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ARTC

InlandRail

**Narromine to Narrabri
Options Report
November 2017**



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EXECUTIVE SUMMARY

This Options Report summarises the process, inputs and decisions made by the Australian Rail Track Corporation (ARTC) to assess alternative options and identify the Study Area for the Melbourne to Brisbane Inland Rail (Inland Rail) between Narromine and Narrabri.

Background

The Narromine to Narrabri section of Inland Rail is one of the three ‘missing link’ projects in New South Wales (NSW). Located in mid north western NSW, it is approximately 307 km in length and is the longest greenfield section of the Inland Rail programme to be delivered.

The original Study Area between Narromine and Narrabri was identified in ARTC’s 2010 Inland Rail Alignment Study, which informed the development of the Inland Rail Business Case in 2015.

The Phase 1 Concept Assessment commenced in early 2016. This involved the development of the 2016 Concept Alignment based on the ARTC 2010 Inland Rail Alignment Study. The 2016 Concept Alignment informed initial discussions with the community and stakeholders including local councils, landowners, and farmers’ representatives. Feedback from these discussions highlighted the expectation that ARTC should consider alternative options utilising the existing Coonamble rail line and traversing parts of the Pilliga State Forest as part of the Phase 1 Concept Assessment.

Option development and assessment

In response to community and stakeholder feedback, approximately fifty alternative options were developed. ARTC has implemented a process to evaluate and refine alignments across the entire Inland Rail Programme to ensure a consistent approach to the ‘like for like’ comparison of alternative options. The Australian Government and ARTC endorsed a process to consider the comparative performance of options against three factors:

- their ability to meet the Service Offering, which is the level of service required by rail operators and freight customers
- costs, comprising the construction estimate, and track and maintenance and train operating costs for customers and
- Multi-Criteria Analysis (MCA).

MCA workshops were held in October 2016, December 2016 and May 2017 and utilised the following programme-wide [Inland Rail MCA](#) criteria. These compared the various options to the 2016 Concept Alignment, to quantify their comparative merit. The following criteria were considered:

- Technical viability: alignment, impact on public utilities and services, geotechnical conditions, impacts on existing roads and rail networks, flood immunity/hydrology, future proofing.
- Safety: operational safety, public safety, road safety interfaces, emergency response, construction safety.
- Operations: effect/impact on travel time, effect on reliability and availability, network interoperability and connectivity.
- Constructability: construction duration, construction access, construction complexity, resources/material sources, interface with operational railway, staging opportunities.
- Environmental: ecological impacts (flora, fauna and habitats), visual impacts, noise and vibration impacts, flooding and waterway impacts, effect on air quality, effect on greenhouse gas emissions.
- Community and property: property impacts, Indigenous and non-Indigenous heritage, impact on community, community responses, current and future land use impacts.
- Approvals and risk: planning and approval timescale, support of local, state and federal governments, other statutory and regulatory approvals, service authorities.

The outcome of the initial MCA in October 2016 was presented to the community and stakeholders in November 2016. Community and stakeholder feedback, together with further engineering design and field work, informed further refinements to the options, with the second MCA workshop held in December 2016.

Alternative options varied in length across the Study Area, and connected in various combinations. ARTC therefore adopted a locality based approach to option evaluation, with the project broken into sections to enable comparison on a like for like basis at each MCA workshop.

In March and April 2017, ARTC undertook a further round of extensive consultation with communities and stakeholders on both the 2016 Concept Alignment and the shortlisted options. A further MCA workshop was held by ARTC in May 2017 to consider the additional feedback and to select a Study Area for the Phase 2 Feasibility Assessment. The project sections and the proposed alignments considered in the May 2017 MCA are shown in Figure 1 below.

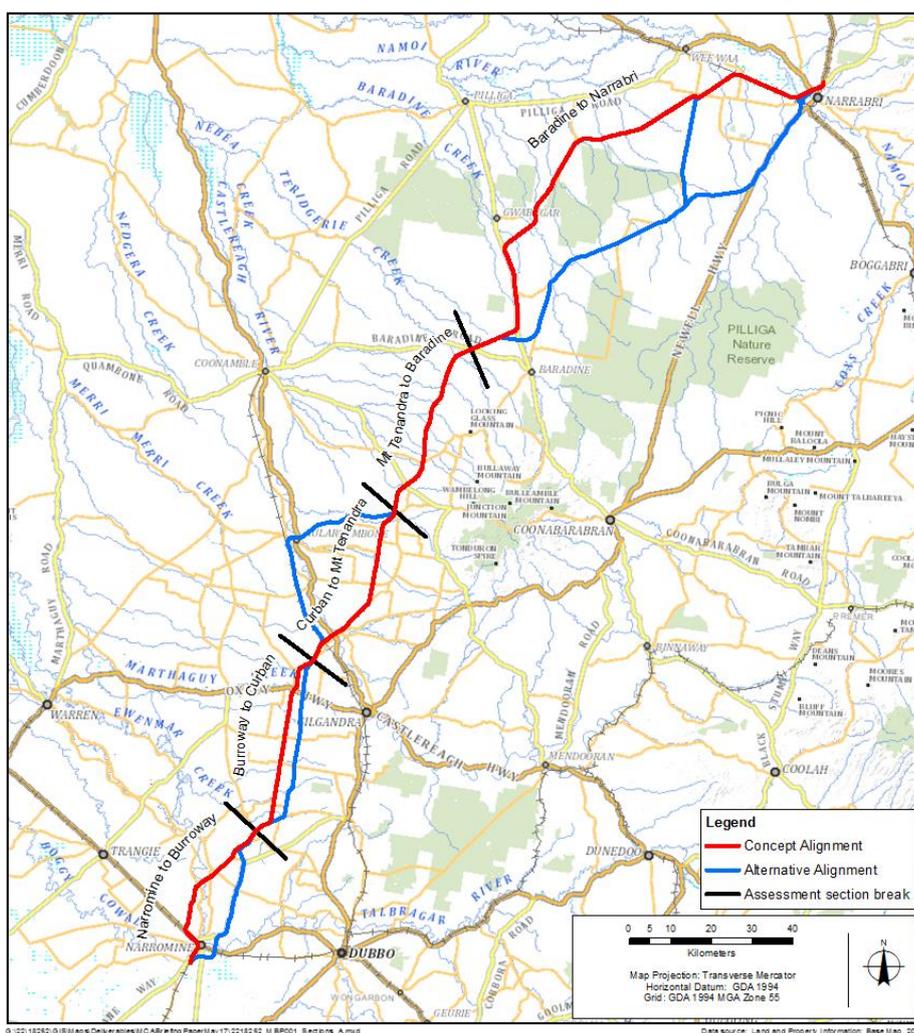


Figure 1 Narromine to Narrabri – Project Sections and the May 2017 MCA Options

Community and stakeholder engagement

Alternative options were presented in information sessions in November 2016, and landowner meetings in March-April 2017. Over 450 community members were consulted, with the following identified as key themes or issues:

- avoid houses and groups of houses; areas of new small lifestyle acreages may experience greater disturbance than the larger properties by a rail line
- minimise impacts to cropping and higher intensity agricultural areas
- follow property boundaries to minimise property severance, but be aware that some properties operate across multiple boundaries and span roads, and operational severance should also be a consideration
- aim to utilise existing rail lines, road corridors, property boundaries as much as possible
- concerns around flooding risk and ground conditions
- be aware that there are close-knit communities along the routes with instances of related landowners and multi-generational farmers; adopt an appropriate community and stakeholder engagement approach to suit.

The Study Area

The Study Area illustrated in Figure 2 was identified as a result of the May 2017 MCA workshop. The Study Area generally has a standard width of 2km for the majority of its length, and localised wider or narrower sections to allow for additional alignment refinement in response to further studies and investigations and consultation to be carried out during the Phase 2 Feasibility Assessment. It contains the following sections options:

- **Narromine:** the Narromine east option
- **Narromine to Curban:** the Eumungerie Road option between Narromine and Burroway, then a combination of the 2016 Concept Alignment and the Gilmores Road Alternative between Burroway and Curban
- **Curban to Mt Tenandra:** the 2016 Concept Alignment
- **Mt Tenandra to Baradine:** the 2016 Concept Alignment, with some potential for minor departures subject to further investigations and stakeholder engagement
- **Baradine to Narrabri West:** Pilliga State Forest Option: Corridor runs through the Pilliga state forest until Newell Highway, then runs along Newell highway and then branching off to the north to connect onto the 2016 alignment west of Narrabri.

ARTC's decision to identify this Study Area was based on the following factors:

- There is a positive impact on the Service Offering with a reduction of 4 minutes 38 seconds in transit time, over 3 hours and 10 minutes, for the total Narromine to Narrabri section. This is approximately a 2.5% decrease.
- There is a 3.3% capital cost saving on an estimated \$1.5billion dollar project.
- The overall MCA scoring is positive.
- The corridor takes into account feedback from the local and broader community and affected landholders.
- The investigation areas include better geotechnical conditions and will provide opportunity for capital cost savings and reduced maintenance costs.
- The hydrology and flooding issues will be reduced.
- The corridor allows for further refinement in areas where additional investigation and consultation is required.

Stakeholder and community engagement allowed for a closer look at constraints and opportunities for improvement along the project length. In locations where there is a clear advantage to deviating from the 2016 Concept Alignment, the alternate option has been adopted as part of the Study Area.

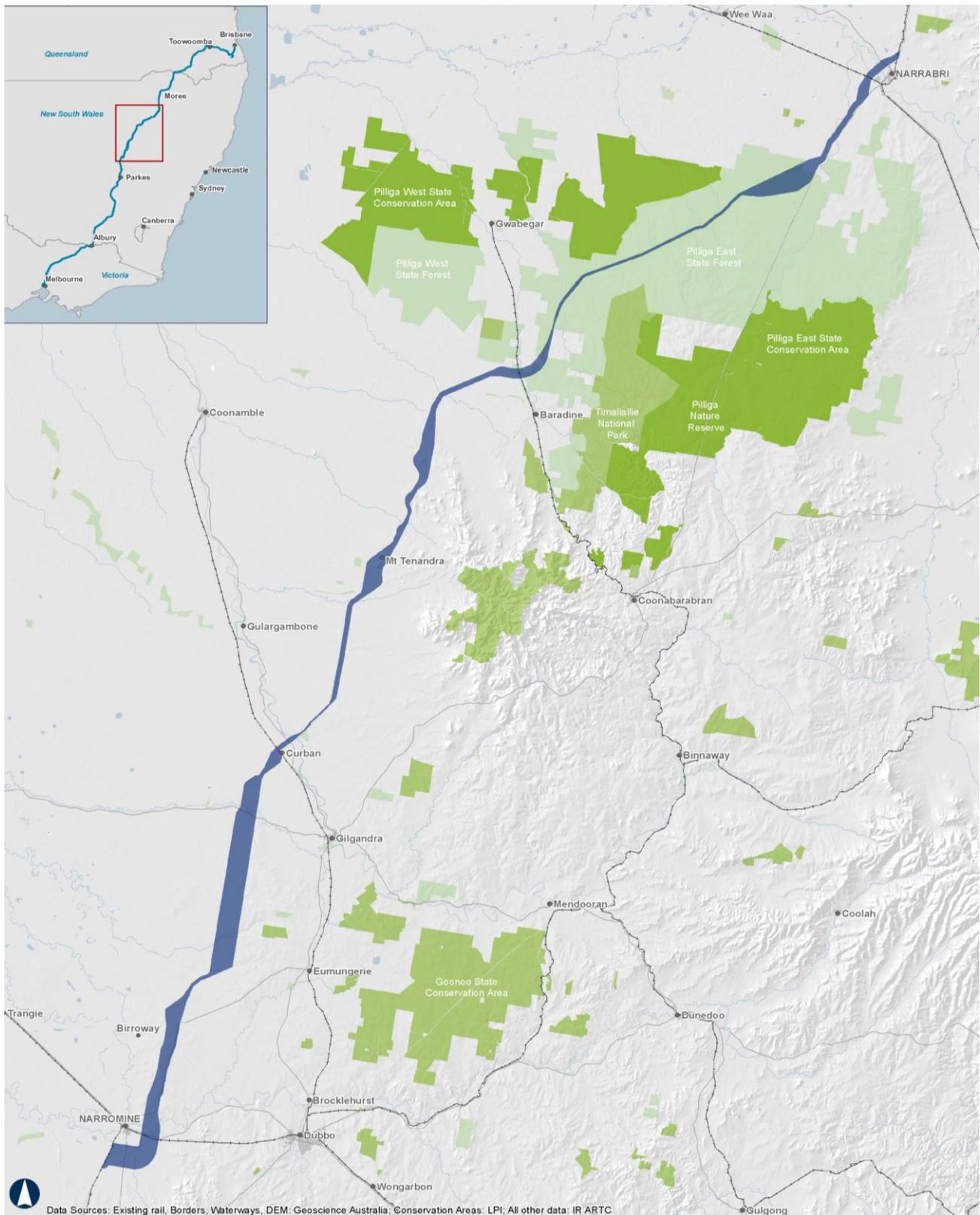


Figure 2 The Study Area

Next steps

The Study Area establishes the area to be investigated during the Phase 2 Feasibility Assessment, for identification of the proposed corridor. These investigations will include a wide range of assessments including geotechnical investigations, topographical surveys, socio-economic studies and environmental and cultural heritage studies. These studies will also inform the preparation of an Environmental Impact Statement (EIS) during the Phase 2 Feasibility Assessment, to be submitted to the NSW Government as part of the formal approval process. The steps in the assessment and approval process are illustrated in Figure 3.

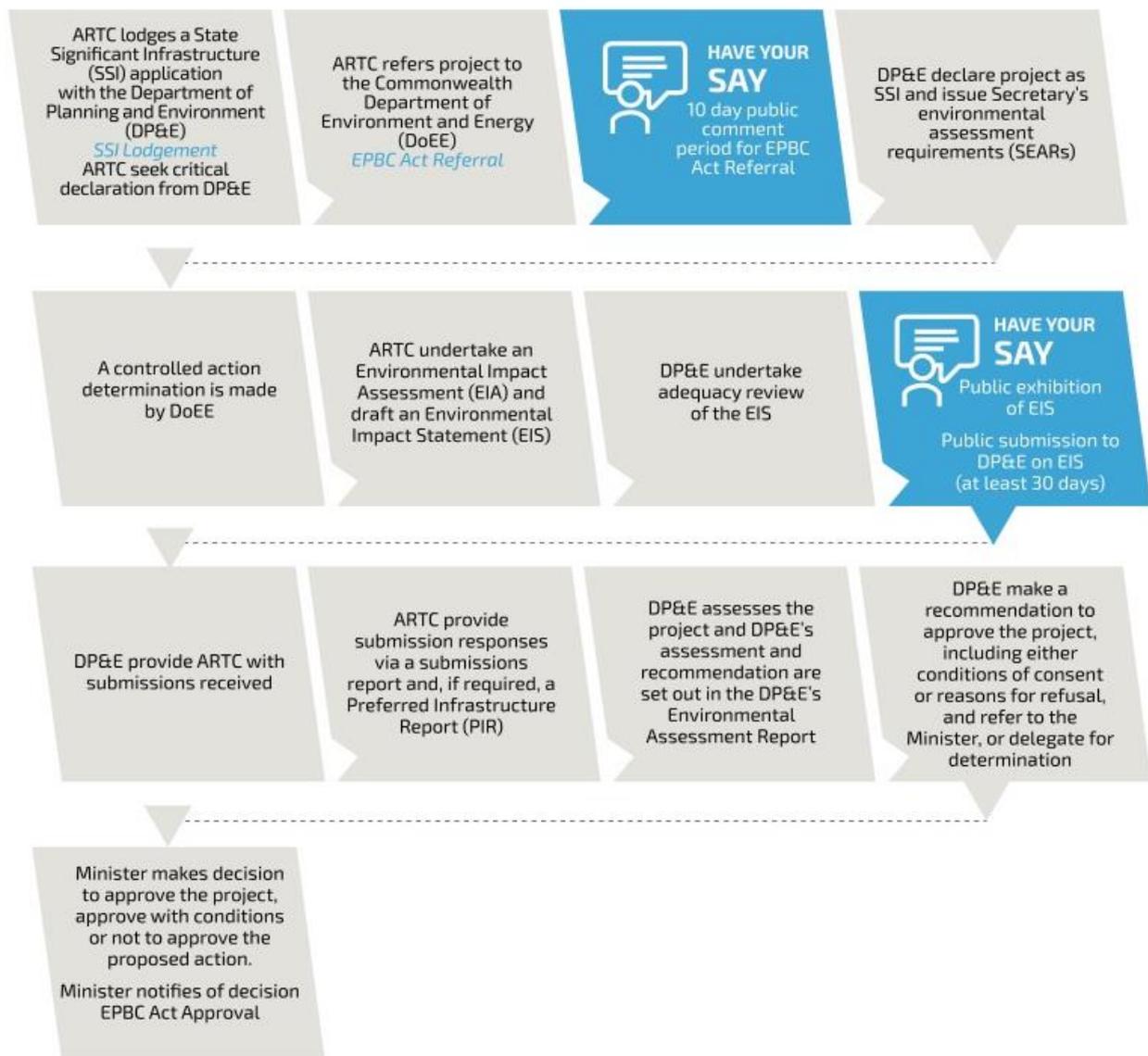


Figure 3 Process to assess State Significant Infrastructure projects in New South Wales

1. INTRODUCTION

The Melbourne to Brisbane Inland Rail is a once-in-a-generation project connecting regional Australia to domestic and international markets.

