INLAND RAIL

CHAPTER 03

Alternatives and Proposal Options

NORTH STAR TO NSW/QUEENSLAND BORDER ENVIRONMENTAL IMPACT STATEMENT

ARTC

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3. Alternatives and proposal options

3.1 Scope of chapter

This chapter demonstrates how alternatives to, and options within, the North Star to NSW/Queensland Border (NS2B) project (the proposal) were analysed to inform the selection of the preferred alignment and infrastructure components. The chapter also demonstrates how the proposal design has been developed to avoid or minimise likely adverse impacts.

Chapter 1: Introduction details the objectives of the proposal and the Inland Rail Program. The identification and evaluation of options for the proposal aim to meet these objectives.

3.1.1 Secretary's Environmental Assessment Requirements

This chapter has been prepared in response to the Secretary's Environmental Assessment Requirements (SEARs) requirements, as shown in Table 3.1.

TABLE 3.1 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS COMPLIANCE

Desired performance outcome	**Item 2: Environmental Impact Statement** The project is described in sufficient detail to enable clear understanding that the project has been developed through an iterative process of impact identification and assessment and project refinement to avoid, minimise or offset impacts so that the project, on balance, has the least adverse environmental, social and economic impact, including its cumulative impacts
Current guidelines	EPBC Act Environment Assessment Process (Department of Sustainability, Environment, Water, Population and Communities (SEWPAC), 2010)

SEARs requirement	EIS section
Item 2.1 The EIS must include, but not necessarily be limited to, the following:	
(e) an analysis of any feasible alternatives to the project;	Section 3.2 and Section 3.3
(f) a description of the feasible options for the project;	Section 3.4
(g) a description of how alternatives to and options within the project were analysed to inform the selection of the preferred alternative/option. The description must contain enough detail to enable an understanding of why the preferred alternative to and option(s) within the project were selected	Addressed throughout chapter
(h) demonstration of how the project design has been developed to avoid or minimise likely adverse impacts	Addressed throughout chapter
(i) A demonstration of how the project design has been developed to avoid or minimise likely adverse impacts	Section 3.1, Section 3.2 and section 3.3

3.2 Inland Rail alternatives

3.2.1 Strategic alternatives—alternative freight transport solutions

Alternative freight transport solutions with the potential to address Australia's current and future freight challenges were considered in Attachment A: ARTC Inland Rail Programme Business Case in *Inland Rail Implementation Group Report to The Australian Government* (Programme Business Case) (ARTC, 2015a).

3.2.1.1 Strategic options assessment

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

- Progressive road upgrades
- Upgrading the existing east-coast railway
- An inland railway.

These capital investment options were subjected to a rigorous assessment, consistent with Infrastructure Australia's *Reform and Investment Framework Guidelines* (2013). The options were assessed against seven equally weighted criteria:

- Capacity to serve future inter-capital and regional/bulk freight market needs on the east coast
- 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 was the preferred option based on its ability to provide dedicated freight capacity, foster growth in regional areas, and optimise environmental outcomes. Progressive road upgrades may be a medium-term solution for freight; however, they are unlikely to meet longer-term needs for freight capacity, they are likely to be high cost, and road capacity would continue to be shared with general traffic. Similarly, upgrading the existing east-coast railway would deliver improvements in capacity, performance and reliability; however, structural limitations of the existing rail alignment and shared track with passenger rail in some locations will constrain future long-term capacity.

3.2.1.2 Review of alternatives

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

- Maritime shipping
- Air freight
- Road freight
- Rail solutions.

The results of the review of alternatives undertaken by the Inland Rail Implementation Group are summarised in the following sections.

Maritime shipping

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

- A dedicated service between 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 to the Australian Government* (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 much 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 can 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. Many 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 to play 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-dependent 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. Road transport is the main mode of transport for many 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 increased 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
- The Australian Government 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 Inland Rail Implementation 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 Inland Rail Implementation 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 Inland Rail Implementation 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 Inland Rail Implementation Report concluded that:

- The existing east-coast rail line would be neither cost nor time competitive with road for the Melbourne to Brisbane intermodal freight task and, as such, 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 most of the future freight task, with associated direct and indirect costs.

3.2.2 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 3.2.1. 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).

The 'do nothing' alternative would not achieve the objectives detailed in Chapter 1: Introduction and as a result this option was not taken any further.

3.2.3 Alternative locations and route options for Inland Rail

After it was established that Inland Rail would meet Australia's future freight challenge, alternative routes for Inland Rail have been considered by the following two studies:

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

The results of these studies are summarised below.

3.2.3.1 North–South Rail Corridor Study Executive Report

The *North–South Rail Corridor Study Executive Report* (Department of Transport and Regional Services, 2006) considered potential routes for Inland Rail. The purpose was to identify a route that would deliver the best overall economic outcome.

Options identified

Potential route options were identified within a north–south rail corridor, which was 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 an inland freight route between Melbourne and Brisbane.

Within this corridor, four sub-corridors were identified, 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 (refer to the *North–South Rail Corridor Study Executive Report* (DoTARS, 2006) for information on how this number was calculated). These options involved different combinations of new track and upgrades to existing 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.

