Australian Government

BUILDING OUR FUTURE

NSW GOVERNMENT

M1 Pacific Motorway extension to Raymond Terrace

Environmental impact statement – Chapter 5: Project description

Transport for NSW | July 2021

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5. Project description

This chapter describes the proposed scope of work, including the route alignment, corridor width, main project elements, ancillary facilities, design standards and construction activities.

The project description presented in this EIS represents the project concept design. Sufficient flexibility has been provided in the concept design to allow for refinement during detailed design, in response to any submissions received following the exhibition of the EIS or to minimise environmental impacts. The final design may therefore vary from the project described in this chapter.

Table 5-1 lists the SEARs as they relate to the project description and identifies where these have been addressed in this EIS.

Table 5-1 SEARs (project description)

Secretary's requirement	Where addressed in EIS
2. Environmental Impact Statement	
1. The EIS must include, but not necessarily be limited to, the following:	
(b) description of the project and all components and activities (including ancillary components and activities) required to construct and operate it, including:	The project scope and key design elements are described in **Section 5.1**, **Section 5.2** and **Section 5.3** The construction of the project is described in **Section 5.4**
− the proposed route;	The proposed route is detailed in **Section 5.3.2** and shown on **Figure 5-1**
− design of the road and its components, including interchanges; bridges and viaducts; structures over roads, rail lines and pipelines; road user, pedestrian and cyclist facilities; and lighting;	The project design and key elements are described in **Section 5.2** and **Section 5.3**
− road upgrade works, including road widening, intersection treatment and grade separation works, property access, parking, pedestrian and cyclist and public transport facilities;	Road upgrade and road widening in **Section 5.3.1** to **Section 5.3.4** Intersection treatments and grade separation works in **Section 5.3.3** Property access in **Section 5.3.20** Construction parking in **Section 5.4.3** Pedestrian and cyclist and public transport facilities in **Section 5.3.16** and **Section 5.3.17**.
− location and operational requirements of construction ancillary facilities and access;	The locations and operational requirements of ancillary facilities (including access arrangements) are detailed in **Section 5.4.3**
− the relationship and/or integration of the project with existing and proposed public and freight transport services;	Integration of the project with existing public and freight transport services is described in **Section 5.3.17** and **Section 5.3.18**. Integration of the project with existing road and rail is described throughout **Section 5.3** and **Section 5.4**.
(r) relevant project plans, drawings, diagrams in an electronic format that enables integration with mapping and other technical software.	Relevant plans, drawings and diagrams are provided throughout this EIS and attached in the appendices

5.1 Project scope

5.1.1 The project

Transport is proposing to extend the M1 Pacific Motorway from Black Hill to the Pacific Highway at Raymond Terrace, a distance of about 15 kilometres, bypassing Beresfield, Hexham and Heatherbrae, as shown in **Figure 1-2**. The project would traverse the City of Newcastle and Port Stephens Council local government areas (LGAs). The suburbs of Beresfield, Tarro, Heatherbrae and Raymond Terrace are located to the north of the project, with Black Hill, Hexham and Tomago located to the south of the project.

The project would provide a critical link in the National Land Transport Network (NLTN), particularly for the coastal Sydney to Brisbane corridor. The project is anticipated to open in 2028. This timing is subject to planning approval and completion of the detailed design.

The project would include the following key features:

- A 15 kilometre motorway comprised of a four lane divided road (two lanes in each direction)
- Motorway access from the existing road network via four new interchanges at:
  - Black Hill: connection to the M1 Pacific Motorway
  - Tarro: connection and upgrade (six lanes) to the New England Highway between John Renshaw Drive and the existing Tarro interchange at Anderson Drive
  - Tomago: connection to the Pacific Highway and Old Punt Road
  - Raymond Terrace: connection to the Pacific Highway.
- A 2.6 kilometre viaduct over the Hunter River floodplain including new bridge crossings over the Hunter River, the Main North Rail Line, and the New England Highway
- Bridge structures over local waterways at Tarro and Raymond Terrace, and an overpass for Masonite Road in Heatherbrae
- Connections and modifications to the adjoining local road network
- Traffic management facilities and features
- Roadside furniture including safety barriers, signage, fauna fencing and crossings and street lighting
- Adjustment of waterways, including at Purgatory Creek at Tarro and a tributary of Viney Creek
- Environmental management measures, including surface water quality control measures
- Adjustment, protection and/or relocation of existing utilities
- Walking and cycling considerations, allowing for existing and proposed cycleway route access
- Permanent and temporary property adjustments and property access refinements
- Construction activities, including establishment and use of temporary ancillary facilities, temporary access tracks, haul roads, batching plants, temporary wharves, soil treatment and environmental controls.

The key operational features of the project are shown in **Figure 1-2**. A detailed description of the project, including key design criteria, details of the proposed permanent work, and property access and acquisition, is provided in **Section 5.2** and **Section 5.3**. The proposed construction work associated with the project is described in **Section 5.4**.

5.2 Design criteria

5.2.1 Design standards

Transport is committed to providing high quality, safe and efficient infrastructure. As such, the development of the project has been guided by recognised standards and criteria. The concept design has incorporated sufficient road corridor width to accommodate design development and refinement opportunities during detailed design.

Design development was based on:

- Austroads guides and publications (with appropriate Roads and Maritime Services supplements)
- Australian standards
- Roads and Maritime Services technical directions, standards, and model drawings
- Australian Rainfall and Runoff: A Guide to Flood Estimation (Ball et al. 2019).

The key design criteria adopted for the project are summarised in **Table 5-2**.

Table 5-2 Key design criteria

Item	Design element	Key design criteria
General	Design vehicle	25m B-double
	Design speed	• Main alignment:110km/h • Ramps: 90km/h
	Posted speed limit	• Main alignment: 110km/h • Ramps: 80km/h
	Number of lanes	• Main alignment: Two lanes in each direction • Ramps: one lane (except the southbound entry ramp at the Black Hill interchange, which is two lanes)
	Lane, verge and median width	• Through and turn lanes: 3.5m • Nearside shoulder width: 2.5m (3.0m on bridges) • Offside shoulder width: 1.0m (1.5m on bridges) • Verge width: 0.5m offside / 1.5m near side • Depressed median width: Varies, up to 12m • Median width: paved 5m / raised: 2.6m
	Grades	Main alignment: • Minimum grade: 0.5% • Maximum grade: 2.6% (Tomago interchange)
	Cut batter slopes	• 2 (horizontal (H)):1 (vertical (V))
	Fill batter slope (embankment)	• 4H:1V (2.5H:1V with barrier)
	Bench width minimum curve radius	• Bench width: 4.5m • Curve radius: Main alignment: 900m / Ramps: 240m

Item	Design element	Key design criteria
	Vertical clearances	• Ramps and local access: Minimum vertical clearance of 5.4m • Rail: Minimum vertical clearance of 7.1m • A navigable channel within the Hunter River, with a minimum vertical clearance of 10m and a minimum horizontal clearance of 32m
	Safety barriers	• Includes wire rope barriers, concrete barriers, W-beam steel safety barriers, and flexible bollards
	Minimum flood immunity requirements	• Both carriageways of the project would target immunity for a 5% annual exceedance probability (AEP) event flood event to the outer edge line of each carriageway
	Pavement design life	• 40 years
Bridges	Bridge design life	• 100 years
	Bridge drainage design	Flows must not extend into the traffic lane for rainfall events up to the 5% AEP event

5.2.2 Urban design objectives and principles

Urban design objectives and principles were prepared to guide the project design as set out in this document. These consider how the project would integrate physically and visually with the surrounding environment.

The urban design objectives and principles for the project are identified in **Chapter 15** (urban design, landscape and visual amenity) and are consistent with the following Urban Design Guidelines:

- Beyond the Pavement 2020 Urban design approach and procedures for road and maritime infrastructure planning, design and construction (Transport for NSW 2020a)
- Bridge aesthetics design guidelines: Design guideline to improve the appearance of bridges in NSW (Transport for NSW 2019a)
- Landscape design guideline: Design guideline to improve the quality, safety and cost effectiveness of green infrastructure in road corridors (Roads and Maritime Services 2018a).

The following overarching urban design objectives were developed for the project:

- Provide a flowing road alignment that is responsive to and integrated with the landscape
- Provide a well vegetated, natural road reserve
- Provide an enjoyable, interesting highway
- Value the communities and towns along the road
- Provide consistency-with-variety in road elements
- Provide a simplified and unobtrusive road design.

Urban design principles were adopted for each urban design objective as described in **Chapter 15** (urban design, landscape and visual amenity).

5.2.3 Detailed design requirements

This EIS seeks approval for the project elements and their functionality as described in this chapter. The concept design presented in this EIS may be refined following the EIS exhibition process and during the detailed design, including future community consultation as part of the detailed design process.

The development of the detailed design would:

- Meet any conditions of approval determined for the project
- Be consistent with key design criteria and functionality as described in this EIS and any subsequent response to submissions
- Avoid or minimise environmental impacts wherever possible
- Further develop and refine environmental management measures
- Appropriately develop and incorporate the urban design and landscape strategy and the urban design objectives and principles presented in **Chapter 15** (urban design, landscape and visual amenity)
- Address risk management during construction and operation
- Allow for safe and cost-effective maintenance of the project during operation in accordance with work health and safety requirements and relevant specifications.

Design outcomes and the construction methodology would be further optimised during detailed design. **Chapter 27** (project synthesis) discusses the further work that would be carried out during detailed design.

5.3 The completed project

5.3.1 Operational footprint

The operational footprint, as shown on **Figure 5-1**, includes the main alignment and additional areas required for the operation and maintenance of the project, comprising the following elements:

- Main alignment
- Interchanges including entry and exit ramps, tie-ins and upgrades to local and state roads
- Embankments and cuttings
- Culverts and drainage structures
- Water quality control measures, including basins and swales
- Landscaping
- Maintenance access
- Fencing
- Other project elements required during operation of the project (e.g. intelligent transport systems (ITS), utilities and variable message signs (VMS)).

The total operational footprint is about 300 hectares. The width of the operational footprint is largely influenced by the width of the main alignment (which is about 20 to 35 metres) and varies between about 35 metres and 160 metres wide to allow for utilities, drainage features, cuttings and embankments and roadside furniture. At interchanges and road connections (including at New England Highway and Pacific Highway) the operational footprint width is up to 400 metres.

The construction footprint for the project is discussed in **Section 5.4.1**.

5.3.2 Main alignment

The main alignment of the M1 Pacific Motorway extension is shown in **Figure 5-1** and consists of the following (heading south to north):

- The main alignment would start on the M1 Pacific Motorway at Black Hill, about 1.2 kilometres south of the John Renshaw Drive and Weakleys Drive intersection. A new interchange would be provided at Black Hill (refer to **Section 5.3.3**) connecting to the intersection of John Renshaw Drive and Weakleys Drive, after which the main alignment then heads east through a major cutting towards Tarro
- The main alignment then proceeds parallel to the existing New England Highway. Twin bridges (B02) would be provided across the unnamed wetland at Tarro and a new interchange would connect the main alignment to Tarro (refer to **Section 5.3.3**). The westbound New England Highway would be realigned and both carriageways of the New England Highway would be upgraded to three lanes for a distance of 800 metres between John Renshaw Drive and Tarro
- The main alignment would then continue on to a viaduct (B05) commencing west of Woodlands Close. The viaduct would cross over Woodlands Close, the Main North Rail Line and the New England Highway before continuing east across the floodplain and Hunter River. The viaduct finishes west of the Tomago interchange, which connects the main alignment, between the Pacific Highway intersections at Tomago Road and Old Punt Road (refer to **Section 5.3.3**). The viaduct is described further in **Section 5.3.5**
- The main alignment would continue north-east in close proximity to, and necessitating the realignment of, the Pacific Highway. It would then travel east, past the existing Heatherbrae industrial area and pass beneath the realigned Masonite Road. A bridge (B11) would be provided across the wetland at Windeyers Creek and the main alignment would conclude at the new Raymond Terrace interchange (refer to **Section 5.3.3**). This interchange would be located south of Raymond Terrace and would enable entry and exit to/from the project. The existing southbound Pacific Highway would be adjusted to traverse over the main alignment via an overpass bridge (B12) to provide space for the Raymond Terrace interchange.

The main alignment would typically consist of two 3.5 metre traffic lanes in each direction with a median that would range from six to 15 metres. The shoulder and verge of the main alignment would provide a width of at least three metres to enable a vehicle to pull over wholly within the shoulder. Entry and exit ramps for the main alignment would typically consist of:

- A single 3.5 metre traffic lane (with the exception of the southbound entry ramp at Black Hill interchange and the northbound Pacific Highway bridge (B06) at Tomago, where two 3.5 metre traffic lanes would be provided)
- A two metre inside shoulder
- A one metre outside shoulder
- 1.5 metre to 2.5 metre verges, depending on the embankment and presence of a safety barrier.

The northbound and southbound traffic lanes would be separated by a 12 metre wide median south of the viaduct (B05) crossing of the Hunter River. From the viaduct (B05) to the overbridge above Old Punt Road intersection (B08), a 3.9 metre wide median with a concrete barrier would be provided. North of Old Punt Road through to Raymond Terrace, the median width would vary from typically six metres (due to corridor and environmental constraints) to 15 metres at the tie into the existing Pacific Highway at Raymond Terrace.

The project design has considered future widening of the main alignment from two lanes in each direction to three lanes in each direction. Allowance has been made in the design, as set out in this EIS, to provide enough space to accommodate the additional travel lanes.

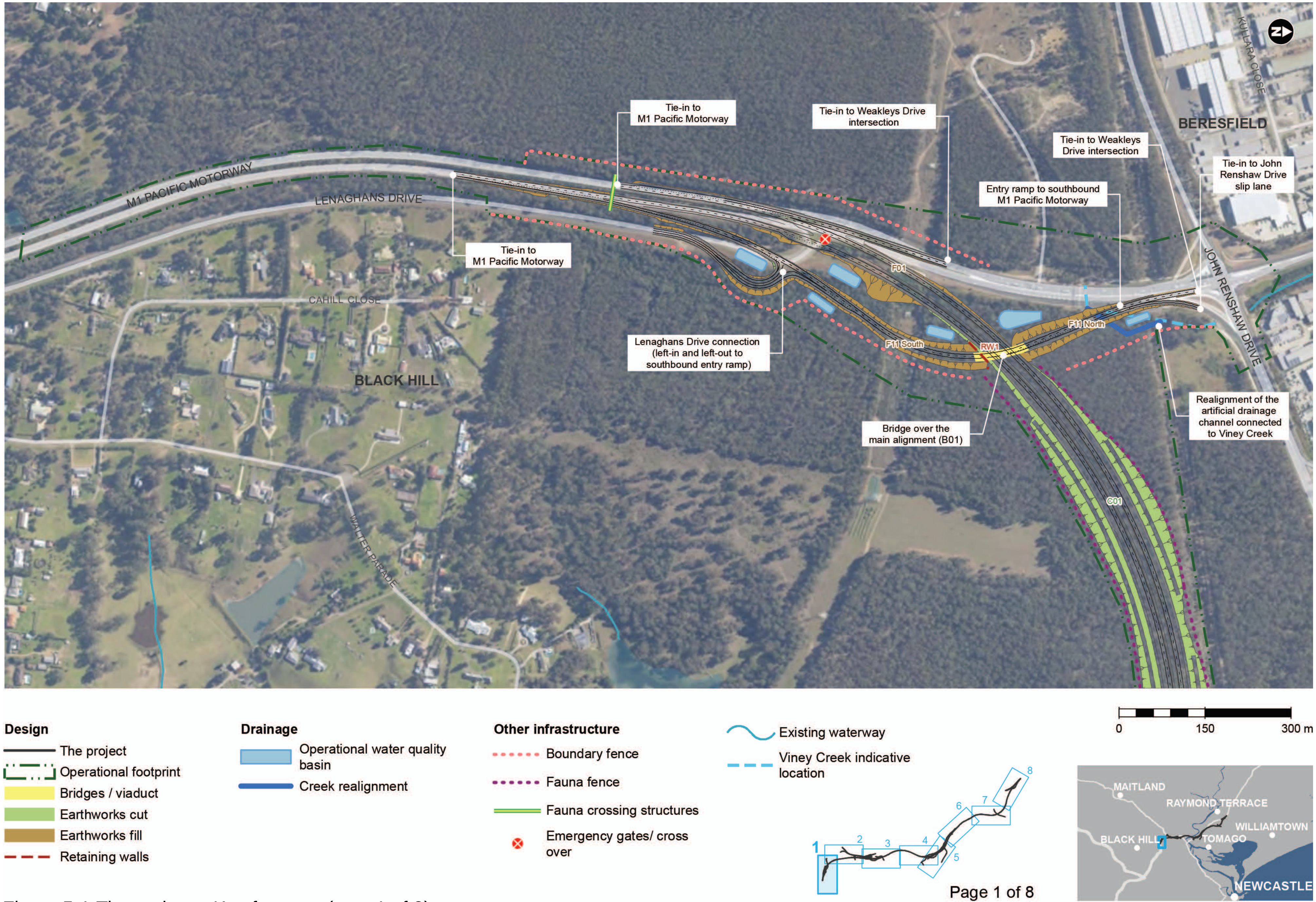


Figure 5-1 The project – Key features (map 1 of 8)

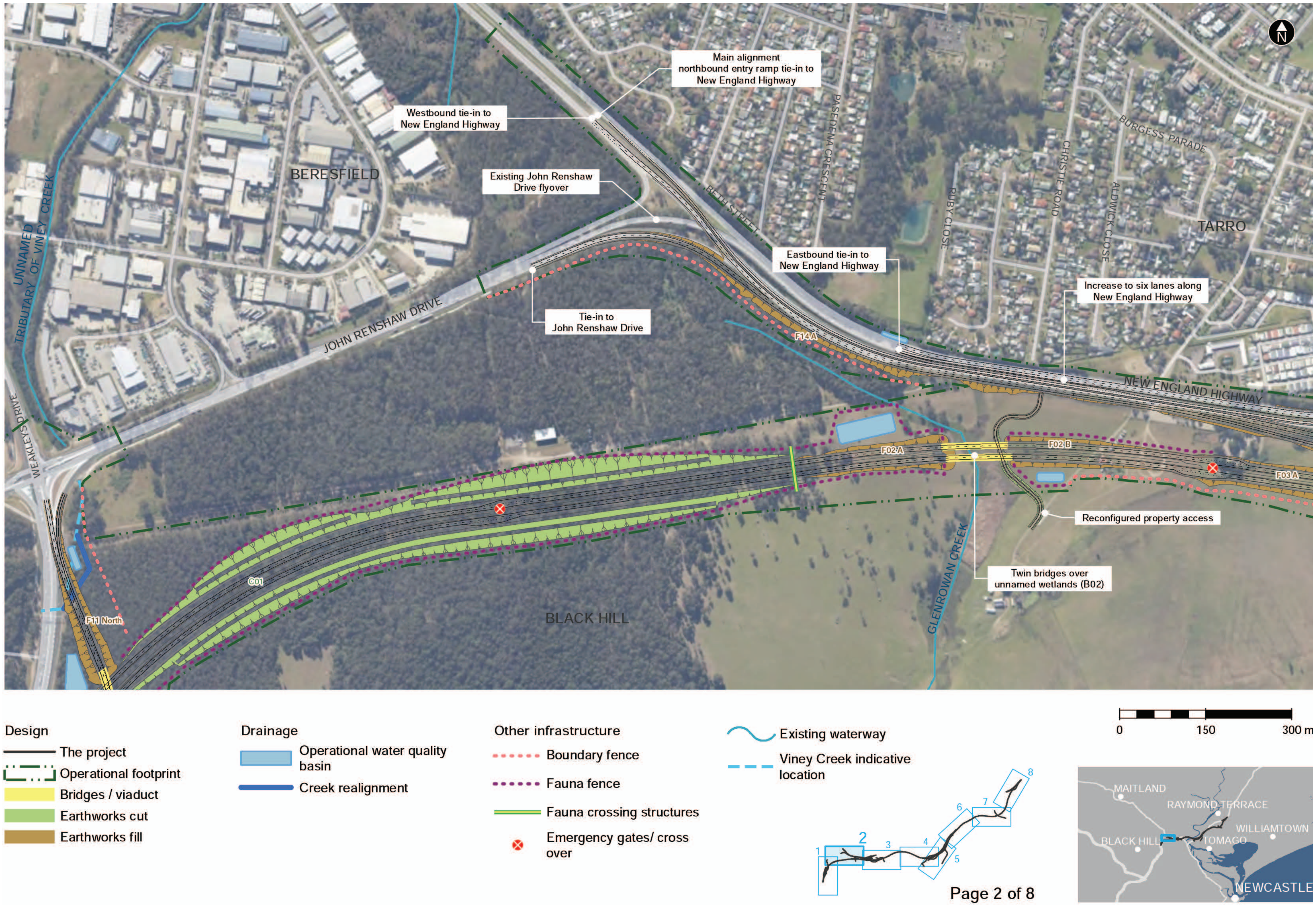
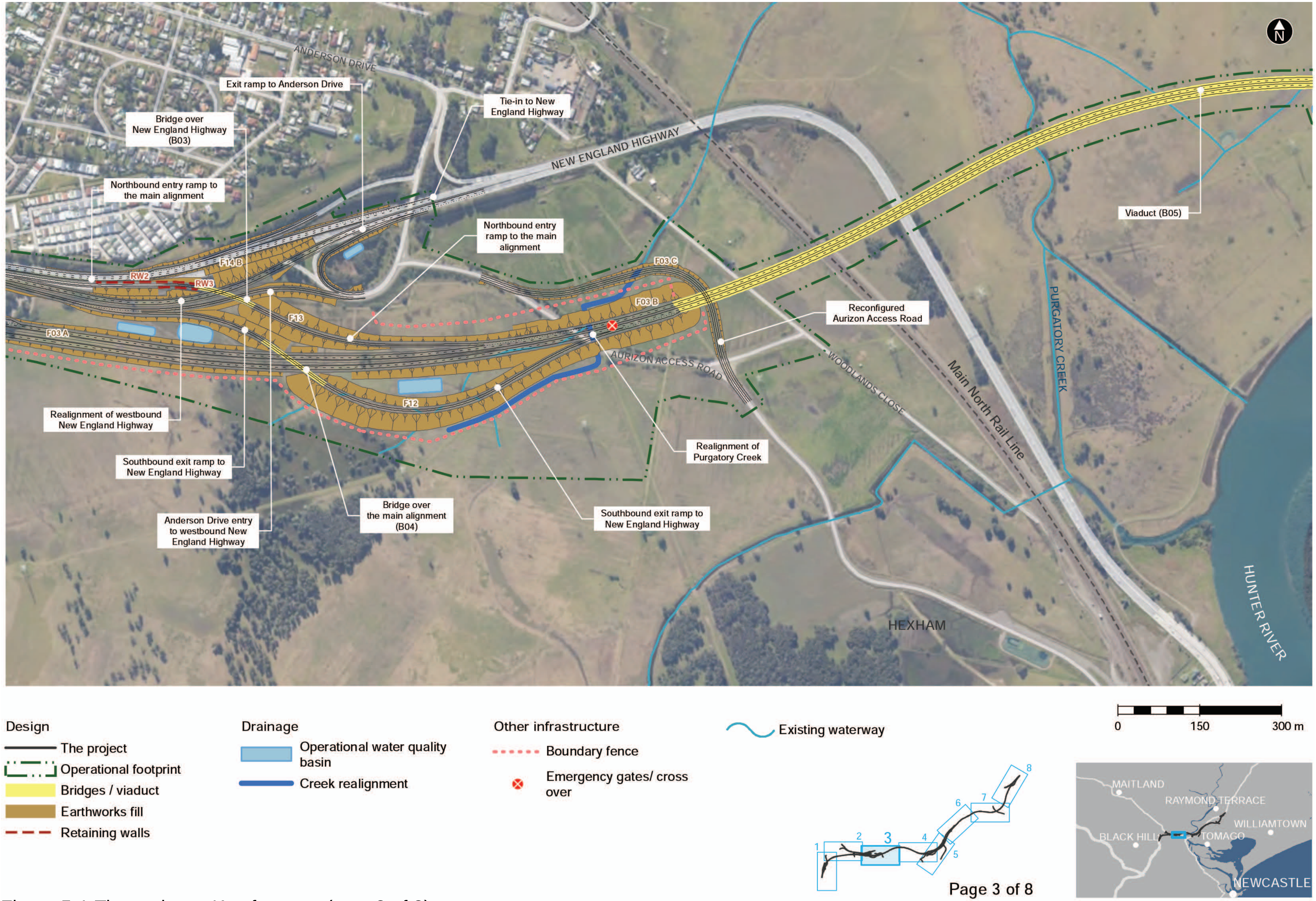


Figure 5-1 The project – Key features (map 2 of 8)



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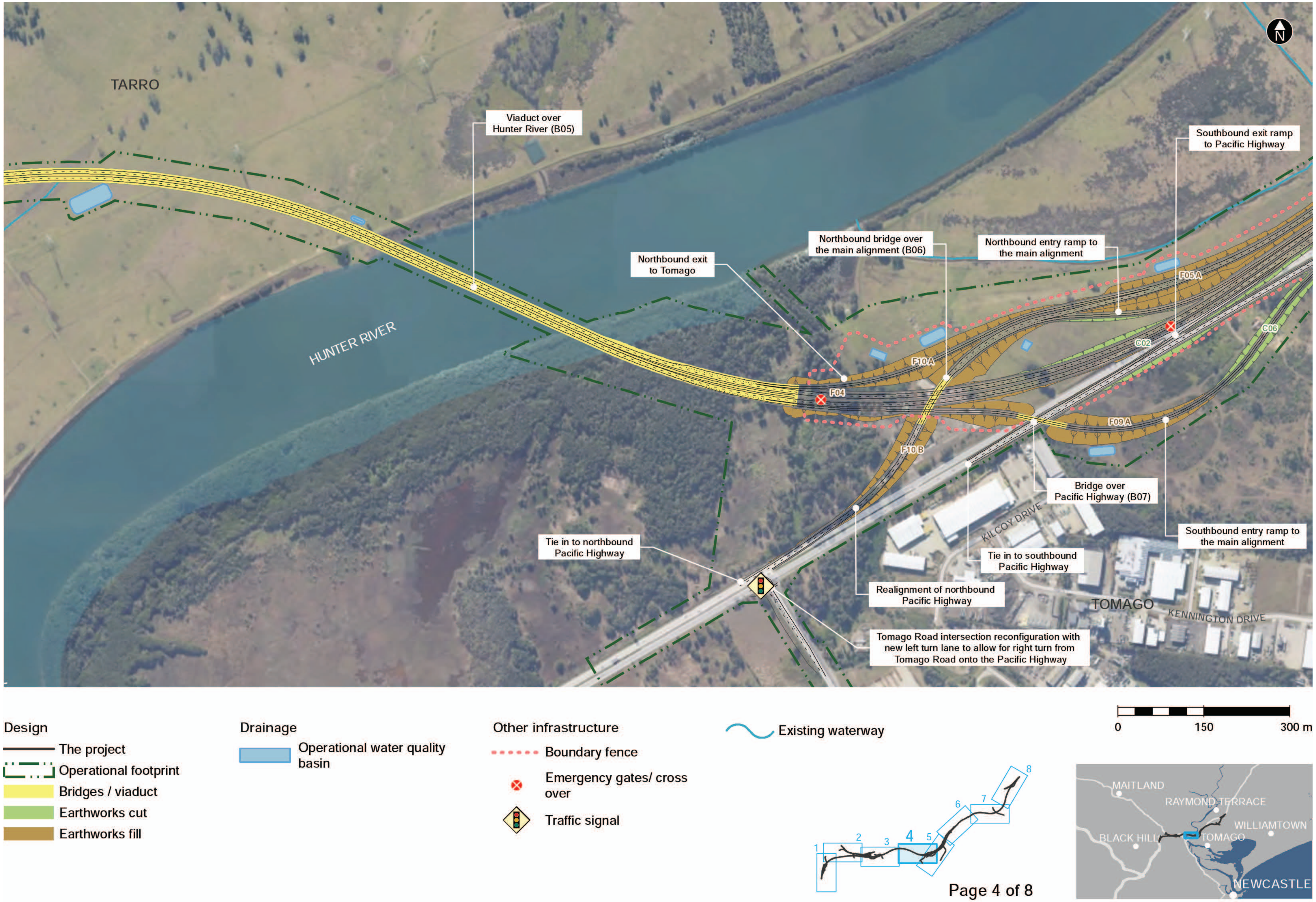

Figure 5-1 The project – Key features (map 4 of 8)

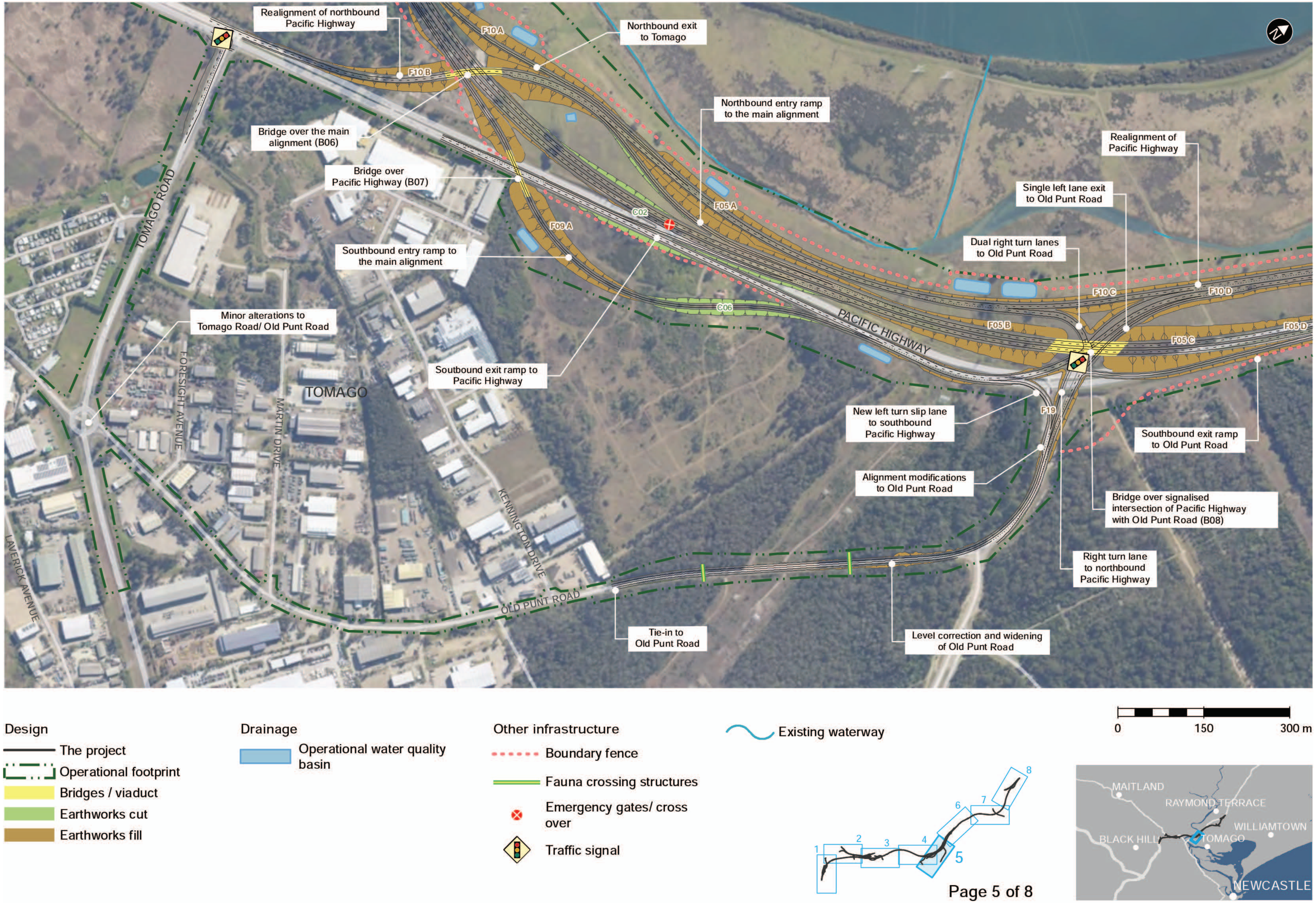

Figure 5-1 The project – Key features (map 5 of 8)

