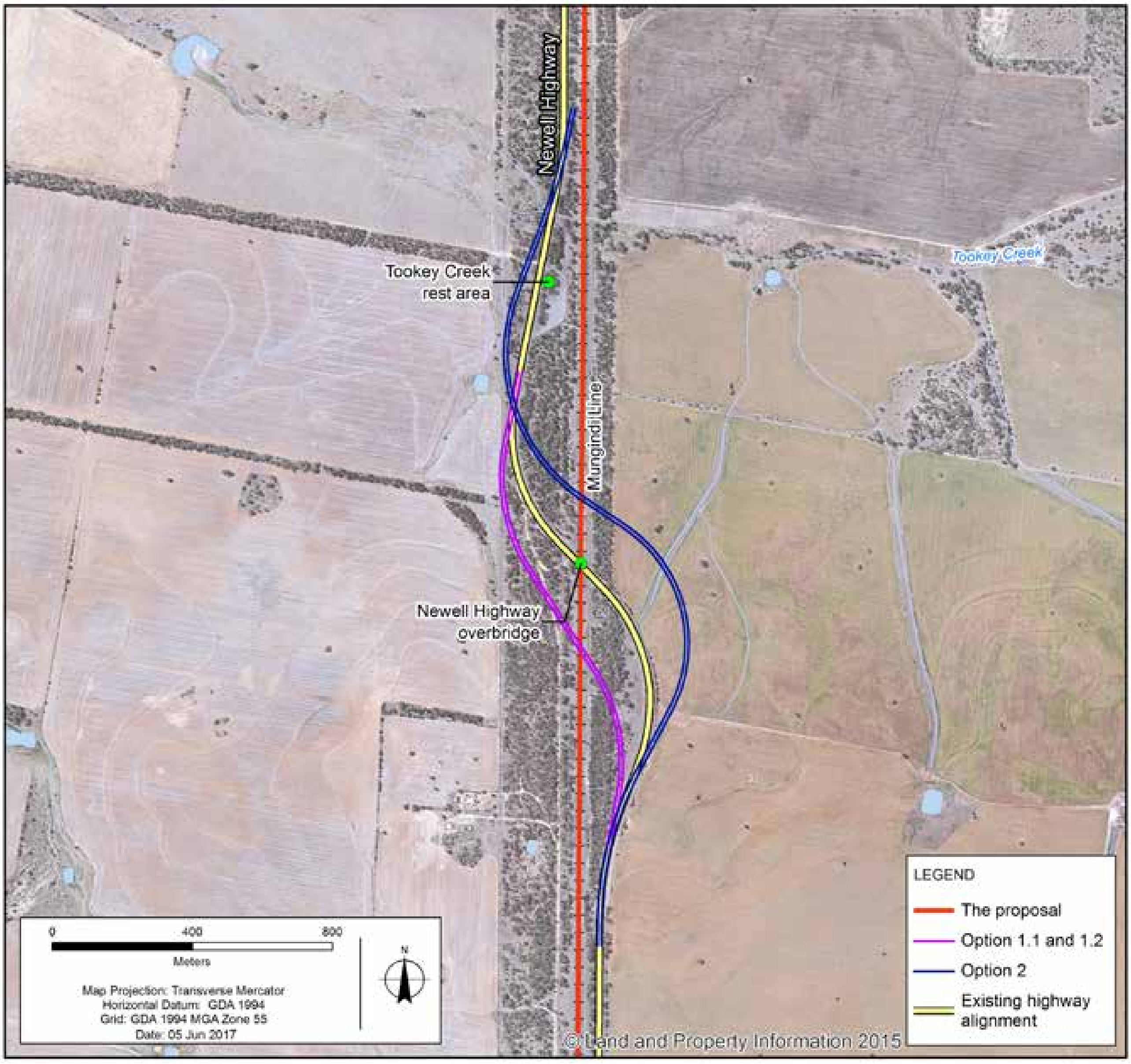
- corridor compliance
- cut-to-fill balance
- construction staging
- structures size
- property impacts
- utilities/services impact
- environmental impact.

The assessment of options considered the design criteria listed in Table 6.3, which incorporates the requirements of the Roads and Maritime Services corridor strategy, where relevant.

Table 6.3 Newell Highway overbridge design criteria

Design criteria	Basis of design
Barrier performance	Medium
Lane width	3.5 m
Footpath	n/a
Shoulder width	2 m
Sign posted speed	100 km/h
Design speed	100 km/h
Bridge clearance	7.4 m

Figure 6.1 Newell Highway overbridge upgrade options



The multi-criteria assessment also took into consideration the following potential constraints:

- the impact on the travelling stock route currently located to the west of the rail track
- a large cut to fill imbalance exists therefore fill would need to be imported
- safety barrier requirements would need to be considered given the significant embankment heights
- the truck rest area located to the north of the overbridge (the Tookey Creek rest area) is an important stop due to the high volume of heavy vehicles which travel along the Newell Highway.

Preferred option

The assessment concluded that option 1.2 (a new 1.5 kilometres long highway deviation to the south, and a new three span bridge) was the preferred option, as it scored highest as an outcome of the multi-criteria assessment, best meets the objectives of the upgrade, and has the following benefits:

- the width of the bridge and road formation complies with Roads and Maritime Services standards
- it ties into the existing alignment to the south of the truck rest area which means it can continue to be utilised unaffected
- there are no impacts to the existing highway except for the tie-in works
- there would be minimal property impacts
- minimal clearing would be required close to the road corridor
- there is minimal potential for noise impacts – there is only one resident to the west
- there would be minimal impacts to existing traffic – it would enable access along Newell Highway to be maintained during construction, as it would be constructed 'offline'.

6.3.3 Camurra bypass

Initial options

As described in Chapter 2, the existing rail corridor includes a tight 'hairpin' curve near the locality of Camurra, which is about 10 kilometres north-east of Moree. At Camurra, the proposal site enters the corridor for the existing Boggabilla Line at the hairpin curve. This curve does not meet the required performance specifications for Inland Rail. An assessment of the potential options to upgrade the rail line is this location, and bypass the existing hairpin curve, was undertaken as part of the design process.

The objectives of the bypass are to:

- improve the alignment to achieve a 115 kilometre per hour design speed
- minimise environmental impacts
- minimise property impacts
- minimise infrastructure impacts.

The following options were identified and assessed:

- Option 1 – existing situation.
- Option 2 – involves 1.6 kilometres of new track to the east of the existing turn, with an 800 metre radius curve.
- Option 3 – involves 2.6 kilometres of new track further to the east of the existing turn, with a 1,000 metre radius curve.
- Option 4 – involves 2.4 kilometres of new track further to the east of the other options.

The locations of the options are shown in Figure 6.2.

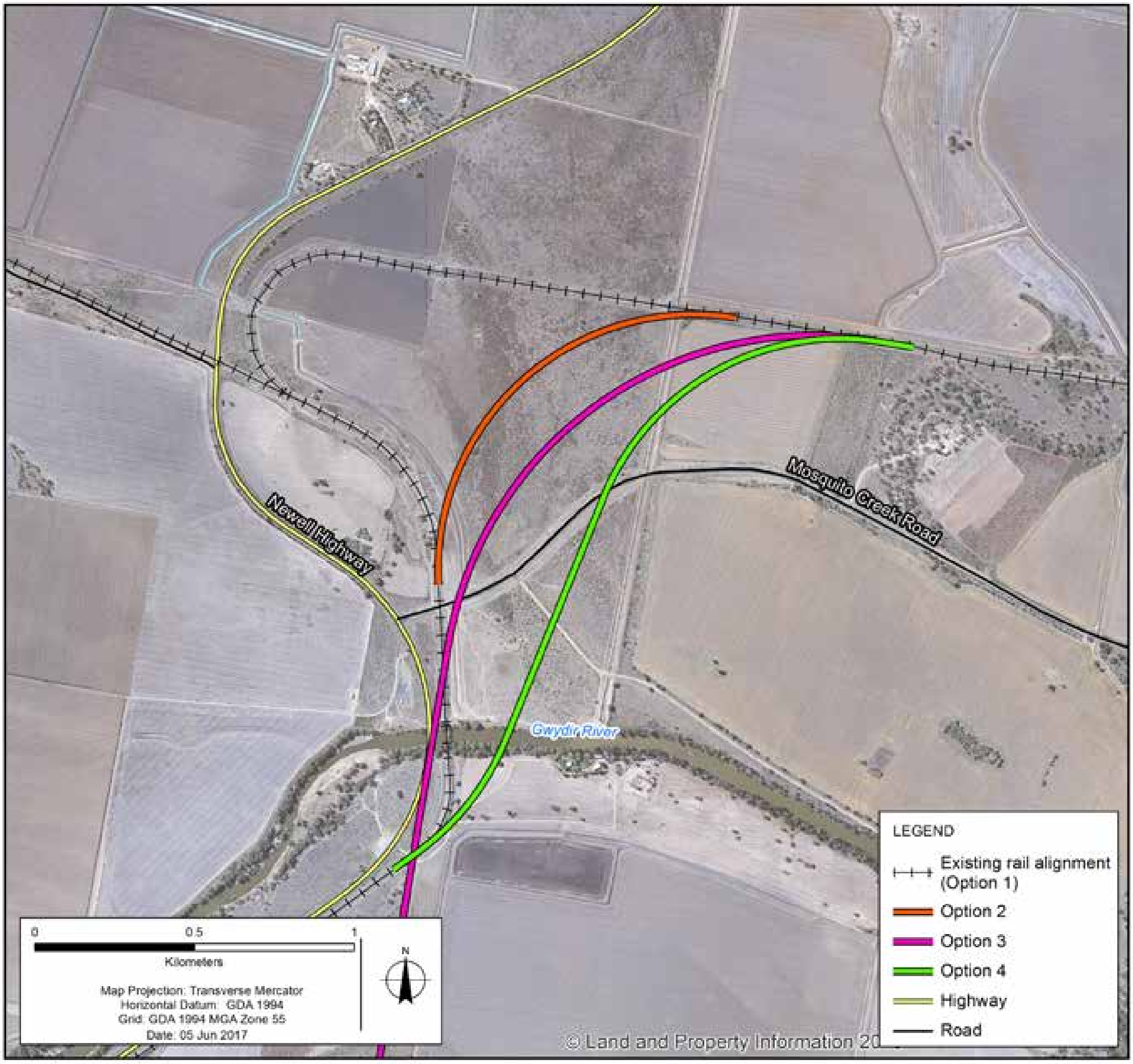
Assessment

A multi-criteria analysis of the options was undertaken to assist in weighting the value of various risks and opportunities associated with each of the options.

The following criteria were used for the assessment:

- operational benefits
- safety (operational/public/emergency response)
- maintenance
- utility impacts
- roads impacts
- environmental impacts
- property impacts
- track
- civil and geotechnical
- capital cost (based on quantities).

Figure 6.2 Camurra bypass options



Preferred option

The assessment concluded that option 2 was the preferred option, as it scored highest as an outcome of the multi-criteria analysis, best meets the objectives of the bypass, and has the following benefits:

- least impact on Mosquito Creek Road
- least impact on the existing irrigation channel
- requires the shortest length of new track to be constructed.

6.3.7 Moree options

As shown in Figure 6.5, the existing rail corridor passes through the south-eastern part of Moree for a distance of about 3.7 kilometres. The proposal would result in an increase in the number of trains travelling through Moree Station, from two to three trains per day (existing rail traffic) to about 12 trains per day in 2025, and about 21 trains per day in 2040.

In Moree Plains Shire Council's submission to the Department of Planning and Environment during preparation of the SEARs, they expressed concerns about the potential impacts of the proposal on Moree, including impacts on connectivity between the areas of the town located on either side of the current railway alignment, and the effect that increased train volumes would have on this. Consequently, the SEAR specifically required consideration of an eastern deviation around the Moree urban area, as an alternative to upgrading the existing rail corridor.

Moree options identification

In accordance with the SEARs, an assessment of options to minimise the potential impacts of the proposal on Moree was undertaken during the design process. The objective of the assessment was to consider options to minimise the impacts of the proposal on the Moree community. The options considered opportunities to improve vehicular, pedestrian, cyclist, and emergency vehicle access between the areas of Moree on either side of the existing rail corridor and included an examination of an eastern deviation around the Moree urban area.

In addition to the do nothing option, the following options were assessed:

- Moree connectivity options – alternative connectivity solutions linked to the upgrade of the existing rail corridor (described below).
- Moree bypass options – alternative alignments to the east of Moree were assessed and a concept design developed of the optimum alignment (described below).

Moree connectivity options assessment

The alternative connectivity solutions assessed to upgrade the existing rail corridor were:

- Level crossing upgrades – level crossing upgrades to enable greater ease for pedestrians and cyclists to safely cross the rail corridor. As the two main level crossings in Moree currently have active protection (lights and boom gates), the required upgrades to these level crossings would be minimal.
- Footbridge(s) – a footbridge at Jones Avenue that spans the rail corridor and Moree Bypass (road), enabling pedestrians to cross from east to west.
- Emergency vehicle access – if a train breakdown was to occur on the section of track within Moree, existing emergency vehicle access routes could be blocked as a result of the length of the trains. A dedicated point of emergency-vehicle-only access to cross the rail line with an alternate access route could be provided adjacent to Blueberry Road.
- Gwydir Highway detour – due to the predicted increase in train numbers, there is a possibility of increased delays at existing road crossings, including the Gwydir Highway. This option involves a detour of the Gwydir Highway to the south, using existing local roads, with the provision of a new level crossing. This option involves a nine kilometre long road detour using existing local roads, which would enable access from Moree east to west, even if a train were to block the two level crossings within Moree.
- Gwydir Highway bypass – this option involves a bypass of the Gwydir Highway to the south of Moree, including an overbridge over the rail corridor, and a major bridge crossing at the Mehi River. This would involve a six kilometre long new road alignment for the Gwydir Highway, which would be comparable to the existing Gwydir Highway alignment that traverses Moree. This option would provide continued access for Gwydir Highway traffic during any rail stoppages, and would divert highway traffic from Moree.
- Moree town overbridges – this option involves constructing new road bridges over the rail corridor within Moree, with various location options considered (described below).

Engagement with Moree Plains Shire Council and local emergency services identified that the provision of a road bridge over the rail corridor (a road overbridge) was the preferred solution to connectively issues. Council and local emergency services considered that the time to travel to the proposed alternate level crossings posed too great a safety risk in emergency situations.

Three options were assessed:

- Option 1 – Jones Avenue overbridge – involves a three span bridge between Jones Avenue and Tycannah Street; spanning the rail corridor, Gosport Street, and the Moree Bypass (Newell Highway).
- Option 2 – Newell Highway (Frome Street) to Tycannah Street overbridge – involves a six span bridge between the Newell Highway/Frome Street and Tycannah Street; spanning the rail corridor for both the Mungindi and Inverell lines, Gosport Street, and the Moree Bypass (Newell Highway).
- Option 3 – Newell Highway (Frome Street) to Bullus Drive overbridge – involves an overbridge located off a new intersection at the Newell Highway, tying into the existing road alignment at the western end of Bullus Drive.

The Moree overbridge options are shown in Figure 6.3.

The following criteria were used for the assessment of each of the options:

- existing infrastructure interface: considers impacts and upgrades required to existing structures and roads
- traffic: considers impacts to road and rail traffic
- construction: considers impacts, such as noise
- community: considers improvements to community connectivity
- property: considers property numbers and impacts.

The assessment concluded that option1 - the upgrade of existing level crossings and provision of emergency access across the corridor via a new overbridge at Jones Avenue was the optimum outcome.

Details of the proposed structure at Jones Avenue is shown in Figure 6.4.

Moree bypass options assessment

Five possible options were identified for a rail corridor bypass to the east of Moree. Analysis of these options involved an assessment of constraints, impacts and opportunities around the following criteria:

- operations and maintenance: considers operational benefits and safety
- technical elements: considers track, civil, utilities, road interface and constructability
- environment: considers biodiversity, noise, flooding and heritage
- community response, land use and property impacts
- capital costs: considers construction quantities and construction methodology.

The five options are described below and are shown in Figure 6.5:

- Option 1 – The proposed alignment is 20.7 kilometres of new track following a direct route across the floodplain bypassing approximately 26 kilometres of the existing alignment including the existing Camurra hairpin curve.
- Option 2 – The proposed alignment is 17 kilometres of new track including the Camurra bypass. It provides a relatively direct route across the floodplain crossing the Mehi and Gwydir rivers at its narrowest point, and bypasses approximately 18 kilometres of the existing alignment.
- Option 3 – The proposed alignment is 14.6 kilometres of new track including the Camurra bypass. It provides a direct route across the floodplain and bypasses approximately 15 kilometres of the existing alignment.
- Option 4 – A derivative of option 3, this option is 13.7 kilometres of new track including the Camurra bypass. Option 4 follows a similar alignment to option 3, however provides a less direct alignment to minimise property severance.
- Option 5 – The proposed alignment is 12.4 kilometres of new track including the Camurra bypass. Of all proposed alignment, it is the shortest in length and the closest to the Moree township.

Figure 6.3 Moree overbridge options

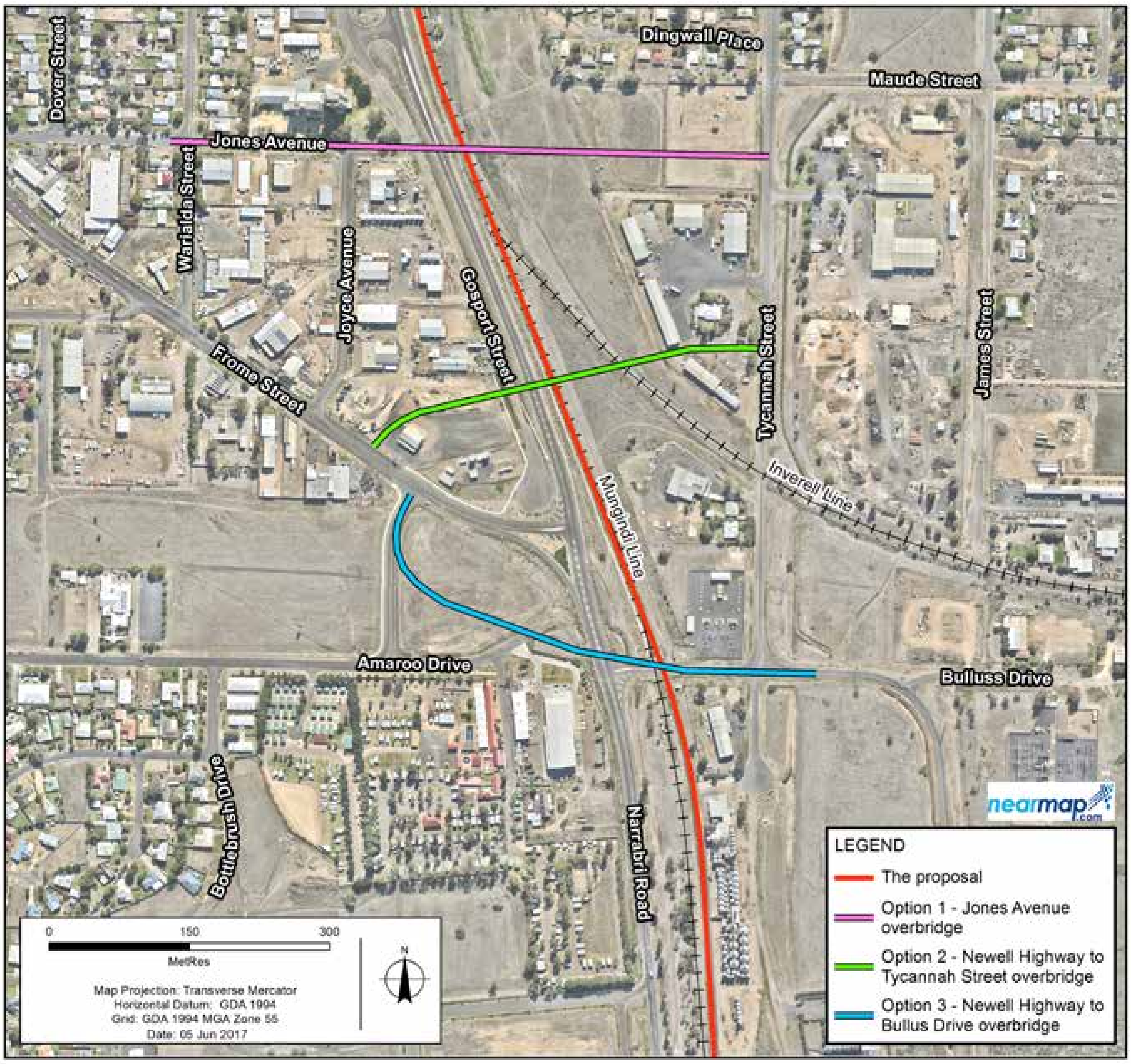
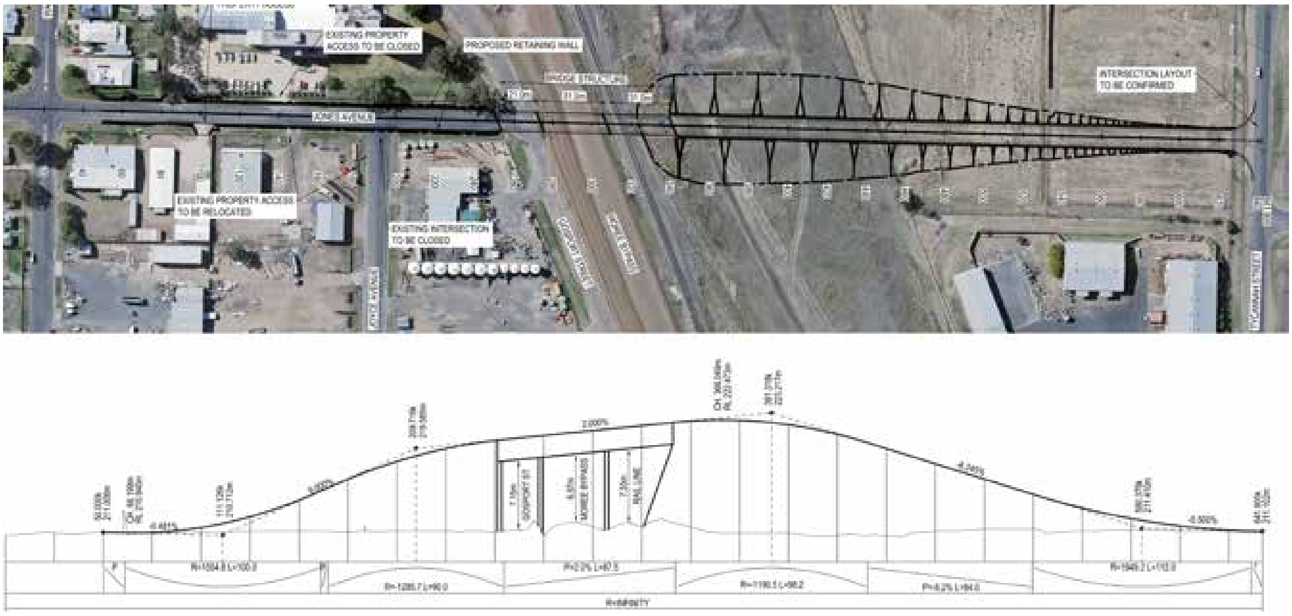


Figure 6.4 Jones Avenue overbridge



The multi-criteria analysis of the Moree bypass options determined that the optimum alignment is option 5.

