Australian Government

BUILDING OUR FUTURE

NSW GOVERNMENT

M1 Pacific Motorway extension to Raymond Terrace

Environmental impact statement – Chapter 4: Project development and alternatives

Transport for NSW | July 2021

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4. Project development and alternatives

This chapter describes the various alternatives to the project that were considered as part of the project development process and explains how and why the project was selected. It then describes and analyses the different route options that were investigated and justifies why the preferred alternative (the project) was selected. Design refinements for particular elements of the project are also presented, demonstrating how the project was developed to avoid or minimise adverse impacts.

Table 4-1 outlines the SEARs that relate to the development of alternatives and options of the project. The project development process to date is illustrated in **Figure 4-1**.

Table 4-1 SEARs (project development and alternatives)

Secretary's requirement	Where addressed in EIS
2. Environmental Impact Statement	
1. The EIS must include, but not necessarily be limited to, the following:	
(e) an analysis of feasible alternatives to the project[3]	An analysis of project alternatives is provided in **Section 4.1**
(f) a description of feasible options within the project[4]	The feasible options within the project are identified and described in **Section 4.2** to **Section 4.5** An evaluation of the options is provided in **Section 4.3.5**.
(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 sufficient detail to enable an understanding of why the preferred alternative to, and option(s) within, the project were selected including: – details of the highway corridors and route options considered, and the criteria that was considered in the selection of the preferred route; and – a justification for the preferred proposal taking into consideration the objects of the *Environmental Planning and Assessment Act 1979* (EP&A Act)	Alternatives to the project are discussed in **Section 4.1**. Route options considered for the project are discussed in **Section 4.2** to **Section 4.5**, with further discussion about alignment options provided in **Section 4.3** A justification for the project against the objects of the EP&A Act is provided in **Chapter 26** (project justification and conclusion).
(i) a demonstration of how the project design has been developed to avoid or minimise likely adverse impacts	A demonstration of how the project design has been developed to avoid or minimise potential impacts is provided in **Section 4.5.1**.

[3] Alternatives to a project are different projects which would achieve the same project objective(s) including the consequences of not carrying out the project. For example, alternatives to a road project may be a rail project in the same area and alternate routes for the road, or a combination of these alternatives.
[4] Options within the project are variations of the same project. For example, options within a road project could be design of an intersection; the location or design of a bridge; locations for a ventilation outlet.

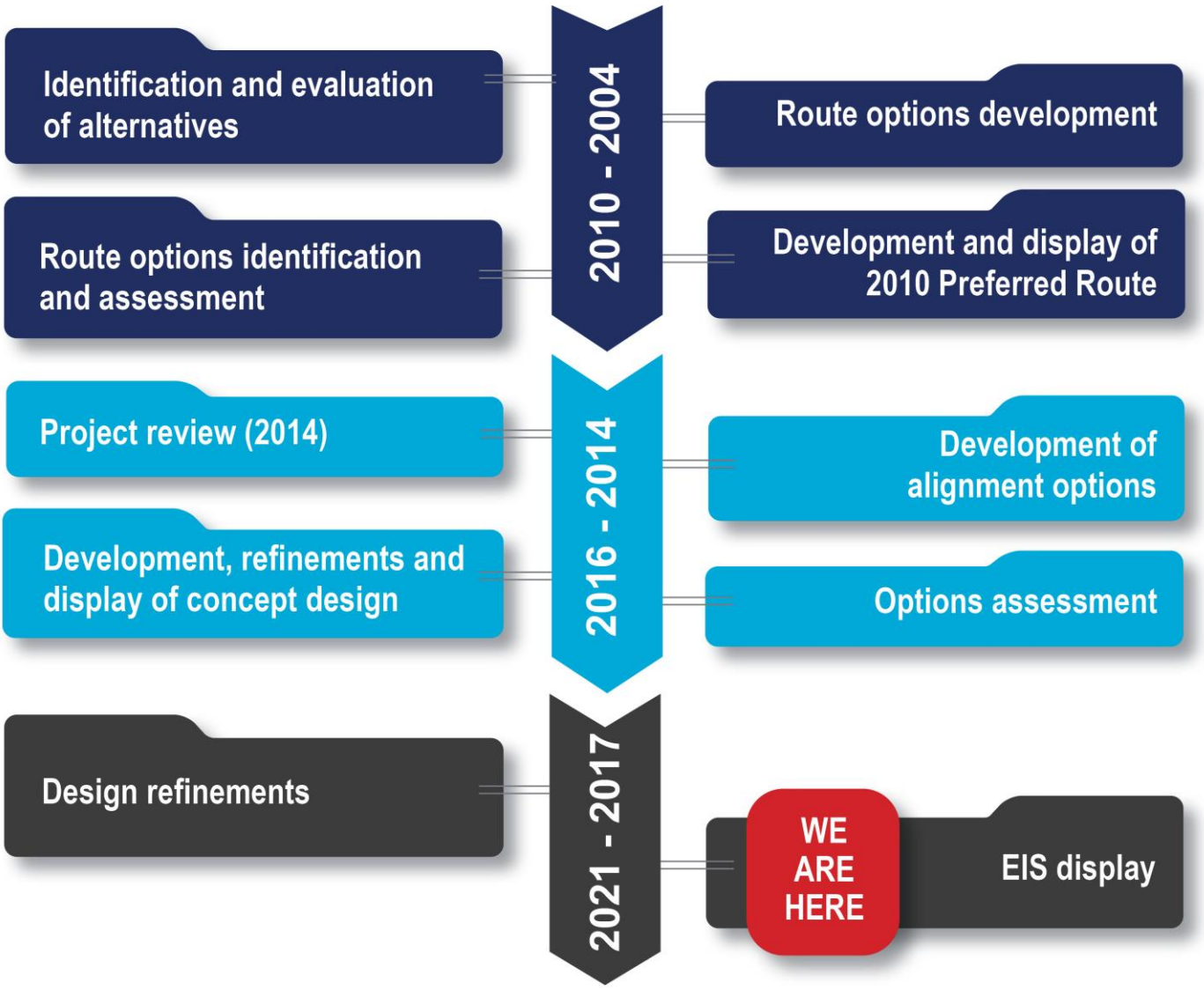

Figure 4-1 Project development process

4.1 Alternatives

The project development process considered possible alternative ways of meeting the project objectives, with the following alternatives considered:

- Alternative 1: Do nothing (base case)
- Alternative 2: Do minimum
- Alternative 3: Rail as an alternative mode of transport and freight
- Alternative 4: Establishing a primary route to the west (New England Highway)
- Alternative 5: A motorway link from the M1 Pacific Motorway at Black Hill to the Pacific Highway at Raymond Terrace (the project).

Figure 4-2 shows the alternatives to the project. The sections below discuss the above alternatives and whether they meet the project objectives.