3.2.3.2 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 Executive Report* (DoTARS, 2006)

Options identified

The *Melbourne–Brisbane Inland Rail Alignment Study* shortlisted and analysed several route options. The 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 (refer to the *Melbourne–Brisbane Inland Rail Alignment Study* for information on how this number was calculated). 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 re-joining 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, predominantly 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 predominantly 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 an approximate length of 1,880 km. 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 km, became the focus for more detailed route, demand, economic and financial analysis.

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

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

3.3 Alternative locations and route options for the proposal

To deliver Inland Rail, ARTC divided the Melbourne–Brisbane alignment into 13 distinct sections. In 2010, this proposal originated as the North Star to Yelarbon section of Inland Rail. Over an eight-year period, the North Star to Yelarbon alignment was refined to become the North Star to NSW/QLD border alignment for the purpose of this environmental impact statement (EIS).

3.3.1.1 Melbourne–Brisbane Inland Rail Alignment Study

The *Melbourne–Brisbane Inland Rail Alignment Study* (ARTC, 2010) was a broad assessment of the preferred route between Melbourne and Brisbane. It proposed two route options for the proposal between North Star and Yelarbon, which would later be refined to become the North Star to NSW/QLD border alignment:

- Eastern Option—a relatively direct, greenfield route between North Star and Yelarbon, approximately 64.5 km in length
- Western Option—a predominantly brownfield route, approximately 72 km in length, that uses a section of the existing non-operational Boggabilla rail corridor through Boggabilla and Kildonan.

The *Melbourne–Brisbane Inland Rail Alignment Study* (ARTC, 2010) recommended that the eastern option be carried forward as the base-case alignment for North Star to Yelarbon (and later for North Star to NSW/QLD border). This was due to the western option having higher direct costs (associated with upgrading existing infrastructure on the Boggabilla rail line) and longer travel times.

3.3.1.2 2015 Alignment Development Assessment Report

In 2015, ARTC commissioned a review of the base-case alignment for North Star to Yelarbon (eastern option), considering new and changing constraints. Due to stakeholder and community interest in the project, it was recommended that additional alignment options between North Star and Yelarbon be investigated. Drivers for investigating additional alignment options included:

- Minimising impacts on existing land uses, including Dthinna Dthinnawan National Park, Bebo State Forests, Yelarbon Desert, travelling stock reserves and Crown land
- Minimising land take by using the existing non-operational Boggabilla rail corridor and connecting to the existing Queensland Rail (QR) South West line
- Minimising the length of track in the Macintyre River and Dumaresq River flood plains
- Minimising the number and length of structures (e.g. bridges, culverts and embankments) required
- Moving the alignment closer to potential sources of fill
- Moving the alignment closer to Goondiwindi, with the intent of providing economic development and revenue streams for Goondiwindi.

The review of the base-case alignment was documented in the *Alignment Development and Assessment Report* (ARTC, 2015a) and two alignment options were presented (Figure **3.1**). The options presented were:

- A greenfield alignment (i.e. the base-case alignment from the *Melbourne–Brisbane Inland Rail Alignment Study* (ARTC, 2010)
- Reintroduction of a brownfield alignment (i.e. the western alignment from the *Melbourne–Brisbane Inland Rail Alignment Study*) that makes use of the existing non-operational Boggabilla rail corridor.

A multi-criteria assessment (MCA) was used to compare the two options. The following criteria were considered:

- Technical viability—impact on utilities, services and existing road and rail networks. geotechnical conditions, flood immunity and future-proofing
- Safety—construction, operational and public safety, road–rail interfaces and emergency response capabilities
- Operations—impact on travel time, reliability, availability, interoperability and connectivity
- Environmental—ecological, visual, noise, vibration, air quality, flooding and waterway impacts, and greenhouse gas emissions
- Community and property—community, property and cultural heritage impacts, and effect on current and future land
- Approvals and risk—support from local, state and federal governments, planning and approval timeframe, and other statutory and regulatory approval considerations.

Based on information available at the time of *the Alignment Development and Assessment Report* (ARTC, 2015a), the outcome of the MCA was that both options should undergo further investigation during 2016 prior to confirming a final alignment.

FIGURE 3.1 EASTERN AND WESTERN ALIGNMENT OPTIONS FROM THE ALIGNMENT DEVELOPMENT AND ASSESSMENT REPORT

3.3.1.3 2016 Phase 1 Concept

During the 2016 Phase 1 Concept Assessment, the following additional investigations were undertaken:

- Engineering and alignment studies
- Environmental and ecological studies
- Flood modelling
- Community and stakeholder engagement
- Geotechnical investigations.

Using information from the additional investigations, five alignment options (Figure 3.2) were subject to an MCA, using the same criteria as the *Alignment Development and Assessment Report* (ARTC, 2015a):

- 2010 base case alignment
- Option 1—73 km of track, 38 km of which is located within the existing non-operational Boggabilla rail corridor between North Star and Whalan Creek
- Option 2—90 km of track, 46 km of which is located within the existing non-operational Boggabilla rail corridor between North Star and Goondiwindi
- Option 3—65 km of greenfield track that avoids the Yelarbon Desert
- Option 4—65 km of greenfield track that avoids the Yelarbon Desert, and is slightly modified near North Star to minimise impacts on existing land uses.

The MCA identified two preferred alignments: Option 1 and Option 4. The MCA could not identify a single preferred alignment due to Options 1 and 4 offering vastly different advantages and disadvantages, particularly regarding stakeholder and flooding risk.