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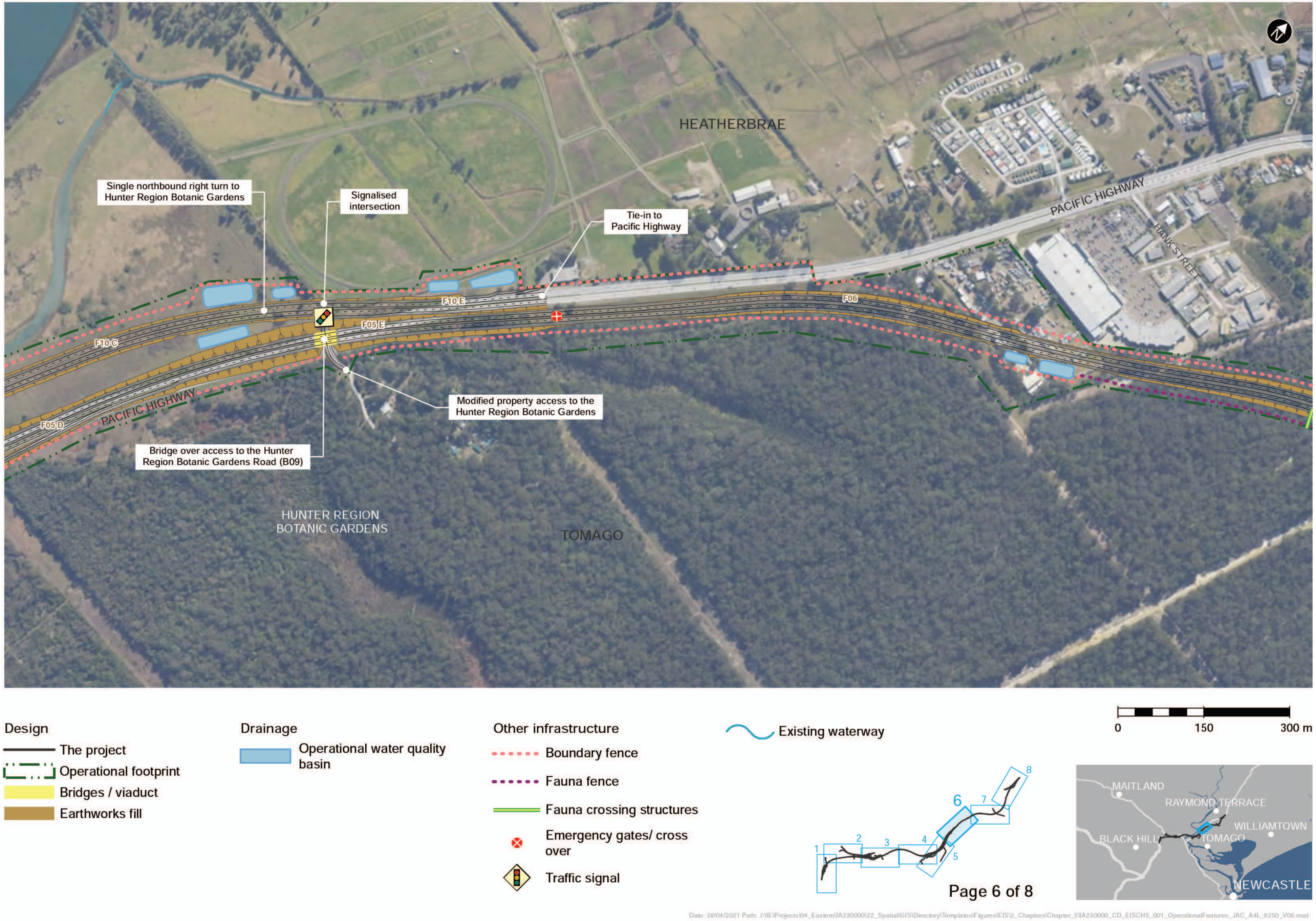

Figure 5-1 The project – Key features (map 6 of 8)

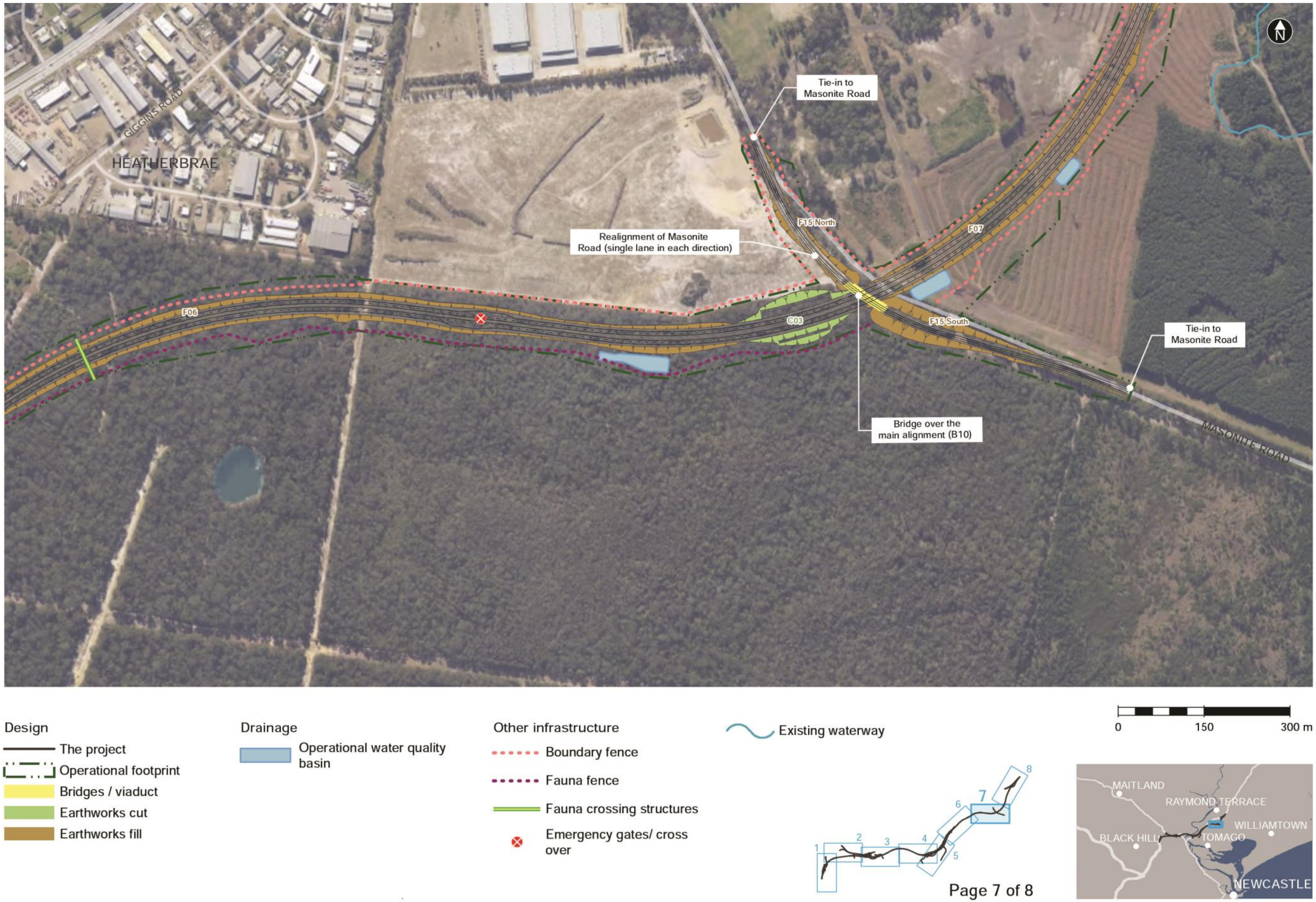

Figure 5-1 The project – Key features (map 7 of 8)

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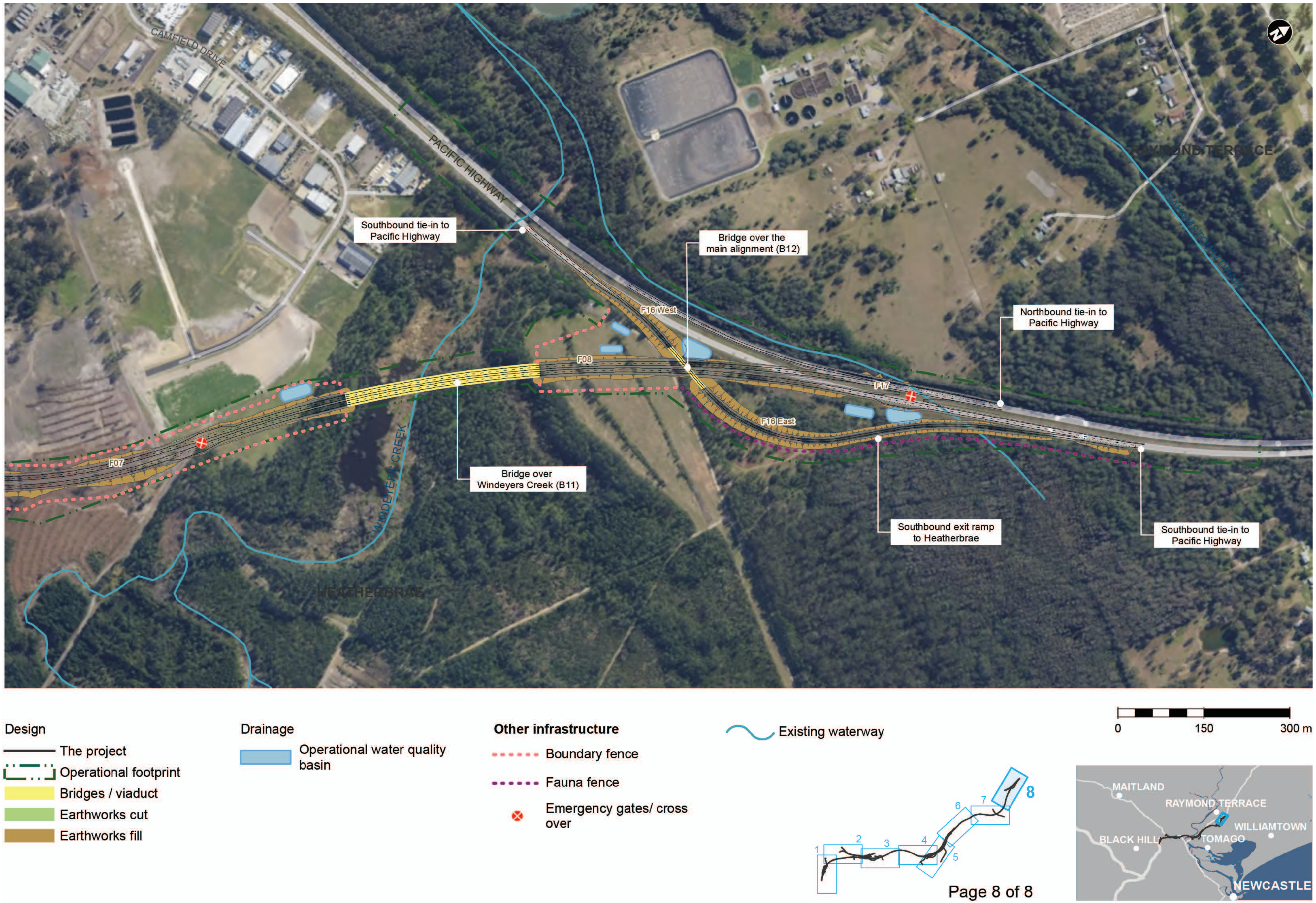

Figure 5-1 The project – Key features (map 8 of 8)

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5.3.3 Interchanges, intersections and local road changes

The project would include four new interchanges to provide free flowing connections for motorists travelling on the main alignment at:

- Black Hill interchange
- Tarro interchange
- Tomago interchange
- Raymond Terrace interchange.

The project would also include adjustments to the following existing intersections:

- M1 Pacific Motorway and John Renshaw Drive intersection
- Tomago Road and Pacific Highway intersection
- Old Punt Road and Pacific Highway intersection
- Old Punt Road and Tomago Road intersection
- Hunter Region Botanic Gardens (HRBG) access road and Pacific Highway intersection.

Several local roads (notably Masonite Road as described below) would be affected by the project. Where affected, local roads would be overpassed or underpassed as described in the following sections. Where local roads cannot be overpassed or underpassed, they would be upgraded or changed to ensure safe and efficient connections with the project as described in the following sections.

These proposed new interchanges and adjustments to intersections and local roads are described in further detail below.

Black Hill interchange

The interchange at Black Hill would be located south of the existing M1 Pacific Motorway and John Renshaw/Weakleys Drive intersection, as shown in **Figure 5-1**. Road users coming from north of the interchange around Beresfield would be required to travel to the Tarro interchange to head northbound along the main alignment. Similarly, road users travelling south on the main alignment would be required to travel to the Tarro interchange to access Beresfield. The key features of the Black Hill interchange include:

- A two lane northbound exit ramp carrying traffic to the signalised intersection of John Renshaw Drive and Weakleys Drive
- A two lane southbound entry ramp, via a bridge (B01) carrying traffic from the intersection of John Renshaw Drive and Weakleys Drive, and the John Renshaw Drive slip lane onto the existing M1 Pacific Motorway
- Left in and left out movements at Lenaghans Drive from the southbound entry ramp
- Realignment of about 220 metres of Lenaghans Drive to about 80 metres southeast of its existing location, connecting it to the southbound entry ramp of the M1 Pacific Motorway.

The configuration of the proposed interchange at Black Hill is shown in **Figure 5-2**, with a visualisation provided as **Figure 5-3**.

M1 Pacific Motorway and John Renshaw Drive intersection

The existing signalised M1 Pacific Motorway and John Renshaw Drive intersection would be upgraded to provide a signalised pedestrian crossing across the southern approach to the intersection to provide a safe crossing location for cyclists.

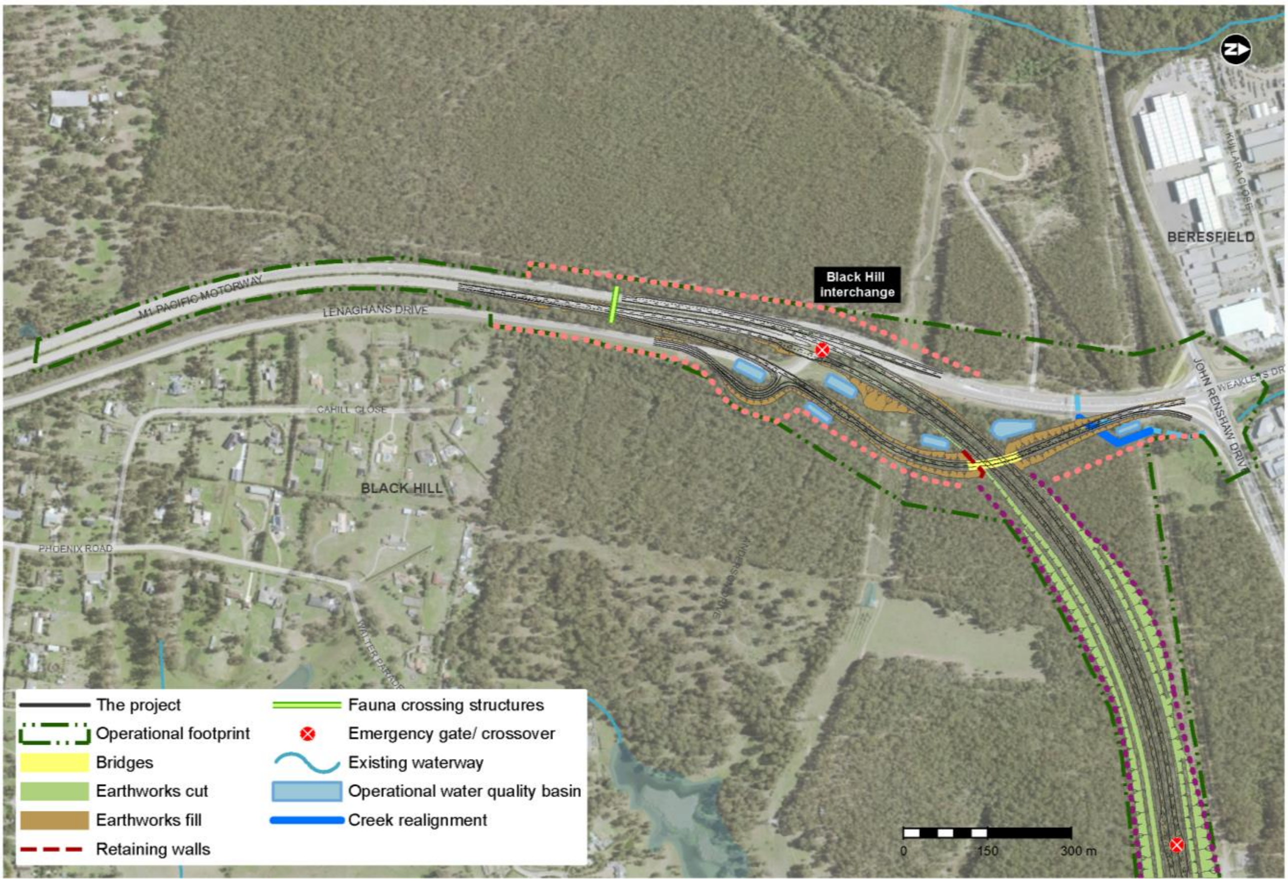

Figure 5-2 Black Hill interchange configuration

Figure 5-3 Black Hill interchange visualisation

Tarro interchange

The interchange at Tarro would be located east of the existing M1 Pacific Motorway and south of the New England Highway, as shown in **Figure 5-1**. Vehicles heading north to the Hunter Valley would exit to the New England Highway at this interchange. The key features of the Tarro interchange include:

- A single lane northbound entry ramp, via a bridge (B03) from New England Highway eastbound to the main alignment
- A single lane southbound exit ramp, via a bridge (B04) from the main alignment to the New England Highway westbound
- Upgrade of the New England Highway from four to six lanes between John Renshaw Drive and the existing Tarro interchange (refer to **Section 5.3.4**)
- Realignment of the New England Highway westbound carriageway to accommodate the Tarro interchange (refer to **Section 5.3.4**)
- Modification of the Anderson Drive westbound entry ramp to the New England Highway to merge with the main alignment southbound exit lane to the New England Highway
- Realignment of Aurizon access road to accommodate the Tarro interchange (refer to **Section 5.3.20**)
- Viaduct (B05) over the realigned Aurizon access road.

The configuration of the proposed interchange at Tarro is shown in **Figure 5-4**, with a visualisation provided as **Figure 5-5**.

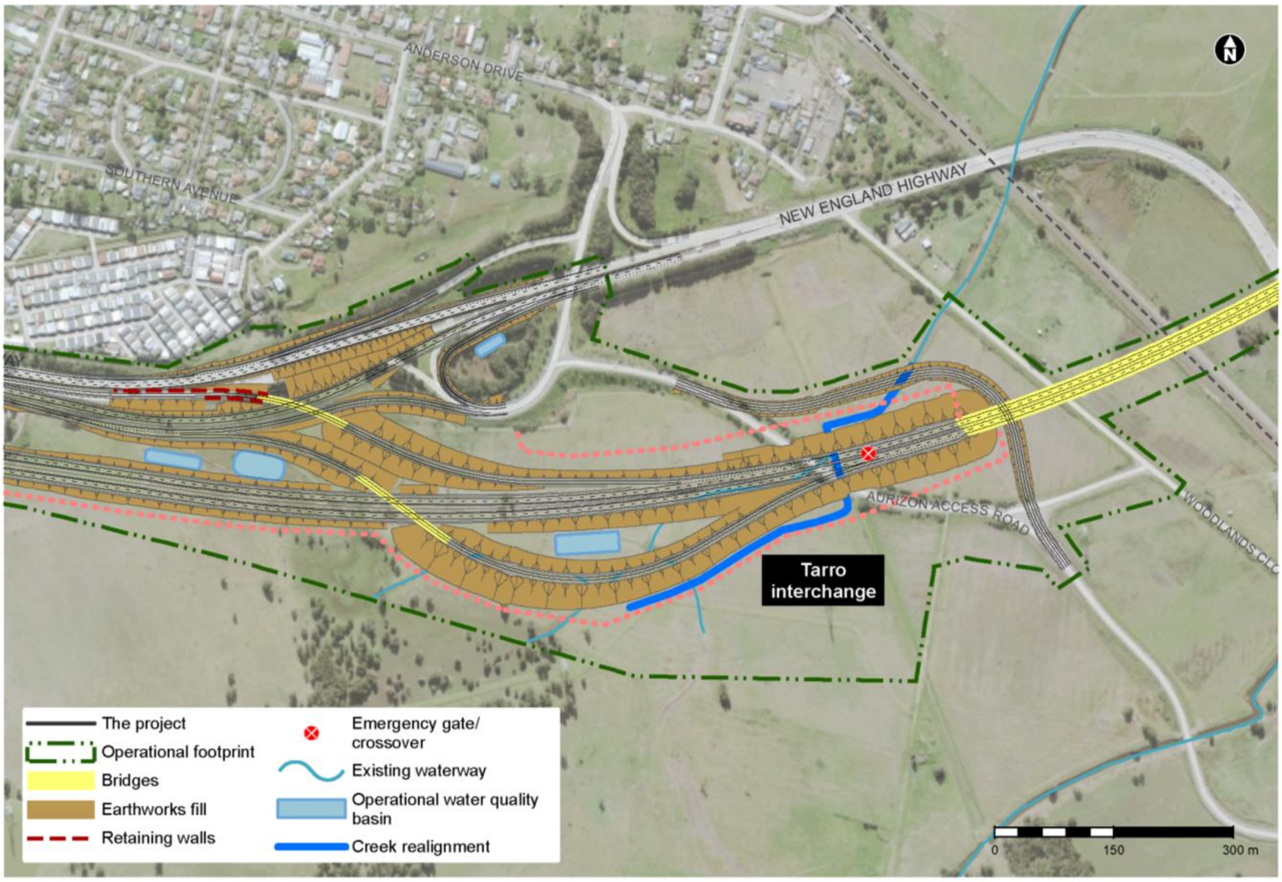

Figure 5-4 Tarro interchange configuration

Figure 5-5 Tarro interchange visualisation

Tomago interchange

The interchange at Tomago would be located immediately north of the existing Pacific Highway, as shown in **Figure 5-1**. The key features of the interchange include:

- A one lane northbound exit ramp carrying traffic from the main alignment to the Pacific Highway northbound
- A one lane southbound exit ramp carrying traffic from the main alignment to the Pacific Highway southbound that would also provide access to Tomago Road
- Realignment and separation of the Pacific Highway northbound and southbound travel lanes to accommodate the main alignment
- A bridge (B06) over the main alignment for traffic travelling northbound along the Pacific Highway, providing continuity of the Pacific Highway
- Twin bridges (B08) to carry traffic along the main alignment over the intersection of Old Punt Road and Pacific Highway
- A one lane southbound entry ramp which would carry traffic from Pacific Highway and Old Punt Road onto the main alignment, via a bridge (B07) over the Pacific Highway.

Tomago Road and Pacific Highway intersection

The existing signalised Tomago Road and Pacific Highway intersection would be upgraded to enable right turn movements from Tomago Road onto the Pacific Highway. A new right turn lane would be provided, while the two existing left turn lanes would be retained.

Old Punt Road and Pacific Highway intersection

The Old Punt Road and Pacific Highway intersection would be upgraded under B08 of the main alignment. This work would also include:

- Upgrade of Old Punt Road between about 110 metres north of Kennington Drive and the Pacific Highway
- A one lane southbound exit ramp carrying traffic from the main alignment to Old Punt Road
- Connectivity to Old Punt Road
- Slip and turning lanes, including:
  - A single left turn slip lane from Old Punt Road to the Pacific Highway southbound
  - A single right turn lane from Old Punt Road to the Pacific Highway northbound
  - A single left turn lane from the Pacific Highway southbound to Old Punt Road
  - Two right turn lanes from the Pacific Highway northbound to Old Punt Road.

The configuration of the proposed interchange at Tomago is shown in **Figure 5-6**, with a visualisation provided as **Figure 5-7**.

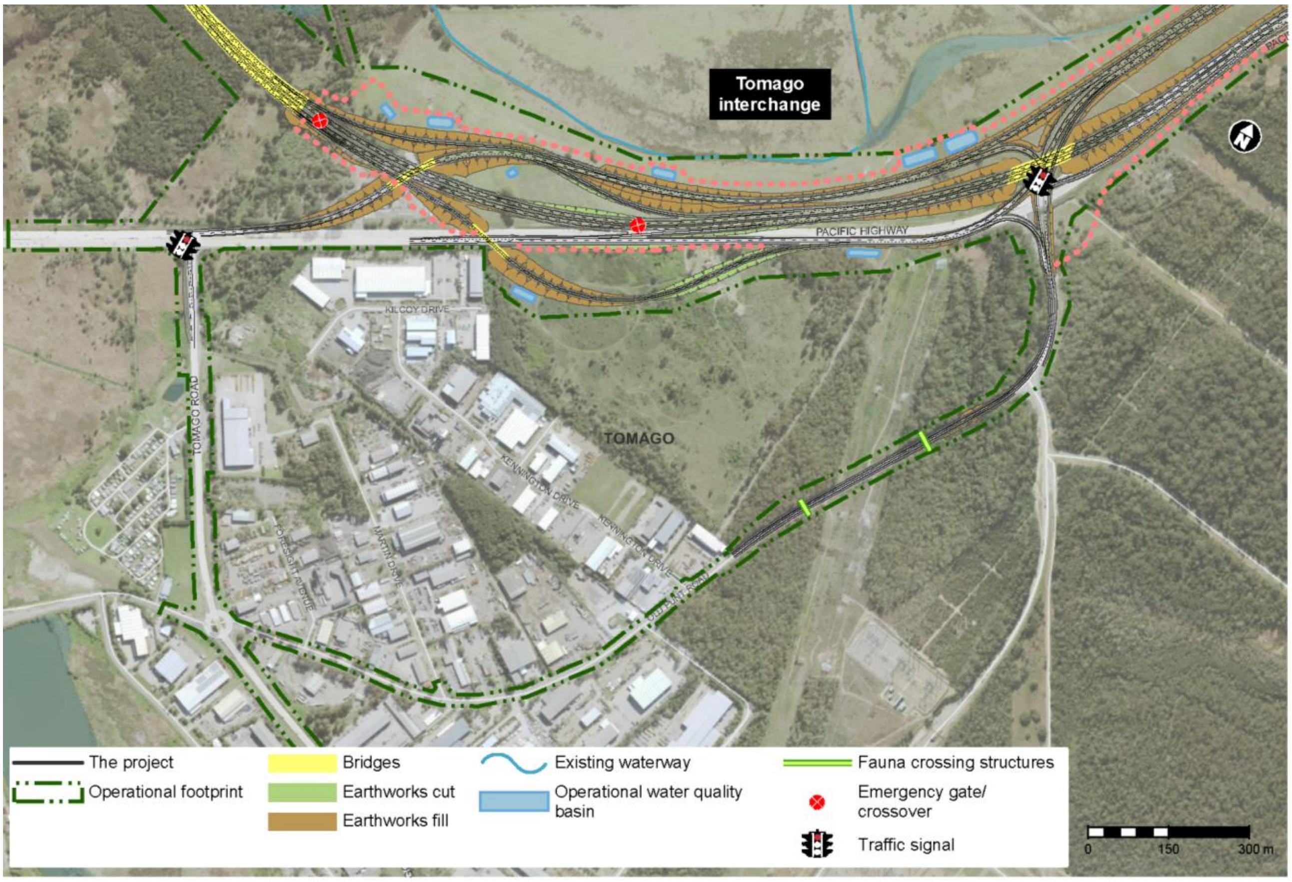

Figure 5-6 Tomago interchange configuration

Figure 5-7 Tomago interchange visualisation

Raymond Terrace interchange

The interchange at Raymond Terrace would be located on the southern side of the Pacific Highway, as shown in **Figure 5-1**. The key features of the interchange at Raymond Terrace would include:

- One lane northbound entry ramp carrying traffic from the Pacific Highway to the main alignment tie in with the Pacific Highway
- One lane southbound exit ramp carrying traffic via an overpass (B12) from the main alignment to Pacific Highway.

The configuration of the proposed interchange at Raymond Terrace is shown in **Figure 5-8**, with a visualisation provided as **Figure 5-9**.

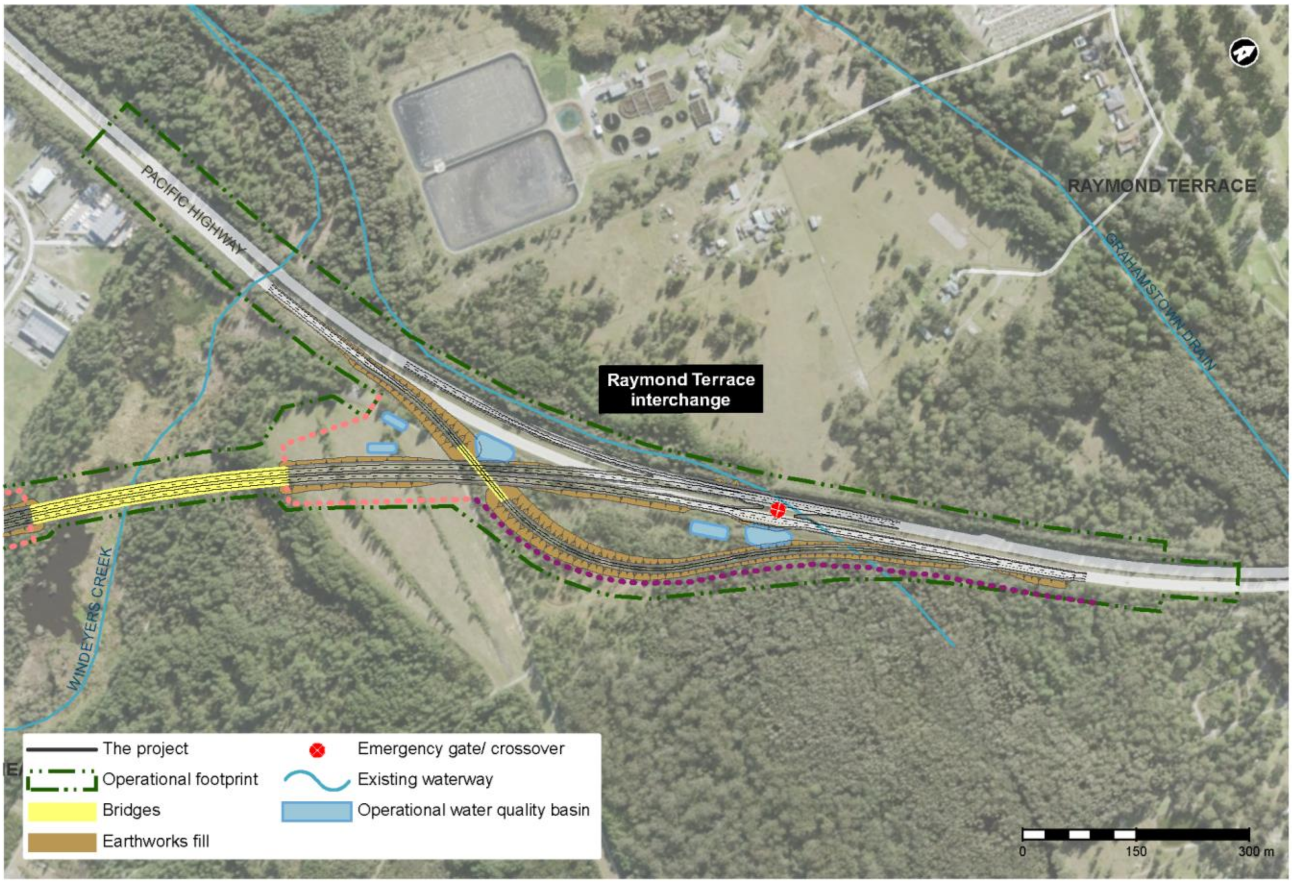

Figure 5-8 Raymond Terrace interchange configuration

Figure 5-9 Raymond Terrace interchange visualisation

Old Punt Road and Tomago Road intersection

Parts of Old Punt Road would have pavement and kerb adjustments to cater for heavy vehicle movements and utilities work. In addition, minor intersection upgrades including adjustments to kerbs and median would occur at the Old Punt Road and Tomago Road intersection to cater for heavy vehicle movements (refer to **Figure 5-1**).