A concept design of the optimum Moree bypass option was developed to determine the solutions extent of culverts, bridges, road and rail crossings. The concept design alignment is shown in Figure 6.6.

Overall preferred Moree option

To ensure a consistent approach to the 'like for like' comparison of all alternative route options, a multi-criteria analysis was undertaken. The following broad ranges of qualitative and quantitative criteria were used to compare the optimum Moree connectivity option (including Jones Avenue overbridge) with the optimum Moree bypass alignment:

- technical viability: considers the alignment, impact on public utilities, geotechnical conditions, impacts on existing road and rail networks, flood immunity and hydrology and future proofing
- safety assessment: considers construction safety, operational safety, public safety, road safety interfaces and emergency response
- operational approach: considers the impact on travel time, reliability and availability, and network interoperability and connectivity including interfaces with rail terminals and network
- constructability and schedule: considers construction duration, access, and complexity, resources, interface with operational railway and staging opportunities
- environmental impacts: considers the ecological impacts (flora, fauna and habitats), visual impacts, noise and vibration impacts, flooding and waterway impacts and the effect on air quality and greenhouse gas emissions
- community and property impacts: considers property impacts, Aboriginal and non-Aboriginal heritage, heritage, impact on community, community response and current and future land use and links to economic impacts
- approvals and stakeholder engagement: considers planning and approval requirements, State and Australian Government agency buy-in, local government buy-in, other statutory and regulatory approvals and service authorities, such as utilities
- construction costs: considers costs of trackwork and crossings, earthworks and fencing, utilities, culverts, bridges, noise walls, environmental issues, contractor costs and client costs.

The multi-criteria analysis concluded the Moree connectivity option (including the Jones Avenue overbridge) was the overall preferred option.

Figure 6.5 Moree bypass options

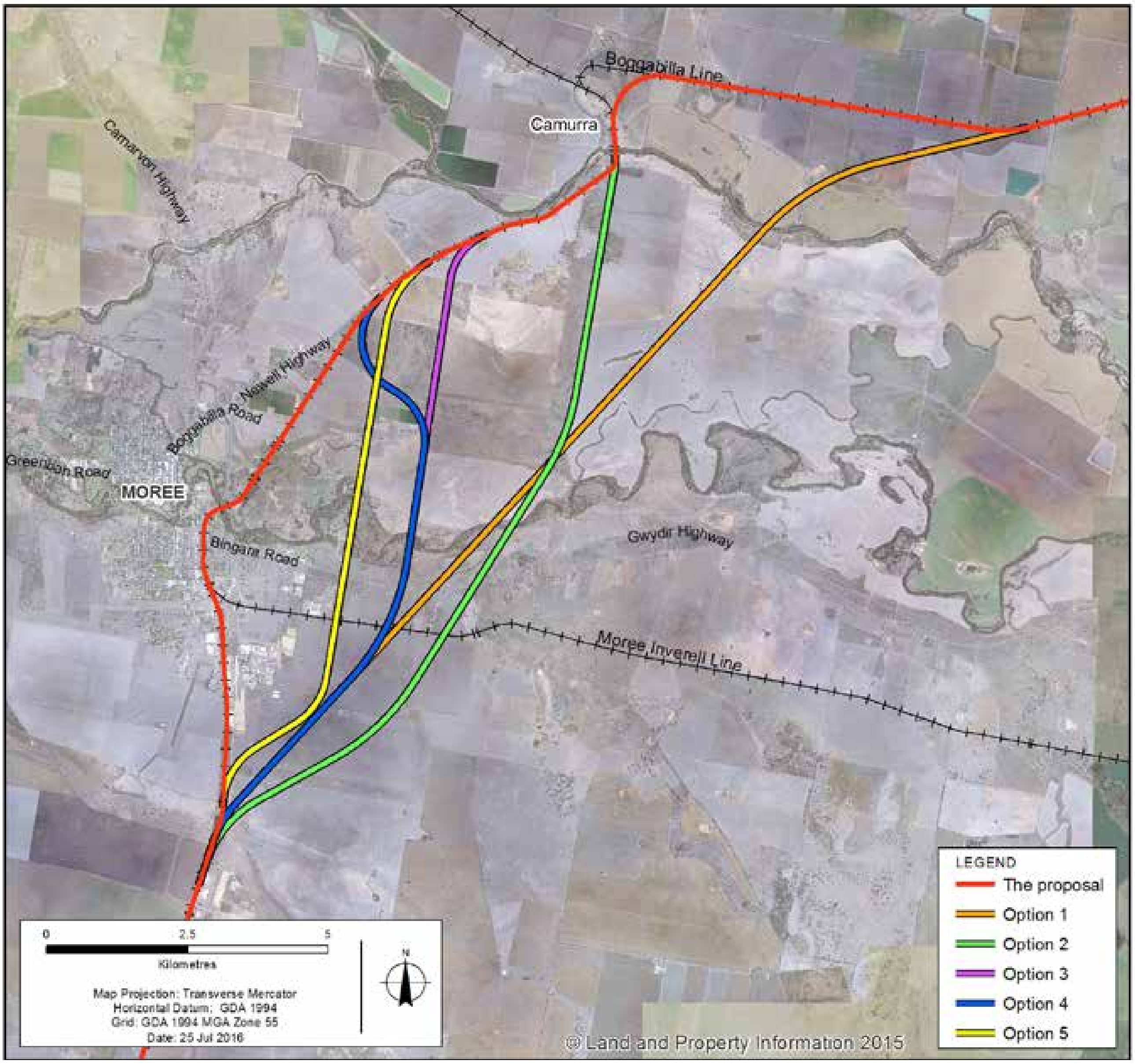
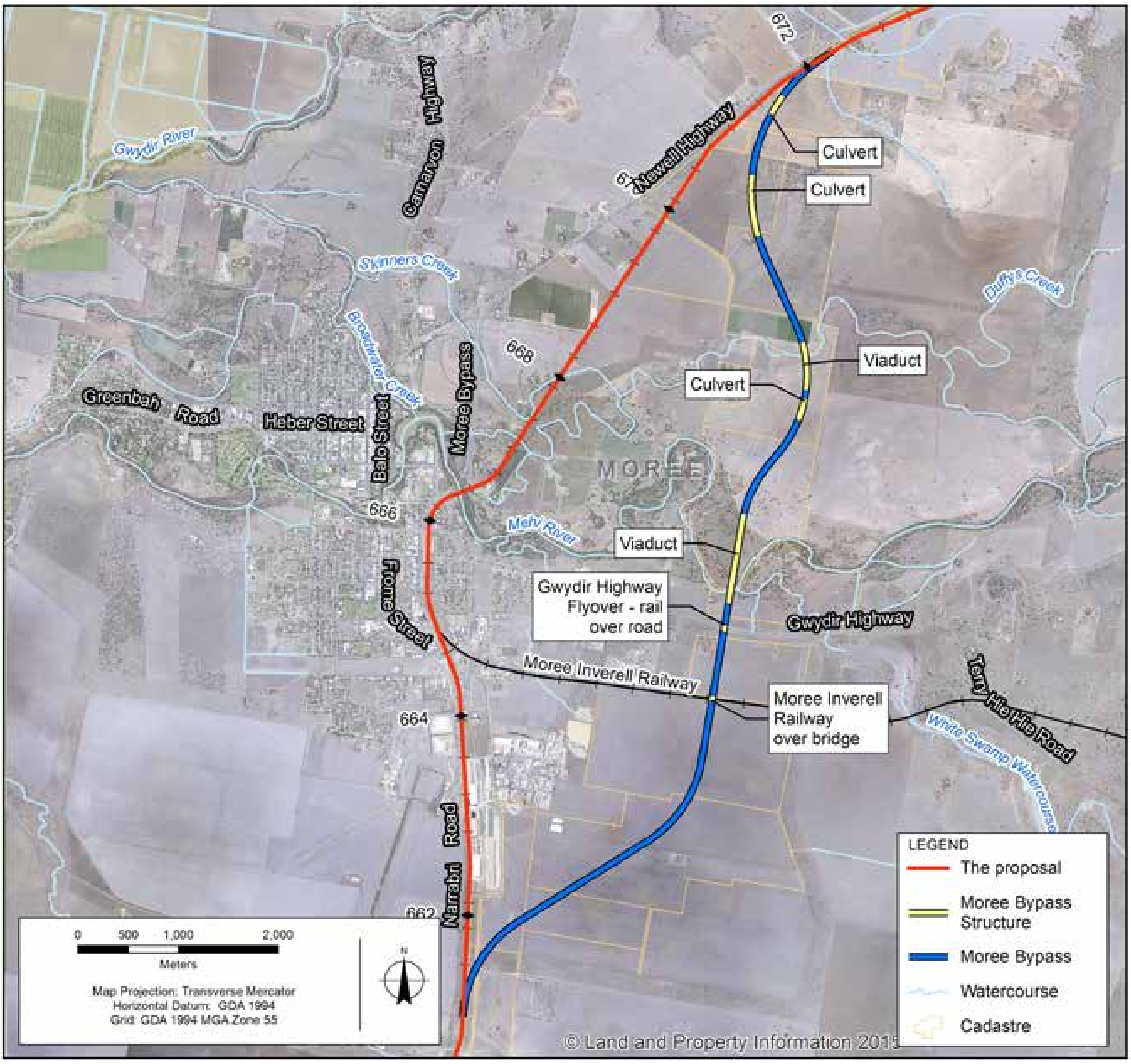


Figure 6.6 Concept design of optimum Moree bypass alignment



7. Proposal features and operation

This chapter provides a description of the proposal's features and operation for the purposes of the EIS. It includes a description of the approach to avoiding/minimising impacts during the design of the proposal, the infrastructure proposed, land acquisition likely to be required, and how the proposal would operate. The proposed approach to construction of the proposal is described in Chapter 8.

7.1 Overview

7.1.1 The proposal

The key features of the proposal, which are shown in Figure 1.2, are as follows:

- upgrading the track, track formation, culverts and underbridges within the existing rail corridor, for a distance of 188 kilometres, between Narrabri and North Star via Moree
- realigning the track within the existing rail corridor at Bellata, Gurley, and Moree stations to conform with required platform clearances for Inland Rail trains
- providing five new crossing loops within the existing rail corridor at Bobbiwaa, Waterloo Creek, Tycannah Creek, Coolleearllee and Murgo
- providing a new section of rail line at Camurra about 1.6 kilometres long, to bypass the existing hairpin curve ('the Camurra bypass')
- removing the existing bridges and providing new rail bridges over the Mehi and Gwydir rivers and Croppa Creek
- realigning about 1.5 kilometres of the Newell Highway near Bellata, and providing a new road bridge over the existing rail corridor ('the Newell Highway overbridge')
- providing a new road bridge over the existing rail corridor at Jones Avenue in Moree ('the Jones Avenue overbridge').

The key features of the proposal are described in Sections 7.2 and 7.3.

Ancillary work would include works to level crossings, signalling and communications, signage, fencing, and services and utilities. Ancillary works are described in Section 7.4.

The Mungindi line, and a short section of the former Inverell line, are existing operational rail lines that join the proposal around Moree. These lines will continue to operate following construction of the proposal. Accordingly, only the relevant direct impacts on these existing lines, as described in Section 2.5, form part of the proposal. Any associated maintenance works and other minor works, undertaken by ARTC in accordance with existing ARTC procedures and processes and under relevant State legislative requirements on these existing lines, do not form part of the proposal.

7.1.2 Approach to avoiding or minimising impacts

The approach to design development (shown in Figure 7.1) has included a focus on avoiding and/or minimising the potential for impacts during all key phases of the process.

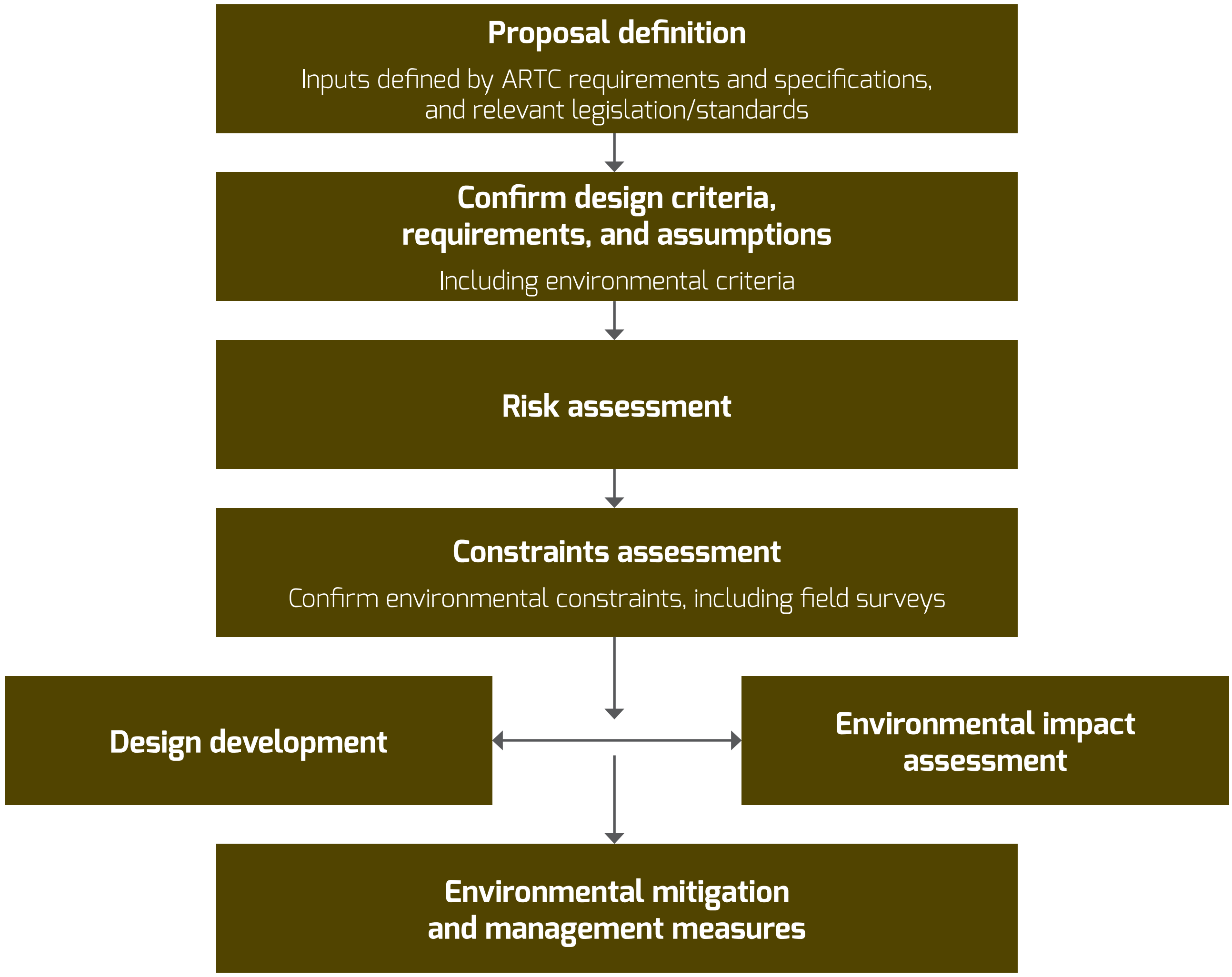
As described in Chapter 6, the multi-criteria assessments undertaken during the option selection and design process for key pieces of infrastructure included consideration of environmental and social impacts. Various options assessments have been undertaken, and the preferred option chosen based on the outcome of the assessments. The options assessment process also included assessment of opportunities and risks.

Examples of approaches to minimising the potential impacts of the proposal are described below.

Reuse of material

Track upgrade works make up a large part of the overall proposal. The design involves removing some of the existing material and replacing it with 'structural' and 'capping' materials. These materials are specification controlled, and are therefore generally required to be imported onto a site from a quarry or other suitable location. Importing material and exporting spoil requires truck movements.

Figure 7.1 Approach to avoiding and minimising impacts during the design process



For the proposal, the track works have been designed to reuse as much existing material as possible. Geotechnical investigations have been undertaken to identify what materials are contained within the proposal site. This has enabled the proposal to include reuse of as much existing material as possible via a site-specific formation design.

By undertaking this approach, import quantities have been reduced, and spoil quantities have been minimised.

Culvert design

Replacement culverts have been designed to ensure they take into account local constraints and existing flood flows. If the existing water flow situation was ignored and substantial changes made to the track structure, significant increases in the areas inundated during flood inundation events could eventuate.

Heritage items

Moree Station is listed on the Moree Plains LEP 2011 and Railcorp's section 170 heritage register. To minimise the potential impacts of the proposal on this item, options to realign the existing track would be explored further during detailed design. One option involves moving the track further away from the platform (up to about 1.5 metres from the existing platform) than currently proposed, to avoid potential impacts to the platform during track works.

7.2 Description of key proposal features within the existing rail corridor

This section describes those features of the proposal that would be located within the existing rail corridor.

7.2.1 Track upgrading

The existing track would be upgraded within the existing rail corridor for a distance of about 188 kilometres. All of the existing track would be upgraded in some way. As noted in Section 6.3.1, this would involve a combination of:

- track reconstruction
- skim reconditioning
- skim plus reconditioning.

Track reconstruction would involve replacing the existing track and formation. An indicative design for this form of treatment is provided in Figure 7.2.

Skim reconditioning would involve using the existing track ballast and sub-ballast as structural capping on the existing consolidated subgrade. An indicative design for this form of treatment is shown in Figure 7.3.

Skim plus reconditioning would involve a combination of skim reconditioning and track reconstruction. This form of treatment seeks to reuse as much existing material as possible. An indicative design for this form of treatment is shown in Figure 7.4.

7.2.2 Track realignment

At Bellata, Gurley, and Moree stations the rail line would be reconfigured within the existing rail corridor to conform with required platform clearances for Inland Rail trains. The location of the proposed realignment works are shown in Figure 7.5 to Figure 7.7.

At Bellata Station, the realignment works would involve reconfiguring the existing crossing loop to allow trains on the main rail line to bypass the platform with sufficient clearance.

At Gurley and Moree stations, the realignment works would involve moving the existing track about 125 millimetres away from the existing station platform to allow Inland Rail trains to pass the station platform. As described in Section 7.1.2, the detailed design of the realignment at Moree Station would consider the heritage significance of the station, and options to further minimise the potential impacts of the proposal on the station would be explored during detailed design.

In addition, the eastern side of the platform at Moree Station may need to be upgraded to allow passengers to join or alight from the Xplorer passenger service.

Additional works near Moree Station involve upgrading the existing pedestrian level crossing at the northern end of the station to include gates with lights and bells to alert passengers of approaching trains.