It will complete the ‘spine’ of the national freight network between Melbourne and Brisbane via regional Victoria, New South Wales and Queensland. It’s the largest freight rail infrastructure project in Australia and is expected to be operational in 2024-2025.

Australian Rail Track Corporation (ARTC) was requested to develop a business case, update the cost estimate and to commence environmental approvals, design, engineering, corridor protection and early works. The Australian Government has committed \$9.3B in funding to deliver Inland Rail.

The Inland Rail Programme has been divided into 13 individual projects of which the Narromine to Narrabri Project is one. An overview of the project (showing the 2010 Concept Alignment) is shown in Figure 4.



Figure 4 Narromine to Narrabri project location 2010 Concept Alignment

1.1. Need for the project

The Narromine to Narrabri section is one of the three ‘missing link’ projects in NSW. Located in mid north western NSW, it is approximately 307 km in length and is the longest greenfield section of the Inland Rail Programme to be delivered.

1.2. Purpose of this report

This report describes the development and selection of the Study Area for the Narromine to Narrabri section of Inland Rail, providing an overview of alternative options considered along with the criteria and considerations that have informed the options assessment. It also describes how stakeholder and community feedback has been taken into consideration in both the identification of alternative options and the options analysis.

1.3. Inland Rail objectives

Inland Rail is being designed and will be constructed to achieve the following objectives for the movement of freight between Melbourne and Brisbane as outlined in the Inland Rail Service Offering:

- 98% reliability
- Road competitive pricing
- Less than 24 hours transit time
- Freight availability in line with market needs.

These objectives, along with key technical characteristics are illustrated in Figure 5.

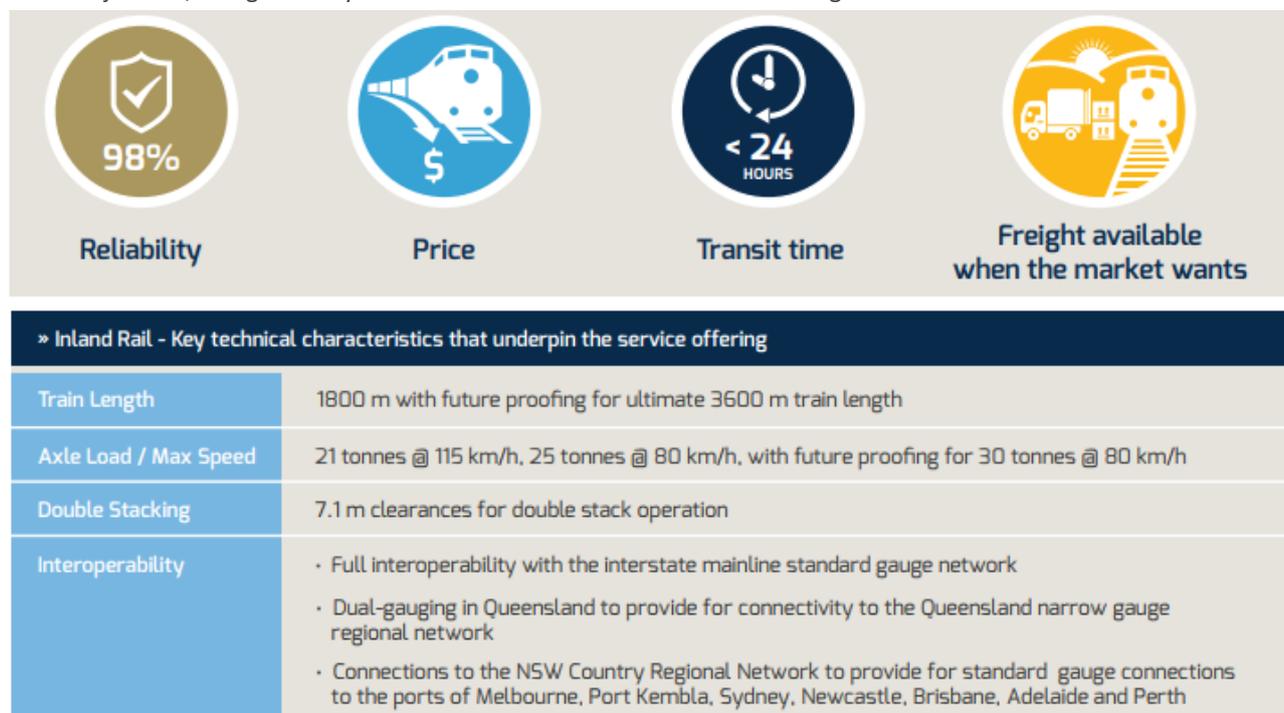


Figure 5 Service Offering Objectives

The Narromine to Narrabri project must also satisfy the Inland Rail Service Offering. This requirement has informed the options assessment process documented in this report. The Service Offering is one of the three factors that are considered during the process to refine route selection.

The following aims underpin the design and delivery of Inland Rail, including the Narromine to Narrabri Project:

- Put safety at heart of everything we do.
- Minimise our environmental footprint.
- Engage early and meaningfully with all stakeholders, including Aboriginal parties in accordance with established practices.
- Make decisions based on a strong understanding of technical, economic, environmental and social issues.
- Future-proof Inland Rail so it is efficient and effective in the long term.
- Promote economic benefits within regional communities.
- Regularly review and audit processes and performance.

2. APPROACH

2.1. Background

The original Study Area between Narromine and Narrabri was identified in ARTC’s 2010 Inland Rail Alignment Study, which informed the development of the Inland Rail Business Case in 2015.

The Phase 1 Concept Assessment commenced in early 2016. This involved the development of the 2016 Concept Alignment based on the ARTC 2010 Inland Rail Alignment Study. The 2016 Concept Alignment informed initial discussions with the community and stakeholders including local councils, landowners, and farmers’ representatives. Feedback from these discussions highlighted the expectation that ARTC should consider alternative options utilising the existing Coonamble rail line and traversing parts of the Pilliga State Forest as part of the Phase 1 Concept Assessment.

2.2. Option development and assessment

In response to community and stakeholder feedback, approximately fifty alternative options were developed. The alternate option development and MCA assessment process timeline is illustrated in Figure 6.



Figure 6 Option development and assessment timeline

ARTC has implemented a process to evaluate and refine alignments across the entire Inland Rail Programme to ensure a consistent approach to the ‘like for like’ comparison of alternative options. This process considers the comparative performance of options against three factors:

- their ability to meet the Service offering, as outlined in section 1.3
- costs, comprising the construction estimate, and track and maintenance and train operating costs for customers
- Multi-Criteria Analysis (MCA), which is further discussed in section 2.2.2.

Alternative options vary in length across the Study Area, and connect in various combinations ARTC therefore adopted a locality based approach to option evaluation, with the project broken into sections to enable comparison on a like for like basis at each MCA workshop, as shown on Figure 7.

In March and April 2017, ARTC consulted with the community and stakeholders on both the 2016 Concept Alignment and the alternative options. A further workshop was held by ARTC in May 2017 to consider the additional feedback and to select a Study Area for the Phase 2 Feasibility Assessment.

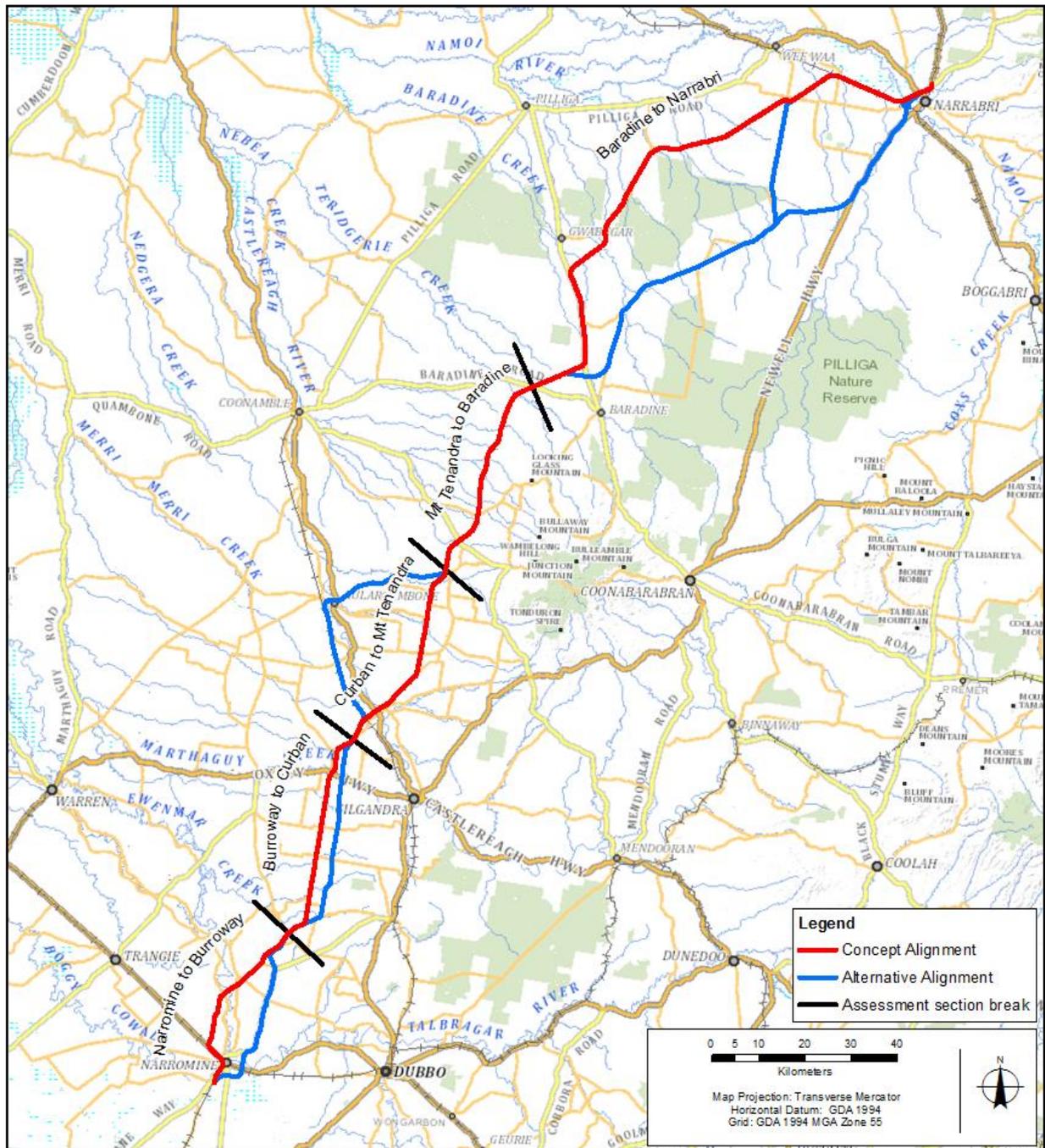


Figure 7 Narromine to Narrabri – Project Sections and May 2017 MCA Options

2.2.1. Constraints, design and technical considerations

The 2016 Concept Alignment and alternative options were developed with consideration of environmental, physical and operational considerations. This included desktop assessment, with targeted field work to confirm the desktop assessments of the following:

- Aboriginal and historic heritage
- topography, geology, and soils
- land ownership and use
- biodiversity
- noise and vibration
- air quality
- contamination
- surface water and flooding.

Design and technical considerations include:

- engineering design criteria
- design life
- flood immunity and drainage
- geotechnical considerations and ground conditions
- property and land use impacts.

2.2.2. MCA criteria

MCA workshops held in October 2016, December 2016 and May 2017 utilised the following programme-wide [Inland Rail MCA](#) criteria. These compared the various options to the 2016 Concept Alignment, to quantify their comparative merit. The following criteria were considered:

- Technical viability: alignment, impact on public utilities and services, geotechnical conditions, impacts on existing roads and rail networks, flood immunity/hydrology, future proofing.
- Safety: operational safety, public safety, road safety interfaces, emergency response, construction safety.
- Operations: effect/impact on travel time, effect on reliability and availability, network interoperability and connectivity.
- Constructability: construction duration, construction access, construction complexity, resources/material sources, interface with operational railway, staging opportunities.
- Environmental: ecological impacts (flora, fauna and habitats), visual impacts, noise and vibration impacts, flooding and waterway impacts, effect on air quality, effect on greenhouse gas emissions.
- Community and property: property impacts, Indigenous and non-Indigenous heritage, impact on community, community responses, current and future land use impacts.
- Approvals and risk: planning and approval timescale, support of local, state and federal governments, other statutory and regulatory approvals, service authorities.

The MCA process relies on a combination of qualitative and quantitative value judgements. Some values and criteria are subjective by nature, or require value judgments based on prediction of likely sensitive or degree of impact. Sensitivity testing is therefore undertaken as part of the process, to evaluate the influence, if any, subjective assessments have on the consensual outcome.

2.2.3. Service Offering

The length and predicted travel time was used to evaluate the comparative performance of alternative options in relation to the Service Offering.

2.2.4. Comparative capital cost estimates

A preliminary bill of quantities was developed for each option, based on the engineering and investigative work undertaken. These were then rated, to prepare high-level, comparative construction-cost estimates as inputs to the decision process for a Study Area.

2.3. Community and stakeholder engagement

Alternative options were presented in information sessions in November 2016, and landowner meetings in March-April 2017. Over 450 community members were consulted, with the following identified as key themes or issues:

- avoid houses and groups of houses; areas of new small lifestyle acreages may experience greater disturbance than the larger properties by a rail line
- minimise impacts to cropping and higher intensity agricultural areas
- follow property boundaries to minimise property severance, but be aware that some properties operate across multiple boundaries and span roads, and operational severance should also be a consideration
- aim to utilise existing rail lines, road corridors, property boundaries as much as possible
- concerns around flooding risk and ground conditions
- be aware that there are close-knit communities along the routes with instances of related landowners and multi-generational farmers; adopt an appropriate community and stakeholder engagement approach to suit.