Hunter Region Botanic Gardens access road and Pacific Highway intersection

The Pacific Highway would be realigned near the HRBG to accommodate the main alignment of the project. To ensure that access is maintained, the project would provide a signalised intersection at the HRBG access road and the realigned Pacific Highway. The access road would travel under the main alignment (refer to **Figure 5-10**).

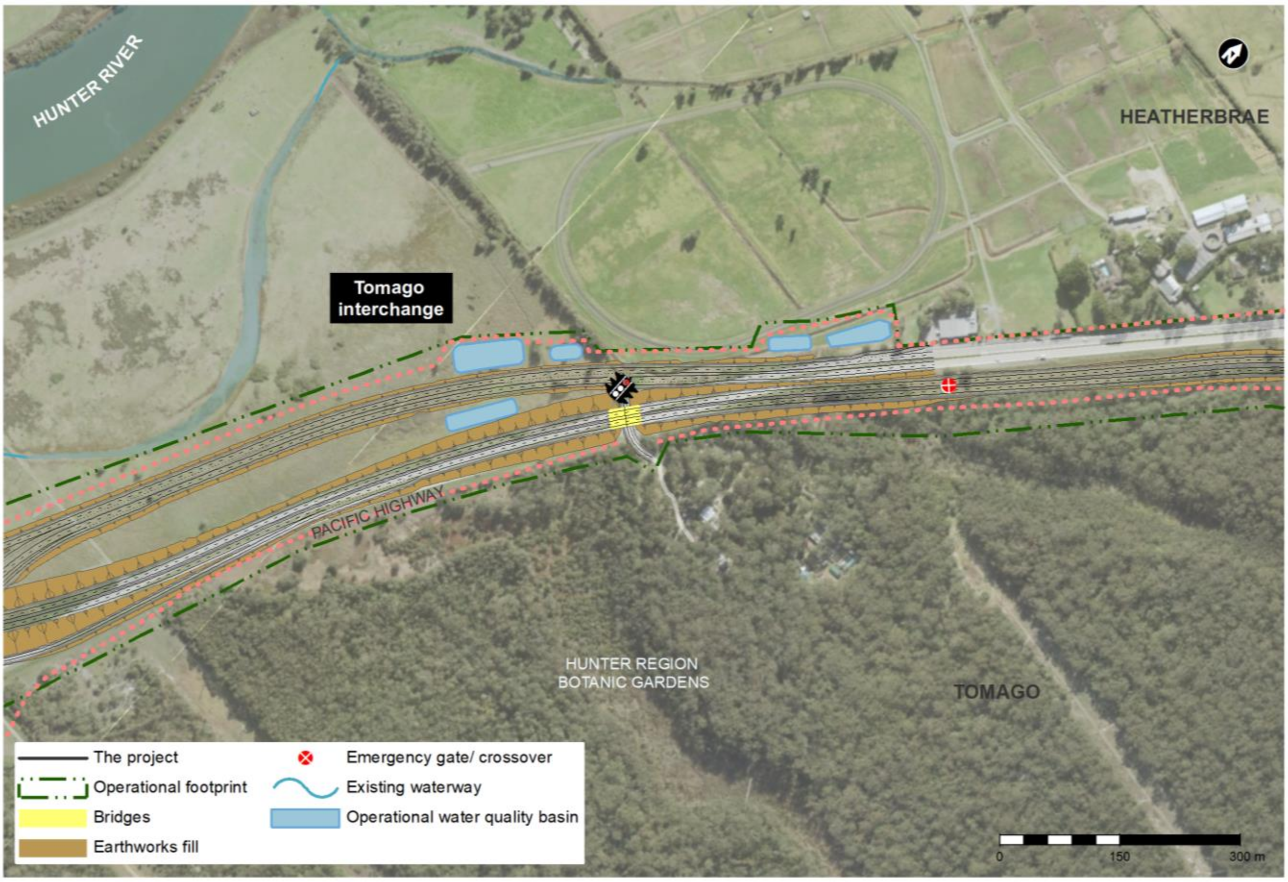

Figure 5-10 Hunter Region Botanic Gardens access

Masonite Road

Currently, Masonite Road is comprised of one lane in each direction. As part of the project, Masonite Road would be realigned, widened and upgraded with a bridge (B10) to pass over the main alignment within the operational footprint. The project would provide two 3.5 metre traffic lanes (one in each direction) with two metre shoulders along Masonite Road. It would have a one metre verge with a three per cent cross fall. Tie ins would be located about 330 metres to the northwest and about 500 metres southeast of the bridge (B10). A new three metre wide shared path would also be located next to the southbound lane (refer to **Figure 5-1**).

5.3.4 New England Highway

As described in **Section 5.3.2**, the New England Highway would be upgraded and realigned between John Renshaw Drive and Tarro to accommodate the Tarro interchange. This is shown in **Figure 5-11** and would include:

- Widening the New England Highway from four to six lanes generally between John Renshaw Drive and the Tarro interchange
- Realigning the existing westbound New England Highway, and the John Renshaw Drive exit from the New England Highway, to accommodate the northbound entry ramp to the main alignment
- Constructing an additional lane of the existing westbound New England Highway to provide access for the southbound exit ramp from the main alignment
- Modifying the existing New England Highway exit ramp to Anderson Drive and modifying the Anderson Drive westbound entry ramp to the New England Highway to merge with the main alignment exit ramp to the New England Highway.

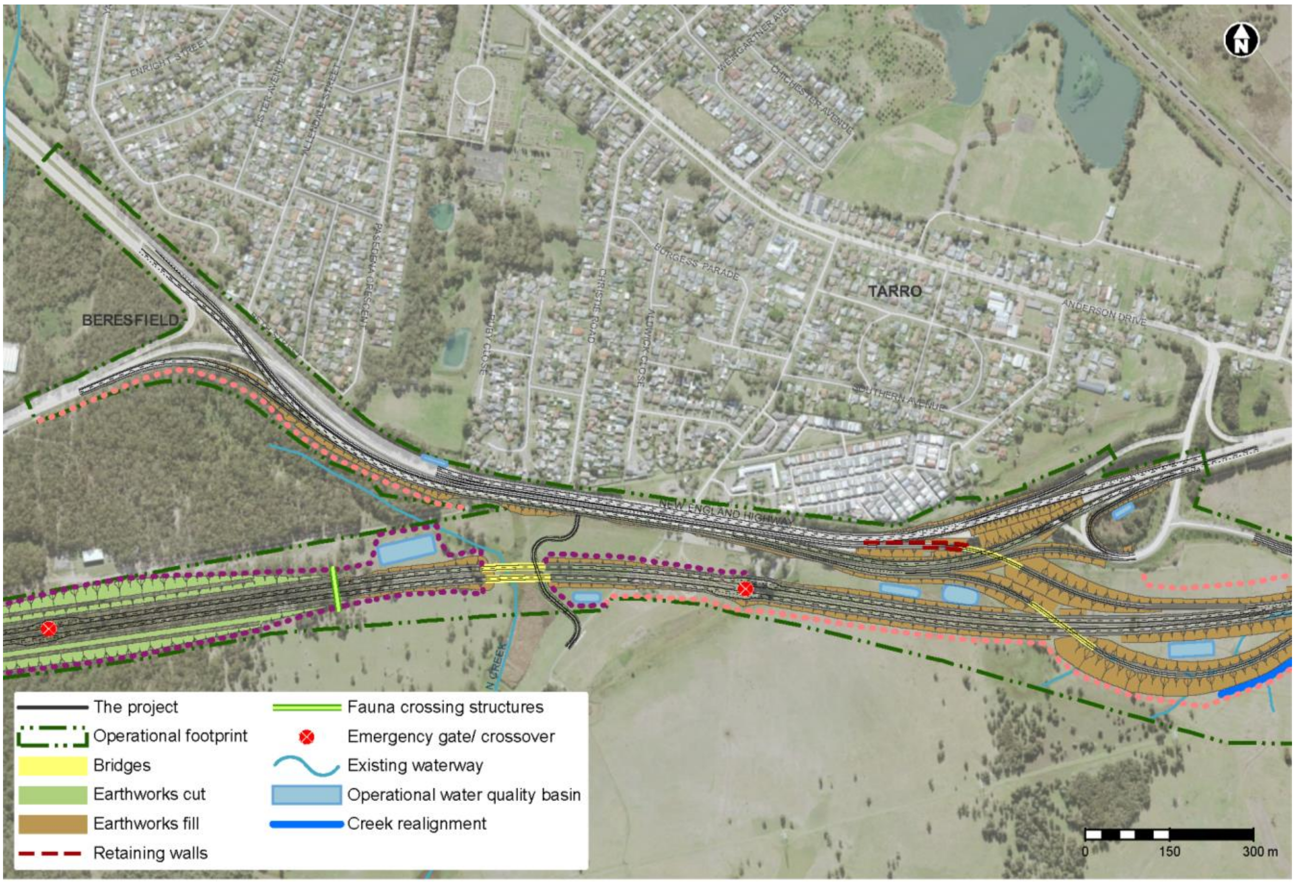

Figure 5-11 New England Highway upgrade and realignment

5.3.5 Bridge structures and viaducts

The project would require 12 new bridge structures, the largest of which is a viaduct (B05) that would traverse the Hunter River floodplain. Bridge structures would:

- Provide grade separation for the interchanges from the existing road network
- Maintain connectivity of existing local roads
- Span over waterways and environmentally sensitive areas.

Bridges and the viaduct are presented in **Table 5-3**, with locations shown in **Figure 5-12**.

The superstructure for each bridge (the portion of the bridge that is supported on piers and abutments) would include one or more of the following four super structure types:

- Precast super-T girder
- Precast bulb-T girder
- Precast segmental box girder
- Cast in place voided slab.

Most bridges for the project would have a super-T or bulb-T superstructure. However, the viaduct (B05) would be a combination of a super-T and box girder structure while the twin bridges over Old Punt Road intersection (B08) would be cast in place voided slab structures. An indicative drawing of each bridge structure type is provided in **Figure 5-13** to **Figure 5-16**.

All bridge details are based on the design as set out in this chapter and are subject to change during detailed design. The urban design of the proposed bridges is detailed further in **Chapter 15** (urban design, landscape and visual amenity).

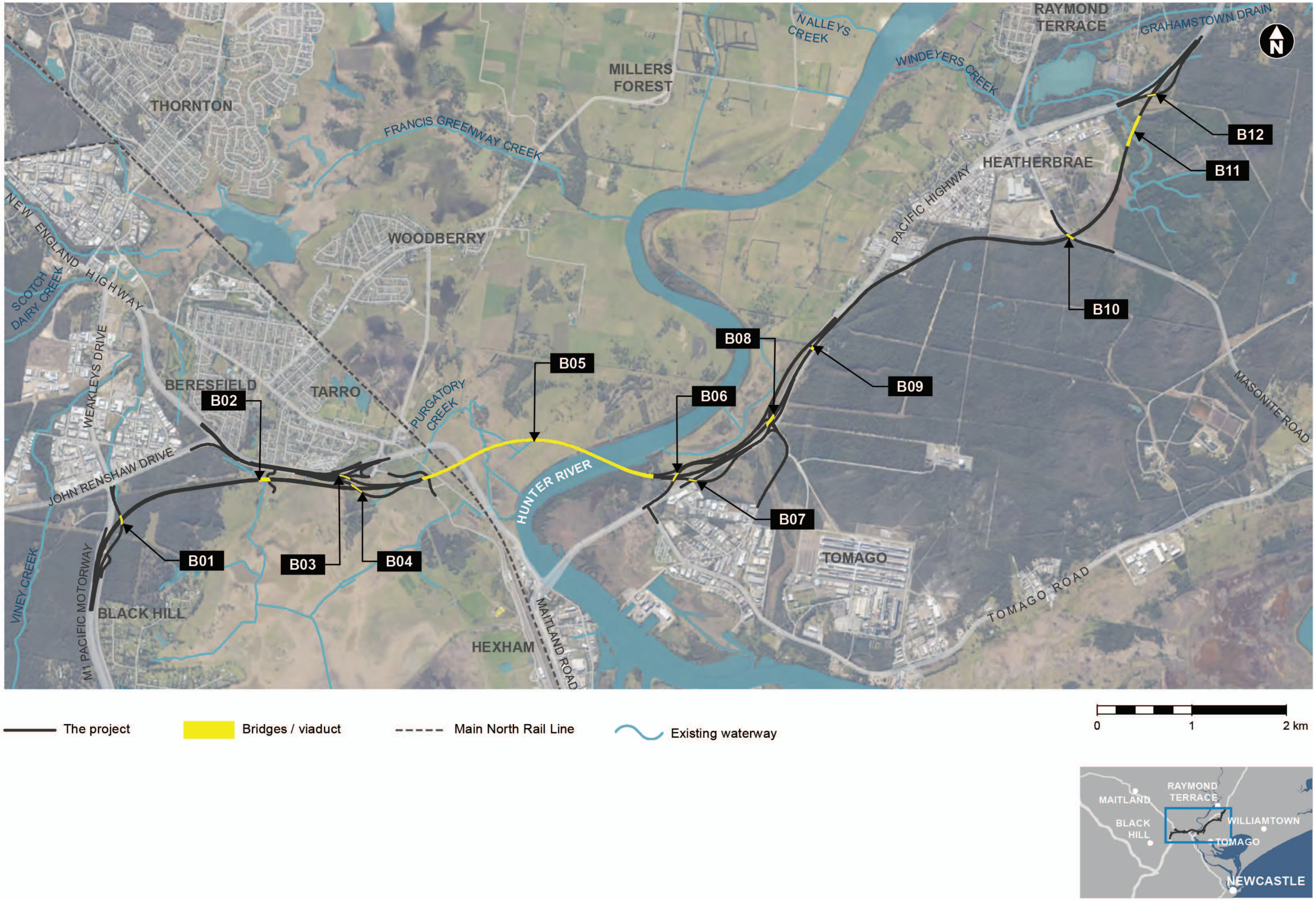

Figure 5-12 Project bridge locations

Table 5-3 Bridges and viaducts

<table>
<tr><th>Bridge reference and location</th><th colspan="2">Description</th><th>Superstructure</th><th>Indicative length (m)</th><th>Indicative number of spans</th></tr>
<tr><td>B01
Black Hill</td><td colspan="2">A southbound entry ramp bridge over the main alignment at Black Hill. The bridge includes a reinforced soil wall (RW1) to reduce span length and skew angle. The bridge would provide about 5.5m of vertical clearance to the main alignment.</td><td>Super-T</td><td>72</td><td>2</td></tr>
<tr><td>B02
Tarro</td><td colspan="2">Twin (northbound and southbound) bridges over unnamed wetlands classified under the Coastal Management SEPP at Tarro. The bridge would pass over the realigned property access south of the New England Highway at Tarro.</td><td>Super-T</td><td>104</td><td>4</td></tr>
<tr><td>B03
Tarro</td><td colspan="2">A northbound entry ramp bridge from Tarro over the westbound travel lanes of the New England Highway. The bridge would carry traffic from the New England Highway eastbound to the main alignment northbound. A reinforced soil wall (RW3) would minimise the extent of embankment. The bridge would provide about 6.6m vertical clearance to the New England Highway.</td><td>Bulb-T</td><td>101</td><td>4</td></tr>
<tr><td>B04
Tarro</td><td colspan="2">A southbound exit ramp bridge over the main alignment. The bridge would carry traffic from the main alignment southbound to the New England Highway westbound. The bridge would provide about 5.8m of vertical clearance to the main alignment.</td><td>Bulb-T</td><td>117</td><td>4</td></tr>
<tr><td rowspan="4">B05
Hunter River floodplain</td><td rowspan="4">The 2550m long viaduct would carry the main alignment over the Hunter River between Tarro and Tomago. It would pass under existing major electrical facilities and rise on approach to the Hunter River to provide clearance for maritime traffic.
The bridge consists of three different sections:
• The southern approach which crosses Woodlands Close, the Main North Rail Line, New England Highway, Hunter River floodplain
• The Hunter River crossing
• The western approach to the Tomago interchange.</td><td>Abutments</td><td>-</td><td rowspan="4">2550</td><td rowspan="4">78</td></tr>
<tr><td>South of the New England Highway to the Hunter River</td><td>Super-T</td></tr>
<tr><td>Over the Hunter River</td><td>Box girder</td></tr>
<tr><td>North of the Hunter River</td><td>Super-T</td></tr>
<tr><td>B06
Tomago</td><td colspan="2">A northbound bridge for the realigned Pacific Highway over the main alignment at Tomago. The bridge would carry traffic from the realigned Pacific Highway northbound over the main alignment and provide access to the northbound entry ramp to the main alignment. The bridge would provide a vertical clearance to the main alignment of about 6.6m.</td><td>Bulb-T</td><td>82</td><td>3</td></tr>
</table>

Bridge reference and location	Description	Superstructure	Indicative length (m)	Indicative number of spans
B07 Tomago	A southbound entry ramp bridge from the realigned southbound Pacific Highway over the Pacific Highway. The bridge would carry traffic from the Pacific Highway southbound and Tomago to the main alignment southbound. The bridge would provide a minimum 5.6m of vertical clearance to the Pacific Highway.	Bulb-T	70	3
B08 Tomago	Twin (northbound and southbound) bridges over the intersection between the Old Punt Road and the Pacific Highway. The bridge would carry traffic along the main alignment. The bridge would provide about 6.4m vertical clearance to the Pacific Highway.	Voided slab	110	3
B09 Tomago	A single bridge over the HRBG access road at Tomago. The bridge would carry the main alignment over the access road from the realigned Pacific Highway to the HRBG. The bridge would provide about 5.1m vertical clearance to the access road.	Super-T	28	1
B10 Heatherbrae	A bridge over the main alignment at Masonite Road, Heatherbrae. The bridge would carry traffic travelling along Masonite Road over the main alignment. The bridge would provide about 5.7m vertical clearance to the main alignment.	Super-T	68	2
B11 Heatherbrae	A single bridge over Windeyers Creek and associated wetlands. The bridge would carry traffic travelling along the main alignment.	Super-T	330	10
B12 Raymond Terrace	A southbound exit ramp bridge over the main alignment. The bridge would carry traffic on the Pacific Highway southbound over the main alignment. The bridge would provide a vertical clearance to the main alignment of about 5.4m.	Bulb-T	76	2

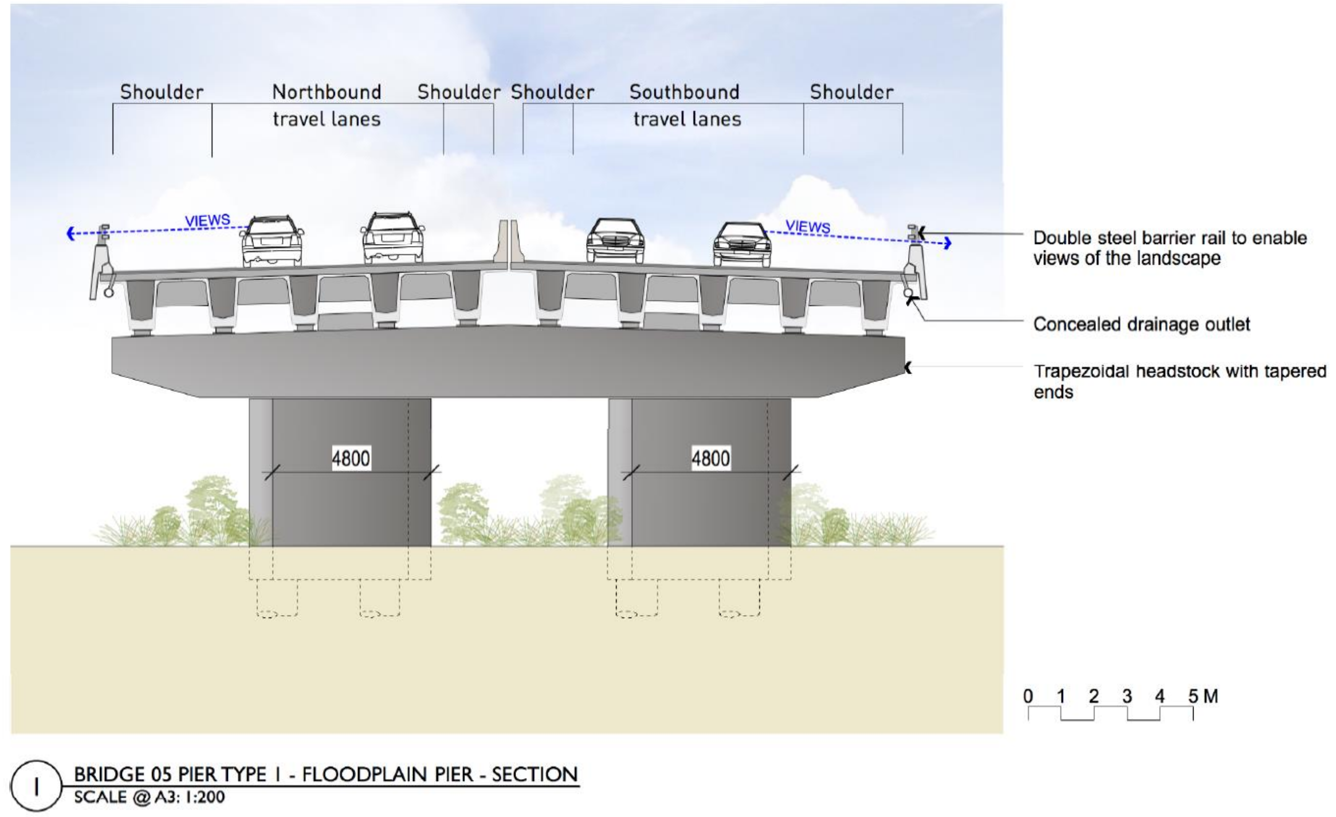

Figure 5-13 Indicative drawing of super-T girder bridge structure (B05)

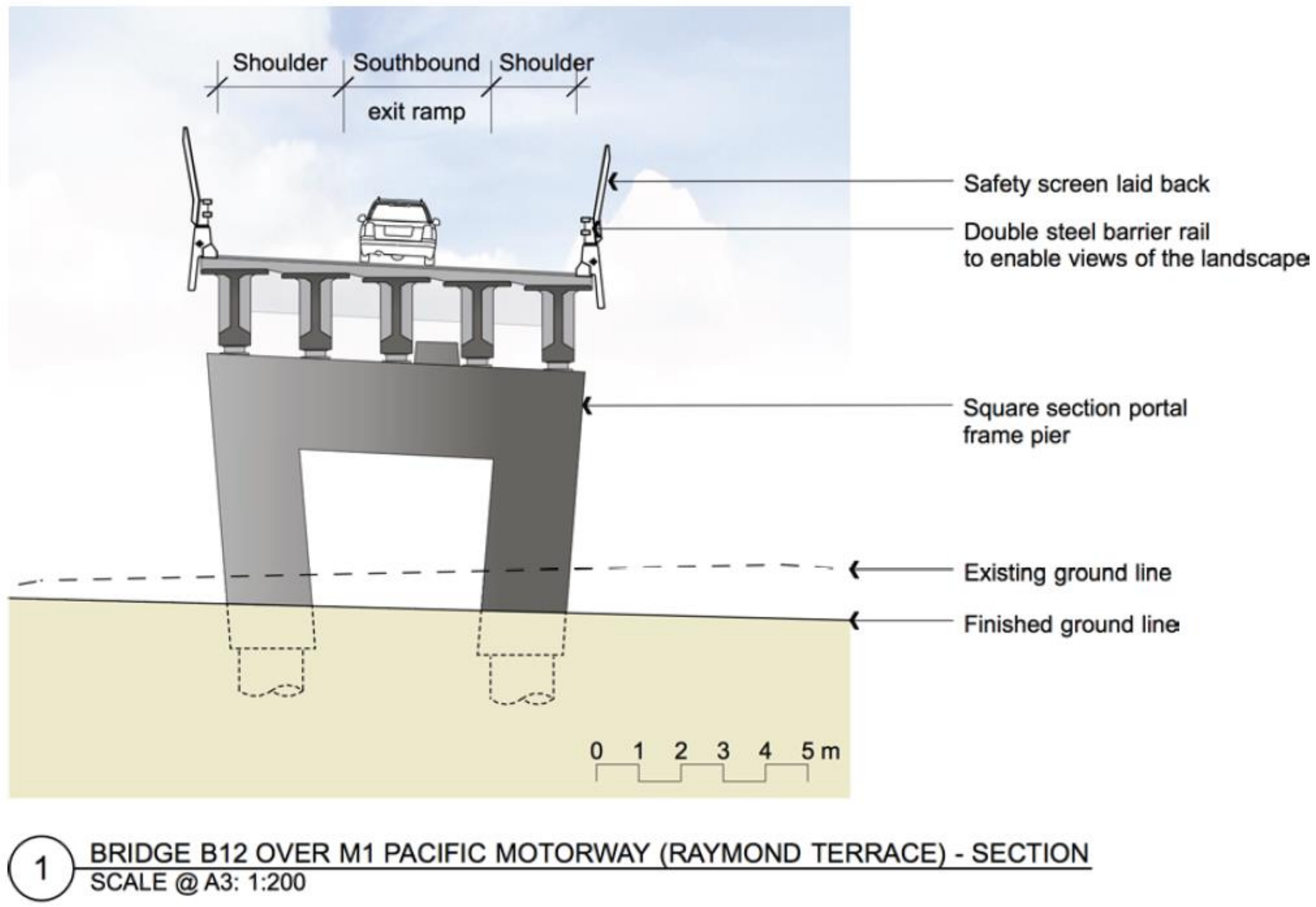

Figure 5-14 Indicative drawing of a bulb-T girder bridge structure (B12)

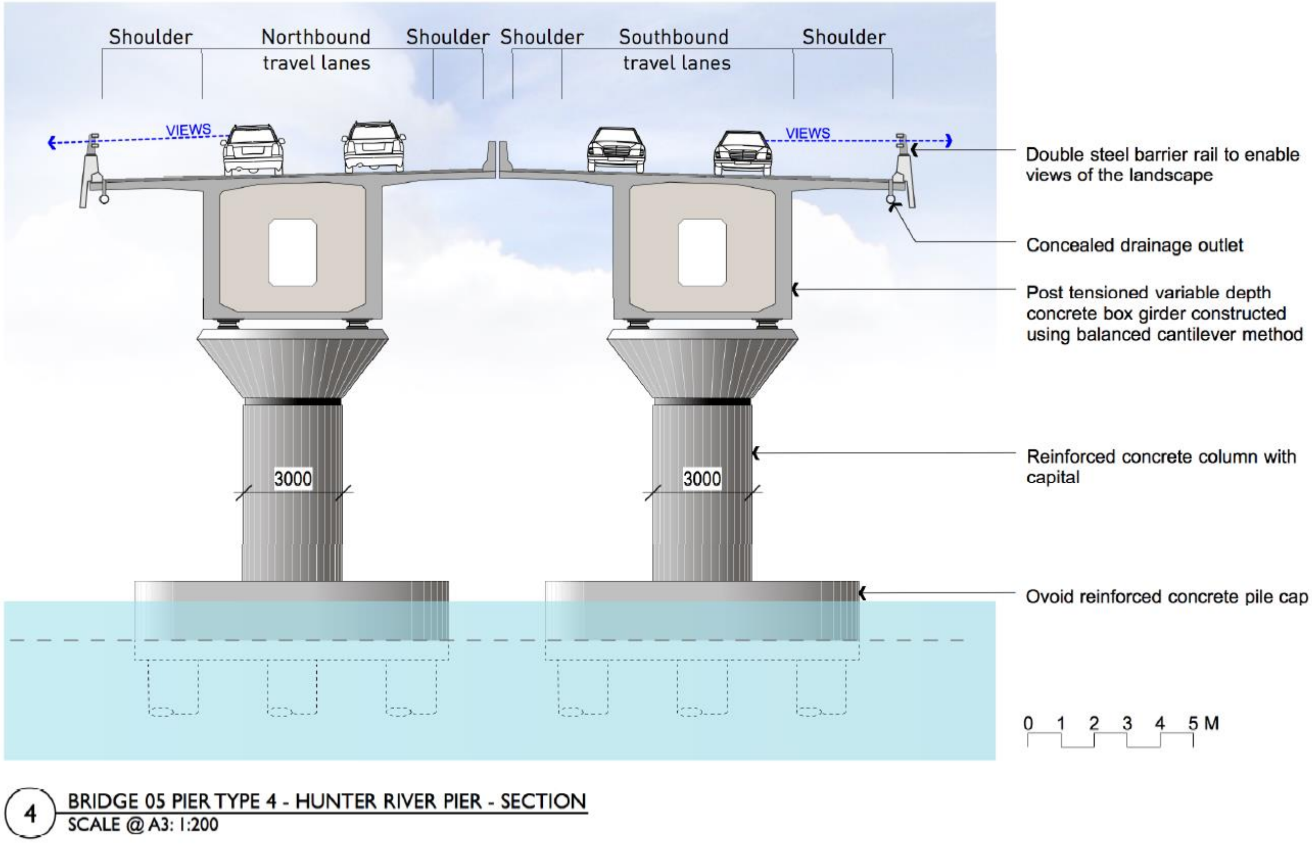

Figure 5-15 Indicative drawing of box girder bridge structure (B05)

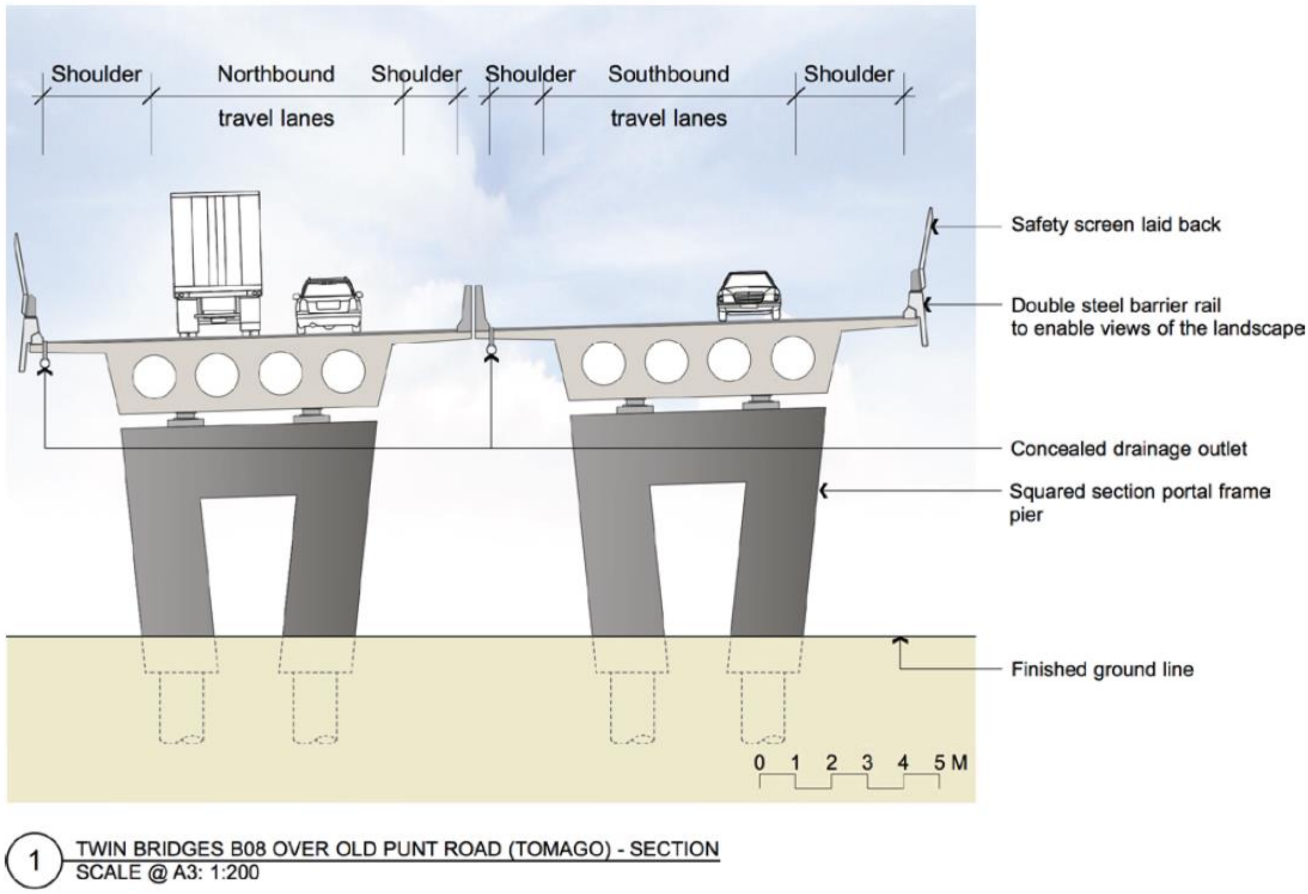

Figure 5-16 Indicative drawing of the voided slab bridge structure (B08)

5.3.6 Road cuttings, fill embankments and retaining walls

Road cuttings and fill embankments

Large road cuttings and embankments are not proposed along local roads. A number of road cuttings and fill embankments would be required along the main alignment due to the undulating topography, including:

- At the Black Hill interchange
- Along the main alignment from Black Hill to Tarro
- At the Tarro interchange
- Along the New England Highway
- At the Tomago interchange
- Along the main alignment from the Tomago interchange to Masonite Road
- Along Masonite Road
- Along the main alignment from Masonite Road to the Raymond Terrace interchange
- At the Raymond Terrace interchange.