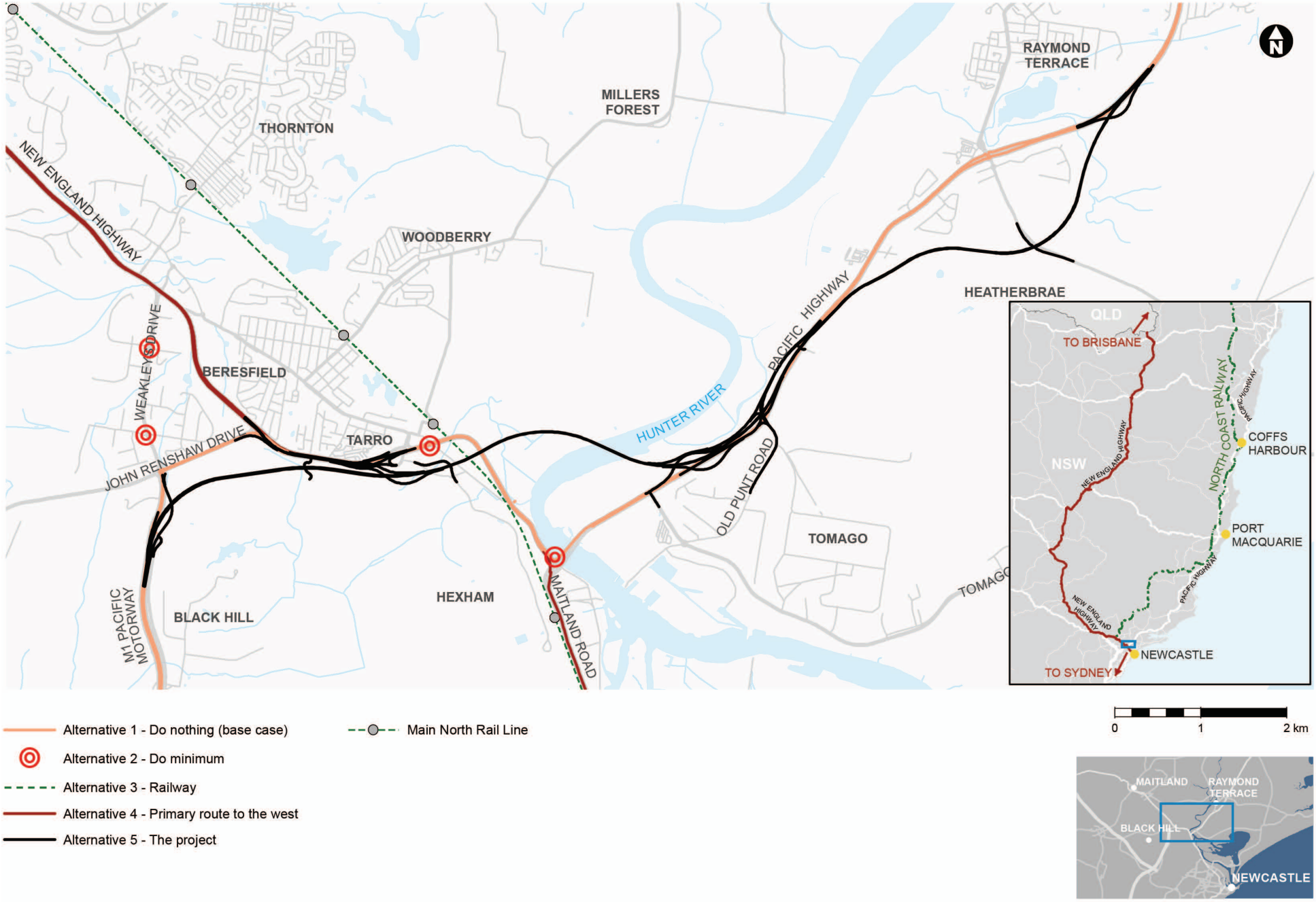

Figure 4-2 Alternatives to the project

4.1.1 Alternative 1: Do nothing (base case)

The ‘do nothing’ alternative involves retaining the existing route between the M1 Pacific Motorway and Raymond Terrace, via John Renshaw Drive, the New England Highway and the Pacific Highway. Ongoing maintenance of existing roads such as line-marking, refurbishing the road pavement surface and maintaining the verge and median would still occur.

Evaluation

The ‘do nothing’ alternative would provide no additional transport capacity in the road network. This alternative would avoid the capital cost associated with a major road project while avoiding environmental and social impacts associated with construction.

However, this alternative would have a number of drawbacks:

- It would not meet the project objectives (refer to **Table 4-2**)
- It would not meet the objectives of strategic planning and transport policies of the NSW and Australian governments, which are discussed in **Chapter 3**.

The ‘do nothing’ alternative would result in:

- A continued increase in travel times, especially on the Pacific Highway and New England Highway, resulting in reduced efficiency for freight and commuters on the National Land Transport Network (NLTN)
- Intersections would experience further congestion where local traffic conflicts with high through traffic volumes. These delays may result in economic impacts, especially related to delays in freight traffic travelling to local areas or over long distances. Further, the Hexham Bridge would remain as a key constraint to freight traffic travelling on the Pacific Highway
- No improvements to flood immunity or holiday peak travel times along the Pacific Highway, New England Highway and M1 Pacific Motorway corridor
- A likely increase in crashes, especially at major intersections along the M1 Pacific Motorway, the Pacific Highway, the New England Highway, and John Renshaw Drive. Crashes at Hexham Bridge and between local and arterial roads would also likely increase.

Increases in travel times may also result in:

- An impact on local and regional growth patterns. Increases in travel times could reduce the attractiveness of the local area to commercial traffic and the area may suffer economically. For example, the Port of Newcastle would be a less attractive option for freight shipping if access to the port is constrained
- Localised increases in noise and air pollution, which may impact on properties located close to the existing highway network.

The ‘do nothing’ alternative was, therefore, discounted as a realistic alternative and not considered further.

4.1.2 Alternative 2: Do minimum

The ‘do minimum’ alternative involves retaining the existing route between the M1 Pacific Motorway and Raymond Terrace, via John Renshaw Drive, the New England Highway and the Pacific Highway. Ongoing maintenance of existing roads such as line-marking, refurbishing the road pavement surface and maintaining the verge and median would still occur.

Other upgrades planned for the network would still be progressed including:

- Pacific Highway, Maitland Road and New England Highway intersection upgrade west of the Hexham Bridge
- Duplication of Weakleys Drive between John Renshaw Drive and New England Highway and the conversion of roundabouts to signalised intersections
- Implementation of ramp metering at the Anderson Drive eastbound onramp to the New England Highway.

Evaluation

The 'do minimum' alternative would add capacity to the road network at key pinch points, providing short to medium benefits to traffic flow. This alternative would also have safety benefits in the vicinity of the upgrades planned for the network.

However, this alternative would have a number of issues:

- It would not meet the project objectives (refer to **Table 4-2**) or the objectives of state and federal strategic planning and transport policies (including the NLTN) as discussed in **Chapter 3**
- It would not provide network wide traffic benefits. Traffic assessment carried out with 'Do Minimum' road upgrades demonstrated future delays of over 30 minutes for movements through the network.

Similar to the base case, doing the minimum would result in an increase in travel times and corresponding indirect impacts and a likely increase in crashes (refer to **Section 4.1.1**). The 'do minimum' alternative was, therefore, discounted as a realistic alternative and not considered further.

4.1.3 Alternative 3: Rail as an alternative mode of transport and freight

This alternative would involve using the existing rail network to support north-south transport and freight in this location.

Evaluation

This alternative would not meet the objectives of state and federal strategic planning and transport policies as discussed in **Chapter 3**, including completion of the broader Pacific Highway upgrade program and completing a critical link in the NLTN. Additionally, while this alternative would remove some vehicles from the existing road network, it would only partially contribute to improving travel times on key roads and road safety, therefore not meeting the project objectives (refer to **Table 4-2**).

The rail alternative was, therefore, discounted as a realistic alternative and not considered further.

4.1.4 Alternative 4: Establishing a primary route to the west

This alternative would involve using the existing inland route between the Hunter Region and the Queensland border via the New England Highway (the western route), instead of along the Pacific Highway (the coastal route). This route is currently available to road users as the alternate route to the Pacific Highway, serving a smaller number of road users and linking a smaller population base.

Evaluation

Similar to 'do nothing' (Alternative 1), this alternative would avoid the local environmental and social impacts associated with motorway construction between Black Hill and Raymond Terrace.

However, this alternative would have a number of drawbacks:

- Significant funding would be required to bring the New England Highway up to a motorway standard between the Hunter Region and the Queensland border. There are currently minimal motorway standard sections along this corridor
- It would not meet the project objectives (refer to **Table 4-2**) or the objectives of state and federal strategic planning and transport policies as discussed in **Chapter 3**
- It would not complete a critical link in the NLTN (specifically the coastal Sydney to Brisbane corridor), and would not realise the full transport benefits of the Pacific Highway upgrade program for freight movements due to the remaining Hexham Bridge restrictions
- It would not provide improvements to key strategic freight routes around the Greater Newcastle area, or improve travel time on the M1 Pacific Motorway, John Renshaw Drive, the New England Highway and Pacific Highway
- It would also increase travel times by about three hours between Sydney and Brisbane.

This alternative was therefore discounted as a realistic alternative and not considered further.

4.1.5 Alternative 5: M1 Pacific Motorway extension to Raymond Terrace (the project)

This alternative would extend the M1 Pacific Motorway at Black Hill to the Pacific Highway at Raymond Terrace. This would provide a motorway-standard road between Black Hill and Raymond Terrace.

Evaluation

This alternative would assist in developing a continuous motorway-standard route between Sydney and Brisbane by:

- Completing a critical link in the NLTN, specifically the coastal Sydney to Brisbane Corridor
- Representing the missing link required to realise the full transport benefits of the Pacific Highway upgrade program, although not part of the program (refer to **Chapter 3**).

This alternative responds to and supports the NSW and Australian Governments' strategic planning and transport policies as detailed in **Chapter 3**.

While environmental and social impacts are associated with this alternative (as assessed in this EIS), this alternative would meet the project objectives (refer to **Table 4-2**) by:

- Improving road safety for all road users due to the high standard design, including dual carriageways and controlled access conditions
- Improving travel times and transport efficiency for local and regional traffic, including freight transport
- Increasing traffic capacity and improve the level of service for the route, resulting in less congestion and fewer delays, especially during peak holiday periods.

Considering the alternatives against the project objectives and NSW and Australian Governments' strategic planning and transport policies, Alternative 1 to Alternative 4 were rejected. Alternative 5 was preferred.

4.1.6 Performance of alternatives against project objectives

Alternative 1 to Alternative 5 were reviewed against the project objectives. **Table 4-2** summarises whether each alternative meets the project objectives.

Table 4-2 Performance of alternatives against project objectives

Project objective	Meets objective?				
	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5 (the project)
Improve travel time and road network efficiency for freight and commuters on the National Land Transport Network at the key strategic junction of the M1 Pacific Motorway, the New England Highway and the Pacific Highway	No	No	Partially	No	Yes
Provide improved long term route reliability along the M1 Pacific Motorway corridor, particularly in relation to congestion reduction, flood immunity and high demand holiday peak travel	No	No	No	No	Yes
Improve road safety for all road users	No	Partially	No	No	Yes
Provide more efficient access to facilitate economic growth for the Lower Hunter and from key regional employment areas such as Port of Newcastle, Newcastle Airport, Tomago, Beresfield, Black Hill.	No	No	No	No	Yes

4.2 Route options development

Route option development commenced in 2004. At this early stage of the project, between December 2004 and January 2005, route option workshops identified 14 possible route options, with three selected for further analysis (Options A, B and C). Early stage route options are shown in **Figure 4-3**.

Following further investigation, Option C was found to be unfeasible due to the depth of the soft soil conditions within the Hunter River floodplain and the associated costs of construction. Option A and B were therefore progressed as feasible route options. These two options were split into three sections (western (1), central (2) and eastern (3)) and were named A1, A2, A3 and B1, B2, B3 (refer to **Figure 4-3**). These options were placed on public display for community comment between October 2005 and December 2005.