This feedback was taken into consideration throughout the various MCA workshops.

3. OPTION EVALUATION

3.1. Initial MCA – October 2016

An initial MCA was completed in October 2016. During this process, 28 corridor options were assessed across the project. To facilitate this, the project was broken into five discrete geographic sections. The options considered in each of these sections are shown in Figure 8.

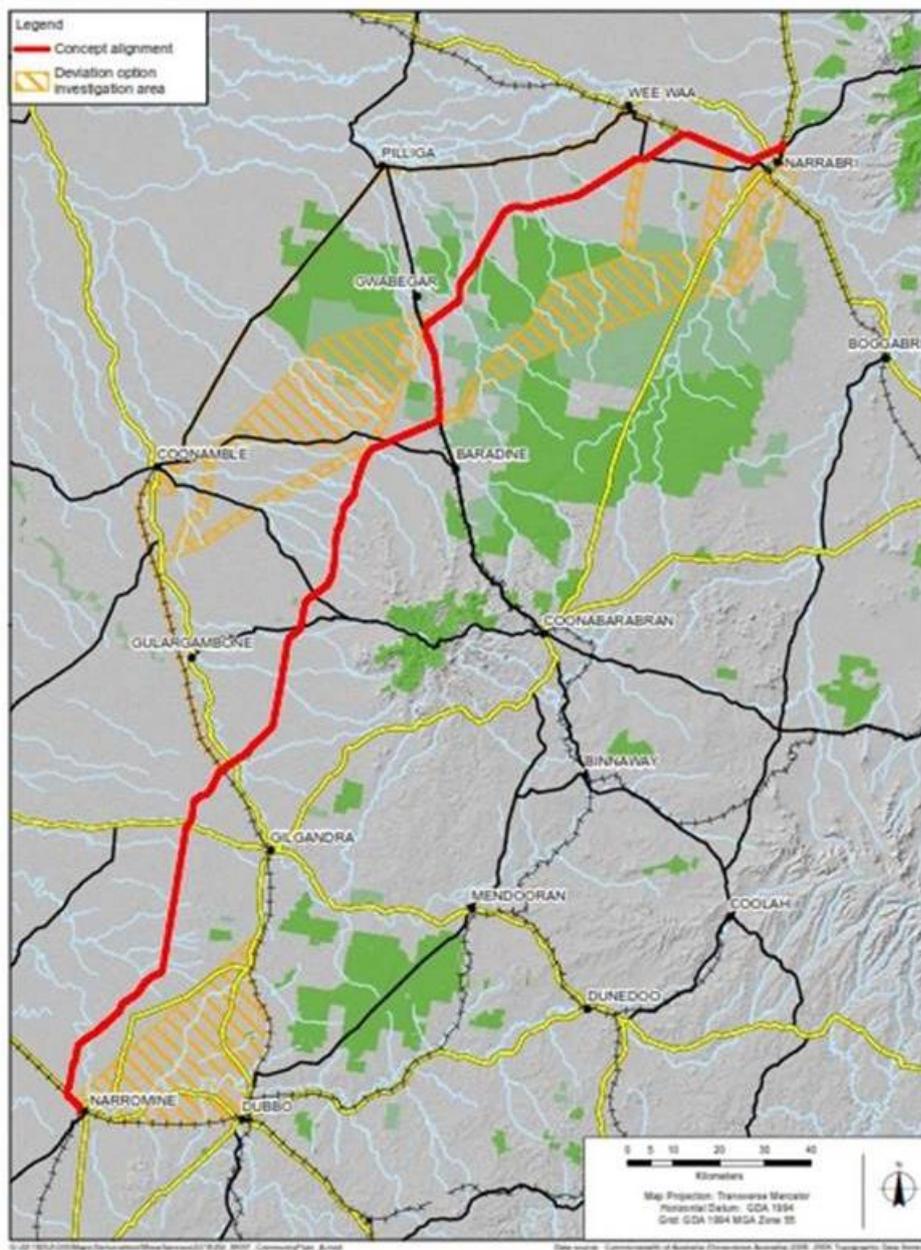


Figure 8 October – December 2016 MCA Options Outcome

Options considered in the October 2016 MCA are shown in Figures 9-11. A summary of the options considered for further investigation and the discounted options are shown in Tables 1 and 2 below.

Table 1 Initial MCA – additional options

Section	Initial MCA – additional options
Narromine	Two options were shortlisted in Narromine, the Narromine West option (based on the original 2016 Concept Alignment) and the Narromine East option (a combination of two sections of alternate option, 101 and 107).
Narromine to Curban	Three options were shortlisted in this area, including the 2016 Concept Alignment, the Coonamble line option (option 101) and the combined Narromine East/2016 Concept Alignment (option 107).
Curban to Kenebri	The 2016 Concept Alignment forms the basis of both shortlisted options in this section, with one adopting the Coonamble line to Gulargambone (option 206).
Kenebri to Narrabri	Four options were shortlisted between Kenebri and Narrabri. These were the 2016 Concept Alignment, the Pilliga Forest Way option (combination of option 403 and 404), the direct route (option 408 and 409) and the Yarrie Lake/ 2016 Concept Alignment option (option 403/404 combined with option 401).
Narrabri	The 2016 Concept Alignment and the Narrabri East option (connecting to the Pilliga options) were shortlisted at the northern end of the Study Area.

Table 2 Discounted options

Description	Rationale
Option 102 follows the Mitchell Highway to the east of Narromine for approximately 6 km before branching north over open country to join the Coonamble line at Eumungerie.	Greater potential for flooding issues and an increased likelihood of soft soils, as it runs in a valley next to a watercourse.
Option 103 follows the Mitchell Highway to the east of Narromine for approximately 20 km before crossing the Macquarie River at Rawsonville and continuing north, joining the Coonamble line 15km south of Eumungerie.	Utilises a greater length of existing railway, resulting in marginally less property impacts, however it was a longer corridor than other options traversing this section.
Option 104 is similar to 103, but continues east at Rawsonville to join the Coonamble line earlier, approximately 8 km north of Dubbo.	Ruled out due to its length and comparative travel times, similar to 103.
Option 105 is similar to 104, with an alternative crossing point on the Macquarie River.	Ruled out due to its length and comparative travel times, similar to 103.
Option 106 maximised the use of existing rail corridor by following the Main Western line to Dubbo and then the Coonamble line to Curban. Rail bypass would be required at Dubbo to avoid tight radii and restrictions on the existing track through the centre of Dubbo.	Longest option, addition approximately 22 minutes journey time. Interaction with existing rail traffic on the Main Western and Coonamble lines with higher potential for impacts to reliability.
Options 201-205 – Considered the use of the existing Coonamble line and then traversing north east.	These options were discounted due to the additional transit time it presented between Narromine to Narrabri.

Description	Rationale
<p>Option 402 - Similar start to 401, but takes more direct line through bushland between Rail Survey Road and Pilliga Forest Way. Exits forest to north before Newell Highway and follows existing track to north, over Yarrie Lake Road to join the Walgett Line to the west of Narrabri.</p>	<p>Ruled out due to higher impact to environmental and heritage</p>
<p>Option 405 - Similar start to other options along Cumbill Road and then parallels Pilliga Forest Way (403,404) on slightly higher ground. Crosses over Newell Highway and approaches Narrabri from the south parallel to Westport Road.</p>	<p>Similar in length to options 403 and 404, but would require more significant cleared to undertake construction. Potential impacts on productive forestry areas and large lot residential zoning on approach to Narrabri.</p>
<p>Option 406 - Similar to 405, but approach to Narrabri further to the east, along Jacks Creek.</p>	<p>Similar in length to options 403 and 404, but would require more significant cleared to undertake construction. Potential higher impacts on productive forestry areas and large lot residential zoning.</p>
<p>Option 407 - Enter the forest along Cumbill road and then take a direct line from Etoo Creek to the Newell Highway. These alignments are the shortest. 407 exits the forest to the north, similar to 402, to join the Walgett line and approach Narrabri from the west.</p>	<p>Potential for steeper gradients requiring more extensive cut to fill.</p>