Indicative drawings of cuts are shown in **Figure 5-17** to **Figure 5-21**.

Cuttings would generally have a slope of 2H:1V, with the exception of the Black Hill interchange, which would have a slope of 2.5H:1V with a 6.5 metre wide bench where required. Where space permits, embankments would have a slope of 4H:1V. Where required to reduce the overall operational footprint, embankments of up to 2H:1V would be constructed. Safety barriers would be provided where the height of embankment exceeds two metres and/or where embankments are steeper than 4H:1V. To improve stability, benches (flat steps in the slope) would be provided where the cut height exceeds eight metres and the embankment height exceeds 10 metres.

Further description of proposed earthworks is provided in **Section 5.4.5**. Cuttings are subject to change following geotechnical analysis and further design development. The location and dimension of cuttings and embankments would be confirmed during detailed design.

Where space is limited or there is a need to reduce property acquisition or vegetation clearing, retaining walls may be considered in place of embankments to minimise the operational footprint. Additional retaining walls would be confirmed during detailed design.

All slopes would be revegetated to the edge of the indicative road corridor or existing landforms, where reasonable and feasible, to integrate the project with the surrounding landscape.

The project would integrate cutting and embankment slopes with the surrounding topography where possible. Cut batters in hard rock would be left as natural stone where:

- It is stable or
- 2H:1V slopes are not feasible or
- It is not reasonable and feasible to revegetate the cut batter.

Any slope treatments would be in accordance with the urban design guidelines described in **Section 5.2.2**.

Retaining wall structures

Two types of retaining wall structures would be required for the project:

- A reinforced soil wall: Comprising an earth embankment strengthened with soil reinforcement (comprising steel straps or geotextiles between layers of compacted fill material), which is attached to concrete fascia panels or blocks which are placed on a concrete levelling pad
- L-shaped concrete structures: Typically consisting of a concrete wall supported by a flat concrete footing which prevents instability from overturning, uplifting or sliding.

Three key retaining walls would be required for the project as summarised in **Table 5-4** and shown in **Figure 5-1**. The extent and design of retaining walls would be refined during detailed design.

Table 5-4 Retaining wall summary

ID	Location	Description	Maximum height (m)	Length (m)
RW1	Black Hill interchange	Reinforced soil wall at the bridge (B01) abutment	5.5	60
RW2	Tarro interchange	Concrete retaining wall at the bridge (B03) abutment	4.5	200
RW3	Tarro interchange	Reinforced soil wall at the bridge (B03) abutment	9	70

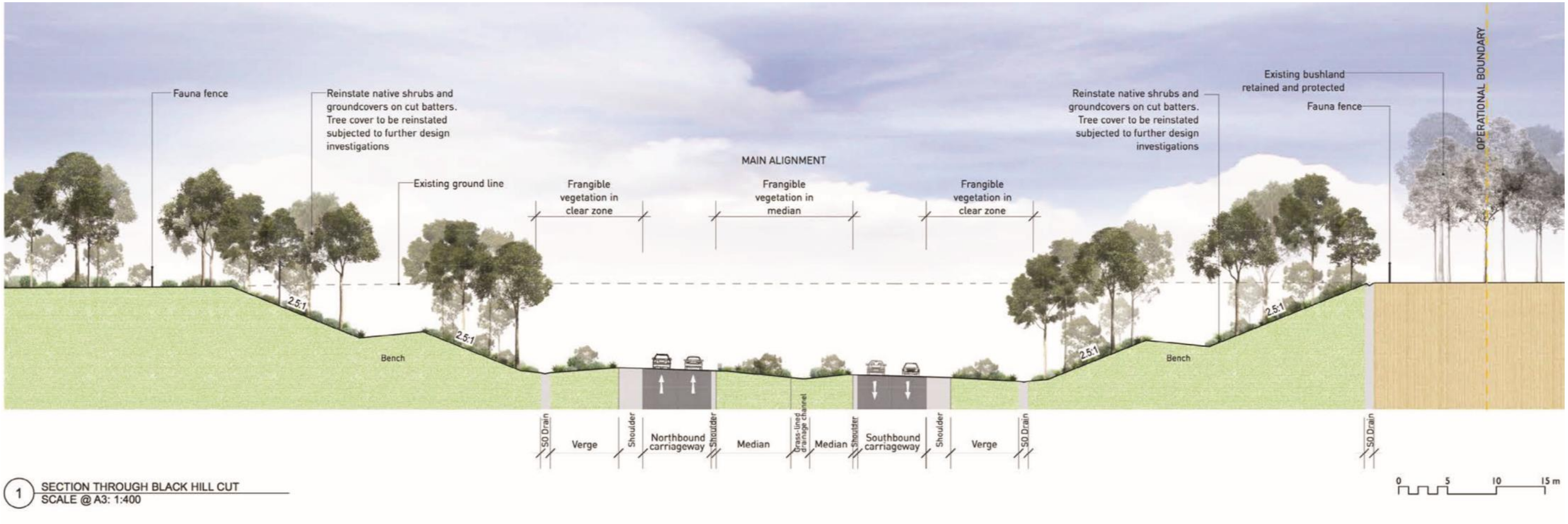

Figure 5-17 Indicative drawing of Black Hill section

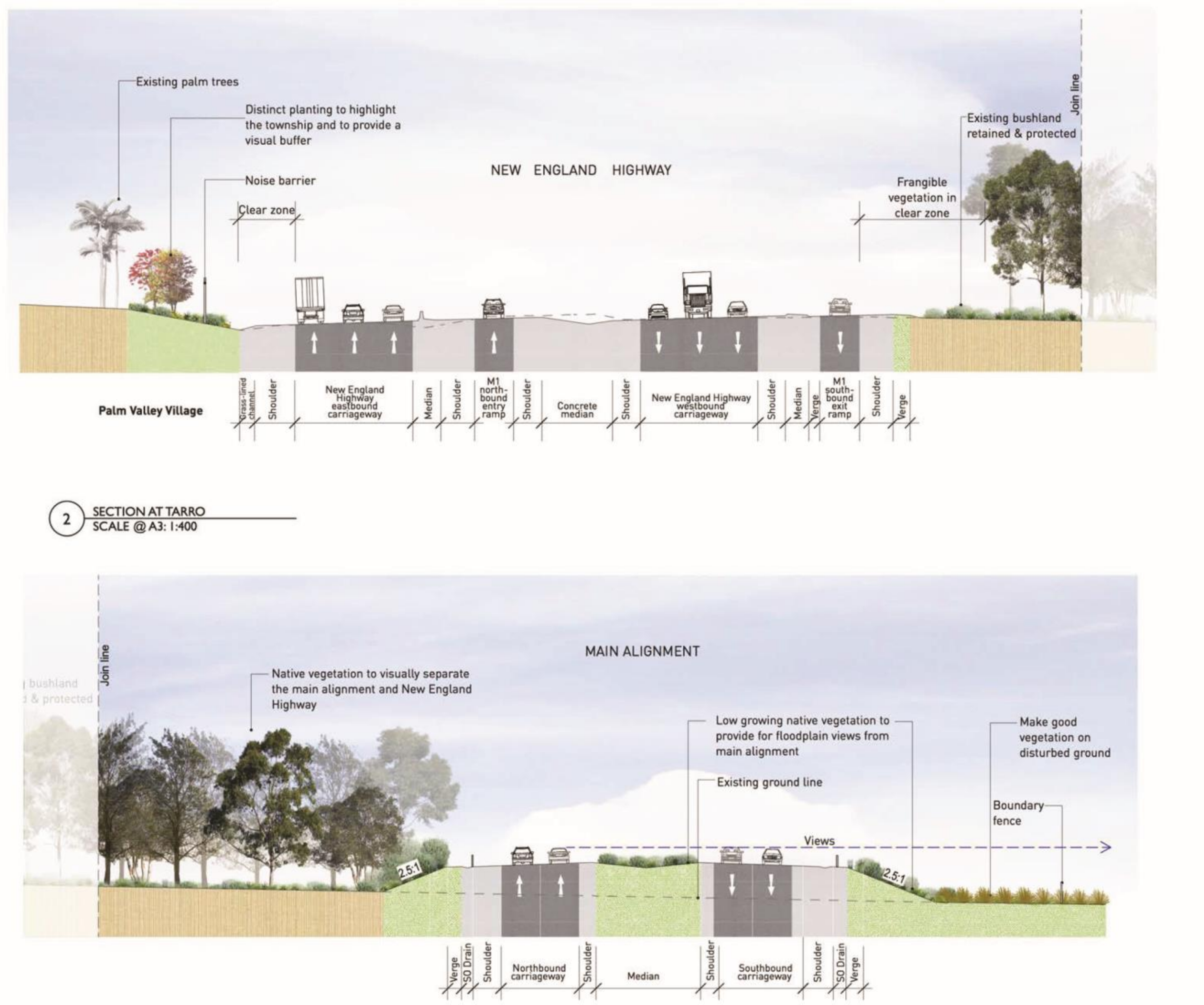

Figure 5-18 Indicative drawing of Tarro section

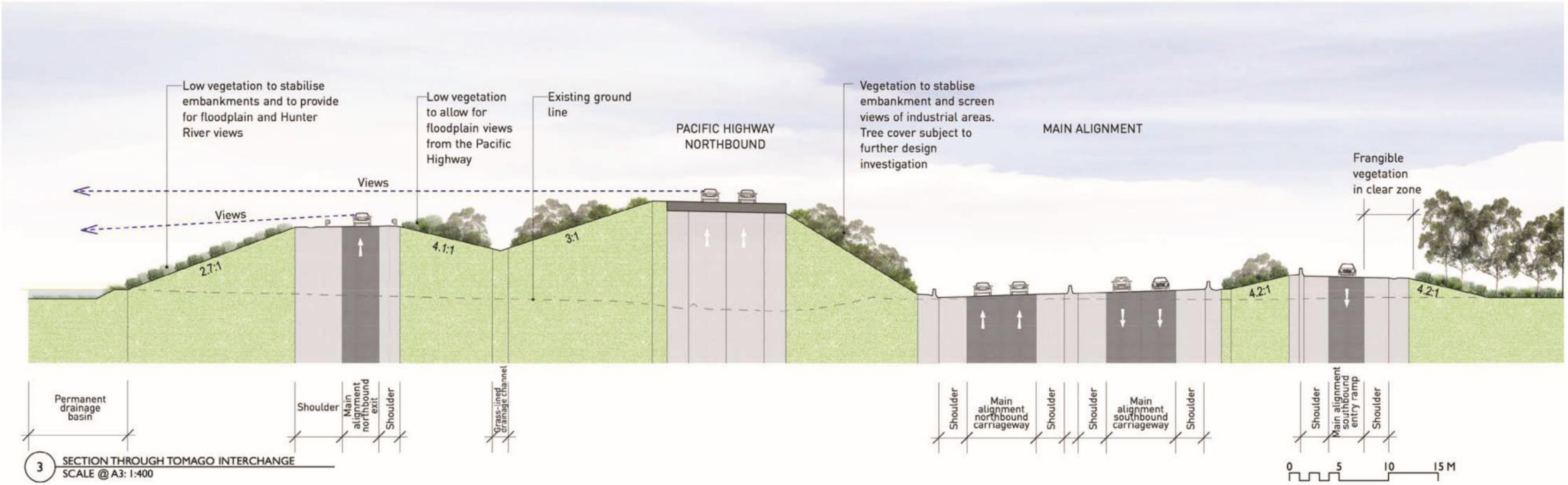

Figure 5-19 Indicative drawing of Tomago interchange section

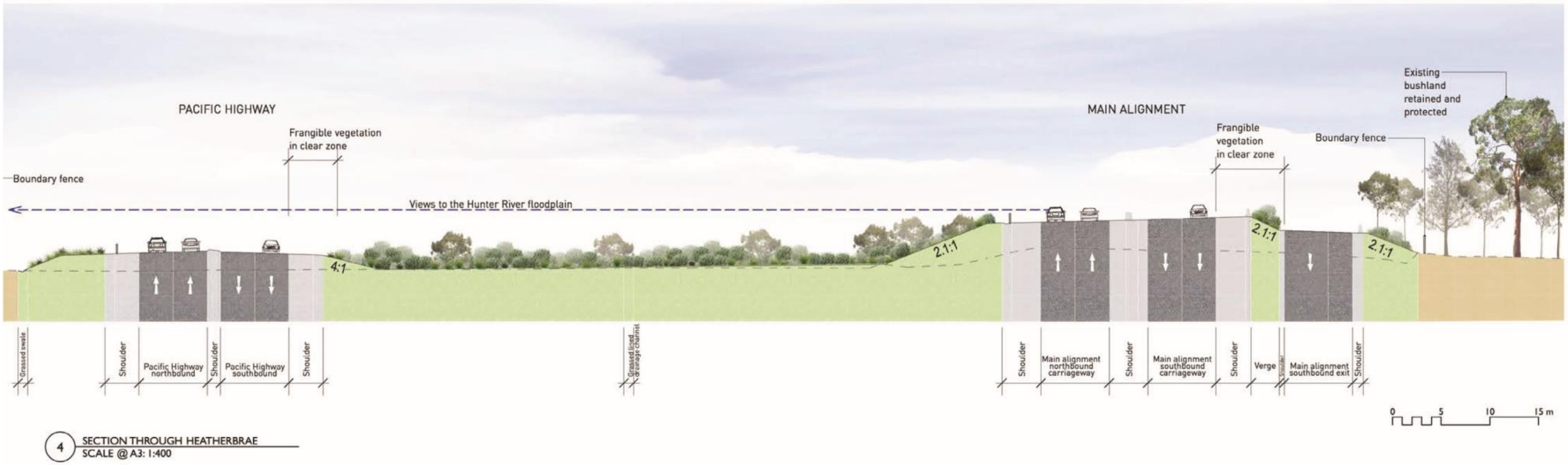

Figure 5-20 Indicative drawing of Heatherbrae section

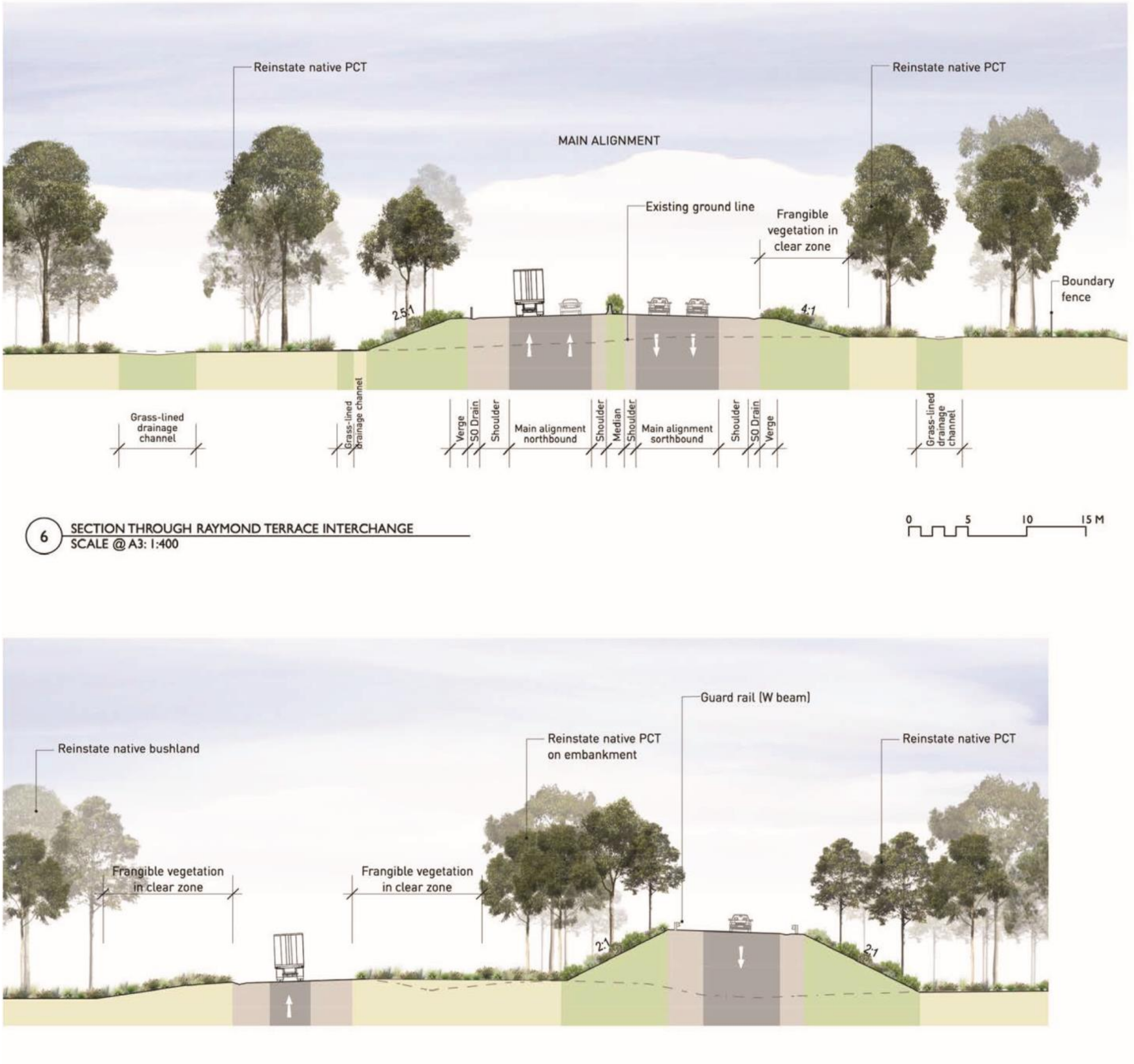

Figure 5-21 Indicative drawing of Raymond Terrace interchange section

5.3.7 Pavement

The road pavement would likely vary for each of the following components of the project:

- The main alignment
- Entry and exit ramps
- Intersections and interchanges
- Arterial and local roads
- Property access roads
- Shared user path and footpaths (limited locations)
- Median islands.

In general, new pavement along the project would consist of a heavy-duty pavement (in accordance with Transport design guidelines) with a nominal design life of 40 years.

Pavement types investigated for the main alignment include a plain concrete base with lean mix concrete sub-base and full depth asphalt. Pavement types assessed for ramps, the New England Highway and local roads include deep strength asphalt with a lean mix sub-base and deep strength asphalt with heavily bound sub-base. Existing pavement would be rehabilitated at the New England Highway, Pacific Highway and Old Punt Road and where the project ties into the existing road network.

Pavement types for the project would be refined during the detailed design stage of the project.

The new pavement would be marked in accordance with Transport requirements to delineate travel lanes, traffic merges and vehicle movements permitted at intersections.

5.3.8 Drainage infrastructure

Water management design criteria

Drainage infrastructure that would be installed or modified for the project is discussed below. Infrastructure would generally comply with criteria outlined in **Table 5-5**. **Table 5-5** outlines the flood events for which drainage infrastructure has been designed. The table shows the AEP, which is used to describe the chance of a flood of a given or larger size occurring in any one year.

Table 5-5 Drainage criteria for water management structures

Drainage infrastructure	Design criteria
Drainage	• Pavement drainage: 10% AEP event • Cross drainage: 5% AEP event • Culverts main alignment: 1% AEP event • Culverts main alignment (flood affected): 5% AEP event • Width of flow into traffic lanes: 1% AEP event generally, to 5% AEP event • Deck drainage: 5% AEP event • Piped system (including pits): 150mm in 10% AEP event.
Culverts (reinforced concrete)	• 600mm to 1500mm diameter for piped culverts • 1800mm to 3000mm wide x 750mm to 900mm high for box culverts

Drainage infrastructure	Design criteria
Permanent water quality basins	• Designed to capture and treat runoff from the main alignment, where the point source discharge is within 500m of a sensitive receiving environment. • Provide for accidental spill containment of 20,000L • Within the Tomago Sandbeds Catchment Area the minimum containment volume will be 30,000L • By default, all permanent basins provide spill containment through underflow baffles proposed at the outlet side of the basin.

Drainage and stormwater management

In addition to the bridges described in **Section 5.3.5** that would carry the project over waterways and floodplains, a number of cross drainage structures would be required to convey water under and around the project. These would generally consist of concrete box culverts and pipes. Drainage infrastructure aims to reduce scour impacts and minimise flooding impacts from the project.

Types of drainage include:

- Road surface drains: consisting of stormwater inlets and pits that connect to reinforced concrete pipes which would cater for run-off from the road surface, cut batters and the median
- Longitudinal catch drains (channels): would be located at the top of cuttings or at the bottom of the embankment, at culvert inlets and outlets and from the water quality basins to the drainage outlet points
- Bridge deck drainage: in the form of scuppers and carrier pipes directed to water quality control measures before discharging into a waterway
- Cross drains (culverts): would convey surface water under the project
- Spill containment structures and permanent water quality basins
- Existing drainage infrastructure: would be reused at connections with existing roads.

The design of the project would generally allow the natural flow regimes to be maintained. With the exception of the Masonite Road bridge (B10) where the risk of spills impacting groundwater is much lower, all bridges would include drainage systems that would discharge to the road surface drainage system and would not directly discharge into waterways. Bridge abutments would generally be located to minimise scour velocities and impacts on flood behaviour. Appropriate scour protection would be provided on both upstream and downstream ends of all structures where increased velocities have the potential to cause scour.

The main alignment pavement drainage in the vicinity of the Tomago Sandbeds Catchment Area diverts runoff towards permanent water quality basins. These basins ensure that any runoff is treated before any discharge or overflow occurs within the Tomago Sandbeds Catchment Area (limited to after rainfall events). Pavement drainage from the realignment of Masonite Road discharges to the northeast and outside of the Tomago Sandbeds Catchment Area.

The proposed road drainage network would either connect to the existing council drainage network (in the case of local road adjustments) or discharge at defined locations to operational water quality control structures before discharging to waterways or existing overland flow paths.

The main alignment would mostly be located in greenfield areas where there is no existing drainage system. In the areas where the project intersects with existing drainage systems, alterations or adjustments would be made to appropriately manage drainage from the project.

The permanent water quality control measures for the operational phase of the project are discussed further in **Section 5.3.9**.

5.3.9 Water quality management

A strategy to ensure an appropriate water quality outcome was developed for the project which considered existing land use and traffic loading, landform and topography, environmental and heritage issues, the presence of the Tomago Sandbeds as a drinking water catchment) and consideration of the construction and operational requirements of the project. The strategy aims to improve or maintain the environmental values of nearby, connected and affected water sources, groundwater and dependent ecological systems.

Operational water quality controls for road pavement runoff were based on design criteria and assessment criteria (water quality objectives) as discussed in **Chapter 11** (surface water and groundwater quality) and the Surface Water and Groundwater Working Paper (**Appendix K**).

Permanent water quality control measures proposed for the operational phase of the project are outlined in **Table 5-6** and detailed further below.

Table 5-6 Operational water quality controls

Control	Description	Indicative location	Benefits
Permanent water quality basins	Permanent water quality basins are stormwater detention systems that promote settlement of sediments by slowing down and temporarily detaining flows. Water quality basins can be wet or dry.	Permanent water quality basins would be located to capture and treat runoff from the main alignment, where diffuse or point source discharge is within 500m of a sensitive receiving environment (an environment that has a high conservation or community value or support uses of water that are particularly sensitive to pollution or degradation of water quality). Their specific location would be been governed by available space within the operational footprint.	Permanent water quality basins would reduce the amount of total suspended solids, (i.e. solids in water that can be trapped by a filter), and associated pollutants, including nitrogen and phosphorus.
Vegetated swales	Vegetated swales are open channels that convey stormwater runoff and provide water quality treatment.	Vegetated swales would be located in conjunction with permanent water quality basins, where they can be used to reduce basin size.	Vegetated swales would achieve nutrient removal through the capture of suspended solids and nutrient uptake by plants.
Spill containment	Spill containment would be incorporated in water quality basins, which have been designed to contain a 20,000L spill. Within the Tomago Sandbeds Catchment Area the minimum containment volume will be 30,000L.	Spill containment would be provided at drainage outlets that are located within 500m of aquatic environmentally sensitive areas.	The water quality controls would use a combination of bunds, negatively graded pipes and baffle boards to trap spilled liquids (particularly hydrocarbons) while allowing stormwater to continue to be discharged during rain events.

In order to capture and treat runoff, 39 permanent water quality basins are proposed for the operation of the project. Of these, 33 water quality basins would be converted from construction use (refer to **Section 5.4.11**).

Twenty-five water quality basins would intersect with the groundwater table. Groundwater intersection impacts are assessed in **Chapter 10** (hydrology and flooding) and **Chapter 11** (surface water and groundwater quality), the Hydrology and Flooding Working Paper (**Appendix J**) and the Surface Water and Groundwater Quality Working Paper (**Appendix K**).

The proposed locations of permanent water quality basins are shown in **Figure 5-1**. The location, design and size of all permanent water quality basins would be subject to refinement during detailed design.

Vegetated swales would be installed on approach to basins where appropriate. These would operate in conjunction with the permanent water quality basins to treat water allowing for reduced basin size.

Permanent water quality basins and grassed swales within in the Tomago Sandbeds Catchment Area, as well as in locations with a high salinity intrusion, would be lined to avoid contamination of groundwater.

The permanent water quality basins and grassed swales are discussed in more detail in **Chapter 11** (surface water and groundwater quality), together with an assessment of water quality performance achieved by those controls.

Scour protection and energy dissipation measures (such as rock rip rap, rock mattress, geotextile layers) would be identified during detailed design for the specific requirements of each culvert. Where required, the engineered treatments would extend downstream from the culvert outlet to the operational footprint.

5.3.10 Waterway adjustments

The project has been designed to minimise impacts on waterways. However, Purgatory Creek at Tarro and a section of a tributary of Viney Creek would need to be adjusted in order to accommodate the project. The existing section of Purgatory Creek at Tarro has been substantially modified by artificial incision and stabilisation, removal of native riparian vegetation and floodgate management. A description of the adjustments are provided in the following sections.

The need for, extent and design of the adjustments would be investigated further during detailed design with the aim of minimising changes to the natural creek alignment and form. The proposed adjustments would be designed to behave in a similar hydrologic and geomorphic manner as existing conditions.

The adjusted waterway channels would be rehabilitated following construction work in accordance with the urban design plans for the project described in the Urban Design, Landscape Character and Visual Amenity Working Paper (**Appendix O**). The location and extent of on-site rehabilitation would be confirmed during detailed design.

Potential ecology, hydrology and water quality impacts of the potential creek adjustments are detailed in **Chapter 9** (biodiversity), **Chapter 10** (hydrology and flooding) and **Chapter 11** (surface water and groundwater quality).

Tributary of Viney Creek

About 150 metres of an artificial drainage tributary of Viney Creek would be adjusted up to 70 metres to the east to accommodate the M1 Pacific Motorway entry ramp at the Weakleys Drive and John Renshaw Drive intersection as shown in **Figure 5-22**. The tributary is ephemeral with an ill-defined channel and is considered to be more of a drainage line than a natural creek at this location.

The adjustment of the tributary would commence at the culvert that crosses the existing M1 Pacific Motorway, would extend under the entry ramp via a culvert, and then northwards towards the Hunter Water Corporation easement for about 90 metres where it would join the existing tributary of Viney Creek.

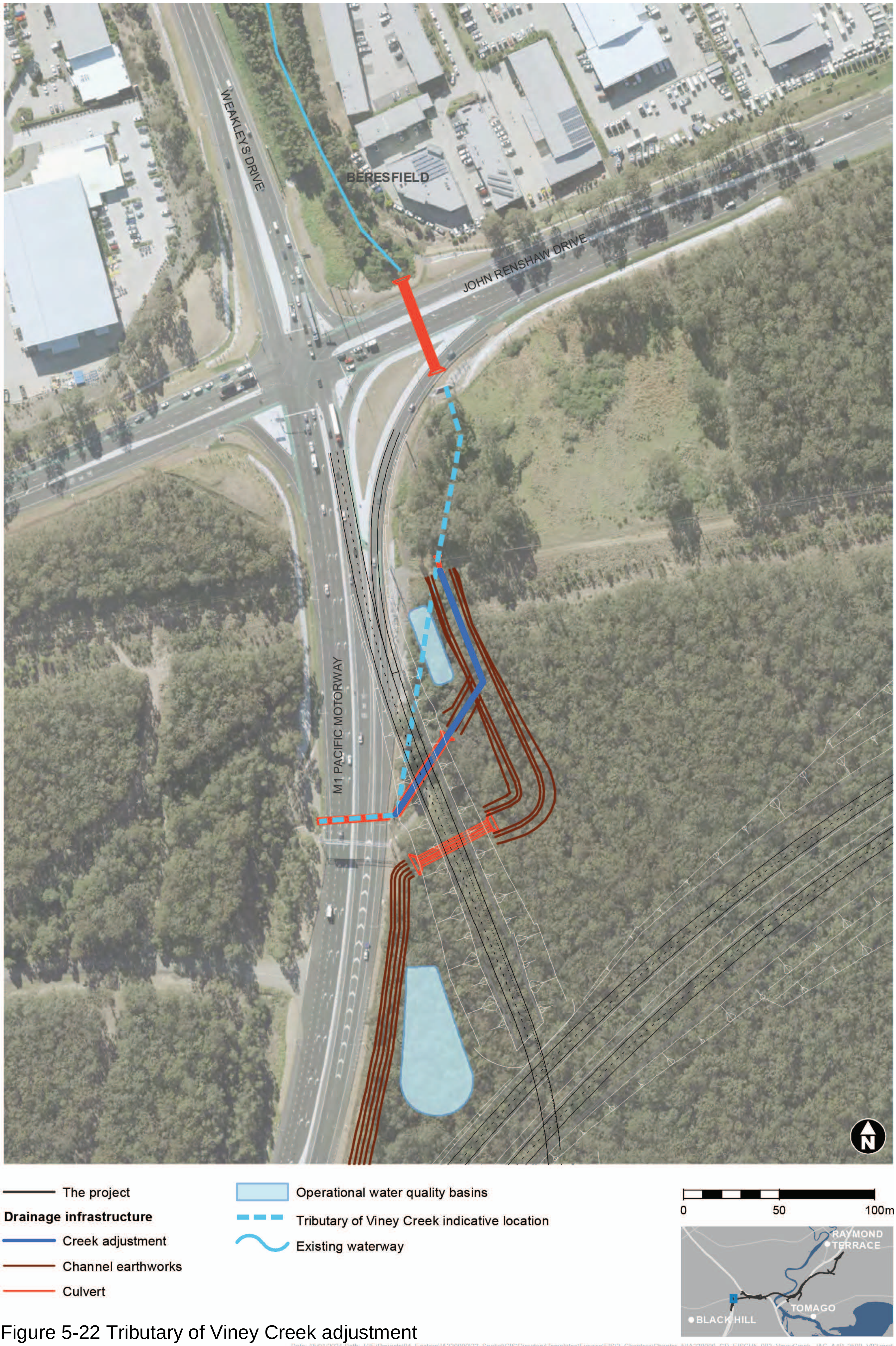

Figure 5-22 Tributary of Viney Creek adjustment

Purgatory Creek

Where crossing the project at Tarro interchange, Purgatory Creek is an ephemeral creek. Purgatory Creek becomes perennial about 1.5 kilometres upstream of its confluence with the Hunter River. About 320 metres of Purgatory Creek would be adjusted to accommodate the Tarro interchange as shown in **Figure 5-23**. The creek would be adjusted with a 10 metre wide grass-lined channel to generally match its existing form.

