



**Glenugie to Maclean Sections 3 and 4**

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Prepared for



**SECTION 3 and 4**

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Cover image  
Oblique aerial of Maclean and Clarence River South Arm looking north-west  
Source Pacific Complete.

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# Executive summary

## Background

The Woolgoolga to Ballina Pacific Highway upgrade is a joint commitment by the New South Wales (NSW) and Federal Governments comprising about 155 kilometres of dual carriageways extending from around six kilometres north of Woolgoolga to around six kilometres south of Ballina. This route is the largest of the Pacific Highway upgrades and is managed into 11 sections as identified in the *Woolgoolga to Ballina Environmental Impact Statement (EIS)* and the *Submissions/Preferred Infrastructure Report (SPIR)*. The upgrade will improve road safety, reduce highway congestion and provide a safer local road network with enhanced experience for road users.

GHD, BG&E and CM<sup>+</sup> are undertaking the detailed design between Glenugie and Maclean. This section of the project encompasses Glenugie to Tyndale – Section 3 and Tyndale to Maclean – Section 4.

This report covers about 45 kilometres of the overall project. This section features predominantly forest or rural landscape areas away from the existing Pacific Highway with interchanges at Glenugie, Tyndale and Maclean (Figure 1).

## Purpose of this Plan and Minister's Conditions

The purpose of the draft urban design and landscape plan (UDLP) is to address the requirements of the Minister's Conditions of Approval (MCoA) D20. The draft UDLP develops the mitigation and management measures identified in the *Woolgoolga to Ballina Environmental Impact Statement (EIS)* and the *Submissions/Preferred Infrastructure Report (SPIR)* and in so doing underpins the concurrently developed landscape construction documentation. In achieving the Ministerial and environmental requirements and measures, this UDLP will present an integrated and detailed urban and landscape design from Glenugie to Maclean, refer to Chapter 7.

The project is approved as State Significant Infrastructure under Part 5.1 of the *New South Wales Environmental Planning and Assessment Act 1979* (SSI-4963, approval dated 24 June 2014). The project is also approved under the *Commonwealth Environment Protection and Biodiversity Act 1999* (012/6394 approval dated 14/08/14).

The specific requirements of MCoA D20 and where they are addressed in this UDLP are outlined in Table 2.

## Reference documents

Key reference documents include:

- *Beyond the Pavement – Urban Design Policy Procedures and Design Principles*, Roads and Maritime Services January 2014
- *Upgrading the Pacific Highway Design Guidelines*, Roads and Maritime Services March 2015
- *Pacific Highway Urban Design Framework 2013 – Urban Design Vision, Objectives and Design Principles for the Upgrade of the Pacific Highway from Hexham to Tweed Heads*, Roads and Maritime Services 2013
- *Bridge Aesthetics – Design Guidelines to Improve the Appearance of Bridges in NSW*, Roads and Maritime Services July 2012.

Refer to Figure 2.



Figure 1: Staging diagram. Source: Roads and Maritime Services.



Figure 2: Roads and Maritime Services various report covers. Source: Roads and Maritime Services.

### Vision Statement

To create significant infrastructure that complements the Clarence River Valley with its open plains and forested slopes. The design reinforces the identities of nearby towns and provides an experience for drivers and the community that enhances ecological values, highlights the natural features and characteristics of the landscape.

### Urban design objectives

The Pacific Highway urban design objectives are to

- Provide a flowing road alignment that is responsive and integrated with the landscape
- Provide a well vegetated, natural road reserve
- Provide an enjoyable, interesting highway with varied views and vistas of the landscape and pleasant restful places to stop
- Respect the communities along the route
- Provide 'consistency with variety' in road elements
- Provide a safe, simplified and unobtrusive road design.

Source: *Pacific Highway Urban Design Framework 2013 – Urban Design Vision, Objectives and Design Principles for the Upgrade of the Pacific Highway from Hexham to Tweed Heads*, 2013 Roads and Maritime Services.

Additional objectives include:

- Incorporate environmentally sustainable urban and landscape design solutions.
- Reduce the visual impact of the infrastructure on the surrounding environment.

Refer to Chapter 4 for details.

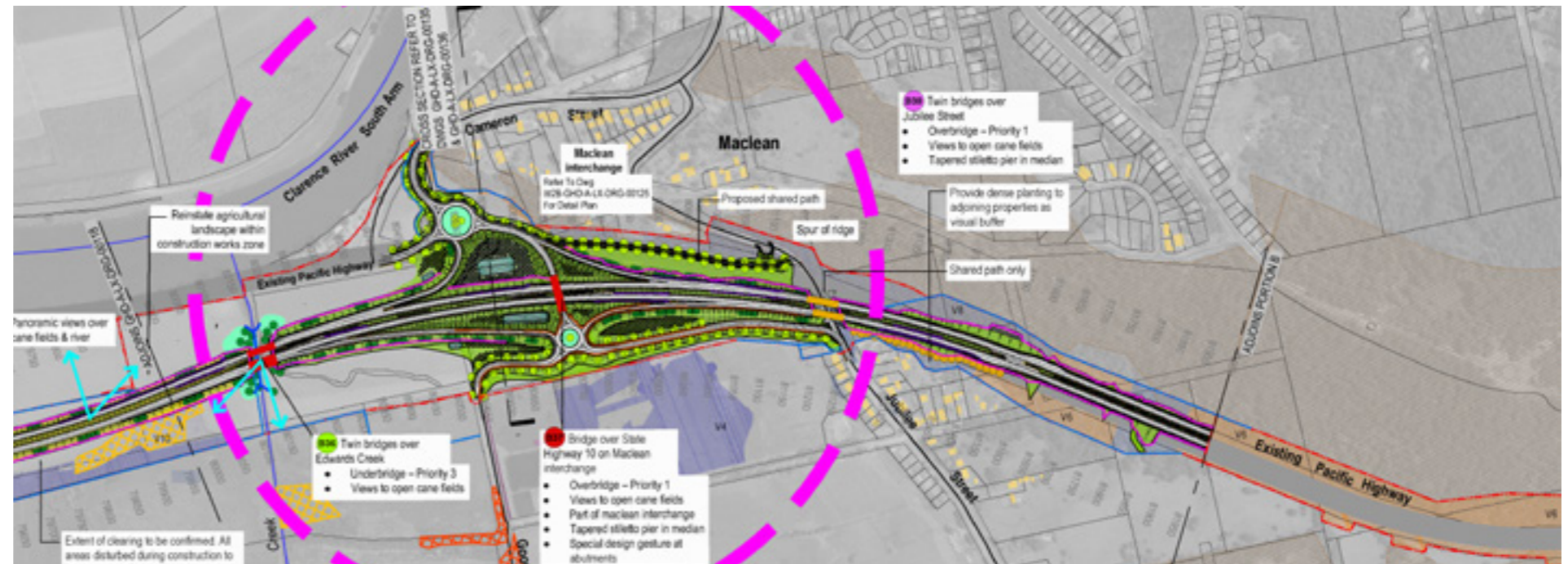


Figure 3: Part of typical urban design and landscape plan, Maclean interchange concept plan subject to further community consultation and design development.

The following strategies are adopted for the project sections covered in this draft UDLP, which support the Pacific Highway design objectives:

- Maintaining appropriate curtilage of areas of environmental significance and of natural beauty
- Developing landscape concepts that offer a variety of experiential views and vistas of the key landscape features
- Providing a coordinated family of high quality, simplified bridge structures, with a hierarchy based on visual significance, consistent with the Pacific Highway.
- Incorporating the rest areas into the overall design with simple geometry and appropriate screening
- Integrating earthworks (including cut and fill batters), landscape mounds, water treatment ponds and other drainage elements into the surrounding landforms with batter roundings and natural shapes
- Minimising impact upon the natural drainage systems and ecology of plateaus, ridges, foothills and clearings
- Providing landscape screening where alignment is in close proximity to houses.

Refer to Chapter 4 and Chapter 8 for details.

Key project elements described in Chapter 6.1 include:

- About 43 bridges including
  - Overbridges at Eight Mile Lane, Old Six Mile Lane, Avenue Road, Wooli Road, Bostock Road, Quarry Access Road, Crowley's Road, Bondi Hill Road, Byrons Lane, McIntyres Lane and property access overbridges. These complete the consistent appearance of overbridges on the Pacific Highway (Figure 8)
- A number of twin bridges over creeks and existing roads to maintain local lateral connectivity including Somervale Road, Mitchell Road and Jubilee Street, high quality local road bridges (Figure 9)
- Special bridges at Glenugie south interchange, Tyndale southbound exit ramp and Shark Creek have a slightly different aesthetic configuration to the other bridges on the project
- Feature interchanges at Glenugie, Tyndale and Maclean to alert road users to opportunities beyond the Pacific Highway (Figure 6 and 7)
- Two rest areas, one northbound and one southbound between Bostock Road and Somervale Road, consistent with other road alignments along the Pacific Highway (Figure 5)
- A significant number of fauna crossings to allow movement of fauna across the Pacific Highway (Figure 4).



Figure 4: Twin bridges over combined fauna and drainage crossing. Subject to further community consultation and design development.

- Major cuttings at Bondi Hill, Tyndale, and Green Hill which are utilised to improve road geometry (Figure 6)
- An integrated suite of road safety furniture such as bridges, retaining structures that are consistent with other Pacific Highway road furniture
- Dense vegetation of riparian creek corridors and at operational water quality control ponds to improve water quality, enhancing valuable habitat and increasing biodiversity (Figure 4).

#### Key design outcomes

Interchanges and rest areas provide opportunities for placemaking, wayfinding and enhance the driver experience. Key design outcomes are described in Chapter 8 and include:

- Integration of earthworks with batter rounding throughout the project to blend with the surrounding
- Integration of potential landscape/spoil mounds into the earthworks design based on principles established
- Development of appropriate topsoil management measures
- Reinforcement of the landscape setting of the area to ensure that the interchange is fully integrated into the local area and is not intrusive



Figure 5: View of rest area from Pacific Highway upgrade. Subject to further community consultation and design development.

- Revegetation of areas affected by Endangered Ecological Communities (EEC) with species derived from adjoining community.

The following is a description of the main features of the works.

#### Glenugie interchange south and north

- Subject to further community consultation and design development.

#### Rest area

The rest areas are located along the northbound and southbound alignment between Bostock Road and Somervale Road. Key design outcomes are described in Chapter 8.2.2 and include:

- Provision of a distinct forest experience with subtle changes to the forest landscape to mark entries (Figure 5)
- Reduction of visual impacts from the Bostock Road overbridge by providing an elegant design and integration of the bridge into the overall driver experience
- Furnishings located appropriately to encompass *Crime Prevention Through Environmental Design* (CPTED) issues (Figure 5).



Figure 6: Tyndale interchange south. Subject to further community consultation and design development.

#### Tyndale interchange south

This grade separated interchange occurs just to the north of Tyndale at Bondi Hill. Key design outcomes are described in Chapter 8.1.1 and include:

- Landscape treatments at underbridges frames the backdrop of Bondi Hill for drivers exiting the interchange along the southbound carriageway (Figure 6)
- Landscape treatments and batter rounding in the large cuts that integrate into the surrounding environment
- Revegetation of areas affected by EEC with species from adjoining community (Figure 6).

#### Tyndale interchange north

Key design outcomes are described in Chapter 8.1.1 and include:

- Views from overbridges will be a feature of the experience of arrival and departure from Tyndale
- Landscape treatments frames backdrop of Bondi Hill for drivers exiting the interchange along the southbound carriageway
- Improved connectivity across the Pacific Highway at intersections to improve the cohesiveness of the town.



Figure 7: Maclean interchange – aerial view looking north.  
Subject to further community consultation and design development.



Figure 8: Maclean overbridge looking north.  
Subject to further community consultation and design development.



Figure 9: Bridge over Shark Creek.  
Subject to further design development.

### Maclean interchange

This full interchange is located at the northern end of the project, near to the existing Pacific Highway, and provides the entry to the township of Maclean and Townsend. Key design outcomes are described in Chapter 8.1.1 and include:

- Accent tree planting along local roads (Figure 7)
- Improved connectivity across the Pacific Highway upgrade intersections to maintain the cohesiveness of the town. A shared path is provided between Cameroon Street and Jubilee Streets
- The interchange is used to highlight the cultural heritage of the town featuring its relationship to the river and reinforcing the Cameron Street and Goodwood Street as gateways (Figure 7).

### Overbridges

The overbridges mostly cross over the mainline carriageways and form a visible part of the driven experience, seen as a family of similar bridges along the Pacific Highway. Key design outcomes are described in Chapter 8.1.2 and include:

- Two span bridges with tapered median piers in both directions
- Tapered piers used for bridge deck spans less or equal to 10 metres

- Stiletto piers used for bridge deck spans greater than 10 metres that allows for greater sightlines through the bridge structure (Figure 8).

### Twin bridges/underbridges

Twin bridges/underbridges span watercourses, local roads and/or fauna and drainage crossings and are mostly less visible to the public. Key design outcomes are described in Chapter 8.1.2 and include:

- Single or multi span bridges with circular piers and tapered headstocks
- Services carefully located and mostly concealed
- Smaller bridges form single spans with open spill through abutments.

### Special bridges

Special bridges are classified to be those which have a different arrangement to the overbridges and underbridges due to their lengths, geometry and span configurations. Key design outcomes are described in Chapter 8.1.2 and include:

- Special bridges are classified to be those which have a different arrangement to the normal overbridges and underbridges, due to their lengths, geometries and spanning configurations
- Landscape treatment will be provided at abutments of all bridges.

### Conclusion

The collaboration and employment of high quality standards set out in the key reference documents ensures an integrated approach to urban design. Well considered engineering also ensures high quality urban and landscape design outcome for the project. The implementation of the mitigation measures proposed ensure that the significance of the social, cultural and ecological values are maintained or enhanced through the design initiatives provided.

The draft UDLP covers the following items as part of MCoA D20 requirements:

- Contextual analysis (Chapter 5)
- Design objectives, principles and strategies (Chapter 6)
- Urban design and landscape plan (Chapter 7)
- Detailed responses to urban and landscape design (Chapter 8)
- Planting, topsoil, drainage and water quality and fauna crossings (Chapters 9 –12).



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# Glossary

Terminology	Definition
Bioregion	Classification of Australia's landscape into 89 distinct bioregions based on climate, geology, landform and native vegetation and species information. The project site is within the NNC - New South Wales North Coast Bioregion as defined by ABRA mapping.
Compost blanket	Consists of high quality compost incorporating organic tackifiers, biological stimulants, wetting agents, soil ameliorants and seed mix that is applied to the batter surface with pneumatic blowers at a thickness of between 25-100 millimetres depending on type of vegetation to be established.
Cover crop	Fast growing, but short lived non-native pasture grasses used to revegetate exposed batters to minimise erosion and weed infestation.
Direct return	Stripping and replacement of site soils that contains a seed bank of native indigenous species.
Drill/broadcast seeding	Seeding using a mechanical disc seeder towed by a tractor. Drill seeders have metal discs that create small furrows into which seed is placed. Broadcast seeding involves the mechanical spreading of seed on the soil surface using a trailer or truck mounted spinning type or agitator type seed spreader. Following seeding, the soil is harrowed to cover the seed with a thin layer of soil.
Fauna crossing structure	Structures that allow animals to safely cross over human-made barriers such as highways.
Frangible	Planting which breaks under the impact of a motor vehicle (and hence helps to stop a vehicle). Generally trees and shrubs with a mature trunk diameter of less than 100 millimetres at approximately 500 millimetres above ground are considered frangible.
Hydromulching	Various types of organic fibrous materials mixed with water and sprayed onto the soil surface in slurry form that sets to form a layer that provides temporary protection from wind and water erosion. The mix may include seed of a cover crop, legume, native ground cover,
Hydroseeding	Hydraulic application of seed, seed carrier and soil ameliorants added to a tank fitted with an agitator and pump. It is commonly followed by hydromulching or straw mulching to provide surface protection.
Indigenous species	Plant species native to the bioregion in which the project is located.
Landscape Management Plan	A defined combination of techniques and frequency of activities for the successful establishment, maintenance and ongoing management of all landscape areas developed by seeding, planting or bushland regeneration.

Terminology	Definition
Landscape soil	Soil profile that is either modified from a natural soil or manufactured and installed using artificial components for the purpose of sustaining vegetation that is chosen to achieve a particular landscape design outcome or revegetation.
Local provenance seed	Seed collected from plants growing in the locality of the project site which may include the road corridor and adjoining areas within the NSW North Coast Bioregion.
Native Grasses	Grass species that are native to Australia.
Natural soils	Soils remaining in-situ which have formed distinct horizons and typically sustaining specific plant communities.
Non-native	Plants that are not native to the bioregion in which the project site is located.
Noxious	Plants declared noxious weeds which are classified into one of five control classes with specified action for each class by the Noxious Weed Act, 1993 and Weed Control Order 2014.
Pasture Grass Mix	Mix of grasses and legumes; predominantly grasses with a portion of legumes to provide nitrogen; typically used on areas that are not to be managed.
Plant container	Containers for plant stock in various sizes and volumes.
Reconstruction	The practice of revegetating areas where the soil profile is disturbed by construction activity; the process involves soil treatment, which may include return of bushland soil, followed by drill seeding, hydromulching or mass planting.
Regeneration	The practice of restoring disturbed or cleared bushland areas where the soil profile remains intact by reinstating and reinforcing the natural regeneration processes in areas within or adjoining bushland, primarily through weed control (weed cover should be less than 15% after 12 months from commencement of the work).
Revegetation	Re-establishing vegetation on an area by direct seeding with native species using manual or mechanical means such as hydromulching, straw mulching, or tractor seeding. A cover crop of annual grass or legume species may be required to provide surface protection in some situations.
Seed provenance	The area from which seed is collected from native plants.
Tubestock	Rigid plant containers with a top edge length or diameter of 40-50 millimetres or 75 millimetres. Includes individual containers as well as trays, and may have proprietary names.



# Abbreviations

**Alignments/Pacific Highway upgrade/highway**

Refers to upgraded Pacific Highway Woolgoolga to Ballina

**CCTV**

Closed circuit television

**CPTED**

Crime Prevention Through Environmental Design

**CEMP**

Construction Environment Management Plan

**CMS**

Changeable message signs

**DoP&E**

Department of Planning and Environment

**EEC**

Endangered Ecological Communities

**EIS**

Environmental Impact Statement

**EPA**

Environmental Protection Agency

**FDD**

Final Detailed Design

**FDSC**

Fixed digital speed cameras

**HVIWS**

High visual impact warning signs

**IDD**

Initial Detailed Design

**IFC**

Issue For Construction

**ISCA**

Infrastructure sustainability Council of Australia

**MCoA**

Minister's Conditions of Approval

**LGA**

Local government area

**LMP**

Landscape Management Plan

**OEH**

Office Environment and Heritage

**PH/Ex.PH**

Refers to existing Pacific Highway

**PSC**

Professional Services Contract

**Project**

Refers to Glenugie to Tyndale – Sections 3 and  
Tyndale to Maclean – Section 4

**Roads and Maritime**

Roads and Maritime Services

**SAP**

Sustainability Action Plan

**SDD**

Substantial Detailed Design

**SPiR**

Submissions/Preferred Infrastructure Report

**UDLP**

Urban design and landscape plan

**VMS**

Variable message signs

**VSLs**

Variable speed limit signs

**WQCP**

Water quality control pond

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# 1.0 Introduction

## 1.1 Background

The Pacific Highway upgrade is one of the largest road infrastructure projects in NSW. It connects Sydney and Brisbane, and is a major contributor to Australia's economic activity. The road is a vital piece of the nation's infrastructure and is a key link in the National Land Transport Network. The Australian and NSW governments have been jointly upgrading the Pacific Highway since 1996.

An upgraded Pacific Highway must continue to service the needs of the travelling public and achieve transport efficiencies, while also ensuring ecological sustainability and meeting the needs of the coastal communities that live along the highway. Upgrading new sections and carrying out safety improvements to the existing highway have brought major improvements to road conditions. These improvements support regional development and provide:

- Safer travel
- Reduced travel times with improved transport efficiency
- More consistent and reliable travel
- Improved amenity for local communities.

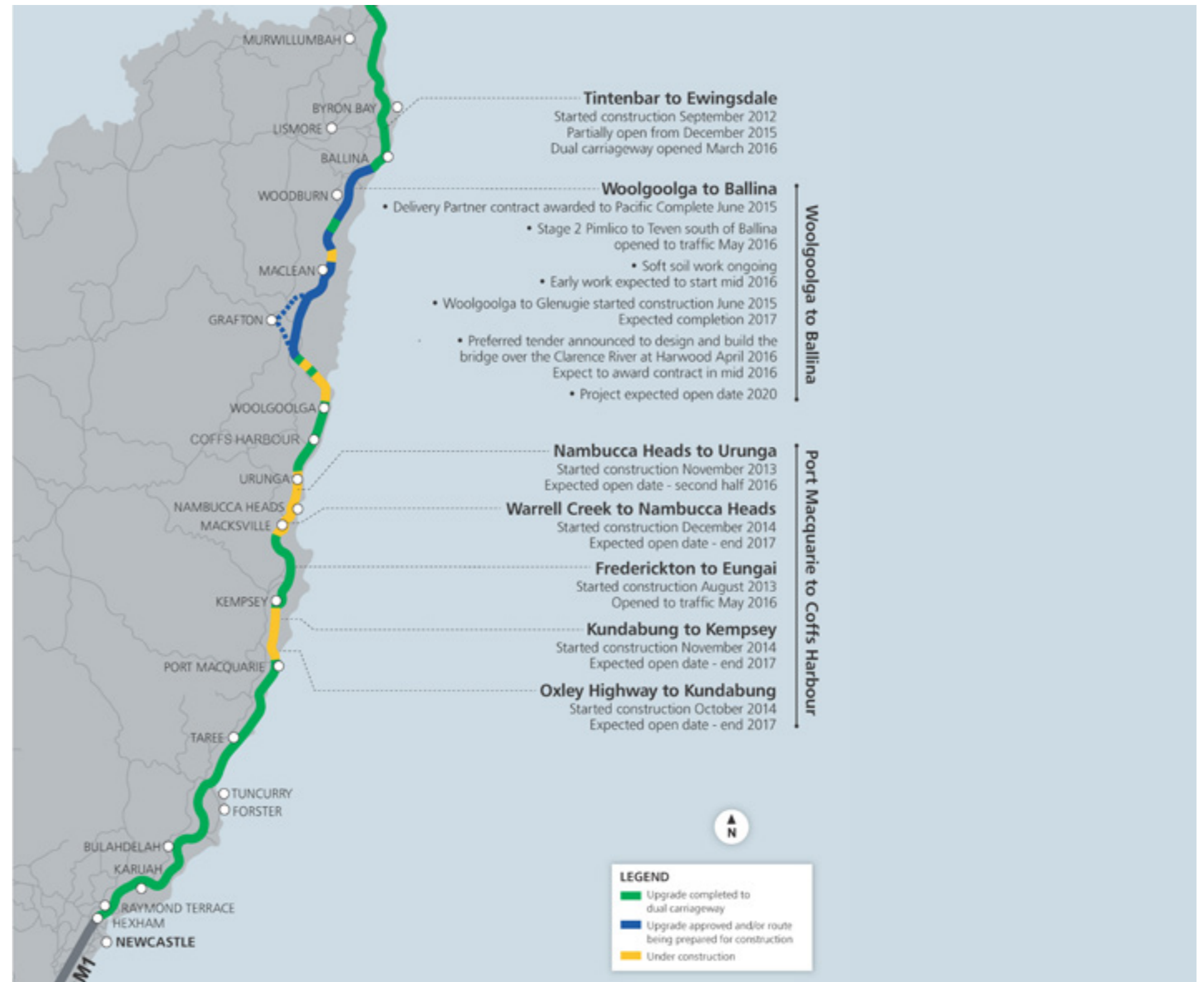


Figure 10: Status of dual carriageway – July 2016. Source: Roads and Maritime Services.



Figure 11: Staging diagram. Source: Roads and Maritime Services.

## 1.2 Overview of the Woolgoolga to Ballina upgrade

The 155 kilometre upgrade between Woolgoolga to Ballina is the last highway link between Hexham and the Queensland border to be upgraded to four lanes. The project will duplicate the existing highway to two lanes in each direction from about six kilometres north of Woolgoolga (north of Coffs Harbour) to about six kilometres south of Ballina.

The project bypasses the towns of Grafton, South Grafton, Ulmarra, Woodburn, Broadwater and Wardell. The project will include building new lanes and realigning the road.

Key features of the upgrade include:

- Duplicating 155 kilometres of the Pacific Highway to a motorway standard (Class M) or arterial road (Class A), with two lanes in each direction and room to add a third lane if required in the future
- Split-level (grade-separated) interchanges at Range Road, Glenugie, Tyndale, Maclean, Yamba/Harwood, Woombah (Iluka Road), Woodburn, Broadwater and Wardell
- Bypasses of South Grafton, Ulmarra, Woodburn, Broadwater and Wardell
- More than 100 bridges including major crossings of the Clarence and Richmond rivers
- Bridges over and under the highway to maintain access to local roads that cross the highway
- Access roads to maintain connections to existing local roads and properties
- Structures designed to safely encourage animals over and under the upgraded highway where it crosses key animal habitat or wildlife corridors
- Rest areas conveniently located at intervals to assist with reducing driver fatigue
- Heavy vehicle checking stations near Halfway Creek and north of the Richmond River
- Connections from the project to the local road network and other sections of the Pacific Highway
- Emergency stopping facilities, and U-turn bays
- Relocation of utilities and provision of roadside furniture, fencing (including wildlife exclusion fencing) and lighting.

## 1.3 Project type and staging

The Pacific Highway Office is responsible for the 657 kilometre Pacific Highway upgrade program between Hexham and the Queensland border and is leading the wave of major infrastructure projects in NSW with an equally strong focus on delivery and leaving a positive legacy. A clear benefit of the program office is that it provides a single point of contact for the general public and key stakeholders while also offering an integrated and collaborative office tasked with developing and delivering the upgrade program.

In order to realise Roads and Maritime's vision of 'driving a better highway upgrade' the program office has adopted a delivery partner model for the Woolgoolga to Ballina upgrade.

The delivery partner model is based on the approach used to oversee construction of the London Olympics and supports collaboration and innovation by bringing business, workers, consumers and suppliers together. It encourages the best ideas and solutions from the private sector while also drawing on the Roads and Maritime's knowledge to ensure better engineering and design, customer outcomes and public value including:

- Greater access to resources and optimising resources from within the public and private sector
- Greater flexibility in resource use to better respond to delays and disruptive events
- Better customer outcomes through a consistent and coordinated approach
- Economies of scale and better access to competitive suppliers and subcontractors
- Direct engagement of design, management and construction skills to fast track the upgrade.

The delivery partner Pacific Complete, comprising Laing O'Rourke and WSP. Parsons Brinkerhoff is working closely with the Pacific Highway office to oversee the project and handle multiple contracts for professional services and building of the \$4.36 billion upgrade.

The project was divided into 11 sections in the Environmental Impact Statement (referred to in the following text as the EIS) for assessment purposes, excluding the completed Glenugie and Devils Pulpit upgrades.

Sections 1 and 2 of the upgrade, between Woolgoolga and Glenugie, are being built and Sections 3-11 are being managed during design development in the following portions (Figure 11).

- Glenugie to Maclean (sections 3 and 4)
- Maclean to Devils Pulpit (sections 5 and 6)
- Devils Pulpit to Richmond River (sections 7, 8 and 9)
- Richmond River to Pimlico (sections 10 and 11).

Design and construction of the bridges crossing the Clarence and Richmond rivers is being managed separately.

## 1.4 Purpose of this plan

This plan has been developed to address the requirements of the MCoA D20 and present an integrated urban design for the Woolgoolga to Ballina project. This plan specifically addresses Glenugie to Maclean (sections 3 and 4) and demonstrates commitment to the mitigation and management measures identified in the Woolgoolga to Ballina EIS, SPIR and other approved environmental management documentation.

## 1.5 Urban and landscape design methodology

The urban and landscape design methodology has been revised at each design stage. As the project progresses through detailed design an integrated multidisciplinary design approach has been instilled to achieve urban design and landscape objectives which provide a holistic, yet varied and consistent design strategy (Figure 12).

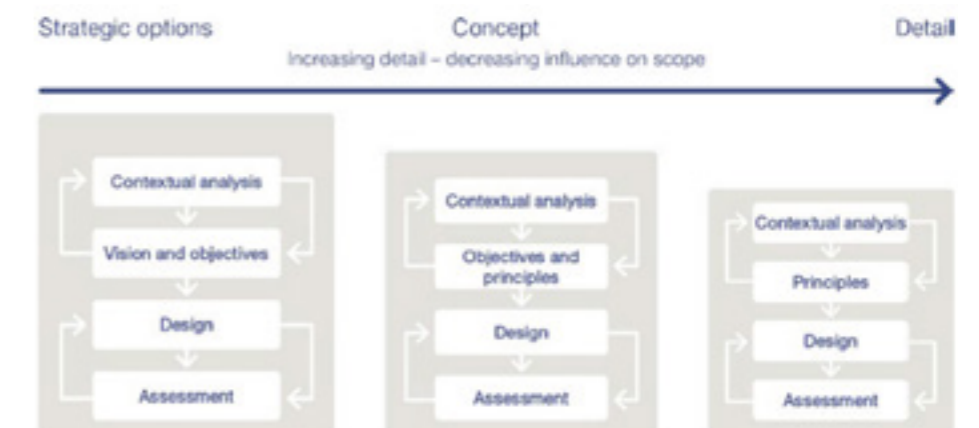


Figure 12: Methodology process diagram.