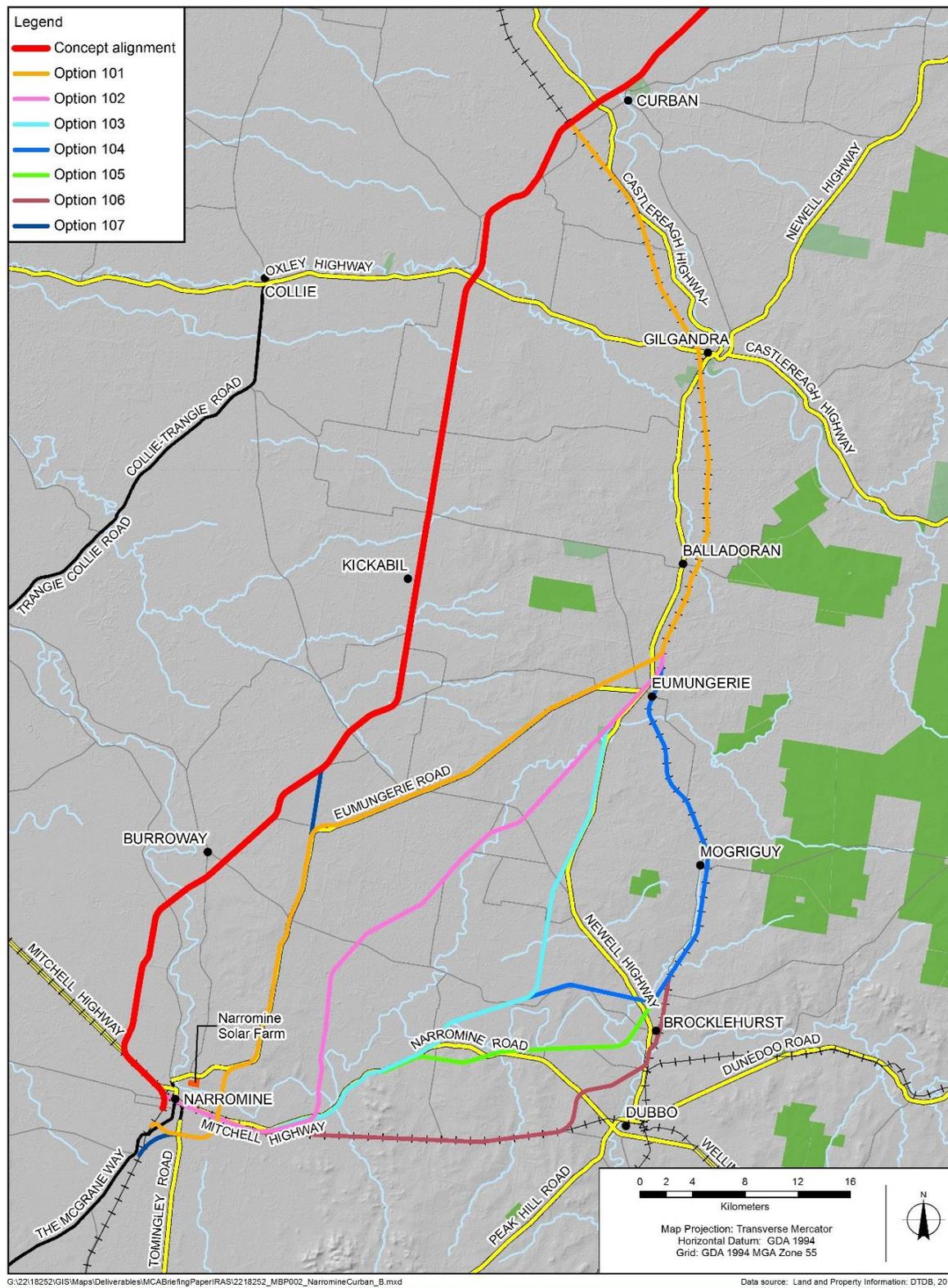


Figure 9 Discounted options from initial MCA – Narromine to Curban

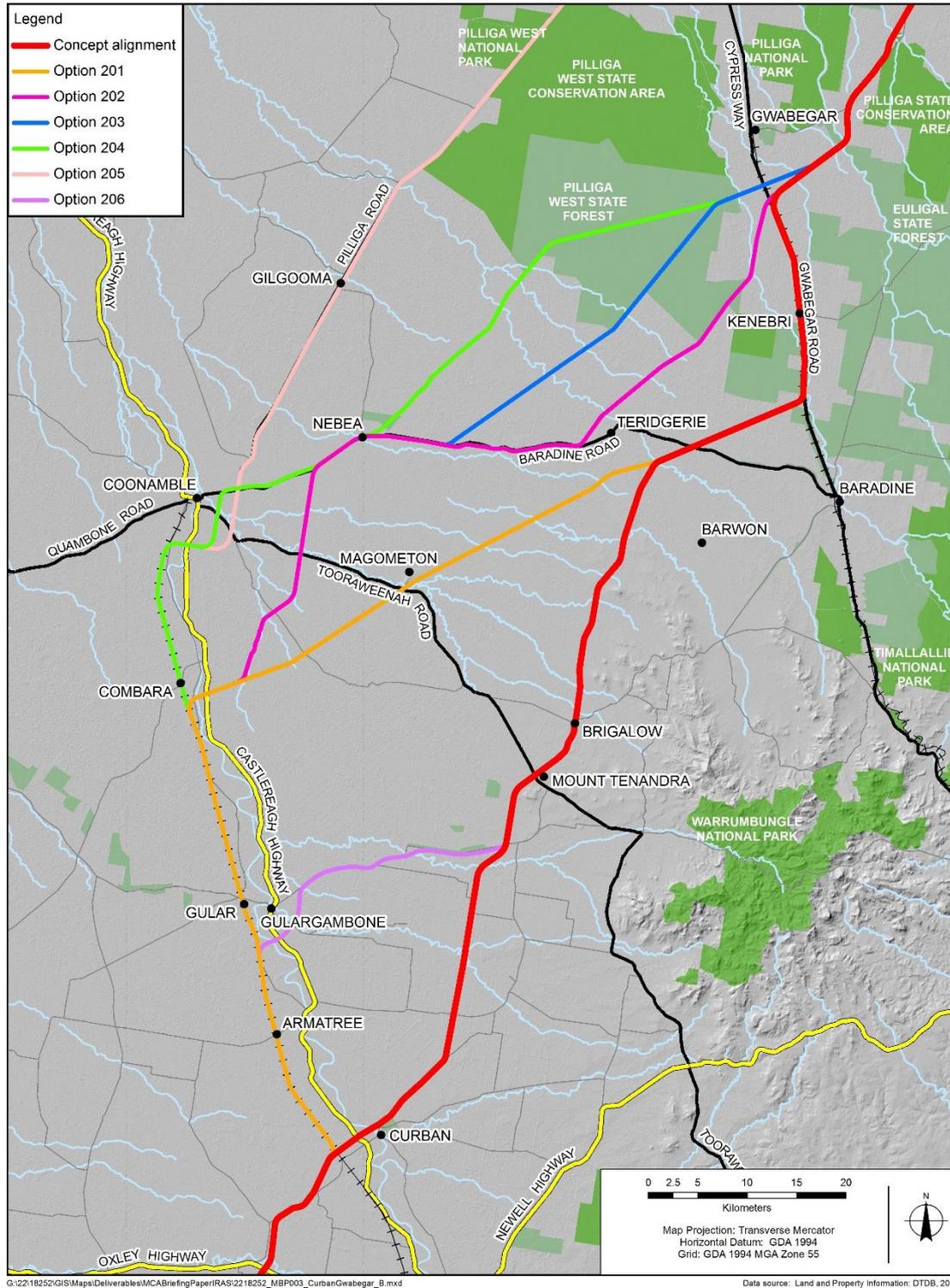


Figure 10 Discounted options from initial MCA – Curban to Gwabegar

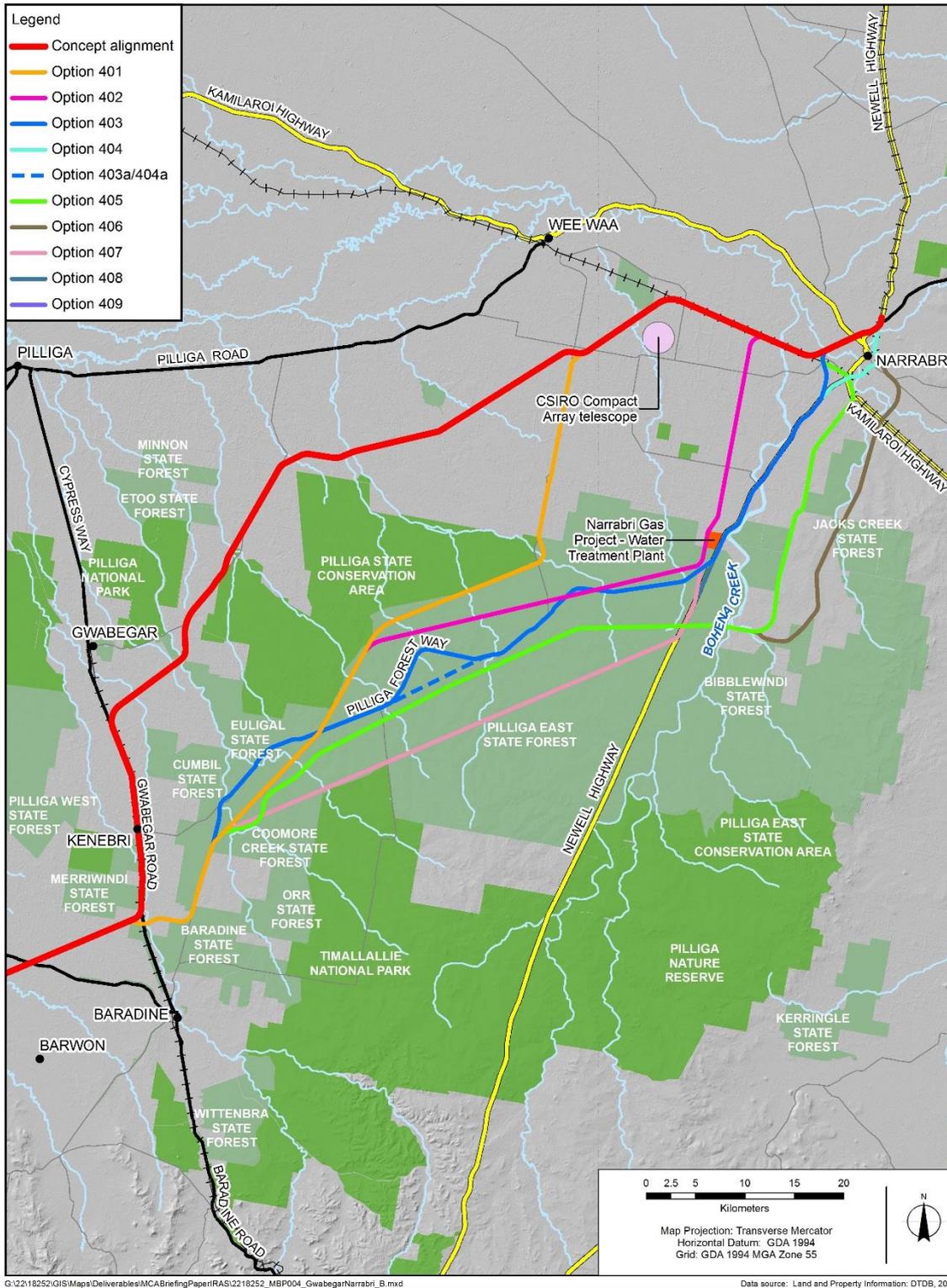


Figure 11 Discounted options from initial MCA – Baradine to Narrabri

3.2. Second MCA– December 2016

The shortlisted outcomes from the October 2016 workshop resulted in further alignment refinements that were taken to the MCA workshop held on 15 December 2016. The purpose of this MCA was to determine options unlikely to proceed and to determine which options to take forward for further investigation and consultation with local land owners and the community during the first quarter of 2017. The project sections and options agreed to be taken forward for further investigation are outlined in Table 3 and shown in Figure 12, with Table 4 outlining the rationale for discounting options.

Table 3 Options considered for further investigation - December 2016 MCA

Section	Second MCA – options for further investigation
Narromine	The two options previously shortlisted in Narromine, the Narromine West option (based on the original 2016 Concept Alignment) and the Narromine East option (a combination of two sections of alternate option, 101 and 107) were retained.
Narromine to Curban	The 2016 Concept Alignment was retained, and the Paper Road option (option 109) was added. Further option combinations or refinements required stakeholder/ landowner feedback.
Curban to Mt Tenandra	In addition to the 2016 Concept Alignment, the Coonamble line to Gulargambone / along Box Ridge Road option was selected (option 206).
Mt Tenandra to Baradine	The 2016 Concept Alignment was retained, allowing for potential minor adjustments subject to further landowner consultation and geotechnical investigations.
Baradine to Narrabri West	The Pilliga Forest Way option (option 403 and 404a) was selected for further investigation, along with the option that connects to the 2016 Concept Alignment near Lake Yarra (option 413). This option required confirmation of the potential viaduct location near Narrabri and the comparison with the Newell Highway approach option to Narrabri.
Narrabri	The 2016 Concept Alignment was retained, and the potential for a viaduct and alternative alignments to the west of Narrabri were agreed.

Table 4 Discounted options

Description	Rationale
Option 101 followed Eumungerie Road to join Coonamble line North of Eumungerie and then Coonamble line to Curban.	This option is comparatively longer than other option in this section, and resulted in longer travel times. It requires greater interfaces with existing Coonamble line traffic, which has implications for reliability. It is also considered to have greater construction complexity and costs due to the need for multiple grade separations.
Option 112 was similar to Option 101, with a section of option 103 to bypass Gilgandra.	Longer option with negative impacts on travel time and train operations on the Coonamble line.
Option 111 runs parallel to Collie Road as far as the Oxley Highway, then heads in north easterly direction to Gulargambone.	This option has higher geotechnical and flood risks being further to the west.

3.3. Third MCA – May 2017

An MCA workshop was held on 11 May 2017 to review additional alignment options developed between Narromine and Narrabri and consider stakeholder and community feedback obtained on the options received during meetings with stakeholders, property owners and tenants through March to April 2017. The MCA workshop outcomes, which had regard to the extensive public consultation process, resulted in:

- the elimination of options that were considered unlikely to proceed due to their lower comparative merit
- agreement on options to be used to identify the Study Area.

A summary of the inputs, considerations, and decisions for each section is provided below.

3.3.1. Narromine to Burroway

The two shortlisted route options considered between Narromine and Burroway were the 2016 Concept Alignment and the Option A - Eumungerie Road, shown in Figure 13. The key characteristics of each are summarised in Table 5 with a description of the attributes of each option in Table 6.

Table 5 Narromine to Burroway option characteristics

Metric	2016 Concept Alignment	Option A - Eumungerie Road option
Alignment	Length: 41.9 km Transit time: 25 minutes	Length: 42.9 km Transit time: 25 minutes
Geotechnical Conditions	Brownfield reconstruction: 8.1 km Estimated Local Structural Fill: 47%	Brownfield reconstruction: 0km Estimated Local Structural Fill: 72%
Length of flood plain crossing (1:100 year)	15.9 km	1.6 km (viaduct length subject to confirmation through further flood modelling)
Level crossings	Private level crossings: 13 Public level crossings: 15	Private level crossings: 7 Public level crossings: 15
Properties impacted by the rail alignment	Private properties: 22 Publicly owned properties: 7	Private properties: 36 Publicly owned properties: 4

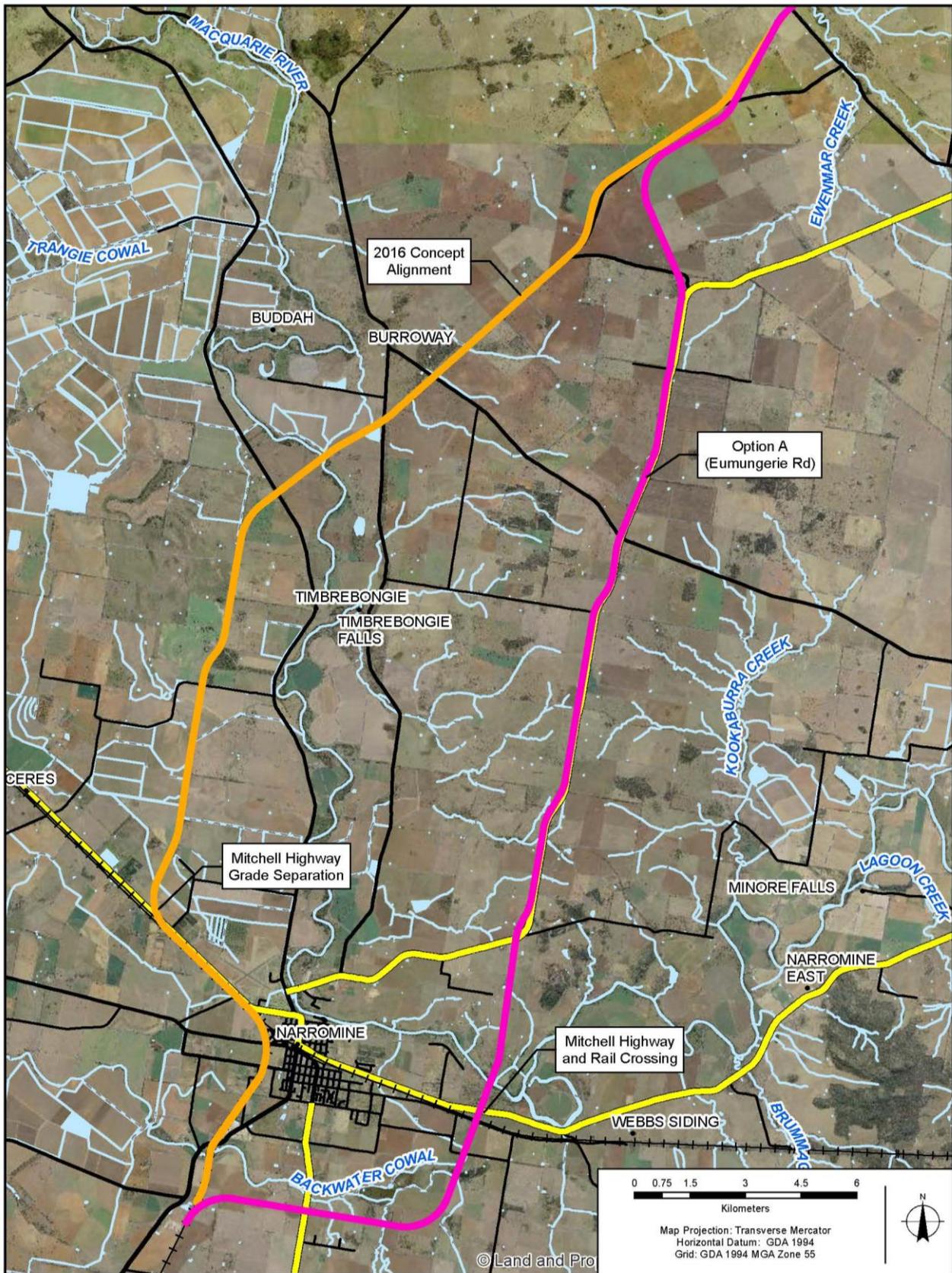


Figure 13 Narromine to Burroway options

Table 6 Narromine to Burroway options

Attributes	2016 Concept Alignment	Option A - Eumungerie Road option
General	<p>The 2016 Concept Alignment leaves the existing Parkes to Narromine railway south of Narromine and joins the existing Cobar Branch Line for approximately 4 km before heading north across open farmland towards Burroway. A local realignment of the Mitchell Highway would be required to enable the construction of a grade separated crossing (road over rail) at an acceptable angle.</p> <p>As the 2016 Concept Alignment approaches the Macquarie River, it passes through a variety of irrigated cropping farm land, including cotton and oranges. After crossing the river near Burroway, land use changes to wheat and grazing.</p>	<p>The Eumungerie Road option leaves the Parkes to Narromine Railway to the south of Narromine and heads in an easterly direction for approximately 5 km, before turning north and crossing the Dubbo to Narromine Railway and the Macquarie River. Further investigations and stakeholder consultation would be required to confirm the bridge location.</p> <p>North of the river, this option passes through farmland for approximately 5 km before joining Eumungerie Road. Part of this farmland has recently been rezoned for residential use. This option then runs parallel to Eumungerie Road for 18 km, before turning north west and crossing cropping farmland for approximately 5 km to join the 2016 Concept Alignment along Cobboco Road.</p>
Ground conditions (Geotechnical)	<p>Alluvial soils are expected to be encountered within the Macquarie River valley. Embankments constructed from local materials would require flatter batter slopes, and approximately 1m depth of structural fill would be required below the capping layer.</p> <p>The poorer ground conditions in the Macquarie River flood plain result in the risk of requiring deeper track formation, increased quantity of imported structural fill for a length of approximately 21 km.</p>	<p>The first 11km of this option traverse areas of alluvial soils, similar to the 2016 Concept Alignment, before encountering better geotechnical conditions following Eumungerie Road over sandstone. Nearby granite and existing Council quarry offer the potential for borrow pits.</p> <p>The poorer ground conditions in the Macquarie River/Backwater Cowal floodplain to the east of Narromine result in the risk of requiring deeper track formation and increased quantity of imported structural fill for a length of approximately 10km.</p>
Flood Risk	<p>The 2016 Concept Alignment crosses the Macquarie River flood plain. It is anticipated that viaduct structures will be required to raise the track above the 1:100 year flood level and to provide conveyance for flood flows to contain upstream afflux levels within acceptable limits. Further analysis and engineering will be required to minimise flood risk and afflux.</p>	<p>This option crosses flood prone land to the south east of Narromine, requiring flood relief structures, however these are not anticipated to be as extensive as structures within the larger Macquarie River flood plain required for the 2016 Concept Alignment.</p> <p>This option then leaves the Parkes to Narromine railway and heads east across the relatively flat flood plain area</p>

Attributes	2016 Concept Alignment	Option A - Eumungerie Road option
		<p>associated with the Backwater Cowal and Macquarie River.</p> <p>It is expected that the section of track to the south of the Macquarie River would require a number of flood relief culverts. The number and size of culverts would however be expected to be less than for 2016 Concept Alignment.</p> <p>Once the alignment crosses the Macquarie River, it rapidly gains higher ground along the ridge line that runs parallel to Eumungerie Road, for approximately 30 km. This section is well above the Macquarie River flood plain and would not be at risk from flooding from the river. This option provides a better opportunity to select an alignment above the 1:100 year flood level than the 2016 Concept Alignment.</p>
Major Structures	<p>This option requires grade separation and localised realignment of the Mitchell Highway, enabling a road bridge over the rail. It also requires up to 1.1 km of viaduct structures across the Macquarie River flood plain, including the crossing of the river.</p>	<p>This option requires grade separation of the new rail over the Mitchell Highway and the Dubbo to Narromine railway. It also requires a bridge over the Macquarie River, and also potential viaducts on either side over the flood plain.</p> <p>Tomingley Road and Eumungerie Road may require grade separation (road over rail).</p>
Railway operations - interoperability	<p>This option connects with the Cobar Branch Line to the west of Narromine. To provide connectivity between traffic in the Up direction on the Cobar Branch Line and Brisbane, a new triangle would be required with a north fork. This would also impact on the grade separation of the Mitchell Highway, resulting in a longer structure.</p>	<p>If Inland Rail passes over the Dubbo to Narromine line, there would be no connectivity between the two lines unless a new triangle is constructed on the Parkes to Narromine line, south of Narromine.</p> <p>Interoperability with the Cobar Line and Narromine – Dubbo Line would be possible.</p>
Constructability	<p>Construction access to the area between Narromine and Burroway is satisfactory, with an existing network of public and private roads. Construction haul roads would be required along the alignment to connect with major materials supply routes.</p> <p>There is also the opportunity to win structural</p>	<p>The southernmost 11 km of this option is likely to have soft alluvial soils and could be affected by wet weather or flooding. Over this length, fill material for construction of the track formation would need to be imported from quarries or borrow pits to the south and east of</p>