FIGURE 3.2 EASTERN AND WESTERN ALIGNMENT OPTIONS FROM THE 2016 PHASE 1 CONCEPT ASSESSMENT

3.3.1.4 2016 Phase 1 Continuity

Option 1 (Base Case West) and Option 4 (Base Case East) were subject to additional assessments during Phase 1 Continuity works (Figure 3.2). These assessments included stakeholder and community engagement, geotechnical site investigations, flood modelling, and detailed costing.

An MCA was used to distinguish between Base Case West and Base Case East, taking into account the findings of the additional assessments. The MCA identified Base Case West as the preferred corridor.

Given the level of community and stakeholder interest in the proposal, it was considered high risk to continue refining the alignment without re-engaging the community and any newly impacted landowners. Subsequently, the study area was widened around the Macintyre River crossing (up to 6 km wide), resulting in a preferred study area to be carried forward to 2017 Phase 2 Preparatory Works. The 6 km wide Macintyre River study area is shaded grey in Figure 3.3.

3.3.1.5 2017 Phase 2 Preparatory Works

In February 2017, the preferred study area was announced by the then Federal Minister for Infrastructure and Transport, Hon. Darren Chester Member of Parliament (MP), and the Federal Member for Parkes, Mark Coulton MP. It was also at this time that the north boundary of the study area was adjusted to become the North Star to NSW/Queensland border project.

After the preferred study area was announced, additional work was undertaken to refine the 6 km buffer around the Macintyre River crossing to a 2 km wide buffer. This included:

- Flooding studies:
  - The purpose of the flooding study was to mitigate the risk of adopting an alignment based on assumptions and insufficient understanding of the drainage structures required to reduce flooding impacts.
- Environmental studies including field observations:
  - During Phase 1, assumptions were made on critical information relating to property, farming operations and landowner impacts. Field investigations were undertaken to inform the alignment development; however, access was typically restricted to public land due to timeframe restrictions. Further investigations during Phase 1 enabled increased access and non-intrusive field observations to be fed back into the alignment development and assessment process. This process was repeated during Phase 2, considering new and updated information.
- Consultation with key stakeholders (e.g. potentially affected landowners, elected representatives, industry groups and government agencies) between December 2016 and May 2017:
  - Feedback from the community highlighted the need to investigate a Boggabilla Lane alignment option (Option A in Figure 3.3) to ensure community concerns were adequately assessed.

Six greenfield alignment options were developed during Phase 2 (Figure 3.3) and assessed during an MCA workshop. The outcome of the MCA was that 'Option D st 1D' was the preferred alignment. This was due to:

- Reduced impacts on environment, utilities, land use and property
- Improved hydrological and flooding outcomes in the vicinity of Whalan Creek and the Macintyre River
- Improved safety outcomes due to a reduction in the number of road–rail interfaces
- Opportunities to connect with regional transport and freight hubs in northern NSW.