Source: *Beyond the Pavement – Urban Design Policy Procedures and Design Principles, Roads and Maritime Services January 2014.*

### 1.6 Urban design guidance

Urban design for the project is guided by three key documents:

- The overarching best practice urban design principles as set out in *Beyond the Pavement – Urban Design Policy Procedures and Design Principles* by Roads and Maritime Services' Centre for Urban Design, 2014
- The urban design framework for the *Pacific Highway upgrade – Pacific Highway Upgrade Urban Design Framework – Urban Design Vision, Objectives and Design Principles for the Upgrade of the Pacific Highway from Hexham to Tweed Heads*, Roads and Maritime Services, 2013
- The Urban Design report prepared as part of the EIS for the *Woolgoolga to Ballina project – Pacific Highway Upgrade Woolgoolga to Ballina Urban Design Report Landscape Character and Visual Impact Assessment*, Hassell, September 2012.

In addition, the UDLP has been prepared with reference to the following approval and policy guideline documents.

#### Approval documents (Figures 13 and 14):

- *Project Approval Notice dated 14 August 2014. Modification 2 of the Project Approval* is dated 7 October 2015
- *The Woolgoolga to Ballina – Pacific Highway Upgrade – Environmental Impact Statement (EIS)*, Roads and Maritime Services 2012
- *Woolgoolga to Ballina Urban Design Report Landscape Character & Visual Impact Assessment*, Roads and Maritime Services 2012
- *The Woolgoolga to Ballina – Pacific Highway Upgrade – EIS Working Paper – Biodiversity Assessment*, Roads and Maritime Services 2012
- *Upgrading the Pacific Highway – Design Guidelines*, March 2015.

#### Guidelines documents (Figures 13 and 14):

- *Guideline for Better Surface Stabilisation using vegetation*, Roads and Maritime Services, April 2015
- *Environmental Impact Assessment Practice Note: Guidelines for Landscape Character and Visual Impact Assessment (“EIA No4 Guidelines”)*, Roads and Maritime Services, March 2013
- *Soils for Landscape and Garden Use*, Australian Standards AS 4419
- *Composts, Soil Conditioners and Mulches*, Australian Standards AS 4454
- *Construction Specifications including R178 Vegetation and R179 Planting*, Roads and Maritime Services
- *Beyond the Pavement – Urban Design Policy, Procedures and Design Principles*, Roads and Maritime Services January 2014
- *Bridge Aesthetics – Design Guidelines to Improve the Appearance of Bridges in NSW*, Roads and Maritime Services, July 2012
- *Landscape Guidelines*, Roads and Maritime Services, April 2008
- *Shotcrete Design Guidelines*, Roads and Maritime Services, March 2016
- *Noise Wall Design Guidelines*, Roads and Maritime Services, March 2016
- *Biodiversity Guidelines – Protecting and Managing Biodiversity*, Roads and Maritime Services September 2011



Australian Government  
Department of the Environment

**Approval**  
Pacific Highway Upgrade – Woolgoolga to Ballina, NSW (EPBC 2012/6394)  
This decision is made under sections 130(1) and 133 of the Environment Protection and Biodiversity Conservation Act 1999.

**Proposed action**

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**person to whom the approval is granted** Roads and Maritime Services

---

**proponent's ABN** ABN 76 236 371 068

---

**proposed action** To upgrade approximately 155 km of the Pacific Highway from Woolgoolga to Ballina, NSW [See EPBC Act referral 2012/6394].

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**Approval decision**

Controlling Provision	Decision
Listed threatened species and communities (sections 18 & 18A)	Approved
Listed migratory species (sections 20 & 20A)	Approved

**conditions of approval**  
This approval is subject to the conditions specified below.

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**expiry date of approval**  
This approval has effect until 31 December 2064.

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**Decision-maker**

**name and position** The Hon Greg Hunt MP  
Minister for the Environment

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**signature** 

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**date of decision** 14 August 2014

Figure 13: Covers of reference documents.

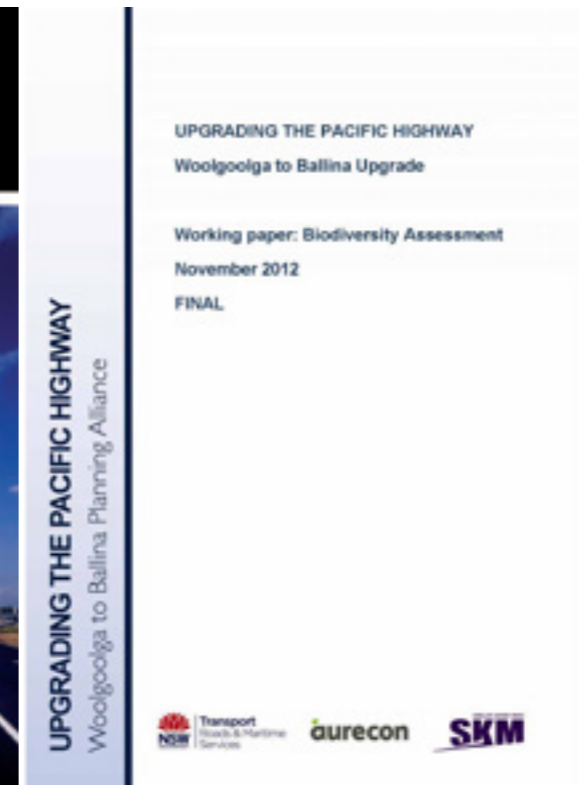
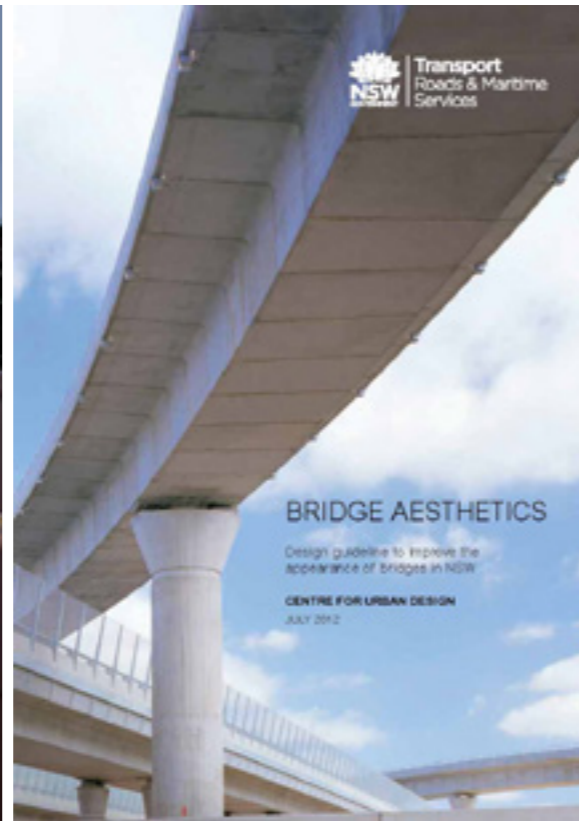


Figure 14: Covers of reference documents.

## 1.7 Document structure

The structure and content of the UDLP is presented in Table 1.

Table 1: Document structure.

Title	Description
Executive Summary	Provides a summary of the UDLP.
Chapter 1 - Introduction	Provides a broad overview of the project and identifies the purpose and structure of the UDLP.
Chapter 2 – Overview of the Pacific Highway Upgrade	Provides a broad overview of the Pacific Highway Upgrade.
Chapter 3 - Consultation	Describes the consultation undertaken, and identifies the corresponding issues raised and where they are addressed in this UDLP.
Chapter 4 – Project wide urban design landscape objectives and principles	Describes the project wide urban design and landscape objectives and principles.
Chapter 5 – Sections 3 to 4 – Contextual analysis	Describes specific contextual analysis.
Chapter 6 – Sections 3 to 4 – design principles	Describes the specific design principles.
Chapter 7– Sections 3 to 4 – urban design and landscape plan	Concept urban design and landscape plans presenting the integrated landscape and urban design solutions.
Chapter 8 – Detailed responses for urban and landscape design	Detailed descriptions of all urban and landscape design elements.
Chapter 9 – Planting	Describes planting at the interchanges, intersections and underpasses.
Chapter 10 – Topsoil	Describes topsoil treatments and management.
Chapter 11 – Drainage and water quality	Describes water quality treatment systems.
Chapter 12 – Fauna crossing	Describes planting at the fauna crossings.
Chapter 13 – Conclusion	Summary of design outcomes.
Chapter 14 – Bibliography	Catalogue of referenced documents.
Chapter 15 – Appendices	Catalogue of supporting documents.



## 2.0 Compliance with environmental approval documents

### 2.1 Minister's conditions of approval

The Woolgoolga to Ballina project has been approved as State Significant Infrastructure under Part 5.1 of the *New South Wales Environmental Planning and Assessment Act 1979* (SSI-4963, approval dated 24 June 2014). The project is also approved under the *Commonwealth Environment Protection and Biodiversity Act 1999* (012/6394 approval dated 14/08/14).

MCoA D20 relates to the preparation of an UDLP to be implemented before the start of permanent built work and/or landscaping. The specific requirements of MCoA D20 and where they are addressed in this plan are outlined in Table 2.

Table 2: Ministerial Conditions of Approval (D20).

Ministerial Conditions of Approval (D20)	Document Reference
D20 The Applicant shall prepare and implement an Urban Design and Landscape Plan prior to the commencement of permanent built works and/or landscaping, unless otherwise agreed by the Secretary, to present an integrated landscape and design for the SSI. The Plan shall be prepared in accordance with the Roads and Maritime Services urban design and visual guidelines, the design principles outline in the EIS, and the revegetation principles outline in the EIS Working Paper – Biodiversity. The Plan shall be prepared by an appropriately qualified expert in consultation with the relevant council and community, to the satisfaction of the Secretary. The Plan shall include, but not necessarily be limited to:	W2B-GHD-A-LX-RPT-00001 (this document)

Ministerial Conditions of Approval (D20)	Document Reference
D20 (a) Identification of design principles and standards based on: <ul style="list-style-type: none"> <li>Local environmental values</li> <li>Heritage values</li> <li>Urban design context</li> <li>Sustainable design and maintenance</li> <li>Community amenity and privacy</li> <li>Relevant design standards and guidelines</li> <li>The urban design objectives outlined in Section 4.2 of the EIS Working Paper Urban Design Landscape Character and Visual Impact.</li> </ul>	Please refer to: <ul style="list-style-type: none"> <li>Chapter 6.3</li> <li>Chapter 6.4</li> <li>Chapter 6.2</li> <li>Chapter 6.5</li> <li>Chapter 6.6</li> <li>Chapter 1.6 and Chapter 14</li> <li>Chapter 5</li> </ul>
D20 (b) the location of existing vegetation and proposed landscaping (including use of indigenous and endemic species where possible). Details of species to be replanted/ revegetated shall be provided, including their appropriateness to the area and habitat for threatened species.	Please refer to Chapter 9.1 and Appendix B
D20(c) a description of locations along the corridor directly or indirectly impacted by the construction of the SSI (eg temporary ancillary facilities, access tracks, watercourse crossings, etc.) and details of the strategies to progressively rehabilitate regenerate and/or revegetate the locations with the objective of promoting biodiversity outcomes and visual integration.	Please refer to Chapter 6.7, Chapter 9.3 and Chapter 12
D20(d) take into account appropriate roadside planting and landscaping in the vicinity of heritage items and ensure no additional heritage impact.	Please refer to Chapter 9.5

Ministerial Conditions of Approval (D20)	Document Reference
D20(e) a description of disturbed areas (including borrow sites) and details of the strategies to progressively rehabilitate, regenerate and/or revegetate these areas, including clear objectives and time frames for rehabilitation works, procedures for monitoring success of regeneration or revegetation, and corrective actions should regeneration or revegetation not conform to the objectives adopted.	Please refer to Chapter 9 and Chapter 10
D20(f) location and design treatments for any associated footpaths and cyclist element, and other features such as seating, lighting (in accordance with AS 4282-1997 Control of the Obtrusive Effect of Outdoor Lighting), fencing, materials and signs.	Please refer to Chapter 8.2 and Chapter 8.3
D20 (g) an assessment of the visual screening effects of existing vegetation and the proposed landscaping and built elements. Where properties have been identified as likely to experience high visual impact as a result of the SSI and high residual impacts are likely to remain, the Applicant shall, in consultation with affected landowners, identify opportunities for providing at-property landscaping to further screen views of the SSI. Where agreed with the landowner, these measures shall be implemented during the construction of the SSI.	Please refer to Chapter 9.4

Ministerial Conditions of Approval (D20)	Document Reference
D20(h) graphics such as sections, perspective views and sketches for key elements of the SSI, including but not limited to built elements of the SSI.	Please refer to Chapter 7 and Chapter 8
D20(i) Strategies for progressive landscaping and other environmental controls such as erosion and sedimentation controls, drainage and noise mitigation.	Please refer to Chapter 10 and Chapter 11
D20 (j) monitoring and maintenance procedures for the built elements, rehabilitated vegetation and landscaping (including weed control). Including performance indicators, responsibilities, timing, and duration and contingencies where rehabilitation of vegetation and landscaping measures fail.	
D20 (k) evidence of consultation with the relevant council and community on the proposed urban design and landscape measures prior to its finalisation.	Refer to Appendix E

## 2.2 Compliance with EIS and SPIR environmental mitigation measures and landscape strategies

In the EIS a range of environmental outcomes and management measures were identified to avoid or reduce the impact the project has on the environment. During the SPIR these measures were further refined, additional commitments were identified and conditions that had already been fulfilled were removed. Table 1 in Appendix D outlines compliance with relevant environmental mitigation measures related to landscape and urban design specific to sections 3 and 4.

The EIS identified a range of strategies and management measures to minimise the visual impact and adverse changes to the landscape character by the project. This UDLP has been developed based on the landscape character and visual assessment and landscape strategy prepared as part of the EIS and revised in the SPIR.

## 2.3 Urban design and landscape compliance with the EIS

Chapter 11 of the *EIS – Urban Design, Landscape Character and Visual Impact Assessment* presented a summary of the landscape character and visual impact assessment carried out to assess the direct and indirect impact of the project. Overall, it was identified the project was expected to have a low to moderate impact on landscape character. Table 3 identifies EIS landscape strategies related to landscape and urban design specific to sections 3 and 4 (Table 3). For locations of the viewpoints please refer to Chapter 7.4.2.

Table 3: Urban design and landscape compliance with EIS applicable to Sections 3 and 4.

EIS Compliance	Applicable to sections 3 and 4	Document reference
11.4.1 Urban design and landscape strategy <ul style="list-style-type: none"> <li>Retain the strong contrasting experience of driving through forest and open agricultural land as a feature of the Pacific Highway experience</li> <li>Acknowledging and celebrate the small and medium sized coastal towns that mark progress along the coastal Pacific Highway journey</li> <li>Highlight and celebrate the numerous minor and major creek and river crossings that punctuate the Pacific Highway journey over the coastal floodplains</li> <li>Acknowledge and preserve the natural and cultural landscapes and landmarks identified along the full length of the Pacific Highway journey.</li> </ul>	Yes	Chapters 5 to 12

Table 4: Viewpoint mitigation measures related to urban design and landscape compliance with EIS applicable to Sections 3 and 4.

EIS Compliance	Applicable to sections 3 and 4	Document reference
<b>Project Section 3</b>		
9_ Old Six Mile Road, near Wants Lane <ul style="list-style-type: none"> <li>Minimise loss of existing trees</li> <li>Plant dense low grasses/ground covers on low fill batters</li> <li>Reinstate woodland trees between Six Mile Lane and the project.</li> </ul>	Yes	Chapters 7 to 12
10_ Avenue Road – crossing at Wants Lane <ul style="list-style-type: none"> <li>Plant dense low grasses/ground covers on low fill batter</li> <li>Highlight new interchange with landscape treatment including local woodland trees in accordance with detailed landscape design.</li> </ul>	Yes	Chapters 7 to 12
17_ Pine Brush Forest <ul style="list-style-type: none"> <li>Minimise loss of existing trees</li> <li>Plant local forest trees on cut/fill batters</li> <li>Reinstate local forest vegetation where applicable.</li> </ul>	Yes	Chapters 7 to 12
18_ Pacific Highway, Tyndale <ul style="list-style-type: none"> <li>Minimise loss of existing forest trees</li> <li>Lay back and feather top cut batters (1:3) to blend with natural landform</li> <li>Plant local forest trees on cut/fill batters</li> <li>Provide new landscape treatment in accordance with the concept design</li> <li>Use steep batters (0.25H:1V) wherever there is competent rock to minimise the loss of forest vegetation.</li> </ul>	Yes	Chapters 7 to 12

EIS Compliance	Applicable to sections 3 and 4	Document reference
<b>Project Section 4</b>		
20B_ Cane fields, Tyndale (north) <ul style="list-style-type: none"> <li>Minimise loss of existing vegetation</li> <li>Provide screen tree and shrub planting on embankments and between access and service roads in accordance with the landscape concept strategy and to provide a screen to nearby homes.</li> <li>Prepare detail landscape designs in accordance with the landscape concept strategy.</li> </ul>	Yes	Chapters 7 to 12
20C_ Byrons Lane, Tyndale (north) <ul style="list-style-type: none"> <li>Minimise loss of existing vegetation</li> <li>Provide screen tree and shrub planting on embankments and between access and service roads in accordance with the landscape concept strategy and to provide a screen to nearby homes.</li> <li>Prepare detail landscape designs in accordance with the landscape concept strategy.</li> </ul>	Yes	Chapters 7 to 12
24A_ Ferry Park, Maclean <ul style="list-style-type: none"> <li>Provide landmark tree planting to highlight to entry to Maclean from the exiting highway. In accordance with the concept design</li> <li>Consider additional fill between highway service roads to minimise the excessive height of embankments.</li> </ul>	Yes	Chapters 7 to 12
24B_ Schwonberg Street, Townsend <ul style="list-style-type: none"> <li>Replace existing roadside screen vegetation to provide a screen between the highway and local homes along Schwonberg and Jubilee Streets.</li> </ul>	Yes	Chapters 7 to 12

## 2.4 Urban design and landscape compliance with the EIS working paper - biodiversity

The Woolgoolga to Ballina project EIS Working Paper: *Biodiversity (W2BPA 2012b)* identified the potential biodiversity impacts of the project to be:

- Loss of vegetation, threatened species and wildlife habitat
- Wildlife mortality during construction
- Edge effects and weeds
- Habitat fragmentation, barrier effects and wildlife mortality during operation
- Impacts on aquatic habitats, changed hydrology and fish passage.

To ensure a consistent approach to the mitigation, management and offsetting of biodiversity for the project, an overarching management strategy was developed as part of the EIS, comprised of: a Mitigation Strategy, a Monitoring Strategy and an Offset Strategy.

The Biodiversity Assessment calculated the area of impact and an area required to be offset to recompense the impact from the project. The offset strategy to meet the requirements of the assessment is being developed by Roads and Maritime and Pacific Complete in consultation with Office of Environment and Heritage (OEH).

Compliance with the requirements for connectivity is managed through the Fauna Crossing Report and associated Fauna Connectivity Register.

The Biodiversity Offset Strategy, which is being developed in consultation with OEH and the Fauna Crossing Reports, being developed by the environmental team detail connectivity requirements to address compliance with the EIS working paper - Biodiversity.

Table 5 identifies each of the vegetation and landscape design principles for connectivity measures as outlined in the EIS Biodiversity Connectivity Strategy, and where they are addressed in this report.

Table 5: Vegetation and landscape design principles for connectivity measures identified in the Biodiversity Connectivity Strategy

Design Principle	Applicable to sections 3 and 4	Document reference
Riparian corridors to be protected during construction works and any areas of riparian vegetation impacted by construction are to be rehabilitated to a pre-determined benchmark condition to be specified in the CEMP.	Yes	Chapter 9 and 12
Revegetation actions around crossing structures should consider the height and density of vegetation so as not to screen the structure from view, but also aim to provide some cover for fauna approaching and exiting the structure.	Yes	Chapter 9 and 13
Roadside plantings in emu crossings should not be within the first 40 metres of the road unless there is fauna exclusion fencing in place or as part of the exclusion barrier discussed above. In particular common landscape species such as Gahni, Lomandra and Dianella spp. represent food plants for emus and may attract them to the road edge and should avoid being planted.	Yes	Chapter 9 and 14
Plantings under bridges in emu crossing zones including the approaches to the crossing are to use grasses or low ground covers and avoid dense plantings of trees including low trees such as Acacia or Causarina. This is to leave the opening clear. Ground cover crops such as soybean and oats or rye grass could be used on disturbed ground around the approaches to the bridge to attract the emus to the crossing zone.	Yes	Chapter 9 and 15

Design Principle	Applicable to sections 3 and 4	Document reference
Plantings around dedicated and combined underpasses is to ensure that entrances to the structure do not obscure the structure and provide a line of sight.	Yes	Chapter 9 and 16
It is important for landscaping at entrances not to intrude/shadow the window of the entrances.	Yes	Chapter 9 and 17
Landscaping should use locally indigenous species and should target key fauna food resources to encourage usage either side of the structure and thus provide the habitat linkage to the structure.	Yes	Chapter 9 and 18

## 2.5 Compliance with threatened species management plans

Threatened species management plans outline specific mitigation measures and monitoring identified for target threatened species before work, during major work and operation of the project.

Threatened Species Management Plans for the Woolgoolga to Ballina project and their applicability to the section, are outlined in Table 6.

Table 6: Threatened Species Management Plan applicable to sections 3 and 4.

Threatened Species Management Plan Compliance	Applicable to Sections 3 and 4	Document reference
Koala management plan.	No	Not applicable
Coastal emu management plan.	Yes	Chapter 7 and Chapter 12
Rainforest communities and threatened rainforest plants management plan.	No	Not applicable
Threatened flora management plan.	Yes	Chapter 9.2
Threatened glider management plan.	Yes	Chapter 7 and Chapter 12
Threatened mammal management plan.	Yes	Chapter 7 and Chapter 12
Threatened frog management plan.	Yes	Chapter 12
Threatened fish management plan.	No	Not applicable
Threatened invertebrate management plan.	No	Not applicable
Flora Translocation Strategy.	Yes	Chapter 9

This UDLP addresses the mitigation measures related to landscape and urban design stipulated in the threatened species management plans that are applicable to the area between Glenugie and Maclean (sections 3 and 4).

## 3.0 Consultation

Community and stakeholder consultation for the project has been carried out in line with the *Woolgoolga to Ballina Communications and Stakeholder Engagement Strategy*. The strategy identifies the key stakeholders and communities, and the methods by which they would be consulted.

The strategy outlines the following communication and engagement objectives for the project:

- Provide clear, consistent and timely information about the project to local communities, road users and stakeholder groups
- Raise awareness of the project and develop relationships with communities and key stakeholders
- Provide a single point of contact for communities
- Anticipate and manage local issues
- Manage community feedback and complaints in a timely fashion
- Identify opportunities for local and regional communities and stakeholder groups to be involved in the project
- Inform government and other major stakeholders, including emergency services of project progress
- Monitor and evaluate feedback to measure success and review overarching communications and community involvement strategy and actions plans as required.

The key consultation activities for the project are:

- Project notifications
- Variable Message Signs (VMS)
- Community information sessions
- Staffed information displays
- Stakeholder briefings
- Face-to-face meetings
- Woolgoolga to Ballina information centre
- Community focus groups
- 1800 information line
- Email
- Collaborative map
- Community contact database and complaints handling procedure.

### 3.1 Community consultation

Limited preliminary draft detailed design concepts for the UDLP were available for community review and comment during community information sessions held in April and May 2016. The draft UDLP will be placed on public exhibition for the community to provide input. Following the exhibition period all community comments will be collated and where appropriate the UDLP will be revised and finalised in response to community comments.

### 3.2 Stakeholder consultation

Agency stakeholders identified in the Woolgoolga to Ballina Communications and Stakeholder Engagement Strategy were advised the draft UDLP would be available for review and comment. Stakeholders who will be provided the UDLP to review include:

- NSW Environment Protection Agency
- NSW Department of Primary Industries – Fisheries
- Clarence Valley Council.

Following agency review all stakeholder comments will be collated and where appropriate the UDLP will be revised and finalised in response to those comments.



Figure 15: Oblique aerial of around Tyndale interchange north. Source Pacific Complete.

## 4.0 Pacific Highway urban design, landscape objectives and principles

### 4.1 Vision

The Pacific Highway Urban Design Framework (Roads and Maritime Services, 2013) has established a vision for the Pacific Highway which is:

**'The upgrade should be a sweeping, green highway providing panoramic views to the Great Dividing Range and the forests, farmlands and coastline of the Pacific Ocean; sensitively designed to fit into the landscape and be unobtrusive; and characterised by simple and refined road infrastructure.'**

### 4.2 Pacific Highway urban design objectives

In fulfilling this vision a number of key objectives have been developed by Roads and Maritime:

- Provide a flowing road alignment that is responsive 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.

### 4.3 Urban design and landscape principles

Four key landscape and urban design principals were outlined in the project EIS:

- Retain the strong contrasting experience of driving through forest and open agricultural land as a feature of the Pacific Highway experience
- Acknowledge and celebrate the small and medium sized coastal towns that mark progress along the coastal Pacific Highway journey
- Highlight and celebrate the numerous minor and major creek and river crossings that punctuate the Pacific Highway journey across the coastal floodplains
- Acknowledge and preserve the natural and cultural landscapes and landmarks identified along the full length of the Pacific Highway journey.

To achieve these strategies, the project would incorporate urban design and landscape key objectives and design principles that are consistent with the key Roads and Maritime guiding documents – *Beyond the Pavement (2014)* and *Pacific Highway Urban Design Framework (2013)*.

### 4.4 Urban design and landscape strategy

The project EIS Working paper *Urban Design Report, Landscape Character and Visual Impact Assessment* (Hassell, 2012) outlined typical landscape and urban design strategies to be adopted for the length of the project (Figure 16).

The strategies were incorporated into the concept design and recommended mitigation strategies for the project at EIS stage and have been carried through the detailed design for the UDLP.

#### 4.4.1 Project wide landscape and urban design strategies

The project wide landscape and urban design strategies outlined in the project EIS Working paper *Urban Design Report, Landscape Character and Visual Impact Assessment* (Hassell, 2012) are as follows:

- Built environment, landscape character and land use
  - Highlight major towns on-route with distinctive landscape treatments
  - Highlight creek and river crossings.
- Views
  - Ensure open or filtered views to pastureland are retained
  - Provide screen planting on batters to specifically mitigate the visual impact of the project to adjacent residences.
- Ecology
  - Reinststate disturbed areas of riparian vegetation where possible and comply with core riparian zone requirements
  - Maximise riparian vegetation under creek crossings to encourage wildlife connectivity along creek lines
  - Use local and endemic species on batters to complement existing vegetation patterns and reduce the visual impact of earthworks. This is particularly important for disturbed areas on prominent ridge lines
  - Adhere also to ecological requirements outlined in specialist reporting.

#### • Landscape treatment

- Install large size plant stock at interchanges and near townships to maximise impact and mitigation at project outset
- Lay back the top batter of cuttings and tie back into the existing landform. Revegetate the top of the profile to blend with the existing landscape
- Where competent rock is encountered, steepen batter grades (1V:0.25H) and expose rock faces
- Avoid use of shotcrete at all cutting locations. If shotcrete is to be used at cutting locations then any treatments and pigmentation must blend with the surrounding vegetation and rock setting
- Provide frangible planting within clear zones
- Where possible reinststate agricultural land uses
- Provide functional and safe rest areas with high landscape amenity. Provide planting in the medians to reduce headlight glare.

#### • Built elements

- Minimising both the use and scale of noise walls and ensuring they are recessive in the landscape, or transparent, where they are required
- Minimise the road furniture that is required in the project and ensure that road furniture proposed is an integrated and cohesive set of elements
- All materials and finishes of the built infrastructure are to be of high quality for durability and appearance.

#### 4.4.2 Sections 3 to 4 specific landscape and urban design strategies

Refer to Chapter 6 of this report for the area between Glenugie and Maclean (sections 3 and 4) specific landscape and urban design strategies outlined in the project EIS Working paper: *Urban Design Report, Landscape Character and Visual Impact Assessment* (Hassell, 2012).