Figure 7.2 Track reconstruction

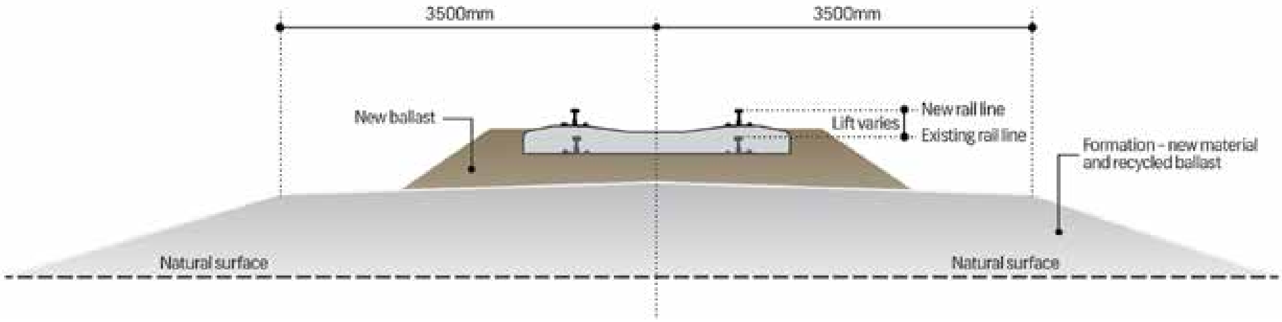


Figure 7.3 Skim reconditioning

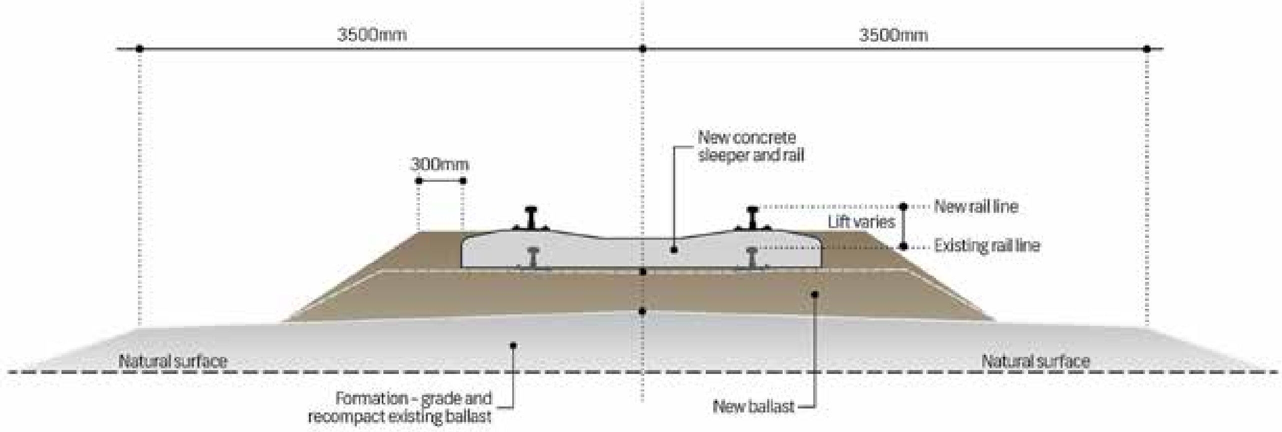


Figure 7.4 Skim plus reconditioning

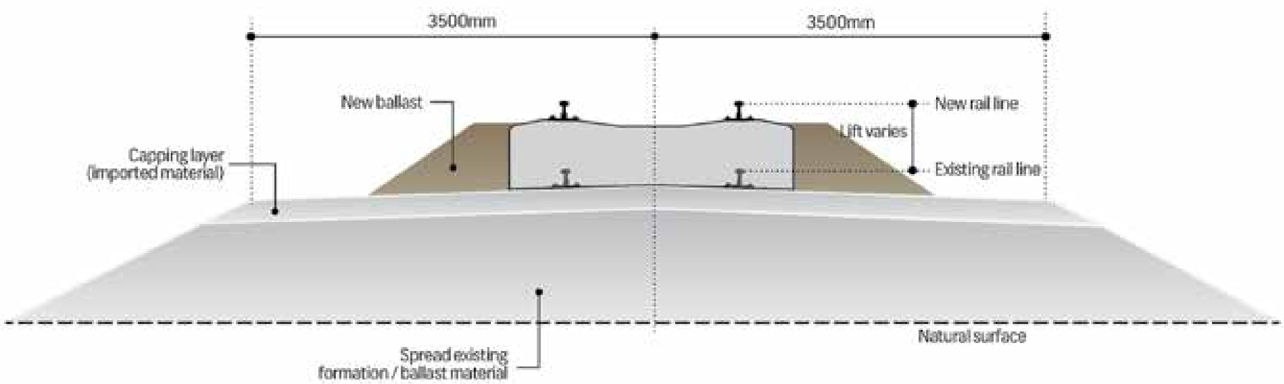


Figure 7.5a   Bellata Station track realignment

Figure 7.5b Bellata Station track realignment

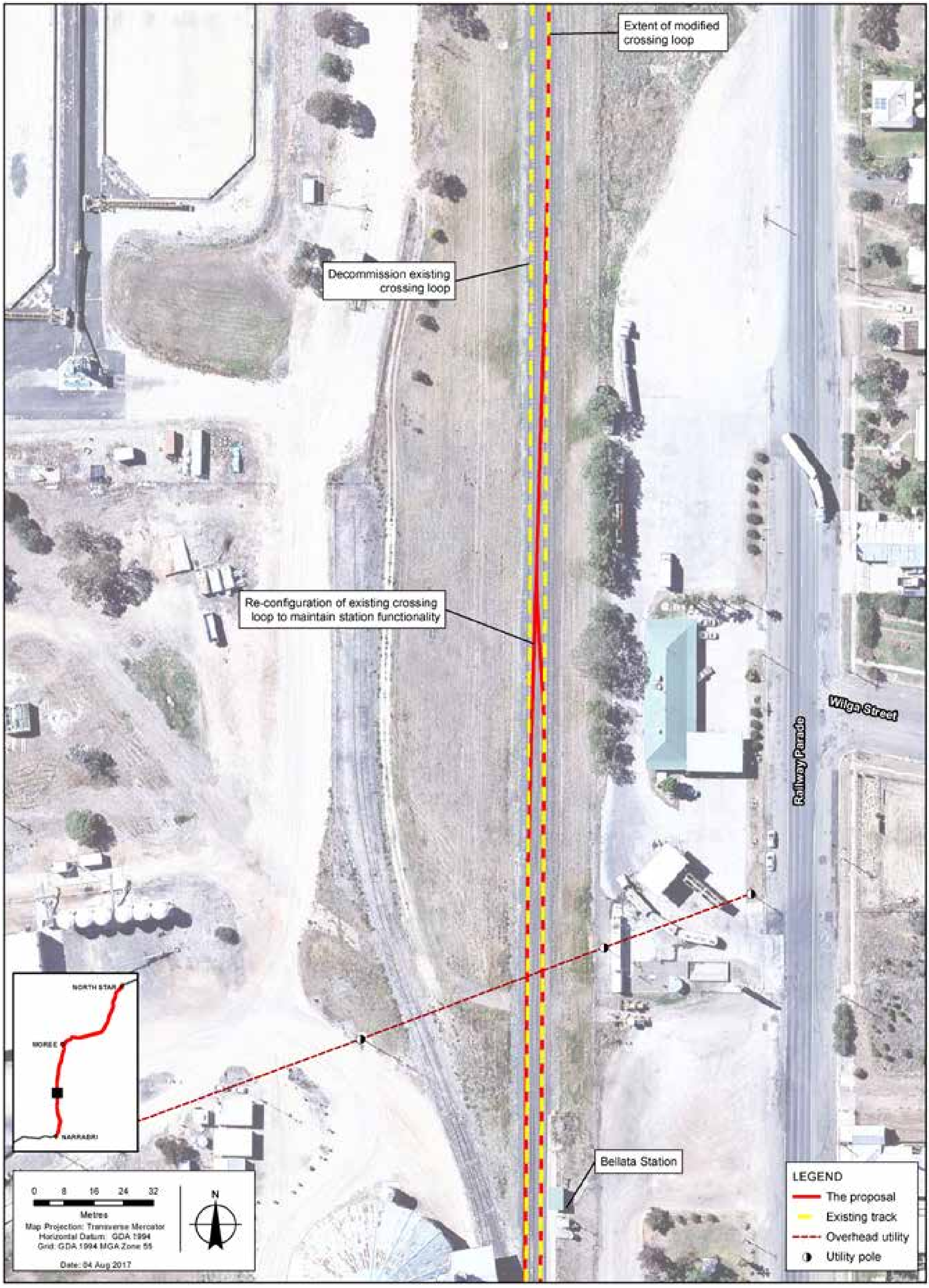


Figure 7.6 Gurley Station track realignment

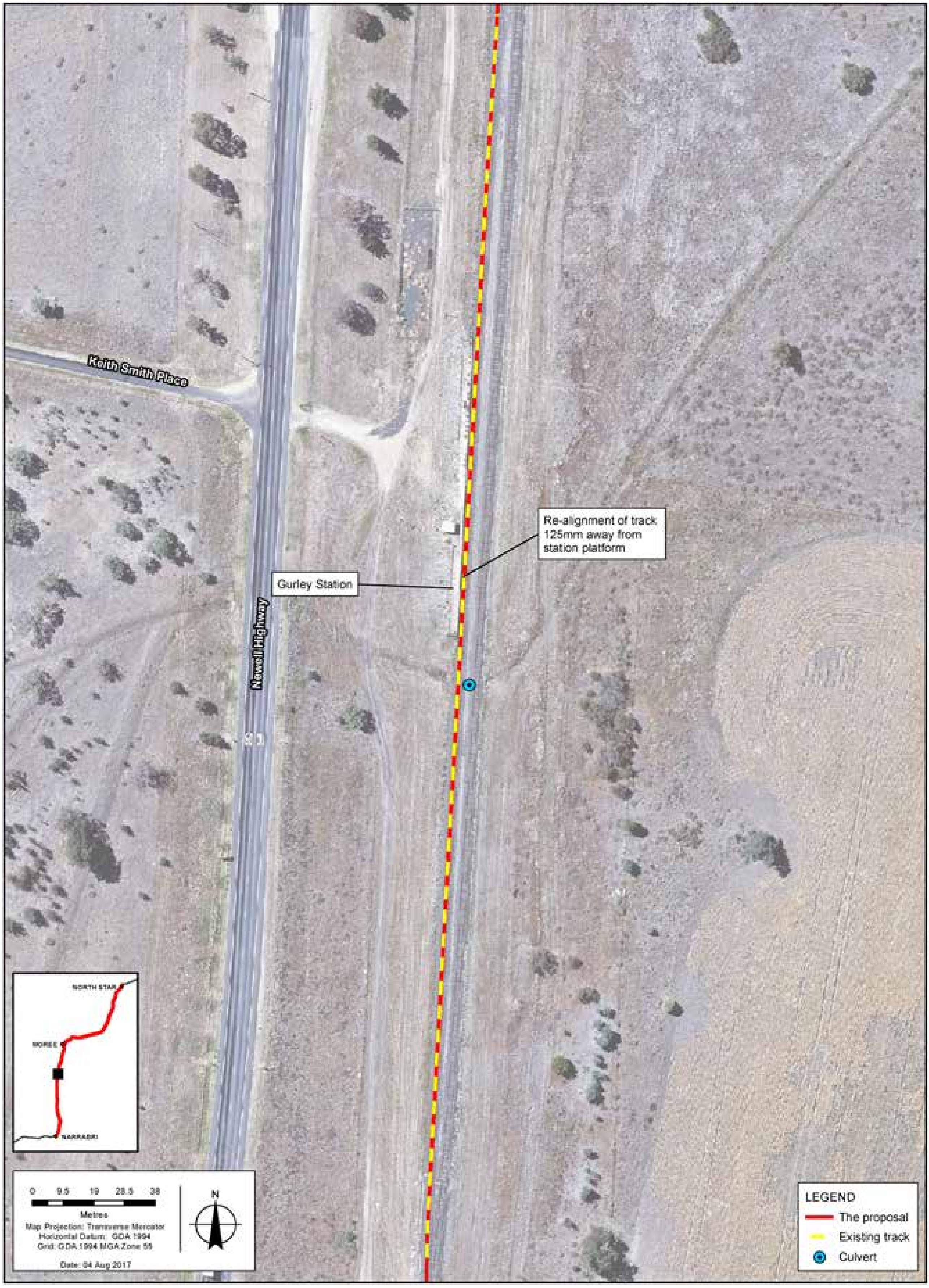


Figure 7.7 Moree Station track realignment

7.2.3 Culverts and underbridges

There are 211 culverts of varying types and sizes and 17 underbridges along the proposal site. Culverts are structures that allow water (in a watercourse or drain) to pass under the rail line. Like culverts, underbridges also allow water to pass under the rail line, however their span is longer and they are constructed differently. The majority of these structures (187 culverts) need to be replaced as part of the proposal to meet Inland Rail operational requirements. The remaining 24 culverts are proposed to be either retained or extended, pending further assessment.

Seven new culverts would also be built along the new alignment at the Camurra bypass. The location of the new culverts along the Camurra bypass has been selected to maintain the existing flow paths and minimise the potential impacts to flood depths upstream and downstream of the culverts. The culverts under the existing Camurra hairpin curve would be retained (four in total). Although it is likely that these culverts would experience a slight reduction in flow compared with the existing situation. The proposal does not include decommissioning the existing Camurra hairpin curve and as such, it is expected that ponding will occur between the existing and proposed Inland Rail alignment. The inundation is expected to be very similar to pre-development conditions.

The design of new/replacement culverts and underbridges has been informed by a hydrologic and hydraulic assessment of the proposal site, a geotechnical assessment, and a preliminary assessment of the existing structures. An assessment of flooding events has been undertaken for each structure. The target design condition for the new structures is the one per cent annual exceedance probability (AEP) flood event, where reasonably practicable.

The new structures have been designed to:

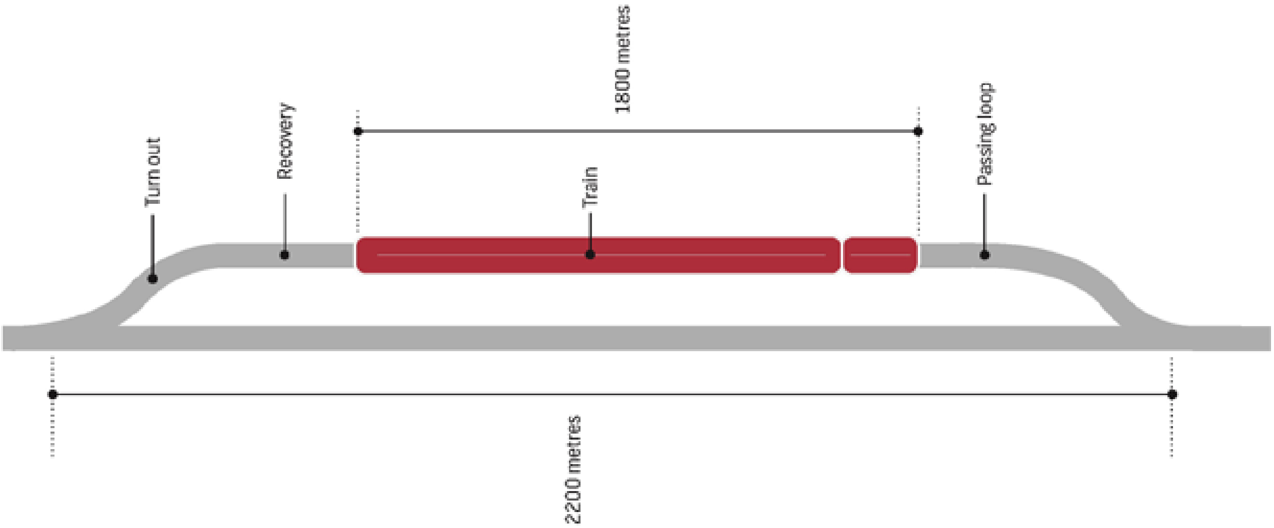
- take into account local constraints and flooding/hydrological conditions (described in Chapter 15)
- permit an appropriate flow and minimise the potential for adverse flooding impacts, by:
  - locating culverts at low points along the proposal site to prevent upstream water ponding
  - ensuring that the inside base of the culverts and underbridges match the natural surface level
  - retaining (at a minimum) the existing flow
  - minimising the potential for increases in the area of flood inundation
  - ensuring that sizes and capacities are as close to the existing situation as practicable, to minimise impacts on adjacent land and infrastructure
- meet ARTC design standards
- ensure that the flooding situation is no worse than the existing situation.

Culverts would be constructed of concrete, and would consist of three types:

- low level culvert consisting of twin cells, with approximate dimensions for each cell of 300 millimetres high by 755 millimetres wide
- mid level culvert consisting of a single cell with approximate dimensions of 700 millimetres high by 2.6 metres wide
- high level culvert consisting of a single cell with approximate dimensions of 1.5 metres high by 2.5 metres wide.

Underbridges would be constructed of reinforced concrete with a ballast top.

Figure 7.8 Indicative crossing loop design



7.2.4 Crossing loops

Five new crossing loops are proposed at Bobbiwaa, Waterloo Creek, Tycannah Creek, Coolleearllee, and Murgo. The loops would be constructed as new sections of track roughly parallel to the existing track. They would each be 2,200 metres long, to fit the design length of the train (1,800 metres). The existing rail corridor is of sufficient width to accommodate the new crossing loops.

An indicative crossing loop design is shown in Figure 7.8. The loops are shown in Figure 7.9 to Figure 7.13.

7.2.5 Turnouts

Turnouts allow the train to be guided from one track to another. The proposal involves replacing some existing turnouts, and providing new turnouts, as described in the following subsections.

New turnouts

Turnouts would be provided at the beginning and end of each crossing loop (10 in total) as well as at Bellata Station (an additional two to allow for reconfiguration of the existing crossing loops as described in Section 7.2.2).

Replacement turnouts

Eighteen turnouts would also be replaced at existing siding locations. All siding turnouts are maintained by ARTC under agreement with the siding owner. Although still within the proposal site, some sections of these turnouts may be partially located outside the existing rail corridor.