4.2.1 Route options assessment and identification of preferred option

The route options were evaluated within a value management process between November 2005 and February 2006. Key steps during this evaluation process included:

- Development of assessment criteria
- Value management workshop
- Further development of options as recommended at the value management workshop
- Further technical and environmental investigations
- Route selection workshop.

Prior to the value management workshop, evaluation criteria were developed. The evaluation criteria were categorised into engineering, environmental, social and economic categories and were based on the Pacific Highway upgrade program and project specific objectives, issues raised in the community involvement process, statutory requirements and policy guidelines for environmental issues.

The value management workshop in December 2005 recommended that further investigations be carried out on Option A1, B2 and A3. This included design investigations on Option A1, environmental investigations on Option B2 and social and community investigations on Option A3.

Additional technical and environmental investigations included ecology surveys, socio-economic assessment, land use and planning considerations (including cultural heritage), traffic modelling and revised cost estimates. Additional consultation with the Heatherbrae community including property owners, businesses and residents was also carried out. Following these investigations and consultation, Options A1, B2, A3 and B3 were refined and adjusted.

In February 2006, a route options workshop was held to select the better performing route option (A or B) within Sections 1, 2 and 3, with consideration of the options preferred in December 2005 (Option A1, B2 and A3). Options were assessed against the evaluation criteria previously identified in 2005 in a paired analysis. The workshop identified Option A1 and B2 as preferred for Sections 1 and 2. For Section 3, Option B3 performed better against Option A3 with regards to socio economic, technical and cost considerations (specifically properties requiring acquisition, maintaining current local access through Heatherbrae and being the best overall value for money option). Additionally, Option B3 was considered to better satisfy community expectations. Accordingly, Option A1, Option B2 and Option B3 together were identified as the preferred route for the project (as shown on **Figure 4-3**). The corridor for the preferred route was placed on public display between August and October 2006.

4.2.2 Development and display of 2010 Preferred Route design

Following selection of a preferred route and consideration of the community and stakeholder feedback, the preferred route design for the project was progressed into a concept design. This concept design was placed on public display, with feedback sought from the community between July and August 2008. Key issues raised by the community related to interchange arrangements, access to Heatherbrae and the Tomago interchange (further detail is provided in **Chapter 6**).

A submissions report responding to the issues raised was issued in December 2010. Following the submission report display, a corridor was reserved in the Newcastle and Port Stephens Local Environment Plans (LEPs). This corridor was generally consistent with the preferred route identified in 2006. The 2010 concept design (referred to as '2010 Preferred Route') and the gazetted LEP corridor are shown on **Figure 4-4**.

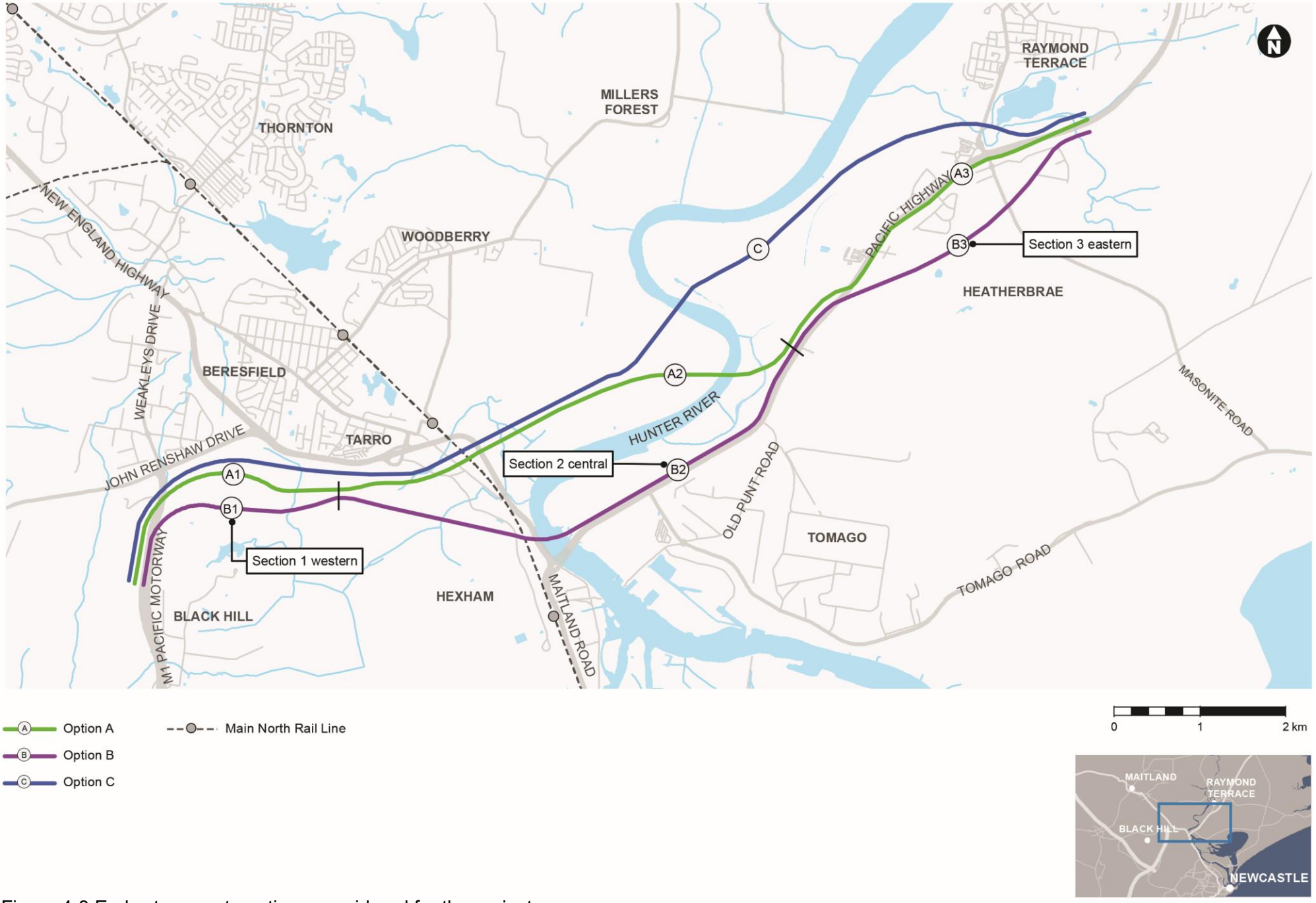

Figure 4-3 Early stage route options considered for the project

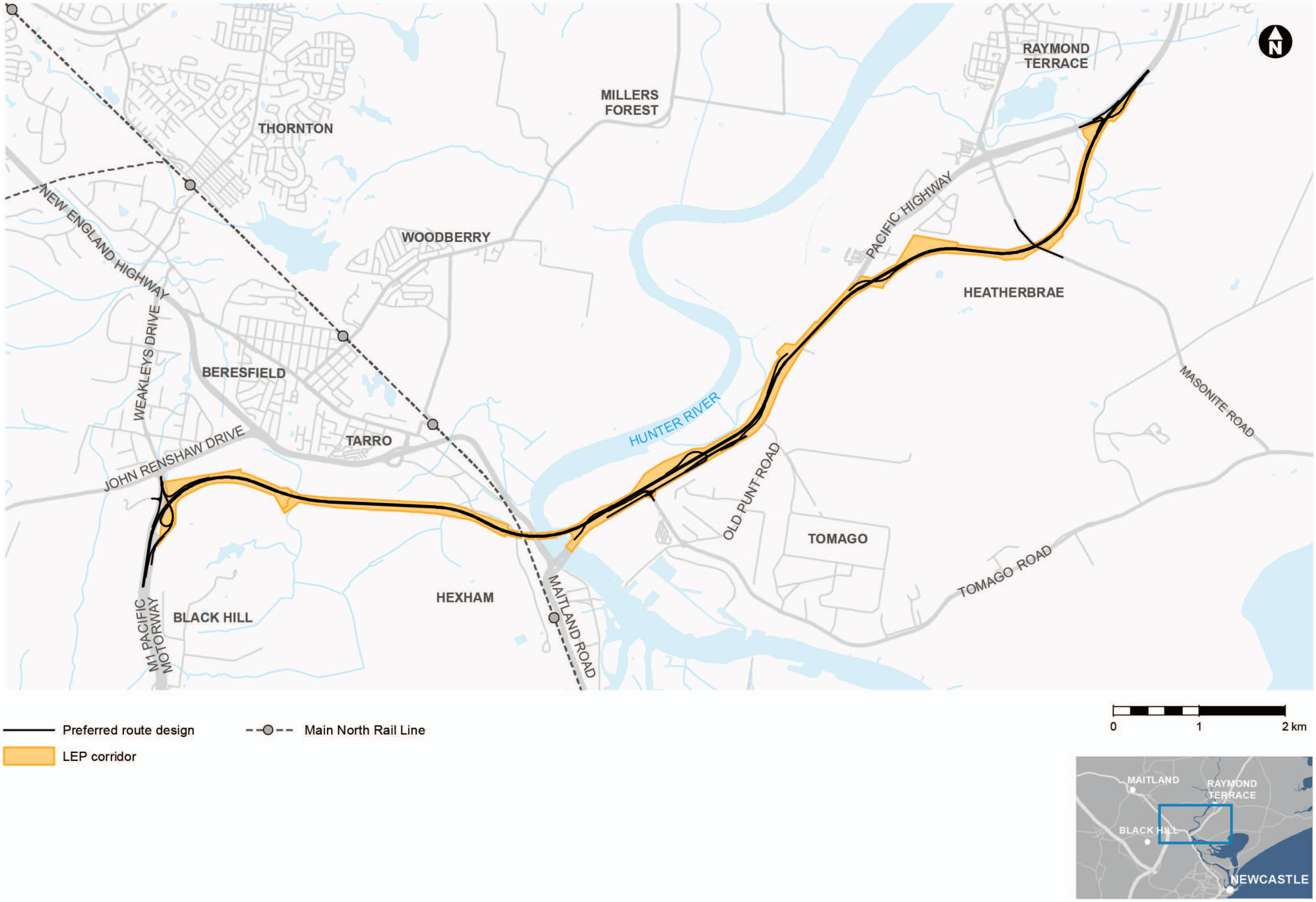

Figure 4-4 The 2010 Preferred Route and LEP corridor

4.3 Project review: alignments

In 2014, the NSW Government allocated funding to continue project development. Following this, a project review of the 2010 Preferred Route design was carried out to identify and investigate potential improvements to the project. The project review found that there were opportunities for improvement in the following key aspects for the project:

- Functionality and performance, including connectivity to the regional road network
- Design and geometric elements of the project, and how lessons learnt from recently completed Pacific Highway projects in floodplain and soft soil areas could be incorporated into a revised concept design
- Traffic characteristics, particularly regarding changes to the regional road network since the opening of the Hunter Expressway and completion of other road projects
- Environmental impacts, particularly regarding changes to environmental policy and legislation (including the implementation of the now repealed State Environmental Planning Policy No 14 – Coastal Wetlands)
- Integration with the existing transport network and the ability to accommodate any potential future upgrades.

4.3.1 Alignment options

Alternate alignment options to the 2010 Preferred Route were identified to address the issues raised in the project review and to better meet the project objectives. This included providing improved accessibility and connectivity across the road network, addressing design constraints in crossing the Hunter River and floodplain and minimising environmental impact. Accordingly, the area between Black Hill and south of Heatherbrae was reviewed. Alignment 1 and Alignment 2 were progressed for further investigation.

Further detail on these options is provided in the M1 Pacific Motorway extension to Raymond Terrace: Discussion paper – Revised concept design (Roads and Maritime Services 2015a). The alignment options are shown on **Figure 4-5**.

A number of interchange arrangements were also investigated at Black Hill, Tarro, Tomago, Heatherbrae and Raymond Terrace. All of these options met the project objectives.

4.3.2 Alignment 0 – 2010 Preferred Route

This option refers to the preferred route design as displayed in December 2010, as discussed in **Section 4.2.2** and as shown in **Figure 4-5**. Updates to the 2010 Preferred Route design (refer to **Figure 4-4**) included changes to reduce traffic weaving movements at the Black Hill interchange and Raymond Terrace interchange. Additionally, a viaduct was included to replace the proposed embankment across the Hunter River floodplain to reduce changes to flood behaviour and constructability issues as a result of building high earth embankments in soft soil areas.

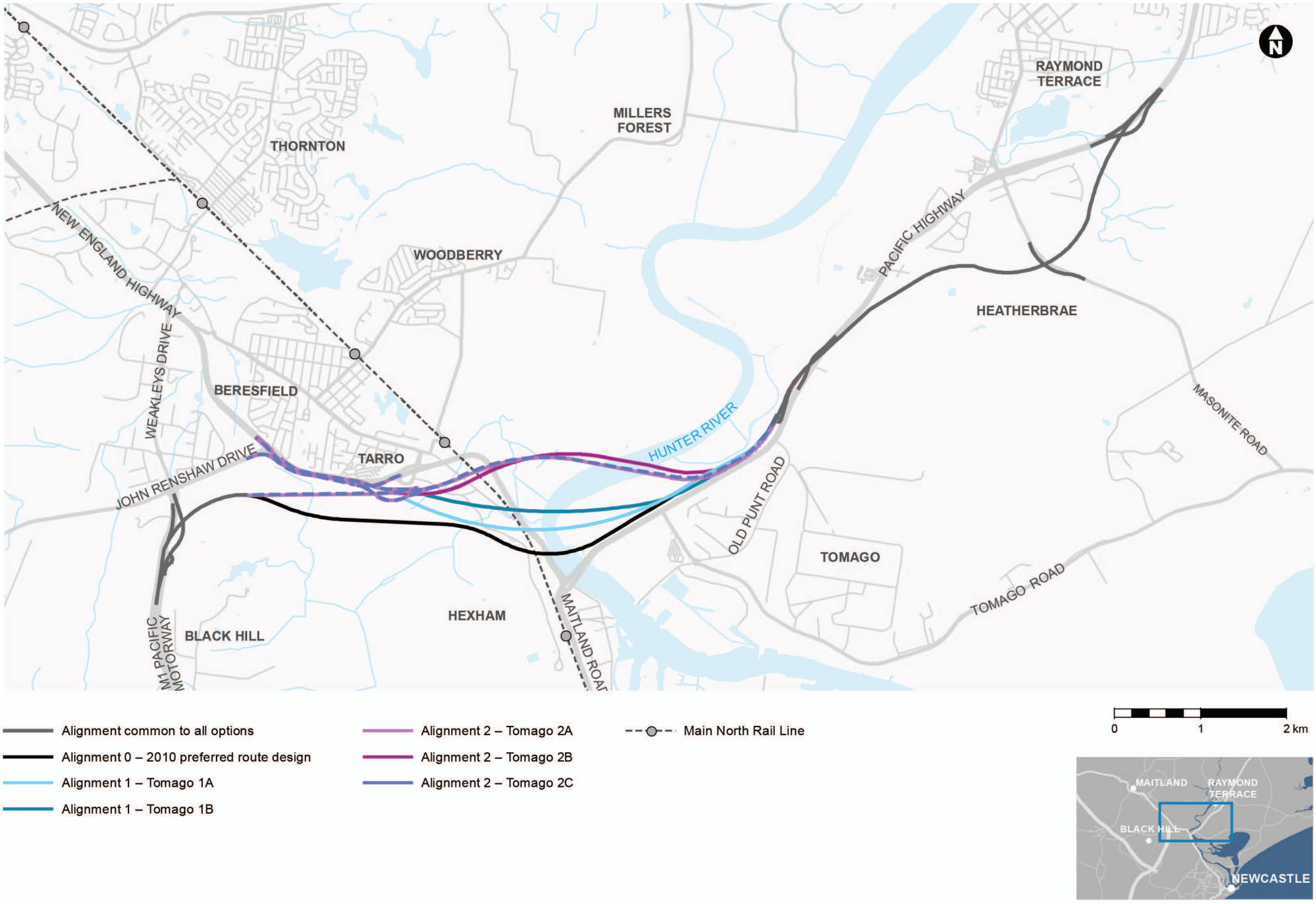

Figure 4-5 Alignment options

4.3.3 Alignment 1

This option runs between Alignment 0 and the New England Highway in a roughly parallel direction until the Tarro interchange at the New England Highway (refer to **Figure 4-5**). It crosses the Hunter River north of the existing bridges, passes through wetland areas and re-joins the existing Pacific Highway at the Tomago Road intersection. This option was considered to provide a more constructible major bridge structure across the Hunter River and its floodplain.

Two main variations for the Tomago interchange were considered for this alignment (refer to **Figure 4-6**):

- Tomago 1A: with a northbound exit ramp directly into Tomago Road, northbound and southbound entry ramps at Pacific Highway north of Tomago Road via overpasses, a southbound entry ramp from Tomago Road and a northbound entry from Pacific Highway south of the Tomago Road intersection
- Tomago 1B: the alignment across the Hunter River was adjusted to avoid salt marsh and coastal wetlands. This arrangement provided northbound exit and southbound entry ramps at the Pacific Highway and Tomago Road intersection via an underpass, and northbound entry and southbound exit ramps at an upgraded Pacific Highway and Old Punt Road intersection. This alignment is a variation of Tomago 1A in response to recommendations made at the value management workshop held between 28 and 29 April 2015 (as discussed in **Section 4.3.5**). Refinements to Tomago 1A to arrive at Tomago 1B included:
  - An at-grade intersection at Tomago Road
  - Adjusting the alignment to reduce impacts on ecological communities listed under the EPBC Act and the TSC Act (which was in force at the time).

4.3.4 Alignment 2

This option follows Alignment 1 until the Tarro interchange at the New England Highway (refer to **Figure 4-5**). It passes to the north of Alignment 1, and crosses the Hunter River and its floodplain to the north-east of the existing bridges, re-joining the Pacific Highway between the Tomago Road and Old Punt Road intersections. This alignment avoided the high-value wetlands and State and Commonwealth-listed threatened environmental communities on the northern side of the Hunter River.