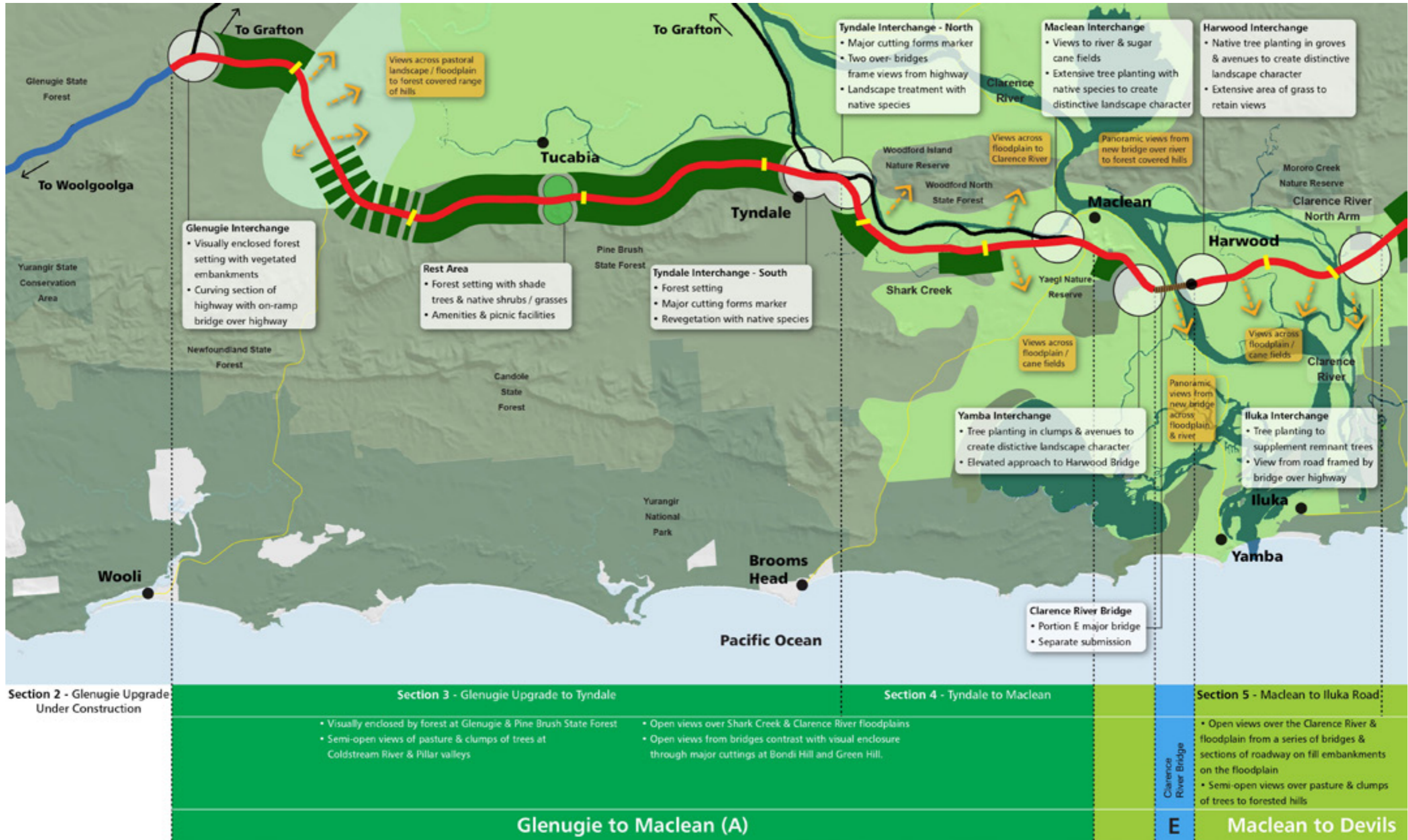
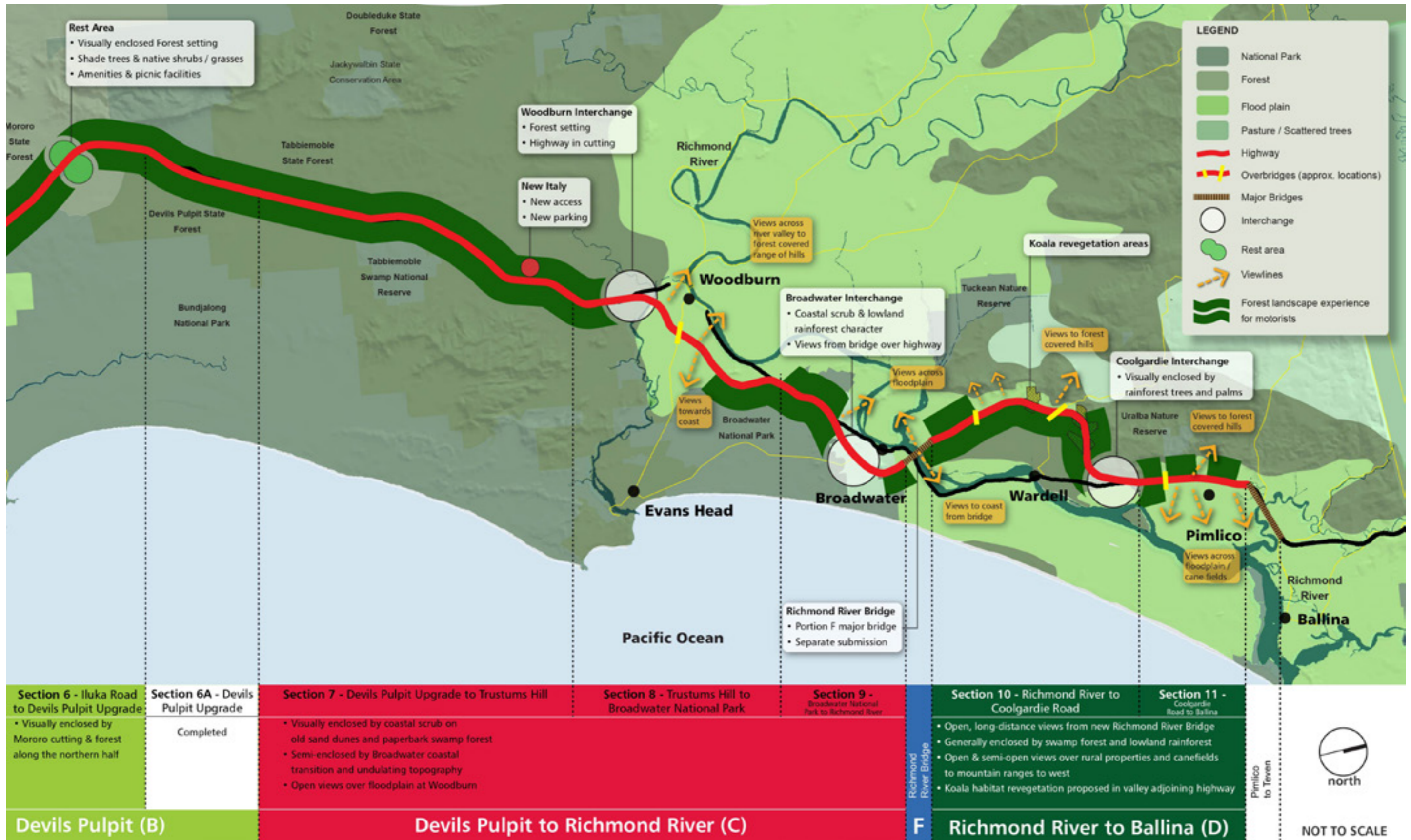


Figure 16: Urban design and landscape strategy diagram. Source: Pacific Complete.





#### 4.5 Landscape outcomes

The landscape works to be carried out as part of the project upgrade will take time to develop as the new vegetation is established and grows. These changes are illustrated by Figures 17 to 27.

The photographs have been taken at a number of different locations along other sections of the Pacific Highway upgrade. They illustrate the visual character of the landscape works at various stages of development which include:

- During completion of the landscape works
- Soon after completion
- Subsequent years after the vegetation has had time to grow.



Figure 17: Ballina Bypass February 2011.



Figure 18: Ballina Bypass January 2015.



Figure 19: Bonville Koala Bridge  
September 2008.



Figure 20: Bonville Koala Bridge  
February 2009.



Figure 21: Bonville Koala Bridge  
September 2011.



Figure 22: Devils Pulpit rest area seeding  
August 2014.



Figure 23: Devils Pulpit rest area seeding  
January 2015.



Figure 24: Glenugie upgrade April 2011.



Figure 25: Glenugie upgrade July 2012.



Figure 26: Glenugie upgrade August 2013



Figure 27: Glenugie upgrade August 2014.

## 5.0 Contextual analysis

The project is being developed to meet the MCoA, specifically item D20 which specifies how the design principles will address local environmental values, heritage values and community amenity and privacy among other items.

The 'Key Design Principles' identified in the *EIS Working Paper Volume 5 Urban design, landscape character and visual impact* include:

### Principle 1

Acknowledge the small and medium sized coastal towns that mark progress along the coastal Pacific Highway journey.

### Principle 2

Highlight and celebrate the numerous minor and major creek and river crossings that punctuate the Pacific Highway journey over the coastal floodplains.

### Principle 3

Retain the strong contrasting experience of driving through forest and open land as a feature of the Pacific Highway experience.

### Principle 4

Acknowledge and preserve the natural and cultural landscapes and landmarks identified along the full length of the Pacific Highway journey.

Implementation of these principles in the design of the highway and its surrounds are outlined in the following pages.

### 5.1 Character zones

Based on the detailed Landscape character and visual assessment illustrated in the EIS and the SPIR documents, Sections 3 and 4 can be simplified into nine distinct character zones as noted below:

#### Character zone 1 – Glenugie State Forest

- Heavy forest and woodland setting
- Closed views of forest
- Scattered rural residential, generally not visible from highway.

#### Character zone 2 – Coldstream and Pastureland

- Scattered pasture and woodland setting
- Intermittent open views of pastureland and forest
- Scattered rural residential, some visible from highway.

#### Character zone 3 – Pillar Valley

- Intermittent forest setting
- Occasional open valley views
- Scattered rural residential, generally not visible from highway.

#### Character zone 4 – Pine Brush State Forest

- Heavy forest and woodland setting
- Intermittent open views to the west
- Scattered rural residential, generally not visible from highway.

- **Character zone 5 - Bondi Hill – Tyndale Township**
- Scattered pasture and woodland setting
- Intermittent views to surrounding
- Close proximity to settlement of Tyndale township
- Major cutting through Bondi Hill as part of Tyndale interchange
- Village settlement partially visible from highway.

#### Character zone 6 – Shark Creek Floodplain

- Open floodplain and agricultural setting
- Open views to cane fields
- Scattered rural residential, some visible from highway.

#### Character zone 7 – Green Hill Cutting

- Heavy forest and woodland setting
- Closed views of forest
- Scattered rural residential, mostly not visible from road
- Major cutting through Green Hill
- Views to scattered rural residential from highway.

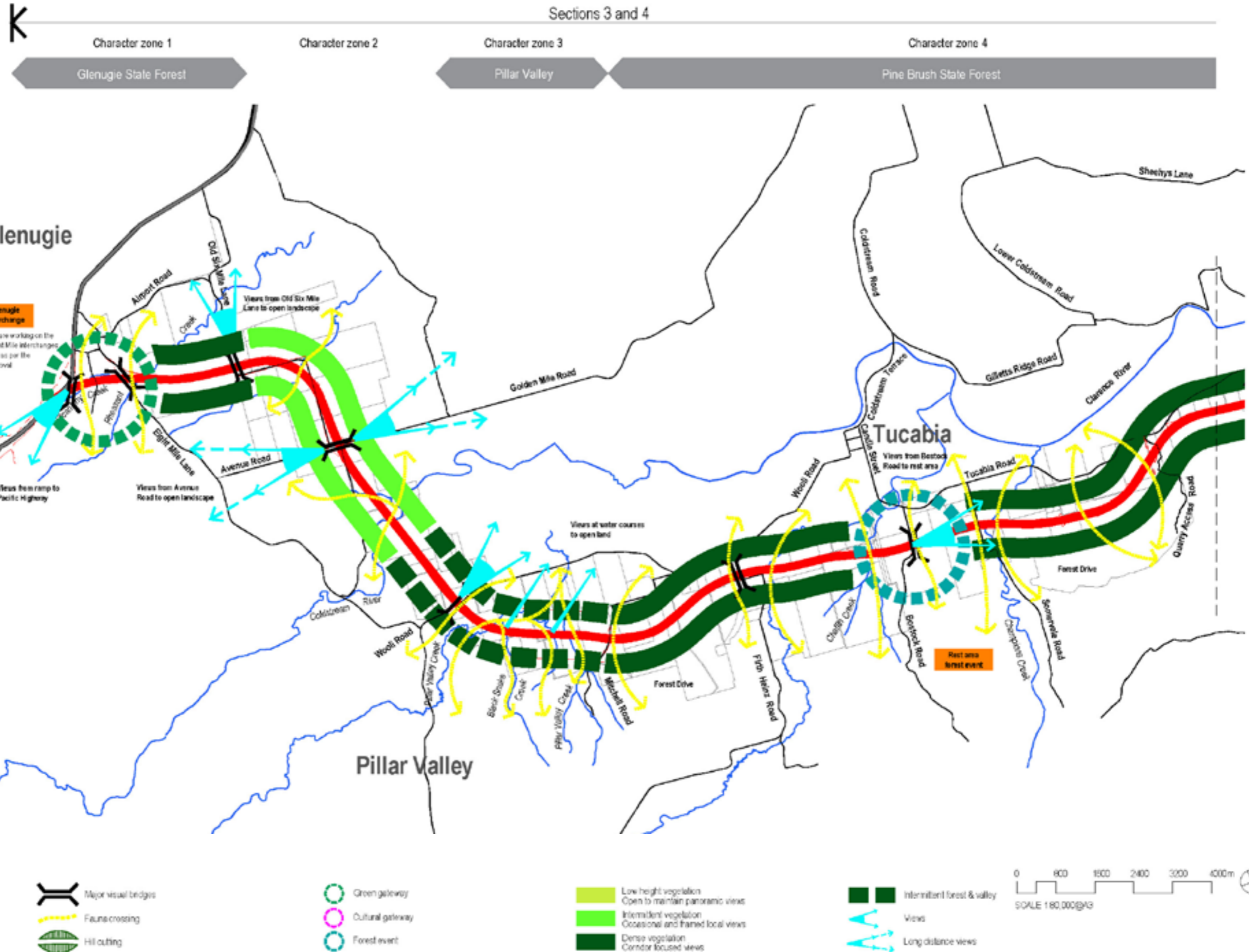
#### Character zone 8 – Clarence River Floodplain

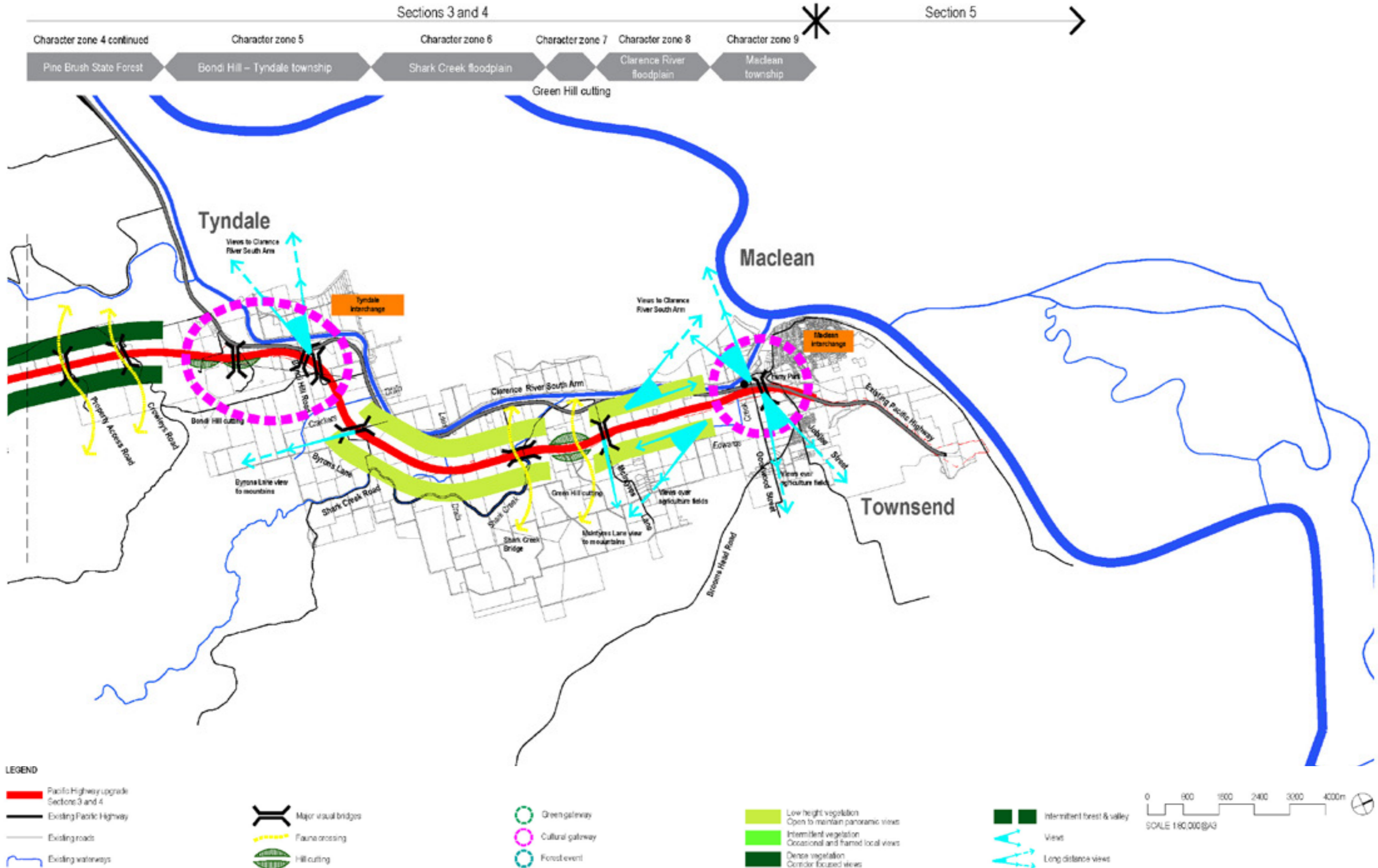
- Open floodplain and agricultural setting
- Open views to cane fields
- Scattered rural residential, some visible from highway.

#### Character zone 9 - Maclean Township

- Open floodplain and agricultural setting
- Open views to cane fields and Clarence River south arm
- Close proximity to settlement of Maclean township.

Refer to Drawing 1 and Drawing 2.





**LEGEND**

- Pacific Highway upgrade Sections 3 and 4
- Existing Pacific Highway
- Existing roads
- Existing waterways
- Major visual bridges
- Fauna crossing
- Hill cutting
- Green gateway
- Cultural gateway
- Forest event
- Low height vegetation Open to maintain panoramic views
- Intermittent vegetation Occasional and farmed local views
- Dense vegetation Corridor focused views
- Intermittent forest & valley
- View
- Long distance views

0 800 1600 2400 3200 4000m  
SCALE 1:80,000 @A3

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Sections 3 and 4 strategy diagram

Drawing and designs subject to further development.

## 5.2 Land use and communities

### Acknowledge the small and medium sized coastal towns that mark progress along the coastal Pacific Highway journey.

The route traverses highly scenic forest, pastoral and riverine landscape with significant agricultural, tourism, and community values. A number of communities and towns will be affected by the introduction of the upgraded highway to the region. As the upgraded highway generally traverses a new alignment, many of these effects will be secondary in nature and relate more to changed traffic patterns than to actual highway construction.

Community values will inform the interchange designs and be specifically structured with plantings to create awareness and visual interest at the interchanges. This approach will alert road users to the villages otherwise bypassed in Sections 3 and 4. Feature plantings, where appropriate, for roads associated with the interchanges would alert road users to local features.

Tourist and advance road signage would provide the preliminary advice to road users of facilities in villages and surrounding areas. It is anticipated that the reduction in traffic in the villages, currently associated with freight traffic, would improve environmental conditions in these villages (reduction of noise and exhaust pollution). Medium term improvements and enhancements of the villages by local councils may help with social and cultural impacts of the bypassing of the villages. There is anecdotal evidence of these anticipated outcomes for many of the bypassed villages along recently completed Pacific Highway projects.

The following towns are directly or indirectly in the vicinity of the route, generally traversing from south to north:

- Glenugie
- Grafton
- Ulmarra
- Tucabia
- Tyndale
- Maclean
- Gulmarrad
- Townsend.

Glenugie is a sparsely settled area that straddles the existing Pacific Highway. The Glenugie State Forest comprises much of the land in this Local Government Area (LGA). Some of the lands with the Glenugie State Forest are identified as High Conservation Value Old Growth Forest. Grafton Airport is also located in this LGA. Appropriate signage will be needed to signal the proximity of the airport. Traffic in the southern part of the LGA will remain on the upgraded Pacific Highway and is not expected to be significantly altered by the project. Traffic in the northern part of the LGA closer to the airport may see a reduction in through traffic as the Pacific Highway Upgrade essentially provides a bypass of Grafton to the north.

Grafton is a hub of the southern reaches of the Clarence Valley. It has a number of attractions and contains a number of colonial buildings featuring Victorian and Edwardian architecture. It is known for its tree lined streets, cafés, and cultural features. Many buildings are classified by the National Trust including the Christ Church Cathedral and the Grafton Gaol. As the upgraded Pacific Highway essentially provides a bypass of Grafton, it will be important to provide appropriate signage to signal drivers to the town's attractions, to ensure Grafton can continue to benefit from its location along the Clarence River and the coastal corridor. South Grafton will likely see a reduction in through traffic with a corresponding reduction in noise and exhaust pollution.

Ulmarra lies along the existing Pacific Highway along the Clarence River. It currently provides a pleasant rest stop for drivers and offers a number of attractions such as its riverfront open spaces, heritage buildings and streetscapes. The village was the site of a butter factory that processed milk from the surrounding dairies. The village contains a number of small businesses that cater to tourists such as bed and breakfast stays, small hotels, cafes and craft shops. It will be important to provide information to drivers to alert them to the location of this village so that business activity can be maintained (Figure 28).

Tucabia is a small village located near the rest area. It currently serves as a local village centre providing for the surrounding grazing lands. Tucabia will not be connected to the highway and it is expected that the function of the village will remain largely unchanged. The highway can provide an opportunity through signage or interpretation at the rest area to highlight Tucabia's location and potentially suggest an alternate scenic route along the highway could be part of the driver's experience through the Clarence Valley (Figure 29).



Figure 28: Ulmarra view from Coldstream Street looking east.



Figure 29: Tucabia view from Cordini Street looking east.

Tyndale is the site of a major interchange with the existing Pacific Highway. It currently provides a service point for travellers with accommodation, food and fuel. With the provision of the Tyndale interchange, these functions could be expected to become more important as Tyndale becomes the link between the highway and other villages along the existing Pacific Highway (Figure 30).

Maclean is located between the Clarence River and the existing Pacific Highway. Much of the town is designated as a Heritage Conservation Area which includes its interface with the river and much of the town streetscape. Its interface with the upgraded highway will essentially maintain its current relationship to the highway. The Maclean interchange will also provide a suitable link for residents to the east at Townsend and Gulmarrad. An opportunity exists to provide a more pleasant formalised town entry that signifies Maclean's cultural and environmental values. Appropriate signage and potential interpretative elements will be used to highlight the area's Aboriginal and non-Aboriginal heritage. Maclean also provides a scenic heritage drive between the Maclean interchange and the connection via Yamba Road to the Bridge over the Clarence River.

Gulmarrad is located to the east of Maclean. It is identified for future growth with a population of about 3,700 which would essentially double its current population. As noted in the SPIR, the maintenance of direct access from Gulmarrad to the existing Pacific Highway is important for residents while allowing for circulation of cane vehicles.

Townsend, located to the east of Maclean currently accesses the existing Pacific Highway at Maclean. It provides a base for some light industry and support for surrounding agricultural areas. The settlement is largely residential and contains a heritage item near the highway. Traffic in Townsend is not expected to be significantly altered by the upgrade as Townsend is currently on the route to the highway from points east and south (Figure 31).

### Community amenity and privacy

The communities located along the route vary in size and relationship to the highway. The existing Pacific Highway winds through many of these communities and generally has an established landscape setting that provides some screening and buffering to immediate surroundings. The upgraded Pacific Highway will be a wider corridor and will generally be in either cut or batter conditions. A robust revegetation strategy will be employed to ensure that screening, to the greatest extent practicable, is provided along the highway. In cut conditions the natural batter of the cut will help in this screening. In fill conditions consideration will need to be given to placing screening.

Community sensitivity to the local context is acknowledged as an important aspect of the project. The upgrade is specifically designed to respond appropriately to this context.

### Strategies

- Provide appropriate signage to signal local attractions
- Develop a narrative for the journey that emphasises the string of towns and villages along the coastal route
- Explore opportunities to provide interpretive expression in the design of infrastructure elements
- Involve the local communities in the design of the highway including potential complementary projects that may be undertaken by local councils in response to the upgraded highway
- Explore opportunities for place making in residual areas left over by the upgrade so they can become a usable community space and integrated into the overall fabric of the town.

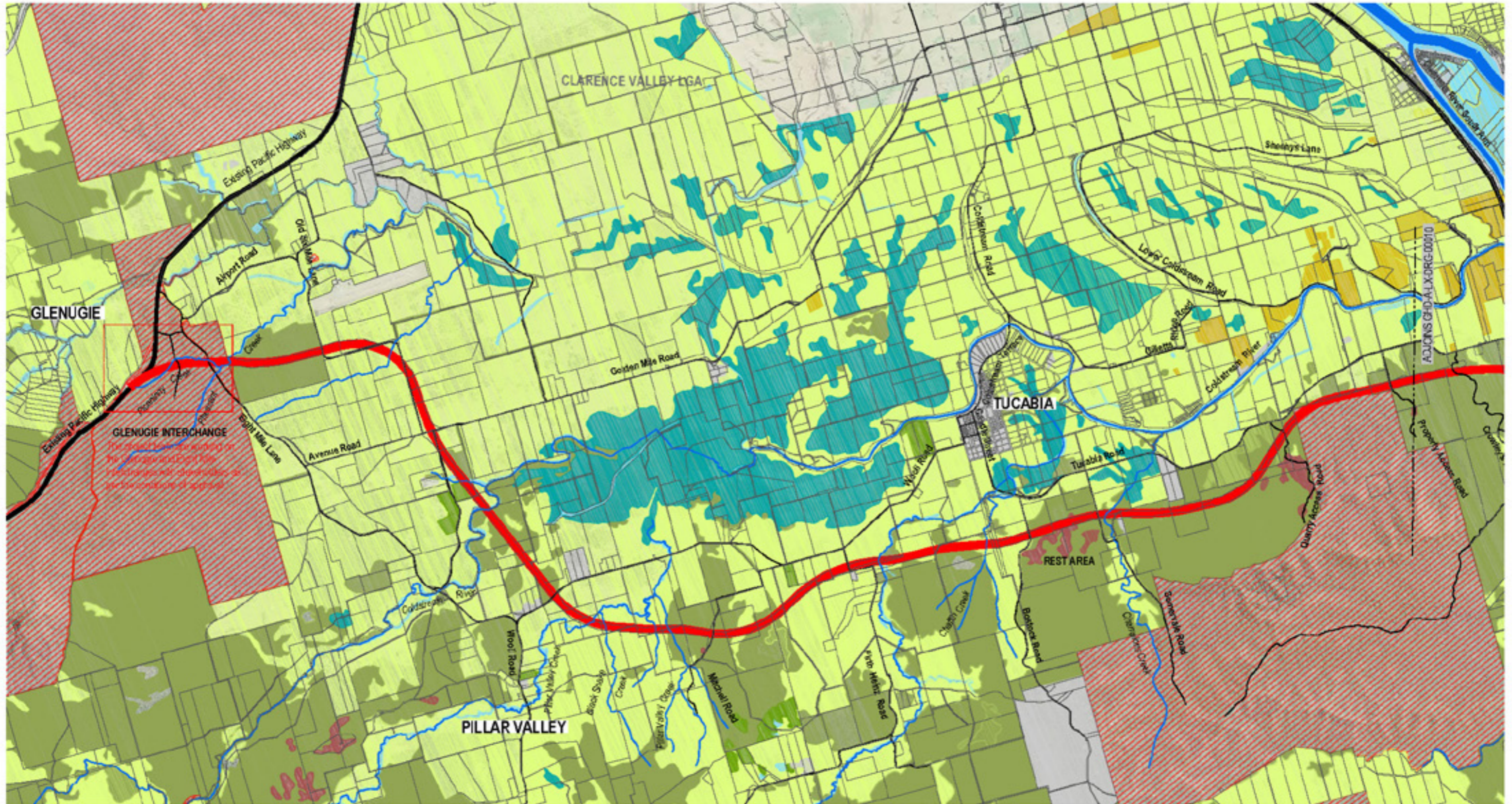
Refer to Drawing 9 and Drawing 10.



Figure 30: Tyndale view from Sheehys Lane looking north.



Figure 31: Townsend view from Jubilee Street looking west.



LEGEND

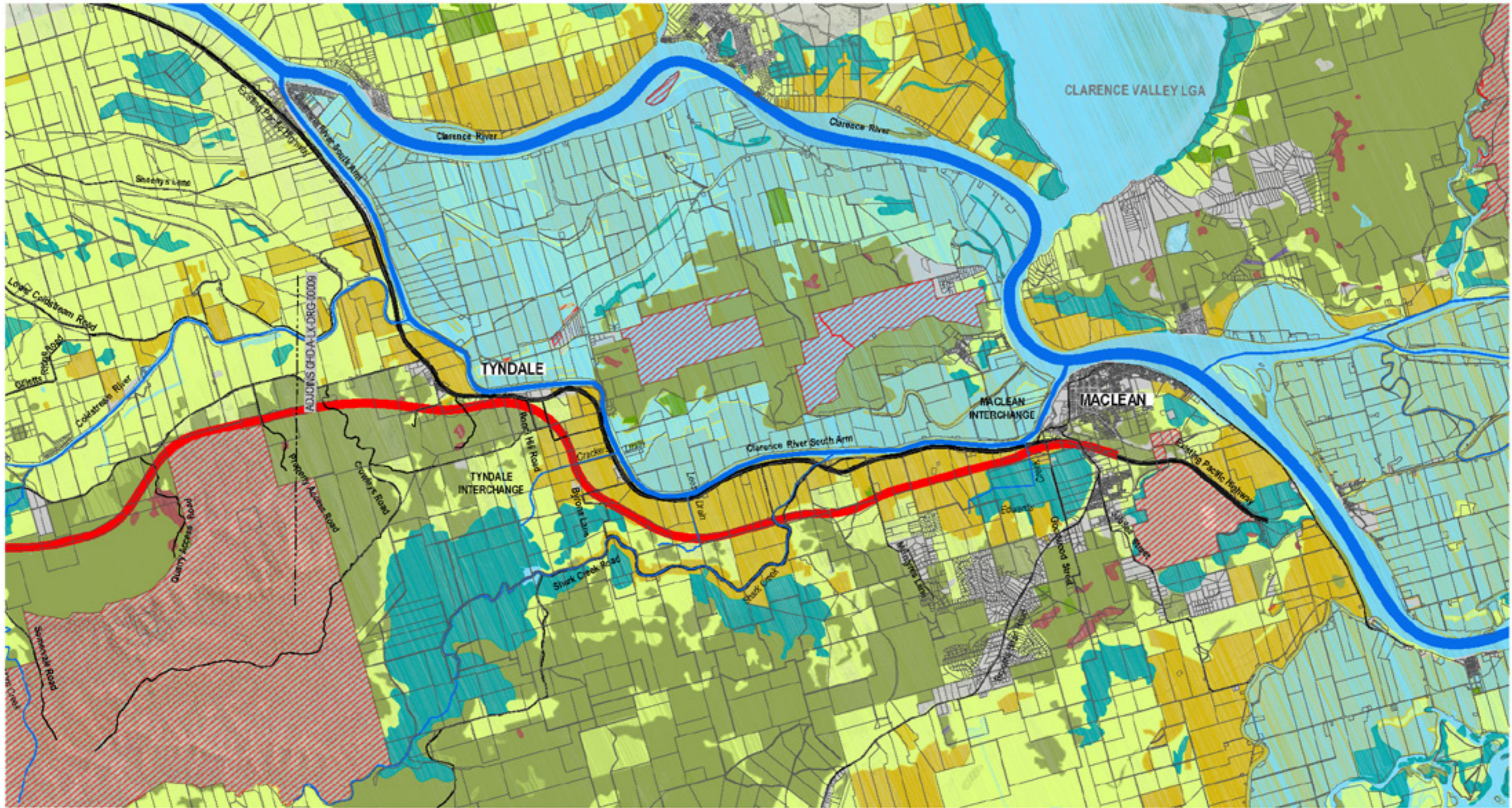
- Pacific Highway upgrade Sections 3 and 4
- Existing Pacific Highway
- Existing roads
- Existing major watercourses
- Conservation area
- Copping
- Grazing
- Horticulture
- Urban
- Mining and quarrying
- Power generation
- River and drainage system
- Wetland
- Tree and shrub cover
- Special category



Drawing and designs subject to further development.