Figure 7.9 Bobbiwaa crossing loop

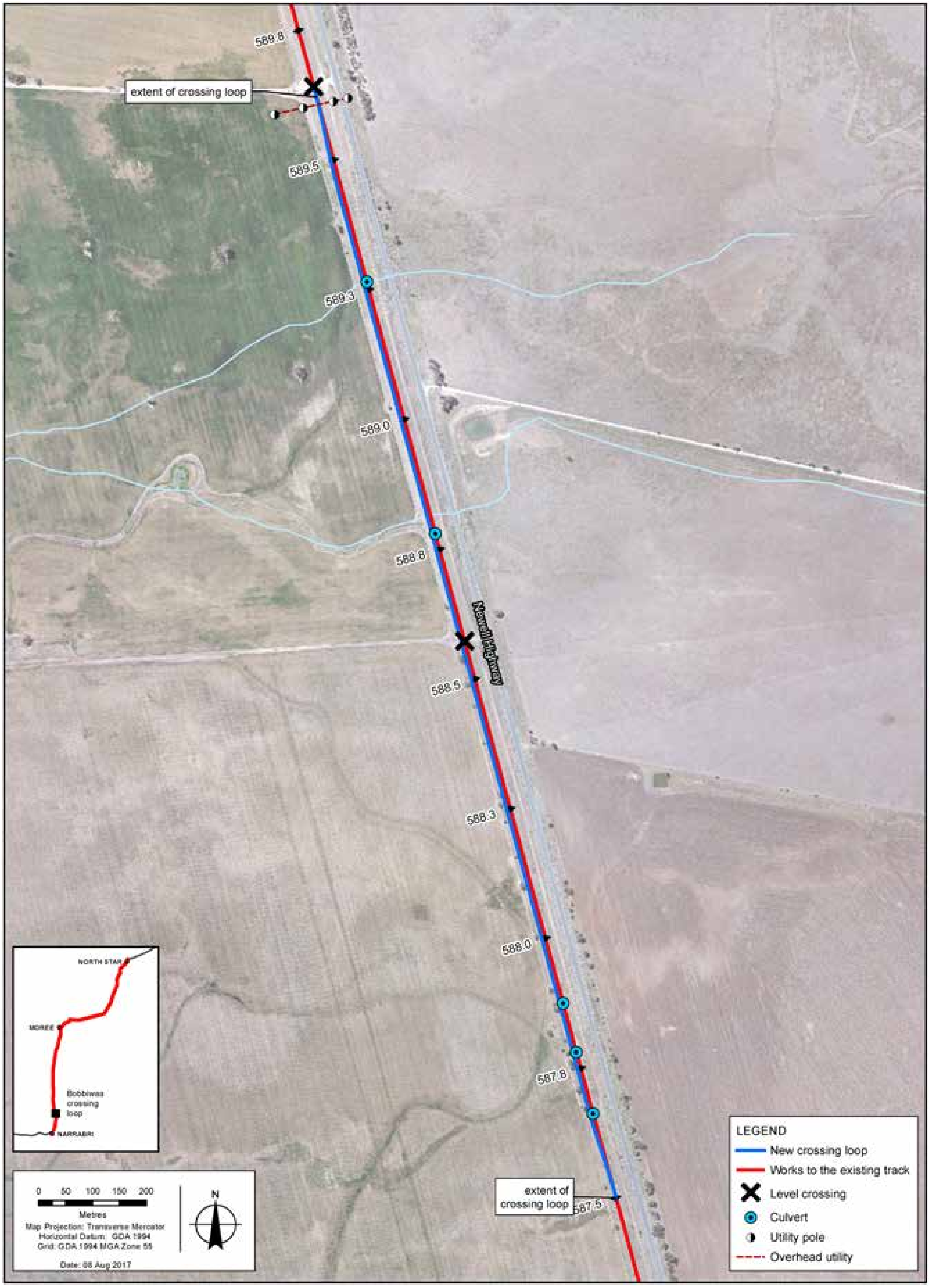


Figure 7.10 Waterloo Creek crossing loop

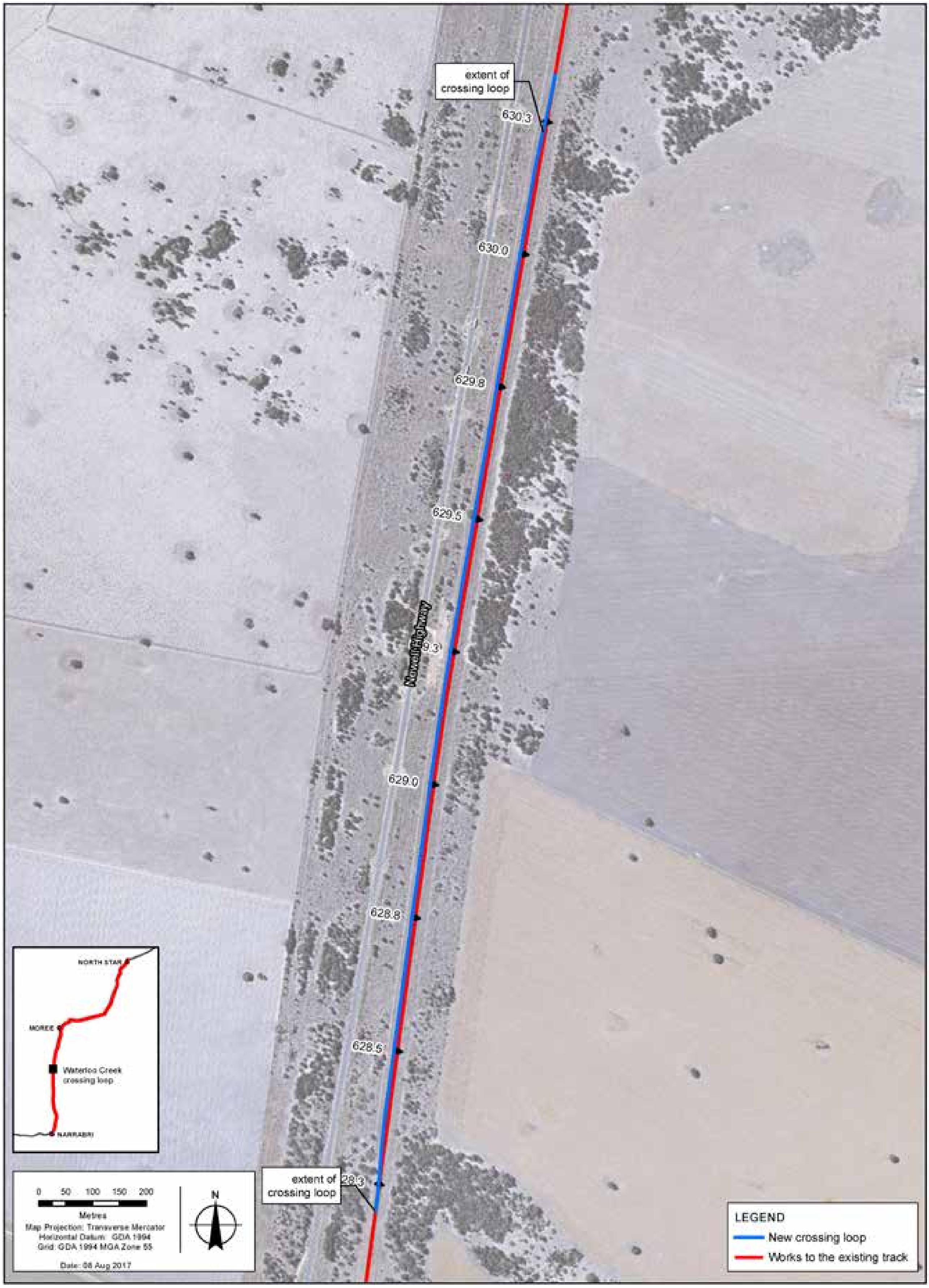


Figure 7.11 Tycannah Creek crossing loop

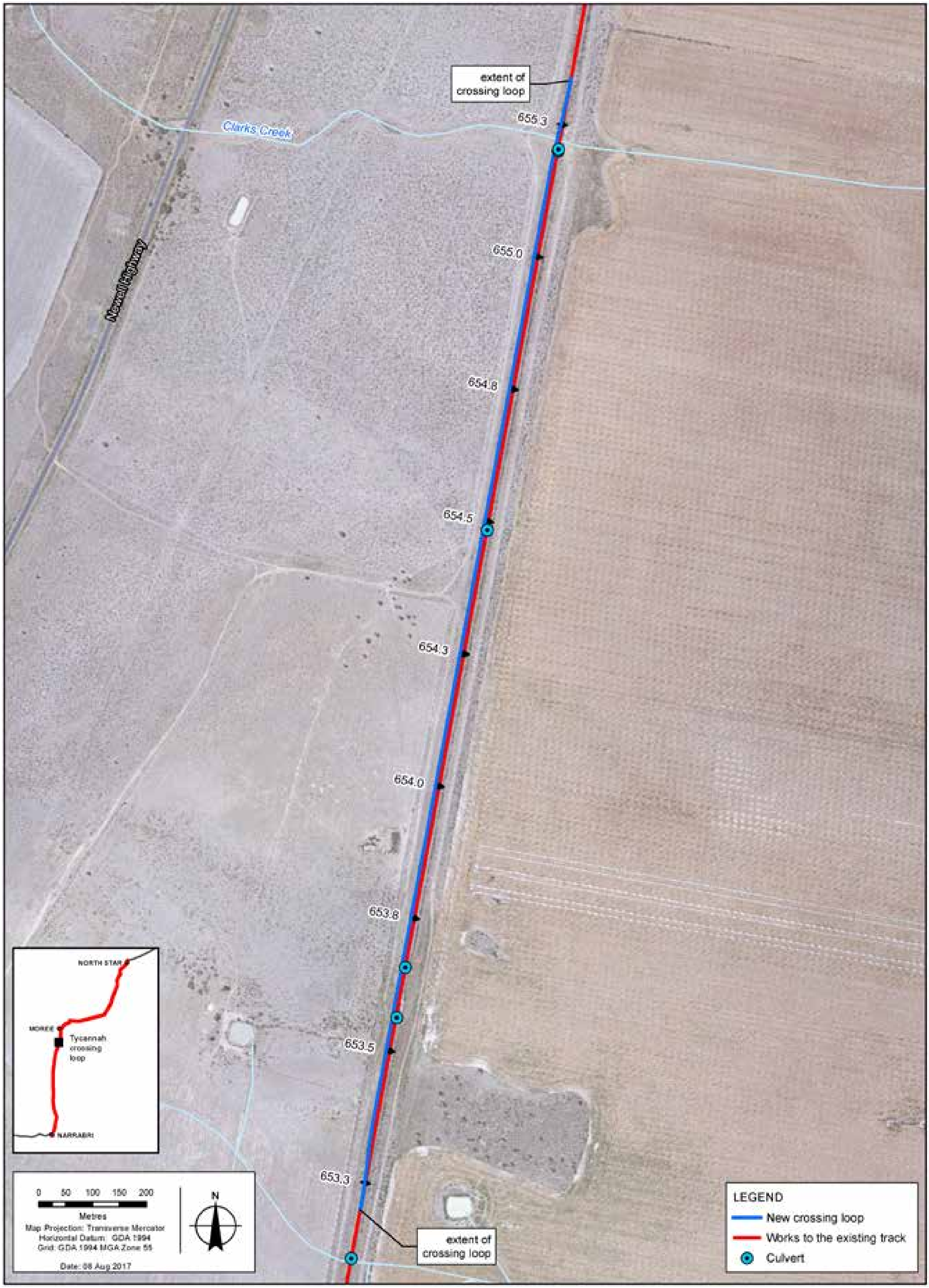


Figure 7.12 Coolleearllee crossing loop

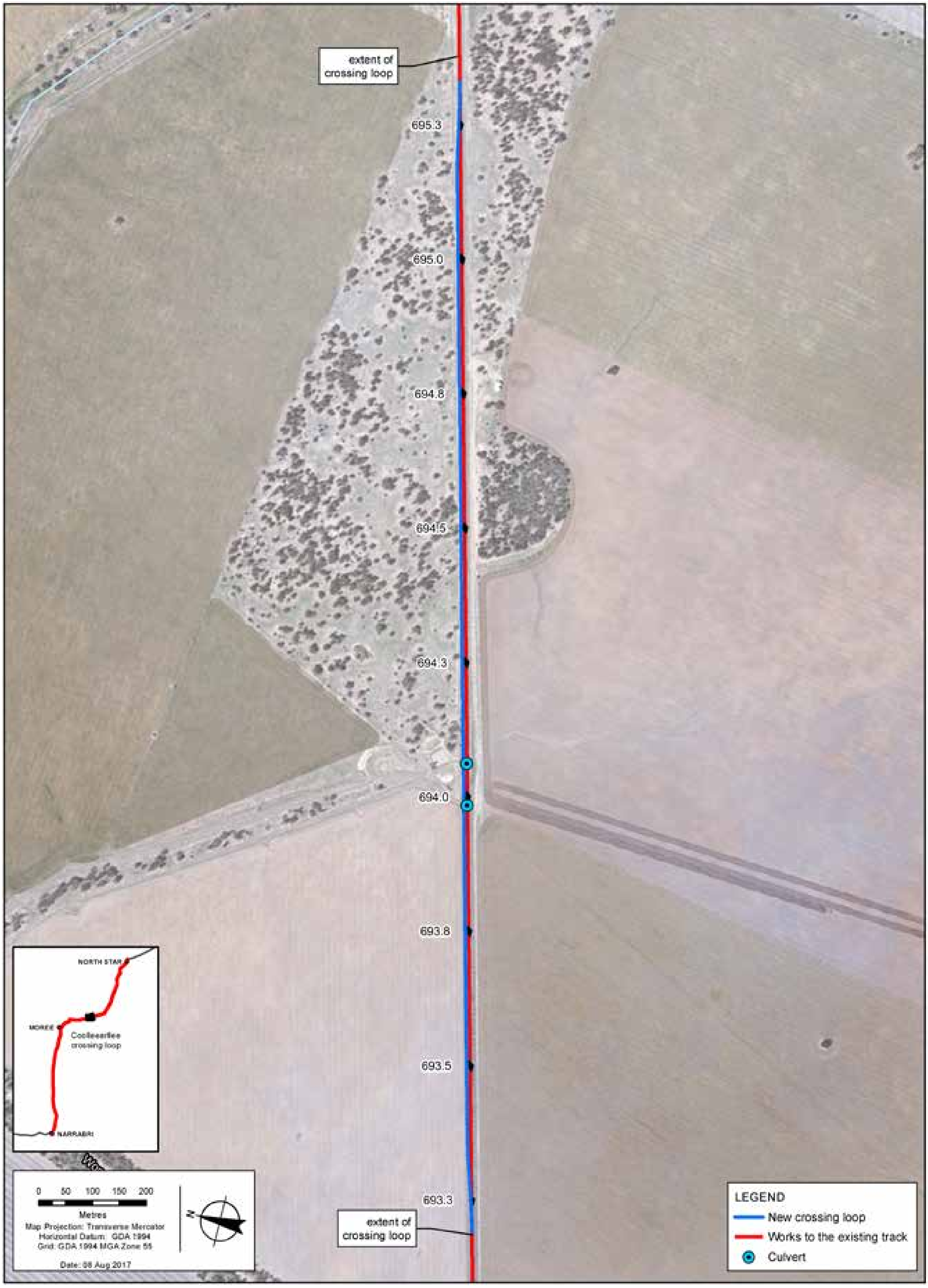
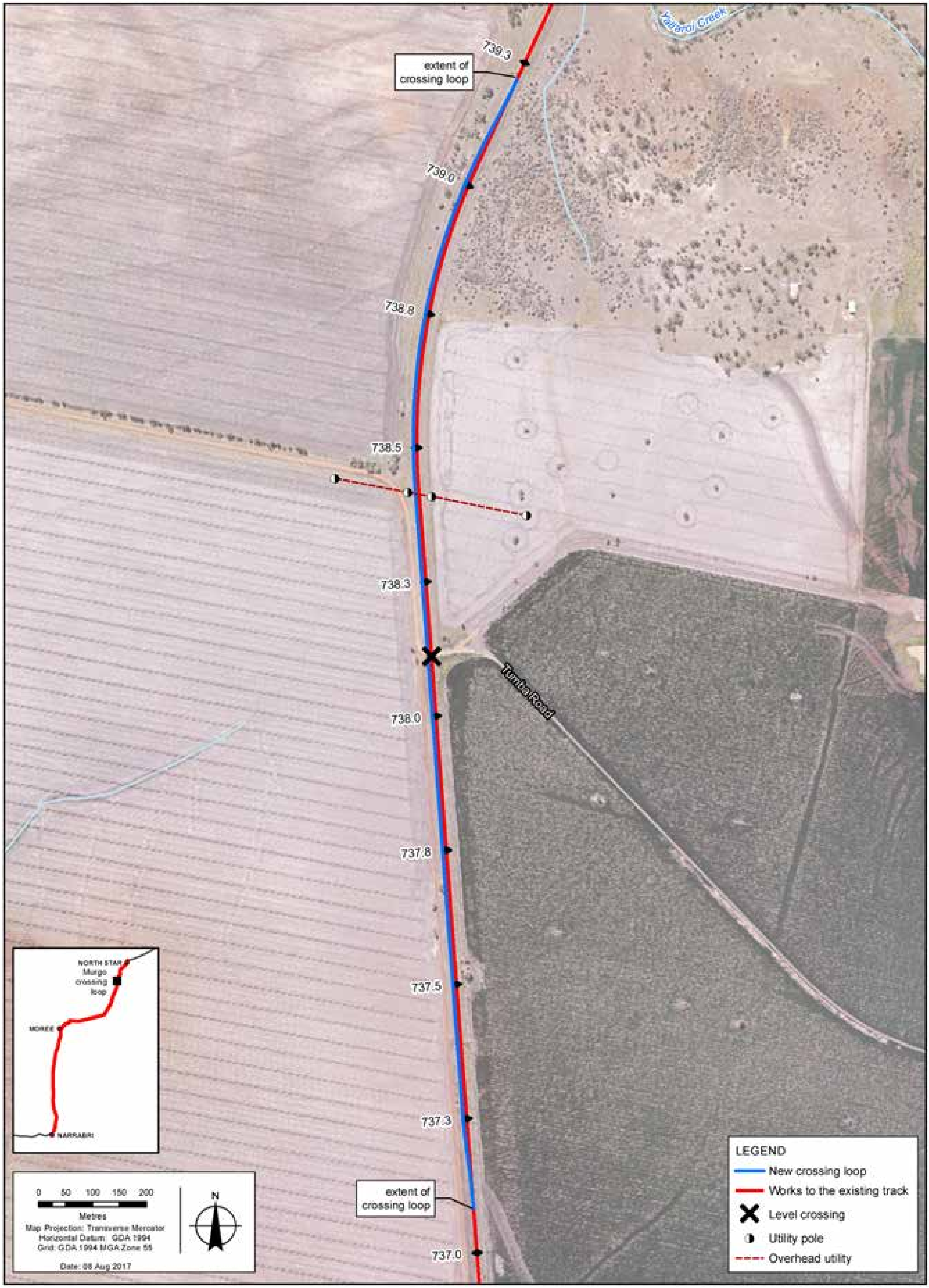


Figure 7.13 Murgo crossing loop



7.2.6 New bridges

New bridges are proposed to replace the existing bridges over Croppa Creek and the Gwydir and Mehi rivers as the existing bridges do not meet Inland Rail requirements. The locations of the existing and replacement bridges are shown in Figure 7.14 to Figure 7.16.

The existing bridges would be removed prior to construction to allow construction of the new bridges on the same alignment. The replacement bridges would consist of a bridge foundation based on bored piles and reinforced concrete blade piers, and 0.7 metres high ballast walls on each side of the structure.

Key features of the replacement bridges include:

- Mehi River bridge:
  - 152 metres long
  - 12 section/span bridge structure
  - height of about 6 metres from the river bed to the top of rail.
- Gwydir River bridge:
  - 126 metres long
  - nine section/span bridge structure
  - height of about 5 metres from the river bed to the top of rail.
- Croppa Creek bridge:
  - 75 metres long
  - three section/span bridge structure
  - height of about 13 metres from the river bed to the top of rail.

7.3 Description of key proposal features outside the existing rail corridor

This section describes those features of the proposal that would be located outside the existing rail corridor.

7.3.1 Newell Highway overbridge

A new road overbridge is proposed to enable the Newell Highway to pass above the rail corridor with sufficient clearance for double stacked Inland Rail trains to pass beneath. The overbridge would consist of about 1.5 kilometres of new two-lane road with a design speed of 100 kilometres per hour and a maximum grade of four per cent, and would include a bridge structure and two tie-ins.

Key features of the overbridge are described below and are shown in Figure 7.17.