Three variations of Tomago interchange were considered for this alignment (refer to **Figure 4-6**):

- Tomago 2A: provided a northbound exit ramp to the Tomago Road intersection via a reverse-loop ramp and northbound and southbound entry ramps from the Tomago Road intersection. A southbound exit ramp provided at an upgraded Old Punt Road intersection
- Tomago 2B: provided a northbound entry ramp from Tomago Road intersection, a northbound exit ramp passing over the alignment to join Pacific Highway southbound and southbound entry and exit ramps at Tomago Road intersection
- Tomago 2C: provided a northbound entry ramp from Pacific Highway west of Tomago Road via an overpass. A northbound entry and exit ramp and a southbound entry ramp provided east of Tomago Road via a roundabout and overpass. This overpass connects to new intersections at Old Punt Road and Tomago Road. A southbound exit ramp connects to an upgraded Pacific Highway and Old Punt Road intersection. This variation of Alignment 2 was developed as an evolution of Tomago 2A. Recommendations from the value management workshop and further investigations drove the changes to Tomago 2A as discussed in **Section 4.3.5**. The main refinements to Tomago 2A to arrive at Tomago 2C included improvement of the Tomago interchange to achieve a longer-term solution to meet traffic demand.

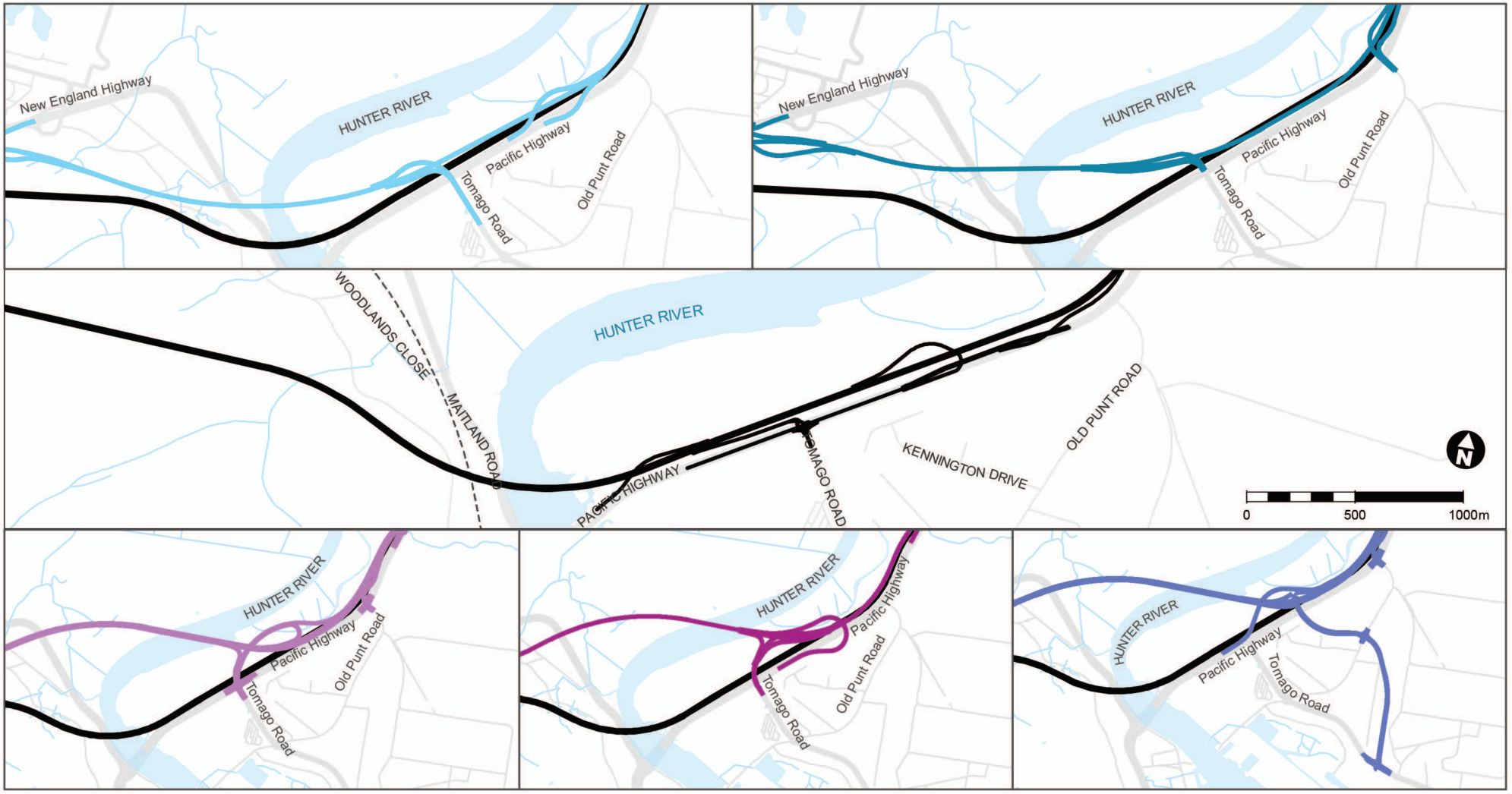

Figure 4-6 Interchange options at Tomago

4.3.5 Evaluation of alignment options

A value management workshop was held on 28 and 29 April 2015 to assess the alignment options. (Alignment 0, Alignment 1 – Tomago 1A, Alignment 2 – Tomago 2A and Tomago 2B). The value management workshop was held with the project team, project stakeholders, local council representatives and representatives of the community.

Values important to the project were identified through desktop investigations and during collaborative workshops and meetings with key stakeholders. These values included the Ecologically Sustainable Development (ESD) considerations**.** These values informed the assessment criteria used to identify a preferred option. The workshop used criteria in the following categories to assess the options as shown in **Figure 4-7**.

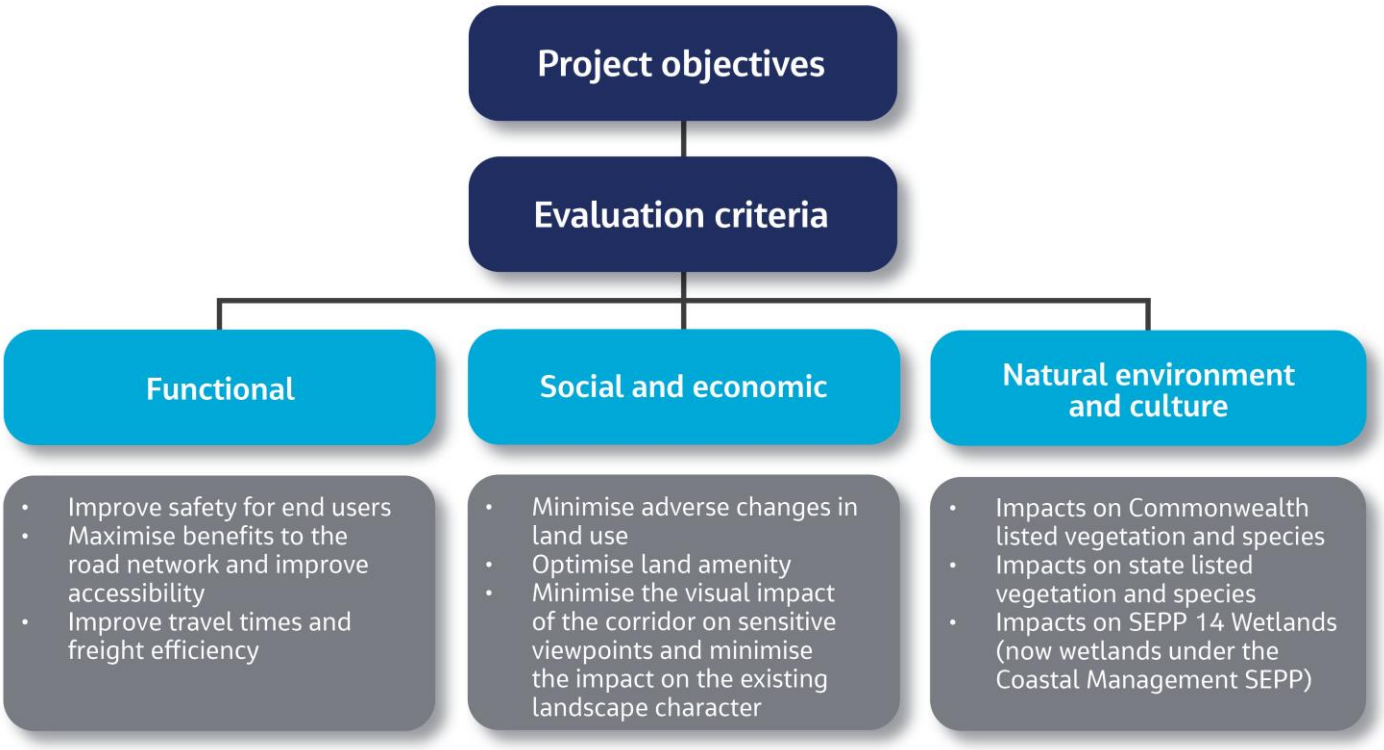

Figure 4-7 Evaluation criteria

The Value Management Workshop recommended that Tomago 1A and Tomago 2A be progressed for further consideration. Both alignments performed equally from a social and economic perspective. Tomago 1A was the best performer from a functional perspective, while Tomago 2A was the best performer from an environmental perspective. It was also concluded that Alignment 0 and Tomago 2B should not proceed any further.

Following the Value Management Workshop, further refinements were made to Tomago 1A to provide an intersection with Tomago Road that was comparable with Tomago 2A and to reduce the impact on the sensitive environment near the Hunter River. This refined alignment has been called ‘Tomago 1B’.

A review of Tomago 1B and Tomago 2A found that the functionality and cost of these options were very similar. However, Tomago 2A was preferred due to the improved environmental avoidance it provided in accordance with ESD principles.