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Land use





LEGEND

- |  |                   |                      |                           |                      |
|--|-------------------|----------------------|---------------------------|----------------------|
| Pacific Highway upgrade Sections 3 and 4 | Conservation area | Horticulture         | Power generation          | Wetland              |
| Existing Pacific Highway                 | Cropping          | Urban                | River and drainage system | Tree and shrub cover |
| Existing roads                           | Grazing           | Mining and quarrying | Special category          |                      |
| Existing major watercourses              |                   |                      |                           |                      |



Drawing and designs subject to further development.

W2B-GHD-A-LX-DRG-00010  
Land use

### 5.3 Landform and hydrology

**Highlight and celebrate the numerous minor and major creek and river crossings that punctuate the Pacific Highway journey over the coastal floodplains.**

Creeks and other drainage crossings along the route will be appropriately signed by Roads and Maritime to bring these geographic features into the driver experience and highlighted along the route. These features will be generally crossed by twin bridges with a standard design that signals the crossings. Lateral views into creek valleys and sometimes the creeks themselves will likely be visible to drivers.

The bridge structures will feature a single rail parapet to allow greater visual openness to the surroundings, especially along the river flood plains in the northern area of Sections 3 and 4, to provide a greater panoramic view shed for drivers. This will also potentially allow improved lateral views to the meandering creeks in this area.

The project traverses through the following major and minor creek crossings:

- Pheasant Creek
- Coldstream River and its tributaries – including a major bridge structure over the main Coldstream River about 320 metres long
- Pillar Valley and north of Pillar Valley Creeks
- Chaffins and north of Chaffins Creeks
- Champions Creek
- Crackers Drain
- Lees Drain
- Shark Creek – crossed by a bridge which is about 865 metres long and is the longest bridge in Sections 3 to 4
- Edwards Creek.

Flood modelling studies are subject to detailed design development and consultation with local communities.

#### Strategies

- Locate appropriate signage at each watercourse crossing
- Consider appropriate landscape treatments to signal the riparian environment to drivers
- Develop a consistent bridge language that signals the watercourses to drivers
- Provide appropriate fauna landscape for those creeks that will be used as fauna crossings.

#### Topography and views

The route from Glenugie to Tyndale – Section 3 and Tyndale to Maclean – Section 4 follows the fringe of a major ridge line to the east of the alignment from Glenugie to Tyndale and opens up into the floodplain of the Clarence River catchment between Tyndale and Maclean. A major ridge line at Woodford Island signifies the topography to the west of the alignment. The topography is dominated by the Summervale ranges to the east, and Dirty Creek Ranges to the south. These landforms have influenced the alignment of the major roads and restricted access between Woolgoolga and Ballina.

Long distance views to some of the peaks (Glenugie Peak and Clarence Peak) are visible through the open pasture areas and the flood plains. The design will ensure that the interrelationship of the route topography and significant views are maintained or enhanced along key locations of the route. Refer to Figures 32-38, Drawing 16 and Drawing 17.



Figure 32: Shark Creek character.



Figure 33: Chaffin Creek character.



Figure 34: Oblique aerial looking east to Tucabia with Clarence Peak in background.



Figure 38: Glenugie Peak looking north along existing Pacific Highway near Glenugie.



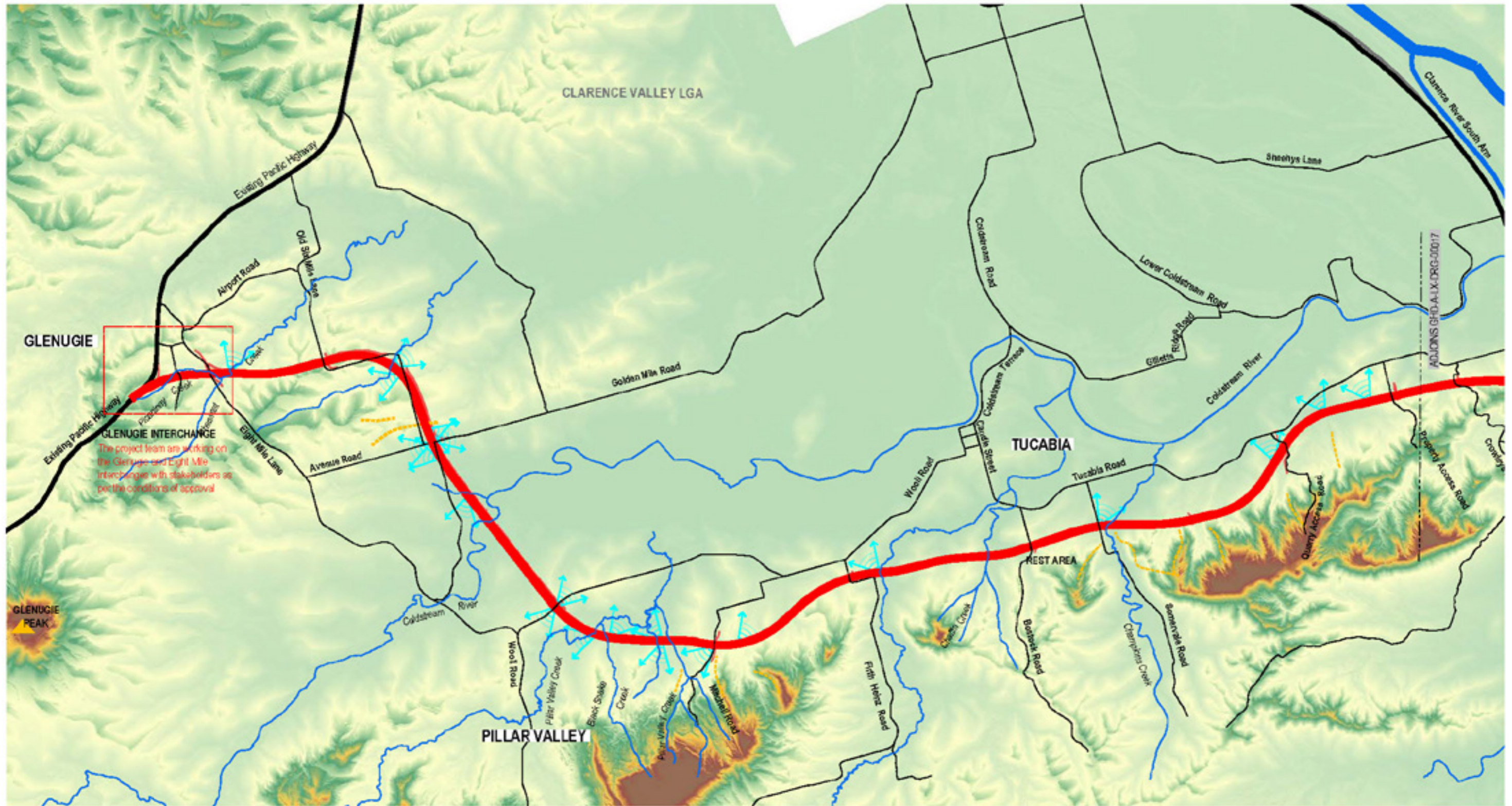
Figure 35: Coldstream/Pillar Valley character.



Figure 36: Maclean lookout view looking east.



Figure 37: Major ridges and peaks.

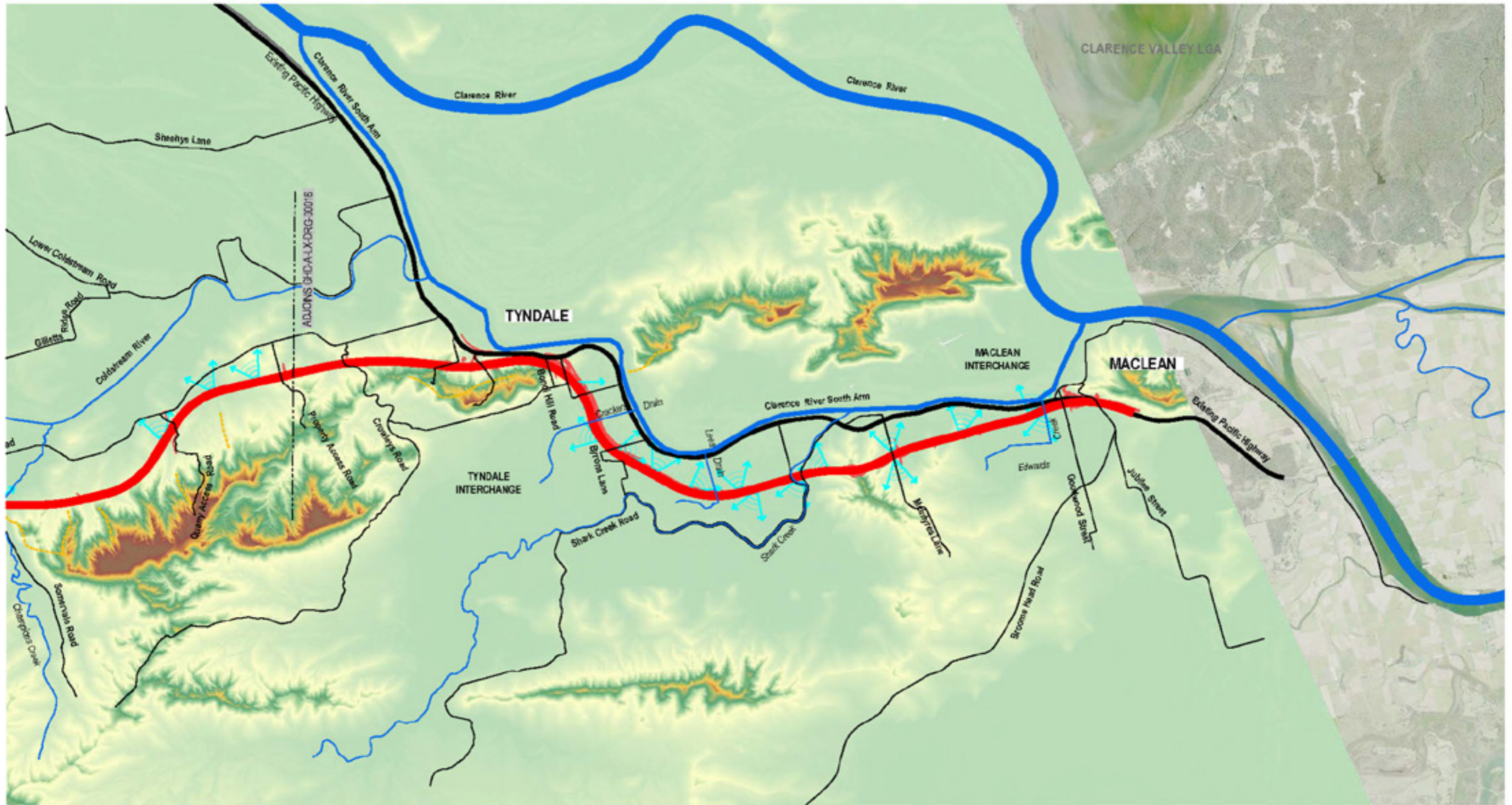


DTM Source: GHD

LEGEND

- Pacific Highway upgrade Sections 3 and 4
- Existing Pacific Highway
- Existing roads
- Existing major watercourses
- Strong Ridgelines
- Views
- 10 metres above sea level
- 268 metres above sea level
- 339 metres above sea level





CTM Source: GHD

LEGEND

- Pacific Highway upgrade Sections 3 and 4
- Existing Pacific Highway
- Existing Roads
- Existing Major Watercourses
- Strong Ridgelines
- Views
- 10 metres above sea level
- 200 metres above sea level
- 300 metres above sea level



Drawing and designs subject to further development.

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Topography and views

## 5.4 Flora and fauna

### Retain the strong contrasting experience of driving through forest and open land as a feature of the Pacific Highway experience.

Landscape will be provided to enhance the contrast between these two types of driver experiences. Sections 3 and 4 contain a number of areas where this shift is evident and can be reinforced. These include Pillar Valley, Glenugie and the transition from forest areas to cane fields at the north of the section.

#### Strategies

- Ensure that landscape treatments are appropriate to the local existing landscape communities
- Frame views through the corridor to reinforce the richness of the journey
- Provide subtle changes in forest and open landscape to inform drivers of their contextual significance.

Refer to Figures 39-40, Drawing 4, Drawing 12 and Drawing 13.

## 5.5 Heritage

### Acknowledge and preserve the natural and cultural landscapes and landmarks identified along the full length of the Pacific Highway journey.

Significant areas of Aboriginal heritage and non-Aboriginal heritage have been identified in proximity to the project. The EIS *Main Volume 1B, Chapter 13 – Historical (non-Aboriginal) Heritage* describes in detail these aspects of the project.

Refer to Drawing 14, Drawing 15 and Chapter 6.4 for details.



Figure 39: Enclosed forest driver experience.



Figure 40: Open valley driver experience.

## 5.6 Geology and soils

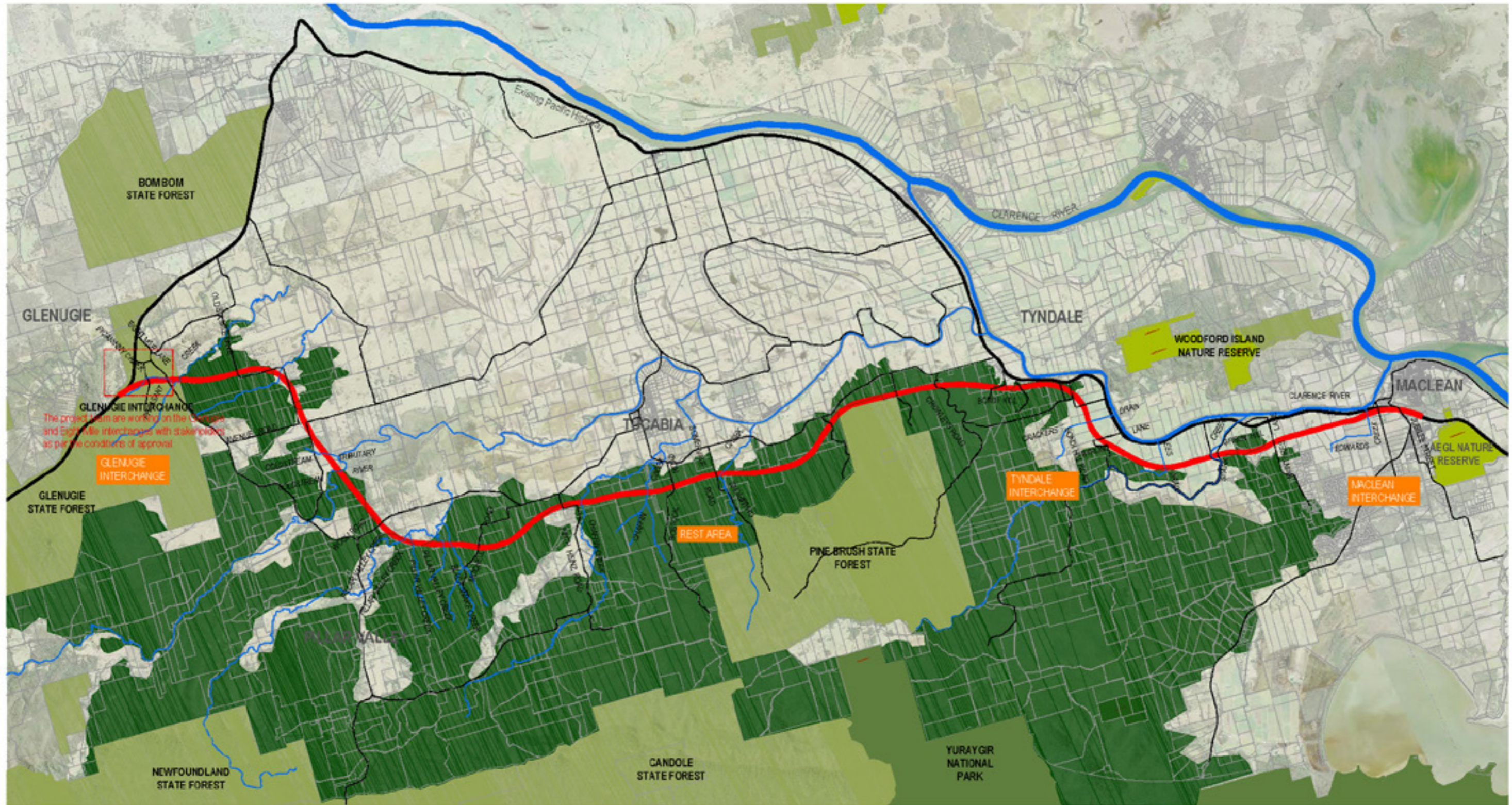
The predominant geology in Sections 3 and 4 is Kangaroo Creek Sandstone with Grafton formation (interbedded conglomerates and sandstones) in the south. Marine influences occur in the floodplain areas and associated with anabranches of the Clarence River. The Kangaroo Creek Sandstone geology has a consistent quartz sandstone composition. Soils derived from the sandstone are sandy and low in nutrients. Where these soils are thin the vegetation is often low heath.

The Grafton formation overlies and grades into the Kangaroo Creek Sandstones. The soil derived from Grafton formation are iron rich creating a very red coloured soil.

The design will ensure that the appropriate landscape types are proposed which suit the geology, soil and climatic conditions in the vicinity of the route traversed (Drawing 7 and Drawing 8).

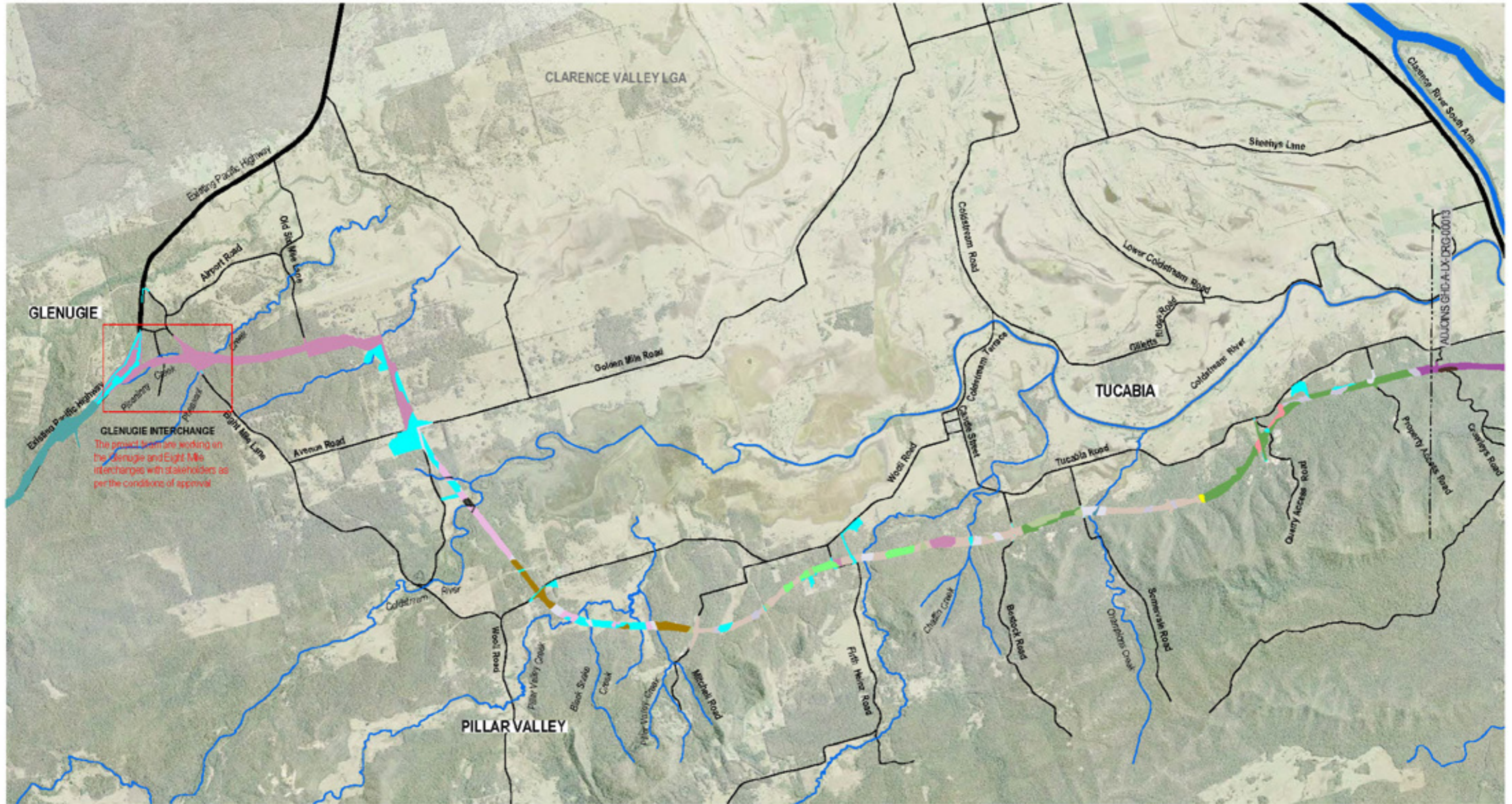
## 5.7 Key views

Key views are based on the various viewpoints identified in the EIS and are illustrated in Chapter 7.4.



Drawing and designs subject to further development.

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Existing national parks and state forests



Based on biometric data

LEGEND

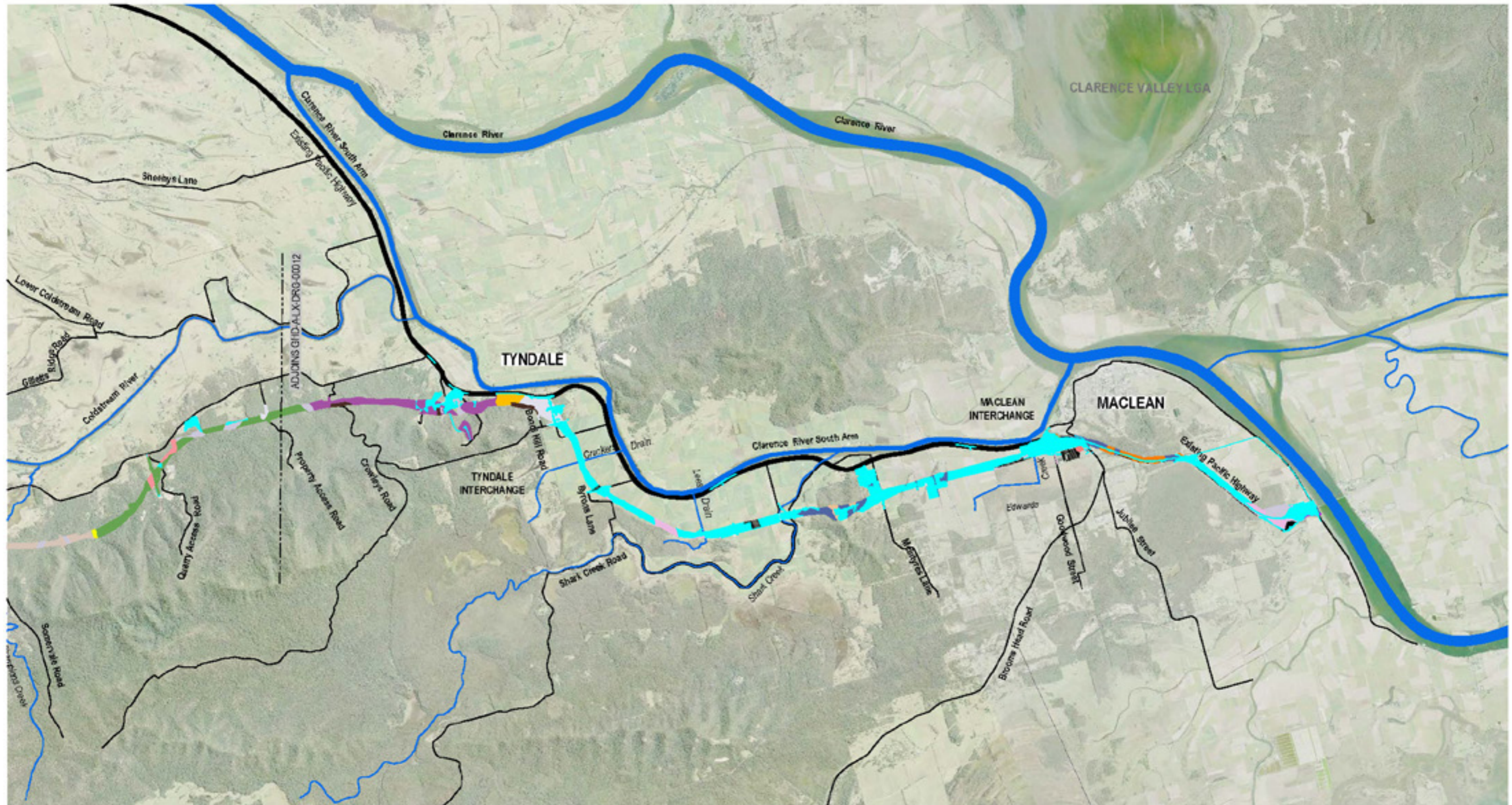
- |   |  |   |  |  |
|---|--|---|--|--|
| <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #8B4513; border: 1px solid black; margin-right: 5px;"></span> Angophora sp. shrubby forest and woodland on sandstones of the North Coast</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #FFD700; border: 1px solid black; margin-right: 5px;"></span> Black Bean - Weeping Lilly Pilly riparian rainforest of the North Coast</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #90EE90; border: 1px solid black; margin-right: 5px;"></span> Blackbutt - Eloodwood dry healthy open forest on sandstones of the northern North Coast</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #FF69B4; border: 1px solid black; margin-right: 5px;"></span> Swamp Box swamp forest of the coastal lowlands of the North Coast</li> </ul> | <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #ADD8E6; border: 1px solid black; margin-right: 5px;"></span> Coastal floodplain sedgelands, mudlands and foreshores</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #4682B4; border: 1px solid black; margin-right: 5px;"></span> Coastal freshwater meadows and foreshores of lagoons and wetlands</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #FF8C00; border: 1px solid black; margin-right: 5px;"></span> Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #9ACD32; border: 1px solid black; margin-right: 5px;"></span> Swamp Malogary swamp forest of the coastal lowlands of the North Coast</li> </ul> | <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #D8BFD8; border: 1px solid black; margin-right: 5px;"></span> Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #4682B4; border: 1px solid black; margin-right: 5px;"></span> Grey Gum - Grey Ironbark open forest of the Clarence lowlands of the North Coast</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #FFD700; border: 1px solid black; margin-right: 5px;"></span> Narrow-leaved Ironbark dry open forest of the North Coast</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #FF69B4; border: 1px solid black; margin-right: 5px;"></span> Swamp Oak swamp forest of the coastal lowlands of the North Coast</li> </ul> | <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #D8BFD8; border: 1px solid black; margin-right: 5px;"></span> Paperbark swamp forest of the coastal lowlands of the North Coast</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #800080; border: 1px solid black; margin-right: 5px;"></span> Pink Bloodwood - Tallwood moist open forest of the far northern ranges of the North Coast</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #FF00FF; border: 1px solid black; margin-right: 5px;"></span> Scribbly Gum - Needlebark Stringybark healthy open forest of coastal lowlands of the northern North Coast</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #3CB371; border: 1px solid black; margin-right: 5px;"></span> Turpentine moist open forest of the coastal hills and ranges of the North Coast</li> </ul> | <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #8B4513; border: 1px solid black; margin-right: 5px;"></span> Scribbly Gum - Red Bloodwood healthy open forest of the coastal lowlands of the North Coast</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #FFDAB9; border: 1px solid black; margin-right: 5px;"></span> Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #800080; border: 1px solid black; margin-right: 5px;"></span> Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #00FFFF; border: 1px solid black; margin-right: 5px;"></span> Cleared</li> </ul> |
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Drawing and designs subject to further development.