Attributes	2016 Concept Alignment	Option A - Eumungerie Road option
	<p>fill over sandstone areas (approximately 20 km in length).</p>	<p>Narromine. This is likely to include some general fill to elevate the railway above the 1:100 year flood level, plus all structural fill.</p> <p>The next 20 km of this option runs parallel to Eumungerie Road and would have good access from this sealed road. Eumungerie Road is a dedicated heavy vehicle freight route and traffic control would be required to manage access and egress points. New haul roads would be required. The northernmost 10 km crosses through open farmland with generally good ground conditions.</p> <p>Opportunity to win structural fill over sandstone areas (approximately 30 km in length).</p>
<p>Environment</p>	<p>The majority of the 2016 Concept Alignment passes through cropping land. Rapid field surveys have been undertaken and it significant impacts to flora or fauna are not anticipated. A number of Aboriginal sites listed on the AHIMS database are located in the vicinity of this option. There is also potential for Aboriginal archaeological heritage to be found at creek crossings, especially around the banks of the Macquarie River.</p>	<p>The majority of the Eumungerie Road option traverses open farmland that is used for wheat, grazing or irrigated crops. Critically endangered ecological communities are located in the reserve area to the south of the Macquarie River, traversed by this option. Preliminary Aboriginal heritage studies also indicate that there are likely to be Aboriginal archaeological heritage present around the Macquarie River.</p>
<p>Properties impacted</p>	<p>110 Or 29 properties (excluding existing rail corridor)</p> <p>The 2016 Concept Alignment passes through irrigation properties within the Macquarie River flood plain. Adjustments to irrigation bores and channels are likely to be required to accommodate Inland Rail.</p>	<p>126 40 properties</p>
<p>Community and stakeholders</p>	<p>Concerns raised by landowners associated with this option included:</p> <ul style="list-style-type: none"> • reduction in property values and compensation • impacts on irrigation schemes • impacts on farming operations • noise and vibration • flooding 	<p>Concerns raised by landowners associated with this option included:</p> <ul style="list-style-type: none"> • reduction in property values and compensation • impacts on irrigation schemes • impacts on farming operations • noise and vibration • visual impacts

Attributes	2016 Concept Alignment	Option A - Eumungerie Road option
	<ul style="list-style-type: none"> impacts on lifestyle and community. 	<ul style="list-style-type: none"> flooding impacts on threatened species and Aboriginal artefacts impacts on lifestyle and community.
Public utilities and services	The existing Parkes to Narromine railway passes under a 132kV overhead electricity line to the south of Narromine. This line may need to be raised to accommodate double stacked containers.	The Eumungerie Road option passes under two 132kV overhead electricity lines that are located close to the proposed bridge that would take Inland Rail over the Mitchell Highway and the existing Dubbo to Narromine railway. These lines may need to be raised or diverted to accommodate Inland Rail. Alignment would need to avoid electricity substation.

3.3.2. Recommendation – Narromine to Burroway

Option A has been recommended as the Study Area for Narromine to Burroway This recommendation is made for the following reasons:

Strengths

- Overall MCA scoring was positive.
- The route was preferred by the broader community in general, as it reduces property severance by following Eumungerie Road or if routed to the back of properties reduces level crossings.
- By avoiding Narromine, the route will minimise future environmental and social issues that may exist with a route closer to town.
- The geotechnical conditions are better and will provide more opportunity for capital cost savings and reduced maintenance costs.
- The hydrology and flooding issues are reduced.

Weaknesses

- The impact on the Service Offering is only an additional 24 seconds.
- Option A is 2.4% more in capital value across the total project estimate

Opportunities

The Study Area:

- Includes a zone up to 5km wide at the Southern end to:
 - allow for a connection to the Inland Rail Parkes to Narromine project
 - avoid or minimise the flooding effects of the Backwater Cowal
 - target a better crossing point of the Dubbo to Narromine line, the Mitchell Highway and Macquarie River
- Follows the Western side of Eumungerie Road with a corridor up to 2.5km wide to provide for an option along the back- boundaries of adjacent properties

3.4. Burroway to Curban

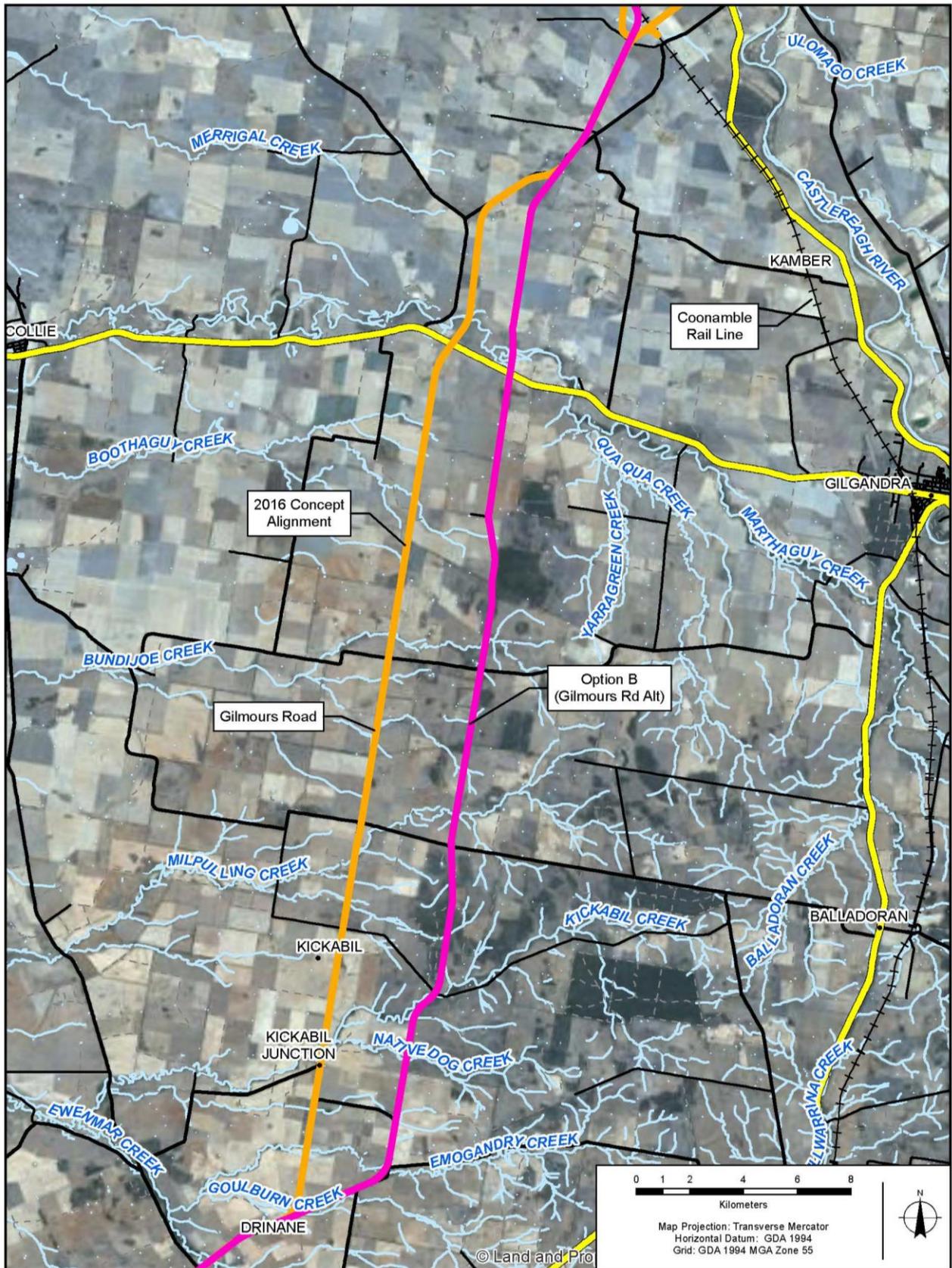
The two shortlisted route options considered between Burroway and Curban were the 2016 Concept Alignment and Option B - Gilmours Road alternative option, shown in Figure 14. Key characteristics of each shortlisted option are summarised in Table 7 and described further in Table 8.

The key issues differentiating the options are:

- Geotechnical conditions including potential for better construction materials above underlying sandstone on the Gilmours Road Alternative Option
- Local flooding at Kickabil Creek that affects access on Gilmours Road
- Level crossings and impacts on property access, including configuration of crossings on Gilmours Road or Link Road
- Impacts on residences.

Table 7 Burroway to Curban option characteristics

Metric	2016 Concept Alignment	Option B Gilmours Road alternative option
Alignment	Length: 46.8 km Transit time: 27 minutes	Length: 47.5 km Transit time: 28 minutes
Geotechnical Conditions	Estimated Local Structural Fill: 47%	Estimated Local Structural Fill: 72%
Length of flood plain crossing (1:100 year)	0 km	0 km
Level crossings	Private level crossings: 10 Public level crossings: 7	Private level crossings: 9 Public level crossings: 6
Properties impacted by the rail alignment	Private properties: 20 Publicly owned properties: 1	Private properties: 16 Publicly owned properties: 3



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Data source: Land and Property Information, DTDB, 2012.

Figure 14 Burroway to Curban options

Table 8 Burroway to Curban options

Attributes	2016 Concept Alignment	Option B - Gilmours Road alternative option
General	<p>The 2016 Concept Alignment leaves Cobboco Road and passes over open farmland to connect with Old Mill Road. It follows Old Mill Road for approximately 4 km before turning north and to following property boundaries to Gilmours Road. The alignment follows Gilmours Road for approximately 24 km and then continues over Leeches Creek Road and across open farmland to the Oxley Highway. A new grade separation would be required to take the Oxley Highway over Inland Rail.</p> <p>After the Oxley Highway, the route heads in a north easterly direction to run alongside the back boundaries of properties fronting Berida-Bullagreen Road and to avoid a residence near the road. On reaching Berrida Road, the alignment generally follows the road around to the existing Coonamble Line at Curban.</p>	<p>This option runs parallel to Gilmours Road, generally following rear property boundaries, crown (paper) roads and Nancarrows Road. The Gilmours Road Alternative Option was developed to reduce impacts on property access from Gilmours Road by aligning the rail line with the back property boundaries and ‘paper’ roads. While construction access would be marginally more difficult, this option is considered likely to result in long term safety improvements through reduced traffic over private level crossings.</p>
Ground conditions	<p>Geotechnical conditions are generally reasonable.</p>	<p>The underlying geology appears to have a greater proportion of sandstone, which is likely to translate to better ground conditions, when compared to the 2016 Concept Alignment</p> <p>This may also result in more opportunities for borrow pits.</p>
Flooding and hydrology	<p>In general, the increase in the predicted 1:100 year flood level following construction of Inland Rail can be managed to be less than 100 mm and in many cases, less than 10 mm.</p>	<p>Flooding impacts would be generally similar for each option with a potential marginal reduction in flooding for the Gilmours Road Alternative Option as it crosses creeks higher in the catchments.</p>
Major structures	<p>This option requires grade separation of the Oxley Highway. It is anticipated that a new bridge will be constructed to take the highway over the rail line.</p>	<p>This option requires grade separation of the Oxley Highway. It is anticipated that a new bridge will be constructed to take the highway over the rail line.</p>
Rail operations	<p>There are no connections to existing railways in this section.</p>	<p>There are no connections to existing railways in this section.</p>
Constructability	<p>Generally follows the alignments of</p>	<p>Construction of the railway will require dedicated</p>

Attributes	2016 Concept Alignment	Option B - Gilmours Road alternative option
	<p>existing roads along Cobboco Road, Old Mill Road and Gilmours Road.</p> <p>Whilst Gilmours Road presents an opportunity for light vehicles servicing the construction project, as a public road it would not be suitable for a haul road. Therefore, a new haul road would be required for construction plant.</p> <p>Capping and ballast would need to be imported</p>	<p>haul roads to manage cut to fill earthworks and to import structural fill, capping, ballast, sleepers and rail. Whilst Gilmours Road presents an opportunity for light vehicles servicing the construction project, as a public road it would not be suitable for a haul road. Therefore, a new haul road would be required for construction plant.</p> <p>Geotechnical conditions may be marginally better than on the 2016 Concept Alignment, with a greater proportion of sandstone underlying the alternative option. This could result in some advantages for constructing construction access and for winning structural fill material for the rail embankment.</p> <p>Capping and ballast would need to be imported.</p>
Environment	<p>There are threatened fauna and threatened flora records in the area. The recorded threatened fauna sightings relate mainly to birds and it is likely that some of these species would be encountered on either the 2016 Concept Alignment or the Gilmours Road Alternative Option.</p> <p>Registered Aboriginal sites in the vicinity primarily relate to scarred or modified trees and scattered artefacts found around creek banks.</p> <p>Land generally to the north of the Oxley Highway is subject to a Native Title Claim from the Gomeroi People (ref NC2011/006). This claim covers a large area, extending northwards to the Queensland border.</p> <p>An additional Native Title Claim has also been lodged by the Ngemba, Ngiyampaa, Wangaapuwan and Waylwan people (NC2012/001). This covers an area west of the Castlereagh Highway to Cobar.</p> <p>Local heritage items are associated with the Berida Woolshed Group to the north of the Oxley Highway.</p>	<p>The Gilmours Road alternative passes through previously undisturbed areas, particularly in the 'paper' road sections. A visual inspection of the site and reference to aerial photographs indicates that there would be some clearing of native vegetation required for the alignment. Environmental surveys will be completed in the next phase of the project to assess the impacts of the route in this area and any mitigating measures required.</p> <p>There is also an increased potential for finding Aboriginal archaeological heritage in previously undisturbed areas.</p>
Property	39 (21 properties within 2 km corridor)	25 (19 properties within 2 km corridor)
Level Crossings	The 2016 Concept Alignment crosses 10 private accesses, where which would need to be provided as level crossings.	The Gilmours Road alternative option generally follows back property boundaries and crown roads. Nine new level crossings would be required to

Attributes	2016 Concept Alignment	Option B - Gilmours Road alternative option
	It is expected that access tracks connecting to Gilmours Road would be the primary access points for properties.	preserve access, but the number of trips over these crossings is expected to be less than for level crossings located on the 2016 Concept Alignment that are generally on the primary access roads to properties. The Gilmours Road alternative option would therefore have a reduced safety risk for these private level crossings.
Community and stakeholders	ARTC has consulted with over 90% of the landowners between Burroway and Curban on both the 2016 Concept Alignment and the Gilmours Road Alternative Option. The general feedback is that local residents do not want Inland Rail to pass near their properties, irrespective of the alignment chosen, and would like to see the alignment moved to the east to join the existing Coonamble Line.	
Public Utilities and services	To be investigated next phase.	To be investigated next phase.