Further refinement of Tomago 2A was then carried out to improve the Tomago interchange and achieve a longer-term solution for traffic demand. This included a new link road to connect between the motorway and Tomago Road and a grade separated interchange between Tomago Road and Old Punt Road. This amended alignment was called ‘Tomago 2C’.

Further investigation and assessment including traffic analysis, capital costs, and environmental factors confirmed Tomago 2C as the best performing alignment across the range of criteria and ESD principles. **Table 4-3** summarises the performance of each alignment option, as each option had been designed to meet each of the project objectives.

Table 4-3 Performance of each option

Option	Advantages	Disadvantages
Alignment 0	• Existing road that requires the least number of new property acquisitions.	• Impacts on high value biodiversity areas including wetlands north and south of the Hunter River • Poor functionality and connectivity to the local road network, particularly at Black Hill and Tomago • Requires the existing bridge crossing of the Hunter River to be widened and constructed as twin bridges.
Alignment 1 – Tomago 1A	• Improved functional performance at Black Hill and Tarro with new interchanges proposed providing improved connectivity to the adjoining road network • Improved alignment providing simpler construction than Alignment 0 • Grade separated interchange at Tomago provides improved functionality over Alignment 0.	• Worst performer on the basis of environmental impact. In particular, this option would have a major impact on the wetlands located on the northern side of the Hunter River • Tomago interchange could have constructability issues due to proximity to floodplain and environmental constraints • Does not have the improved connectivity of other options at Tomago.
Alignment 1 – Tomago 1B	• Improved functional performance at Black Hill and Tarro with new interchanges proposed providing improved connectivity to the adjoining road network • Improved alignment providing simpler construction than Alignment 0 • Improved alignment over Alignment 1A due to decreased impact on environmentally sensitive areas including of the wetlands south of the river and the Commonwealth-listed coastal saltmarsh north of the Hunter River. • Tomago interchange provides improved connectivity by connecting to existing traffic signals at Tomago Road and Old Punt Road.	• This option would still have a major impact on the wetlands located on the northern side of the Hunter River • Tomago interchange would perform with less functionality and road safety than other options due to connection into the signalised intersection • Tomago interchange could have constructability issues due to proximity to floodplain and environmental constraints.
Alignment 2 – Tomago 2A	• Improved functional performance at Black Hill and Tarro with new interchanges proposed providing improved connectivity to the adjoining road network • Minimises environmental impact (i.e. avoids severance of high quality vegetation and avoids the majority of the wetlands north and south of the river) • Improved alignment providing simpler construction than Alignment 0 • Tomago interchange provides improved connectivity by connecting to existing traffic signals at Tomago Road and Old Punt Road.	• Requires new property acquisitions in comparison to Alignment 0 • Requires a more complex Hunter River bridge crossing due to the angle of the river crossing • Road safety issues at proposed northbound exit ramp to Tomago (reverse loop) • Tomago interchange could have constructability issues due to proximity to floodplain and environmental constraints.

Option	Advantages	Disadvantages
Alignment 2 – Tomago 2B	• Improved functional performance at Black Hill and Tarro with new interchanges proposed providing improved connectivity to the adjoining road network • Minimises environmental impact (i.e. avoids severance of high quality vegetation and avoids the majority of the wetlands north and south of the river) • Improved alignment providing simpler construction than Alignment 0.	• Requires new property acquisitions in comparison to Alignment 0 • Requires a more complex Hunter River bridge crossing due to the angle of the river crossing • Tomago interchange provides less functionality for the changed northbound exit. Additional infrastructure requirements to provide the interchange • Tomago interchange could have constructability issues due to proximity to floodplain and environmental constraints.
Alignment 2 – Tomago 2C	• Improved functional performance at Black Hill and Tarro with new interchanges proposed providing improved connectivity to the adjoining road network • Minimises environmental impact (i.e. avoids severance of high quality vegetation and avoids the majority of the wetlands north and south of the river). Avoiding and minimising impacts satisfies the NSW Offsets Policy for Major Projects as well as the Federal requirements under the bilateral agreement with NSW. • Improved alignment providing simpler construction than Alignment 0 • Tomago interchange provides improved connectivity and functionality due to provision of grade separated interchange • Allows for improved constructability of Tomago interchange, predominantly out of the floodplain and located for simplified construction.	• Requires new property acquisition in comparison to other options, due to additional new link road at Tomago.

4.3.6 Preferred alignment

The preferred alignment to progress was Alignment 2 – Tomago 2C. This alignment best met the project objectives (refer to **Table 4-2**), had less environmental impacts, provided better opportunities to connect to the regional road network, improved the interface and constructability across existing rail and road infrastructure and had the best allowance for future urban development.

The preferred alignment and associated design was announced in October 2015. **Figure 4-8** illustrates the preferred alignment.

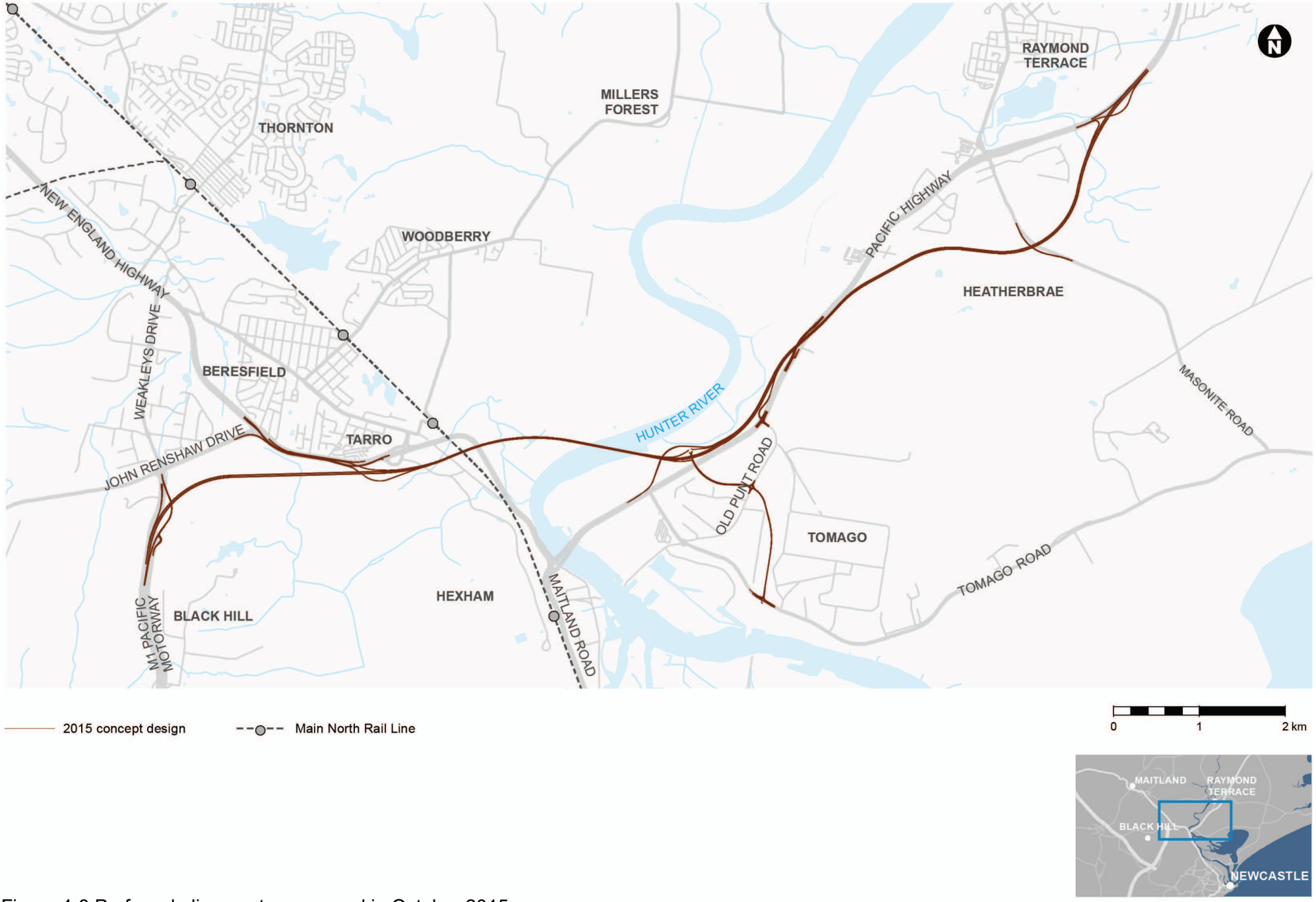

Figure 4-8 Preferred alignment announced in October 2015

4.4 The preferred option – 2016 concept design

Following the announcement of the preferred alignment, the concept design was revised based on feedback received from the community and stakeholders, as well as the outcomes of further field investigations carried out in 2015 and 2016.

Key issues raised during public display of the preferred alignment and property owner discussions related to timing of the project, access to Heatherbrae, impacts to the existing road network, traffic impacts and the project alignment. **Chapter 6** provides further detail on consultation that occurred during display of the preferred option.

Design revisions are detailed in **Table 4-4** and shown on **Figure 4-9**. The key change made to the design as a result of consultation was the introduction of a northbound exit ramp south of Heatherbrae. These revisions were developed with consideration of the project objectives and only refinements that met the project objectives were progressed as part of the concept design.