Figure 7.14 Mehi River bridge

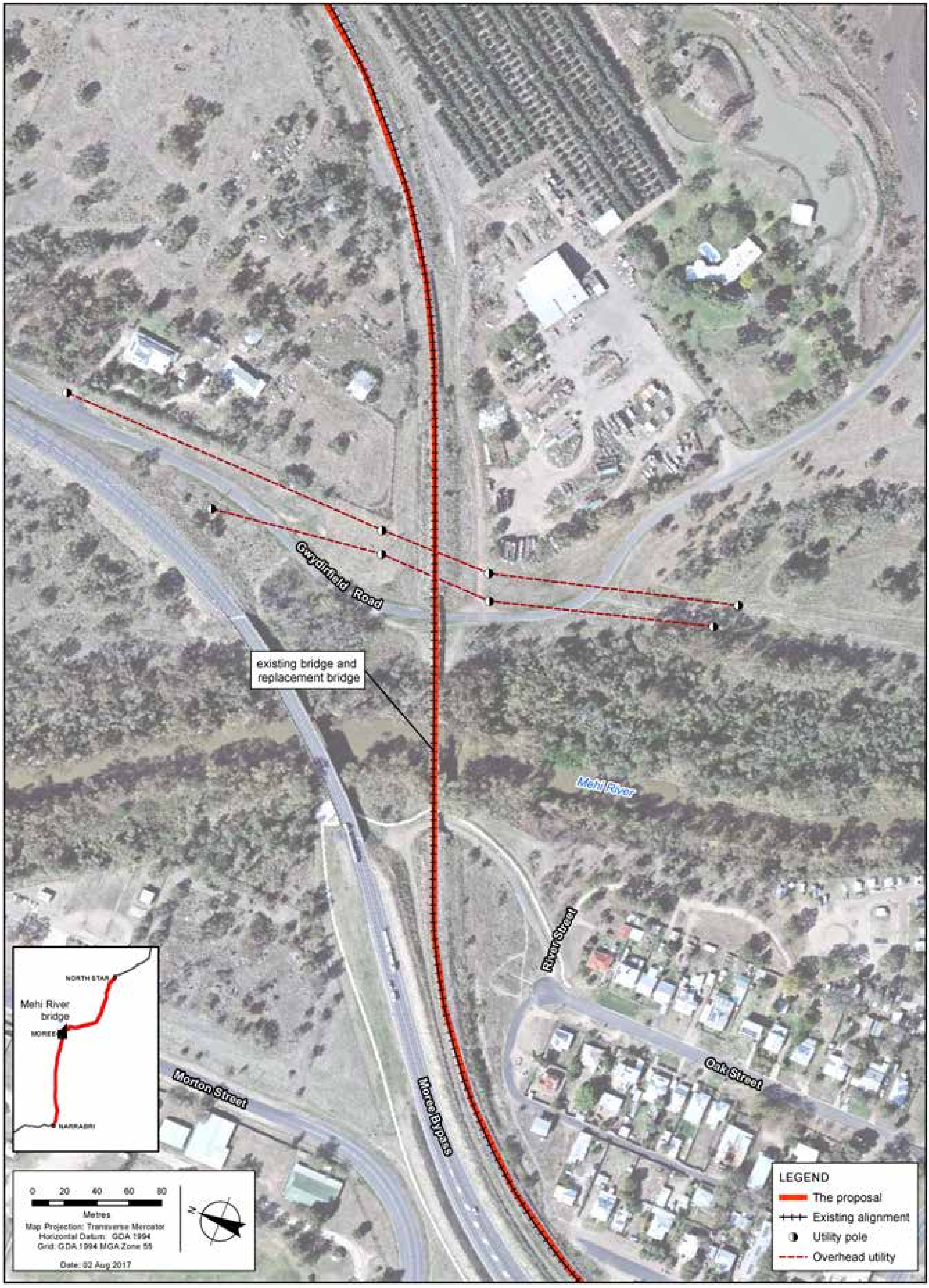


Figure 7.15 Gwydir River bridge

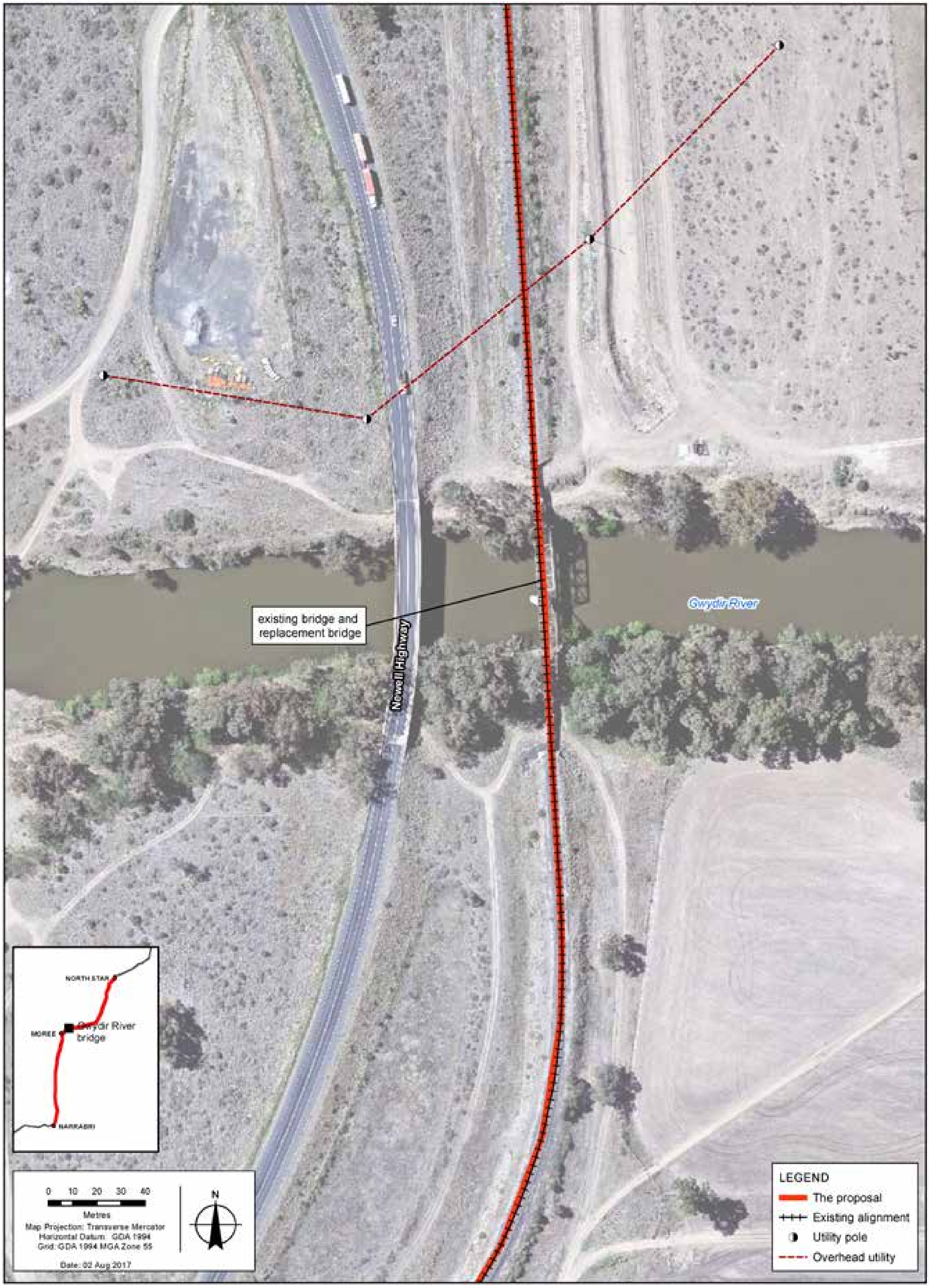


Figure 7.16 Croppa Creek bridge

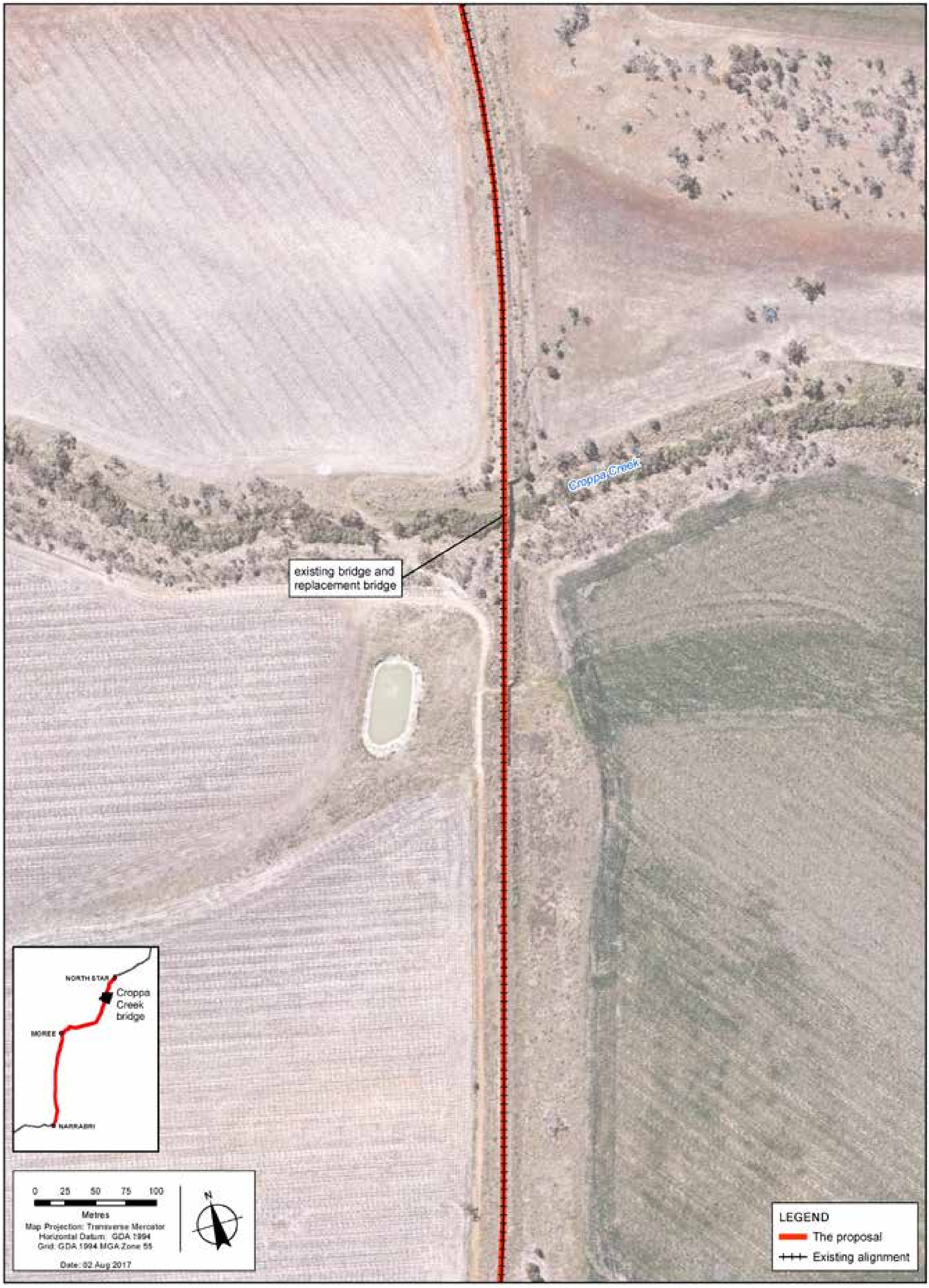
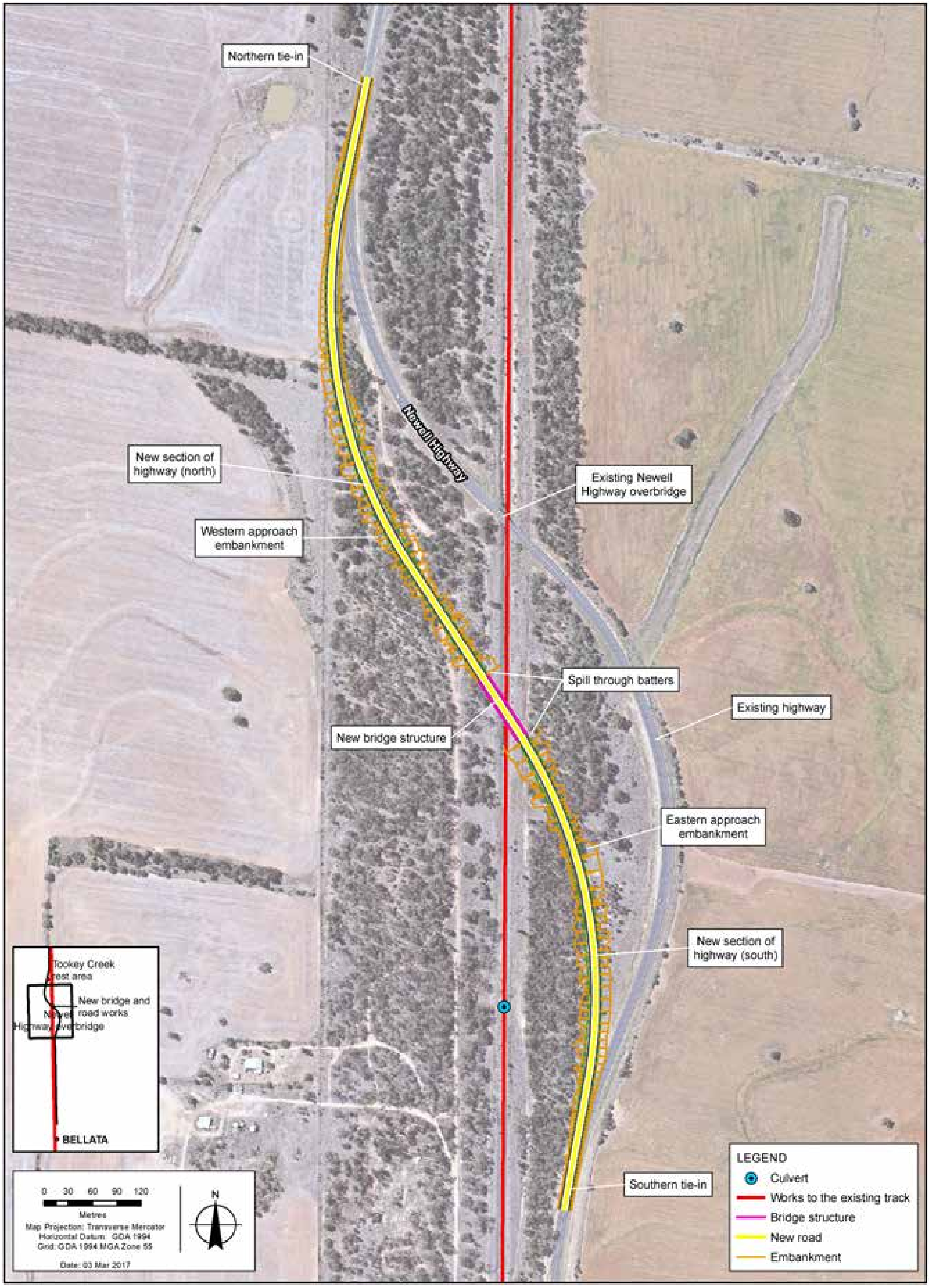


Figure 7.17 Newell Highway overbridge



Bridge structure

The bridge structure would consist of:

- a new 83 metre long three span super T girder bridge structure, supported on cast insitu reinforced concrete piers/abutments, and founded using reinforced concrete bored piles
- road pavement consisting of two lanes with a width of 3.5 metres each, and two shoulders with a width of 2 metres each
- reinforced soil wall abutments with a maximum height of 10 metres
- spill through batters at the eastern and western abutments
- a bridge clearance height of 7 metres.

Tie-ins

New sections of road (known as 'tie-ins') would be constructed at the northern and southern ends of the overbridge to connect the bridge to the existing section of Newell Highway. The tie-ins would be about 600 metres long on the southern side, and about 790 metres long on the northern side. They would include a 350 metre long eastern approach embankment and a 500 metre long western approach embankment. The tie-ins would consist of two lanes with a width of 3.5 metres each, and two shoulders with a width of 2 metres each.

7.3.2 Camurra bypass

A new section of track would be built at Camurra outside of the existing rail corridor to allow trains to bypass the existing hairpin curve (shown in Figure 7.18). The Camurra bypass involves:

- 1.6 kilometres of new track to the east of the existing turn, with an 800 metre radius
- constructing seven culverts
- connections to the existing rail lines to the east and west
- property acquisition, including 50 metres of irrigation channel and a portion of a travelling stock reserve.

7.3.3 Jones Avenue overbridge, Moree

The proposal involves providing a road overbridge and road connections between Jones Avenue to the west of the rail corridor (between Warialda Street and Joyce Avenue), and Tycannah Street to the east of the road corridor (a distance of about 710 metres). The overbridge would enable road traffic to pass over Gosport Street, the Moree Bypass (Newell Highway) and the rail corridor. Truck access to the industrial area south of Jones Avenue would be maintained or appropriate alternative access routes created. The overbridge would consist of about 620 metres of new road with a design speed of 50 kilometres per hour, and would include a bridge structure and two tie-ins.

Key features of the overbridge are described below and are shown in Figure 7.19.

Figure 7.18 Camurra bypass

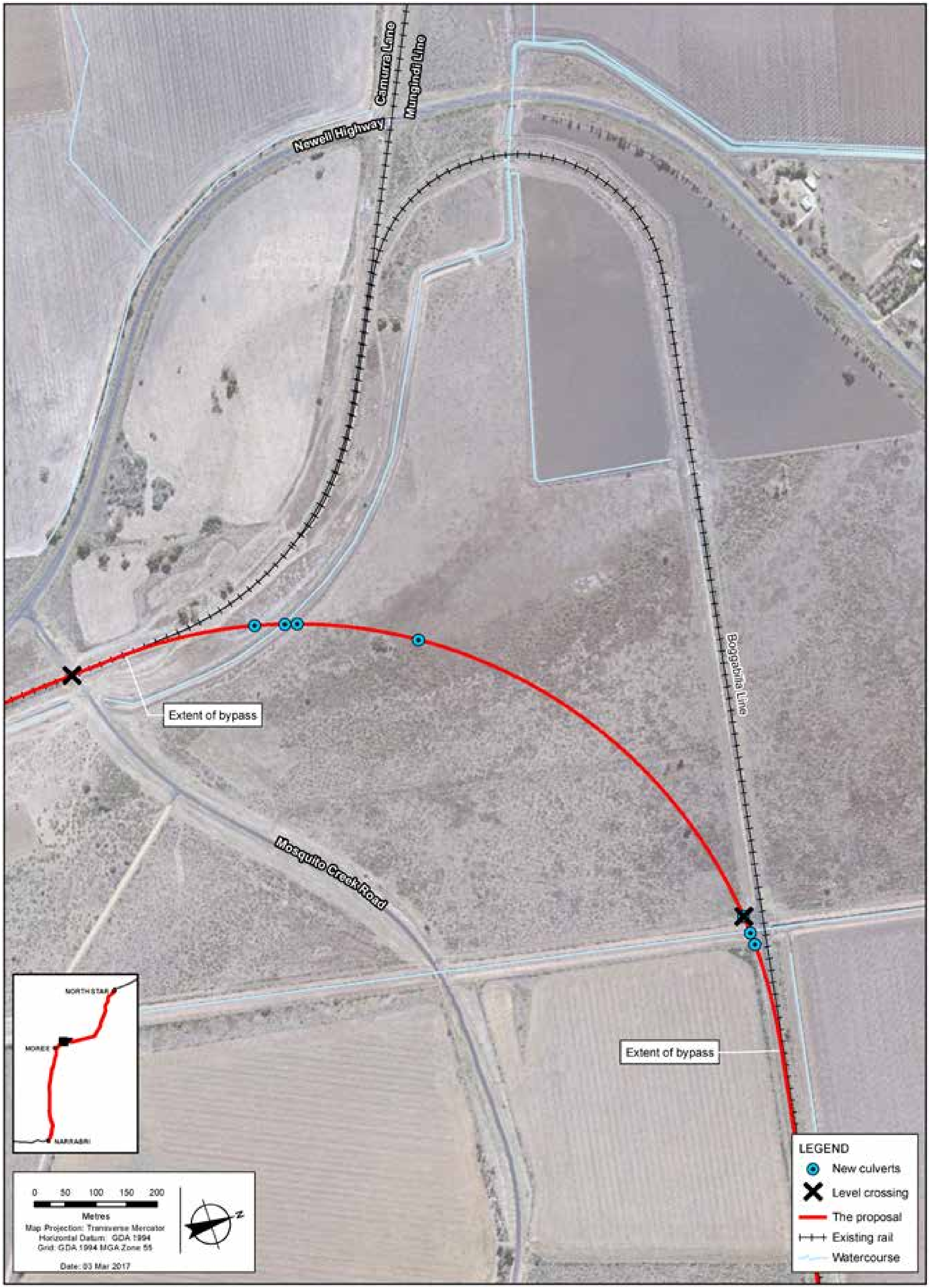
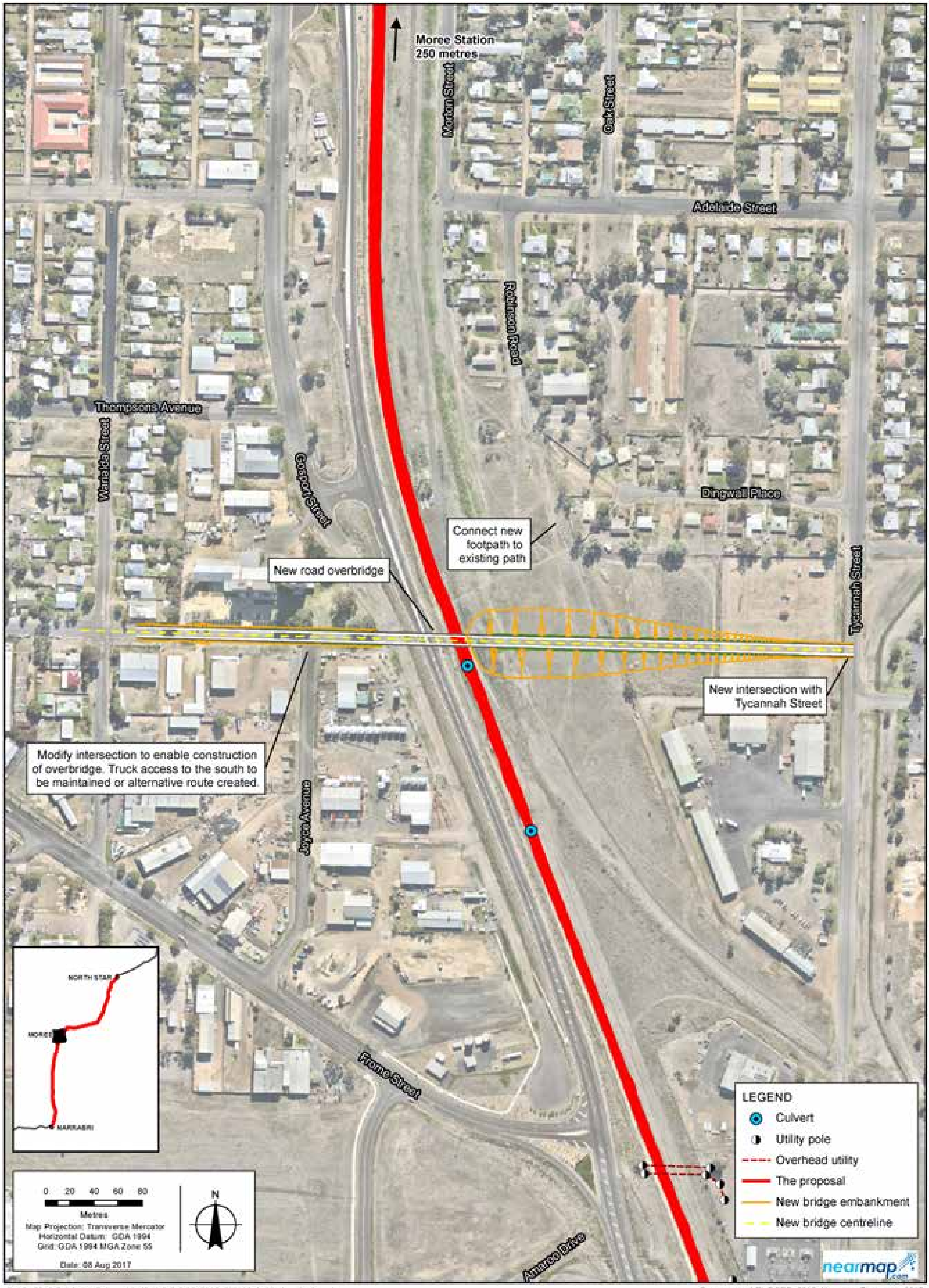


Figure 7.19 Jones Avenue overbridge



Bridge structure

The bridge structure would consist of:

- a new 89.5 metre long three span super T girder bridge structure, supported on cast insitu reinforced concrete piers/abutments, and founded using reinforced concrete bored piles
- road pavement consisting of two lanes with a width of 3.5 metres each, two shoulders with a width of 1.0 metre each and one 1.5 metre wide shared pedestrian/cycle path with kerb separation on the northern side of the bridge
- 10 metre high embankments east and west of the bridge
- throw screens on both sides of the bridge
- bridge clearance of 7.1 metres.

Tie-ins

New sections of road would be constructed at the western end of the overbridge to connect the bridge to the existing section of Jones Avenue and at the eastern end to create a road intersection with Tycannah Street. The tie-ins would be about 200 metres long on the western end and include a retaining wall, and would be about 250 metres long on the eastern side consisting of an approach embankment. The tie-ins would be about 11.7 metres wide, and would consist of two lanes with a width of 3.5 metres each, and two shoulders with a width of 1.0 metre each and one 1.5 metre wide shared pedestrian/cycle path.