The creek adjustment would commence about 400 metres to the south of the New England Highway and would follow an alignment along the southern edge of the M1 Pacific Motorway southbound exit ramp. Culvert crossings would be provided beneath the main alignment and the realigned Aurizon access road.

The concept design includes about 550 metres of channel on the northern edge of the Tarro northbound entry ramp to direct flows from the Tarro interchange batters into Purgatory Creek.

The Purgatory Creek adjustment would have a similar waterway capacity to the existing creek channel and as far as practicable, would be designed in a way that mimics natural flow conditions.

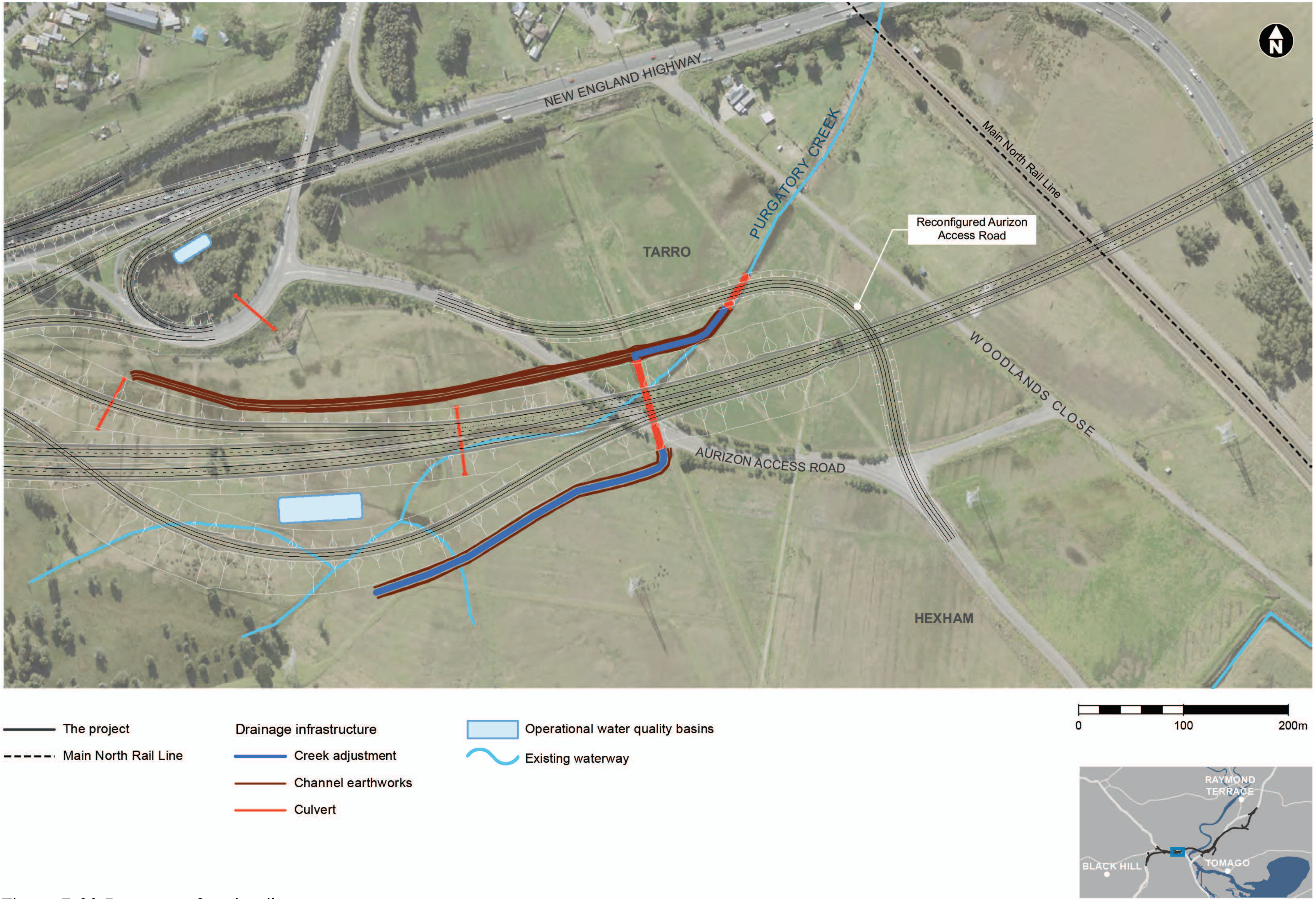

Figure 5-23 Purgatory Creek adjustment

5.3.11 Roadside furniture, fencing and lighting

Roadside furniture would be installed for the project as described in **Table 5-7**. The final locations and extents of the roadside furniture, fencing and lighting infrastructure would be confirmed during detailed design and in consultation with property owners. No rest areas would be included as part of the project as the project provides opportunity for motorists to enter and exit the main alignment at interchanges to access existing facilities in Beresfield, Tomago and Heatherbrae.

Table 5-7 Roadside furniture

Roadside furniture	Description
Safety barriers	Barriers would be used along the main alignment of the project. These would differ depending on the design of the road to be either: • Wire rope barriers • Concrete barriers • Steel rail safety barriers • Flexible bollards.
Safety screens	Screens would be about 3.4m high and would be installed on bridge structures as required and would be integrated with safety barriers to reduce the risk of objects falling onto the roads below.
Fencing	Fencing would be installed where required (refer to **Figure 5-1**) to prevent unauthorised access to the main alignment and other operational areas. Fencing would be erected as close as possible to the final road, and would also be used to prevent animals from entering the road and to guide animals to the crossing structures described in **Section 5.3.12**.
Signs	Signs would be installed along the project to enforce road rules and regulations and to provide information on direction of travel, posted speed limit and parking restrictions.
Systems for monitoring and managing traffic	Systems would be installed for the project as required, and may include closed circuit television (CCTV), VMS, and power and communications backbone cabling for the provision of ITS.
Emergency telephones	Telephones would be provided at each of the emergency U-turn bays along the main alignment, at each end of the viaduct and at the mid-point of the viaduct. Telephones would be solar powered and would connect with the communications network using 4G wireless technology.
Line marking	Line marking would be provided in accordance with design and construction specifications and would comprise: • Longitudinal markings such as lane lines, edge lines and continuity lines • Transverse markings such as stop or hold lines and give way lines • Posted speed numbers and pavement arrows to provide clear information for drivers.
Lighting	Lighting would be provided at interchanges and associated ramps and along the New England Highway and John Renshaw Drive, Old Punt Road and at the Old Punt Road and Pacific Highway intersection for safety reasons. Lighting would be in accordance with the Australian Standards (Lighting for roads and public spaces AS/NZS1158.1.1:2005).

5.3.12 Fauna connectivity

A Biodiversity Connectivity Strategy has been prepared as part of the project and is detailed in **Section 9.5.1** and the Biodiversity Assessment Report (**Appendix I**). This strategy proposes the use of fauna crossing structures as required in the Wildlife Connectivity Guidelines (Roads and Maritime Services 2011a). Proposed crossing structures and associated fencing for the project is detailed in **Table 5-8** and shown in **Figure 5-1**.

Table 5-8 Fauna crossing and fencing structures

Location	Proposed structure
Fauna crossing structures	
Black Hill	• East–west rope crossing across the main alignment linking large areas of Lower Hunter Spotted Gum Ironbark Forest • North–south rope crossing across the main alignment. This would include strategic planting of Eucalypts to improve link to existing vegetation.
Heatherbrae	North–south rope crossing across the main alignment to link isolated patch of remnant Smooth-barked Apple –Blackbutt open forest.
Old Punt Road	Glider poles on Old Punt Road linking vegetation to the east and west
Fauna exclusion fencing	
Black Hill to Tarro (located along the alignment on both sides)	Exclusion fencing (combined with property boundary and cattle fence)
Heatherbrae (located on the southern side of the alignment)	Fauna exclusion fencing
Eastern side of Pacific Highway at Raymond Terrace	Fauna exclusion fencing to tie in within existing exclusion fence on start of Raymond Terrace Bypass

Fencing designs would differ depending on characteristics of local fauna. Fauna fencing would be further refined in detailed design in consultation with relevant government agencies.

5.3.13 Emergency service access and traffic management features

The project would include the features for emergency service access and traffic management described in the sections below. Combined emergency crossover, U-turn facilities and stopping bays (in addition to the road shoulder) would be provided to allow U-turns by Transport and emergency vehicles and for diversion of traffic to the other carriageway in the case of an emergency, including bushfire, as shown in **Figure 5-1**. Some locations do not have additional stopping bays due to design constraints. The following 10 locations provide locations for emergency cross over and traffic management:

- At the Black Hill interchange
- South of the utility easement in Black Hill
- West of the Tarro interchange, Tarro
- West of the southern end of the viaduct (B05) at Tarro
- East of the northern end of the viaduct (B05) at Tomago
- At Tomago near the southbound off ramp to the Pacific Highway
- South of Heatherbrae near the HRBG
- West of the Masonite Road overbridge, Heatherbrae
- North of Windeyers Creek, Heatherbrae
- At the merge with the Pacific Highway, Raymond Terrace.

Roadside furniture such as steel rail gates or flexible bollards would be installed to act as a deterrent for unauthorised vehicles from using the U-turn facilities.

The project includes 2.5 metre minimum nearside shoulders along the main alignment. This allows vehicles to pull over at any location in the event of a breakdown or other incident and provides space between the stationary vehicle and passing traffic.

On the viaduct and bridges, the nearside shoulder width would be between 2.5 and 3.5 metres wide. This would be adequate for most vehicles to be able to stop clear of traffic.

5.3.14 Noise barriers

Noise mitigation treatment would be carried out in accordance with Transport guidelines and may include low-noise pavements, noise barriers or at-property treatments. Noise barriers, in the form of noise walls, screens or mounds would be installed as part of the suite of noise treatments where required to address operational noise impacts.

The proposed noise barriers are based on feasibility constraints including integration with existing noise barriers, as well as interactions with existing utilities, established landscaping and vegetation, heritage, landscape character, visual amenity and constructability. The project noise barriers are shown in **Figure 5-24** and comprise:

- NB.01: a relocated noise barrier with a similar height (about 2.5 metres, allowing for variations in topography) and about 265 metres in length
- NB.02: an extension of an existing barrier about 3.8 metres in height to about 1105 metres long
- NB.03: a new barrier about four metres in height and about 740 metres long.

A summary of the noise barrier analysis carried out for the project, and a discussion of reasonable and feasible mitigation measures are summarised in **Chapter 8** (noise and vibration) and the Noise and Vibration Working Paper (**Appendix H**). Noise barriers would be reviewed further during detailed design to confirm the exact location and height of noise barriers.

Figure 5-24 Noise barriers

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5.3.15 Utility services

The following existing utilities are located within the operational footprint:

- Electricity supply and street lighting: Ausgrid and TransGrid (high voltage transmission lines)
- Telecommunications: Telstra, Optus, NBN and Nextgen optic fibre and telephone cables
- Gas: Jemena and AGL
- Water and sewer services and infrastructure including the Hunter Water Corporation Chichester Trunk Gravity Water Main.

Utilities would need to be relocated, adjusted or protected where they may be affected by project construction, particularly in areas where ground disturbance is required. Potential utility adjustment or protection are outlined in **Table 5-9**.

Utility work within the construction footprint is considered and assessed in this EIS. The location of existing utility services and any changes required would be confirmed by the construction contractor during the detailed design in consultation with the relevant utility provider. Utility work during construction would be carried out in consultation with asset owners.

Further work would be carried out during detailed design to confirm the exact impact on utilities and any permanent relocations that would be required. Depending on the utility service being relocated, work may be required to occur outside the construction footprint to meet the utility service provider requirements. Changes to utilities that are located outside the construction footprint would be subject to separate environmental assessment.

Table 5-9 Potential utility relocations, adjustments and protection

Location	Asset owner	Asset type	Potential impact and indicative protection strategy
• Black Hill interchange • Across the floodplain west of the Hunter River • Tomago interchange	TransGrid	Major overhead high voltage transmission lines	A minimum overhead clearance of 12m is required. The project would achieve this at Black Hill and Tomago. However, the project is unable to achieve the minimum vertical clearance across the floodplain, west of the Hunter River. Therefore, the overhead lines would be lifted here via the installation of a mid-span suspension structure to achieve the minimum clearance over the main alignment. A minimum horizontal clearance of 20m is required for transmission tower structures. This is achieved at the Tomago interchange. Minor embankments would encroach on the clearance at Black Hill. Transport will continue to consult with TransGrid regarding this issue.
Pacific Highway between Tomago Road and Heatherbrae	Ausgrid	Overhead and underground high and low voltage lines	High voltage overhead and underground low voltage lines near the Tomago interchange would be impacted by the project. These lines would be relocated adjacent to the realigned Pacific Highway and main alignment.
Black Hill between Weakleys Drive and Lenaghans Drive	Ausgrid	Overhead high voltage line	The high voltage overhead lines located parallel to the M1 Pacific Motorway between Weakleys Drive and Lenaghans Drive would be impacted by the project. These lines would be relocated adjacent to the project.

Location	Asset owner	Asset type	Potential impact and indicative protection strategy
Black Hill, south of Weakleys Drive	Ausgrid	Overhead transmission and high voltage lines	The concrete pole supporting the overhead transmission and high voltage lines from John Renshaw Drive, east and west of the M1 Pacific Motorway, may be impacted by widening required for the project. This pole may require relocation or protection in consultation with Ausgrid.
Beresfield / Tarro between John Renshaw Drive and Anderson Drive	Ausgrid	Overhead transmission lines	The overhead transmission lines located parallel to the New England Highway between John Renshaw Drive and Woodlands Close would be impacted by the widening and realignment of the New England Highway. These lines would be relocated adjacent to the project main alignment in consultation with Ausgrid. The overhead lines that cross the New England Highway east of John Renshaw Drive and connect to Christie Road may also require minor adjustments.
Woodlands Close, Tarro	Ausgrid	Overhead high voltage transmission lines	The overhead lines located parallel to Woodlands Close would be impacted by the viaduct (B05). These lines would be relocated underground adjacent to Woodlands Close.
Heatherbrae, near Jura Street	Ausgrid	Underground and overhead high voltage lines	High voltage overhead and underground lines that intersect the project near Jura Street, Tomago. Minor adjustments to the overhead and underground lines would be required in consultation with Ausgrid.
Masonite Road, Heatherbrae	Ausgrid	Overhead high voltage transmission lines	The overhead lines located adjacent to Masonite Road would be impacted by the realignment of Masonite Road. These lines would be relocated adjacent to the realigned Masonite Road in consultation with Ausgrid. Additional minor adjustments may be required where the lines cross the main alignment north-east of Masonite Road.
Heatherbrae, near Camfield Drive	Ausgrid	Overhead transmission lines and potential All-Dielectric Self-Supporting (ADSS) Fibre Optic	The overhead transmission lines and potential ADSS Fibre Optic cross the project alignment near Camfield Drive and would require minor adjustments to ensure that adequate clearances are maintained.
Pacific Highway, north of Masonite Road, Raymond Terrace	Ausgrid	Overhead high voltage and low voltage lines	The overhead electrical lines located at the Pacific Highway would be impacted by the project. A section of these lines would be relocated adjacent to the project in consultation with Ausgrid.
Tarro interchange	Hunter Water Corporation	Proposed Chichester Trunk Gravity Main (CTGM)	A substantial length of the gravity main would be beneath the project at Tarro. The CTGM would need to be either protected or relocated by the project in consultation with Hunter Water Corporation.
• Black Hill • Tomago • Heatherbrae • Raymond Terrace	Hunter Water Corporation	Water mains and sewer mains	A number of water and sewer mains would be impacted by the project. These assets will be further considered during detailed design and protected or relocated depending on their accurate location and depth.

Location	Asset owner	Asset type	Potential impact and indicative protection strategy
Multiple locations within construction/ operational footprint	Telstra, Nextgen, and Optus	Optical fibre and copper network	Numerous major and minor aerial and underground cables are located along and through the project and would be impacted by the project at various locations. These cables are typically located within existing road corridors. Locations where telecommunications utilities would be impacted and require either protection and/or relocation include: • The main alignment, Lenaghans Drive, Weakleys Drive and John Renshaw Drive at Black Hill • The New England Highway at Beresfield and Tarro • Woodlands Close at Tarro • Tomago Road and Old Punt Road at Tomago • The Pacific Highway at Tomago, Heatherbrae and Raymond Terrace • Masonite Road at Heatherbrae. Further survey to accurately locate these cables will be carried out during detailed design to determine the need for protection and/or relocation.
Tomago	AGL	High pressure gas main and proposed plant site	The Tomago to Hexham gas pipeline would be in the vicinity of the project and may require protection and relocation. In addition, a gas-fired power station is proposed at Tomago between the Pacific Highway and Old Punt Road, near ancillary facility AS12. The proposed power station would be in the vicinity of the main alignment, and an easement for the gas pipeline would be impacted by the project.
Pacific Highway between Tomago and Heatherbrae	Jemena	Gas main	Gas mains are in the vicinity of the project and would be relocated to avoid potential impacts.
Old Punt Road, Tomago	AGL	Gas main	A gas main is located in the vicinity of the project at Old Punt Road and may require protection or relocation to avoid impacts.

5.3.16 Walking and cycling

Walking

The area surrounding the project is predominantly comprised of agricultural and industrial land uses, with limited land uses generating walking, which leads to very low volumes of pedestrians. While pedestrian infrastructure is limited along the existing M1 Pacific Motorway for these reasons, footpaths are located to connect to local facilities. Signalised pedestrian crossings are provided at the following intersections:

- Tomago Road and Pacific Highway: across the eastern leg of the intersection to access the bus stop on the Pacific Highway servicing the Tomago industrial area
- Pacific Highway and Hank Street: across all approaches to the intersection due to the adjacent commercial and retail developments in Heatherbrae.

The project would provide a shared path about 900 metres long along the southbound lane of Masonite Road in order to provide safe access across bridge B10 and to accommodate future development in the surrounding area.

The proposed signalised intersection at the HRBG would provide a signalised pedestrian crossing which would provide access to the bus stop located on the eastern side of the Pacific Highway. It would also offer improved pedestrian access to the HRBG.

No other shared paths would be provided along the main alignment or local roads forming part of the project.

Cycling

No existing cycle routes would be impacted by the project. No dedicated cycle paths are located in the construction footprint, with cyclists currently using the shoulders of the existing road network. While no dedicated cyclist infrastructure would be provided along the main alignment, cycling opportunities would be provided using the wide road shoulders along the main alignment. Changes to the existing cycle network include:

- An improved cyclist crossing at the Weakleys Drive/John Renshaw Drive intersection with connectivity to the project
- Relocating the existing cyclist crossing on the New England Highway, east of John Renshaw Drive further west before the northbound entry ramp at the Tarro interchange
- Provision of a westbound cyclist crossing on the New England Highway across John Renshaw Drive
- Replacing the existing gore crossings at the Tarro interchange with new ramps which would create a link between the main alignment in both directions and the future Richmond Vale Rail Trail from Tarro to Shortland
- Provision for northbound cyclists on the Pacific Highway crossing to access Old Punt Road and for crossing from Old Punt to access the northbound Pacific Highway Carriageway
- Provision for northbound cyclists on Pacific Highway to access the main alignment at Tomago interchange and to connect to the traffic signals at Tomago Road
- Provision for northbound cyclists on Pacific Highway to access the HRBG
- Provision for northbound and southbound cyclists to use an access point off Masonite Road.

Further information on cycling is provided in **Section 7.3.7**.

5.3.17 Public transport

Coaches and buses carrying passengers between destinations such as Sydney, Newcastle, Port Macquarie, Coffs Harbour and Brisbane use the M1 Pacific Motorway, New England Highway and Pacific Highway. Buses would be able to use the project once opened. No additional public transport infrastructure along the main alignment would be provided.

Three existing bus stops would be relocated to accommodate the project. These are:

- The bus stop on the Pacific Highway, just north of the Tomago Road intersection
- The northbound bus stop on the Pacific Highway, near the HRBG access road and Pacific Highway intersection
- The southbound bus stop on the Pacific Highway, near the HRBG access road and Pacific Highway intersection.

The relocated bus stops would be located as close as possible to the original bus stop locations, and pedestrian pathways would be provided to allow access to the relocated bus stops. Consultation would be carried out with the affected bus operators during detailed design (refer to **Chapter 6**).

The rail network in the vicinity of the project consists of the Main North Rail Line, which primarily serves freight traffic from the Hunter Valley mining industry with some passenger rail. Railway stations close to the project, including Thornton, Beresfield, Tarro, Hexham and Sandgate, are serviced by the Hunter Line.

The Main North Rail Line is also used by NSW TrainLink regional services between Sydney and Moree, Armidale, Grafton, Casino and Brisbane. However, TrainLink regional services do not stop at stations close to the project. The nearest stations serviced by these trains are Broadmeadow and Maitland, which are located around 11.5 kilometres and 10.5 kilometres from the construction footprint respectively..

5.3.18 Oversize overmass vehicles

The project would generally cater for oversize overmass (OSOM) vehicle movements, with a clearance envelope 8.5 metres wide and 6.5 metres high. There are some locations where design constraints do not allow for vehicles of this size to access the project. Alternative routes available to cater for these OSOM movements are described in **Table 5-10**.

Table 5-10 OSOM restrictions to vehicle movements not catered for by the project

OSOM vehicle movements not catered for by the project	Alternative OSOM vehicle movement
Between Black Hill interchange (B01) and Tarro interchange (B04)	The minimum vertical clearance would be about 5.5m. Alternate route via the New England Highway and John Renshaw Drive in both directions.
Between Raymond Terrace interchange (B12) and Tomago interchange	The minimum vertical clearance under Raymond Terrace interchange (B12) would be about 5.4m. Alternate route via the Pacific Highway through Heatherbrae in both directions.
Tomago Interchange at Old Punt Road (B08)	The minimum vertical clearance under the main alignment at Old Punt Road at B08 would be about 6.4m. The OSOM strategy provides a gated opening in the median barrier and additional pavement would be provided to allow OSOM to cross over between the main alignment and the Pacific Highway carriageways under traffic control and lane closures.
Tomago Interchange for southbound entry under Pacific Highway (B06)	The minimum vertical clearance under B06 would be about 6.6m. The OSOM strategy provides a gated opening in the median barrier and additional pavement would be provided to allow OSOM to cross over between the main alignment and the Pacific Highway carriageways under traffic control and lane closures.

5.3.19 Property acquisition

The project has been designed and aligned to minimise fragmentation of land and property acquisition where reasonably practicable.

Where land acquisition is required for the project, it would be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*, the Land Acquisition Information Guide (NSW Government 2014b) and the land acquisition reforms announced by the NSW Government in 2016. It is Transport’s preferred approach to complete all acquisitions by negotiation without the need for compulsory acquisition.

Properties impacted by acquisition or adjustments are listed in **Chapter 14** (land use and property). In summary, 43 lots have been purchased by Transport for the project. An additional 19 properties (comprising 36 lots) would be acquired for the project in addition to those previously purchased by Transport. The project would directly impact three dwellings, including two dwellings on rural land and one dwelling associated with a commercial property at Heatherbrae.

The extent of property impacts would be confirmed during detailed design, in consultation with the property owners. Transport would consider the acquisition of any residual parcels created by the location and design of the project. For partial acquisitions, property adjustment plans would be developed in consultation with the property owner. Following consultation with property owners, some of the lots listed as requiring partial acquisition may be totally acquired.

Properties required to accommodate ancillary facilities during the project's construction would be subject to temporary lease as discussed in **Section 5.4.3** and **Chapter 14** (land use and property).

If a property is wholly acquired, but not all land is required for the project, the excess land would be either:

- Sold after construction is complete
- Kept by Transport for future use
- Transferred to the local council or another government agency.

Severance or fragmentation of rural properties would be managed as described in **Chapter 14** (land use and property).

5.3.20 Property access

The project design allows for all property access to be maintained by incorporating some changes to existing property access arrangements.

The project would require realignment of two property access roads and a modification to the HRBG access road. These access changes include:

- Property access road south of the New England Highway at Tarro: This road would be realigned to the west of the existing access and pass under the twin bridges (B02) over the unnamed wetlands (refer to **Figure 5-1**)
- The Aurizon access road off Anderson Drive: A permanent diversion would be provided, with the diversion traversing the viaduct (B05) abutment, passing under the viaduct (B05) then tying into the existing access road south of the main alignment embankment (refer to **Figure 5-1**). This road would also serve as the new route for the Tarro to Shortland cycle route proposed by the City of Newcastle
- HRBG: The entry to the HRBG and the carpark would be modified to cater for the Pacific Highway realignment at this location. Access to the HRBG would be provided as part of a new signalised intersection with the Pacific Highway. The modified access road would pass under the bridge (B09) on the main alignment (refer to **Figure 5-1**).

The project would also require adjustments to existing tracks and trails, including access and easement tracks to utility infrastructure and associated easements and driveways to three private properties.

Where required, and where the project severs existing access tracks, (including fire trails) turnaround facilities would be provided on access tracks to allow vehicles to turn around. Access tracks and driveway adjustments would be confirmed during detailed design and consultation with property owners.

Access to all existing and proposed infrastructure for maintenance purposes would be provided by maintaining existing access and easement arrangements where possible or developing alternative maintenance access arrangements where required.

5.4 Construction work

5.4.1 Construction footprint

The construction footprint is the total area required to construct the project, as shown in **Figure 5-25**. The construction footprint is generally broader than the operational footprint, and includes the area required for road work, bridge and viaduct work, access for construction vehicles and plant, drainage infrastructure, utility and service adjustments, construction and operational water quality controls measures, temporary stockpiles and construction ancillary facilities.

The construction footprint was established to minimise environmental impacts while providing sufficient room to allow the project to be constructed in a safe manner. The total construction footprint area is about 466 hectares.

The construction footprint has been used to assess the maximum area of disturbance during construction. This footprint is indicative only and would be refined during detailed design and construction. Some factors that could affect the final construction footprint include the location and size of water quality controls measures, drainage, the location of final ancillary facilities, utility relocations, the construction methodology and arrangements made with directly affected landowners.