Table 4-4 Revisions to the concept design

Location and design element	Change	Justification for change
Black Hill interchange	• Converting the northbound exit ramp from a single lane ramp to a double lane ramp	Traffic modelling identified that additional capacity would be required to cater for modelled traffic volumes at this ramp. The impact for the project would remain the same at this location. No additional environmental impact is expected as a result of the change.
Project alignment at Black Hill and Tarro interchange	• Adjusting the main alignment closer to New England Highway • Moving Tarro interchange further north and east	A review of the alignment at Black Hill identified the opportunity to reduce the area of property impacted between the New England Highway and the project, reducing the area of property acquisition for the project. This would reduce the area of native vegetation fragmented by the project at Black Hill. The main alignment change would also shorten the bridge structure over the wetlands, reducing direct impacts to the wetlands. Moving the Tarro interchange further north and east would provide additional distance between lane changes on the New England Highway, improving motorist safety and reducing weaving movements.
Main viaduct across the Hunter River floodplain	• Realignment of the viaduct and crossing of Hunter River	This change would improve road geometry across the viaduct, reducing the angle at which the Hunter River is crossed. The viaduct alignment was adjusted endeavouring to avoid features on the property located on the eastern bank of the Hunter River.
Tomago interchange	• Removing roundabout and converting the interchange to a free flow interchange • A new southbound on ramp from the Pacific Highway at Tomago	This change would improve traffic conditions due to the free flow access at Tomago and would provide a safer interchange for road users by removing a conflict point associated with the roundabout when exiting the motorway. It would improve access for heavy vehicles using the southbound entry ramp onto the main alignment. This change would also remove the need to widen the viaduct directly west of the interchange. This change was in response to submissions received during the public display of the revised concept design in 2015.

Location and design element	Change	Justification for change
New link road at Tomago	• Realigning the link road further west outside of the transmission line easement, to run parallel to a property boundary	This change would reduce impacts on TransGrid's high voltage transmission infrastructure due to the vertical clearances required, while avoiding a Commonwealth-listed threatened flora population of *Grevillea parviflora* subsp. *parviflora*.
Heatherbrae interchange	• A new northbound exit ramp at Heatherbrae	This change was in response to submissions received during the public display of the revised concept design in October 2015, which identified a need to review access to Heatherbrae. Stakeholder and community concern was expressed about the lack of direct access to Heatherbrae, specifically the lack of a ramp for northbound traffic south of Heatherbrae, and the effect that this may have on Heatherbrae local business. A larger impact to native vegetation in this area would be expected due to the larger footprint of the new ramps.
Project alignment at Raymond Terrace	• Moving the Masonite Road bridge to the east	This change was implemented to allow continued operation of Masonite Road during construction. This change would also improve the geometry of the Masonite Road bridge, improving safety for motorists. This change also allows additional room for drainage channels and water quality basins, improving water quality in this location.
Raymond Terrace interchange	• Removing the northbound exit ramp • Moving the southbound exit ramp to the south	Removing the exit ramp to travel south to Heatherbrae, minimises impacts on native vegetation in this area. This change was applied because a northbound exit ramp, south of Heatherbrae, was provided for better connectivity. The adjustment to the southbound exit ramp would not be expected to result in increased environmental impacts.

Further community consultation was carried out in August and September 2016 to communicate the design changes carried out since the previous design display and consultation period in late 2015. Further detail on community consultation is provided in **Chapter 6**.

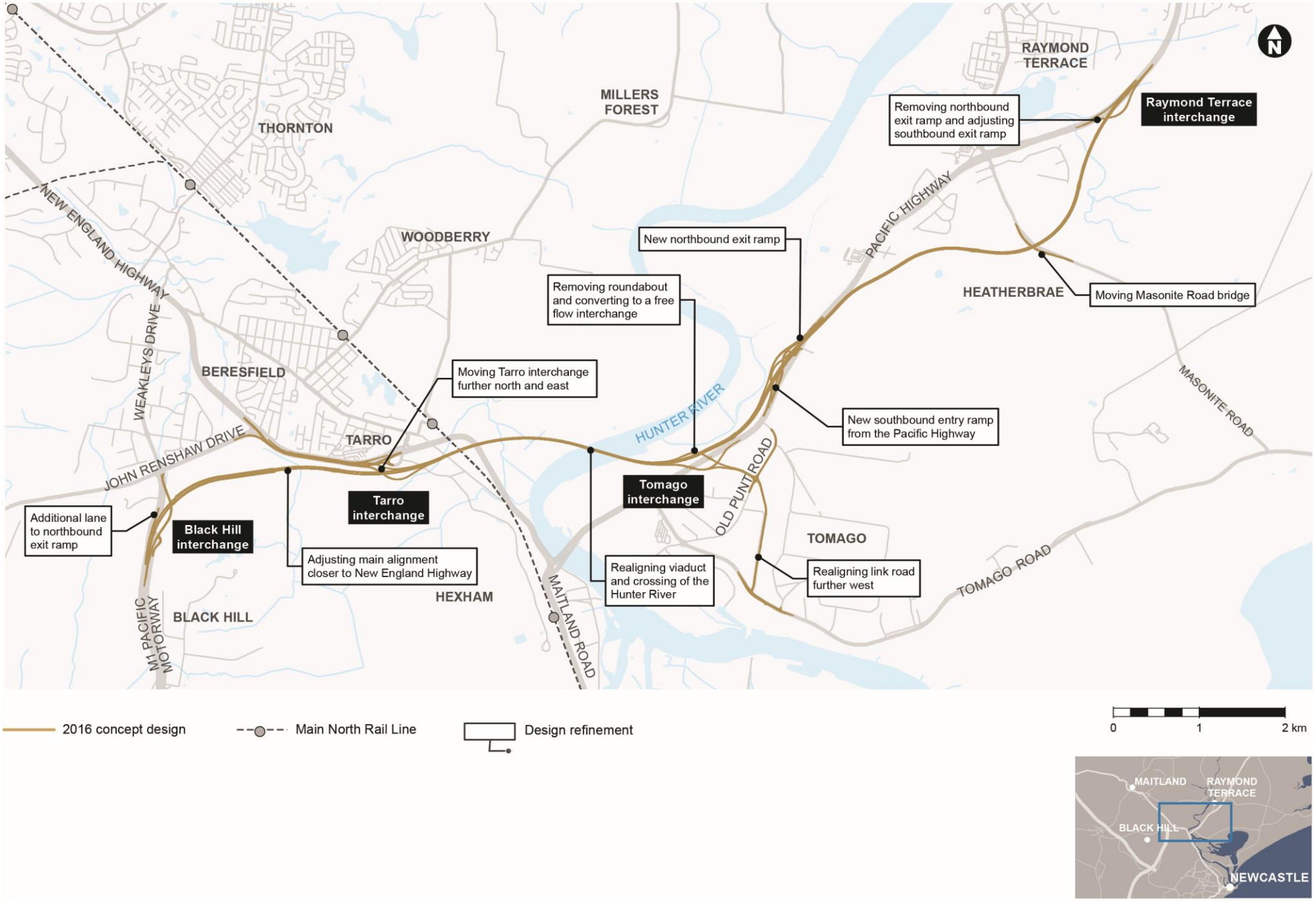

Figure 4-9 The preferred option – 2016 concept design

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4.5 Design refinements

Since the community consultation periods in 2016, remaining issues being investigated and refined include impacts on the Hunter Region Botanic Gardens and their access, private property access, and general improvement to the concept design outcomes.

Further consultation, subsequent to the community consultation, with landowners, utility providers and key stakeholders identified further design refinements.

The further design refinements that have led to the project design and environmental assessment are detailed in **Table 4-5** and shown on **Figure 4-10**.

Table 4-5 Refinements to the concept design

Location and design element	Change	Justification for change
Black Hill interchange	• Widening the southbound bridge from John Renshaw Drive onto the M1 Pacific Motorway to allow for additional lanes in the future	A future third lane would possibly be required to cater for traffic growth, particularly if major adjoining employment land use occurs. Increasing widths allows any future changes to minimise impacts to the future operation of the project. The additional bridge widening would not require an increase in the footprint of the project at this location, and no additional environmental impacts from this change would be expected.
Tarro interchange	• Adjusting the westbound exit ramp and eastbound entry ramp to and from New England Highway to the south east • Adjusting the alignment to enable the viaduct realignment • Changing the bridge arrangement at the interchange so that the northbound entry ramp would go over the westbound carriageway of the New England Highway (rather than vice versa)	Reduction in impact on the property located to the west of New England Highway and also provide space required to realign the Aurizon private access road. Changing the bridge arrangement of the interchange so that the entry ramp goes over the New England Highway rather than having the New England Highway over the entry ramp provides a more suitable alignment for the New England Highway. This arrangement also reduces noise from the New England Highway, allowing for minor noise benefits and a minor reduction in resource use during construction at this location.
Main viaduct across the Hunter River floodplain	• Horizontal realignment of the viaduct	The viaduct was realigned to maintain an acceptable horizontal road geometry and to reduce the skew (angle) at which the Hunter River is crossed, allowing for greater capacity to simplify the bridge type. This change also addresses concerns from consultation existing residents near the New England Highway, between Purgatory Creek and the M1 Pacific Motorway extension by relocating the alignment further away. Changing the alignment of the viaduct over the Hunter River would result in a minor reduction in resource use during construction and a generally more constructible design.