3.4.1. Recommendation – Narromine to Burroway

Option B - Gilmours has been recommended as the preferred option for Burroway to Curban.

This recommendation is made for the following reasons:

Strengths

- Overall MCA scoring was positive
- Option B is 2.0% less in capital value across the total project estimate
- The geotechnical conditions are better to the east and will provide more opportunity for capital cost savings and reduced maintenance costs
- The hydrology and flooding issues are reduced.

Weakness

- The impact on the Service Offering is only an additional 1 minute and 20 seconds

Opportunities

- By setting a wider Study Area the opportunity for the community to engage in the development of alignment refinements is greatly increased
- Refinements will occur after further site work and consultation is carried out in Phase 2, the results of which will provide the community with an open and robust process.

3.5. Curban to Mt Tenandra

The two options considered between Curban and Mt Tenandra were the 2016 Concept Alignment and the Option C - Box Ridge Road option, shown in Figure 15.

Key characteristics of each option are summarised in Table 9 and described further in Table 10.

The key issues differentiating the options are:

- Box Ridge Road Option is 16.4 km longer, resulting in an additional transit time of approximately 9 minutes.
- The 2016 Concept Alignment crosses productive cropping land. The Box Ridge Road Option is an alternative route developed to reduce property severance and associated impacts on farming operations.
- Geotechnical conditions appear to be better on the 2016 Concept Alignment. Preliminary investigations suggest that the 2016 Concept Alignment has approximately half the exposure to black soils than the Box Ridge Road Option (indicatively 8 km versus 16 km). There are also better opportunities to win structural fill materials locally on the 2016 Concept Alignment.
- Operational interfaces with the Country Regional Network (CRN) network would need to be resolved between ARTC and Transport for New South Wales (TfNSW) if approximately 25 km of this line are to be used by the Box Ridge Road Option. Assessments indicate that the service offering would not be met due to the complexity of operations on this existing line
- Box Ridge Road has a wide road reserve that could accommodate Inland Rail. The benefits of reduced property acquisition however need to be balanced against clearing of native vegetation, productive forests and impacts on travelling stock routes.
- Once leaving the Coonamble line the Box Ridge Road option passes through the Pilliga West National Park / State conservation area with comparatively great flood risk, particularly between Pilliga and Wee Waa.
- Flood immunity to be provided for the existing Coonamble Line is assumed as either 'no worse than existing' or the 1:100 year flood level.

Table 9 Curban to Mt Tenandra option characteristics

Metric	2016 Concept Alignment	Option C - Box Ridge Road option
Alignment	Length: 44.3 km Realignment of Coonamble line: 3.1 km Transit time: 26 minutes	Length: 60.7 km Realignment of Coonamble line: 0 km Transit time: 35 minutes
Geotechnical Conditions	Brownfield reconstruction: 0 km Estimated Local Structural Fil: 15%	Brownfield reconstruction: 24.7 km Estimated Local Structural Fill: 0%
Length of flood plain crossing (1:100 year)	0 km	0 km (subject to confirmation through further flood modelling)
Level crossings	Private level crossings: 9 Public level crossings: 9 plus 1 grade separation	Private level crossings: 14 Public level crossings: 11 plus 1 grade separation
Properties impacted by the rail alignment	Private properties: 27 Publicly owned properties: 2	Private properties: 17 Publicly owned properties: 7

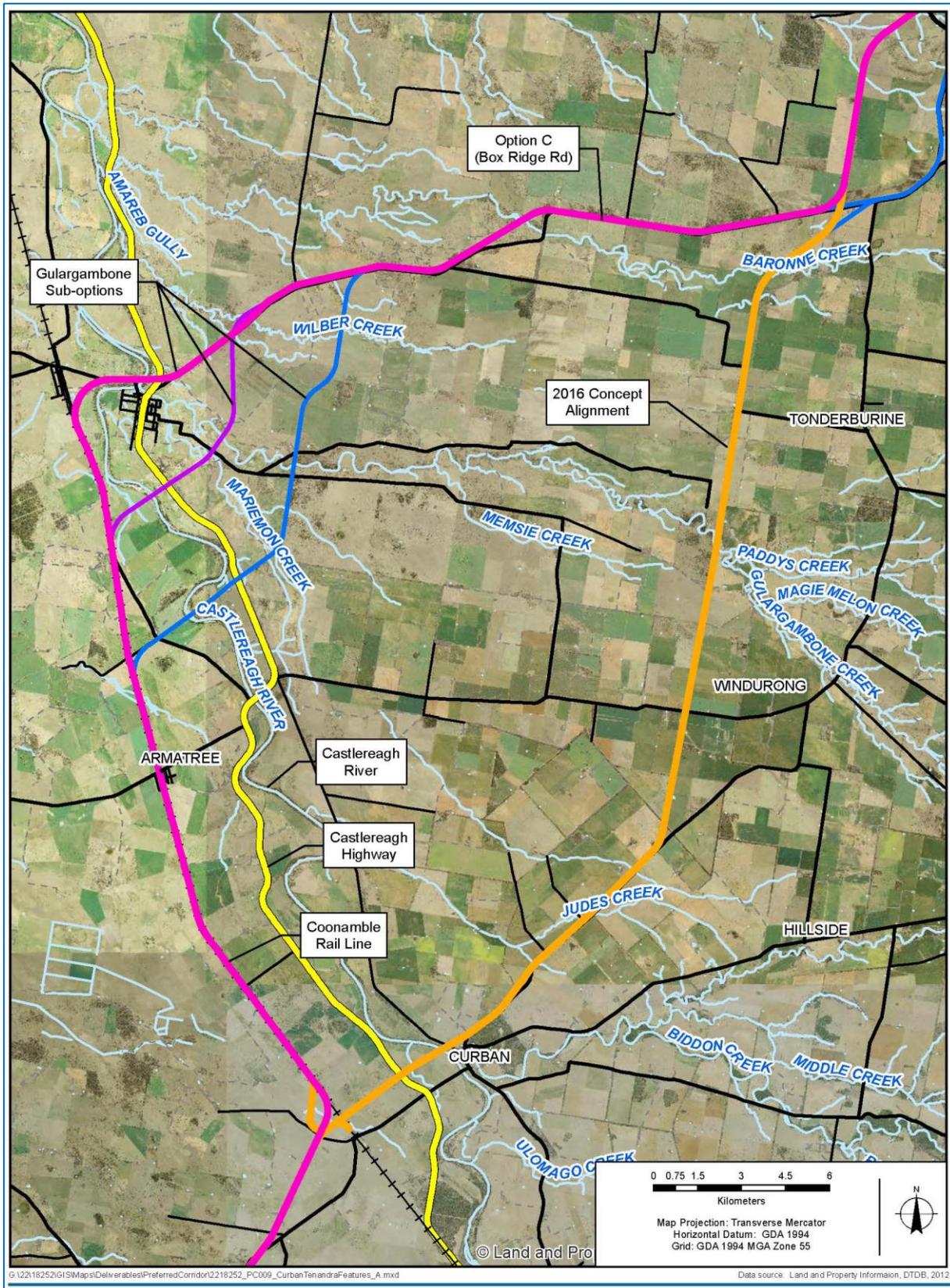


Figure 15 Curban to Mt Tenandra options

Table 10 Curban to Mt Tenandra options

Attributes	2016 Concept Alignment	Option C - Box Ridge Road option
General	<p>The 2016 Concept Alignment adopts the shortest route between Curban and Mt Tenandra, whilst generally following road and property boundaries. This area is locally recognised as having very fertile soils with high cropping yields and is consequently intensively farmed for wheat.</p>	<p>This option follows the existing Coonamble Line and Box Ridge Road. It is approximately 16.4 km longer than the 2016 Concept Alignment, but follows the exiting Coonamble Line and then Box Ridge Road. There may be opportunities for the option to be located within the Box Ridge Road reserve, thus reducing private property acquisition. Two sub-options exist within the Box Ridge Road Option at Gulargambone to cross from the Coonamble Line to Box Ridge Road. Route statistics presented in this report are for the longer, most northerly option.</p>
Ground conditions	<p>The 2016 Concept Alignment generally crosses alluvial soils comprising Kandosols and Vertisols. The first section of the alignment traverses predominantly weathered sedimentary rocks and red or brown earths. The second section crosses clayey black soils in the vicinity of Seven Mile Road. These fall primarily within geotechnical units I and II and would be anticipated to be reactive with poor engineering properties. Geotechnical conditions are expected to be better than the Box Ridge Road option.</p>	<p>The first 25 km of this alignment follow the existing Coonamble Line to the north of Curban. It is anticipated that soils under the railway line have been modified by the construction of the railway and that some consolidation would have taken place over time. However, the track formation is unlikely to be suitable for Inland Rail traffic and will require reconditioning. The alignment leaves the Coonamble line near Gulargambone and crosses the Castlereagh River and the highway. Geotechnical conditions for the river crossing and road grade separation are anticipated to be poor, but similar to those likely to be encountered for the crossings at Curban. Between Gulargambone and Mt Tenandra, the route follows Box Ridge Road. The underlying ground conditions are expected to be poor with clayey 'black' soils that are often gilgaid. Geotechnical conditions are expected to deteriorate from east to west.</p>
Flooding and hydrology	<p>The Curban to Mt Tenandra section involves a major crossing of the Castlereagh River at Curban. This option will need to address flooding issues associated with the crossing of the river and sheet flow from the Warrumbungles.</p>	<p>The section of track that follows the Coonamble Line predominantly follows the watershed between the Castlereagh River and creeks draining to the Macquarie Marshes. There are some local cross drainage channels over this length, but no major creeks or rivers are crossed. It is expected that a viaduct structure will be required over the Castlereagh flood plain. A recent flood study for Gulargambone suggested that the Castlereagh River breaks its banks in events greater than the 1:20 year ARI. If this option proceeds, a decision is required on the flood</p>

Attributes	2016 Concept Alignment	Option C - Box Ridge Road option
		<p>immunity to be provided for the existing Coonamble line as either 'no worse than existing' or the 1:100 year ARI event.</p> <p>From the Coonamble Line along Box Ridge Road, the alignment crosses fewer creeks than the 2016 Concept Alignment, but lower down in the catchments. It would therefore be expected that fewer structures would be required, but these would be larger.</p>
Structures	<p>The major structures in this section are a bridge over the Castlereagh River and a grade separation of the Castlereagh Highway.</p>	<p>The major structures on the Box Ridge Road option are a bridge/viaduct over the Castlereagh River and a grade separation of the Castlereagh Highway. The bridge/viaduct over the Castlereagh River is likely to be larger than for the 2016 Concept Alignment as it crosses further downstream and the floodplain is less constrained.</p> <p>The grade separation of the Castlereagh Highway is likely to be similar to the 2016 Concept Alignment.</p>
Rail operations	<p>Inland Rail connects with the Coonamble Line at Curban, with the Inland Rail to be developed as the main line in this location. This will require realignment of the Coonamble Line to provide at-grade junctions. The alignment crosses the Coonamble Line approximately 800 m north of the Curban siding to allow for a future shunting neck to be constructed following construction of Inland Rail. This alignment also avoids the level crossing and residence on the corner of Bardens Road and Berida Road.</p> <p>To provide full interoperability in accordance with the Service Offering additional triangles would be required or provision would need to be made for shunting movements on the Coonamble Line to enable trains to reverse direction.</p>	<p>At Curban, the Box Ridge Road option would connect to the Coonamble Line, with the Inland Rail becoming the main line. A turnout would be provided for local traffic travelling between Coonamble and Dubbo.</p> <p>At Gulargambone, Inland Rail would continue as the main line towards Box Ridge Road and a turnout would be provided for traffic heading between Dubbo and Coonamble.</p> <p>Connectivity has been provided similar to the 2016 Concept Alignment.</p> <p>This option results in greater operational complexity, which also impacts on the ability to achieve the service offering in this section.</p>
Constructability	<p>The 2016 Concept Alignment between Curban and Mt Tenandra is generally flat with a grade separation of the Castlereagh Highway and a bridge/viaduct over the Castlereagh River. The key issues are expected to be ground conditions, water management and materials availability.</p>	<p>The Box Ridge Road option follows the Coonamble line and would involve reconditioning approximately 25 km of existing track, installing new rail and sleepers and re-ballasting. Access for construction traffic would be along Bardens Road and the Gular Rail Road which may need to be upgraded in places to provide all-weather access. The Castlereagh Highway also connects Curban to</p>

Attributes	2016 Concept Alignment	Option C - Box Ridge Road option
	<p>Ground conditions over the second two thirds of the alignment are expected to be poor with a higher proportion of clayey soils. Haul roads would need to be constructed for all weather access, to mitigate potential delays due to wet weather.</p>	<p>Gulargambone. This is a good quality sealed road. From Gulargambone, Box Ridge Road provides good access for light vehicles. Haul roads for off-road vehicles would need to be constructed along the alignment. Ground conditions are expected to be generally poor over black soils. It is likely that some general fill would need to be imported to construct the track formation and all structural fill would need to be imported by on-road plant.</p>
<p>Environment</p>	<p>There have been previous sightings of threatened fauna relating to birds and it is likely that some of these species would be encountered on the 2016 Concept Alignment.</p> <p>Registered aboriginal sites around Paddy's Creek and Magie Melon Creek has evidence of a camp ground and burial site. Other registered sites relate to scarred or modified trees.</p> <p>Land generally to the north of the Oxley Highway is subject to a Native Title Claim from the Gomeroi People (ref NC2011/006). An additional Native Title Claim has also been lodged by the Ngemba, Ngiyampaa, Wangaapuwan and Waylwan people (NC2012/001). The area between the Castlereagh Highway and the river is shown on Gilgandra Shire Council's LEP as Woodvale Park Private Cemetery.</p>	<p>The Box Ridge Road option has the potential to reduce impacts on private property by aligning the rail corridor within the road reserve. This would however need to be balanced against the greater impacts on native vegetation and travelling stock routes within the road reserve. A rapid field survey noted the presence of Weeping Myall Woodlands and Poplar Box Grassy Woodland. The former is listed as a critically endangered ecological community under the EPBC Act. The latter has been accepted for nomination as a threatened ecological community, under the EPBC Act but is still under assessment by the Department of Environment and Energy.</p>
<p>Number of properties</p>	<p>37</p>	<p>80</p>
<p>Community and stakeholders</p>	<p>Impacts on wheat producers including severance of smaller farming operations.</p>	<p>Potential clearing of native vegetation if route is within Box Ridge Road reserve. Could be avoided/mitigated if alignment is along boundary, but within adjacent properties. Community feedback supports Box Ridge Road option.</p>

3.5.1. Recommendation – Curban to Mt Tenandra

The recommendation is made to nominate the 2016 Concept Alignment as the Study Area for Curban to Mt Tenandra.

This recommendation is made for the following reasons:

Strengths

- The Concept Alignment compared with Option C provided a run time saving 9 minutes and 35 seconds
- The Concept Alignment compared with Option C provided a capital cost benefit of 2.24%
- Option C scored a negative MCA value against a base case comparison of 0.

Weaknesses

- Preference from community consultation for Option C.

Opportunities

- The Study Area will avoid Gulargambone and will allow the project to refine the alignment along the route with further investigations and engagement with the local community and stakeholders.

3.6. Mt Tenandra to Baradine

The alignment between Mt Tenandra and Baradine is constrained by the foothills of the Warrumbungles Range to the east and poor draining ‘black’ soil areas to the west. Consequently, there are few practical corridor options - and all of these follow the 2016 Concept Alignment. Several alignment refinements within this Study Area have been proposed to reduce impacts on cropping areas and residential properties, in response to discussions with landowners.