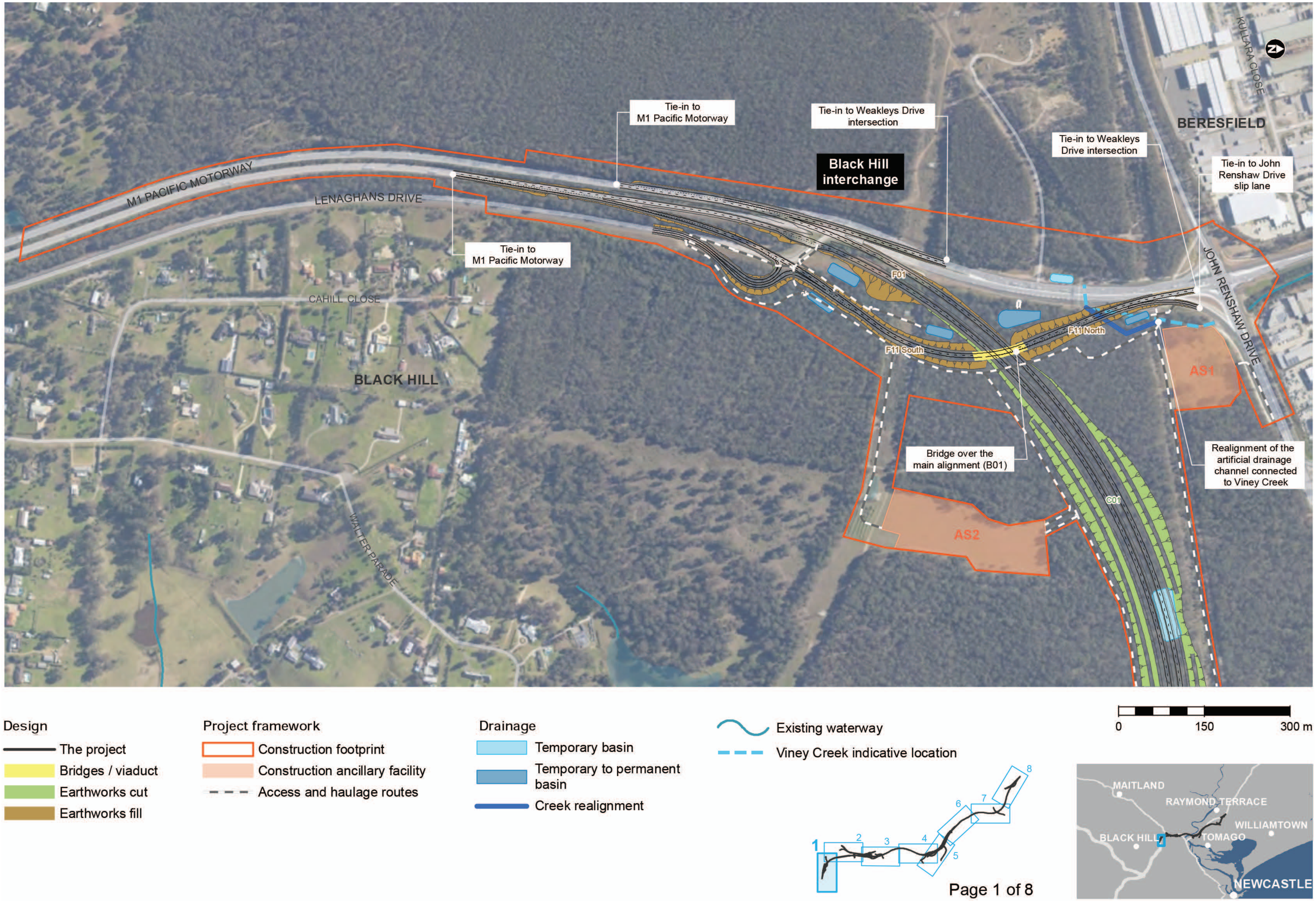

Figure 5-25 Construction footprint (map 1 of 8)

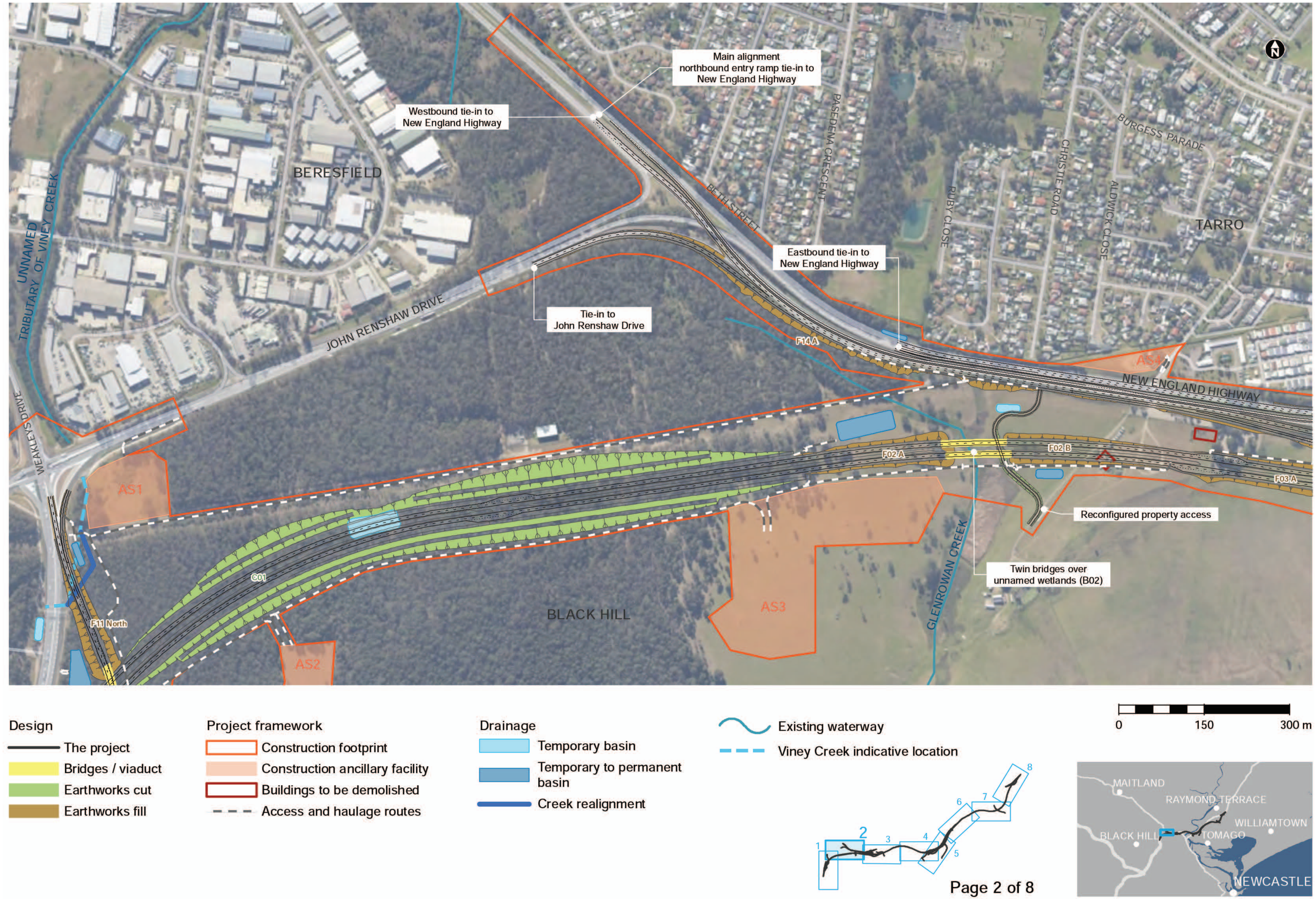

Figure 5-25 Construction footprint (map 2 of 8)

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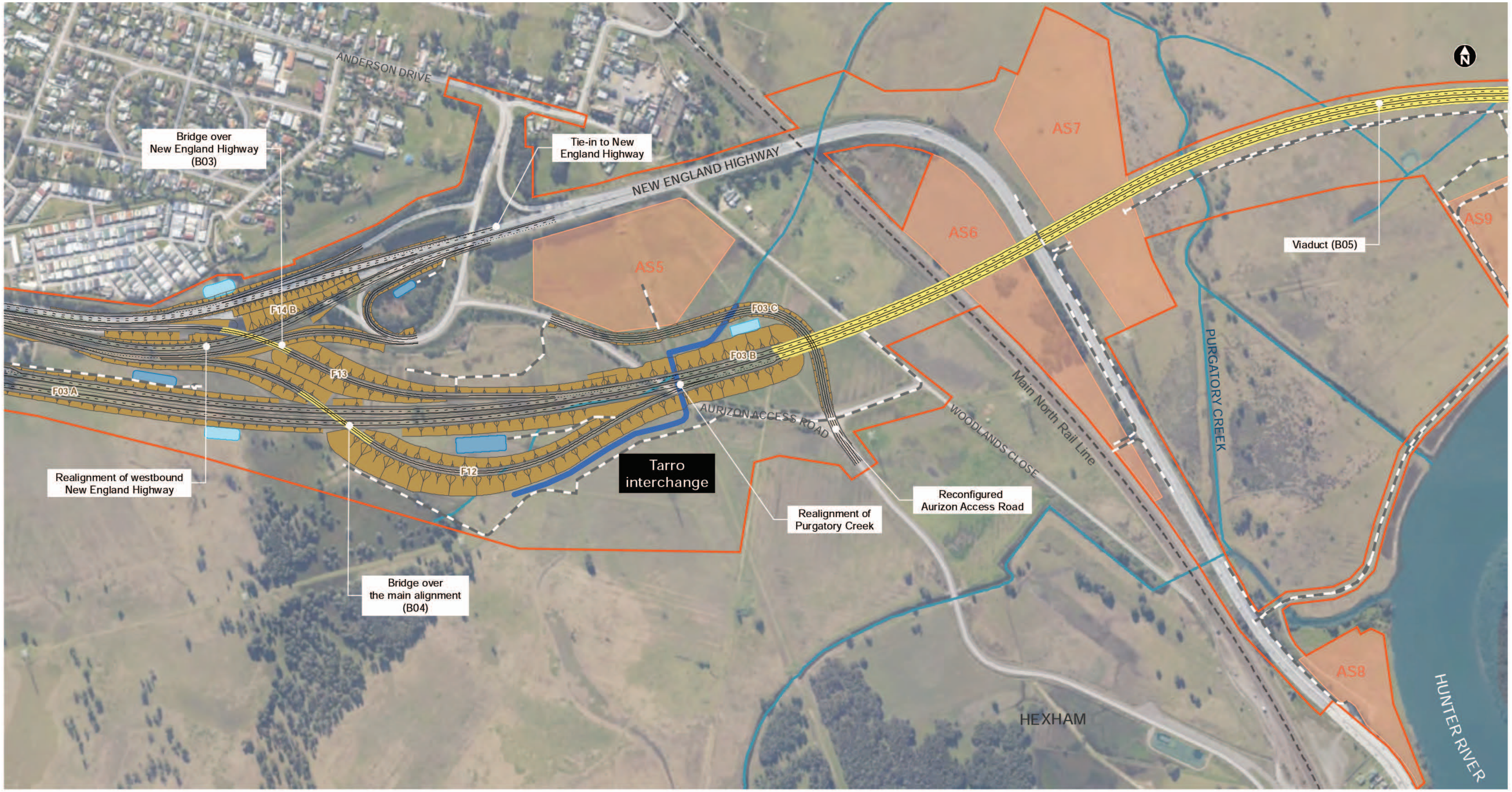

Design
- The project
- Bridges / viaduct
- Earthworks fill

Project framework
- Construction footprint
- Construction ancillary facility
- Access and haulage routes

Drainage
- Temporary basin
- Temporary to permanent basin
- Creek realignment

Existing waterway

0 150 300 m

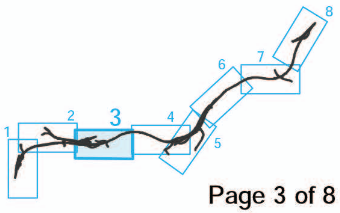

Figure 5-25 Construction footprint (map 3 of 8)

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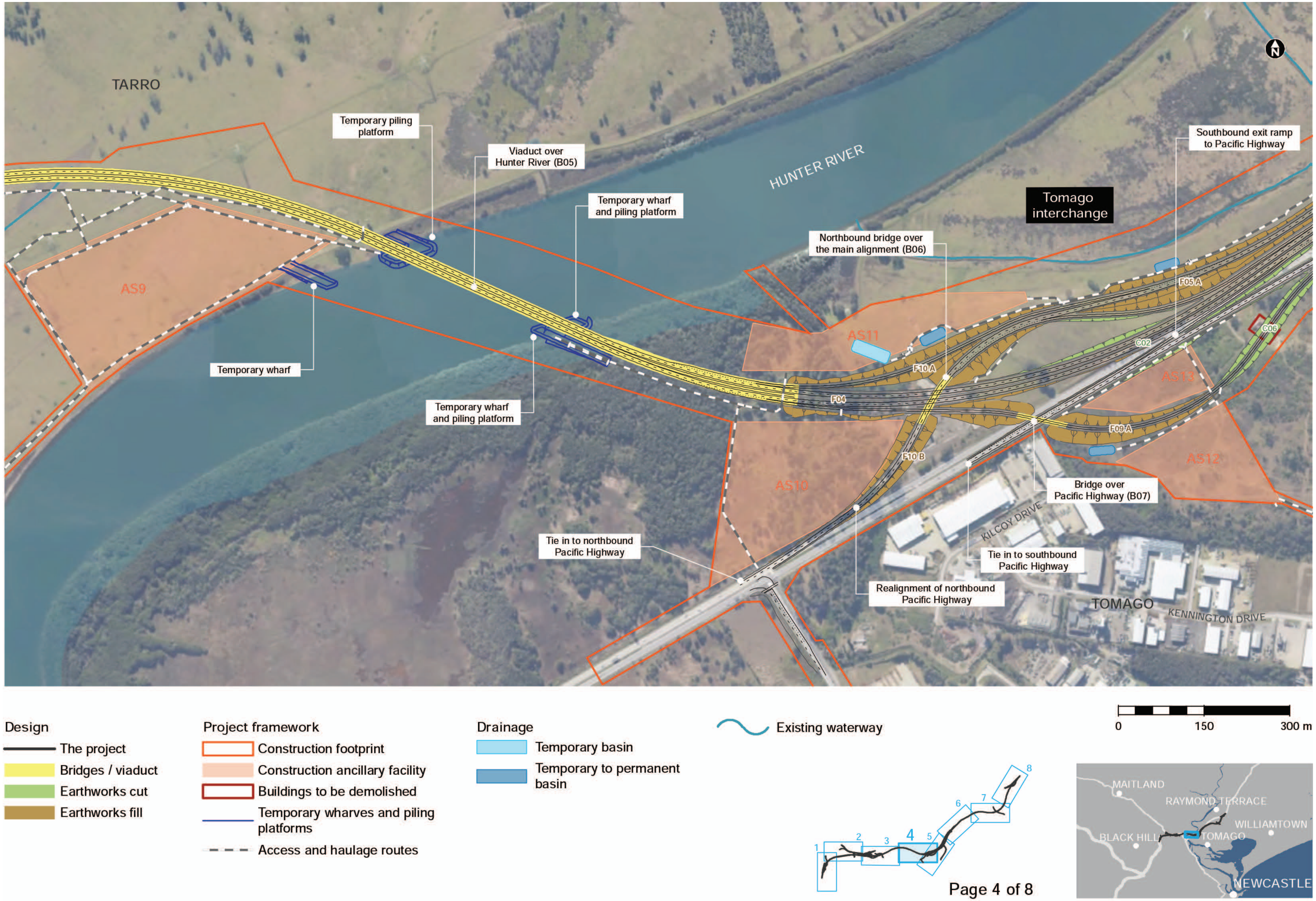

Figure 5-25 Construction footprint (map 4 of 8)

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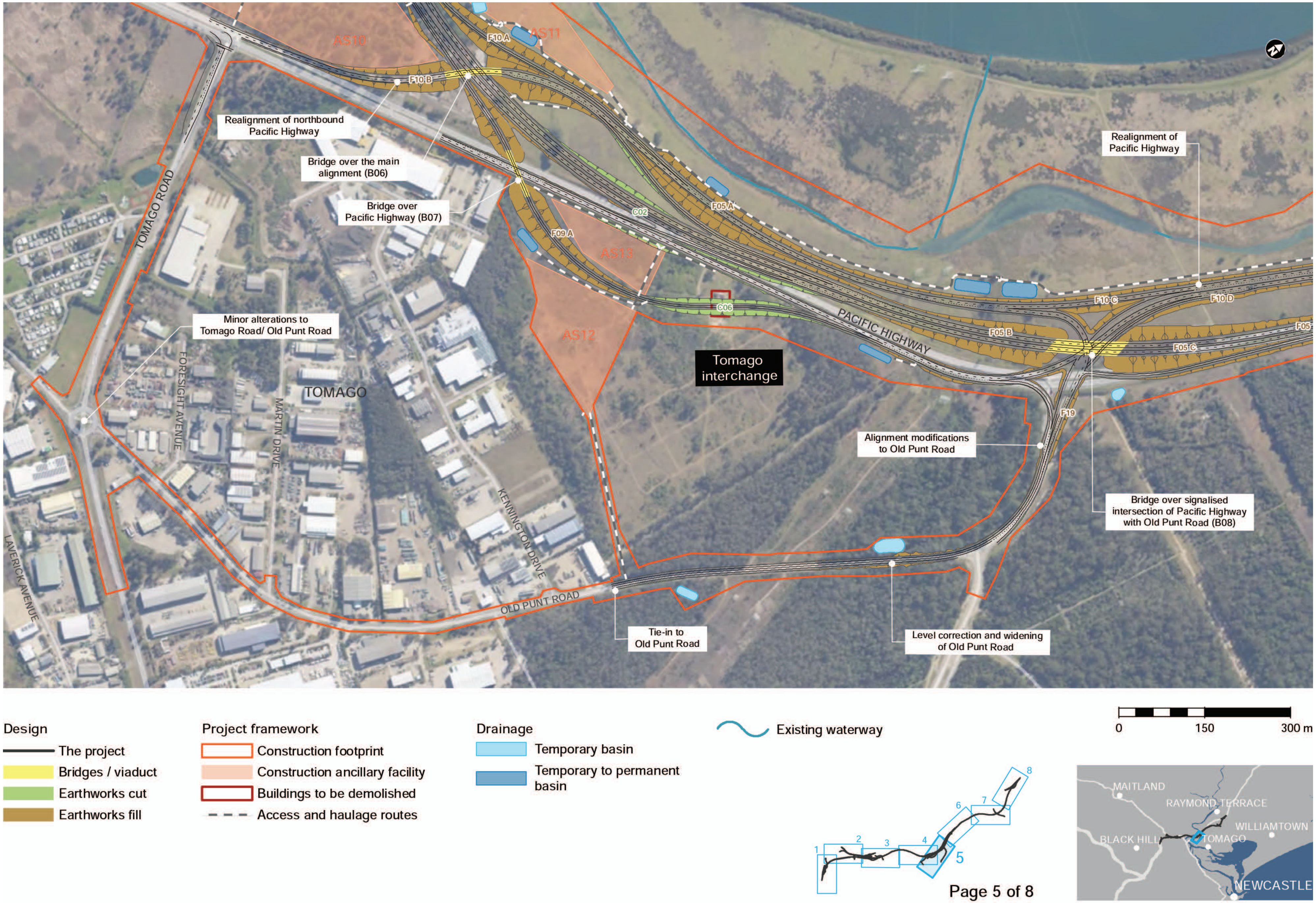

Figure 5-25 Construction footprint (map 5 of 8)

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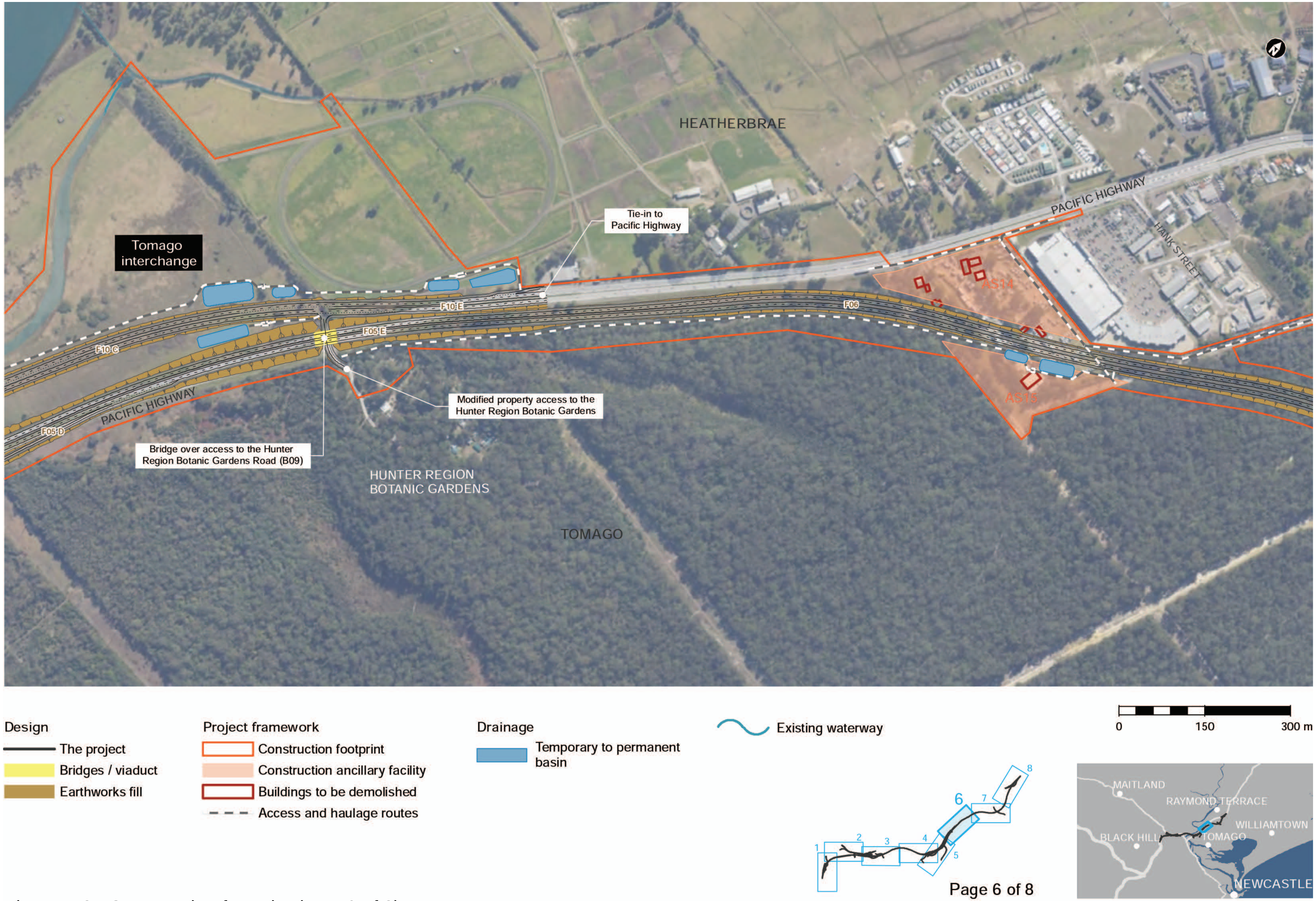

Figure 5-25 Construction footprint (map 6 of 8)

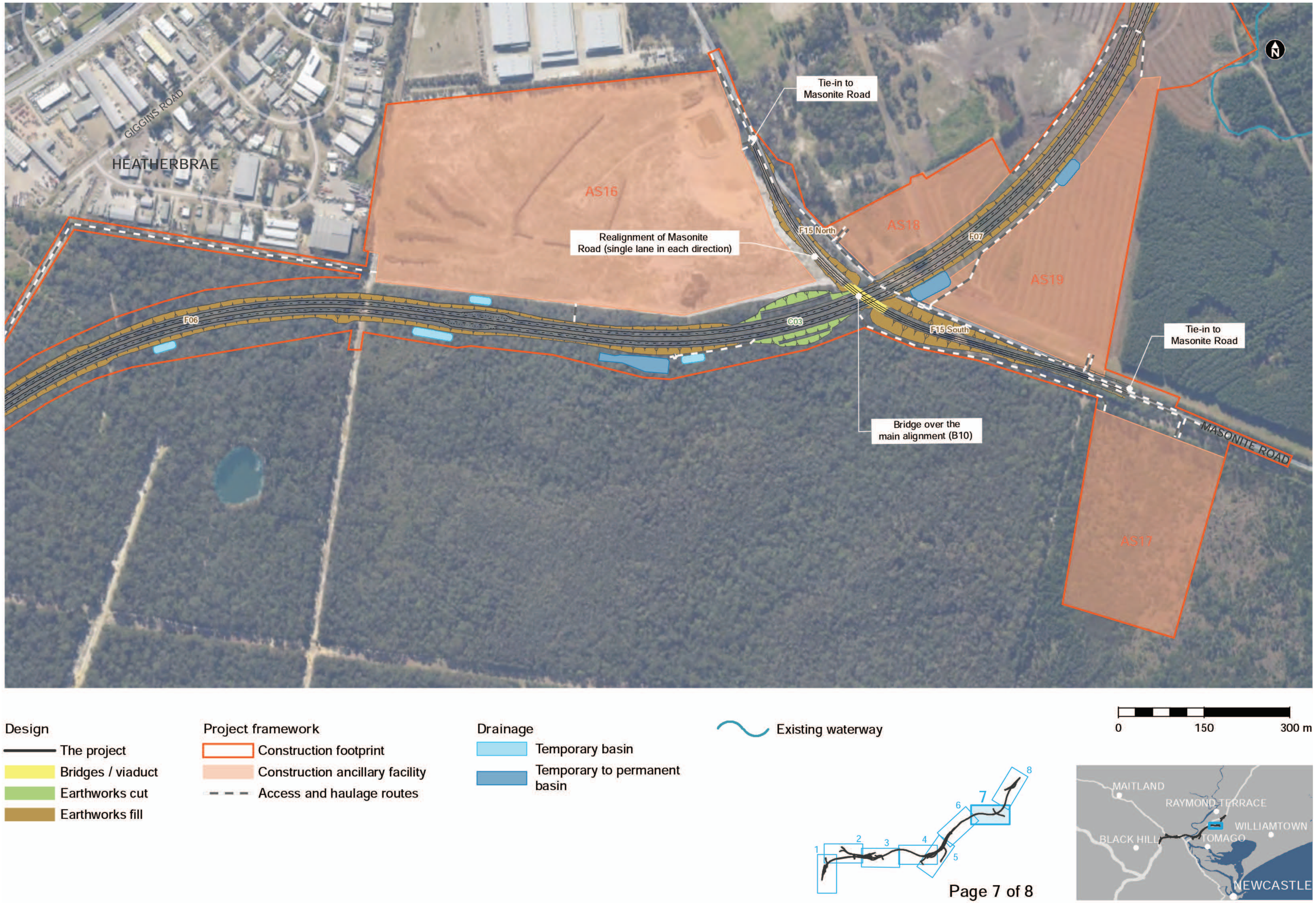

Figure 5-25 Construction footprint (map 7 of 8)

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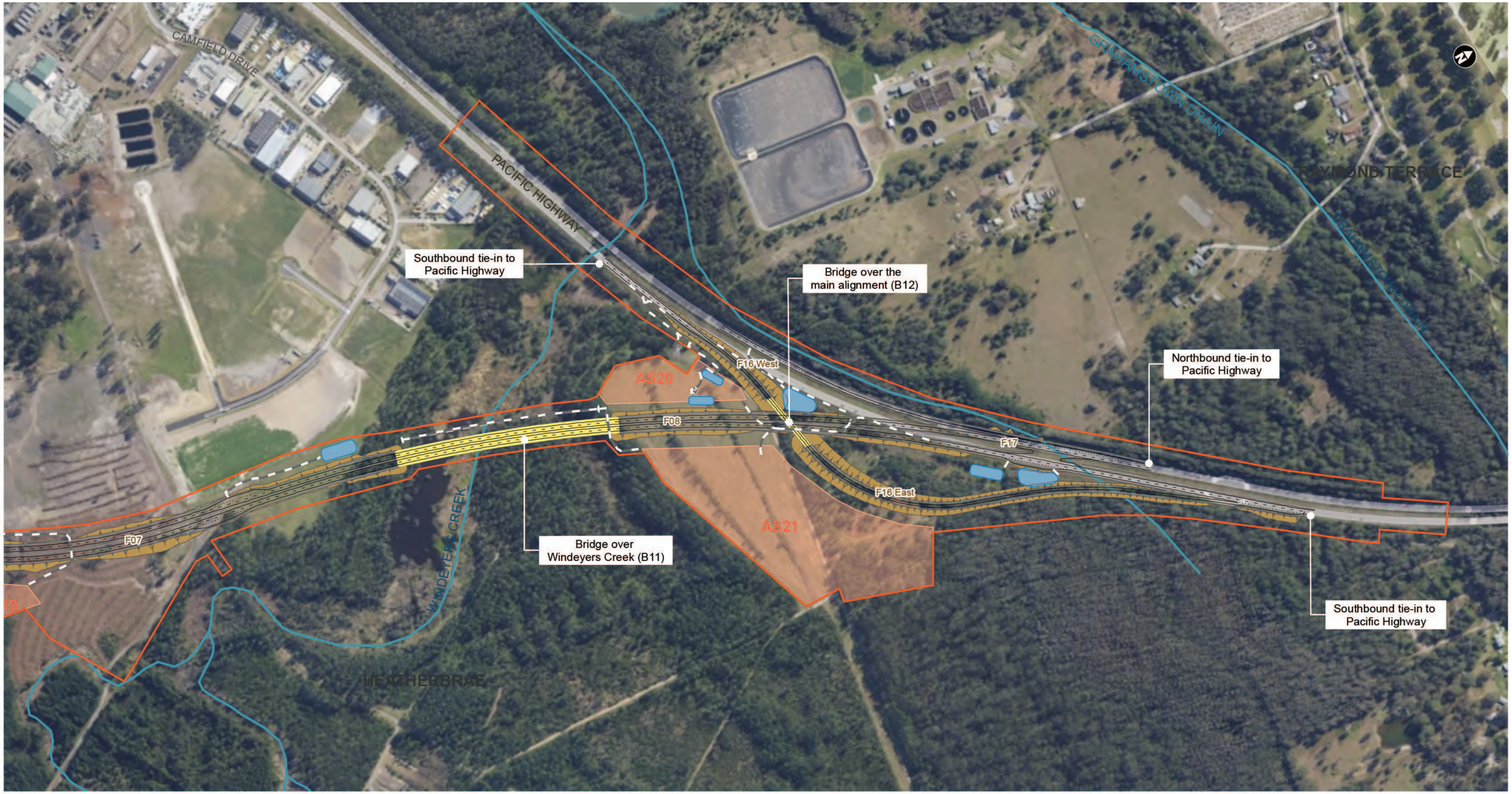

Design
- The project
- Bridges / viaduct
- Earthworks cut
- Earthworks fill

Project framework
- Construction footprint
- Construction ancillary facility
- Access and haulage routes

Drainage
- Temporary to permanent basin

Existing waterway

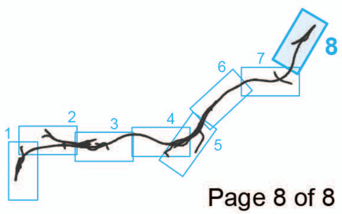

Figure 5-25 Construction footprint (map 8 of 8)

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5.4.2 Overview of construction activities

The principles of ecologically sustainable development (ESD) were a key consideration throughout the options development process and the selection of the preferred option (refer to **Chapter 4**) and will continue to be considered during detailed design and construction of the project. In addition, the project has also considered the ESD principles in the assessment of environmental impacts, as outlined in **Chapter 7** (traffic and transport) to **Chapter 23** (cumulative impacts).

The overview of construction work described in this section is based on the concept design. Further construction planning would be carried out during detailed design. Construction planning would consider specific work methods and scheduling to manage community and environmental issues including noise, access, amenity and general disruption, and concurrence with Work Health and Safety legislation.

The construction methods and mitigation measures to minimise environmental impacts would be detailed in the Construction Environmental Management Plan (CEMP), which would be prepared by the construction contractor.

Overview of construction work

The project would likely be built using conventional methods used on most highway projects. Key construction components would include:

- Enabling work
- Construction of ancillary facilities
- Operation of ancillary facilities
- Drainage and water quality control measures
- Clearing, grubbing, and demolition
- Bulk earthwork
- Construction of pavements
- Construction of bridges and the viaduct
- Construction of roadside furniture and finishing work
- Traffic management and control
- Landscaping work.

It is expected that many of these construction activities would occur concurrently or consecutively across different locations within the construction footprint, with some activities occurring as enabling work to maximise efficiency. The typical construction plant and equipment for each component is provided in **Section 5.4.4**.

More information about the main components of these construction activities is provided in the following sections.

Construction components

The typical activities associated with construction are summarised in **Table 5-11**. This includes the work associated with the main alignment, intersections, interchanges, bridges and the viaduct. This work has been separated into construction components to consider:

- The need to minimise road user delays
- The need for local road and property access
- The need for land acquisitions
- The earthwork balance – both locally and across the project
- Areas that may require soft soil pre-loading
- The sequence in which completed sections could be opened to traffic.

Table 5-11 Construction components and activities

Component	Typical activities
Enabling work and utilities	• Property acquisition and adjustments, including property access changes • Detailed investigations and survey work including geotechnical investigative drilling, excavations, and archaeological investigations and salvage • Road dilapidation and building condition surveys • General site clearance, site establishment work, fencing and signage • Temporary traffic management arrangements including construction of access roads • Installation of environmental controls including temporary or permanent fencing, and erosion and sediment control mitigation measures • Construction of temporary drainage controls including temporary creek crossings • Adjustment, relocation and protection of public utilities and services.
Construction of ancillary facilities	• Initial site survey • Installation of erosion and sediment control measures • Establishment of construction site access points, traffic management measures and site access roads • Site clearance and establishment work including fencing, signage and lighting • Establishment of hardstand and bridge work areas • Establishment of facilities, including site offices and amenities.
Operation of ancillary facilities	• Operation of ancillary facilities, including stockpiling, delivery and storage of materials, and worker parking • Operation of batch plant and pre-cast fabrication, including crushing and screening of excavated material, stockpiling and loading activities.
Drainage and water quality control	• Installation of cross drainage including culverts, and inlet and outlet work (channel diversions and scour protection) • Installation of water quality control measures, including drainage, temporary sediment basins and swales • Dewatering of basins as required.
Clearing, grubbing, and demolition	• Clearing and grubbing of vegetation • Mulching of vegetation for reuse in landscaping activities (where possible) • Stripping of topsoil and stockpiling for reuse in landscaping activities • Demolition of dwellings and farm sheds (refer to **Section 5.4.7**) • Minor demolition of pavements, kerbs and other road elements and structures
Bulk earthwork	• Excavation of bulk earthwork cuttings and stabilisation of cut batters • Rock removal using rock breakers, hammers or controlled rock blasting • Crushing and screening • Haulage of materials from excavated cuttings, borrow sites and external sources to fill locations • Construction of embankments and earth mounds including foundation drainage • Ground improvement activities.
Pavements	• Construction of pavement and sub surface drainage • Construction of pavement layers including wearing surface.

Component	Typical activities
Bridges and the viaduct	• Construction of wharf areas for loading and unloading of plant and equipment from barges on Hunter River • Installation of silt fences and other environmental controls • Construction of temporary platforms to enable construction of Hunter River crossing piers located on the bank and in the Hunter River • Construction of bridge and abutment foundations (bored or driven piles) • Installation of embankment and utility service piles (at required locations) • Construction of pile caps • Construction of bridge abutments and piers • Construction of bridge superstructure including deck and road surface (cast in situ or precast bridge elements) • Construction of scour protection and reinforced soil walls where required • Dewatering.
Roadside furniture and finishing work	• Construction of concrete barriers, wire rope fencing and guardrails • Installation of traffic lights, road markings, signposting, roadside furniture, lighting, VMS and ITS • Removal of temporary work • Restoration and landscaping of ancillary facilities • Restoration of construction access roads (where required) • General site clean up • Removal of temporary environmental controls.
Traffic management and control	• Temporary traffic barrier installation and movement – including anchor drilling • Temporary pavement construction • Traffic switches.
Landscaping	• Progressive landscaping and tree planting • Rehabilitation and reinstatement of existing conditions • Landscape maintenance.