Location and design element	Change	Justification for change
Tomago interchange	• Consolidation of the Tomago and Heatherbrae interchanges into a single interchange • Adjusting Tomago Road intersection to allow northbound vehicles to access the project at Tomago, and adjusting the Old Punt Road intersection • Minimising impacts on land proposed for the Newcastle Power Station • Provision of improved access to Hunter Region Botanic Gardens.	Two matters were still to be resolved after community consultation in 2016. • Planning for the Newcastle Power Station was developed, then proposed by AGL on land that was in conflict with the 2016 design. • Access to the Hunter Region Botanic Gardens. Both matters were considered in refinement of the project design between Tomago Road and north of the Hunter Region Botanic Gardens access. The design refinements were displayed in a community update in November 2020 and provide the following: • A consolidated Tomago interchange at Old Punt Road to avoid conflict to the Power Station proposal. • The design allows direct northbound and southbound access to the Hunter Region Botanic Gardens to be retained and improved from the Pacific Highway. • A new right turn from Tomago Road and the new northbound Pacific Highway alignment allows for vehicles from Tomago to access the Motorway to travel north more efficiently. • Direct connection to the realigned Pacific Highway under the Motorway to a new signalised intersection.
Project alignment at Heatherbrae	Raising the project vertical alignment through the Hunter Water Corporation land in the Tomago Sandbeds Catchment Area	This change was implemented to improve protection and endeavour to avoid water quality impacts on the Tomago Sandbeds Catchment Area. The vertical alignment change allowed for pavement drainage to be graded so that stormwater would be directed towards lined water quality basins for treatment prior to discharge (refer to **Chapter 11** (surface water and groundwater quality)). This refinement would minimise effects on sensitive habitats, such as waterways and wetlands, native vegetation and fauna.
New link road at Tomago	Removing the link to Tomago Road	The link road was removed as it would have caused major impacts to existing adjoining land use to cater for the design. Removing the link road would avoid impact to state-listed threatened ecological communities.

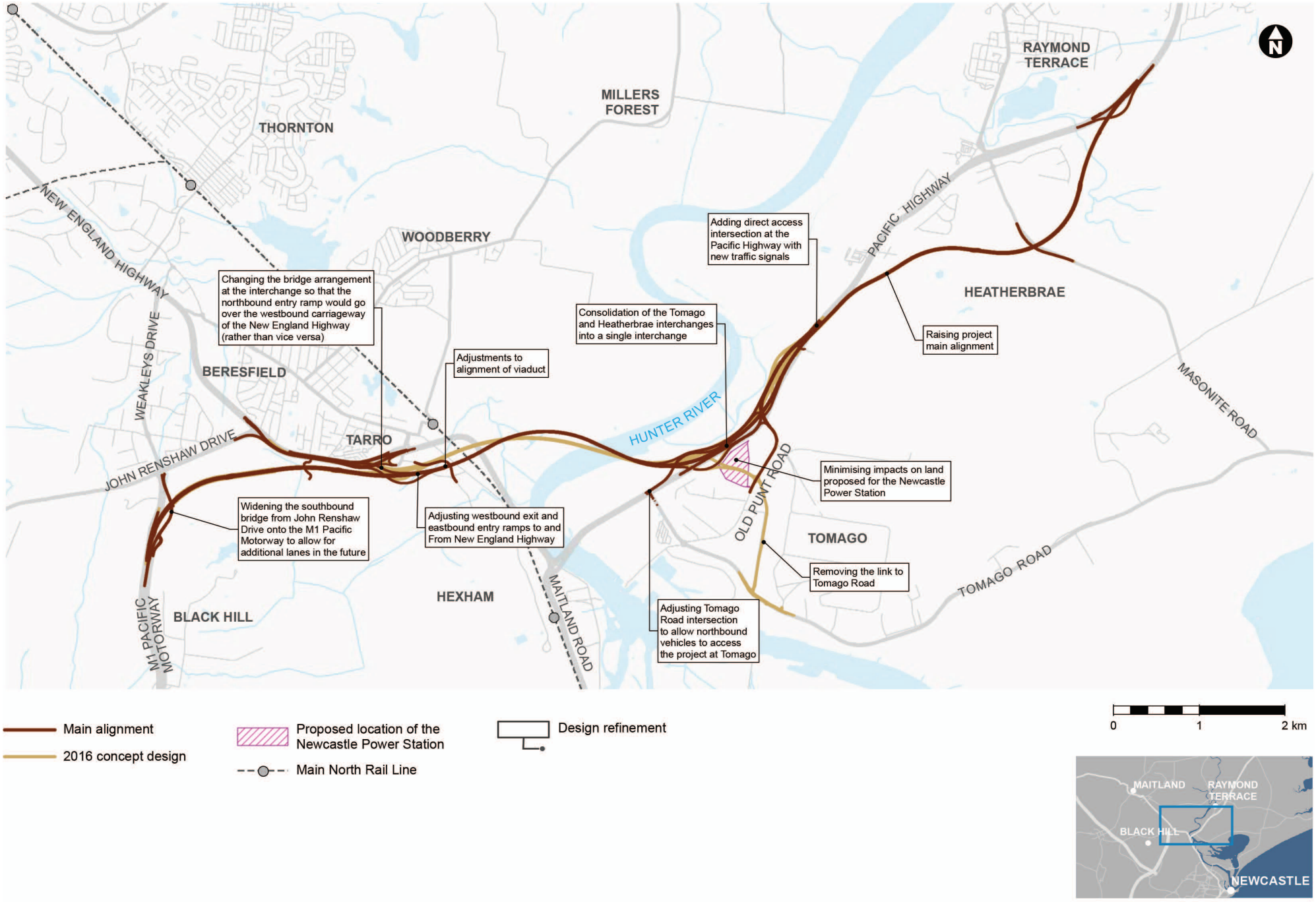

Figure 4-10 The preferred option and design refinements

4.5.1 Minimising and avoiding environmental impacts

A number of environmental impacts have been avoided or minimised throughout the development of the project. As discussed in **Section 4.1**, **Section 4.2** and **Section 4.3**, alternatives and options have been identified and assessed against a range of engineering, environmental, social, land-use and economic considerations. As a result of the project development process, the project has avoided and minimised many environmental impacts associated with:

- Biodiversity:
  - Minimising direct impacts to wetlands west of Woodlands Close
  - Avoiding and minimising impacts to floodplain wetlands and associated biodiversity with a viaduct across the Hunter River floodplain instead of an embankment
  - Minimising fragmentation of habitat, including koala habitat, by aligning the project closely to existing infrastructure and land use
  - Avoiding impacts to remnant vegetation, potential habitat for threatened species, connectivity impacts and a population of Commonwealth-listed *Grevillea parviflora* subsp. *parviflora* with the removal of the link road at Tomago.
- Hydrology and flooding:
  - Minimising substantial upstream flooding impacts by replacing embankment with a 2.6 kilometre long viaduct across the Hunter River floodplain and providing multiple bridges across waterways. This would minimise impact to upstream drainage capacity, flood storage and conveyance and local afflux.
- Water quality:
  - Minimising surface water quality impacts by realigning the project with less impacts across the floodplain
  - Minimising groundwater impacts by reducing soft soil consolidation activities.
- Non-Aboriginal heritage:
  - Minimising impacts at the Glenrowan Homestead complex, and avoiding impacts to Hexham Bridge, Hexham Shipbuilding Yards and Hannell Family Vault structure through modifications to the alignment.
- Land use and property:
  - Project alignment has been refined to be more closely aligned to existing infrastructure to minimise the land severance and impacts to existing properties and land use.
- Socio-economic:
  - Design changes providing improved interchange arrangements at Black Hill and Tarro, and at Tomago and Raymond Terrace that have improved accessibility and minimised impacts to existing businesses at Beresfield and Heatherbrae respectively.

The project has, through its design and construction methodology, sought to minimise environmental impacts. For further detail on how the project has minimised and avoided impacts based on the application of environmental management measures, refer to **Chapter 7** (traffic and transport) through to **Chapter 23** (cumulative impacts) as well as **Chapter 24** (summary of environmental management measures).

4.6 The project

As discussed throughout this chapter, the preferred option and design for the project were determined and refined through an extensive evaluation, community consultation (as discussed in **Chapter 6**) and review process. Changing the project alignment to allow connection to the New England Highway has resulted in the project better aligning with project objectives, while improving local and regional connectivity. This change has also resulted in minimising environmental impacts including reducing socio-economic and land use, biodiversity and heritage impacts (as discussed in **Section 4.5.1**). The change from an embankment across the floodplain to a viaduct has resulted in avoiding substantial environmental impacts associated with flooding, groundwater, surface water quality and hydrology as discussed in **Section 4.5.1**).

Overall, the project development process has ensured that the project best meets the project objectives, while minimising social and economic and natural environment impacts to ultimately provide value for money.

The preferred option for the project as described in **Section 4.4** together with the design refinements detailed in **Section 4.5** comprises the project.

In summary, the project as shown on **Figure 1-2** consists of:

- A new dual-carriageway motorway, with two lanes in each direction, between Black Hill and Raymond Terrace
- Interchanges at Black Hill, Tarro, Tomago and Raymond Terrace
- Realignment of New England Highway, Pacific Highway and other local roads to maintain existing routes and tie-in with the project.

Refinements to the design as set out in this EIS may occur as a result of submissions received as part of the community consultation and EIS submission process. The design may also be refined during the detailed design of the project.

A detailed description of the project and its elements is provided in **Chapter 5**.