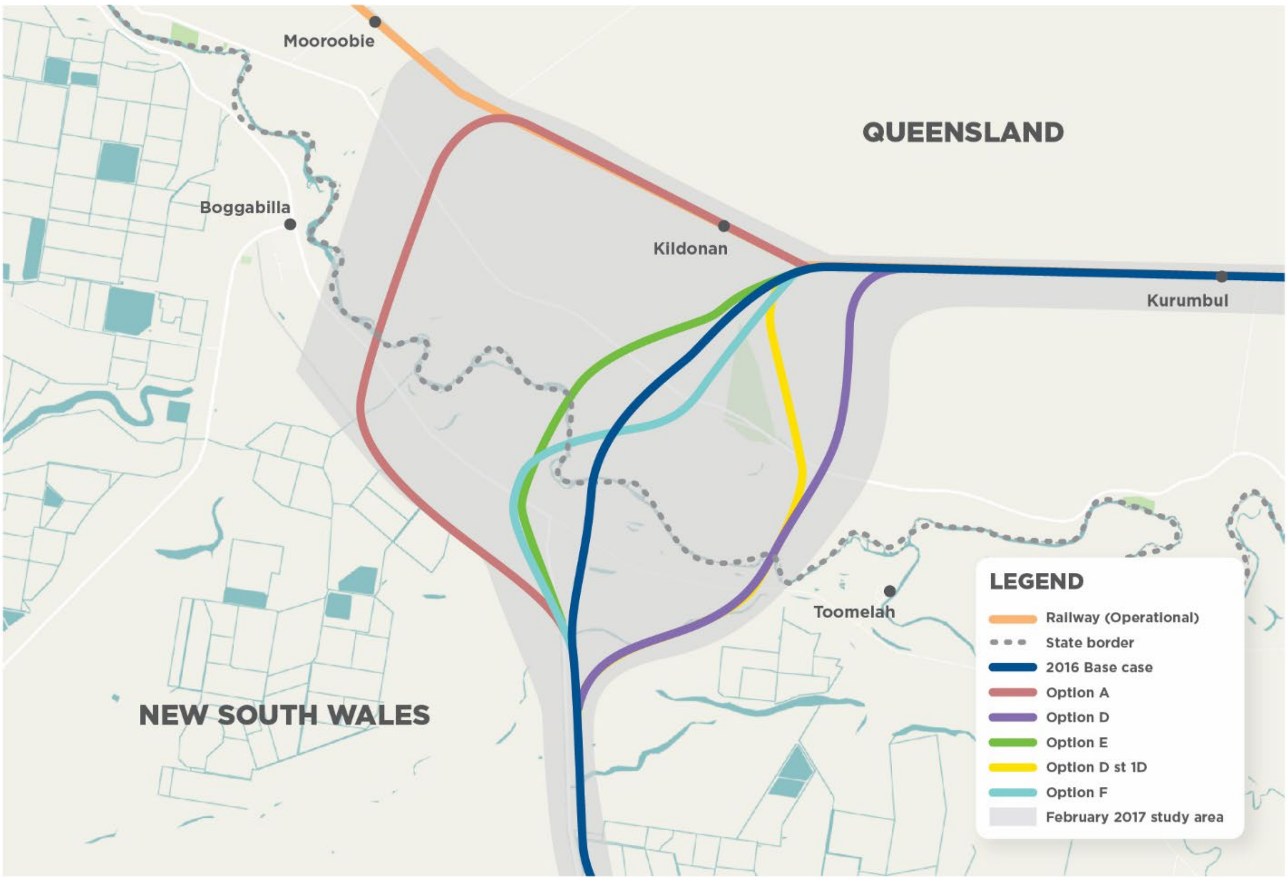


FIGURE 3.3 GREENFIELD ALIGNMENT OPTIONS FOR THE NORTH STAR TO NSW/QLD BORDER SECTION OF INLAND RAIL

3.3.1.6 2018 Phase 2 Greenfield Alignments

The preferred alignment was refined once more during the feasibility design phase, within an approximately 50 m wide corridor centred on 'Option D st 1D'. Option D st 1D was referred to as the 'base case' for the purpose of this analysis (Figure 3.4).

Six alternative greenfield alignments were developed and assessed using an MCA. The six greenfield alignments differ in terms of:

- Property severance and access
- Small variances in bridge lengths
- Small variances in potential environmental and cultural impacts based on currently available information.

Note: Figure 3.4 shows a 7 km section of new track north of the NSW/QLD border that ties into the existing QR South Western Line near Yelarbon, Queensland. For the purpose of obtaining the necessary environmental approvals, this 7 km section of new track will be assessed as part of the Inland Rail Border to Gowrie project, for which a separate EIS under the *State Development and Public Works Organisation Act 1971* (Qld) is currently being prepared.

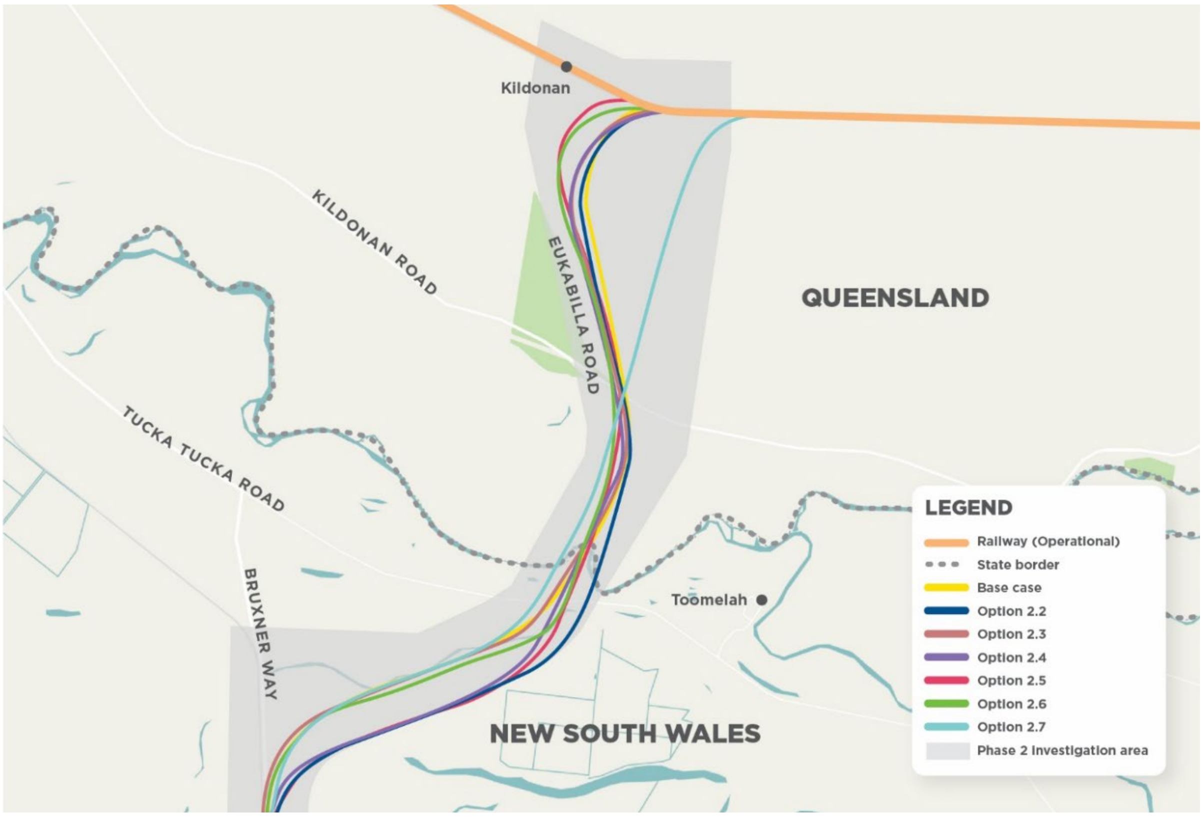


FIGURE 3.4 PHASE 2 ALTERNATIVE GREENFIELD ALIGNMENTS

The MCA identified Option 2.5 (shown in Figure 3.5) as the preferred alignment for the feasibility design phase, and development of the EIS. Key features of Option 2.5 include:

- Option 2.5 crosses Whalan Creek and the Macintyre River slightly east of the base case alignment (i.e. 'Option D st 1' from phase 2 preparatory works). This brings the Whalan Creek and Macintyre River crossings into closer proximity, thereby reducing the potential for waterway impacts.
- Option 2.5 aligns with the Eukabilla Road reserve north of the NSW/QLD border, which reduces the amount of farming land that must be acquired
- A tighter radius curve is used to tie into the QR South West rail line, further reducing the amount of farming land that must be acquired. Option 2.5 intersects cultivated and irrigated paddocks; however, the impact is greatly reduced from the base case.
- Compared to Option 2.2, Option 2.5 impacts less regulated vegetation and the length of alignment within the floodplain is reduced.

FIGURE 3.5 PREFERRED ALIGNMENT FOR PHASE 2 FEASIBILITY DESIGN

3.3.1.7 Validation of the 2017 Phase 2 Preparatory Works

During the reference design phase, Option D st 1D from the *2017 Phase 2 Preparatory Alignment Assessment Report* (ARTC, 2017) has been refined based on extensive engineering and environmental investigations. It forms the basis for this EIS, as detailed in Chapter 6: The Proposal.

Given these refinements, it was necessary to revisit the findings of the *2017 Phase 2 Preparatory Alignment Assessment Report* (ARTC, 2017) to ensure that Option D st 1D is still the preferred alignment for the greenfield section of the proposal. This scope of this work was limited to comparing the original assumptions of Option D st 1D and Option A from the *2017 Phase 2 Preparatory Alignment Assessment Report* (Figure 3.3). This assessment was in response to community feedback during the development of this EIS.

To allow for a like-for-like comparison between Option D st 1D and Option A, the design of Option A was progressed to match the current level of design of Option D st 1D (i.e. reference design). The following quantities were calculated for Option A:

- Track length
- Earthworks quantities
- Bridge lengths
- Number of culverts
- High-level road impacts, including road–rail interfaces.

A comparison of Option D st 1D and Option A in terms of the above quantities is shown in Table 3.2 and Figure 3.6. The comparison was only concerned with Ch 24.0 km – Ch 37.6 km for Option D st 1D and Ch 24.0 km to 47.1 km for Option A, as the two alignments would be identical between Ch 0.9 km and Ch 24.0 km. Note that for the purpose of obtaining the necessary environmental approvals, new track and infrastructure north of the NSW/QLD border will be assessed as part of the Inland Rail Border to Gowrie project, for which a separate EIS under the *State Development and Public Works Organisation Act 1971* (Qld) is currently being prepared. For design purposes, however, it was necessary to consider the Queensland portion of the alignment when comparing Option D st 1D and Option A to inform alignment selection.

For the comparison, Option A was designed to match the horizontal and vertical alignment of Option D st 1D at Ch 24.0 km, and also at the tie-in point with the existing QR South West Line. The number, length and type of bridges and culverts required for Option A was determined based on the flood modelling developed for this EIS, and the need to minimise afflux and unacceptable flooding impacts on nearby sensitive receptors. The Macintyre flood model that was developed during the feasibility design phase was used for this assessment, focusing on the 1% annual exceedance probability (AEP) event only, consistent with Option Da st 1D assessment.

Overall, the comparison of Option D st 1D and Option A validates the findings of the *2017 Phase 2 Preparatory Alignment Assessment Report* (ARTC, 2017). Relative to Option D st 1D, Option A requires a greater quantity of fill as well as increased bridge and culvert infrastructure. It would also result in an additional two new level crossings.