W2B-GHD-A-LX-DRG-00012  
Existing vegetation communities





LEGEND

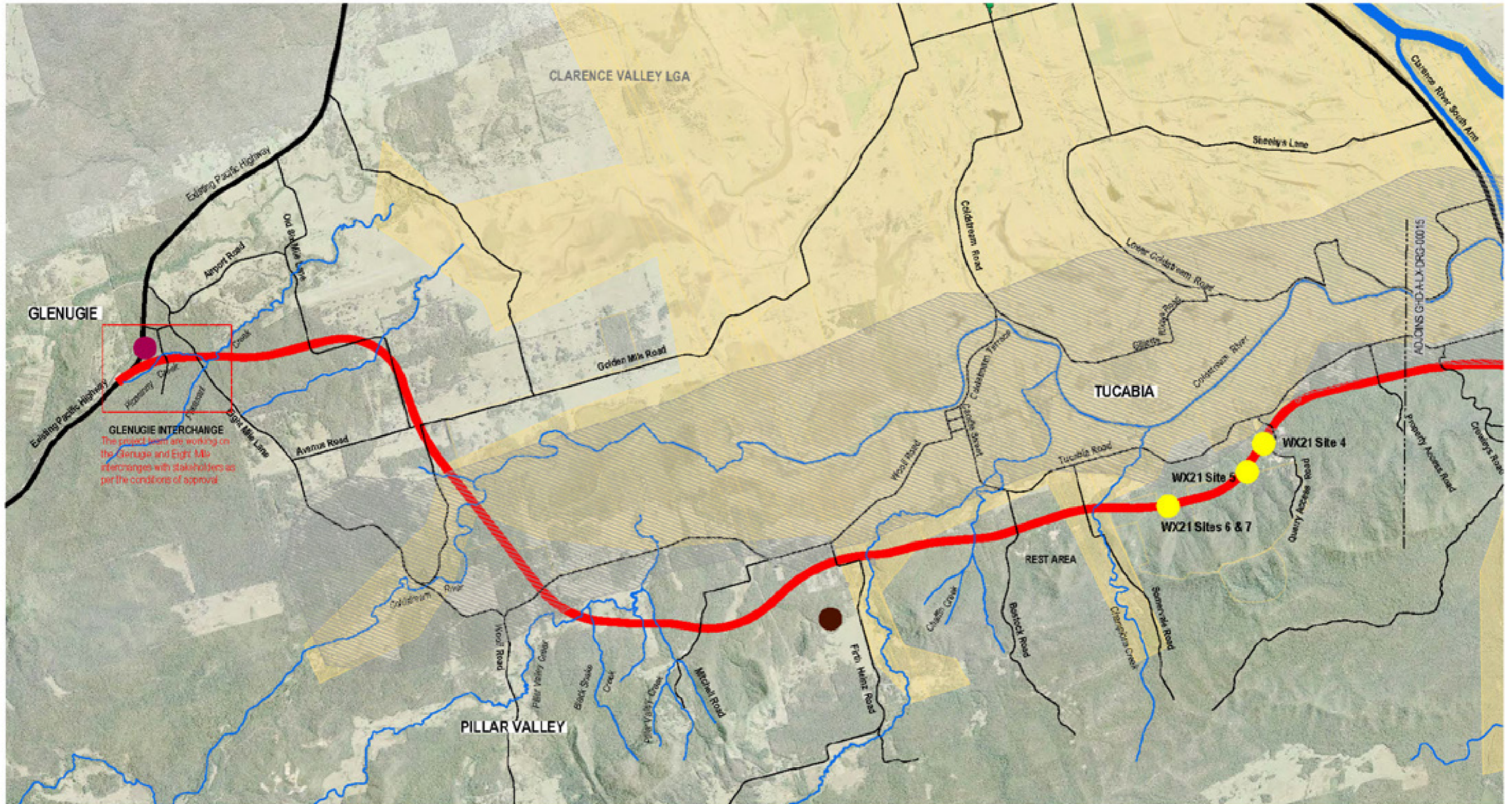
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| Angophora robor shrubby forest and woodland on sandstones of the North Coast            | Coastal floodplain sedgelands, rushlands and terlands                         | Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast    | Paperbark swamp forest of the coastal lowlands of the North Coast   | Scribbly Gum - Red Bloodwood healthy open forest of the coastal lowlands of the North Coast                 |
| Black Bean - Weeping Lily Pilly riparian rainforest of the North Coast                  | Coastal freshwater meadows and/orlands of lagoons and wetlands                | Grey Gum - Grey Ironbark open forest of the Clarence lowlands of the North Coast | Pink Bloodwood - Tallowood moist open forest of the far northern ranges of the North Coast                | Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast   |
| Blackbutt - Bloodwood dry healthy open forest on sandstones of the northern North Coast | Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast | Narrowleaved Ironbark dry open forest of the North Coast                         | Scribbly Gum - Needlebark Stringybark healthy open forest of coastal lowlands of the northern North Coast | Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast |
| Swamp Box swamp forest of the coastal lowlands of the North Coast                       | Swamp Mahogany swamp forest of the coastal lowlands of the North Coast        | Swamp Oak swamp forest of the coastal lowlands of the North Coast                | Turpentine moist open forest of the coastal hills and ranges of the North Coast                           | Cleared   |



Based on bimetric data

Drawing and designs subject to further development.

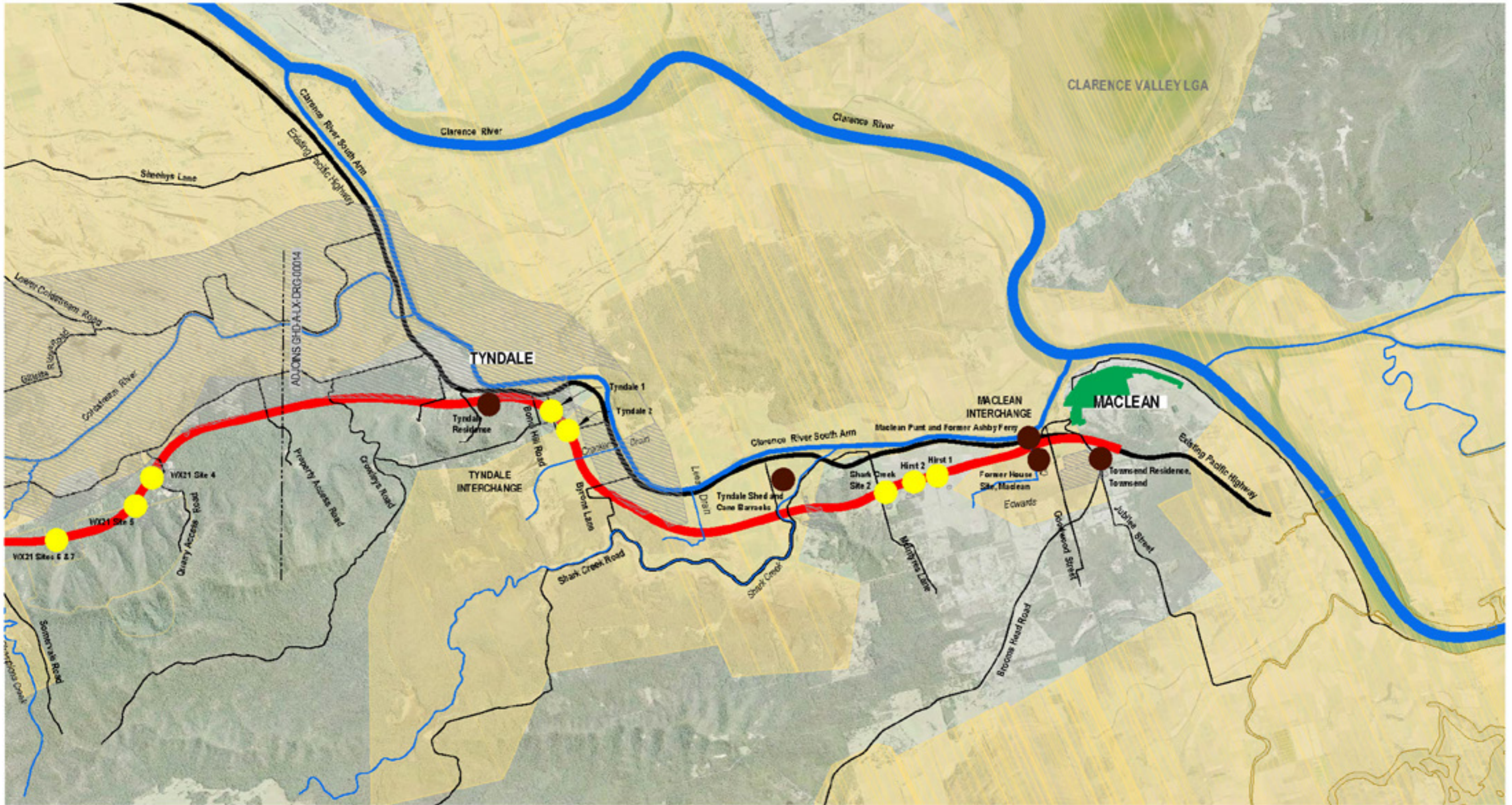
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Existing vegetation communities



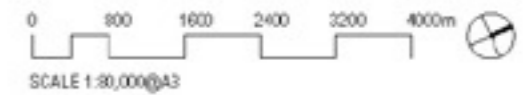
LEGEND

- Pacific Highway upgrade Sections 3 and 4
- Existing Pacific Highway
- Existing roads
- Existing major watercourses
- Aboriginal sites buffer zone
- Heritage conservation areas
- National registered estate
- Non-Aboriginal historic sites
- Archeological sites
- Heritage burial features



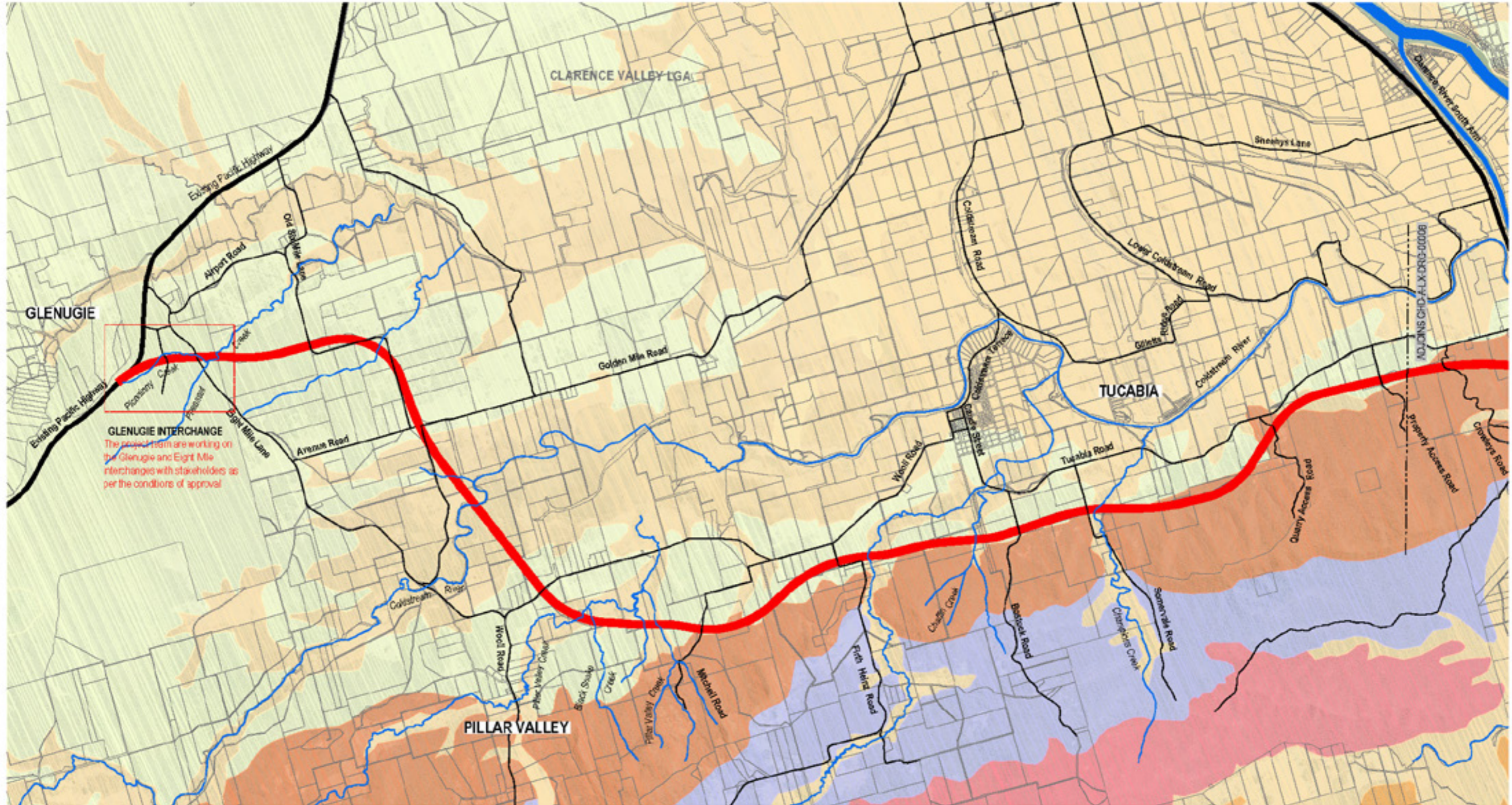


- LEGEND**
- Pacific Highway upgrade Sections 3 and 4
  - Existing Pacific Highway
  - Existing roads
  - Existing major watercourses
  - Aboriginal sites buffer zone
  - Heritage conservation areas
  - National registered estate
  - Non-Aboriginal historic sites
  - Archeological sites
  - Burial features



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Heritage

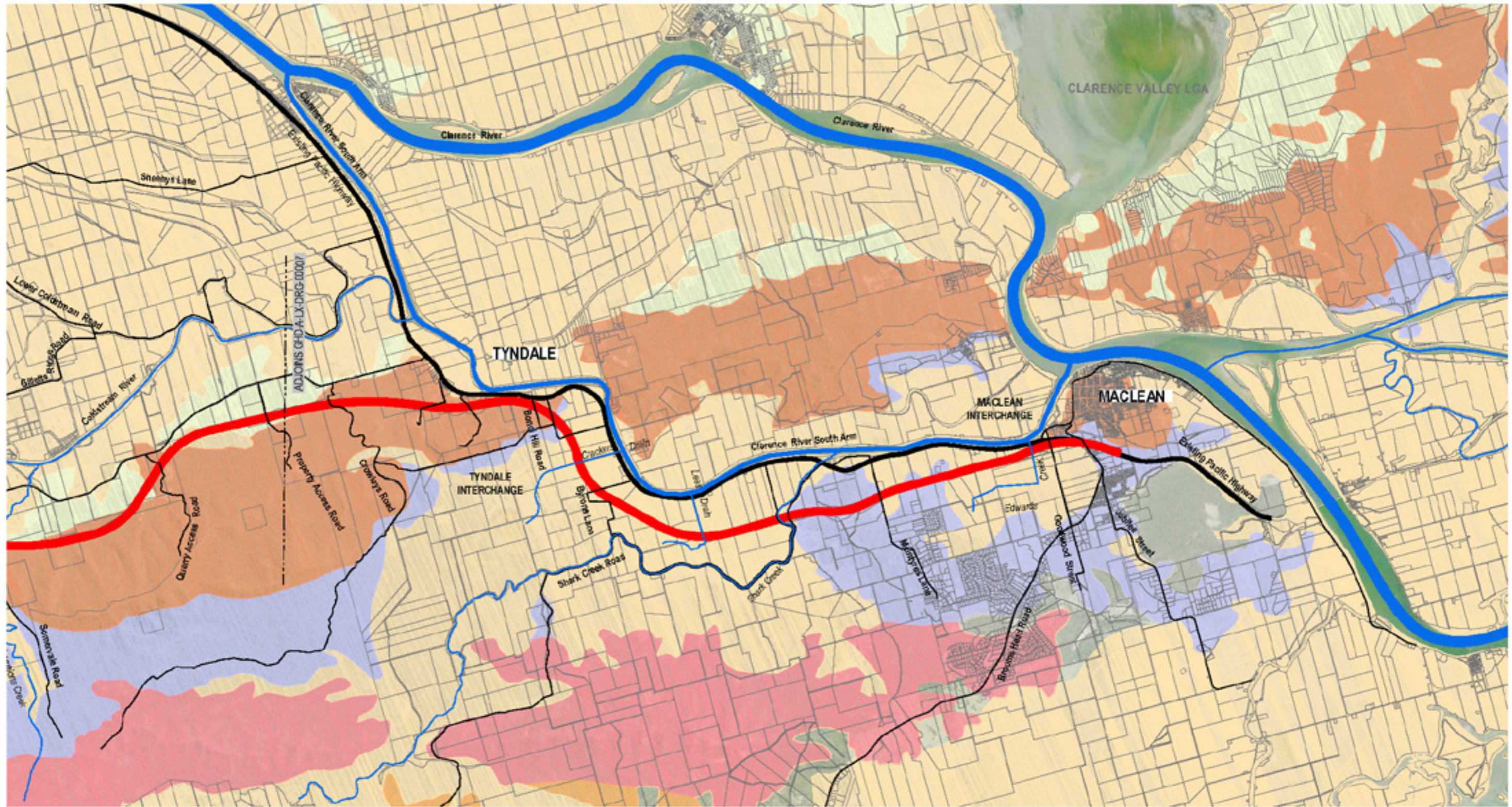
Drawing and designs subject to further development.



LEGEND

Pacific Highway upgrade Sections 3 and 4	Chillingham Volcanics	Grafton Formation	Loyal Range Conglomerate	Neranleigh-Ferrvale Beds	Tallawidjah Leucodsmelite
Existing Pacific Highway	Coramba Beds	Kangaroo Creek Sandstone	Lismore Basalt	Racview Formation	Walloo Coal Measures
Existing roads	Grafton Sandstone	Koukandowie Formation	Marine	Ripley Road Sandstone	Water
Existing major watercourses					





LEGEND

Pacific Highway upgrade Sections 3 and 4	Chillingham Volcanics	Grafton Formation	Laytons Range Conglomerate	Neranleigh-Ferrals Beds	Talawudjah Leucadamellite
Existing Pacific Highway	Oramba Beds	Kangaroo Creek Sandstone	Lismore Basalt	Raceview Formation	Walloon Coal Measures
Existing roads	Gatton Sandstone	Koukandewie Formation	Marine	Ripley Road Sandstone	Water
Existing major watercourses					



Drawing and designs subject to further development.

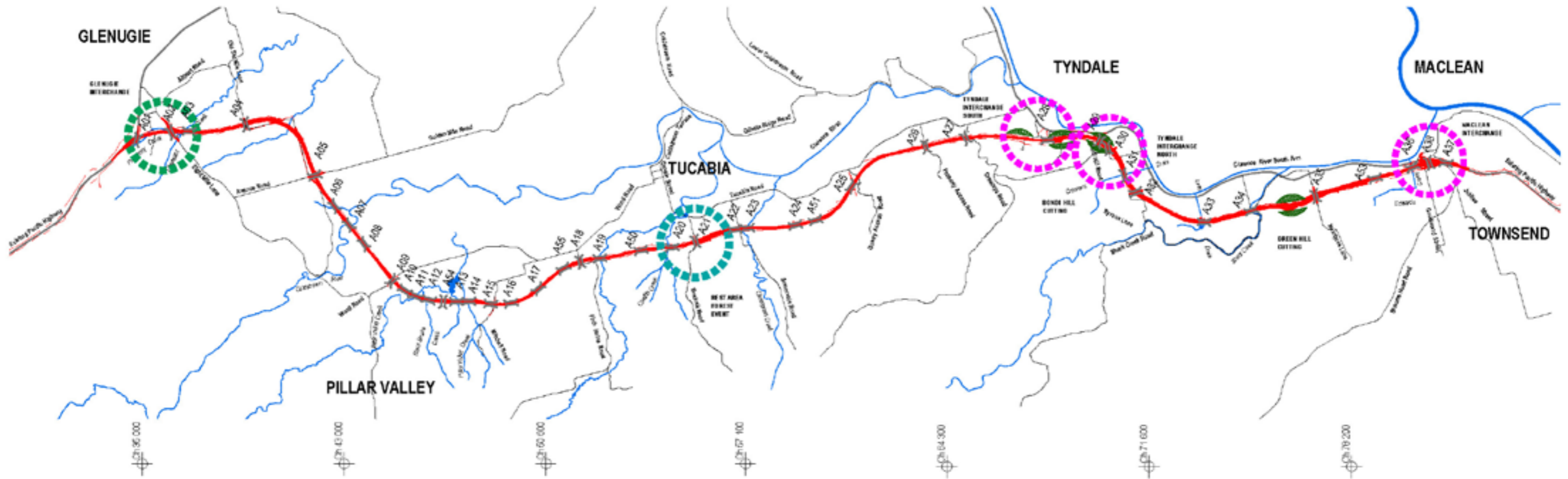
W2B-GHD-A-LX-DRG-00008  
Geology

A01	Bridge over State Highway 10 on Glenugie Southbound on ramp
A02	Bridge over State Highway 10 on Eight Mile Lane
A03	Twin bridges over Pheasant Creek
A04	Bridge over State Highway 10 on Old Six Mile Road
A05	Bridge over State Highway 10 on Avenue Road
A06	Twin bridges over Coldstream River 1
A07	Twin bridges over Coldstream River 2
A08	Twin bridges over Coldstream River 3
A09	Bridge over State Highway 10 on Wool Road
A10	Twin bridges at Pillar Valley 1
A11	Twin bridges at Pillar Valley 2

A12	Twin bridges of Pillar Valley 3
A13	Twin bridges of Pillar Valley 4
A14	Twin bridges at Pillar Valley 5
A15	Twin bridges over Mitchell Road
A16	Twin bridges north of Pillar Creek 1
A17	Twin bridges north of Pillar Creek 2
A18	Bridge over State Highway 10 on Fath Heinz Road
A19	Twin bridges over Chaffin Creek
A20	Twin bridges north of Chaffin Creek
A21	Bridge over State Highway 10 on Dostock Road
A22	Twin bridges over Sosnervale Road

A23	Twin bridges over Champions Creek
A24	Twin bridges north of Champions Creek
A25	Twin bridges over Quarry Access Road
A26	Bridge over State Highway 10 on property access road
A27	Bridge over State Highway 10 on Crowleys Road
A28	Twin bridges over Tyndale Interchange (south)
A29	Bridge over State Highway 10 on Bondi Hill Road
A30	Bridge over State Highway 10 on Southbound off ramp
A31	Twin bridges over Crackers Drain
A32	Bridge over State Highway 10 on Dyrans Lane
A33	Twin bridges over Lees Drain

A34	Bridge over Shark Creek
A35	Bridge over State Highway 10 on McInnes Lane
A36	Twin bridges over Edwards Creek
A37	Bridge over State Highway 10 on Maclean interchange
A38	Twin bridges over Jubilee Street
A50	Twin bridges over combined fauna drainage 1
A51	Twin bridges over combined fauna drainage 2
A53	Twin bridges over floodplain on State Highway 10
A54	Twin bridges for additional Eru crossing 1
A55	Twin bridges for additional Eru crossing 2



Pacific Highway Upgrade from Woolgoolga To Ballina - Sections 3 and 4



LEGEND

- Proposed Pacific Highway upgrade Sections 3 and 4
- Existing Pacific Highway
- Existing roads
- Existing major creeks
- Bridges
- Change
- Green gateway
- Cultural gateway
- Forest event
- Hill cutting



Drawing and design subject to further development.

W2B-GHD-A-LX-DRG-00019  
PROJECT FAMILIARISATION DIAGRAM

## 6.0 Design principles

### Vision Statement

To create significant infrastructure that complements the Clarence River Valley with its open plains and forested slopes. The design reinforces the identities of nearby towns and provides an experience for drivers and the community that enhances ecological values, and highlights the natural features and characteristics of the landscape.

### 6.1 Section 3 and 4 description

The Woolgoolga to Ballina Pacific Highway upgrade is a joint commitment by the NSW and Federal Governments comprising about 155 kilometres of dual carriageways extending from around six kilometres north of Woolgoolga to around six kilometres south of Ballina. This is the largest of the Pacific Highway upgrades and is managed into 11 sections from sections 3 – 11, as identified in the EIS and the SPIR. The upgrade will improve road safety, reduce highway congestion and provide a safer local road network with enhanced experience for road users.

GHD, BG&E and CM<sup>+</sup> are carrying out the detailed design between Glenugie and Maclean. This section of the project encompasses Glenugie to Tyndale – Section 3 and Tyndale to Maclean – Section 4. This report covers about 45 kilometres of the overall project. Refer to DRG-00019.

These sections predominantly feature forest or rural landscape through open and closed views, with interchanges at Glenugie, Tyndale and Maclean. The alignment mostly diverges from the existing Pacific Highway at Glenugie towards the east passing through greenfield sites and joins the existing Pacific Highway at Maclean.

The sequence of the driver experience, travelling from south to north is below:

- Begins at Glenugie and extends from the previously upgraded section of the Pacific Highway heading in a northerly direction through the Glenugie State Forest towards Grafton Airport crossing under Eight Mile Lane and over Piccaniny Creek
  - Gently rolling terrain and is heavily forested
  - A number of fauna crossings
  - Comprises the Glenugie interchange, which is currently subject to further design development.
- Continues north towards the environs of Grafton Airport and then turns significantly to the north-east at Old Six Mile Lane
  - Terrain is flatter countryside of the Coldstream Valley
  - A number of fauna crossings
  - Scattered pasture and woodland setting with intermittent open views
  - Local road grade separated crossings in this area include Old Six Mile Lane and Avenue Road.
- Continues north to Wooli Road as it enters Pillar Valley, mostly following along the foothills of the Clarence Valley and typically skirts the upland of the Coldstream River plain
  - Intermittent forest setting with limited, but significant, views opening up at watercourse and valley crossings with potential glimpses of the river
  - A number of fauna crossings
  - Embankments and cuttings to maintain appropriate gradients.
- Continues into western edge of Pine Brush State Forest about three kilometres east of Tucabia
  - Heavily forested with occasional pasture views towards the west
  - A number of fauna crossings
  - Overbridges at Firth Heinz Road, Bostock Road and underbridges at Mitchell Street and Somervale Road
  - Two rest areas, one each along both the northbound and southbound carriageways located between Bostock Road and Somervale Road, providing facilities and amenities for light and heavy vehicle parking. No connections from local roads to the rest areas.
- Continues north through a series of cut and fill batters until it is near the existing Pacific Highway at Tyndale interchange, located close to the Clarence River South Arm

- Scattered pasture and woodland setting with intermittent views to surrounding
- Potential views to Clarence River South Arm
- Connects to the existing Pacific Highway and Tyndale township
- Significant cut and fill batter through Bondi Hill
- Underbridge, overbridge and local road crossings, and associated surface roadways with major cuttings between the bridges
- Major cuttings prominently visible to drivers on the main alignment and on surface roads.
- Continues north leaving the mostly forested mountainous topography and enters the agricultural floodplain of Shark Creek
  - Dramatic and panoramic views of river, floodplain and mountains
  - A number of fauna crossings
  - Open views to cane fields
  - A long bridge, more than 800 metres over Shark Creek
  - There is little tree cover in this area until after the alignment crosses Shark Creek and passes through Green Hill. A significant cutting is required to maintain appropriate gradients at this cutting.
- Continues north and passes through Green Hill
  - Heavy forest and woodland setting of Green Hill
  - A number of fauna crossings
  - Significant cutting through Green Hill required to maintain appropriate gradients at this point, highly visible to drivers
  - There is little tree cover in this area until after the alignment crosses Shark Creek and passes through Green Hill.
- Continues north and enters the agricultural floodplain of Clarence River
  - Dramatic and panoramic views of river, floodplain and mountains
  - Number of fauna crossings
  - Open views to cane fields.
- Continues north and enters the Maclean township
  - Dramatic and panoramic views of river, floodplain and mountains
  - Open views to cane fields
  - Comprises the Maclean interchange with two roundabouts, an overbridge and a number of connections to local roads
  - Forms a significant new gateway to Maclean and Clarence River.

### Summary of driver experience for Sections 3 and 4

Sections 3 and 4 are defined largely by the interplay of Eucalypt forests with some pasture land, cane fields, floodplain and wetland areas, settlements and homesteads. The alignment passes through the foothills of the coastal range and mountain views are possible in many locations. From some vantage points the Clarence River South Arm will be visible. The alignment crosses a series of valleys as it moves northward and these provide an opportunity to capture new views of the landscape.

A summary of the driver experience includes:

- Visually enclosed forest at Glenugie and Pine Brush State Forest
- Semi-open views of pasture and clumps of trees at Coldstream River and Pillar Valley
- Open views over Shark Creek and Clarence River floodplains
- Open views from bridges contracting with visual enclosure through major cuttings at Bondi Hill and Green Hill.

### Summary of key elements of the project

Key features of the proposed Woolgoolga to Ballina upgrade are as follows:

- About 43 bridges including:
  - The 865 metres long Shark Creek Bridge located within the Clarence River South Arm Flood Plain
  - Overbridges at Eight Mile Lane (TBC), Old Six Mile Lane, Avenue Road, Wooli Road, Bostock Road, Quarry Access Road, Crowleys Road, Bondi Hill Road, Byrons Lane, McIntyres Lane and property access overbridges
  - A number of twin bridges over creeks and existing roads to maintain local lateral connectivity including Somervale Road, Mitchell Road and Jubilee Street
- Interchanges at Glenugie, Tyndale and Maclean
- Two rest areas, one northbound and one southbound between Bostock Road and Somervale Road
- Fauna crossings where appropriate to allow movement of fauna beneath the alignment or overbridges

- Major cuttings at Bondi Hill, Tyndale, Green Hill and Firth Heinz Road
- An integrated suite of road safety furniture with all other road elements, such as bridges, retaining structures and the like, consistent with other Pacific Highway road furniture
- Dense planting of riparian creek corridors and at operational water quality control ponds to improve water quality, enhancing valuable habitat and increasing biodiversity.

#### 6.1.1 Sections 3 and 4 urban design objectives

The project urban and landscape design objectives align with the Roads and Maritime document *Upgrading the Pacific Highway Design Guidelines* and are intended as over-arching objectives for all sections of the Woolgoolga to Ballina upgrade. These objectives are noted below:

- Provide a flowing road alignment that is responsive and integrated with the landscape
- Provide a well vegetated, natural road reserve
- Provide an enjoyable, interesting highway with varied views and vistas of the landscape and pleasant restful places to stop
- Respect the communities along the route
- Provide 'consistency with variety' in road elements
- Provide a safe, simplified and unobtrusive road design
- Incorporate environmentally sustainable urban and landscape design solutions.