5.4.3 Construction ancillary facilities

Ancillary facilities would be required at different locations across the construction footprint to support project construction as shown in **Figure 5-25**. It is expected the majority of the ancillary facilities would be used for the duration of construction.

Opportunities to use suitable existing sites in the surrounding industrial areas in Black Hill, Beresfield, Hexham, Tomago and Raymond Terrace would be investigated during detailed design to reduce the construction footprint. Preference would be given to suitable sites directly next to the construction footprint.

Activities at each ancillary facility would vary according to the support required at that location. The potential sites that could be used, and the indicative details of the size and purpose of each facility, are provided in **Table 5-12**.

Typically, main ancillary facilities would include:

- Temporary buildings including offices and meeting rooms, amenities and first aid facilities (the size and number of office facilities at the main compound would be greater than at the secondary compounds)
- Hardstand parking areas with sufficient space to accommodate the numbers of construction workers expected at any site
- Materials laydown, storage and handling areas, including purpose-built temporary structures as required and appropriately bunded storage for hazardous and non-hazardous substances
- Secure perimeter fencing, including visual screening of construction compounds where necessary
- Workshops with appropriate safety and environmental controls for servicing plant and equipment.

Access to construction ancillary facilities would be either via the access points on the existing road network or via new access tracks within the construction footprint. Known access locations to ancillary facilities are detailed further in **Section 5.4.12** and shown in **Figure 5-25**.

Areas of land that are leased by Transport for the purposes of construction would be rehabilitated upon completion of construction and restored to their existing condition, or as otherwise agreed with the landowner. Ancillary facilities would be progressively rehabilitated where possible to minimise soil exposure and the potential for dust generation, erosion and sedimentation, and visual impacts.

The final location, use, type and number of ancillary facilities would be confirmed by the construction contractor before construction and identified in a site establishment management plan. Where amendments or additional ancillary facilities are identified outside of the project construction footprint, the contractor would consult with Transport advisor to confirm the suitability of the proposed amendment or additional facility, and whether additional environmental assessment is required.

The main functions of the construction ancillary facilities are described below. The treatment of acid sulphate soils and temporary wharf facilities are described in **Section 5.4.5** and **Section 5.4.6** respectively.

Table 5-12 Proposed construction ancillary facility locations and uses

Ancillary ID	Location	Area (ha)	Potential function											Construction activities			
			Laydown	Stockpiles – (includes mulch)	Crushing and materials processing	Concrete batch plant	Concrete precast yard	Acid sulphate soil treatment	Main compound (incl. parking)	Wharf facilities	Asphalt batch plant	Satellite compound (incl. parking)	Parking	Established for enabling work	Interchange	Viaduct (B05)	Bridge
AS1	**Black Hill:** On the corner of John Renshaw Drive and the M1 Pacific Motorway. North of a transmission line easement, east of vegetation	1.6	✓	✓								✓		✓	✓		✓
AS2	**Black Hill:** East of the M1 Pacific Motorway. South of a transmission line easement	2.7	✓	✓								✓			✓		✓
AS3	**Black Hill:** South of the New England Highway and a transmission line easement	6.7	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓
AS4	**Tarro**: North of the New England Highway. South and west of residential area	0.5	✓	✓									✓		✓		
AS5	**Tarro:** South of the New England Highway, west of Woodlands Close	4.7	✓	✓				✓				✓		✓	✓	✓	✓
AS6	**Tarro:** West of Maitland Road / New England Highway and east of the railway corridor	4.6	✓	✓				✓				✓		✓		✓	
AS7	**Tarro:** East of Maitland Road / New England Highway and north and south of main alignment	6.8	✓	✓	✓	✓	✓	✓	✓		✓					✓	
AS8	**Tarro:** East of Maitland Road / New England Highway and west of the Hunter River	1.7	✓	✓								✓				✓	

Ancillary ID	Location	Area (ha)	Potential function											Construction activities			
			Laydown	Stockpiles – (includes mulch)	Crushing and materials processing	Concrete batch plant	Concrete precast yard	Acid sulphate soil treatment	Main compound (incl. parking)	Wharf facilities	Asphalt batch plant	Satellite compound (incl. parking)	Parking	Established for enabling work	Interchange	Viaduct (B05)	Bridge
AS9	**Tarro:** East of Purgatory Creek and north of the Hunter River	9	✓							✓		✓				✓	
AS10	**Tomago:** North-west of the Pacific Highway and south of the Hunter River. South of the main alignment	5.7	✓	✓		✓	✓	✓	✓		✓	✓		✓	✓	✓	✓
AS11	**Tomago:** North-west of the Pacific Highway and south of the Hunter River. North of the main alignment	3.5	✓	✓		✓	✓	✓			✓	✓			✓	✓	✓
AS12	**Tomago:** South of the Pacific Highway and east of Tomago industrial area. South of the main alignment	2.7	✓	✓	✓	✓						✓		✓	✓		✓
AS13	**Tomago:** South of the Pacific Highway and east of Tomago industrial area. North of the main alignment	1.3	✓	✓								✓		✓	✓		✓
AS14	**Heatherbrae:** East of the Pacific Highway, south of Heatherbrae commercial area. North of the main alignment.	2.9	✓	✓				✓				✓		✓			✓
AS15	**Heatherbrae:** East of the Pacific Highway, south of Heatherbrae commercial area. South of the main alignment	2.1	✓	✓				✓					✓				✓
AS16	**Heatherbrae:** South of the Pacific Highway and west of Masonite Road	25.1	✓	✓		✓	✓	✓	✓		✓			✓			✓

Ancillary ID	Location	Area (ha)	Potential function											Construction activities			
			Laydown	Stockpiles – (includes mulch)	Crushing and materials processing	Concrete batch plant	Concrete precast yard	Acid sulphate soil treatment	Main compound (incl. parking)	Wharf facilities	Asphalt batch plant	Satellite compound (incl. parking)	Parking	Established for enabling work	Interchange	Viaduct (B05)	Bridge
AS17	**Heatherbrae:** South of Masonite Road	7.5	✓	✓		✓	✓		✓		✓	✓		✓			✓
AS18	**Heatherbrae:** South of the Pacific Highway and east of Masonite Road. North of the main alignment	3.2	✓	✓									✓				✓
AS19	**Heatherbrae:** South of the Pacific Highway and east of Masonite Road. South of the main alignment.	8.6	✓	✓		✓	✓	✓	✓		✓	✓		✓			✓
AS20	**Raymond Terrace:** South of the Pacific Highway, west of the main alignment.	1.2	✓	✓									✓		✓		✓
AS21	**Raymond Terrace:** South of the Pacific Highway, east of the main alignment.	5.7	✓	✓				✓				✓			✓		✓

Stockpile and laydown areas

Stockpile and laydown areas would be required to temporarily store:

- General construction materials
- General fill material: Temporary storage of select material, rock or other material at various locations along the project
- Spoil: Excavation of existing ground and road surfaces would create excess spoil material that may need to be stockpiled
- Mulch and topsoil: Stockpiling of topsoil and mulch created from clearing and chipping of vegetation would be needed before this material is re-used on the project.

Temporary stockpiling may be required to suit the sequence of construction activities. The laydown and spoil stockpile areas would be located within the ancillary facilities identified in **Table 5-12** and shown in **Figure 5-25** as well as other areas within the construction footprint.

Batching plants

Asphalt and concrete required for the construction of the project would be obtained from local suppliers as far as practicable. However, existing suppliers may be unable to meet the production rates required where large quantities are required at high production rates for the project. As such, it is likely that one or more on-site asphalt and concrete batching plants would be required to form asphalt and concrete required for the project. Batching plants would be located within ancillary facilities as identified in **Table 5-12**.

To support the batching plants, temporary buildings for staff amenities, offices and quality assurance control would also be required.

It is desirable that crushing plants be located in the vicinity of batching plants. Potential for co-location would be taken into consideration when choosing the relevant locations for the facilities.

Crushing plants

Crushing plants would be required primarily to process rock material from cuttings to make suitable fill material. Aggregate production to support concrete and/or asphalt batching in addition to materials for drainage would also be carried out where possible. The potential location of the crushing and materials processing plants have been identified in **Table 5-12**.

The crushing plants would also be expected to include areas for the stockpiling of material. Stockpiling requirements would depend on the construction staging and contractor’s work methods, but it is assumed that storage would be required either in the crushing plant area or in the construction footprint before it is placed in fill locations.

Crushing plants would be located as near as possible to concrete or asphalt batch plants to minimise haulage on public roads.

Precast facilities

Precast facilities may be required to produce the precast concrete products to build bridge deck segments and girders ready for assembly. The potential location of the precast facilities have been identified in **Table 5-12**.

The need for precast facilities would be determined by the construction contractor and would depend on the bridge construction method adopted, value for money and the availability and proximity of alternative precast facilities.

Assessment of ancillary facilities

Where possible, ancillary facilities identified in this EIS are nominated in locations that:

a) Are more than 50 metres from a waterway
b) Are within or adjacent to land where the project is being carried out
c) Have ready access to the road network
d) Minimise the need for heavy vehicles to travel through residential areas
e) Are on relatively level land
f) Are separated from nearest residences by at least 200 metres (or at least 300 metres for a temporary batching plant)
g) Do not require vegetation clearing beyond that already required for the project
h) Avoid and minimise impact on heritage items (including areas of archaeological sensitivity) beyond those already impacted by the project
i) Do not unreasonably affect the land use of adjacent properties
j) Are above the one in 20 year ARI flood level (equivalent to about an 5% AEP flood level) unless a contingency plan to manage flooding is prepared and implemented
k) Provide sufficient area for the storage of raw materials to minimise, to the greatest extent practical, the number of deliveries required outside standard construction hours.

An assessment of the proposed ancillary facilities against the standard considerations above are summarised in **Table 5-13**. Where the ancillary facility does not comply with the above criteria it has been noted as ‘N’, shaded grey and an explanatory comment included. Where the ancillary facility location does not currently meet the criteria (such as criteria c, h, and j) but would be rectified prior to use, it has been noted as ‘Y’ and shaded light green.

Table 5-14 lists the management measures that would be implemented for ancillary facilities which do not meet the criteria. Further details of environmental management measures are summarised in **Chapter 24** (summary of environmental management measures).

Table 5-13 Assessment of ancillary facilities against standard considerations

Ancillary ID	Compliance with the standard condition criteria										
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
AS1	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
AS2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
AS3	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y
AS4	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y
AS5	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y
AS6	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
AS7	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
AS8	N	Y	Y	Y	Y	N	Y	Y	N	N	Y
AS9	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
AS10	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
AS11	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
AS12	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
AS13	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
AS14	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y
AS15	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
AS16	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
AS17	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
AS18	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
AS19	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
AS20	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
AS21	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table 5-14 Relevant mitigation measures for ancillary facilities

Criteria	Issue	Ancillary facility	Environmental management measure
a)	Ancillary facilities are located next to or within 50m of the Viney Creek tributary, Purgatory Creek or the Hunter River	AS1, AS7-AS9 and AS11	A Soil and Water Management Plan will be prepared as part of the CEMP. This plan will specify a range of measures to be implemented to manage potential impacts to watercourses (**Chapter 11** (surface water and groundwater quality)).
c)	Site access	AS3 and AS9	Access to the ancillary facilities would be provided within the construction footprint or using existing easements (such as the Hunter Water Corporation CTGM easement) (refer to **Section 5.4.12**).
f) and i)	Residences are located between 10m and 175m from the ancillary facility. Noise, light and amenity would need to be managed	AS3-AS5, AS8 and AS14.	A Construction Noise and Vibration Management Plan will be prepared as part of the CEMP. This plan would include a range of measures to manage and mitigate noise and vibration impacts from use of the ancillary facilities (refer to **Chapter 8** (noise and vibration)).
h)	Impacts to known Aboriginal heritage items	AS1-AS4, AS16 and AS17	The management measures identified in the Aboriginal Cultural Heritage Assessment Report (**Appendix L**) will be implemented. This will include the completion of all archaeological investigations and any required actions such as salvage would have been completed prior to the establishment of the ancillary facility
j)	Ancillary facilities are subject to flooding within 5% AEP flood level.	AS5-AS9, AS18 and AS19	The Flood Management Plan will specify a range of measures to be implemented to manage potential flood impact associated with the ancillary facilities and access tracks (refer to **Chapter 10** (hydrology and flooding)). Management measures will include: • Appropriate management measures will be implemented during construction to ensure minimal impact on the Hunter River and floodplain and its capacity to convey flows in the event of a flood • Where feasible, the size of the ancillary facilities will be reduced • Ancillary facilities (and access tracks) will be raised above the floodplain to manage the risk in the event of a flood exceeding 5% AEP • Ancillary facilities will include appropriate erosion and sediment control measures to minimise the sediment that could be transported into the Hunter River.

Temporary leases

The project would temporarily lease land for ancillary facilities, access tracks and construction. The leased areas would be rehabilitated upon completion of construction and restored to existing condition, or as otherwise agreed with the landowner. Properties subject to temporary leases generally include those affected by partial acquisition.

Details of properties that may be temporarily leased within the construction footprint are provided in **Chapter 14** (land use and property) and the Land Use and Property Working Paper (**Appendix N**).

5.4.4 Plant and equipment

Indicative equipment for the different construction components is presented in **Table 5-15**. The final plant and equipment profile would be determined by the construction contractor and may vary to what is listed.

Table 5-15 Indicative construction plant and equipment

Component	Typical plant and equipment
Enabling work and utilities	Trucks (road, fuel and concrete), light vehicles, heavy vehicles (floats, semi-trailers), excavators, backhoe, front end loader, dump trucks, chainsaws, jackhammers, concrete saws, mulchers, water carts, small cranes and lifting equipment, hand tools and welding equipment
Construction of ancillary facilities	Trucks (road and fuel), light vehicles, heavy vehicles (floats, semi-trailers), excavators, backhoes, front end loaders, chainsaws, mulchers, water carts, small cranes and lifting equipment, hand tools, welding equipment, site sheds, light towers, generators and ablutions
Operation of ancillary facilities	Trucks (road and fuel), light vehicles, heavy vehicles (floats, semi-trailers), excavators, backhoes, front end loaders, chainsaws, small cranes and lifting equipment, site sheds, light towers, generators and ablutions, dump trucks, rock crusher and screening equipment For concrete batch plant: Drum mixer with incline conveyor, aggregate storage and feeder bins, silos for cement, fly ash and slag, electrical switch room, generators, air compressors, admixture tanks, water tanks, laboratory, storage containers, storage bins and truck wash bays For asphalt batch plant: Barrel mixer, feeder bins with incline conveyors, storage silos/tankers for bitumen, lime and fuel, control room, water tanks, laboratory, generators, air compressors, containers for general storage, storage bins, truck wash and weighbridge
Drainage and water quality control	Excavators, backhoe, elevated work platforms, mobile cranes, small cranes and lifting equipment, trucks (concrete and road), concrete pumps, compressors, generators, vibratory rollers, light vehicles, hand held compactors, light towers and hand held tools
Clearing, grubbing, and demolition	Excavator, excavator with harvester attachment, fuel truck, bulldozer, dump truck, skidder, chainsaws, tub grinder and mulcher, elevated work platform and light vehicles
Bulk earthwork	Excavators, excavator with hydraulic breaker, dump trucks, bulldozers, front end loaders, graders, scrapers, water cart, truck and dog, vibratory rollers, light vehicles, impact crusher, jaw crusher plant and drilling and blasting equipment
Pavements	Water carts, road trucks, truck compressor, concrete paver, asphalt paver, texturing machines, sprayers for curing, bitumen spraying truck, smooth drum vibratory rollers, multi-tyre roller, aggregate spreader, asphalt rotomill, concrete saw, backhoe, truck compressor, light vehicles, light towers and kerbing machine
Bridges and viaducts	Bored piling rigs, crawler crane with vibrating or impact driving hammer, excavator with sheet piling attachment, excavators, trucks (concrete and fuel), dump trucks, concrete pumps, hand tools, welding equipment, compressors, generators, small cranes and lifting equipment, mobile crane, piling rig barge, elevated work platforms, dewatering pumps, water carts, light towers, post tensioning jacks and equipment, light vehicles and heavy vehicles delivering piling materials, plant, and equipment, and crane and supply barges

Component	Typical plant and equipment
Roadside furniture and finishing work	Excavators, elevated work platforms, trucks (road, concrete and line marking) mobile cranes, small cranes and lifting equipment, concrete trucks, light vehicles, light towers, hand held tools, jackhammers, line and generators
Traffic management and control	Small trucks, light vehicles, light towers, generators and hand tools
Landscaping	Light vehicle, water cart, backhoe, excavator, front end loaders, graders, road trucks, hand held tools and side tipper

5.4.5 Construction resources

Construction of the project would require a range of materials to be transported to and within the construction footprint, including within and between ancillary facilities. The major construction materials are discussed in further detail below. None of these resources are or are likely to become in short supply as a result of the project. Where feasible, materials would be reused and recycled.

Earthwork

Earthwork would be required along the entire length of the project as part of:

- Topsoil stripping
- Cut and fill
- Retaining wall and reinforced soil wall construction
- Site preparation for bridge construction
- Road drainage infrastructure installation
- Sedimentation and erosion control
- Building up of some access tracks and ancillary facilities to provide a level of flood immunity during construction.

Areas of cut and fill are shown in **Figure 5-25** and described in **Section 5.3.6**.

Table 5-16 shows the approximate bulk total earthwork quantities. In summary, project earthworks are likely to result in an estimated net deficit of fill material and would require importation of fill.

Table 5-16 Approximate total bulk earthwork quantities

Type of material	Approximate quantity (m^3)
Total fill material required	1,940,000
Total cut material to be excavated	860,000
Total fill deficit to be imported	1,080,000
Topsoil to be stockpiled	80,000

The project has been designed with a strategy of maintaining an earthwork balance to the south of the Hunter River where possible. The aim is to achieve haulage efficiencies and reduce construction traffic across the existing Hexham Bridge. Haulage movements between the cut and fill areas shown in **Figure 5-25** are expected to be contained in the construction footprint or use the existing road network (refer to **Section 5.4.12**).

As it is undesirable to haul large quantities of general fill materials long distances, alternative sources of construction materials such as from local mine backfill, borrow pits and other Transport projects would be further investigated during detail design.

All suitable excavated material would be reused as general fill either within the same section of work or elsewhere along the project. Where excavated material cannot be reused within the project, material would be managed in the following order of priority:

- Transfer to other Transport projects for reuse in accordance with the NSW EPA's excavated public road resource recovery order and exemption
- Transfer to an approved Transport stockpile site for reuse on a future project if a specific project is identified and statutory and regulatory requirements under the POEO Act are met
- Remove off-site for reuse by a third party in accordance with relevant NSW EPA resource recovery order and exemption or to a NSW EPA licensed waste recovery facility
- Dispose at an accredited materials recycling or waste disposal facility – where excavated material is deemed unsuitable for reuse or emplacement due to contamination, it would be taken to a waste facility licensed to accept the waste.

Cutting at Black Hill

Road cuttings are likely to be excavated by bulldozers. However, controlled rock blasting may be used at the large cutting at Black Hill (C01) to enable the contractor to be more efficient. The location of this cutting shown in **Figure 5-25**.

Rock breaking alternatives such as penetrating cone fracture and hydraulic rock breakers may also be used. No blasting within waterways is proposed for this project.

If required, a Blast Management Plan would be prepared before blasting starts to identify exact blasting locations. Where a blast location is predicted to have an impact on a sensitive receiver, a series of trials would be carried out at a reduced scale to determine site specific blast response characteristics and to define allowable blast sizes. Safety measures for the travelling and general public, including safe blast distances and exclusion zones, would be identified within the Blast Management Plan. **Chapter 8** (noise and vibration) further considers the noise and vibration impacts of blasting.

Based on the geotechnical investigations completed for the project, the material excavated from the cutting at Black Hill (C01) is expected to comprise highly weathered rock and residual soils (clays). With appropriate crushing and blending, it is anticipated that all cut material from Black Hill would be suitable for general fill requirements.

Acid sulfate soils

Regional acid sulphate soil (ASS) maps indicate that there is a high probability of ASS being present within the Hunter River sediments, associated low lying floodplains and swamp areas within the construction footprint. The majority of ASS is expected to be encountered while boring concrete piles for bridges. Potential acid sulphate soils (PASS) and ASS would be either treated where they are extracted or transferred to treatment areas within ancillary facilities (refer to **Figure 5-25** and **Chapter 16** (soils and contamination).

The estimated volume of material to be treated is expected to be about 50,000 cubic metres. Treatment of ASS is to be confirmed during detail design, however, would generally involve:

- Establishing a treatment area prior to the work that is likely to encounter ASS or PASS
- If possible, prior to the disturbance of soil in situ, add lime over the area (limited opportunity for piling spoil)
- Transfer soil to the treatment area
- Place soil in layers on a treatment pad and add lime
- Turn the soil over in such a manner that the lime is mixed and distributed

- Leave the material on the treatment pad for a period of time (typically ranging from a few days to a week), turning the soil when the surface dries out
- Once test results confirm that acceptance criteria have been achieved the material may be reused on site.

Soft soil treatment

Soft soils are geologically young and have not undergone substantial consolidation since their formation. They are soils where settlement criteria cannot be achieved without the use of ground improvement techniques. These soils are problematic as they may move and settle over a long time span.

These areas require improvement of the existing foundation material in order to meet settlement criteria applicable for the project. Areas of soft soils include:

- The viaduct (B05) approach embankment, including the Tarro interchange and Tomago interchange
- Approach to the bridge (B09) at the HRBG access
- Approach to the bridge (B12) on Masonite Road
- Raymond Terrace interchange embankments.

These areas would be improved via the process of preloading the soils up to nine months before construction. Preloading involves applying a load on the ground surface to accelerate consolidation. This would be carried out as part of initial earthwork activity in these areas. Some of the bridges would cross over large extents of soft soils, reducing the area of soft soils that need to be treated.

Wick drains may be installed within the preload soils and embankments to accommodate displaced groundwater expelled (surcharged) from the expected settlement. Discharge from wick drains is considered dewatering discharge and will be monitored and managed in accordance with the Construction Soil and Water Management Plan and Acid Sulfate Soils Management Plan, under the project CEMP (refer to **Chapter 24** (summary of environmental management measures)).

Soils and geology are discussed further in **Chapter 16** (soils and contamination) while groundwater quality is discussed in **Chapter 11** (surface water and groundwater quality).

Construction materials

Concrete and asphalt

Concrete and asphalt would be required for pavements, bridges and road surface sub-base as shown in **Table 5-17**. As described above, asphalt and concrete would be obtained from local suppliers as far as practicable and would be delivered in agitator trucks. Where required, concrete may also be sourced from batching plants. Potential locations for batching plants include AS3, AS7, AS10, AS11, AS12, AS16, AS17 and AS19, as discussed in **Section 5.4.3**.

Table 5-17 Approximate quantities of concrete and asphalt

Type of material	Approximate quantity (m^3)
Selected material zone pavement	155,000
Wearing course (asphalt)	60,000
Wearing course (concrete)	140,000
Bridge structures (concrete)	100,000

Precast girders

About 1030 precast bulb-T and super-T girders are required for the bridge elements within the project. Additionally, about 185 precast segments are required to construct the five spans of the viaduct (B05) over the Hunter River.

Precast girders would be delivered to site as required to avoid double handling, while minimising the storage area required. However, the construction contractor may adopt a different strategy and consideration of possible areas for the storage of precast girders at the various ancillary facilities has been considered in **Section 5.4.3**.

Precast segment manufacturing for the box girder crossing of the Hunter River would likely to be cast in a yard close to site. These precast girders would then be moved into place.

Steel

About 16,000 tonnes of reinforcing steel and 12,000 tonnes of steel piles would be required for structures. Steel would be sourced by the construction contractor, with the final quantity of steel dependent on volumes, quality and performance requirements of the project.

Rock

Rock for drainage blankets, bridging layers, gabion walls, scour protection and pavement gravel would be sourced from road cuttings such as at Black Hill (C01) and local quarries where possible.

Water

Water would be used during construction for a range of purposes including, but not limited to, dust suppression, earthwork compaction, wheel washing, machinery, concrete and asphalt batching, curing structures and for amenities (toilets, sinks, showers, and drinking). Indicative construction water use is estimated in **Table 5-18**.

Construction water sources would be confirmed during detailed design and by the construction contractor but are likely to include a combination of potable mains supply and recycled water, drawn from sources internal and external to the construction footprint. The quantity and quality of the water is readily available in the local area. Relevant approvals required for the extraction of water are discussed in **Chapter 2**.

A water balance for ground and surface water and the sources of water expected for the project are discussed in **Chapter 10** (hydrology and flooding) and **Chapter 11** (surface water and groundwater quality). Further information is provided in the Hydrology and Flooding Working Paper (**Appendix J**) and the Surface Water and Groundwater Quality Working Paper (**Appendix K**).

Table 5-18 Estimated water use during construction

Construction activity	Water use volume (megalitres)
Bulk earthwork	82
Dust suppression	76
Road surface construction	90
Concrete and asphalt batching plants	56
Potable water at ancillary facilities	40
Landscape watering	35
Curing of concrete	1
Total	**380**

Fuel

Plant, equipment and light vehicles would require the use of diesel fuel and petrol during the construction phase of the project. All fuels and chemicals stored in construction areas would be secured in areas with appropriate bunding. Refuelling and maintenance of plant and equipment would only occur in the site compounds or at designated areas in the construction footprint. The dedicated refuelling and maintenance areas would be provided with the necessary controls, including spill kits, to minimise any potential contamination incidents to protect soils and nearby waterways.

Further detail regarding the use and storage of fuel on-site is provided in **Chapter 16** (soils and contamination).

Electricity

Electricity consumption during construction would vary, and would depend on the contractor's proposed site use, facilities, staffing numbers and equipment. Electricity needs for the project would be relatively low and are envisaged to include lighting, air-conditioning and office equipment. Connecting the offices to the local power grid would be sufficient for these purposes.

Generators may be necessary for emergency power supply and at some ancillary facilities where connection to the local power supply is not readily available. Similar recent Transport projects have used a 200 kVA generator to supply the main site office.

Power consumption by the proposed concrete and asphalt batching facility would vary and would depend on the size of the plant. A typical medium-sized batching plant draws about 110 kilowatts per hour.

Spoil and waste disposal

Various waste streams would be generated during construction. The main waste streams would include:

- Surplus spoil (excavated soil, sediment, rock) from bulk earthwork which is unable to be reused within backfilling or restoration
- Demolition waste, including building materials, bridge removal materials, vegetation, kerbs and road surfaces
- Rocks, geofabric and other materials from the bridge work platforms
- Packaging materials from items delivered to site, such as pallets, crates, cartons, plastics, and wrapping materials
- Contaminated soils that may be exposed during construction, and if exposed, would require offsite disposal
- Existing stockpile sites located within the road reserve. The quality of the material within the stockpiles is unknown and could potentially contain contaminated material, including asbestos
- Surplus material from construction and general site reinstatement, such as fencing, sediment from temporary basins, concrete, steel, formwork, and sand bags
- Vegetative waste from clearing and grubbing
- Plant and vehicle maintenance waste, such as oil containers
- General waste from construction sites, including office wastes, scrap materials and biodegradable waste
- Liquid waste
- Sewage waste generated through the use of personnel facilities.

The impact of potential waste expected to be generated by the project and the proposed measures to manage waste are detailed in **Chapter 19** (waste).

5.4.6 Bridge work

Twelve bridge structures would be required for the project, including a 2.6 kilometre viaduct, bridges to cross wetlands or waterways and overpass bridges, as described in **Section 5.3.5**.

All bridge structures would be designed and configured to follow industry accepted construction practices. Potential construction methods and the construction program were considered in the design of bridges. Construction of the bridges would generally involve:

- Construction of bridge footing and substructures, including piles, abutments, piers and headstocks
- Construction of superstructures including beams, girders, decks and barriers
- Installation of anti-throw screens where bridge passes over another roadway.

Nine bridges (B01, B02, B03, B04, B06, B08, B10, B11 and B12) and sections of B05 would be able to be constructed offline. Online construction of three bridges (B05, B07 and B09) and sections of B05 would not require full closures of roads for extended periods. However, they may require temporary road and/or lane closures and traffic diversions during suitable times to allow safe execution of work near:

- Pacific Highway
- New England Highway
- Aurizon access road
- HRBG access road.

Impacts on traffic, including the requirement for temporary road and/or lane closures and traffic diversions are further discussed in **Chapter 7** (traffic and transport).

Construction of the bridge structures at the interchange with the M1 Pacific Motorway at Black Hill, New England Highway at Tarro and Pacific Highway at Raymond Terrace, may have one or a combination of the following impacts on the travel lanes and ramps:

- Speed reductions
- Temporary lane closures while lifting girders above the road
- One directional carriageway closures during off-peak time.

A detailed assessment of bridge options would be carried out during detailed design to minimise the impact of bridge construction on the existing M1 Pacific Motorway, New England Highway and Pacific Highway operations, as much as practically possible.

Construction of the viaduct (B05) over the Main North Rail Line would be carried out in consultation with rail authorities (including Australian Rail Track Corporation (ARTC)) and would occur during rail shut down periods.

The design of the bridges to date has considered the requirements of the Policy and Guidelines for Fish Habitat Conservation and Management (update 2013) which incorporates Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge 2003).

Bridge foundations

Geotechnical investigations carried out to date at the proposed bridge locations indicate that each bridge can be supported on either driven or cast in place (bored) pile footings into bedrock. The depth to low medium strength bedrock or dense sand would be typically greater than 10 metres below existing ground surface levels.

Bridge foundations (including piles, abutments and piers) would be constructed using standard bridge building techniques.

Construction of bridge foundations near existing roads would typically require temporary lane closures and traffic diversions. Full road closures over extended periods would not be required, but closures over short periods may be required to facilitate critical construction activities that cannot otherwise be practically carried out. Impacts on traffic, including the requirement for temporary road and/or lane closures and traffic diversions are further discussed in **Chapter 7** (traffic and transport).

Superstructures

The majority of the bridges would likely be constructed using the precast construction techniques, where superstructure elements would be precast and placed on bridge supports. Generally, precast elements of the bridges would be prepared off-site at dedicated casting yards and transported to the project site by road, however as noted in **Table 5-12**, there is the potential for on-site precast yards at project ancillary facilities. The precast element would be stored at the manufacturer's site and at relevant construction ancillary facilities where required.

A crane would be used to lift the beams and girders into place directly onto the abutments and pier headstocks once the bridge bearings are constructed. Temporary bracing may be required between the girders.

The bridge deck and barriers would typically be constructed from reinforced concrete. In most cases, precast units would be used for the barriers. Concrete bridge decks would require temporary formwork to be installed before pouring. The formwork would typically be supported directly from the bridge girders. Where required, girders would be post tensioned once the concrete cures to its required strength and the falsework and formwork removed.

The abovementioned techniques describe common bridge construction scenarios. Site specific opportunities and constraints identified during detailed design may require alternative construction techniques.

In some circumstances (such as the bridge (B08) over Old Punt Road), bridges would be constructed in place using falsework and formwork. Formwork and its associated falsework (temporary or permanent moulds into which concrete is poured) would be constructed in place then the reinforcing placed within the formwork and the concrete placed using concrete pumps and vibrators.

Work platforms

Work platforms would be required at bridge sites to provide a working area for bridge pier and abutment construction, including piling. Platforms may also be required along the length of the bridge to provide a stable platform for the crane when erecting girders between the bridge piers.

The exact number and location of the working platforms would depend on the construction contractor's preferred construction method and equipment for the bridge work and may differ depending on the bridge type and bridge length. The number and location of work platforms required would be identified in the CEMP.

Specific work platforms required to support the viaduct (B05) are discussed below.

Hunter River crossing

The portion of viaduct (B05) that crosses the Hunter River would be constructed using the precast segmental balanced cantilever method with transitions to precast concrete girder approach spans on either side of the river.

The piers in the centre of the Hunter River are proposed to be constructed using piling rigs, cranes and concrete pumps on barges with secondary barges supplying the materials to the piers and removing spoil.