This option is shown in Figure 16. Key characteristics of this option are summarised in Table 11 and described further in Table 12.

Table 11 Mt Tenandra to Baradine option characteristics

Metric	2016 Concept Alignment
Alignment	Length: 47.8 km Transit time: 27 min 42 Sec
Geotechnical Conditions	Brownfield reconstruction: 0 km
Length of flood plain crossing (1:100 year)	To be assessed at Feasibility Design
Level crossings	Private level crossings: To be assessed at Feasibility Design Public level crossings: To be assessed at Feasibility Design
Properties impacted by the rail alignment	Private and Public properties: 53

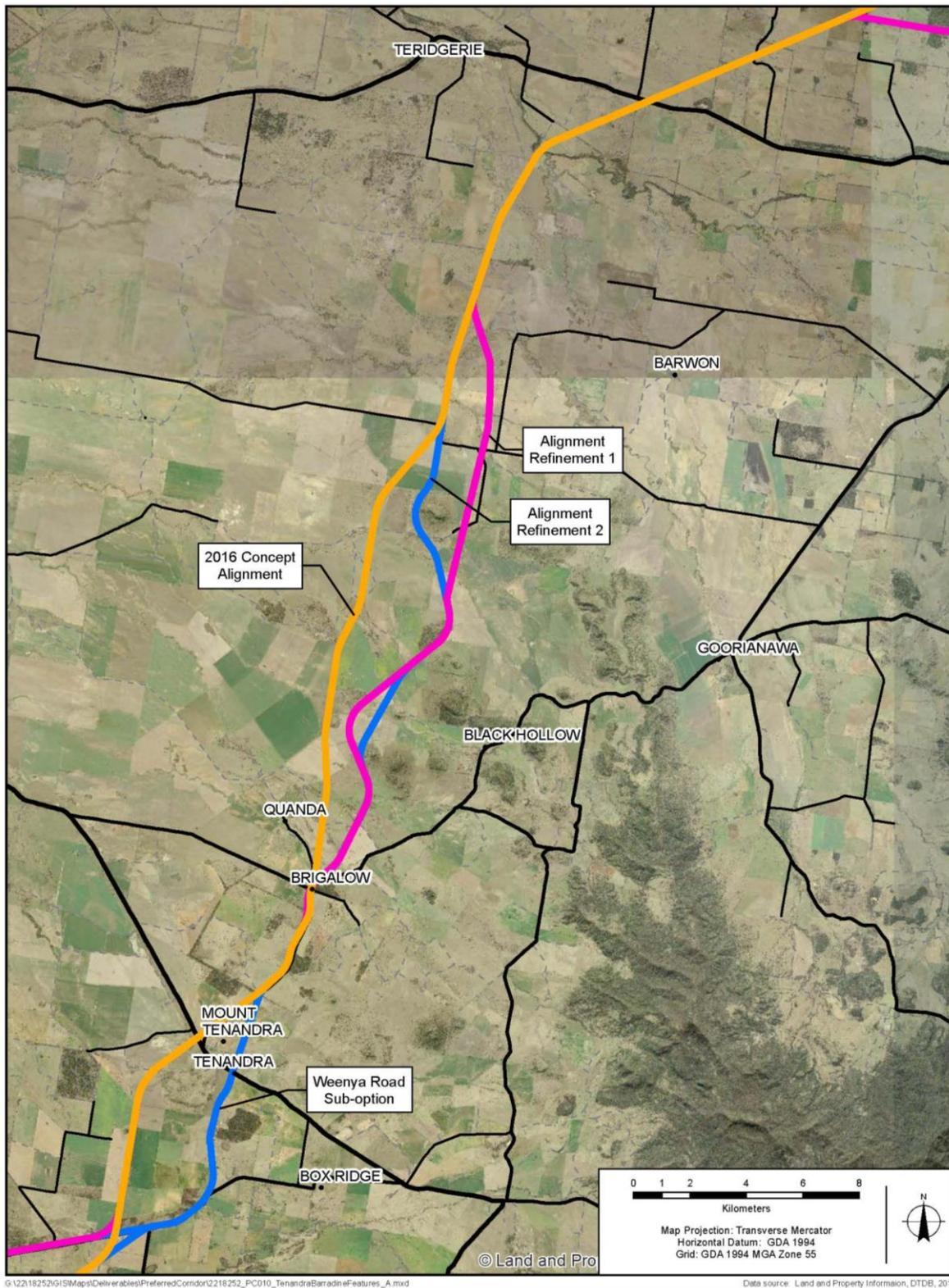


Figure 16 Mt Tenandra to Baradine

Table 12 Mt Tenandra to Baradine option

Attributes	2016 Concept Alignment
General	<p>The 2016 Concept Alignment crosses Box Ridge Road and passes around the western side of Mt Tenandra before following Goorianawa Road for approximately 7 km to Brigalow, also known as 5 ways junction. From this point, the alignment continues in a northerly direction across open cropping land for 32 km until it crosses Baradine Road. It then continues in a straight line across farmland for a further 7 km to the start of the Baradine to Narrabri section.</p>
Geotechnical	<p>The area is characterised by clayey alluvium/gilgaid areas, often referred to as ‘black’ soils and these generally have poor construction qualities and are highly reactive, shrinking and swelling with changes in water content. The black soils have been deposited from sheet wash runoff originating from the Warrumbungle range to the east. There is underlying sandstone which, in places, is topped with a basalt lava flow. The basalt has protected the sandstone from erosion and resulted in the hills in this area, the most prominent of which is Table Mountain.</p>
Major structures	<p>It is envisaged that the majority of drainage structures between Mt Tenandra and Baradine will be formed by concrete box culverts.</p>
Railway operations	<p>There are no interfaces with existing railways between Mt Tenandra and Baradine.</p>
Constructability	<p>Following consultation with local land owners, the 2016 Concept Alignment between Mt Tenandra and Baradine was modified to Alignment Refinement 1 to reduce property impacts. The relocation further to the east also reduces exposure to black soil areas, but introduces a large cut to the east of Table Mountain.</p> <p>Future Phases of the project will consider optimisation of the alignment in this area to balance impacts on properties from Inland Rail with bulk earthworks operations.</p> <p>Construction access to the southern section is possible from National Park Road, Box Ridge Road and Weenya Road. Beyond Mt Tenandra, access is poor and new roads will be required for haul routes and light vehicles. Subject to selection of the final alignment, there may be a surplus of cut material from this section that could be used on adjacent sections, if haul distances are considered to be acceptable.</p> <p>Capping and ballast would need to be imported for track construction, although there may be an opportunity to win these materials locally, if suitable basalt is found nearby.</p>
Environmental	<p>Searches of public databases have identified several threatened species that have been recorded in the area with sightings of superb parrots and turquoise parrots.</p> <p>Aboriginal heritage sites have also been identified, most notably scarred trees and some camp sites towards Baradine.</p> <p>On the basis of the desk top investigations there are no environmental constraints that would significantly influence the alignment.</p> <p>Further investigations will carried out as part of the EIS to identify whether additional threatened or endangered species and Aboriginal sites are located in this area.</p>
Property	<p>There are 53 properties in this section.</p>

Attributes	2016 Concept Alignment
Community and stakeholders	<p>Between February and April 2017, ARTC consulted with landowners whose properties could be affected by the 2016 Concept Alignment. Land between Mt Tenandra and Baradine is primarily used for cropping and grazing, with the main crop being wheat.</p> <p>Phase 1 consultations have resulted in the development of alignment refinements to mitigate impacts on cropping areas and farming activities. These changes may also help to realise engineering improvements by relocating the alignment further to the east over areas mapped as sandstone, thus reducing the track length over potential black soil areas.</p>

3.6.1. Recommendation –Mt Tenandra to Baradine

The recommendation is made to nominate the 2016 Concept Alignment as the Study Area for Mt Tenandra to Baradine, incorporating a wider Study Area to undertake alignment refinements in Phase 2.

This recommendation is made for the following reasons:

Strengths

- There is no impact on the Service Offering or Capital Cost.
- The geotechnical conditions are better to the east and will provide more opportunity for capital cost savings and reduced maintenance costs.
- The hydrology and flooding issues are reduced.

Weaknesses

- Nil

Opportunities

- A widened Study Area allows for more engaged consultation to investigate an alignment outcome in Phase 2 that meets landowner expectations.

3.7. Baradine to Narrabri

Three shortlisted route options were considered between Baradine and Narrabri, the 2016 Concept Alignment, the Pilliga Forest Way option and the Twenty Foot Road option.

These options are shown in Figure 17. Key characteristics of each shortlisted option are summarised in Table 13 and described further in Table 14.

Table 13 Baradine to Narrabri option characteristics

Metric	2016 Concept Alignment	Option D - Pilliga Forest option	Option E - Twenty Foot Road option
Alignment	Length: 130.9 km Transit time: 75 minutes	Length: 117.9 km Transit time: 69 minutes	Length: 122.0 km Transit time: 70 minutes
Geotechnical Conditions	Brownfield reconstruction: 32 km Poor geotechnical conditions for 100km	Brownfield reconstruction: 0 km Better geotechnical conditions in the higher catchment.	Brownfield reconstruction: 13.8 km Relatively good soils in Pilliga State Forest
Length of flood plain crossing (1:100 year)	6.8 km	6.8 km	6.3 km
Level crossings	Private level crossings: 29 Public level crossings: 23 Forest track crossings: 5	Private level crossings: 17 Public level crossings: 9 Forest track crossings: 28	Private level crossings: 29 Public level crossings: 13 Forest track crossings: 23
Properties impacted by the rail alignment	Private properties: 66 Publicly owned properties: 8	Private properties: 36 Publicly owned properties: 14	Private properties: 31 Publicly owned properties: 19

Key issues differentiating the options are:

- Geotechnical conditions including:
 - Suitability of in-situ soils for construction of the railway embankment
 - Proximity to potential borrow pits for structural fill
 - Trafficability for construction plant on haul roads
- Potential cumulative environmental impacts resulting from vegetation clearing in the Pilliga State Forest The Pilliga State Forest covers an area of 164,000 ha and includes approximately 33,400 ha of conservation area, which has cultural and environmental significance. The 2016 Concept Alignment avoids this area.
- Property acquisition, including acquisition of small hobby farms on the 2016 Concept Alignment
- Interaction with Santos' proposed Narrabri Gas Project, including a 'pinch-point' constraint on the Newell Highway
- Connectivity to the Narrabri viaduct
- Potential flood impacts from Bohena Creek.
- Interoperability with the Walgett line.

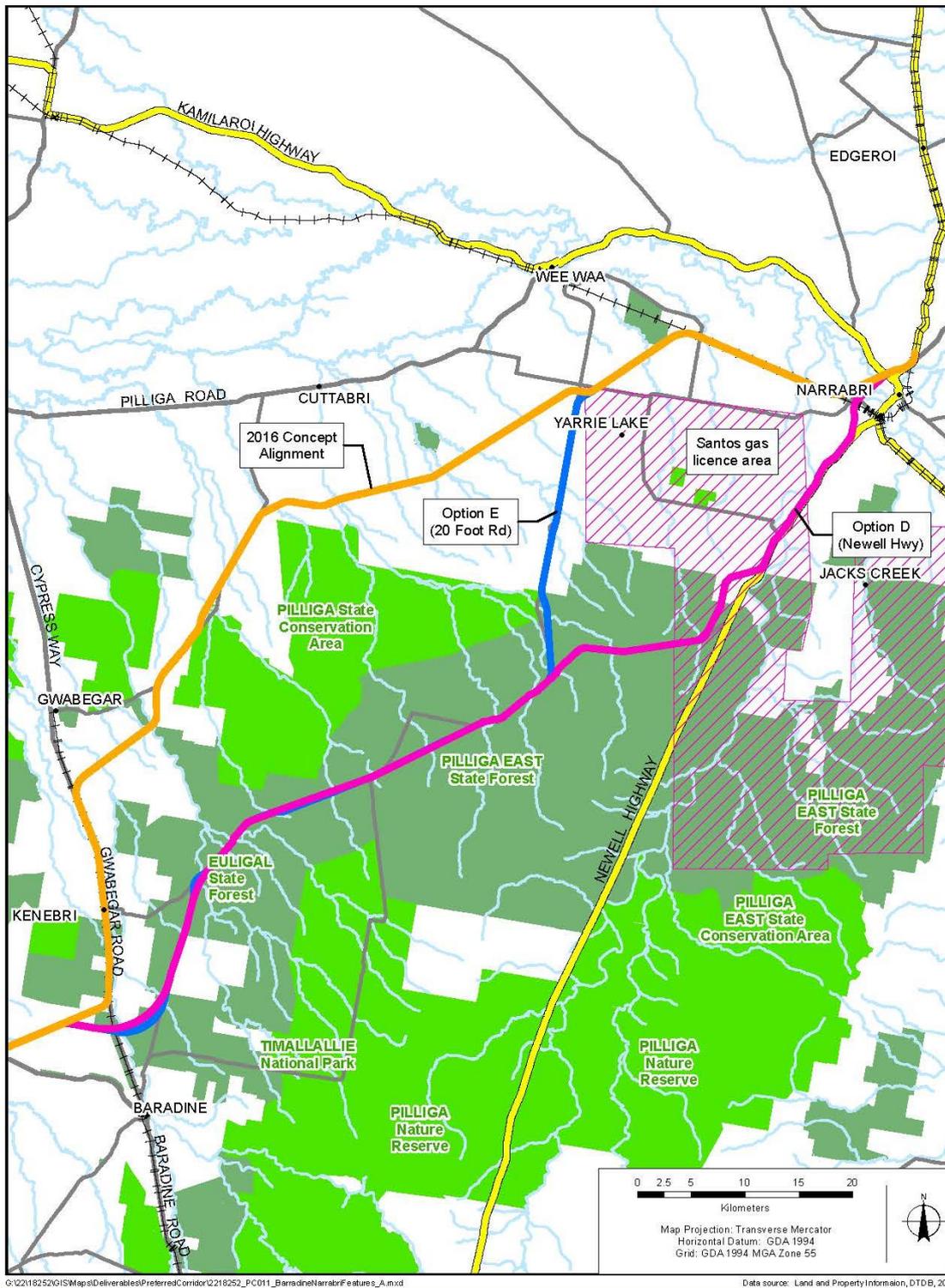


Figure 17 Baradine to Narrabri options

Table 14 Baradine to Narrabri options

Attributes	2016 Concept Alignment	Option D - Pilliga Forest/ Newell Highway option	Option E - Pilliga Forest/ Twenty Foot Road option
General	<p>From Baradine, the 2016 Concept Alignment follows the Gwabegar rail corridor for 20 km, then heading in a north easterly direction passing between the Quegobla and Euligal State Forests. It then follows Gwabegar Road for approximately 18 km before turning west just north of the Pilliga State Conservation Area. It follows a cadastral boundary for around 6 km before running north east for 27 km to Yarrie Lake Road, where grade separation is required. After Yarrie Lake Road, it continues in a north easterly direction until the existing Narrabri – Walgett railway line, west of the Culgoora siding and level crossing. It then follows the existing rail corridor for 14 km before heading north easterly over the Namoi River/Narrabri Creek floodplain on viaduct. At the northern end, this will provide a grade separation over the Kamilaroi Highway, before joining the Narrabri – Moree railway to the north of the Newell Highway overbridge.</p>	<p>The alignment would leave the 2016 Concept Alignment approximately 10 km north of Baradine and head east along a ‘paper’ road, cross over the disused Gwabegar rail line and Baradine Creek before passing through Baradine State Forest and veering north east parallel to Cumbil Road, an unsealed forest road. The alignment follows Cumbil Road for around 14 km before joining Pilliga Forest Way and crossing over Etoo Creek. It then generally follows Pilliga Forest Way in a north easterly direction for 40 km until the junction with Twenty Foot Road to the north. At one point in this section, the Forest Road ‘dog-legs’ to the north and east. It is proposed that in this section, the Inland Rail alignment maintains a straight line and follows the hypotenuse on the triangle. This should be confirmed following receipt of detailed topographic survey for this area.</p> <p>At the junction with Twenty Foot Road, this option continues generally along the Pilliga Forest Way for 19 km and to then follow the western side of the Newell Highway for around 21 km before branching off to the north to connect with the Narrabri Viaduct.</p>	<p>The alignment would leave the 2016 Concept Alignment approximately 10 km north of Baradine and head east along a ‘paper’ road, cross over the disused Gwabegar rail line and Baradine Creek before passing through Baradine State Forest and veering north east parallel to Cumbil Road, an unsealed forest road. The alignment follows Cumbil Road for around 14 km before joining Pilliga Forest Way and crossing over Etoo Creek. It then generally follows Pilliga Forest Way in a north easterly direction for 40 km until the junction with Twenty Foot Road to the north. At one point in this section, the Forest Road ‘dog-legs’ to the north and east. It is proposed that in this section, the Inland Rail alignment maintains a straight line and follows the hypotenuse on the triangle. At the junction with Twenty Foot Road, this option follows Twenty Foot Road to the north.</p>
Ground conditions	<p>Poor geotechnical conditions over approximately 100 km. fill for construction of haul roads</p>	<p>Relatively good soils expected in Pilliga State forest. CBRs 3%-8%+</p>	<p>Better geotechnical conditions likely higher in the catchment. Cut to fill</p>