TABLE 3.2 COMPARISON OF OPTION D ST 1D AND OPTION A

Quantity	Option D st 1D	Option A	Comparison
Track length	13.6 km	23.1 km	Option A is 9.5 km longer than Option D st 1D. As such, Option A may require one additional crossing loop. This would be subject to Inland Rail Program-wide operational modelling; however, preliminary estimates indicate that crossing loops are required approximately every 13 km along the Melbourne–Brisbane Inland Rail alignment.
Earthworks quantities	Total fill 503,298 m^3 Total cut 0.0 m^3	Total fill 775,357 m^3 Total cut 0.0m^3	Option A has a slightly greater fill requirement (272,059 m^3) than Option D st 1D and no cut volume. Option A fill volume represents a 35% increase.
Bridge lengths	7 bridges required for watercourse crossings and/or flood mitigation 1 bridge required for Bruxner Way crossing Total bridge length 3,147 m	6 bridges required for watercourse crossings and/or flood mitigation 1 bridge required for Bruxner Way crossing Total bridge length 3791 m	Option A requires an additional 644 m worth of bridge length. This additional length is attributed to the proximity of sensitive receptors. In floodplain areas, the proximity of sensitive receptors to Option A is such that additional bridge length is required to achieve an acceptable level of afflux at sensitive receptors.
Number of culverts	Floodplain culverts = 178 Local cross drainage culverts = 104 Total culvert cells = 282	Floodplain culverts = 551 Local cross drainage culverts = 200 Total culvert cells = 751	Relative to Option D st 1D, Option A requires 469 additional culverts to achieve an acceptable afflux levels at sensitive receptors.
Road–rail interfaces	2 new level crossings (both in Queensland)	4 new level crossings (all in Queensland) 2 reinstated level crossings (both in Queensland, associated with the existing QR South West Line)	Relative to Option D st 1D, Option A requires an additional 2 new level crossings, and 2 reinstated level crossings. Note that the assessment of road–rail interfaces for Option A was based on existing roads only. No provisions were made for severed properties or maintaining informal access routes within private properties.
Access strategy	2 grade-separated crossings have been provided (over Bruxner Way and Tucka Tucka Road)	1 grade-separated crossing has been provided (over Bruxner Way)	Neither option constrains traffic flow or access within/between private properties. Bridge structures for flood mitigation (i.e. bridges not spanning a road or watercourse) provide the minimum clearance for light vehicles, and agricultural plant and equipment.

In conclusion, the review of the original Option A and Option D st D1 assumptions has validated that the current proposed alignment (Option D st D1) in that it achieves improved outcomes compared to that of Option A:

- Reduced impacts on environment, including less requirements for importing fill and materials
- Minimal structures within the Macintyre floodplain
- Improved safety outcomes due to a reduction in the number of road–rail interfaces
- Maintaining opportunities to connect with regional transport and freight hubs in northern NSW.

As identified within this report, the proposal does recognise that there is community support for Alignment A. Chapter 8: Consultation and Appendix D: Consultation Summary Report contain further information on how the assessment has responded to this feedback.

3.4 Proposal option development

Option D st 1D from the 2017 Phase 2 Preparatory Alignment Assessment Report has been refined based on extensive engineering and environmental investigations and forms the basis for this EIS, as detailed in Chapter 6: The Proposal.

The proposal meets the objectives detailed in Chapter 1: Introduction, and consists of:

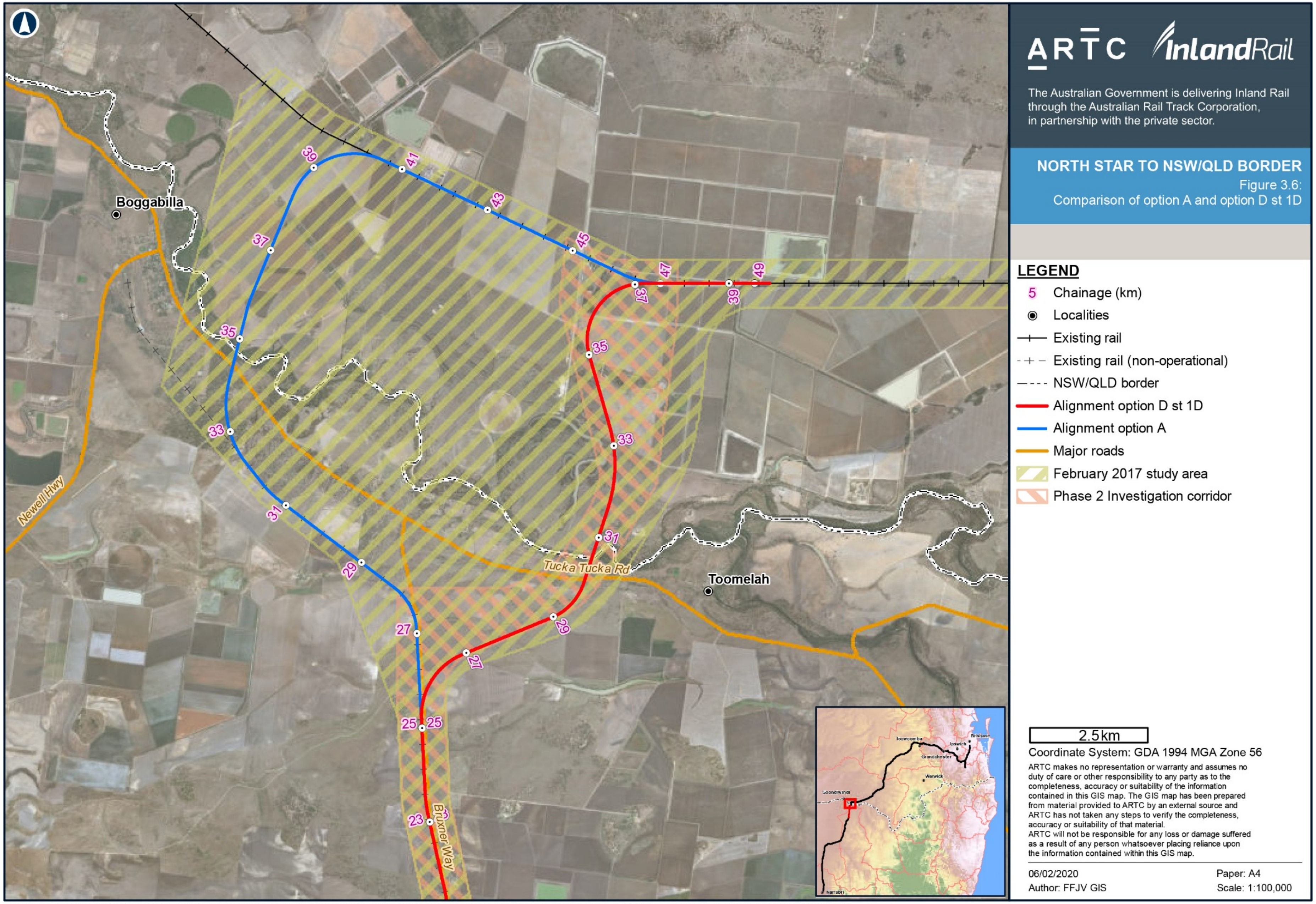
- Approximately 25 km of new, single-line, standard-gauge track within the existing non-operational Boggabilla rail corridor, between North Star (Ch 0.9 km) and the greenfield deviation (Ch 25.7 km)
- Approximately 5 km of new, single-line, standard-gauge track within a greenfield rail corridor, between the greenfield deviation (Ch 25.7 km) and the NSW/QLD border (Ch 30.6 km).