To aid in bridge construction, temporary work, such as temporary rock platforms, temporary bridges and temporary wharves, would be installed in the Hunter River. While the majority of the bridge work on the Hunter River would be carried out using barges, the piers directly next to the riverbanks would be in an area too shallow for barges to access. This temporary work would be installed between the riverbank and the piers to provide access for plant such as piling rigs, cranes and concrete pumps.

Two temporary work options have been considered to facilitate construction of the bridge over the Hunter River:

- Temporary rock platforms would be built by placing geotextile fabric on the Hunter River bed, installing silt fencing and laying down rocky material to create a platform about 15 metres by 25 metres in size. An example of a temporary rock platform is shown in **Photo 5-1**
- Temporary bridges would be built by driving steel piles into the riverbed. A temporary bridge deck would be used, typically made of precast concrete or steel.

The final decision about what type of structure to use would be dependent on the contractor's construction methodology, as well as the flooding, water quality and aquatic ecology impacts of a rock platform. The temporary structure type would be confirmed during construction planning. These temporary structures would be removed following construction.

In addition, up to two temporary wharves of about 15 metres by 15 metres would be constructed on one or both sides of the river to service the barges for construction of the river crossing. An example of a temporary wharf is shown in **Photo 5-2**. The wharf would likely be constructed in a similar manner to the temporary platforms, however sheet piles could also be used in order to provide a vertical end to the wharf. Alternatively, the wharf could be constructed as a temporary bridge using piles and precast deck.

Final details regarding temporary work would be confirmed during the detailed design phase of the project. Access for marine vessels using the Hunter River would be maintained during construction.

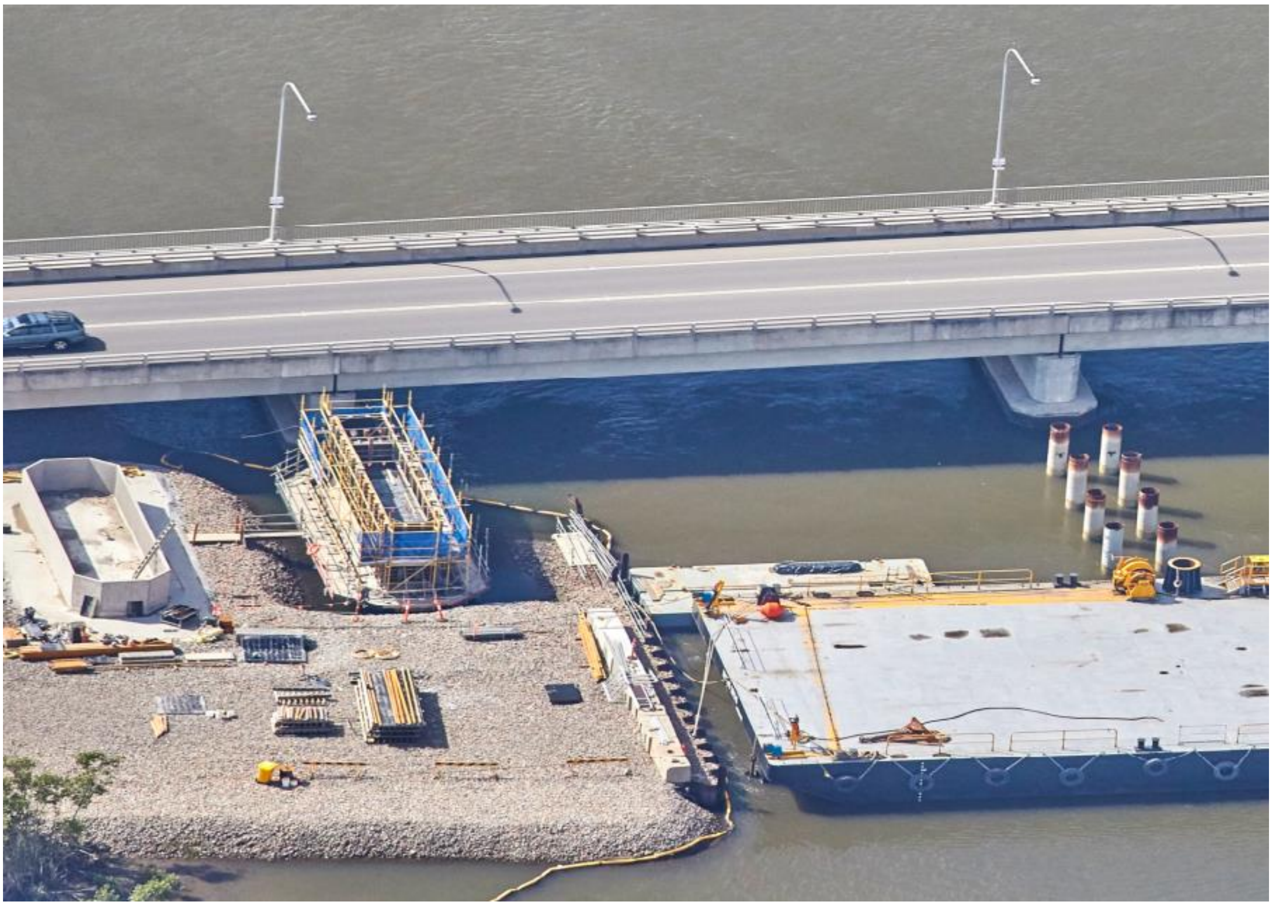

Photo 5-1 Example of a temporary rock platform within a river

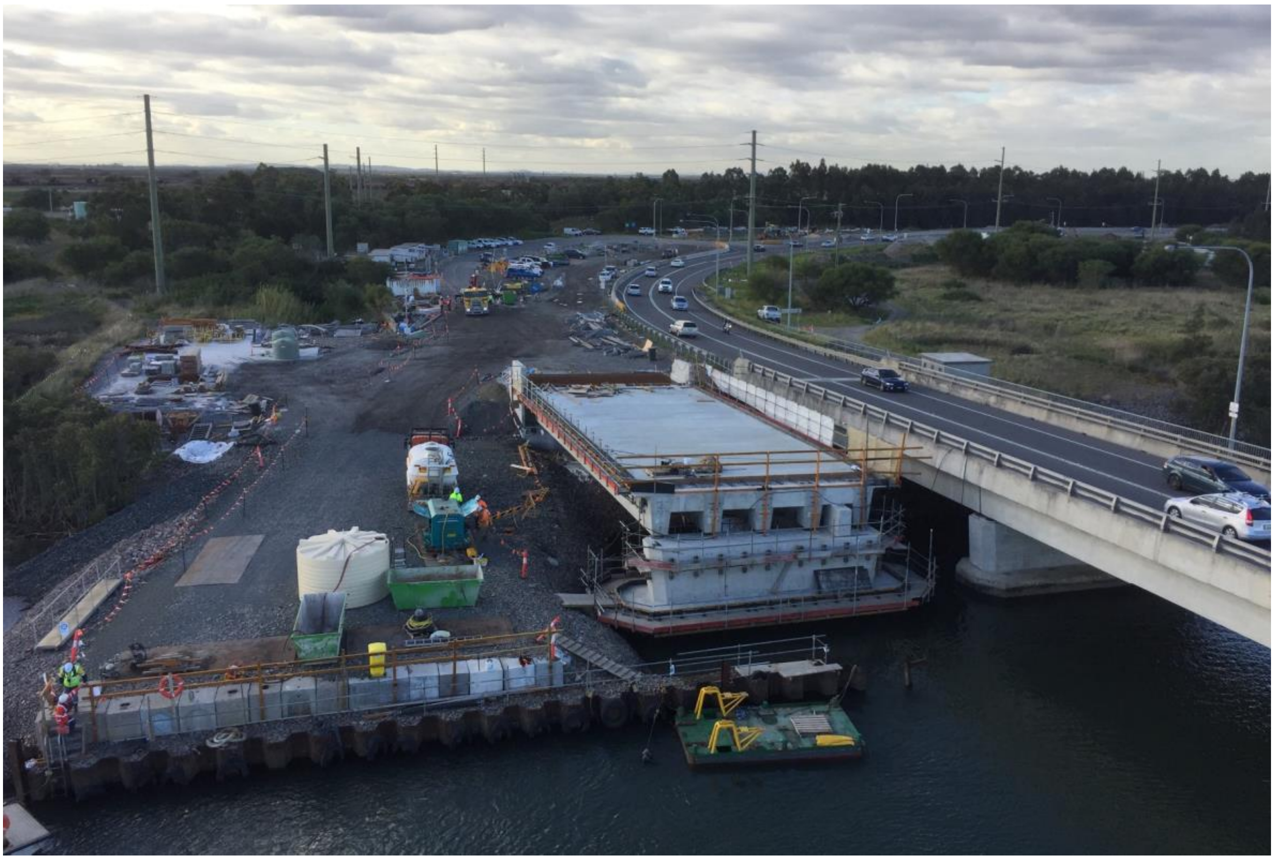

Photo 5-2 Example of a temporary wharf

Dredging

Construction of the viaduct (B05) would require dredging the Hunter River bed within the construction footprint to allow barges to access the site. Dredging is a relatively common activity within New South Wales ports and coastal waters for capital and maintenance projects, with specialised contractors and equipment designed to meet project and environmental requirements in a variety of conditions. An example of a dredge in operation is provided in **Photo 5-3**.

Dredging operations would be carried out within a floating silt curtain enclosure to a depth of two to three metres to minimise impacts to the surrounding aquatic environment. A shallow silt curtain would also be installed next to ecologically sensitive areas to provide additional protection.

Suitable dredged material would be either transported to an ancillary facility for assessment, treatment and potential reuse on site, or disposed of off-site to a licensed facility.

Photo 5-3 Example of dredging within the Hunter River

5.4.7 Demolition

Existing buildings and infrastructure within the construction footprint that would be unable to be reused as ancillary facilities during construction would be demolished and removed. Buildings and infrastructure requiring demolition and removal would include:

- Buildings (including residences), sheds or farm infrastructure: all buildings would be demolished in accordance with Australian Standard AS2601: The Demolition of Structures (AS 2601). Three dwellings would be demolished, including two dwellings on rural land and one dwelling associated with a commercial property at Heatherbrae. The need for and impact of acquisitions are considered in **Chapter 14** (land use and property)
- Road pavement: road adjustments would result in redundant road pavement. For instance, in the vicinity of the interchanges, at new entry and exit ramps to and from the main alignment and at merges with or diverges from the existing M1 Pacific Motorway. After construction, road surfaces and their function would be reinstated to their current standards or better. Redundant pavement would be removed, and the ground rehabilitated in accordance with the project specifications.

Demolition waste would be reused and recycled where possible or disposed of at an appropriately licensed facility.

5.4.8 Waterway adjustments

As described in **Section 5.3.10**, Purgatory Creek and a tributary of Viney Creek would be adjusted. The indicative methodology for the waterway adjustments includes:

- Installation of erosion and sediment control measures to protect the existing creek
- Bulk earthwork for the adjustment would be carried out offline to minimise interruption of the existing creek flow
- The new section of creek would be kept free of flowing water to allow the planting and establishment of local native riparian vegetation and placement of rock for scour protection
- When work is complete and the new channel is established, flow would be introduced to the new channel during a period of low flow in the existing creek

- While the adjusted creek channel is becoming established, water would be allowed to flow along both the old section of creek and the adjusted section. This would allow for a final assessment and checking of the work
- Final diversion of all flows to the new creek channel
- Once the diversion work is complete, the old creek channel would be backfilled.

Temporary diversions of other minor drainage lines may be required for the installation of culverts as discussed in **Section 5.4.9**.

The need for, extent and design of the waterway adjustments would be reviewed during detailed design, taking into account the potential environmental benefits of minimising any changes to the creeks' natural geomorphology.

5.4.9 Temporary creek crossings

Temporary crossings are likely to be required at waterways such as Purgatory Creek and Windeyers Creek for the construction of haul roads and construction access tracks within the construction footprint. These waterways crossings would likely comprise a temporary causeway with culverts or pipes installed to maintain flows and would be maintained for the duration of construction.

Temporary crossings would:

- Maintain flow conditions in the waterways
- Be certified by the road designer to confirm no adverse flooding impacts would occur during design flood events
- Be removed in full and the area rehabilitated following completion of construction.

Temporary waterway crossings would be designed in accordance with Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge 2003).

5.4.10 Drainage infrastructure

The project would require the construction of new drainage infrastructure and alterations to existing drainage infrastructure as described in **Section 5.3.8**. Construction of drainage work would involve localised excavation, compaction and installation of drainage culverts, pipes and pits, and construction of table drains and swales.

Drainage structures such as culverts and pipes would be installed to enable natural flows to be maintained during road formation construction. Where required, temporary diversion channels would be constructed to enable the installation of culverts and pipes. Appropriate controls would be implemented for the diversion channels to minimise the potential for scour. After the culvert or pipe is installed, the drainage line would be reinstated, and the temporary channels removed.

Generally, the construction of new surface drainage on the outside of the carriageways would be carried out in parallel with the earthwork required for road construction.

5.4.11 Water quality management

Construction of the project has the potential to affect water quality through erosion of exposed or disturbed areas and subsequent sedimentation of waterways. To mitigate these effects, erosion and sediment control and temporary sediment basins would be installed along the project to trap sediments and other pollutants from disturbed areas. The proposed water quality control measures are discussed further below.

Erosion and sediment controls

Erosion and sediment controls would be implemented to reduce the potential for impacts on waterways. A detailed assessment of erosion and sediment issues and associated management measures is provided in **Chapter 11** (surface water and groundwater quality) and **Chapter 16** (soils and contamination). Controls would vary from location to location and would typically include:

- Sediment fences and filters to intercept and filter small volumes of construction runoff
- Level spreaders to convert erosive, concentrated flow into sheet flow
- Progressive revegetation as soon as practicable
- On-site diversion drains that collect and divert construction runoff to treatment facilities
- Off-site diversion drains to collect clean runoff from upstream and divert it around or through the construction site without it mixing with construction runoff
- The lining of channels and other concentrated flow paths
- Temporary sediment basins to capture sediment and associated pollutants in construction runoff
- Specific measures and procedures for work within waterways, such as the use of silt barriers and temporary creek diversions.

Temporary sediment basins

The location and size of temporary sediment basins were determined in accordance with the Blue Book criterion. This criterion indicates that if the estimated annual soil loss from a disturbed catchment is less than 150 cubic metres, then a sediment basin may not be required, provided that other erosion and sediment controls are implemented (Soils and Construction, 2008 Volume 2D Main Road) (DECC 2008).

Based on the design as set out in this document, it is expected that up to 47 temporary sediment basins would be required to treat water during construction, as shown in **Figure 5-1**. Further details regarding the proposed temporary sediment basins are provided in **Chapter 11** (surface water and groundwater quality). The detailed design of erosion and sediment controls required during construction may result in changes to basin locations, sizing and/or the number of basins.

Temporary sediment basins would be established at the beginning of construction and maintained in effective working order until construction is complete. Many of the temporary sediment basins would be removed at the end of construction however, up to 33 basins would be retained or modified to provide permanent water quality control measures and/or onsite detention capacity during operation. Where possible, the operational water quality control measures described in **Section 5.3.9** would be constructed early and used during the construction stage. Permanent water quality basins are discussed further in **Section 5.3.9** and shown in **Figure 5-1**.

Progressive erosion and sediment control plans would be prepared for the project to outline the type and location of other required erosion and sediment controls.

Dewatering

Temporary construction dewatering would be required to support construction. Activities most likely to require dewatering include:

- Construction of temporary sediment basins
- Bridge structure construction including piles and pile caps, particularly at the wetlands crossing (B02), the viaduct (B05) and the Windeyers Creek (B11) crossing
- Excavation below the groundwater table for work associated with utilities, either protection of existing, or new utility alignments
- Excavation below the groundwater table for the installation of drainage infrastructure including culverts
- Pre-loading of soft soil areas, through wick drains.

Dewatering would be required where any construction activity occurs below the groundwater table. This is most likely in areas of high groundwater levels, including:

- The unnamed wetlands near the twin bridge (B02) between Black Hill and Tarro
- Around Tarro and New England Highway, including at Purgatory Creek
- The floodplain between New England Highway and the Hunter River
- The floodplain north of the Hunter River
- Tomago between the end of the viaduct (B05) to around the HRBG
- Windeyers Creek crossing.

Dewatering of temporary sediment basins and other excavations would be limited to the duration that excavations are open. Dewatering via wick drains would occur for the duration of soft soil consolidation, with dewatering volumes dependent on groundwater levels and consolidation rates. Dewatering would be managed via a dewatering management plan, which would be prepared as part of the Construction Soil and Water Management Plan, under the CEMP (refer to **Chapter 24** (summary of environmental management measures)).

5.4.12 Traffic management, transport and access

Pedestrian, cyclist and road traffic would be impacted during all stages of construction. These impacts are detailed in in **Chapter 7** (traffic and transport). The timing and sequence of the construction components has been designed to allow the existing road corridor to remain open to traffic, cyclist and pedestrian movements (refer to **Section 5.4.14**).

Traffic management

The construction footprint would intersect or run alongside the existing road network at several locations, as shown in **Figure 5-25**. Construction traffic moving to and from work sites could impact traffic on the existing road network. Where possible, construction traffic would be contained within the construction footprint and would use temporary internal haul roads to move around the project. This would minimise impacts on the public road network.

Construction activities are expected to be completed while maintaining through traffic on existing roads. Access would be maintained, or alternative access provided to properties, businesses and utilities with impacted access during the construction and operation of the project. Alternative provisions would be agreed with affected property, business or utility owners where required.

Temporary traffic management measures would be implemented at various stages of the project in accordance with Traffic Control at Work Sites (Roads and Maritime Services 2018b). These measures would include:

- Modification of lane widths to facilitate safe entry, exit and movement of plant and materials, and to allow for construction staging of work near existing roads
- Placement of separation barriers to protect road users and construction personnel
- Reduced speed zones on roads adversely modified by construction work
- Reduced shoulder widths to allow for tie-in work to be completed
- Traffic detours and switches.

Temporary directional and advisory signs, along with variable message signs, would be used throughout construction where necessary. It is envisaged that the contractor would maintain the current level of serviceability with only minor disruptions to traffic during final road surfacing and line marking.

An assessment of the likely traffic and transport impacts resulting from the construction of the project are presented in **Chapter 7** (traffic and transport). The assessment identifies the management measures that would be implemented to minimise these impacts.

Temporary road pavement, intersection and closures

Permanent road closures are not expected to be required.

Temporary short-term diversions, temporary road closures and temporary traffic intersections may be required, however, to support construction.

In general, temporary road pavement and temporary side-tracks and would be constructed as early as possible to remove live traffic from construction work zones. These would be required to facilitate construction at the interchanges, bridges and tie-ins to the local and state road networks.

To accommodate construction activities and delivery of materials to various sites across the project, the following temporary traffic intersections are proposed:

- New England Highway eastbound exit ramp at Tarro: modification of the existing intersection to allow right turn movements onto Anderson Drive
- Aurizon access road at Tarro: modification of the existing intersection to allow right turn movements onto Anderson Drive
- Anderson Drive at Tarro: modification to allow vehicles to exit to eastbound New England Highway
- Tomago Road intersection with the Pacific Highway at Tomago: modification of the signalised intersection to allow construction vehicles to exit and enter ancillary facility (AS10 and AS11) to the north of Pacific Highway
- Old Punt Road intersection with the Pacific Highway at Tomago: temporary modification of the signalised intersection to facilitate construction work of the realignment to the Pacific Highway
- Masonite Road: channelised intersection to allow right turn movements into ancillary facility AS16 (if a roundabout as part of a previously approved development application is not constructed prior to commencement of the project), Masonite Road would also be realigned to maintain access during construction
- Temporary turn provisions (possibly including acceleration and deceleration lanes) for entry and exit to ancillary facilities across the entire project.

These temporary traffic intersections would be subject to final design, construction staging and contractor usage of ancillary facilities.

Construction site access

Construction access would be from the existing road network including the M1 Pacific Motorway, Pacific Highway, John Renshaw Drive, New England Highway, Lenaghans Drive, Anderson Drive, Woodlands Close, Tomago Road, Old Punt Road, Quarter Sessions Road and Masonite Road. These roads are shown in **Figure 5-25** and would be used or crossed for:

- Importing materials to work areas
- Hauling materials from one work area to another across the local road network
- Providing access for the delivery of all construction materials and consumables
- Providing access for the workforce to the various locations along the project, particularly to the project laydown areas and project site office.

Most of the additional vehicle movements on the existing road network would occur at access points to the construction footprint and on the roads linking sources and suppliers of key construction materials to the construction footprint.

Access points from the construction footprint to the road network would be located at:

- The frontages of construction ancillary facilities (refer to **Table 5-19**)
- Varied locations along the main alignment construction site, with direct access from the existing road network:
  - John Renshaw Drive
  - Lenaghans Drive
  - TransGrid and Hunter Water Corporation easement off the M1 Pacific Motorway (if required)
  - The New England Highway between the existing Tarro interchange and Hexham
  - Tarro interchange/Aurizon access road
  - Pacific Highway at Tomago and Heatherbrae
  - Old Punt Road
  - Masonite Road
  - The Pacific Highway at Raymond Terrace.

Access points to the construction site would be confirmed by the construction contractor before construction and detailed in the Traffic Management Plan (TMP) and be subject to temporary traffic controls.

Table 5-19 Access to ancillary facilities

Ancillary ID	Direct entry access	Direct exit access
AS1	Left in from John Renshaw Drive	Left out to John Renshaw Drive
AS2, AS3	Left in from Lenaghans Drive	Left out to Lenaghans Drive
AS1, AS2, AS3 (alternative access via utility easement)	Left in from the New England Highway (westbound)	Left out to the New England Highway (westbound)
AS4	Left in from Quarter Sessions Road	Right out to Quarter Sessions Road
AS5	Left in from existing Aurizon access road	Right out to existing Aurizon access road
AS6	Left in from the New England Highway (westbound)	Left out to the New England Highway (westbound)
AS7	Left in from the New England Highway (eastbound)	Left out to the New England Highway (eastbound)
AS8	• Left in from the New England Highway (eastbound) • Right in from the New England Highway (westbound)	Left out to the New England Highway (eastbound)
AS9	Left in from the New England Highway (eastbound)	Left out to the New England Highway (eastbound)
AS10, AS11	Left in from the Pacific Highway (northbound)	Left out to the Pacific Highway (northbound)
AS12, AS13	Left in from the Pacific Highway (southbound)	Left out to the Pacific Highway (southbound)
AS12, AS13 (alternate access via Old Punt Road)	Left in from Old Punt Road (northbound)	Left out to Old Punt Road (northbound)

Ancillary ID	Direct entry access	Direct exit access
AS14, AS15	Left in from the Pacific Highway (southbound)	Left out to the Pacific Highway (southbound)
AS16	• Left in from Masonite Road (northbound) • Right in from Masonite Road (southbound)	Left out to Masonite Road (northbound)
AS17	Left in from Masonite Road (northbound)	Left out to Masonite Road (northbound)
AS18, AS19	Left in from Masonite Road (southbound)	Left out to Masonite Road (southbound)
AS20, AS21	Left in from the Pacific Highway (southbound)	Left out to the Pacific Highway (southbound)

Temporary access roads

The project would require construction of temporary access roads in the construction footprint to provide access during construction, as shown in **Figure 5-25**. Some access roads across the floodplain to and along the viaduct (B05) would be retained for maintenance during operation of the project.

Haulage routes and vehicle movements

During construction, haulage of bulk earthwork materials is expected to be the main contributor to additional heavy vehicle movements in the area. Where possible, haulage of materials would generally be carried out within the construction footprint along internal access and haul roads to minimise construction vehicle movements on public roads. Where possible, transport movements on the existing road network would be scheduled to ensure that the number of vehicle movements would be minimised during the morning and evening peak traffic periods. Scheduling of construction transport movements will be detailed in the TMP as part of the CEMP.

In addition to haulage within the construction footprint, construction vehicles would be required to import materials to the construction site along the public road network. Where possible, heavy vehicles would primarily use major roads including Pacific Highway and New England Highway. However, the use of regional and local roads may be required.

Haulage would occur at various times, but haulage planning would consider peak traffic hours and periods, particularly during school and public holidays, to minimise the potential for delay on the existing road network.

Construction vehicle movements would occur throughout the project, and moderate fluctuations in traffic volumes are likely in response to the construction program and key activities in each location. Construction is expected to result in an average of about 1300 truck movements per day. Haulage and delivery of materials may occur during extended construction hours, and the delivery of oversized structural elements requiring police or other escorts may occur out of standard work hours.

Traffic impacts during construction are discussed in **Chapter 7** (traffic and transport).

Rail

Viaduct (B05) construction would impact on the Main North Rail Line, as shown in **Figure 5-25**. As much as possible, construction would occur outside of the rail corridor. However, activities, such as establishing girders (a large iron or steel beam) and placing pre-cast viaduct components, would occur within the rail corridor. Construction would occur during scheduled possessions of the rail line. Transport are currently consulting with ARTC in order to obtain concurrence.

5.4.13 Workforce and construction work hours

Workforce

The size and composition of the construction workforce would vary over the duration of construction depending on the activities carried out and the construction program and staging. The workforce is expected to peak at about 1050 workers per year, including construction workers and professional and administrative staff. Multiple work crews may be constructing the project at any one time.

Construction work hours

The recommended standard hours for construction as noted in the Interim Construction Noise Guideline (DECC 2009) are shown in **Table 5-20**. In the event that the Environmental Planning and Assessment (COVID-19 Development – Construction Work Days) Order 2020 is still in force at the time of construction, or if standard construction work hours are further altered, the standard construction hours for the workforce would be adopted.

Table 5-20 Standard working hours

Day	Start time	Finish time
Monday to Friday	7am	6pm
Saturday	8am	1pm
Sunday and public holidays	No work	

Extended working hours

The Interim Construction Noise Guidelines (DECC 2009) recognises there are some situations where construction may need to be carried out outside of the recommended standard construction hours. This includes public infrastructure work that shortens the construction period of the project.

As the majority of work would be away from residences and sensitive receivers (particularly north of Tarro), Transport is seeking approval for standard construction hours plus:

- An extra hour at the start and end of each day Monday to Friday
- An extra five hours on a Saturday
- Work on Sunday and public holiday from 7am to 5pm.

This is referred to as 'extended construction hours', outlined in **Table 5-21**, and would apply across the project. Transport would carry out targeted consultation with affected residents before work starts.

Table 5-21 Extended working hours

Day	Start time	Finish time
Monday to Friday	6am	7pm
Saturday	7am	5pm
Sunday and public holidays	7am	5pm

Transport aims to achieve a balance between amenity and more efficient delivery of major infrastructure upgrades. As a result, Transport is investigating opportunities for ensuring delivery of the benefits of the project as soon as possible. Early completion of construction would provide considerable benefits to the community and road users. In particular, extended working hours would:

- Reduce the volume of traffic on roads during peak hours due to construction staff and construction vehicles travelling to and from the construction site outside of peak traffic periods
- Time benefits, including potentially bringing forward the opening date for the project by increasing the allowable construction hours
- Cause less disruption to sensitive receivers, the community, local business, motorists, pedestrians and cyclists as work would be completed earlier than compared to adopting standard work hours
- Enable greater flexibility in project scheduling. This would enable the contractor to make allowances for adverse weather and potential flooding events.

The proposed extended construction hours would only apply to normal construction activities. If required, blasting would only be carried out Monday to Friday between 9am and 5pm and Saturday between 9am and 1pm.

Out-of-hours work

The Interim Construction Noise Guidelines (DECC 2009) also recognises there are some situations where specific construction work may need to be carried out outside the recommended standard hours.

In addition to standard working hours and extended construction hours, some construction activities would need to be carried out during evening and night time periods (referred to as 'out-of-hours work'). The activities that may need to be carried out out-of-hours include:

- Delivery of plant and materials that is required outside construction work hours as requested by police or other authorities for safety reasons (e.g. oversized deliveries)
- Installation of traffic controls, such as concrete barriers
- Traffic switches between each construction phase
- Operation of concrete and asphalt batching plants within ancillary facilities
- Resurfacing of asphalt pavement on existing roads and concrete and asphalt pouring
- Construction work interfacing with the M1 Pacific Motorway, New England Highway and the Pacific Highway, including construction of overbridge piers for the M1 Pacific Motorway entry and exit ramps and ramp tie-ins with the M1 Pacific Motorway, cross drainage below existing roads, pavement, surfacing, line markings, kerbs and traffic islands, traffic signs and signals
- Short-term traffic diversions along the existing road network (M1 Pacific Motorway, New England Highway, John Renshaw Drive, Masonite Road, and the Pacific Highway)
- Bridge construction work over the Main North Rail Line and existing roads including the New England Highway, Pacific Highway and Old Punt Road traffic along existing road networks (including establishing temporary protection work, installation of girders, sealing of joints, establishing temporary screens to enable construction to continue on the deck, and removal of temporary work)
- Utility modifications, relocations or protection measures work
- Removal of existing static signage and installation of new signs
- Removal of existing traffic barriers and installation of temporary and permanent traffic barriers
- Removal of existing lane marking and application of new lane marking on existing roads
- Any work that does not cause noise emissions to be audible at any sensitive receiver
- Emergency work to avoid the loss of lives, property or to prevent environmental harm.

Out-of-hours construction activities would be supported by out-of-hours operation of temporary ancillary facilities.

The exact timing of out-of-hours work would depend on construction activities, construction techniques and constraints imposed by the affected communities or the relevant authorities (utility authorities or road and motorway operators) and would be subject to the requirements of the construction contractor.

The potential construction noise and vibration impacts are presented in **Chapter 8** (noise and vibration). Extended and out-of-hours work would be managed through the implementation of a Construction Noise and Vibration Management Plan which would include feasible and reasonable mitigation measures to minimise the potential for adverse impact on the local community. The plan would be implemented in conjunction with an EPL issued under the POEO Act.

5.4.14 Construction program and components

Construction program

The timing and sequence of the project has considered the requirement to minimise impact on existing traffic, enable safe construction access and minimise the duration of construction. Construction of the project is expected to begin in 2023 and end in 2028, with work occurring across the full length of the construction footprint during this period. Construction could occur sooner and would be subject to approvals and funding availability. An overview of the construction program is shown in **Table 5-22**.

Table 5-22 Construction program

Construction component	Year 1				Year 2				Year 3				Year 4				Year 5			
Enabling work and utilities	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
Construction of ancillary facilities	■	■	■	■	■	■	■													
Operation of ancillary facilities			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Drainage and water quality control									■	■	■	■	■	■	■					
Clearing, grubbing and demolition					■	■	■	■	■	■	■	■	■	■	■					
Bulk earthwork					■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Pavements								■	■	■	■	■	■	■	■	■	■	■	■	
Bridges and viaducts					■	■	■	■	■	■	■	■	■	■	■	■	■			
Roadside furniture and finishing work											■	■	■	■	■	■	■	■	■	■
Traffic management and control			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Landscaping														■	■	■	■	■	■	

Construction components

The typical activities associated with each construction component are summarised in **Table 5-11**. This includes the work associated with the main alignment, intersections, interchanges, bridges and the viaduct. The timing and sequence of the construction components would occur as shown in **Table 5-22** and considers:

- The need to minimise road user delays
- The need for local road and property access
- The need for land acquisitions
- The earthwork balance – both locally and across the project
- Areas that may require soft soil pre-loading
- The sequence in which completed sections could be opened to traffic.

The final timing and sequence of the project would be determined by the construction contractor.

Project delivery

Subject to project approval, Transport would consider and select the most suitable procurement method for project construction delivery. This may include:

- A detailed design contract(s) followed by a separate construction contract(s), each awarded through a competitive tendering process
- A combined detailed design and construction contract awarded through a competitive tendering process.

The preferred procurement method would be selected and implemented in compliance with this EIS, the project's approval and any licences or permits. Transport would be responsible for overseeing the construction, including inspections, monitoring and auditing work performed by the construction contractor(s).

5.4.15 Project staging

Construction of the project is expected to begin in 2023 and end in 2028.

Project staging may occur and would be dependent on the confirmed procurement and delivery strategy to most effectively and efficiently complete construction. Any potential staged opening of the project would need to be assessed further. Any such project staging would be investigated further as the project progresses towards construction.