#### Detailed objectives

The detailed objectives and strategies for the urban and landscape design of the project provide focus for design process, and establishes the conceptual framework necessary for implementation.

### Objective 1

Provide a flowing road alignment that is responsive and integrated with the landscape.

#### Strategies

Strategies that have guided the urban and landscape design include:

- Adopt best practice engineering, urban and landscape design solutions to integrate safety features in the design
- Minimise the visual impact of the highway on the environment
- Take a holistic approach to the urban and landscape design, considering all visual aspects of the project to ensure a completely integrated design solution.

#### Implementation

Implementation activities include:

- Integrate earthworks (including cut and fill batters), noise mounds, water treatment ponds and other drainage elements into the surrounding landforms with contouring and rounding of tops, base and edges and appropriate re-vegetation
- Minimise impact upon the natural drainage systems and ecology of the plateaus, ridges and foothills
- Utilise frangible poles, trees and shrubs within clear zones
- Design water quality control ponds (WQCP) and other permanent drainage landforms with variable slope profiles and informal 'natural' layouts.



### Objective 2

Provide a well vegetated, natural road reserve.

#### Strategies

Strategies that have guided the urban and landscape design include:

- Minimise existing vegetation clearing
- Maximise the lateral integration of vegetation communities and habitats
- Minimise impacts on ecologically and culturally sensitive sites.

#### Implementation

Implementation activities include:

- Maintain appropriate curtilage of areas of environmental significance and of natural beauty
- Minimise severance impacts on existing forest
- Minimise vegetation clearing
- Maximise the re-vegetation of the road corridor using endemic trees, shrubs and groundcovers in surrounding vegetation associations to maintain biodiversity
- Minimise impact upon fauna and maximise the safety of travellers through incorporation of grade separated fauna crossings and fauna fencing
- Coordinate the alignment of electricity supply infrastructure and boundary and fauna fence alignments to maximise re-vegetation
- Utilise batters at 2H:1V or steeper to reduce existing vegetation clearing.

### Objective 3

Provide an enjoyable, interesting highway with varied views and vistas of the landscape and pleasant restful places to stop.

#### Strategies

Strategies that have guided the urban and landscape design include:

- Create an interesting and enjoyable journey with a strong identity through visual diversity
- Develop a high quality, robust, contemporary, urban and landscape design inspired by the locality, that is consistent with the urban and landscape design language of the greater Pacific Highway.

#### Implementation

Implementation activities include:

- Emphasise the vegetation spatial patterns that characterise the surrounding landscape
- Undertake the strategic placement of new plantings and vegetation work to frame desirable views for road users
- Develop landscape concepts that offer a variety of views and vistas of the key landscape features including the landmark mountains, forest, plantation, pasture lands, ridgelines and floodplains.

### Objective 4

Respect the communities along the route.

#### Strategies:

Strategies that have guided the urban and landscape design include:

- Incorporate community and stakeholder consultation processes into the design development of the project
- Increase connectivity of pedestrian, cyclist and local vehicular access
- Maintain appropriate identity, convenient access and address from the Pacific Highway to the coastal townships, villages and adjoining rural properties
- Identify and preserve items and places of significant Aboriginal and non-Aboriginal cultural and social heritage.

#### Implementation:

Implementation activities include:

- Design highway intersections to help wayfinding and provide convenient and safe access to local roads
- Ensure residents are screened from the upgrade and associated infrastructure with appropriate planting, where feasible
- Mitigate noise impacts at Tyndale and Maclean utilising appropriate noise attenuation measures
- Screen road users and adjoining houses from noise barriers, if required, with appropriate planting/landscaping.

### Objective 5

Provide 'consistency with variety' in road elements.

#### Strategies:

Strategies that have guided the urban and landscape design include:

- Provide a design solution that is consistent and integrated longitudinally with the overall Pacific Highway, while also incorporating variety and interest inspired by the unique qualities of the locality.

#### Implementation

Implementation activities include:

- Employ a holistic approach to the urban and landscape design considering all aspects of the project, including landscape, bridges, embankments, abutments, columns and piers, barrier details, retaining walls, fencing, lighting, signage structures and noise mitigation structures, if required, to ensure complete integration of all project elements
- Utilise best practice bridging technology and aesthetics that are consistent with existing Pacific Highway structures
- Utilise standard Pacific Highway architecture for the rest area facilities at Bostock Road.

### Objective 6

Provide a safe, simplified and unobtrusive road design.

#### Strategies:

Strategies that have guided the urban and landscape design include:

- Improve road user legibility
- Reduce visual clutter within the upgrade corridor by careful design and placement of elements.

#### Implementation

Implementation strategies include:

- Provide a coordinated family of high quality, simplified bridge structures, with a hierarchy based on visual significance
- Incorporate the rest areas into the overall design with simple geometry and appropriate screening
- Design the main alignment and intersections to be simple and legible
- Minimise the number of different roadside elements to reduce visual clutter
- Ensure road furniture (lighting, signage, barriers, etc) is coordinated and not located within view corridors
- Maximise the use of visually unobtrusive roadside barriers
- Reduce the visual impacts of drainage structures
- Maintain clear sight distance requirements
- Maintain easement requirements to utilities
- Utilise planting to reduce headlight glare.

### Objective 7

Incorporate environmentally sustainable urban and landscape design solutions.

#### Strategies:

Strategies that have guided the urban and landscape design include:

- Adopt precautionary principles and inter-generational equity principles
- Reduce potential pollution during construction and operation.

#### Implementation:

Implementation strategies include:

- Balance cut and fill across the project as far as practicable
- Collect native seeds from sustainable vegetation communities within the road corridor
- Create a low maintenance project design
- Reduce hard surface areas to the minimum
- Protect existing wildlife corridors and ecological habitats and rehabilitate modified habitats
- Deep mulch around plants to reduce water use
- Utilise ponds to improve water quality
- Salvage cleared vegetation for use as habitat and mulch
- Reduce and remove invasive weeds
- Incorporate measures to mitigate leaching of tannins, or other contaminants, from mulched areas or stockpiles per Roads and Maritime tannin guideline. Procedures to implement these measures will be developed in consultation with the project ecologist.

Other detailed objectives have been identified in the Design Brief and will be used to guide the further development of the design at a detailed level.

## 6.2 Urban design context

There are several settlements along the alignment. Each of these has its own cultural heritage, social and economic structures. The area was generally settled around the mid 1800s and includes a mix of agricultural and service centred activities.



Figure 41: Oblique aerial of Maclean township looking north-west and surrounding context. Source: Pacific Complete.

**Glenugie | Population 2011 – 245**

Located just to the north of the alignment, this hamlet straddles the Pacific Highway and consists of scattered houses. It is located to the south of Grafton Airport. Nearby to Glenugie is the North Coast Railway Branch Tramway historic site. Rock from the peak was used in the building of the North Coast rail line. Care must be taken to ensure that impacts to this site, visual or otherwise, are limited. Around 50 per cent of the land is within the Glenugie State Forest (Figures 42-43).

**Principle Activities**

- Tourism, Agricultural Show
- Farming.

**Landscape Character**

- A key landmark of the locality is Glenugie Peak. It is a dolerite peak noted for its dry rainforest
- It sits within pasture and woodland setting.



Figure 42: Existing Pacific Highway near Glenugie.



Figure 43: Glenugie. Source: Google.

**Grafton | Population 2014 – 18,698**

Located along the Clarence River, Grafton currently acts as a hub for its environs and straddles the connection of the existing Pacific Highway with the Gwydir Highway. It is comprised primarily of single family houses and also has an airport just to the east of the town near the alignment of the upgraded Pacific Highway and the outlying areas of South Grafton and Clarenza (Figures 44-45).

**Principle Activities**

- Tourism, Agricultural Show
- Farming
- Local administration.

**Landscape Character**

- Grafton is known as the Jacaranda capital and hosts the Jacaranda Festival. It also has a number of notable avenues of Fig trees
- It sits within a relatively open farming area along the river.



Figure 44: Grafton town centre.



Figure 45: Grafton town centre.

**Ulmarra | Population 2011 – 784**

Located to the west of the alignment along the existing Pacific Highway. This village provides some highway supported services and support for nearby rural areas. Traffic through Ulmarra may be expected to decrease as the upgraded Pacific Highway provides a bypass for this village. Ulmarra has a strong connection to the river as it has direct river frontage and is comprised primarily of single family houses (Figures 46-47).

**Principle Activities**

- Tourism and community functions
- Arts crafts and antiques.

**Landscape Character**

- The entire village is classified by the National Trust
- It sits within a relatively open farming area along the river.



Figure 46: Ulmarra town centre.



Figure 47: Ulmarra town centre.

**Maclean | Population 2011 – 2,600**

Maclean is a major town along the Clarence River and serves as a hub for its surroundings. The Maclean interchange will permit easy access to the town and increase its prominence along the corridor. It is comprised primarily of single family houses organised within a town street grid. The town has a strong Scottish cultural heritage (Figures 48-49).

**Principle Activities**

- Tourism and cultural attractions
- Farming, sugarcane production
- Fishing/river prawn trawling.

**Landscape Character**

- It sits within a forested slope setting of cleared development parcels.



Figure 48: Maclean town centre.



Figure 49: Maclean town centre.

**Tucabia | Population 2011 – 287**

Located to the west of the alignment this hamlet is located in pasture and scattered woodland. No direct connection to the upgraded Pacific Highway is envisioned. The rest areas will be located about three kilometres east of Tucabia (Figures 50-51).

**Principle Activities**

- Tourism and local attractions
- Arts and craft, antiques and museums
- Farming.

**Landscape Character**

- Located between the Coldstream River and forest to the east within a pasture and woodland setting.

**Tyndale | Population 2011 – 334**

Located on the Clarence River South Arm, Tyndale will be connected to the upgraded Pacific Highway by the Tyndale interchange. This village consists of single family residential houses in a rural setting. Tyndale will become an entry point for this area of the mid North Coast. The existing Pacific Highway runs between the river and the town (Figures 52-53).

**Principle Activities**

- Tyndale Tourism Park Roadshow
- Accommodation.

**Landscape Character**

- The southern gateway to the sugar plantations of the Clarence floodplains
- It sits within an intermittent forest landscape on the edge of the floodplain.

**Townsend | Population 2011 – 817**

Located just to the east of Maclean this town is essentially an outlying part of greater Maclean. This area is characterised by single family houses and some light industrial areas. Its main connection to Maclean is through Jubilee Street which crosses under the Pacific Highway and over the ridge to Maclean (Figures 54-55).

**Principle Activities**

- Tourism and local cultural attractions
- Light industry.

**Landscape Character**

- Located at the edge of the floodplain
- It is nestled on relatively flat land between agricultural fields to the south and forest to the north.

**Gulmarrad | Population 2011 – 1,644**

Gulmarrad is located to the south of Townsend and may also be considered part of the greater Maclean area. This area is characterised by single family houses and some mixed use areas. It is nestled on relatively flat land between agricultural fields to the south and forest to the north. Its main connection to Maclean is through Brooms Head Road which also travels south to the coast at Brooms Head (Figures 56-57).

**Principle Activities**

- Tourism and local cultural attractions
- Farming
- Community functions.

**Landscape Character**

- At the edge of the floodplain
- It sits within an intermittent forest setting of cleared development parcels.



Figure 50: Cordini Street, Tucabia looking west.



Figure 52: View of Tyndale from existing Pacific Highway.



Figure 54: Jubilee Street looking west to existing Pacific Highway.



Figure 56: Brooms Head Road, Gulmarrad looking north.



Figure 51: Tucabia Village, Cordini Street looking west.



Figure 53: View of proposed Tyndale interchange south.



Figure 55: Townsend. Source: Google.



Figure 57: View of alignment from Sheehans Lane, near Gulmarrad.

### 6.2.1 Section 3 and 4 urban design strategies

#### Forest setting zone

- Heavily wooded areas with generally closed views. Some views open up toward the plains beyond at valleys and watercourses
- Generally hilly and or lightly mountainous
- The design strategy will emphasise re-vegetation and integration of the highway with the landscape to create a forest drive.

#### Open agricultural setting zone

- Largely comprised of floodplain and sugarcane fields characterised by a generally open landscape with broad views
- The design strategy will emphasise a strategy to reduce the visual intrusion of the motorway in the landscape.

#### Pasture scattered woodland zone

- Comprised largely of scattered groups of trees and pasture land that is generally flat.

#### Green gateway

- Occurs at the connection of the Pacific Highway upgrade to the existing Glenugie upgrade section near Glenugie
- Provides an opportunity to create a forested, green experience that signals this portion of the motorway provides a deep forest experience further to the north
- To create a seamless transition from the previously upgraded motorway to the Woolgoolga to Ballina Upgrade section.

#### Cultural landscape gateways

- Occur at the interchanges at Tyndale and Maclean
- To provide a strong entry experience that references and reinforces the cultural landscapes of these places to enhance the sense of transition from local roads to the highway.

#### Forest event

- Occurs at the rest areas on each side of the motorway, generally within a cutting and form part of the forest experience
- Signature planting and appropriate placement of rest area facilities can create a special place within the forest.

Refer to Figures 58-60 and Drawing 3.



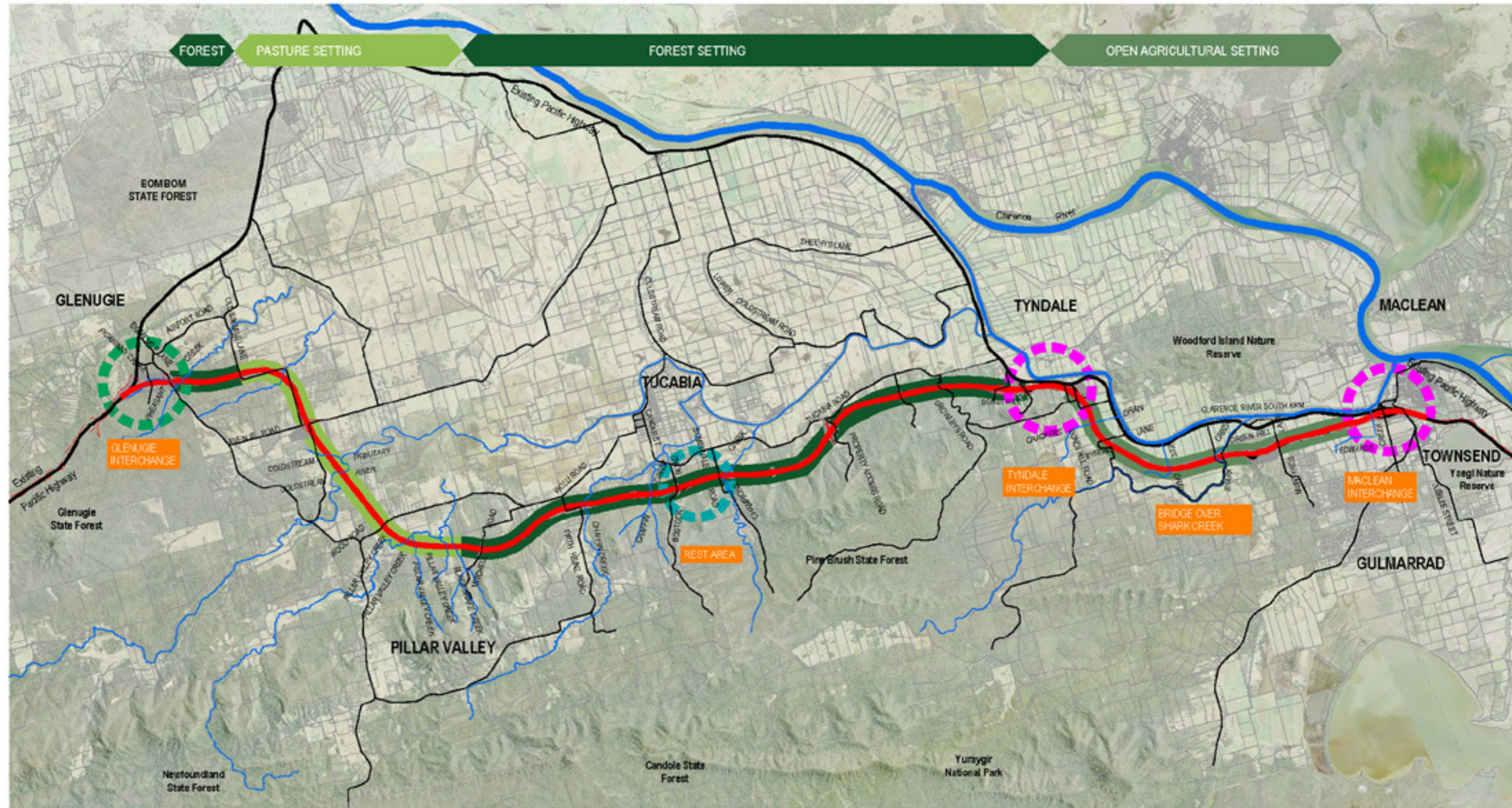
Figure 58: Forest setting zone. Source: Pacific Complete.



Figure 59: Pasture scattered woodland setting zone. Source: Pacific Complete.



Figure 60: Open agricultural setting zone. Source: Pacific Complete.



- LEGEND**
- Pacific Highway upgrade W2B Sections 3 to 4
  - Existing Pacific Highway
  - Existing roads
  - Existing major watercourses

- Green gateway (subject to further design development)
- Cultural landscape gateway
- Forest event



Drawing and designs subject to further development.

W2B-GHD-A-LX-DRG-00003  
Strategic vision

### 6.3 Local environmental values

A number of elements of local environmental value exist along or in the vicinity of the alignment of the proposed highway. These include sensitive EEC, National and State forests, SEPP 14 Wetlands, wildlife connectivity corridors, threatened fauna and flora.

An approach to minimising the impacts to these areas is adopted and is further detailed in the environmental documents. Fauna crossings will be provided at appropriate locations to serve local wildlife populations and to ensure these populations and the habitats that support them are not compromised by construction of the highway.

The landscape conservation areas include the Glenugie State Forest, Pine Brush State Forest both of which contain high conservation value old growth forest and the Yaegl Nature Reserve. A robust revegetation strategy will be put in place to ensure the impacts of the highway are mitigated allowing the forest areas to 'reclaim' the cleared areas used for the highway construction to the greatest extent possible, and enhance biodiversity.

### 6.4 Heritage values

Significant areas of Aboriginal heritage and non-Aboriginal heritage have been identified in proximity to the project. The NSW Roads and Maritime Services, Woolgoolga To Ballina | Pacific Highway Upgrade, EIS, *Main Volume 1B, Chapter 13 – Historical (non-Aboriginal) Heritage* describes in detail these aspects of the project.

#### 6.4.1 Aboriginal heritage

The alignment is optimised to ensure that it does not impact on any of the above items.

Strategies to achieve this include:

- Consult with appropriate Aboriginal representatives (undertaken by others) to ensure that actions taken with respect to cultural places are consistent with the values of the community
- In consultation with appropriate Aboriginal representatives (undertaken by others) explore opportunities to provide interpretive expression in the design of infrastructure elements.

#### 6.4.2 Non-Aboriginal heritage

A summary of non-Aboriginal sites are noted below:

- 11 Tyndale residence
- 10 Tyndale shed and cane barracks
- 12 Maclean punt and former Ashby ferry, Maclean
- 22 Former house site Goodwood Street, Maclean (Property 315)
- 34 Townsend residence Townsend.

The alignment is optimised to ensure that it does not impact on any of the above items.

Strategies to achieve this include:

- Provide appropriate signage to signal local historical heritage attractions
- Explore opportunities to provide interpretive expression in the design of infrastructure elements
- Involve the local communities (undertaken by others) in the design of the motorway including potential marking of heritage items and complementary projects that may be undertaken by local councils in response to the upgraded motorway.



## 6.5 Sustainable design and maintenance

The purpose of this Sustainability Action Plan (SAP) is to outline how the projects' sustainability requirements will be addressed during the design phase. GHD and BG&E intend to develop the design with regard for the three pillars of sustainability; Environment, Social and Economic.

This SAP aims to provide a structured approach to planning and implementing sustainability opportunities and initiatives throughout the project design phase. The objectives of the SAP are to:

- Outline the Sustainability Policy for the Glenugie to Maclean Sections 3 and 4 of the highway
- Identify targets and objectives to implement the project's Sustainability Policy
- Detail a proposed sustainability education campaign related to the sustainability objectives and targets
- Establish the processes by which sustainability will be applied throughout the project
- Provide a structured approach to planning and implementing environmental sustainability measures and initiatives.

As a component of the SAP, the project will target achieving an Infrastructure Sustainability Council of Australia (ISCA) rating greater than 35.

## 6.6 Community amenity and privacy

The communities located along the route vary in size and relationship to the highway. The existing Pacific Highway winds through many of these communities and generally has an established landscape setting that provides some screening and buffering to the immediate surroundings. The upgraded Pacific Highway will be a wider corridor and generally be in either cut or batter conditions. A robust revegetation strategy will be employed to ensure that screening, to the greatest extent practicable, is provided along the highway. In cut conditions, the natural batter of the cut will help in this screening. In fill conditions, consideration will need to be given to placing screening.

Community sensitivity to the local context is acknowledged as an important aspect of the project. The upgrade has been specifically designed to respond appropriately to this context.

### Strategies

- Provide appropriate signage to signal local attractions
- Develop a narrative for the journey that emphasises the string of towns and villages along the coastal route
- Explore opportunities to provide interpretive expression in the design of infrastructure elements
- Involve the local communities in the design of the motorway including potential complementary projects that may be undertaken by local councils in response to the upgraded motorway
- Explore opportunities for place making in residual areas left over by the upgrade so they can become a usable community space and integrated into the overall fabric of the town
- Investigate opportunities with Roads and Maritime urban design representatives for the possibility of providing appropriate place markers which will enhance the cultural significance of the towns and communities in the vicinity of the route.

## 6.7 Temporary work, ancillary facilities, access tracks, watercourse crossings

### Project ancillary facilities

The project will require ancillary facilities to support the building activities associated with the project. The project approval defines an ancillary facility as:

A temporary facility for construction, including for example an office and amenities compound, construction compound, batch plant (concrete or bitumen), material crushing and screening, materials storage compound, maintenance workshop, testing laboratory or material stockpile area.

In accordance with the MCoA D20, Pacific Complete has prepared an Ancillary Facilities Management Plan which outlines how ancillary facilities will be assessed and managed during construction of the project. The management plan provides details of the approval pathway, environmental impact assessment, and includes details of all ancillary facilities approved for the project.

Ancillary facilities covered by the Management Plan include:

- Office compounds – including the main site compounds, site offices, sheds, workshops and storage; satellite compounds – small site offices
- Minor ancillary facilities - including lunch sheds, office sheds, and portable toilet facilities
- Bridge site compounds – site office to allow for easy access to major bridge sites
- Batch plants – for the production of concrete and asphalt
- Crushing plants and material processing sites – plant and equipment for the processing, crushing and screening of excavated material for use on-site
- Plant workshops – for the storage and maintenance of plant and equipment
- Stockpile sites – for the stockpile and storage of excavated material, mulch and spoil
- Material storage (laydown areas) – for the storage of materials delivered to site for construction
- Display centres and visitor parking.

The ancillary facilities associated with the project include areas that are located within the existing or proposed highway corridor that are directly or indirectly impacted by the building work, in addition to locations near or separate to the construction activities. As outlined in the MCoA definitions all ancillary facilities are temporary and can only be used for the project. MCoA B76 of the project approval outlines the rehabilitation requirements of these sites as:

The land on which ancillary facilities are located shall be rehabilitated to at least their pre-construction condition or better, unless otherwise agreed by the landowner.

### **Borrow sites**

The project will also require a number of borrow sites will be used to source material for construction of the project. MCoA D22 of the project approval requires the preparation of a Borrow Sites Management Plan for each of the borrow sites proposed for the project. The plan needs to identify details of the site, assessment of impacts resulting from the borrow operations, and rehabilitation details of the borrow site. The rehabilitation details are to include future landform and use of the borrow site, landscaping and revegetation, and measures to be implemented to minimise or manage the ongoing environmental effects of the site.

### **General location and size**

The temporary ancillary facilities utilised during the highway construction phase will vary in their size and configuration, depending on the nature of use and nearby construction activities. There is likely to be a combination of larger main construction compounds in addition to smaller satellite compounds located within each portion of the project. The specific locations of the ancillary facilities to be used for the project are not fully known at the time of preparation of the Urban Design and Landscape Plan, and as a result are not detailed in the plan. Temporary ancillary and borrow sites are located on two different categories of land that include:

- Land owned by Roads and Maritime for the purposes of the project
- Private properties leased for the construction period of the highway.

All ancillary facilities will be managed for the project in accordance with the approved Ancillary Facility Management Plan. It is anticipated that each ancillary facility will be developed and rehabilitated in accordance with the following principles.

### **Ancillary and borrow site rehabilitation principles**

- Establish landowner requirements and identify rehabilitation objectives
- Consideration of the location context and amenity requirements
- Integrate rehabilitation with nearby landform, topography
- Consider fauna connectivity and wildlife corridors and enhance where possible
- Apply landscape treatments consistent with the project UDLP to ensure an integrated outcome.

### **Commitment to site rehabilitation**

The intention with all Temporary Construction sites is to rehabilitate them as soon as possible after they are no longer required for the highway building operations.

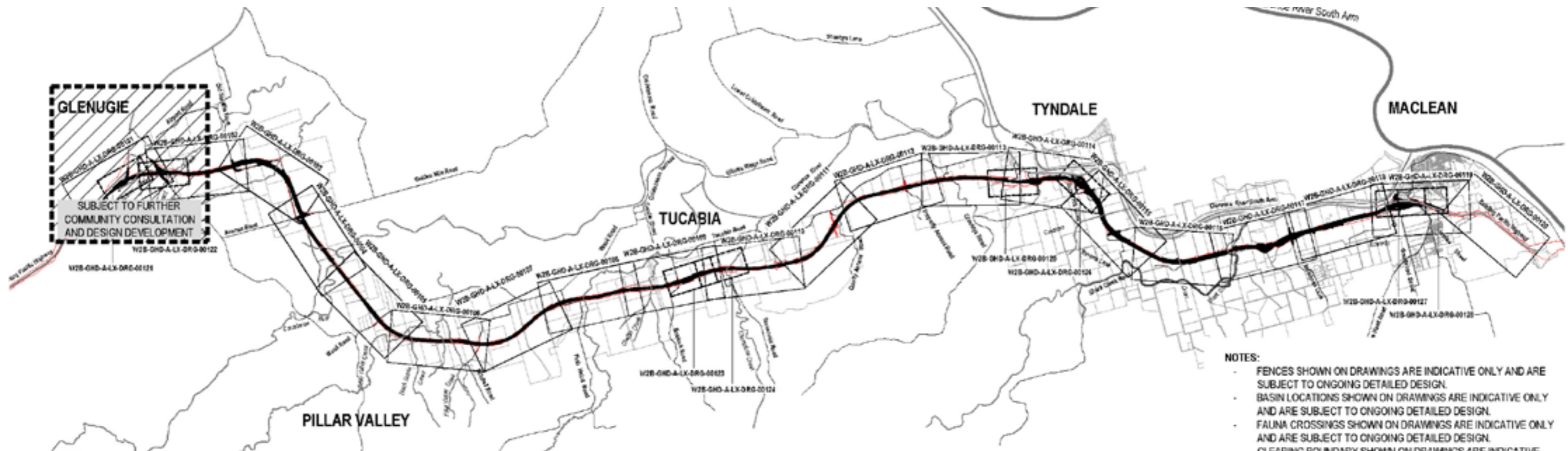
On Roads and Maritime owned sites used for temporary construction that are to be sold, and are located within or near native vegetation communities, the area impacted within those properties will be revegetated with species compatible with the remnant vegetation, as relevant. Where appropriate the revegetation will enhance wildlife habitat values. The rehabilitation work is to include maintenance until the vegetation is well established.

On Roads and Maritime owned sites used for the extraction of construction material the rehabilitation work may include disposal of soil material classified as 'unsuitable' generated by the highway work, regrading to create landforms compatible with adjoining areas and establishment of a stable revegetation cover. Reuse of this material is subject to all relevant waste and planning approval requirements.

On privately owned land the rehabilitation work will be in accordance with an agreement to be reached with the property owner. The rehabilitation work is to meet all relevant environmental requirements.

# 7.0 Urban design and landscape plan

## 7.1 Urban design and landscape concept plans



- NOTES:**
- FENCES SHOWN ON DRAWINGS ARE INDICATIVE ONLY AND ARE SUBJECT TO ONGOING DETAILED DESIGN.
  - BASIN LOCATIONS SHOWN ON DRAWINGS ARE INDICATIVE ONLY AND ARE SUBJECT TO ONGOING DETAILED DESIGN.
  - FAUNA CROSSINGS SHOWN ON DRAWINGS ARE INDICATIVE ONLY AND ARE SUBJECT TO ONGOING DETAILED DESIGN.
  - CLEARING BOUNDARY SHOWN ON DRAWINGS ARE INDICATIVE ONLY AND ARE SUBJECT TO CONFIRMATION AS PART OF ONGOING DETAILED DESIGN.
  - BARRIERS SHOWN ON DRAWINGS ARE INDICATIVE ONLY AND ARE SUBJECT TO CONFIRMATION AS PART OF ONGOING DETAILED DESIGN.
  - REST AREA DESIGN IS SUBJECT TO DETAILED DESIGN (CURRENTLY BEING UNDERTAKEN BY ENGINEERS).
  - CIVIL & STRUCTURAL ALIGNMENTS ARE BEING COORDINATED TO AVOID MISMATCH.
  - REQUIREMENTS FOR RIPARIAN VEGETATION AT CROSSINGS ARE SUBJECT TO ONGOING DETAILED DESIGN.
  - REUSE OF EXISTING BUSHLAND TOPSOILS WILL ENCOURAGE NATURAL REGENERATION FROM THE EXISTING TOPSOIL SEEDBANK TO MATCH ADJOINING VEGETATION COMMUNITIES. WHERE PLANTING AND SEEDING IS REQUIRED, MIXES HAVE BEEN DERIVED FROM EXISTING VEGETATION COMMUNITIES IMMEDIATELY ADJOINING PLANTING/SEEDING AREAS.
  - POTENTIAL LANDSCAPE (SPOIL) MOUNDS NOT SHOWN FOR CLARITY AND ARE SUBJECT TO CONFIRMATION AS PART OF ONGOING DETAILED DESIGN.