3.4.1 Approach to the option development and design process

After the final alignment for the proposal was decided, options for key features of the proposal could be developed. To date, an iterative process of option selection, design development, and evaluation has been undertaken to refine key features of the proposal. Chapter 6: The Proposal details the key features of the preferred option.

The design has evolved and will continue to evolve during the detailed design phases as a result of technical, economic, environmental and social investigations. The option selection and design process will also consider issues raised during consultation with affected stakeholders.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: LCT/GN Z:\GIS\GIS_270_NS2B\Tasks\270-EAP-201906031210_NS2B_Alignment_P1A_vs_P2_5\Output\Maps\20200206\270-EAP-201906031210_ARTC_v1_A4_P1A_vs_P2_5_Comparison_rev3.mxd Date: 6/02/2020 15:48

3.4.2 Option assessment process

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

- Track work
- Crossing loop and maintenance siding
- Level crossings
- Macintyre River Viaduct
- Bruxner Way realignment.

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 tasks:

- Confirming requirements
- Identifying options to be assessed
- Reviewing potential impacts, constraints, risks and opportunities associated with each option
- Agreeing on evaluation criteria
- Assessing the options against the criteria using an MCA
- Identifying the preferred option.

3.4.2.1 Existing track and infrastructure

Much of the proposal is within the existing non-operational Boggabilla rail corridor. While new track and infrastructure is needed for the greenfield section of the proposal, there are two options for track and infrastructure within the existing Boggabilla rail corridor: upgrade existing or remove existing and replace.

Based on field surveys and knowledge of existing track and infrastructure within the Boggabilla rail corridor, the decision was made to remove and replace all existing track and infrastructure. The condition of the existing track and infrastructure is such that significant upgrades would be needed to support the types and speeds of freight trains that would use Inland Rail. For instance:

- Existing sleepers are timber, whereas concrete sleepers are needed for Inland Rail
- Some sections of existing rail, sleepers and bridges are not suitable for operational use
- Weight of existing rail is less than the 60 kg/m that is needed for Inland Rail, meaning that the existing rail would need upgrading if used for Inland Rail.

A representation of the condition of existing track and infrastructure within the Boggabilla rail corridor is shown in Photograph 3.1 and Photograph 3.2.

PHOTOGRAPH 3.1 DERELICT TRACK WITHIN THE BOGGABILLA RAIL CORRIDOR (DATED 9 APRIL 2018)

PHOTOGRAPH 3.2 INDICATIVE CONDITION OF EXISTING TRACK WITHIN THE BOGGABILLA RAIL CORRIDOR (DATED 10 APRIL 2018)

3.4.2.2 Crossing loop and maintenance siding

The proposal includes one crossing loop. As the proposal is for single-line track, the crossing loop will allow trains travelling in opposite directions to pass each other.

The crossing loop is an approximately 2.2 km section of single-line, standard-gauge track, running roughly parallel to the main track. The crossing loop can accommodate trains up to 1,800 m long. It is connected to the main track at both ends via low-speed (80 km/hr) turn outs.

A one-ended, single-line, standard-gauge siding will be incorporated into the crossing loop for maintenance purposes. It will be used for stable rail-mounted track maintenance plant and equipment (e.g. tampers, regulators, rail grinders, 'hi-rail' plant, etc.) during track-maintenance activities. The siding is approximately 250 m long and will be connected to the southern end of the crossing loop via a low-speed (40 km/hr) turn out. Connecting to the southern end is preferred over the northern end due to the straighter, flatter alignment, and lower embankment heights.

Based on the reference design, the optimised location of the crossing loop is between Ch 22.7 km and Ch 24.9 km. The location of the crossing loop may change as the optimisation process progresses, driven by the design of Inland Rail projects that are still in the design phase. The location may change between Ch 16.5 km and Ch 24.9 km as detailed in Chapter 6: The Proposal.

On single-line track, allowing two trains travelling in opposite directions to pass each other causes at least one train to be delayed (the train that enters the crossing loop must stop to wait for the other train to pass). The length of this 'crossing delay' depends on the relative timing of the two trains' arrival at the crossing loop.