Road modifications

Construction of the road overbridge would involve modifications to the intersection of Joyce and Jones avenues (west of the rail corridor). All property access would be maintained along Joyce and Jones avenues.

7.4 Ancillary works and infrastructure

7.4.1 Track drainage

Drainage in the form of a cess drain would be installed within the rail corridor adjacent to the track. Cess drains are surface drains located to the side of the tracks, used to remove water that percolates through the ballast and flows along the capping layer towards the outside of the track formation. Cess drains are used to protect the track formation by keeping it dry.

As the proposal site is relatively flat, cess drains are proposed where the upstream catchment has an area of 5,000 square metres or greater, and is within 25 metres of the rail line.

The cess drains would be positioned towards the outer limit of the rail corridor, with the surrounding earthworks shaped to shed water towards its location.

7.4.2 Spoil mounds

Excess material resulting mainly from the excavation of track formation and cess drains would be stockpiled along the rail corridor. The stockpiles would be located as close as possible to the source of the excavated material and would be formed into permanent spoil mounds, spread out to minimise height. Spoil mounds would be designed to have a maximum height of 2 metres (about one metre above the top of the rails), and in some cases, may need to be located on both sides of the rail track. The mounds would be stabilised as required.

Gaps in the spoil mounds would be provided to allow water to drain away from the formation. The location, sizing and design of the mounds would be determined during the detailed design phase, with consideration given to the results of hydraulic modelling and sight distances. Mounds would not be located in areas where they would impact on flooding or drainage.

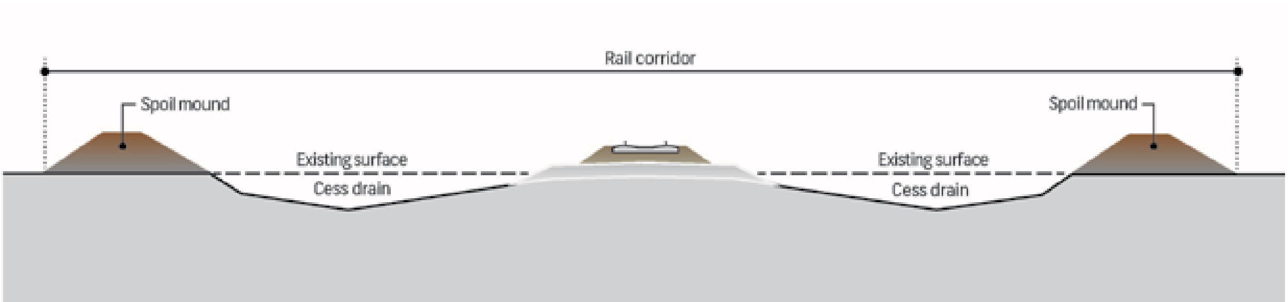
An indicative cross section of the proposal with spoil mounds is shown in Figure 7.20.

7.4.3 Level crossings

Works at the majority of the 86 level crossings along the proposal site are required to ensure crossings meet relevant Australian and ARTC level crossing design standards. The preferred option for level crossings, developed as an outcome of stage 1 of the level crossing strategy, involves a mix of retaining/refurbishing existing crossings, considering the consolidation of some crossings, upgrading the level of control, or installing a gated crossing.

ARTC is currently undertaking stage 2 of the level crossing strategy, which involves consulting with relevant stakeholders (including landowners and road owners) to confirm the preferred approach, and finalising the designs for the works at each crossing.

Figure 7.20 Indicative spoil mound cross-section



Where an existing access to or within a property is proposed to be removed, altered or severed, additional works to reinstate access to the property would be undertaken. This may require works outside the rail corridor.

Further information on the level crossing strategy is provided in Section 6.3.4.

Upgrading signalling and communications

Signalling and communications would be upgraded as part of the level crossing works, to enable any level crossings with active controls to tie into the rail network.

ARTC's Advanced Train Management System (ATMS) would be implemented to manage signalling and communications for the wider rail network. ATMS is a communication based train management system, which communicates via both voice and data between Network Control Centres and locomotives operating on ARTC's rail network.

7.4.4 New fencing

Existing fencing along the rail corridor would be replaced as required. Where the corridor abuts a public road, fencing would be installed on the field side only. The fencing would consist of a standard stock fence (1.2 metres high).

Along sections of the rail line in Moree noise attenuation structures would be constructed instead of fencing. Preliminary noise treatment locations have been identified utilising noise modelling and the location of sensitive receivers relative to the rail line. Key locations include near Moree Station and the proposed Jones Avenue overbridge. The location of the noise attenuation structures would be confirmed during detailed design but generally they would be located towards the outer edge of the rail corridor to improve the effectiveness of the attenuation structures.

7.4.5 Signage

Signage would be provided/replaced where required.

7.5 Land acquisition

The existing rail corridor is owned by the NSW Government (Transport for NSW). The majority of the proposal would be undertaken within the existing rail corridor or on land for which ARTC has existing access agreements.

A limited amount of property acquisition would be required, as summarised in Appendix G. The extent of property impacts would be refined and confirmed during detailed design in consultation with property owners. For partial acquisitions, property adjustment plans would be developed in consultation with the property owner.

Leasing requirements are unknown at this stage. Consultation regarding agreements would be undertaken with landowners prior to works commencing.

All acquisitions would be undertaken in accordance with the requirements of the *Land Acquisition (Just Terms) Compensation Act 1991.*

7.6 Operation of the proposal

7.6.1 Train operations

The proposal would form part of the rail network managed and maintained by ARTC. Train services would be provided by a variety of operators. The existing operation of the Mungindi line (described in Section 2.5.2) would continue prior to, during, and following construction of the proposal. Inland Rail as a whole would be operational once all 13 sections are complete, which is estimated to be in 2025.

Inland Rail would involve operation of a single rail track with crossing loops, to accommodate double stacked freight trains up to 1.8 kilometres long and 6.5 metres high. Train speeds would vary according to axle loads, and range from 80 to 115 kilometres per hour, except through Moree where the maximum train speed would be 65 kilometres per hour due to track geometry.

It is estimated that the operation of Inland Rail would involve an annual average of about 10 trains per day travelling north of Moree (between North Star and Moree) and 12 trains per day travelling south of Moree (between Moree and Narrabri) in 2025. This would increase to about 19 trains per day north of Moree (between North Star and Moree) and 21 trains per day south of Moree (between Moree and Narrabri) in 2040. This rail traffic would be in addition to the existing rail traffic using the Narrabri to North Star line.

The Inland Rail trains would be a mix of grain, bulk freight, and other general transport trains. Total annual freight tonnages would be about 11.8 million tonnes in 2025, increasing to about 19 million tonnes in 2040 (from the existing two million tonnes of grain per year).

The Xplorer passenger train would continue to stop at Moree and Bellata stations. Train stop locations for Inland Rail trains would be confirmed during detailed design.

7.6.2 Maintenance activities

Standard ARTC maintenance activities would be undertaken during operations. Typically, these activities include minor maintenance works, such as bridge and culvert inspections, rail grinding and track tamping, through to major maintenance, such as reconditioning of track and topping up of ballast as required.

8. Construction of the proposal

This chapter provides an outline of the indicative construction activities likely to be used to construct the proposal. It includes a summary of the proposed timing, an indicative construction methodology, likely resources, and proposed access arrangements. This information is preliminary only, and is based on the current stage of the design. The construction methodology would be refined as the design of the proposal progresses, and once the construction contractor is engaged.

8.1 Overview of construction scope and approach

Construction of the proposal would commence once all necessary approvals are obtained, and the detailed design is complete. It is anticipated that construction would take about 24 months, commencing in mid-2018, and concluding in mid-2020.

The construction methodology, sequencing and durations would be confirmed once a possession strategy has been agreed with affected train operators, track stakeholders and relevant government departments. The possession strategy would define the times that rail traffic would not be permitted to operate along the existing rail corridor. An indicative possession strategy and approach to rail traffic management during construction is provided in Table 8.1.

Construction along the existing rail corridor would depend on the possession strategy however, it is anticipated that works would commence north of Moree, then move north of Narrabri in stages, as follows:

- stage 1 – Camurra to North Star
- stage 2 – Narrabri to Bellata
- stage 3 – Bellata to Moree South
- stage 4 – Moree South to Camurra.

Construction of the Newell Highway overbridge, the Camurra bypass, and the Jones Avenue overbridge would be undertaken in parallel with the above stages.

For each stage, the timing of construction along the existing rail corridor would depend on the possession strategy. Further information on working hours is provided in Section 8.3.

8.1.1 Approach to avoiding or minimising impacts during construction

Mitigation and management measures applicable to the design, pre-construction and construction stages would be implemented to avoid or minimise the construction impacts described in Chapters 9 to 26. Mitigation measures are provided in each chapter in Part C, and are summarised in Chapter 27. The measures include preparing and implementing a construction environmental management plan (CEMP) including detailed sub-plans.

The CEMP would be prepared for the construction phase of the proposal by the responsible construction contractor. The CEMP would provide a centralised strategy through which all potential environmental impacts would be managed during construction, and would include detailed management measures to avoid or minimise potential impacts. The requirements for the CEMP are described in Chapter 27. An outline of the CEMP, including the required sub-plans, is provided in Appendix K.

8.2 Indicative construction methodology

For each stage, construction would typically involve:

- site establishment (described in Section 8.2.1)
- main construction works (described in Sections 8.2.2 to 8.2.8)
- testing and commissioning (described in Section 8.2.9)
- finishing works (described in Section 8.2.10).

The construction methodology would be further developed and confirmed during detailed design.

8.2.1 Site establishment

Site establishment would generally involve:

- consult landowners/occupants where required
- install site environment management and traffic controls in accordance with the CEMP
- establish site compounds and facilities
- clear vegetation
- erect temporary fencing
- establish site access roads where required
- utility relocations as required
- deliver and stockpile materials including rail, sleepers, ballast, culverts and structural fill.

8.2.2 Track works

Track upgrading

A general methodology for the main proposed forms of track upgrading is provided below:

- Track reconstruction:
  - remove fastenings, rail and sleepers and stockpile to one side of the rail corridor
  - excavate the existing ballast and earth formation
  - place new earth and recycled ballast into the excavated area and compact
  - place new ballast on top of the earth formation and compact
  - place concrete sleepers and rail tracks on prepared ballast bed and weld up rails
  - place new ballast on top of the sleepers
  - tamp and profile the ballast around the sleepers and line to a smooth alignment.
- Skim reconditioning:
  - remove fastenings, rail and sleepers and stockpile to one side of the rail corridor
  - trim and level the existing ballast bed and compact
  - place concrete sleepers and rail track on prepared ballast bed and weld up rails
  - place new ballast on top of the sleepers
  - tamp and profile the ballast around the sleepers and line to a smooth alignment.
- Skim plus reconditioning:
  - remove fastenings, rail and sleepers and stockpile to one side of the rail corridor
  - trim and level the existing ballast bed and compact
  - place new capping material on top of compacted ballast
  - place concrete sleepers and rail track on prepared ballast bed and weld up rails
  - place new ballast on top of the sleepers
  - tamp and profile the ballast around the sleepers and line to a smooth alignment.

Track realignment works

Track realignment works at Bellata, Gurley, and Moree stations would involve:

- excavate and remove existing track and formation
- construct new track as described above
- weld and adjust track to interface back into existing track alignment.

In addition, the eastern side of the platform at Moree Station may need to be upgraded to allow passengers to join or alight from the Xplorer passenger service. This would be confirmed during detailed design.

Culverts/underbridges

Where required, culverts and underbridges would be removed and replaced as described below. Culvert and underbridge replacement would be undertaken online (the structure would be replaced in the same location). Culverts would be pre-cast off-site, and installed along the proposal site as the track upgrading works progress.

Culvert replacement

- remove existing culvert structure (either concrete or steel pipes)
- excavate to the required depth
- place and compact bedding material
- place pre-fabricated culvert structures on the new formation area and fasten together
- place ballast, sleepers and rail on top of the culverts and tamp and profile the ballast under and around the sleepers and weld up tracks.

Underbridge replacement

- install substructure components including bored/ precast concrete/ steel piles beneath the existing structure
- during a track possession remove existing superstructure (including girders) and substructure components (abutments and piers) and store at nominated locations within the rail corridor
- install any new substructure precast concrete components on the new substructure/ piles
- place new girders (concrete) on the new concrete substructures
- place ballast, sleepers and rail on top of the new bridge and tamp and profile the ballast under and around the sleepers and weld up tracks
- install guard rails as required.

Crossing loops

The general methodology for constructing crossing loops is as follows:

- excavate beside the existing track for the length of the crossing loop
- place and compact formation material
- place ballast, sleepers and rail tracks on top of the new formation
- install signal equipment and associated equipment
- testing and commissioning.

Turnouts

The general methodology for constructing turnouts is as follows:

- cut existing track, remove and dispose of existing turnout (at existing sidings only)
- undertake formation improvement works as required
- install ballast, sleepers and rails
- install control mechanisms (points motor, power supply etc)
- testing and commissioning.

Drainage

The general methodology for drainage construction is as follows:

- prepare survey control points for planned excavation of cess drains
- excavate earth material from the side of the existing track formation, and trim and compact base and sides of the drain
- form spoil mounds.

8.2.3 Level crossings

The general methodology for level crossings is as follows:

- Upgrading controls:
  - remove existing controls, excavate to a suitable depth as required, place new formation material and ballast, replace track and surface panel as required
  - install new controls
  - provide standard road signs and road markings.
- Consolidating level crossings:
  - complete road works and appropriate road signage to redirect traffic
  - remove level crossing signs and road markings
  - upgrade tracks as described in Section 8.2.2.

The pedestrian level crossing at Moree Station would be upgraded as follows:

- remove existing pedestrian crossing
- construct pedestrian footpath and pedestrian maze
- install relevant track circuitry for active crossing control
- line marking and installation of signage.

8.2.4 New bridges

Construction of the new bridges over the Mehi and Gwydir rivers and Croppa Creek would generally involve the following:

- install substructure components including bored/ precast concrete/ steel piles alongside the existing bridge
- install any new substructure precast concrete components on the new substructure/ piles
- remove existing bridge superstructure and demolish the existing visible substructure (piers only) as far as required
- place new girders (concrete) on the new concrete substructures
- construct new earth formation to connect between the existing track alignment and the new bridge alignment
- place ballast, sleepers and rail on top of the new bridge and tamp and profile the ballast under and around the sleepers and weld up tracks
- install guard rails as required.

Demolition of the existing bridges over the Mehi and Gwydir rivers and Croppa Creek would generally involve the following:

- establish a crane pad for an appropriately sized crane (probably at least one on each side of the river bank)
- demolish the steel superstructure (lifting sections onto trucks to be reused elsewhere on ARTC network or disposed of at nearby recycling facility)
- demolish the visible existing brick or concrete piers
- dispose of waste material off-site.

8.2.5 Newell Highway overbridge construction

Construction of the Newell Highway overbridge would generally involve the following:

Bridge works

- construct cast-in-place piles at abutments and piers
- construct spill through abutments, column extensions and pier headstocks
- install pre-stressed concrete girders and construct reinforced concrete deck
- construct reinforced concrete approach slabs
- install expansion joints and steel traffic barrier railing
- install waterproof membrane and asphalt.

Embankment and pavement works

- place bulk general fill to construct approach embankments
- if identified as necessary during detailed design, install a culvert suitable for the travelling stock route
- construct new pavement, including placing and compacting select fill, sub base and asphalt wearing surface
- tie into the existing Newell Highway.

Finishing and landscaping

- rehabilitate disturbed areas and landscape in accordance with the rehabilitation strategy
- line marking and sign posting
- final site clean-up
- switch traffic
- demolish the existing bridge.

8.2.6 Camurra bypass

Construction of the Camurra bypass would involve the following:

- excavate to a depth determined by geotechnical investigations and design
- place imported formation material into the excavated area and compact using vibratory compaction rollers
- place bottom ballast
- place skeletonised track consisting of fastenings, rail and sleepers on bottom ballast
- place ballast on top of the track
- tamp and profile the ballast around the sleepers and line to the design's vertical and horizontal alignment
- construct cess drainage as described in Section 8.2.2
- construct tie-ins to the existing alignment and install turnouts.

8.2.7 Jones Avenue overbridge construction

Construction of the Jones Avenue overbridge would generally involve the following:

Bridge works

- construct cast-in-place piles at abutments and piers
- construct spill through abutment on eastern side and reinforced soil wall abutment on western side
- construct column extensions and pier headstocks
- install girders and construct reinforced concrete deck
- install pedestrian footpath
- construct reinforced concrete approach slabs
- install throw screens
- install expansion joints and steel traffic barrier railing
- install waterproof membrane and asphalt.

Embankment and pavement works

- place bulk general fill to construct approach embankments
- construct new pavement, including placing and compacting select fill, sub base and asphalt wearing surface
- construct pedestrian walkway down the side of the embankments to be *Disability Discrimination Act 1992* compliant
- tie into existing Jones Avenue.

Finishing and landscaping

- rehabilitate disturbed areas and landscape in accordance with the rehabilitation plan
- line marking and sign posting
- modify existing Joyce Avenue intersection with Jones Avenue
- relocate property accesses for affected properties
- final site clean-up.

8.2.8 Earthworks

Earthworks would be required:

- where upgrades to the formation are required
- to widen existing embankments and cuttings to meet design requirements
- to construct the new crossing loops
- to construct the Newell Highway and Jones Avenue overbridges and Mehi River, Gwydir River and Croppa Creek bridges
- to construct the Camurra bypass
- to construct culverts and underbridges.

Minor earthworks would also be required to construct the ancillary infrastructure and undertake the ancillary works associated with the proposal.

8.2.9 Testing and commissioning

Testing and commissioning (checking) of the rail line and communication/signalling systems would be undertaken to ensure that all systems and infrastructure are designed, installed, and operating according to ARTC's operational requirements.

8.2.10 Finishing works/ reinstatement

All construction sites, compounds and access routes would be returned to the same or better condition than prior to construction commencing.
Site reinstatement and rehabilitation would be undertaken progressively during the works and would include the following activities:

- demobilise site compounds and facilities
- remove all materials, waste and redundant structures from the works sites
- forming, and stabilising of spoil mounds
- decommission all temporary work site signs
- remove temporary fencing
- establish permanent fencing
- decommission site access roads that are no longer required
- restoration of disturbed areas as required, including revegetation where required.

Site rehabilitation would be undertaken in accordance with the rehabilitation strategy; the requirements of which would be incorporated into the CEMP (described in Chapter 27).

8.3 Timing, staging and working hours

8.3.1 Timing and staging

An indicative construction program is shown in Figure 8.1. As described in Section 8.1, construction along the existing rail corridor would be undertaken in four stages, subject to agreement with relevant stakeholders. The stages are shown in Table 8.1. For each stage, rail traffic would be interrupted as described in Table 8.1.

Construction of the key features outside the existing rail corridor would be undertaken as follows:

- Newell Highway overbridge – offline construction would be undertaken in parallel with stages 1 to 4 would take about 10 months to complete.
- Offline construction of the Jones Avenue overbridge and the Camurra bypass, would be undertaken in parallel with stages 1 to 4, and would take about six to eight months each to complete.

For the works along the existing rail corridor, it is anticipated that it would take about eight to 10 weeks to construct a 4.5 to 5 kilometre section of track. This does not include location specific works such as culverts and underbridges or the relocation of services and utilities.