**DRAWING LIST**

W2B-GHD-A-LX-DRG-00100	URBAN DESIGN CONCEPT PLAN-KEY PLAN
W2B-GHD-A-LX-DRG-00101	URBAN DESIGN CONCEPT PLAN
W2B-GHD-A-LX-DRG-00102	URBAN DESIGN CONCEPT PLAN
W2B-GHD-A-LX-DRG-00103	URBAN DESIGN CONCEPT PLAN
W2B-GHD-A-LX-DRG-00104	URBAN DESIGN CONCEPT PLAN
W2B-GHD-A-LX-DRG-00105	URBAN DESIGN CONCEPT PLAN
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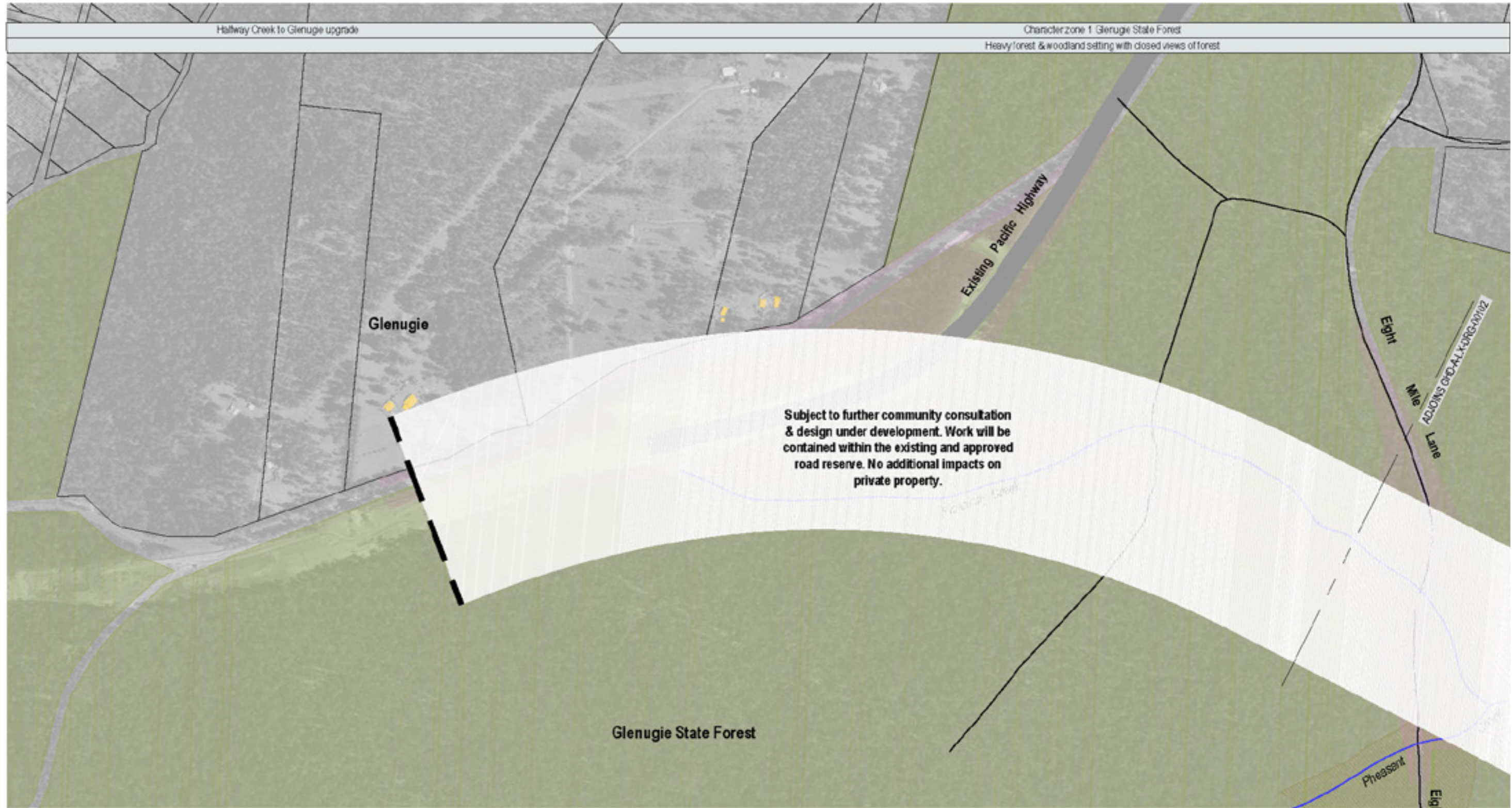
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W2B-GHD-A-LX-DRG-00120	URBAN DESIGN CONCEPT PLAN
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W2B-GHD-A-LX-DRG-00122	GLENUGIE INTERCHANGE NORTH
W2B-GHD-A-LX-DRG-00123	REST AREA
W2B-GHD-A-LX-DRG-00124	REST AREA
W2B-GHD-A-LX-DRG-00125	TYNDALE INTERCHANGE SOUTH
W2B-GHD-A-LX-DRG-00126	TYNDALE INTERCHANGE NORTH
W2B-GHD-A-LX-DRG-00127	MACLEAN INTERCHANGE
W2B-GHD-A-LX-DRG-00128	MACLEAN INTERCHANGE



Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.

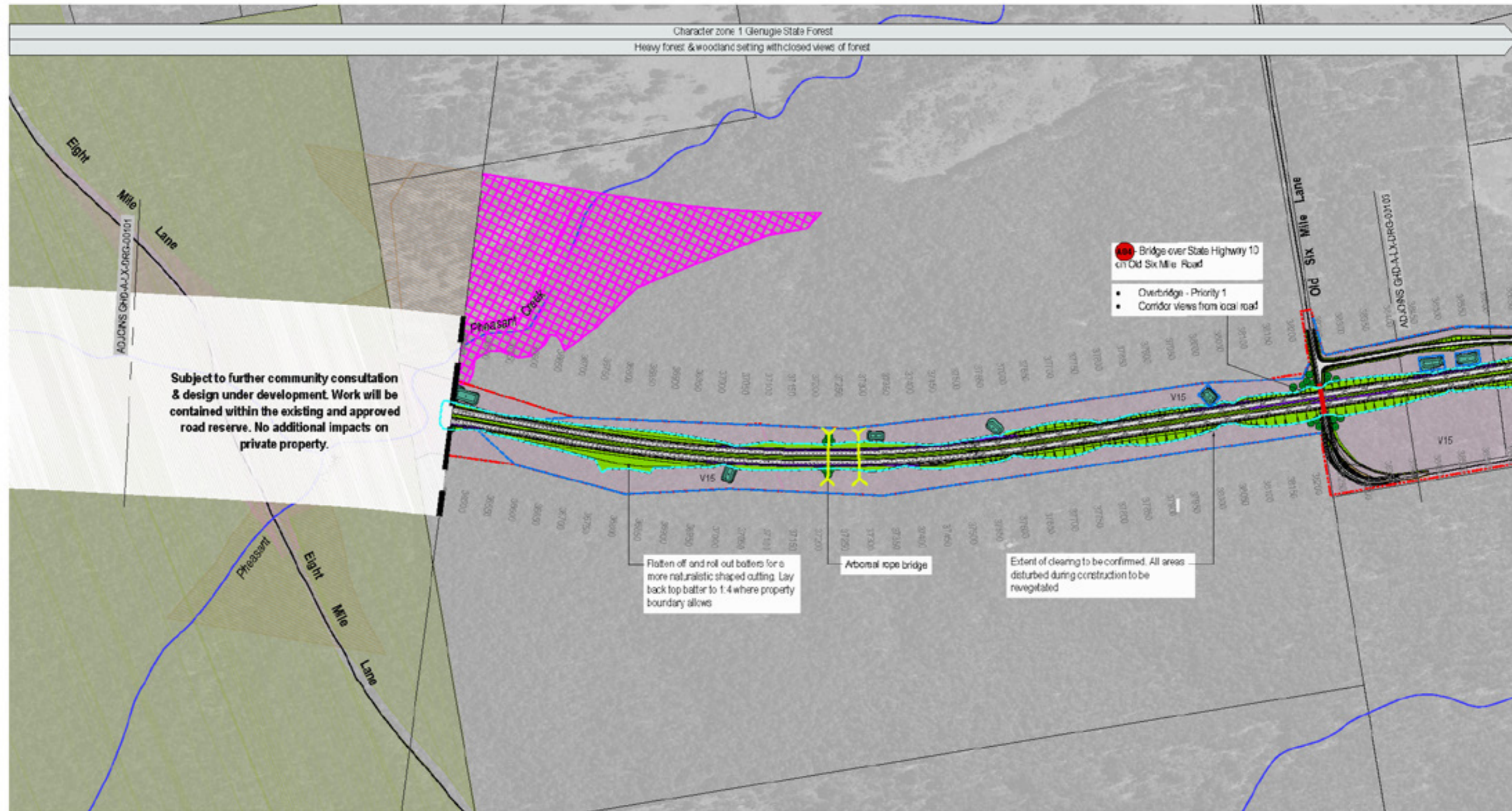
Work in progress

Urban design key plan W2B-GHD-A-LX-DRG-00100

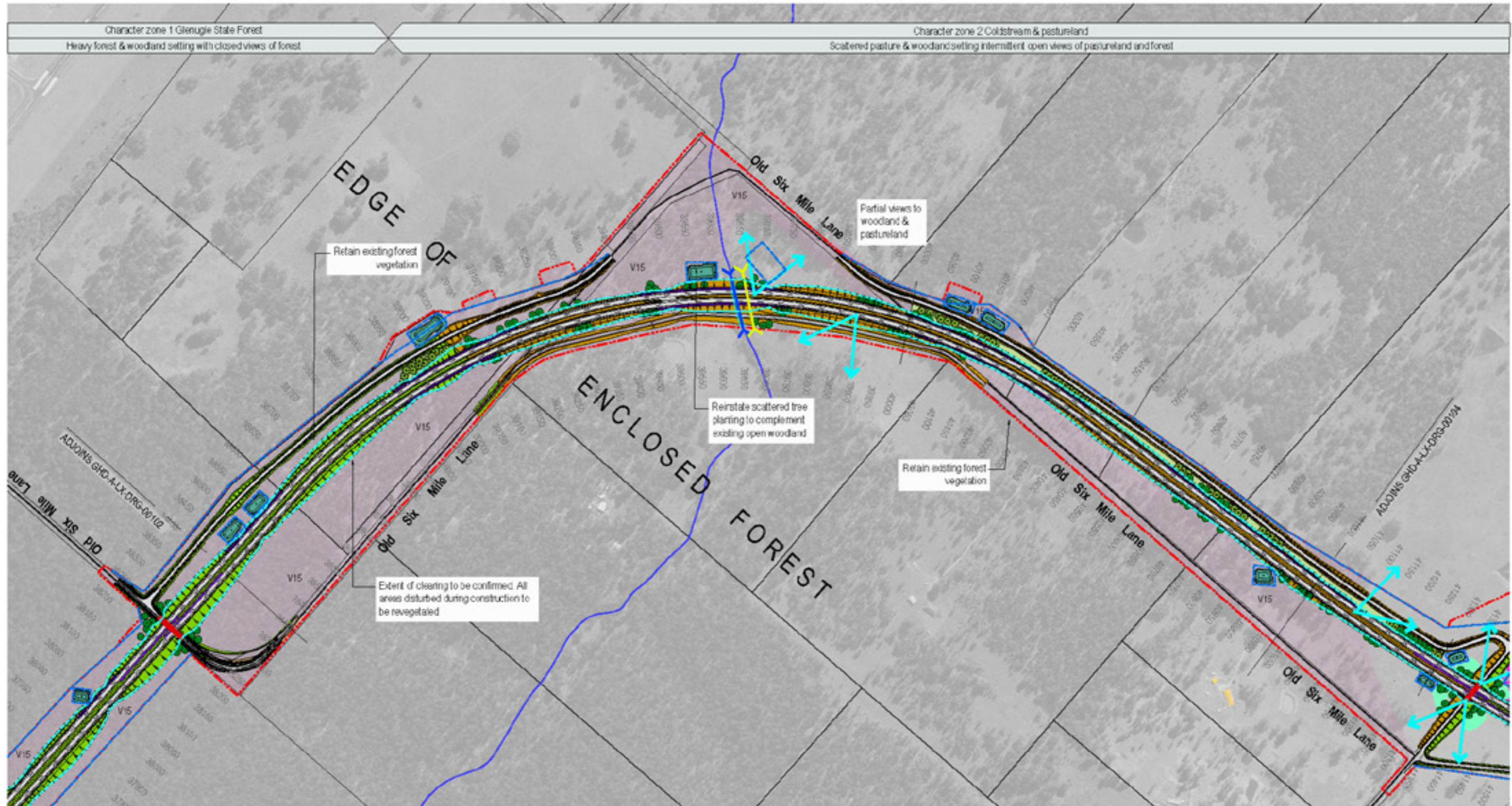


LEGEND		EXISTING VEGETATION COMMUNITIES				EEC			
Existing Pacific Highway	Watercourse	V1 Angophora robust shrubby forest and woodland	V5 Coastal freshwater meadows and forlands of lagoons and wetlands	V9 Narrow-leaved Ironbark dry open forest	V13 Scribbly Gum - Red Bloodwood heathly open forest	V17 Swamp Mahogany swamp forest	Freshwater wetlands on coastal floodplains (EEC)	Swamp oak floodplain forest on coastal floodplains (EEC)	
Existing bridges	Property boundary	V2 Black Bean - Weeping Lilly Pilly riparian rainforest	V6 Flooded Gum - Brush Box moist forest	V10 Paperbark swamp forest	V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest	V18 Swamp Oak swamp forest	Lowland rainforest on coastal floodplains (EEC)	Swamp sclerophyll forest on coastal floodplains (EEC)	
Existing road	Nearby building	V3 Blackbutt - Bloodwood dry healthy open forest	V7 Forest Red Gum - Swamp Box	V11 Pink Bloodwood - Tallwood moist open forest	V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	V19 Turpentine moist open forest	Subtropical coastal floodplain forest on coastal floodplains (EEC)		
	Key views to surrounding landscape	V4 Coastal floodplain sedgelands, ripplands and forlands	V8 Grey Gum - Grey Ironbark open forest	V12 Scribbly Gum - Needlebark Stringybark heathly open forest	V16 Swamp Box swamp forest	Koala habitat			

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Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.



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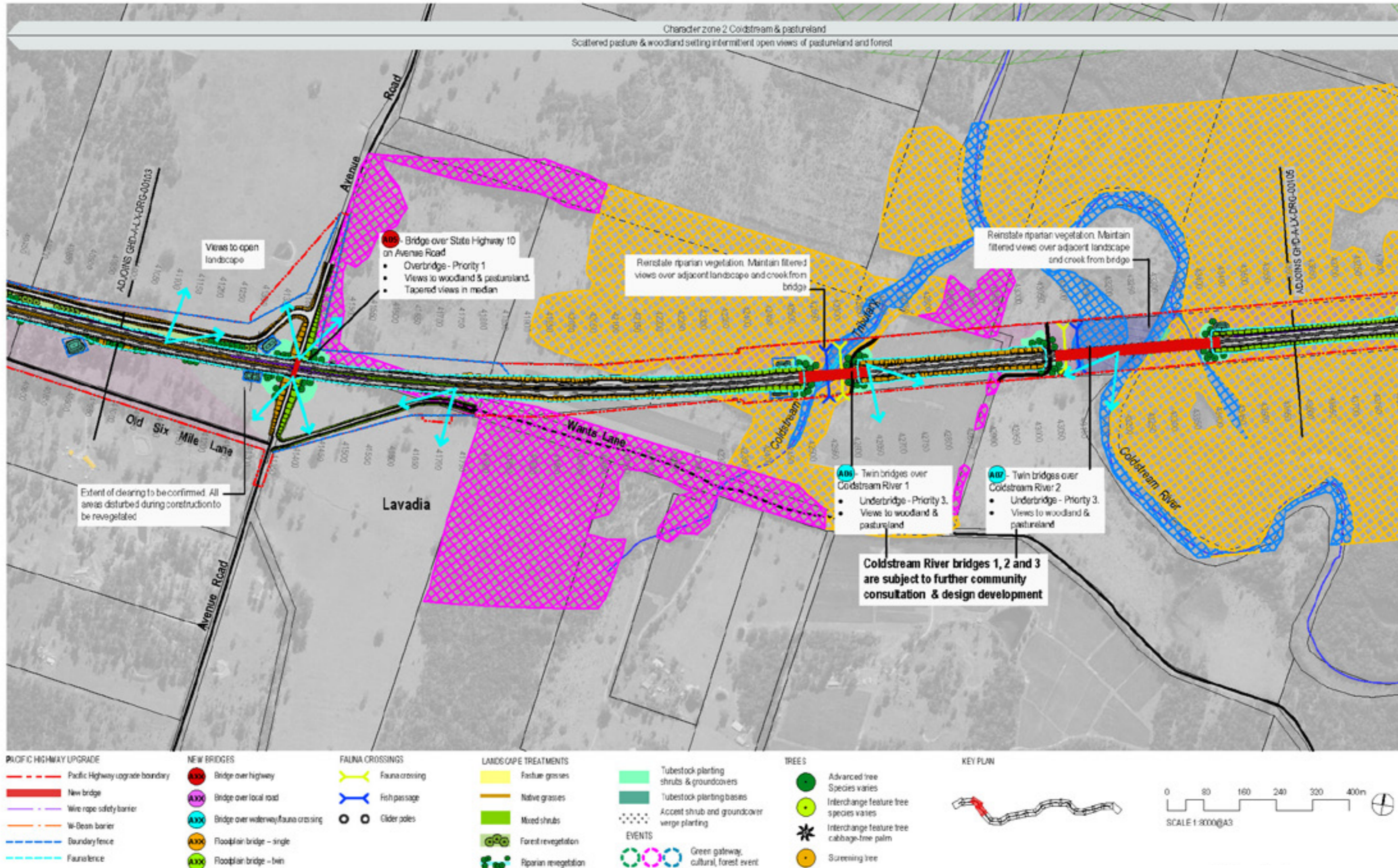
LEGEND		EXISTING VEGETATION COMMUNITIES		EEC	
Existing Pacific Highway	Watercourse	V1 Asphora robur shrubby forest and woodland	V5 Coastal freshwater meadows and forlands of lagoons and wetlands	V9 Narrow leaved Ironbark dry open forest	Freshwater wetlands on coastal floodplains (EEC)
Existing bridges	Property boundary	V2 Black Bean - Weeping Lilly Pilly riparian rainforest	V6 Flooded Gum - Brush Box moist forest	V10 Paperbark swamp forest	Lowland rain forest on coastal floodplains (EEC)
Existing road	Nearby building	V3 Blackbutt - Bloodwood dry heathy open forest	V7 Forest Red Gum - Swamp Box	V11 Pink Bloodwood - Tallwood moist open forest	Subtropical coastal floodplain forest on coastal floodplains (EEC)
Key views to surrounding landscape		V4 Coastal floodplain sedgelands, rushlands and forlands	V8 Grey Gum - Grey Ironbark open forest	V12 Scribbly Gum - Needlebark Stingingbark heathy open forest	Swamp oak floodplain forest on coastal floodplains (EEC)
				V13 Scribbly Gum - Red Bloodwood heathy open forest	Swamp sclerophyll forest on coastal floodplains (EEC)
				V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest	Swamp Mahogany swamp forest
				V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	Swamp Oakswamp forest
				V16 Swamp Box swamp forest	Tupentine moist open forest
					Koala habitat

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Landscape at maturity approximately 15 years.

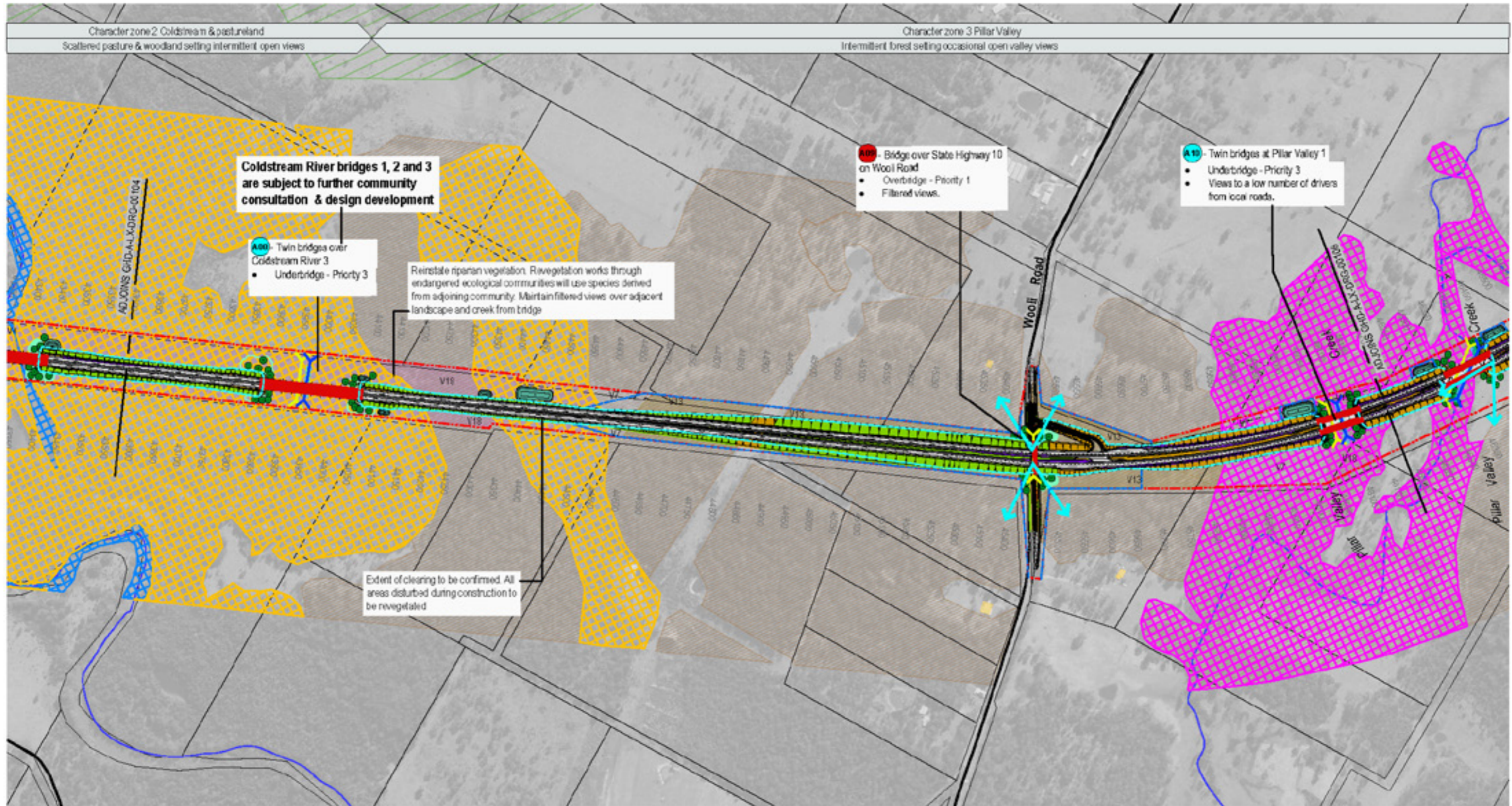
SECTION 3

Urban design and landscape concept plan

W2B-GHD-A-LX-DRG-00103



Drawing and design subject to further development, number of trees/elements shown is indicative only.  
 Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
 Landscape at maturity approximately 15 years.



EXISTING FEATURES		EXISTING VEGETATION COMMUNITIES		EEC	
Existing Pacific Highway	Watercourse	Angophora robur shrubby forest and woodland	Coastal freshwater meadows and forlands of lagoons and wetlands	Scribbly Gum - Red Bloodwood healthy open forest	Freshwater wetlands on coastal floodplains (EEC)
Existing bridges	Property boundary	Black Bean - Weeping Lilly Pilly riparian rainforest	Flooded Gum - Brush Box moist forest	Spotted Gum - Grey Box - Grey Ironbark dry open forest	Lowland rainforest on coastal floodplains (EEC)
Existing road	Nearby building	Blackbutt - Bloodwood dry healthy open forest	Forest Red Gum - Swamp Box	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	Subtropical coastal floodplain forest on coastal floodplains (EEC)
	Key views to surrounding landscape	Coastal floodplain sedglands, rushlands and forlands	Grey Gum - Grey Ironbark open forest	Swamp Box swamp forest	Swamp oak floodplain forest on coastal floodplains (EEC)
		Narrow-leaved Ironbark dry open forest	Paperbark swamp forest	Swamp Mahogany swamp forest	Swamp sclerophyll forest on coastal floodplains (EEC)
		Pink Bloodwood - Tallowood moist open forest	Scribbly Gum - Needlebark Stringybark healthy open forest	Swamp Oak swamp forest	
		Swamp Mahogany swamp forest		Tarpestine moist open forest	
		Coastal freshwater meadows and forlands of lagoons and wetlands		Koala habitat	

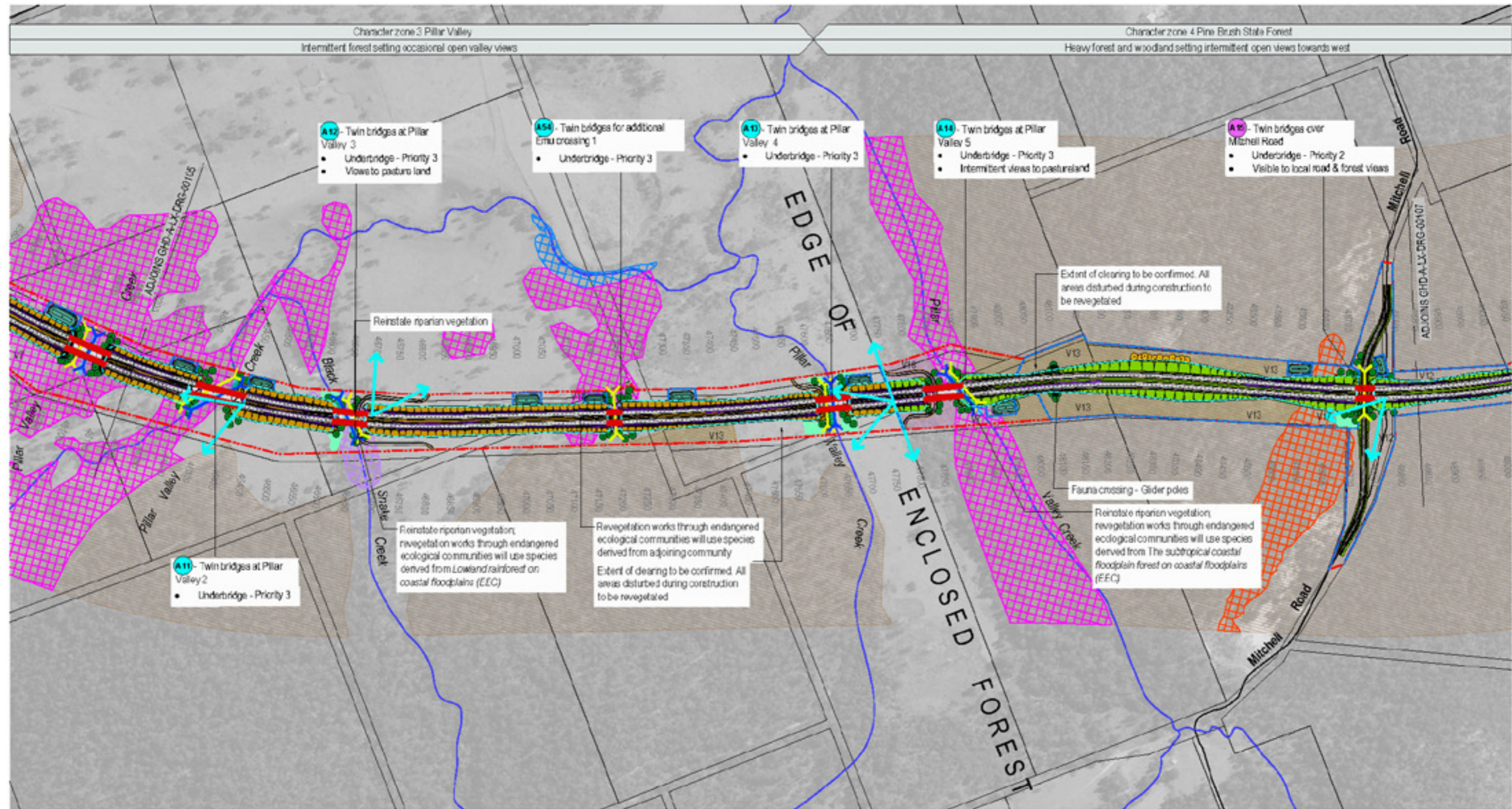
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**SECTION 3**