A key driver of Inland Rail is to achieve a Melbourne–Brisbane transit time of less than 24 hours, with 98 per cent reliability. In order to achieve this target, ARTC is seeking to minimise crossing delays across the entire 1,700 km Inland Rail network by optimising the number and location of crossing loops. This is an iterative process, as all 13 Inland Rail projects are at different stages of design development and construction. Projects that are in the construction phase have definitive crossing loop locations; however, opportunities exist on projects that are still in the design stage (such as NS2B) to optimise the location of crossing loops.

Therefore, the current location of the NS2B crossing loop is subject to change as the optimisation process progresses. Should the location change, ARTC will assess potential impacts in line with the Department of Planning, Industry and Environment's (DPIE) 'maximum parameters' approach.

3.4.2.3 Road–rail interfaces

Public road–rail interfaces are points where the rail alignment crosses a public road. The proposal would require the crossing of state-controlled and local government (Gwydir Shire Council and Moree Plains Shire Council) roads. The proposal would also interface with several private properties along the proposed alignment.

During the feasibility design phase, the following road–rail interface activities were undertaken:

- Identifying all interface locations along the proposed alignment
- Field assessments of interface locations
- Review of proposed interface locations regarding Australian and ARTC level crossing design standards
- Stakeholder consultation
- Identifying preferred treatments and consolidation options for further stakeholder consultation during the development of the EIS.

The following options were considered for each road–rail interface location:

- Elimination so far as is reasonably practicable by closing—closing by consolidating with other crossings or closing by realigning roads to avoid a crossing
- Passive level crossing with stop signs
- Active level crossing the lights and/or boom gates
- Grade separation.

Public road–rail interfaces are summarised in Table 3.3. The preferred treatments involve a mix of active and passive level crossings, road realignments and grade separations. The final number of public and private road–rail interfaces, and preferred treatments, will be determined during the detailed design phase, based on further consultation with affected landowners on a case-by-case basis. Unformed roads will remain unformed as part of this proposal.

TABLE 3.3 PUBLIC ROAD–RAIL INTERFACES

Interface with public road	Approximate chainage (km)
Unnamed Road	Ch 1.5
North Star Road	Ch 7.0
Unnamed Road (Travelling stock reserve (TSR))	Ch 9.2
Unnamed Road (TSR)	Ch 9.3
Forest Creek Road	Ch 12.2
North Star Road	Ch 19.9
Unnamed Road (TSR)	Ch 20.7
Unnamed Road	Ch 20.8
Unnamed Road	Ch 22.4
Unnamed Road	Ch 23.4
Unnamed Road	Ch 25.0
Bruxner Way	Ch 25.5
Bruxner Way	Ch 25.8
Unnamed Road	Ch 26.3
Unnamed Road	Ch 27.3
Unnamed Road	Ch 28.6
Unnamed Road (TSR)	Ch 29.9
Tucka Tucka Road	Ch 30.1

Road–rail interface activities during the detailed design phase will involve:

- Consulting with stakeholders regarding the preferred treatment options
- Reviewing the proposed works for each crossing in detail, taking into account input from stakeholders
- Preparing the detailed design for level crossing works
- Stakeholder consultation
- Finalise the detailed designs for each crossing, taking into account the results of consultation.

3.4.2.4 Macintyre River Viaduct

The proposal includes a 1.8 km long viaduct that crosses Whalan Creek, Tucka Tucka Road and the Macintyre River. Approximately 1.2 km of the viaduct is located in NSW, while the remaining 0.6 km is located in Queensland. Note: because the viaduct is located in both NSW and Queensland, it will be assessed under the *Environmental Planning and Assessment Act 1979* (EP&A Act) (NSW) by this EIS and under the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act) by the Inland Rail Border to Gowrie project EIS.

During Phase 2 of the proposal, the design of the Macintyre River Viaduct was informed by geotechnical and flooding studies. Initially, three separate bridge structures were proposed over Whalan Creek, Tucka Tucka Road, and the Macintyre River; however, an iterative flood assessment of the design, along with a systems approach to maintaining operational speeds and grades, has resulted in a single viaduct structure that minimises upstream flooding impacts.

3.4.2.5 Bruxner Way realignment

The proposal involves a minor realignment of Bruxner Way. Bruxner Way is a classified main road pursuant to the *Roads Act 1993* (NSW) and a regional road. It is a two-lane, two-way road with a posted speed limit of 100 km/hr.

In order to achieve flood immunity, the elevation of the proposal must be significantly higher than Bruxner Way at the point where the proposal intersects Bruxner Way. Therefore, it was decided to design a rail-over-road grade separation with a minimum vertical clearance of 5.4 m at the point of intersection.

At the point where the proposal intersects the existing Bruxner Way, the skew angle is approximately 75 degrees. Engineering investigations found that maintaining this skew angle would involve constructing a bridge with excessively long, non-standard spans. Therefore, it was decided to adopt a more practical skew angle of 45 degrees. To achieve a 45-degree skew angle, it is necessary to realign Bruxner Way to the east, and then back to the existing Bruxner Way on a slight curve.

As part of the reconfiguration, the elevation of Bruxner Way will be maintained or slightly increased. This will maintain or improve flood immunity at this location.