Attributes	2016 Concept Alignment	Option D - Pilliga Forest/ Newell Highway option	Option E - Pilliga Forest/ Twenty Foot Road option
	<p>and rail formation. Approx. 18 km of track reconstruction along disused Gwabegar Line. Approx. 14 km of full depth track reconditioning along the Walgett Line.</p>	<p>expected for approx. 32 km across Pilliga. Sandy textured and alluvial soils are located along the Newell Highway. May require blending with higher quality material for track formation.</p>	<p>earthworks providing opportunities to win structural fill for track formation. Geotechnical conditions deteriorate along Twenty Foot Road and the 2016 Concept Alignment. Approx. 14 km of full depth track reconditioning along the Walgett Line.</p>
<p>Flooding and hydrology</p>	<p>Potential flooding from local creeks. Crosses further downstream in the catchment, therefore flow volumes expected to be higher than options, leading to larger culvert/bridge structures.</p>	<p>Section through Pilliga similar to Pilliga State Forest option. Potential for flooding from Bohena Creek along Newell Highway and Long Creek.</p>	<p>Potential flooding from local creeks. Crosses higher in catchment, smaller structures expected. Primarily forested/grazing areas. Low potential for afflux to affect properties. Joins 2016 Concept Alignment before Yarrie Lake Road.</p>
<p>Major structures</p>	<p>Bohena Creek overbridge on Walgett Line (existing structure may be suitable).</p>	<p>Bohena Creek overbridge (new structure).Bohena Creek scour protection/retaining wall.</p>	<p>Bohena Creek overbridge on Walgett Line (existing structure may be suitable).</p>
<p>Rail operations</p>	<p>Initial 18 km run along disused Gwabegar Line. Interface with Walgett Line – 14 km within existing rail corridor.</p>	<p>Realignment of Walgett line required to form new junction with Inland Rail.</p>	<p>Interface with Walgett Line – 14 km within existing rail corridor.</p>
<p>Constructability</p>	<p>Poor ground conditions requiring imported structural fill for haul roads or high wet weather delay risks. Rail embankment with 1V:4H batters. Approx. 1 m depth of imported structural fill. The existing line is disused and would need to be fully reconstructed to the standard for Inland Rail. Curve easing would be required in several locations to maintain a target minimum radius of 1200 m. This would trigger some property acquisition outside of the existing rail</p>	<p>Relatively good ground conditions through Pilliga State forest. Conditions deteriorate along Newell Highway, but better than Twenty Foot Road. Good access from Newell Highway. Traffic control required.</p>	<p>Relatively good ground conditions with suitable structural fill being available from cuttings or borrow pits. Conditions deteriorate along Twenty Foot Road.</p>

Attributes	2016 Concept Alignment	Option D - Pilliga Forest/ Newell Highway option	Option E - Pilliga Forest/ Twenty Foot Road option
	corridor.		
Environment	Rapid field surveys identified some threatened ecological communities (TECs) particularly native grasses along Walgett Line.	Preliminary field survey indicated native vegetation, but not TECs within Pilliga State Forest.	Preliminary field survey indicated native vegetation, but not Threatened Ecological Communities within Pilliga State Forest. Threatened Ecological Communities identified along Walgett Line.
Number of properties	74 properties within 2 km corridor (excluding existing rail corridor).	50 properties within 2 km corridor.	50 properties within 2 km corridor (excluding existing rail corridor).
Community and stakeholders	This section passes within 400 m of a CSIRO telescope forming part of the Australian Telescope Compact Array	Engagement was undertaken with relevant State and Federal agencies around the Study Area proposal.	Engagement was undertaken with relevant State and Federal agencies around the Study Area proposal.

3.7.1. Recommendation – Baradine to Narrabri

The recommendation is made to nominate Option D as the Study Area for Baradine to Narrabri.

This recommendation is made for the following reasons:

Strengths

- There is a transit time saving 6 minutes and 20 seconds
- Option D is 5.4% less in capital value across the total project estimate
- Option D scored positively in the MCA
- There is support for the route in the direct and broader community and stakeholder groups.
- By avoiding the higher production land and minimising property severance the project will maintain positive community and stakeholder support for this section.

Weaknesses

- Option D traverses through State Forest.

Opportunities

- The nominated corridor around the proposed Santos project will allow the alignment to be refined in that area with further investigations and engagement with Santos.

4. THE STUDY AREA

4.1. Description

The Study Area illustrated in Figure 18 was identified following the May 2017 MCA workshop. It consists of the following options:

- **Narromine:** the Narromine east option
- **Narromine to Curban:** the Eumungerie Road option between Narromine and Burroway, then a combination of the 2016 Concept Alignment and the Gilmores Road Alternative between Burroway and Curban
- **Curban to Mt Tenandra:** the 2016 Concept Alignment
- **Mt Tenandra to Baradine:** the 2016 Concept Alignment, with some potential for minor departures subject to further investigations and stakeholder engagement
- **Baradine to Narrabri West:** Pilliga State Forest Option: Corridor runs through the Pilliga state forest until Newell Highway, then runs along Newell highway and then branching off to the north to connect onto the 2016 alignment west of Narrabri. The Study Area allows for localised alignment refinements, which may be developed in response to further studies and investigations to be carried out during the Phase 2 Feasibility Assessment.

The Study Area accommodates a nominal 2km width, and in areas where local opportunities exist the Study Area has been widened to allow for further investigation in Phase 2.

In summary across the Narromine to Narrabri project the route selection process resulted in a combination of 2016 Concept alignment and alternative options, with the following final outcome against the 2016 Concept Alignment Baseline:

Strengths

- There is a transit time saving 4 minutes and 38 seconds
- A 3.2% reduction in capital costs associated with delivering the project
- An overall positive MCA score
- General support for the route in the direct and broader community and stakeholder groups.

Opportunities

- Phase 2 Design allows for further investigation and resulting in a refinement to the Study Area
- Continued engagement and consultation with landowners and stakeholders to assist in the development of the alignment in Phase 2.

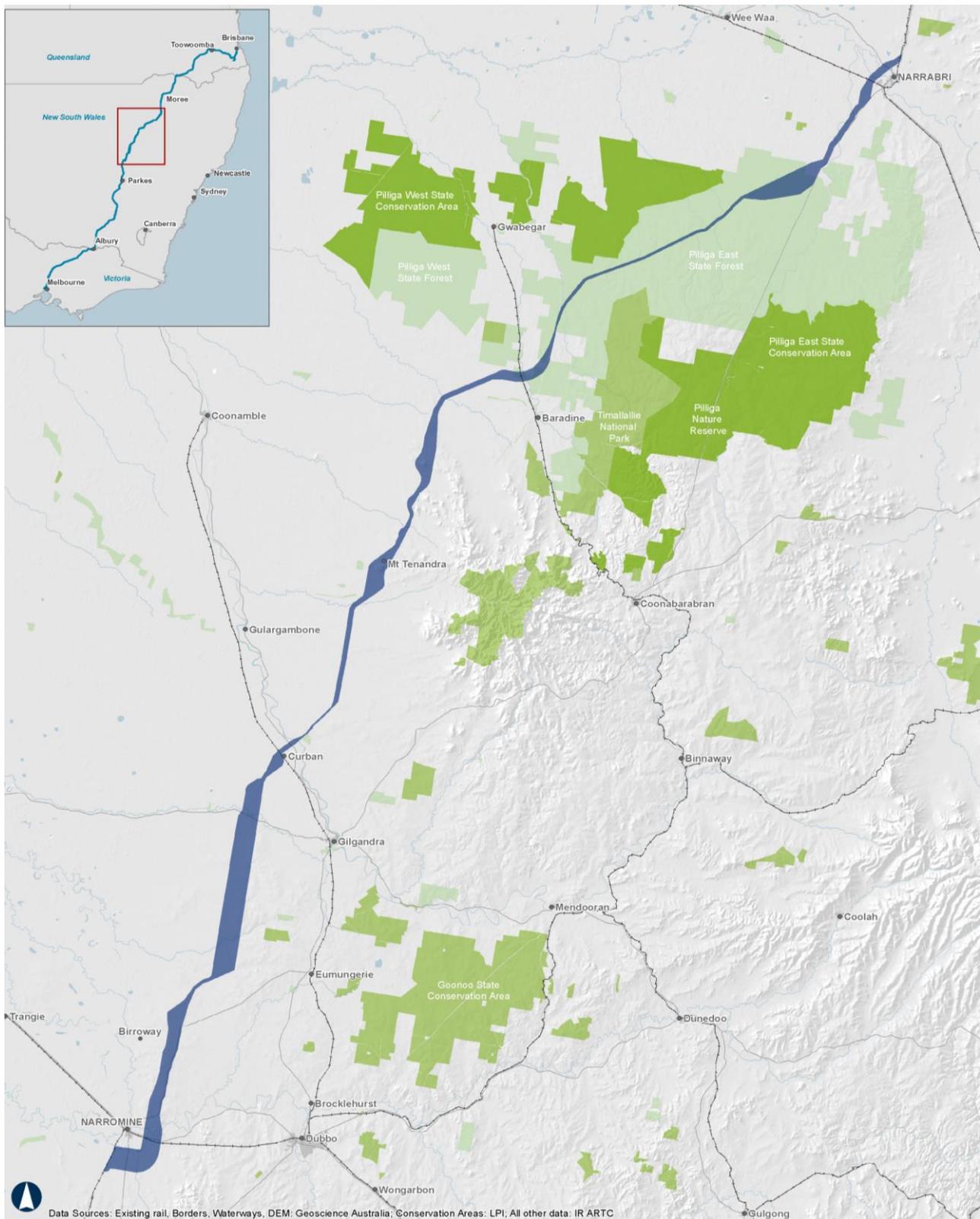


Figure 18 The Study Area

4.2. Next steps

The Study Area establishes the area to be investigated during the Phase 2 Feasibility Assessment, for identification of the proposed corridor. These investigations will include a wide range of assessments including geotechnical investigations, topographical surveys, socio-economic studies and environmental and cultural heritage studies. These studies will also inform the preparation of an Environmental Impact Statement (EIS) during the Phase 2 Feasibility Assessment, to be submitted to the NSW Government as part of the formal approval process. The steps in the assessment and approval process are illustrated in Figure 19.

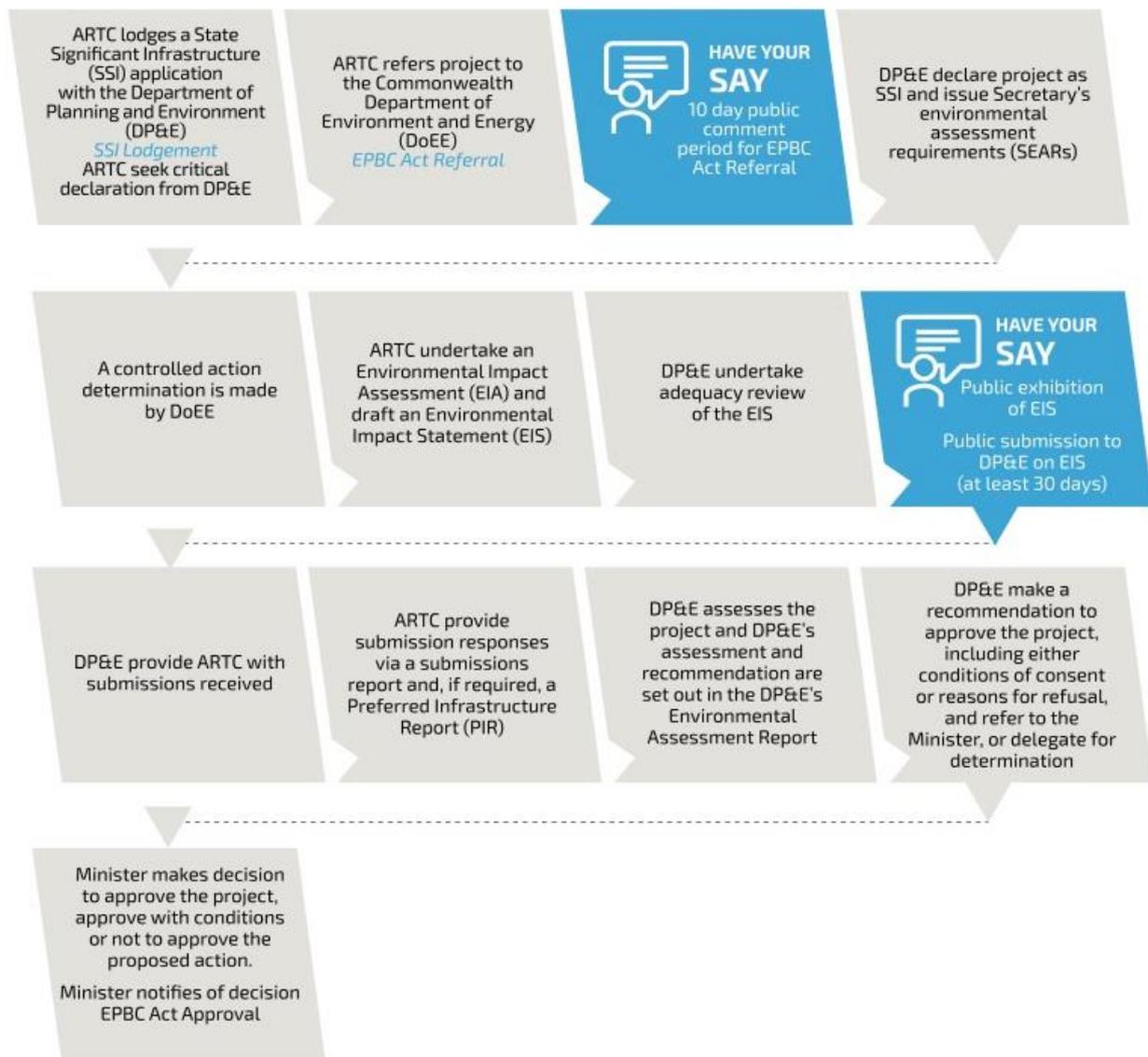


Figure 19 Process to assess State Significant Infrastructure in New South Wales

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