Figure 8.1 Indicative construction program

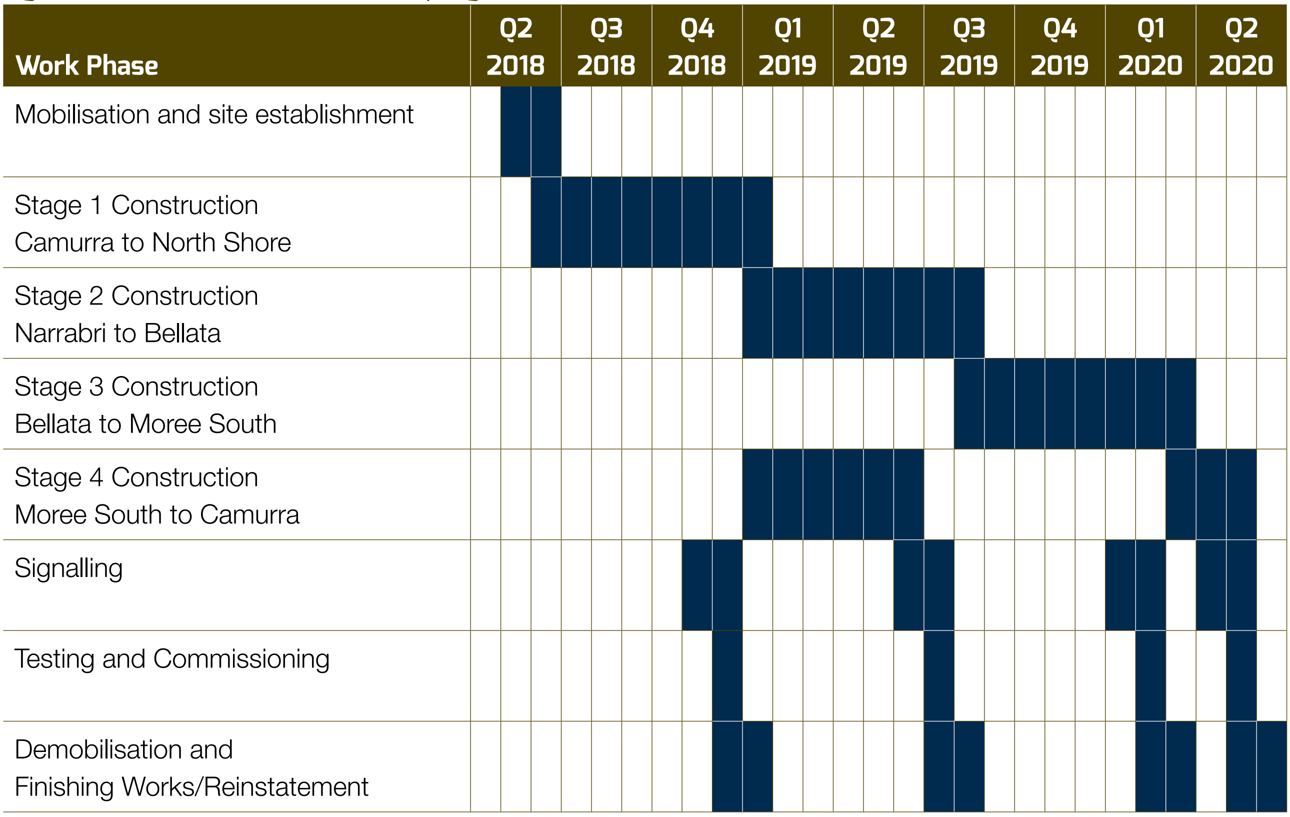


Table 8.1 Rail traffic management during construction

Stage	Location	Distance (km)	Rail traffic	Possession descriptions
1 – Camurra to North Star	Located at the northern end of the proposal site (described in Section 2.2) and stopping about 15 km north of Moree.	81	Between Camurra and North Star the existing line is closed, requiring a seven day advanced notice, and is only used periodically for grain trains. Full closure possessions are proposed for construction of this stage, where road haulage or grain storage solutions may replace rail traffic.	Full closure possession means the railway would be closed for construction for periods longer than 16 days. The timing and duration of the possessions would be agreed with affected train operators, track stakeholders, and relevant government departments.
2 – Narrabri to Bellata	Located between Narrabri and including the Bellata grain siding at the southern end of the proposal site (described in Section 2.2).	52	Roster possessions are proposed, where grain would be stockpiled or road haulage would replace rail traffic during possessions. Passenger rail would be replaced by bus services.	Roster possessions means that, in a 21 day period, the railway would be closed for construction for 16 days, and open for rail traffic for 5 days. The timing and duration of the possessions would be agreed with affected train operators, track stakeholders, and relevant government departments.
3 – Bellata to Moree South	Located between Bellata and Moree South including the Inverell spur line in the middle of the proposal site (described in Section 2.2).	35	Roster possessions are proposed, where grain would be stockpiled or road haulage would replace rail traffic during possessions. Passenger rail would be replaced by bus services.	As above
4 – Moree South to Camurra	Located at Moree and including the Camurra bypass about 10 km north of Moree (described in Section 2.2).	20	Roster possessions are proposed, where grain would be stockpiled or road haulage would replace rail traffic during possessions.	As above

8.3.2 Working hours

Construction working hours

Construction work would be undertaken during the following primary proposal construction hours:

- Monday to Friday: 6:00 am to 6:00 pm
- Saturday: 6:00 am to 6:00 pm
- Sundays and public holidays: 6:00 am to 6:00 pm.

Works would also be undertaken during 24 hour possessions, where required. Work undertaken outside of the *Rail Infrastructure Noise Guideline* (NSW EPA, 2013) standard hours would be in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework.

Work during possessions

Some works may also be undertaken during scheduled rail corridor possession periods. This could include, for example, the connection of the tracks at either end of each stage, and some finishing works. During possessions, works may need to be undertaken on a 24 hour basis.

8.4 Construction compounds

Two types of compound areas are proposed; minor compound/storage areas and larger compound sites.

Minor compounds/storage areas are areas that would be used for the assembly of adjacent infrastructure such as culverts and turnouts. These compounds would be located within the rail corridor.

Larger compound sites would be established for general construction activities associated with each stage of work. For the purposes of the EIS, it is assumed that temporary compounds would be sited outside the existing rail corridor every 4.5 to 5 kilometres (one for each work area described in Section 8.3.1). Indicative compound locations are shown in Figure 8.2.

Each larger compound site would contain:

- stockpiles
- track infrastructure laydown area
- bunded refuelling area
- fencing as required
- office area including parking, offices and ablutions
- mobile plant and equipment
- hazardous material storage.

The design of the proposal has been developed so that infrastructure would either be constructed in place (for example, welding of track) or prefabricated structures would be used (for example, culverts). Therefore, activities undertaken at compound sites would include the following:

- site office operations
- delivery and stockpiling of various construction materials including rail, sleepers, ballast, culverts and structural fill
- movement of plant and equipment
- maintenance of site environmental management controls
- operation of mobile concrete batching plants (where present).

Not all of the above activities would be undertaken at every compound site.

The location of compounds would be determined based on the following criteria:

- at least 50 metres from watercourses and outside the five per cent AEP flood zone
- where no or only minor clearing would be required, and not within areas identified as threatened communities or species habitat
- no significant impacts to utilities, primarily gas and electricity
- at least 1.0 kilometre from the nearest residence or other noise sensitive receiver where possible
- not on or near sites with known Aboriginal or non-Aboriginal heritage value
- minimise use of private land
- where safe access to the road network and rail corridor can be provided
- relatively flat land.

Figure 8.2a Construction work areas

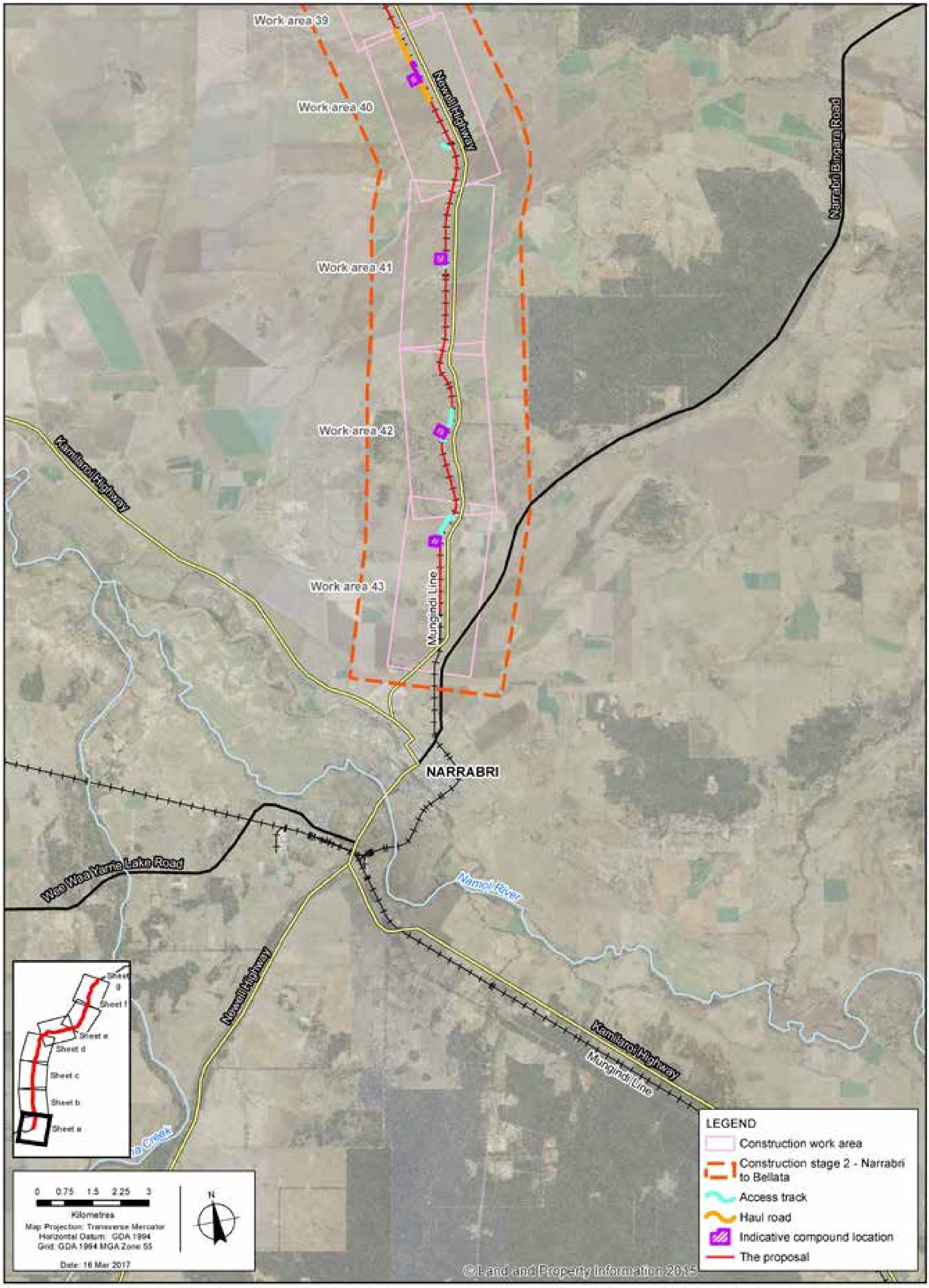


Figure 8.2b Construction work areas

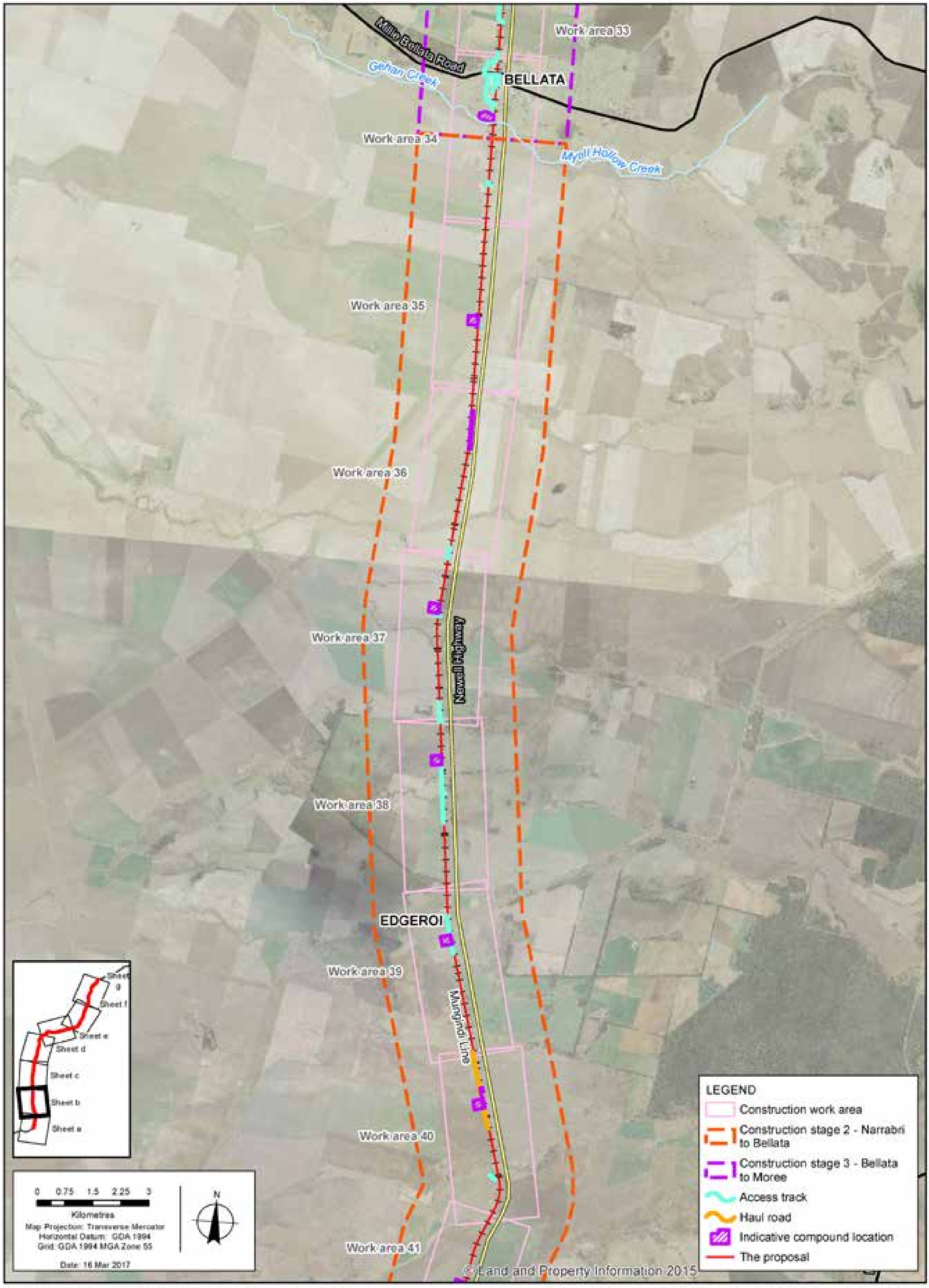


Figure 8.2c Construction work areas

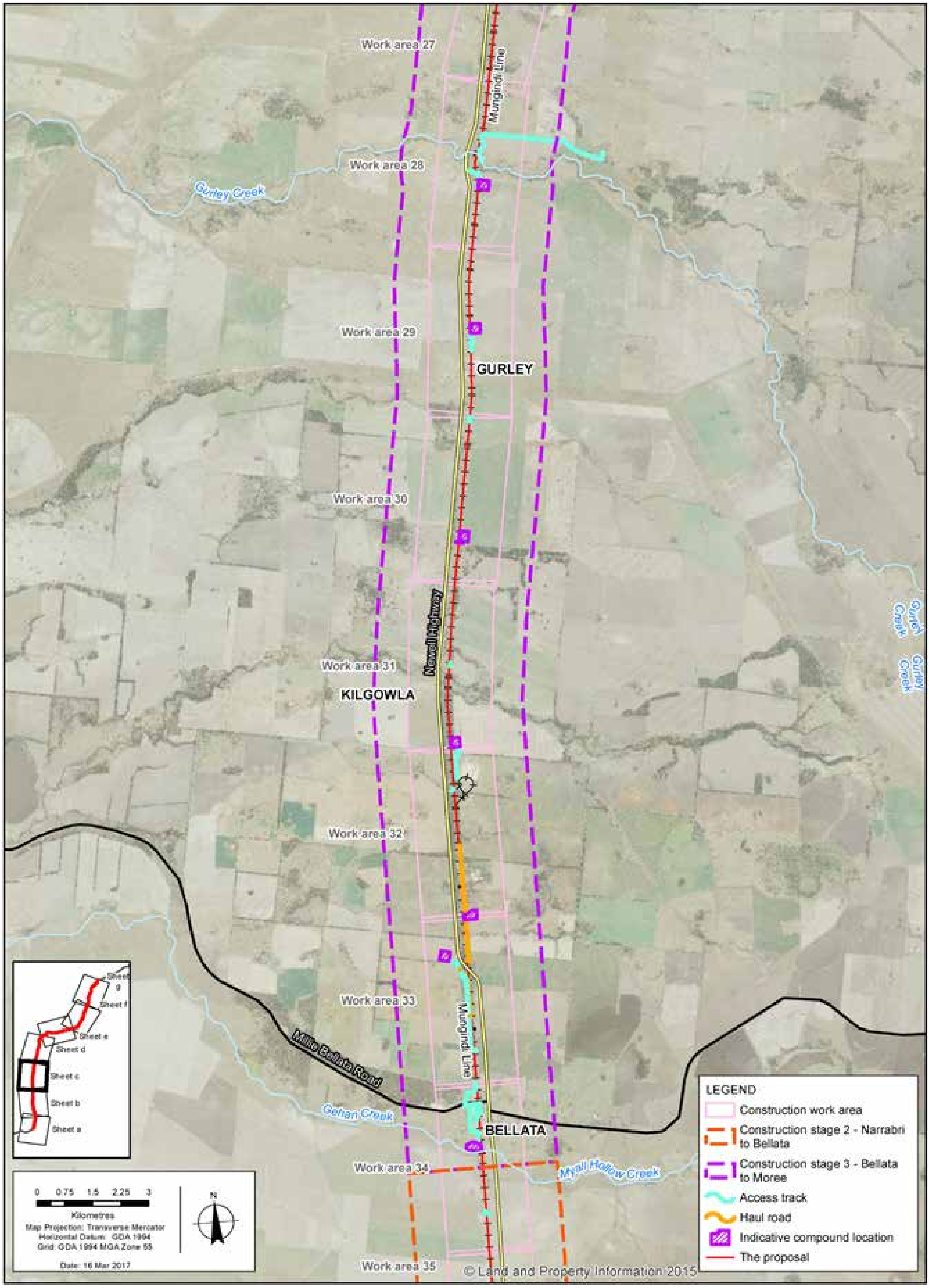


Figure 8.2d Construction work areas

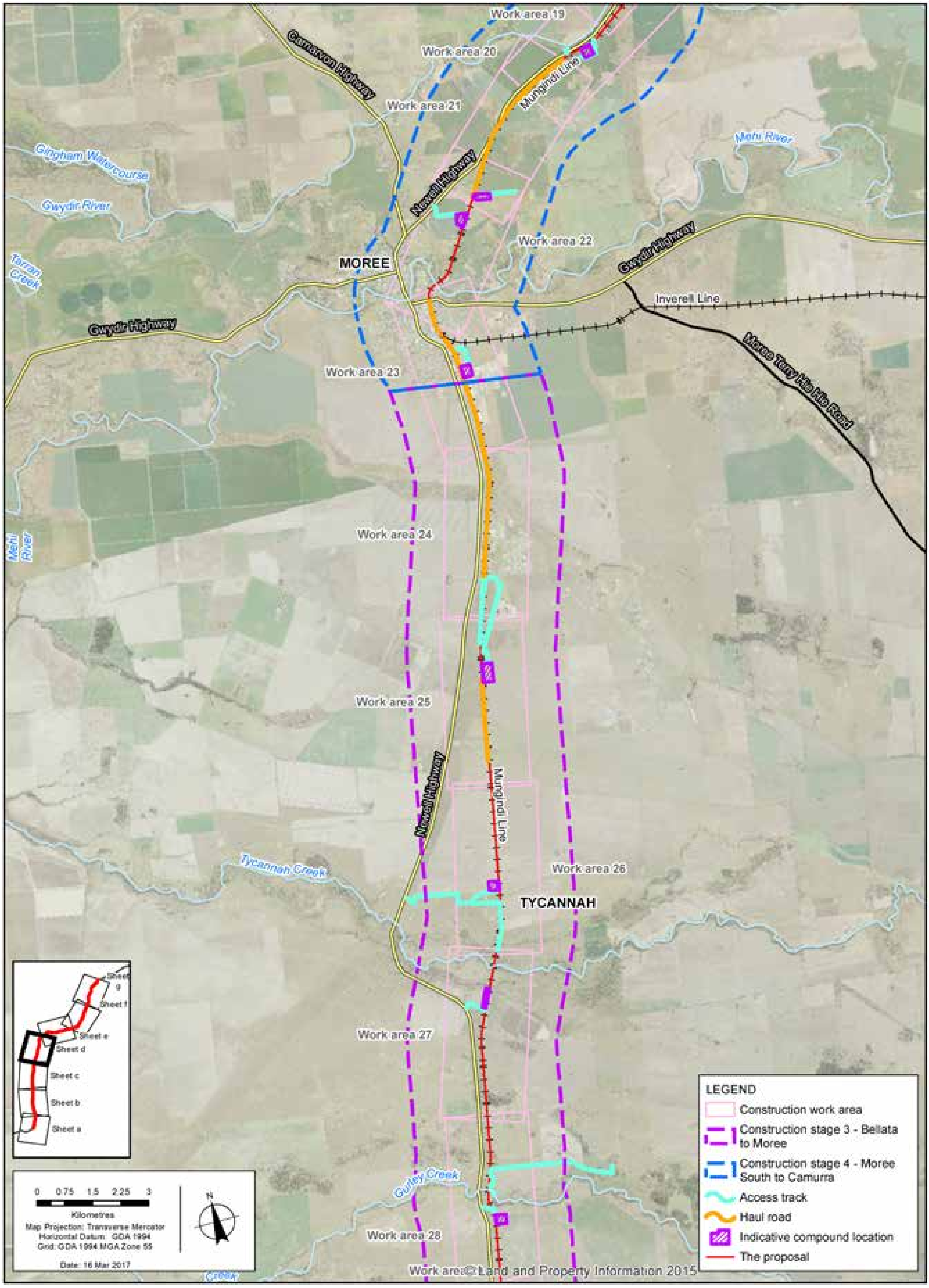


Figure 8.2e Construction work areas

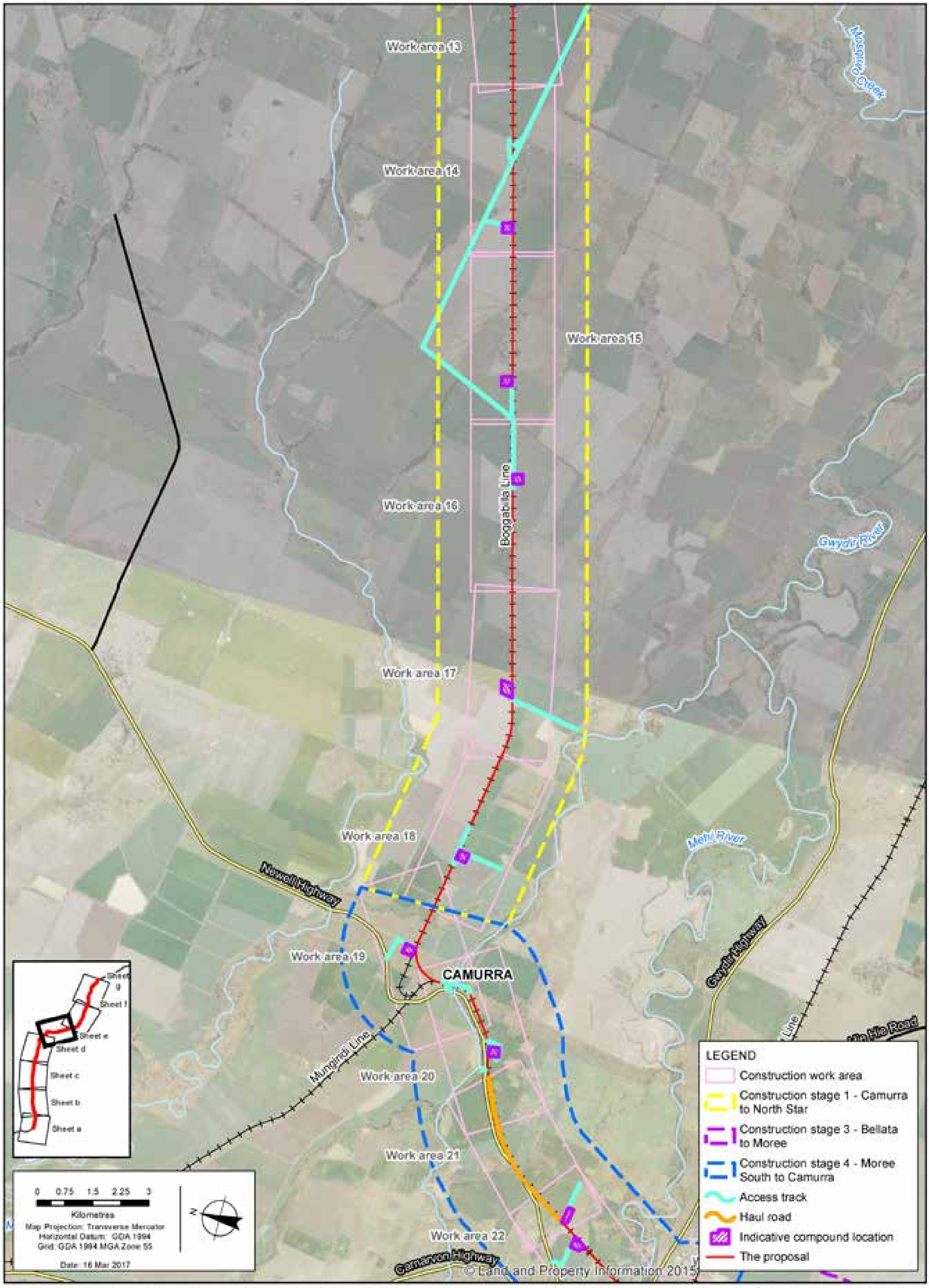


Figure 8.2f Construction work areas

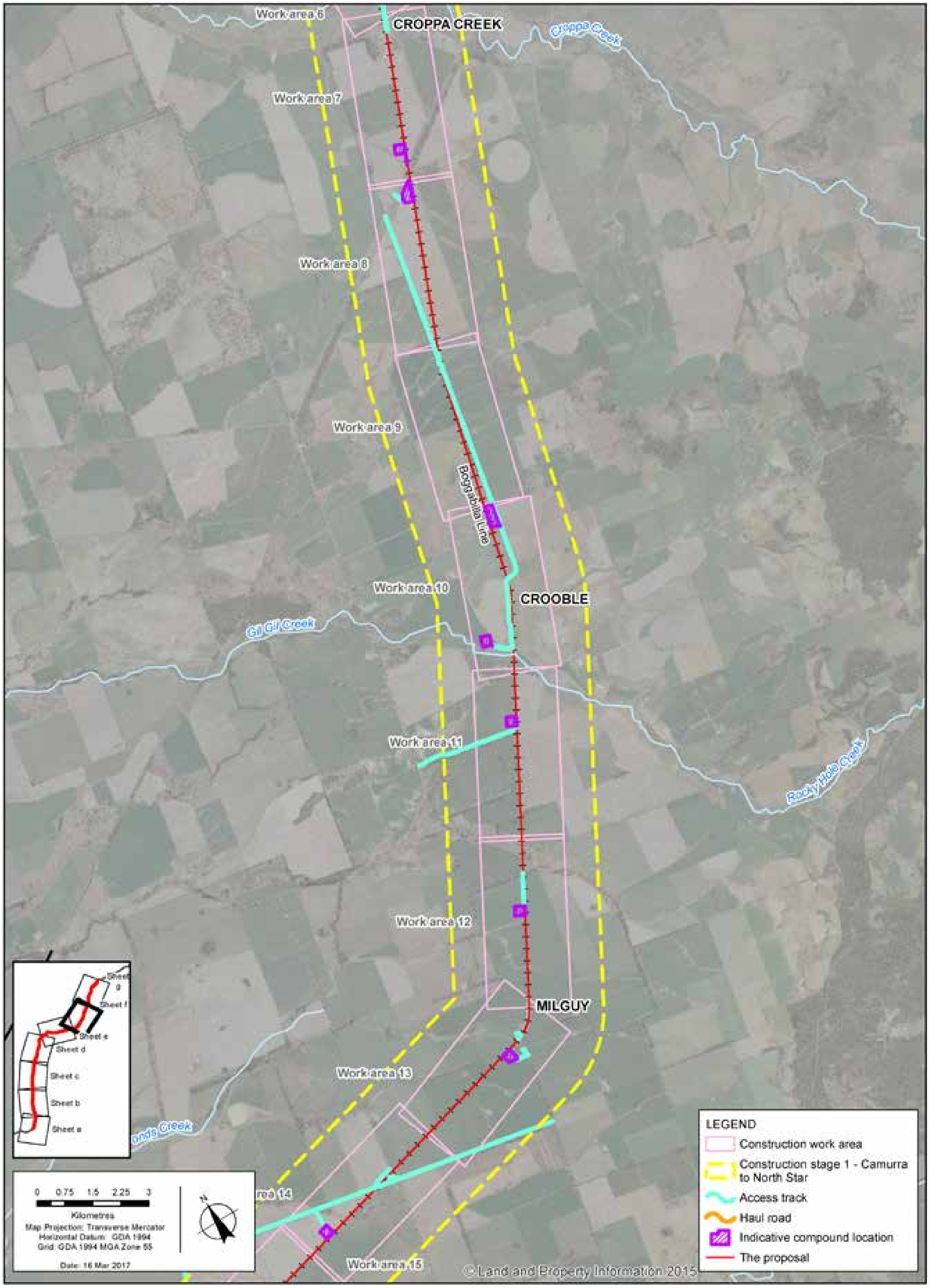
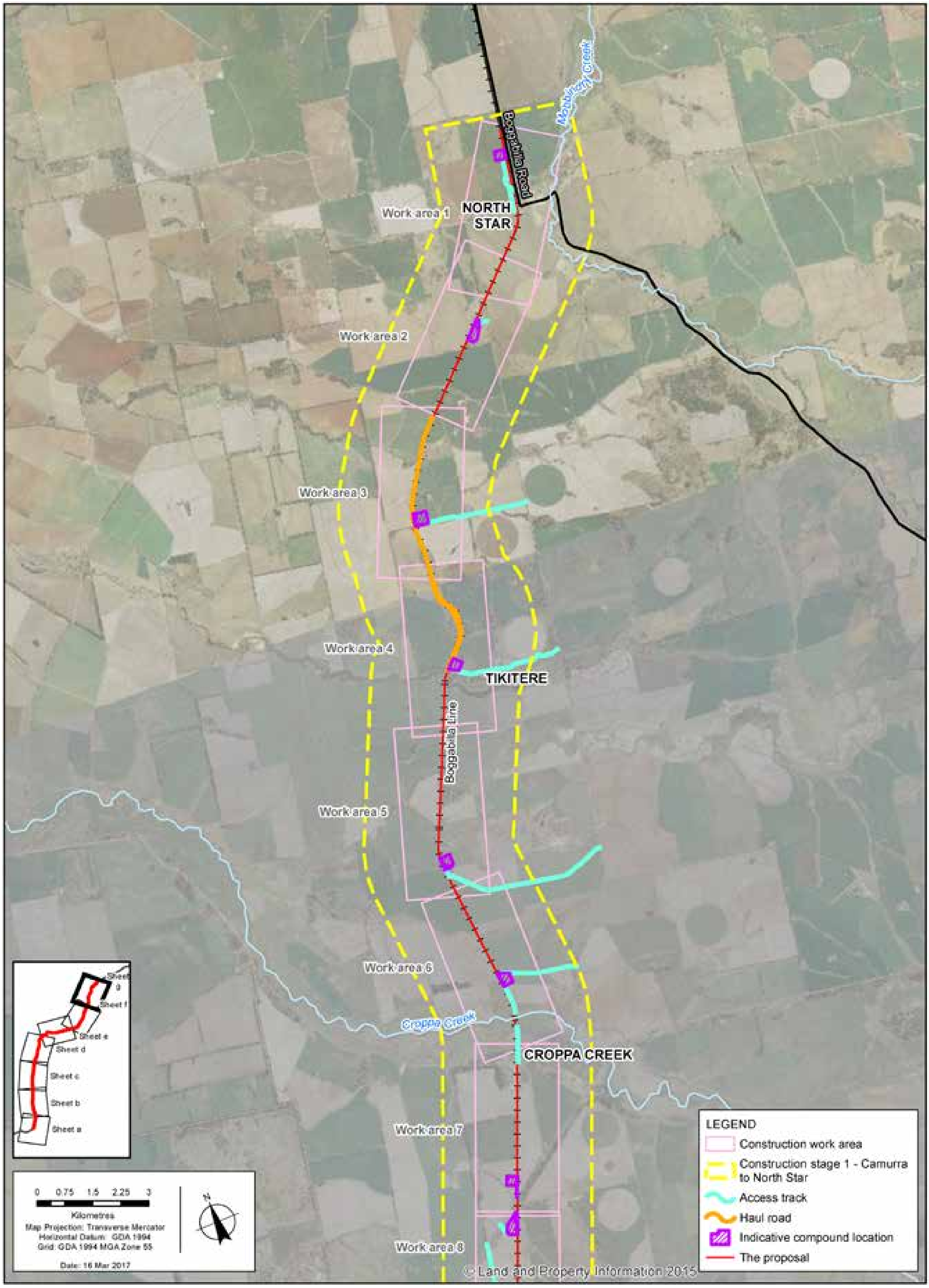


Figure 8.2g Construction work areas



8.5 Construction resources

8.5.1 Workforce

For the majority of the construction period, the workforce would average about 180 people. For some limited items of work an additional short-term workforce may be required.

8.5.2 Materials

The proposal would require quantities of various materials including fill, ballast, concrete sleepers, rail, precast concrete units, ready mix concrete and water. The majority of these materials would be used during track formation works, with the exception of precast concrete units and ready mix concrete, which would be used for construction of concrete structures including culverts and bridges.

Subject to confirmation and the gaining of any necessary approvals, the following local quarries are proposed to be used for structural fill, capping and ballast (ballast would be delivered by train, other materials by truck):

- Runnymede quarry in Milguy
- Narrabri quarry
- Wave Hill quarry in Narrabri.

In addition, subject to the gaining of any necessary approvals, the following greenfield sites may be used as quarry sites for the proposal:

- Oonoonba, located about 9 kilometres east of Bellata
- Tikitere, located adjacent to the existing alignment about 10.5 kilometres south-west of North Star.

This would be further investigated and confirmed during detailed design.

8.5.3 Plant and equipment

A range of plant and equipment would be used during construction. The final equipment and plant requirements would be identified by the construction contractor. An indicative list of plant and equipment that would be used for each construction stage is provided in Table 8.2.

Table 8.2 Indicative construction plant and equipment

Construction phase	Plant and equipment	
Establishment	▸ trucks ▸ cranes	▸ clearance equipment such as chainsaws and chippers
Utility relocations and property adjustments	▸ excavators ▸ rigid and articulated trucks ▸ jackhammers ▸ cranes ▸ concrete pumps ▸ welding equipment	▸ concrete saws ▸ light vehicles ▸ concrete trucks ▸ generators ▸ oxy-cutting equipment
Earthworks and drainage	▸ excavator ▸ jackhammers ▸ rigid and articulated trucks ▸ compactors ▸ water carts ▸ generators	▸ bulldozers ▸ boring machines ▸ graders ▸ profilers ▸ vibrating rollers ▸ trucks and trailers
Track works	▸ 25-30 tonne excavators ▸ 40 tonne dump truck ▸ vibratory roller ▸ water cart ▸ crane ▸ trucks and trailers	▸ graders ▸ bulldozer ▸ lighting ▸ skid steer loader ▸ front end loader
Road overbridges, underbridges and pavement works	▸ excavators ▸ rigid and articulated trucks ▸ drilling rigs and boring machines ▸ cranes ▸ concrete trucks and pumps ▸ generators ▸ welding equipment ▸ trucks and trailers	▸ compactors ▸ graders ▸ paving machines ▸ slip-forming machines ▸ vibrating rollers ▸ water carts ▸ road marking machine
Finishing and landscaping	▸ milling machines ▸ piling machines ▸ trucks ▸ rollers	▸ generators ▸ oxy-cutting equipment ▸ sprayers ▸ trucks

Mobile concrete batching plant

In addition to the plant and equipment listed in Table 8.2 the use of mobile concrete batching plants, to supplement supply from existing readymix plants, is proposed for the following construction works:

- earthworks and drainage
- road overbridges and underbridges.

The size of the plant would be about 15 metres by 10 metres, and up to eight metres high. The plant and ancillary features would have a footprint of about 100 metres by 150 metres to account for a water tanker, concrete trailer and storage of materials including aggregate and sand. The location of the plant would be wholly within the proposal site and would be subject to the same criteria as per that for the construction compounds, described in Section 8.4.

The combined total output from mobile batch plants is estimated to be less than 10,000 metres cubed per annum.

8.5.4 Site servicing requirements

Utilities and services such as water, sewer, electricity and telecommunications would need to be supplied to each of the work and compound sites for use in site offices and amenities. Where these utilities are located close to the sites, opportunities to connect to existing sources would be explored with relevant providers, particularly for electricity. Where connections are not available, power would be provided by generators.

Water would be required for dust control, site compaction and reinstatement during construction. A number of potential water sources have been investigated, including extraction of groundwater or surface water, private bores and watercourses. This would be further explored prior to construction in consultation with local councils and landowners. Where water is not available, it would be transported to the site via tanker truck and stored in temporary storage tanks. Potable water for human consumption would be supplied via bottled water or potable water tanks. Non-potable wash water would be supplied by the use of trailer-mounted storage tanks.

Portable toilet facilities would be used where existing infrastructure is unavailable and sewage pump out services utilised to remove waste off-site.

8.6 Transport, access and haulage arrangements

8.6.1 Access to construction work areas

Access to the construction work areas would mainly be from public roads or existing access routes which are located within the rail corridor. An access track runs parallel to the rail line along the majority of the alignment.

Potential access routes to each construction work area are listed in Table 8.3. Generally, access to construction stage 2 would be from Narrabri, access to construction stage 3 and stage 4 would be from Moree and access to construction stage 1 would be from Moree and North Star. Some areas would have two access points, and some would have alternative routes available, depending on the origin.

Table 8.3 Potential construction access routes to construction work areas

Construction work area (as shown in Figure 8.2)	Primary Route	Secondary Route	Tertiary Route
1 - 9	Newell Highway	-	-
10	Newell Highway	Millie Road	-
11-16	Newell Highway	Gurley Creek Road	Access track
17	Newell Highway	Gurley Creek Road	Access track
	Newell Highway	Gurley Settlers Road	-
18-19	Newell Highway	Access track	-
20-21	Newell Highway	Tapscott Road	-
22	Newell Highway	Bullus Drive	-
23-24	Newell Highway	Access track	-
	Newell Highway	Gwydirfield Road	Access track
25	Newell Highway	-	-
26	Newell Highway	Mosquito Creek Road	-
27	Newell Highway	Mosquito Creek Road	Roydon Road
28-29	Newell Highway	Mosquito Creek Road	Wongabindie Road
	Newell Highway	Croppa Creek Road	Wongabindie Road
30	Gwydir Highway	County Boundary Road	Calimpa Road
	Newell Highway	Croppa Creek Road	Wongabindie Road → Calimpa Road
31	Gwydir Highway	County Boundary Road	-
32	Gwydir Highway	County Boundary Road	Alma Lane
33	Gwydir Highway	County Boundary Road	Gil Creek Road
	Newell Highway	Croppa Moree Road à County Boundary Road	Gil Creek Road
34-35	Newell Highway	Croppa Moree Road	-
	Gwydir Highway	County Boundary Road	Gil Creek Road → Crooble Road → Access Road
36-37	Newell Highway	Croppa Moree Road	Buckie Road
	Newell Highway	Buckie Road	-
	Newell Highway	Croppa Moree Road	Croppa Creek Road → Access Road
38	Newell Highway	Croppa Moree Road	Croppa Creek Road → Tumba Road
	Newell Highway	Buckie Road	Croppa Creek Road → Tumba Road
	Gwydir Highway	County Boundary Road	Croppa Creek Road → Tumba Road

Construction work area (as shown in Figure 8.2)	Primary Route	Secondary Route	Tertiary Route
39-40	Newell Highway	Croppa Moree Road	Croppa Creek Road → Access Road
	Newell Highway	Buckie Road	Croppa Creek Road → Access Road
	Gwydir Highway	County Boundary Road	Croppa Creek Road → Access Road
41	Newell Highway	I B Bore Road	Croppa Creek Road
	Newell Highway	I B Bore Road	Croppa Creek Road
	Gwydir Highway	I B Bore Road	Croppa Creek Road
42-43	Newell Highway	I B Bore Road	-

8.6.2 Access to compounds

Access routes to compounds would be determined based on the following criteria:

- provision of a suitability wide road to achieve a single lane, two-way access
- provision of adequate turning circles for crane and heavy vehicles - at least a 25 metre turning radius capability
- minimal property impacts by using access alignments within and adjacent to the rail corridor and existing agreed property access roads as far as practicable
- provision of more than one access point where possible to allow access from either road direction.

8.6.3 Alternative public transport arrangements

As described in Section 2.5.2 an existing passenger service train (the Northern Tablelands Xplorer) travels between Sydney and Moree, and stops at Bellata and Moree stations within the proposal site.

During construction at Bellata and Moree, buses would be used in place of trains to transport passengers to the nearest active station. The location of the bus stops would take into consideration the safe access of passengers, and proximity to the construction impact zone. The train patronage levels using these stations are low, and therefore delays incurred due to the works are expected to be minimal. Works would be staged where possible to further minimise impacts to passengers.

8.6.4 Haul routes

While a detailed haulage program has not yet been developed, it is expected that some of the proposal's components would be delivered by rail. Other transport would be undertaken by heavy vehicles using the Newell Highway, Gwydir Highway / Alice Street and Kamilaroi Highway and then local roads and existing access roads along the rail corridor.

It is likely that rail components, including sleepers, ballast, and track, would be transported to the work areas via dedicated rail trains; while pre-fabricated concrete units, fill and equipment deliveries would most likely be via road from suppliers or town centres.

8.6.5 Construction traffic numbers

Construction vehicle movements would comprise both heavy and light vehicles as listed in Table 8.4.

Table 8.4 Vehicle movements for each stage of construction

Vehicle type		Numbers on-site per day	Movements per day	Indicative peak hour movements (one-way)
Light vehicles	Cars and utilities	75	170	75
	Total light vehicles	**75**	**170**	**75**
Heavy vehicles	Light trucks	8	24	8
	25 seater buses	5	10	5
	Haulage and delivery trucks	28	200	28
	Total heavy vehicles	**41**	**234**	**41**

Light vehicle movements would largely be based on the amount of construction workers travelling to site each day. Based on an average workforce of 180 people, up to 180 private vehicles could travel to and from the proposal site per day. However, given the remote nature of many of the construction work areas, buses would be provided for construction workers. Workers are likely to use a combination of buses and light vehicles to travel to the proposal site.

8.7 Public utilities

Consultation with public utility authorities is being undertaken as part of the design process to identify and locate existing utilities, and incorporate utility authority requirements for relocations and/or adjustments.

Preliminary investigations have indicated that a number of utilities would need to be relocated or adjusted as part of the proposal. This would be undertaken in consultation with the utility authorities during detailed design.

Desktop review of 'Dial Before You Dig' data indicated that the proposal would impact on a number of services. The number and length of interactions with services within the rail corridor is listed in Table 8.5. Additional services investigations would be undertaken during detailed design. Consultation has commenced with the various utility providers regarding their requirements for relocation or protection of the services impacted by the proposal.

Table 8.5 Services crossings and length

Service type	Number of crossings	Approximate length of service in the corridor (km)
Electricity (Essential Energy)	64	8
Communications (Telstra/Soul/Nextgen)	385	139
Sewer (Moree Plains Shire Council and Narrabri Shire Council)	3	0.1
Water (Moree Plains Shire Council and Narrabri Shire Council)	18	1.2
Stormwater (Moree Plains Shire Council)	1	0.1