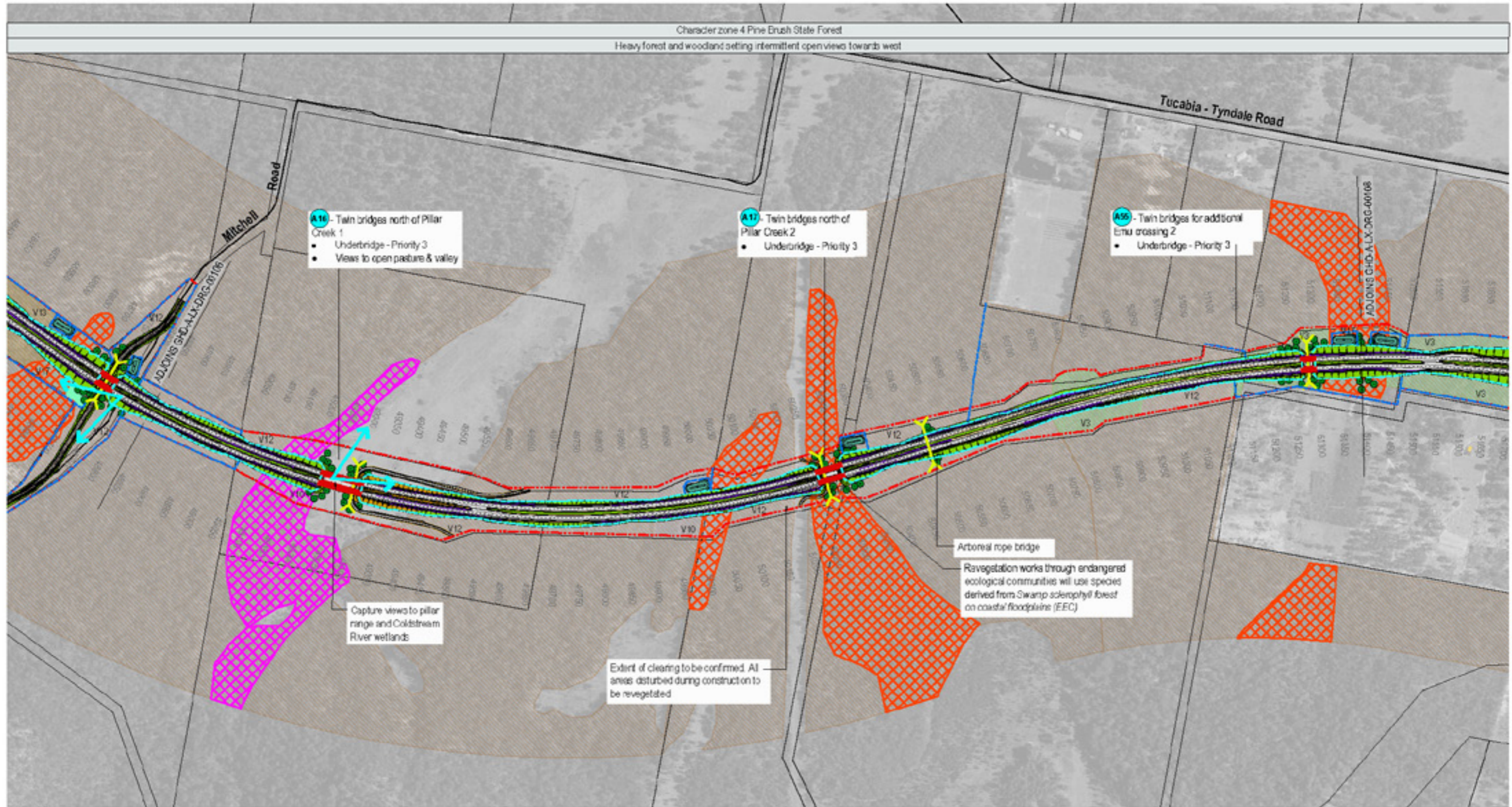
Urban design and landscape concept plan

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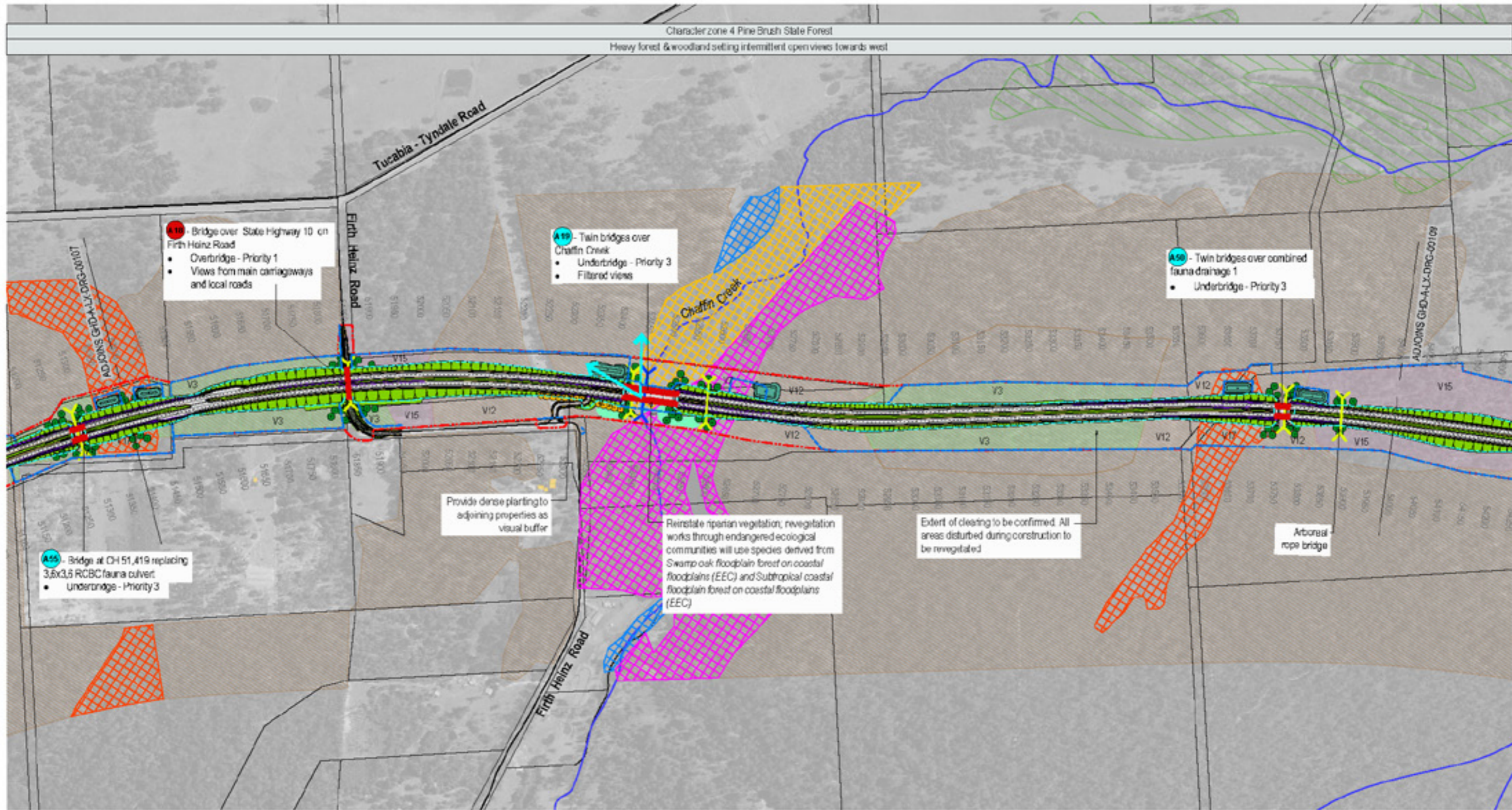




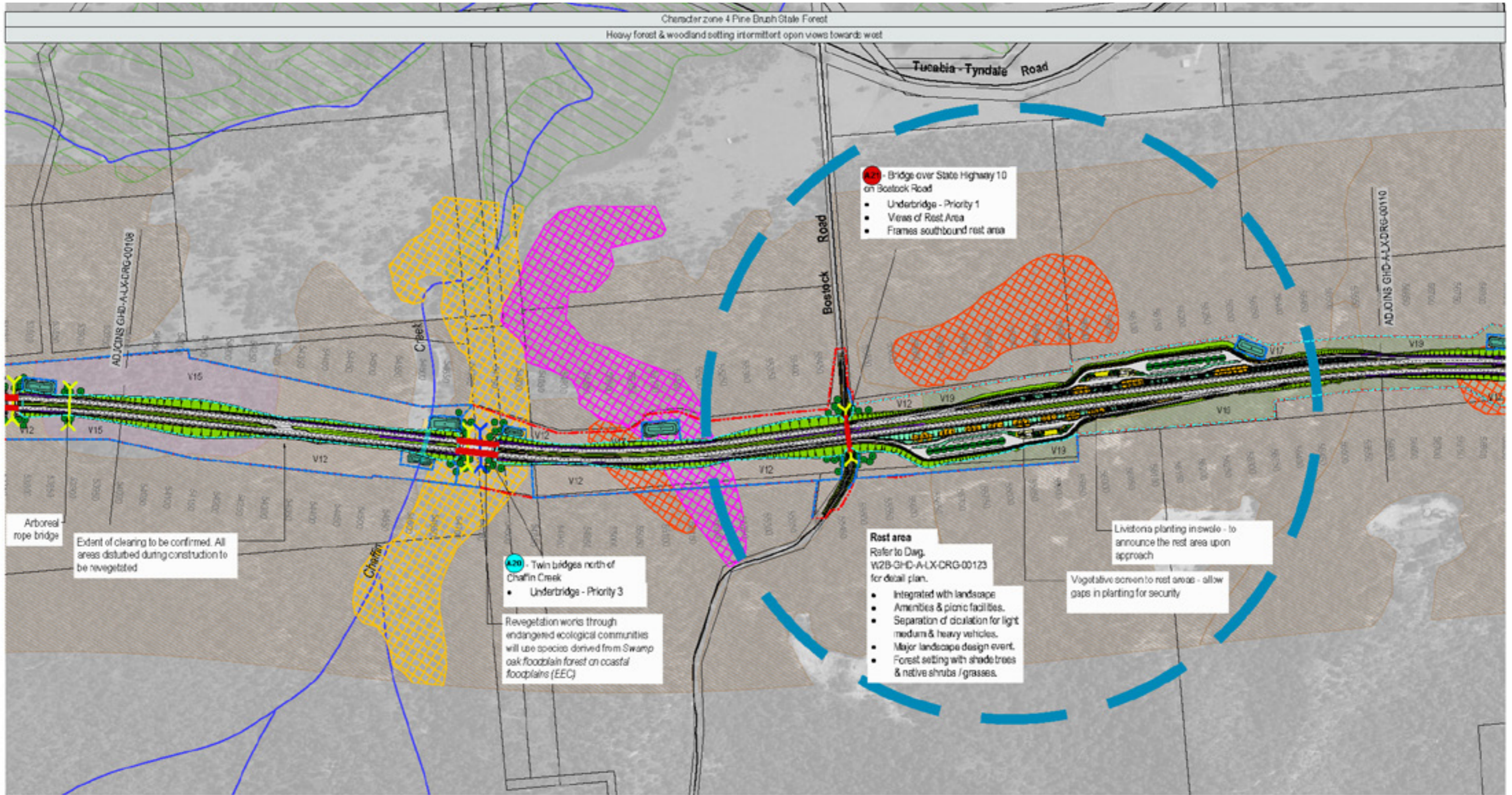
Drawing and design subject to further development, number of trees/elements shown is indicative only. Fence locations, types and shared path locations are to be confirmed, and subject to further design development. Landscape at maturity approximately 15 years.



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 Landscape at maturity approximately 15 years.

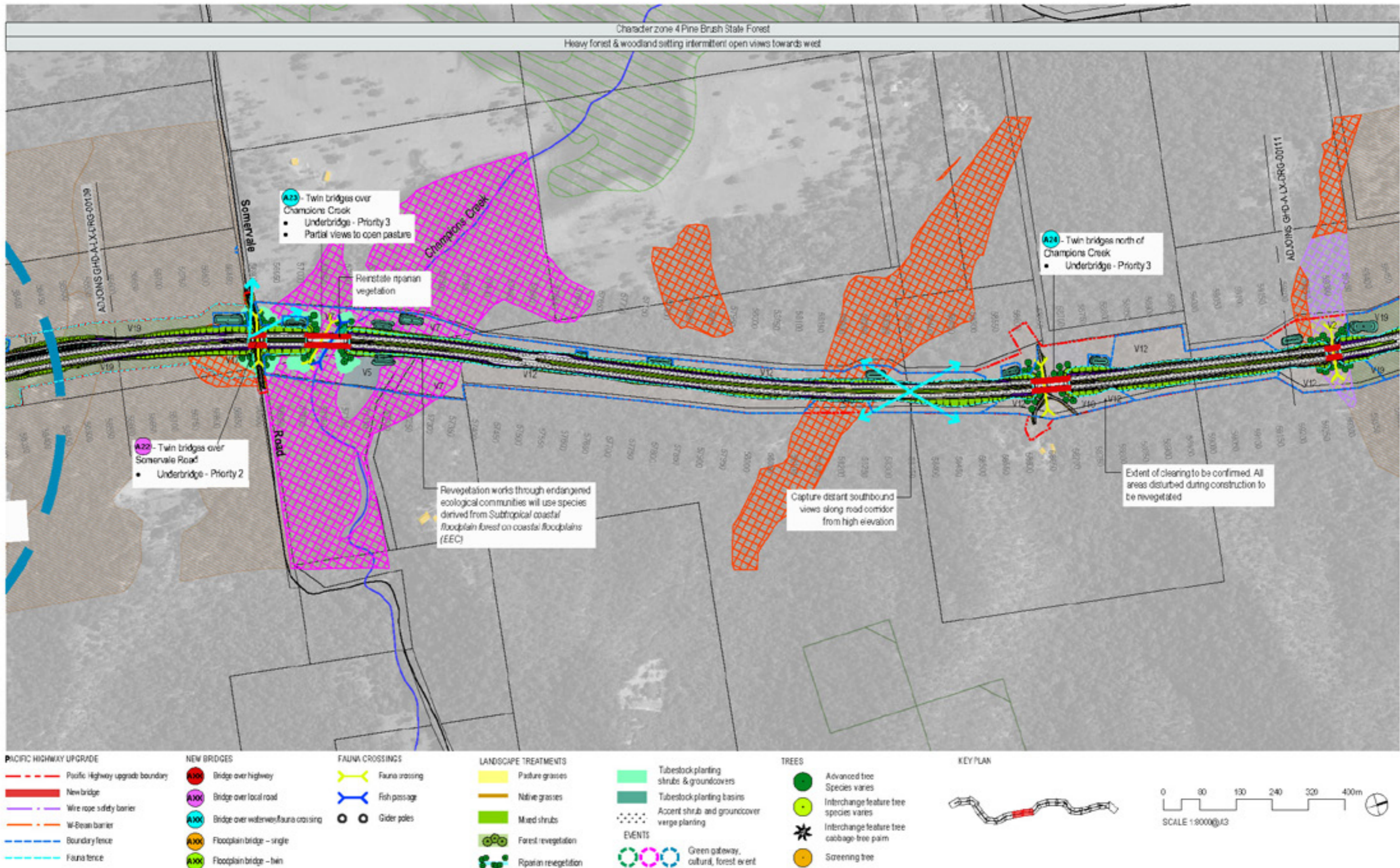


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Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.

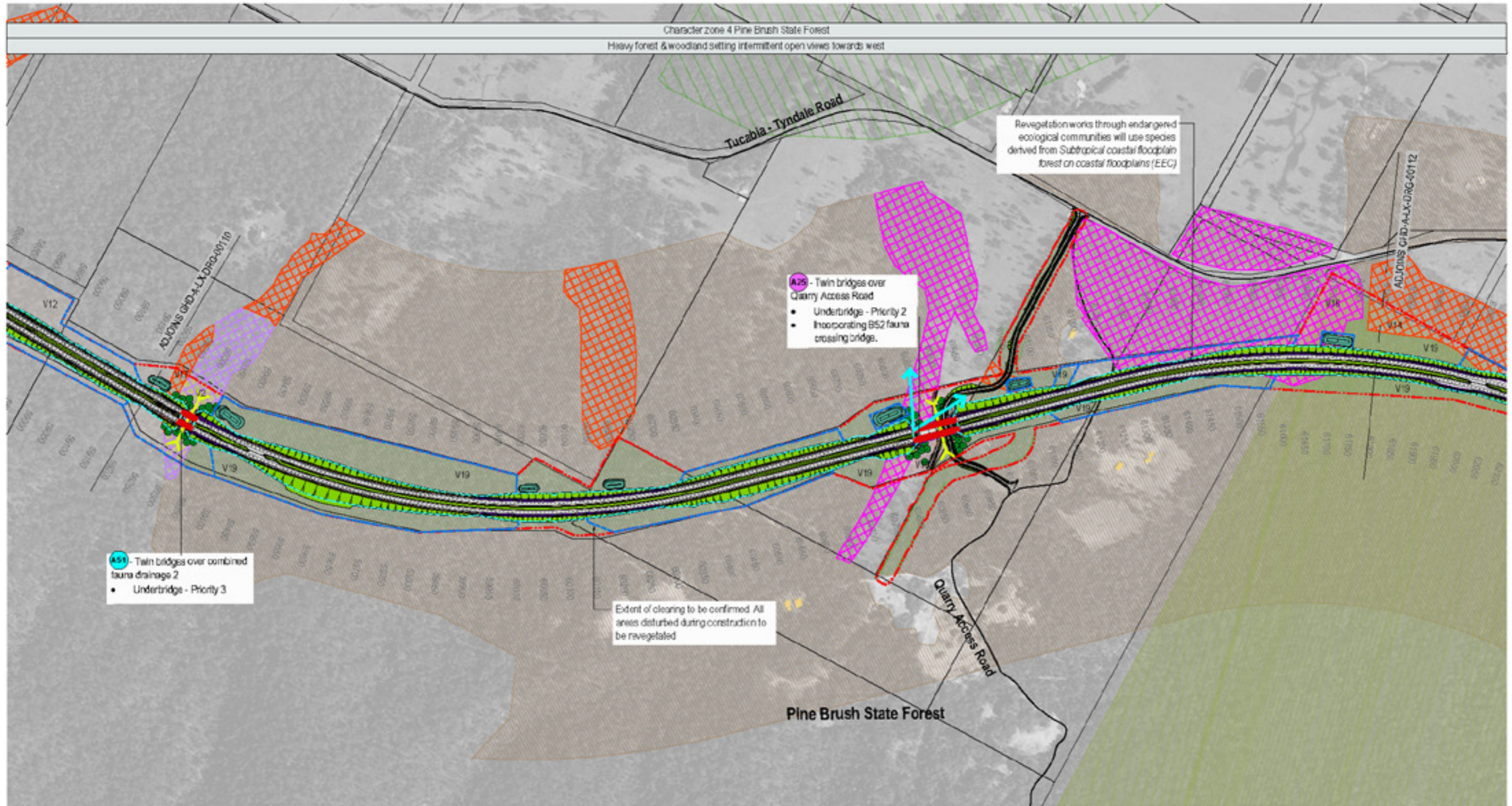


LEGEND		EXISTING VEGETATION COMMUNITIES		EEC	
Existing Pacific Highway	Watercourse	V1 Angophora robor shrubby forest and woodland	V5 Coastal freshwater meadows and forlands of lagoons and wetlands	V13 Scribbly Gum - Red Bloodwood heathy open forest	Freshwater wetlands on coastal floodplains (EEC)
Existing bridges	Property boundary	V2 Black Eean - Weeping Lily Pilly riparian rainforest	V6 Flooded Gum - Brush Box moist forest	V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest	Lowland rainforest on coastal floodplains (EEC)
Existing road	Nearty building	V3 Blackbutt - Bloodwood dry heathy open forest	V7 Forest Red Gum - Swamp Box	V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	Subtropical coastal floodplain forest on coastal floodplains (EEC)
Key views to surrounding landscape	Key views to surrounding landscape	V4 Coastal floodplain seagelands, rushlands and forlands	V8 Grey Gum - Grey Ironbark open forest	V16 Swamp Box swamp forest	Swamp oak floodplain forest on coastal floodplains (EEC)
		V9 Narrow-leaved Ironbark dry open forest	V10 Paperbark swamp forest	V17 Swamp Mahogany swamp forest	Swamp sclerophyll forest on coastal floodplains (EEC)
		V11 Pink Bloodwood - Tallowood moist open forest	V12 Scribbly Gum - Needlebark Stingybark heathy open forest	V18 Swamp Oak swamp forest	
		V19 Turpentine moist open forest		V19 Turpentine moist open forest	
				Koala habitat	

Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.



Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.



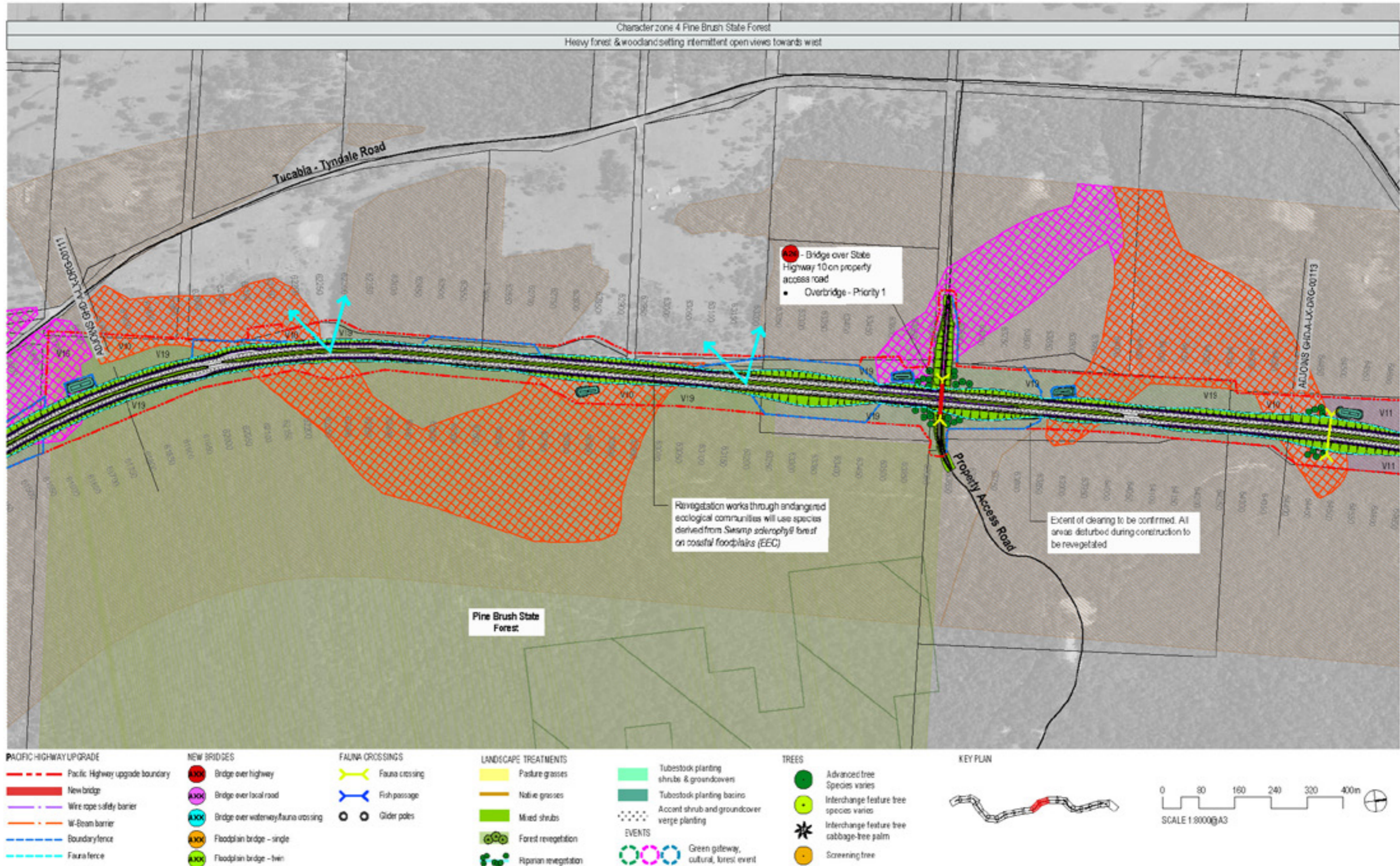
LEGEND		EXISTING VEGETATION COMMUNITIES		EEC	
Existing Pacific Highway	Watercourse	V1 Angophora rebur shrubby forest and woodland	V5 Coastal freshwater meadows and farlands of lagoons and wetlands	E1 Freshwater wetlands on coastal floodplains (EEC)	E2 Swamp oak floodplain forest on coastal floodplains (EEC)
Existing bridges	Property boundary	V2 Black Bean - Weeping Lilly Pilly riparian rainforest	V6 Flooded Gum - Brush Box moist forest	E3 Lowland rainforest on coastal floodplains (EEC)	E4 Swamp sclerophyll forest on coastal floodplains (EEC)
Existing road	Nearby building	V3 Blackbutt - Bloodwood dry healthy open forest	V7 Forest Red Gum - Swamp Box	E4 Subtropical coastal floodplain forest on coastal floodplains (EEC)	
	Key views to surrounding landscape	V4 Coastal floodplains edgeland, rushlands and forlands	V8 Grey Gum - Grey Ironbark open forest	V13 Scribbly Gum - Red Bloodwood healthy open forest	V17 Swamp Mahogany swamp forest
		V9 Narrow-leaved Ironbark dry open forest	V10 Paperbark swamp forest	V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest	V18 Swamp Oak swamp forest
		V11 Pink Bloodwood - Tallowood moist open forest	V12 Scribbly Gum - Needebark Stringybark healthy open forest	V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	V19 Turpentine moist open forest
				V16 Swamp Box swamp forest	Koaia habitat

Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.

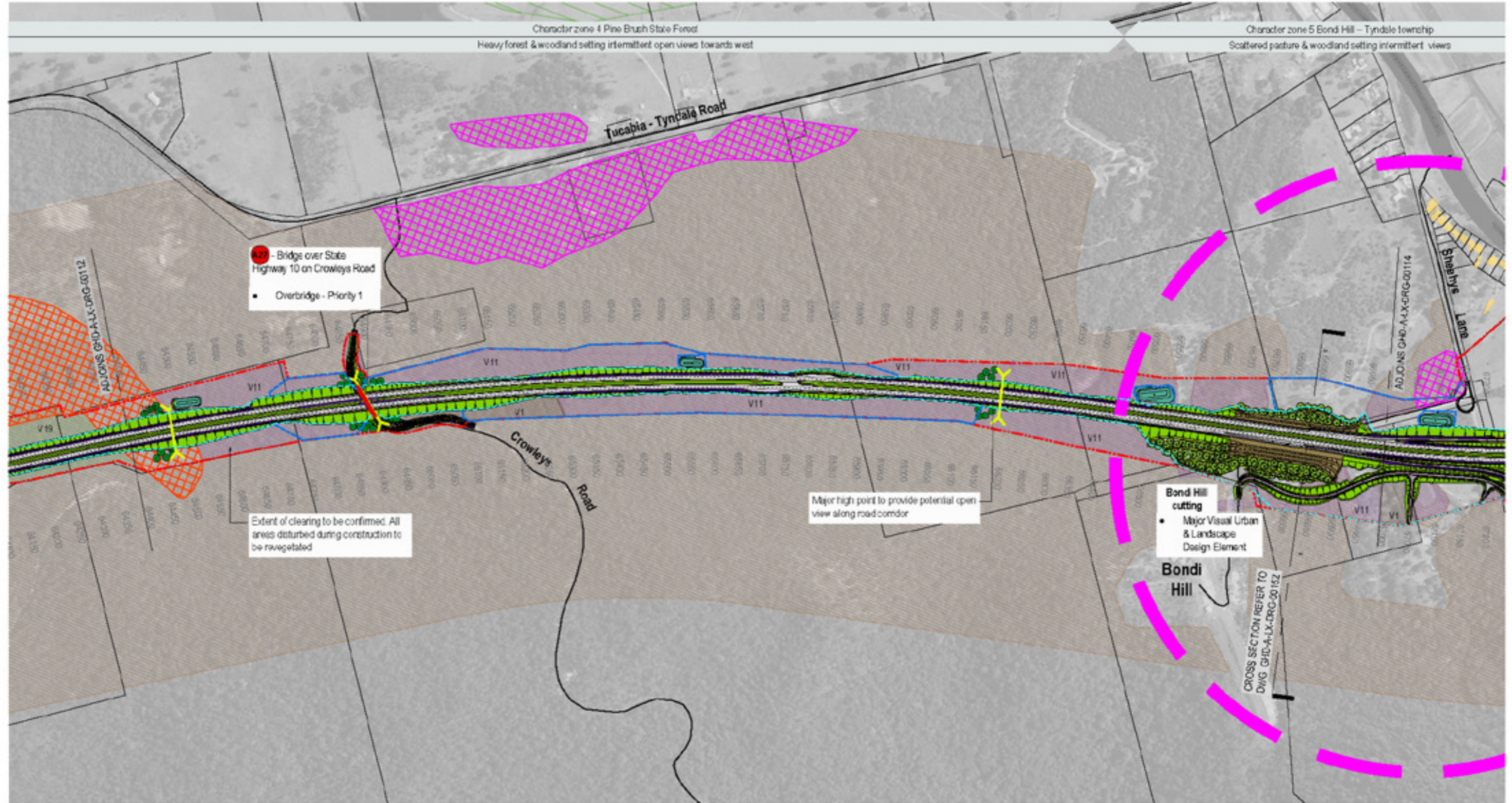
SECTION 3

Urban design and landscape concept plan

W2B-GHD-A-LX-DRG-00111



Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.



LEGEND		EXISTING VEGETATION COMMUNITIES				EEC			
Existing Pacific Highway	Watercourse	V1 Angophora rdbr shrubby forest and woodland	V5 Coastal freshwater meadows and fortilands of lagoons and wetlands	V9 Narrow leaved Ironbark dry open forest	V13 Scribbly Gum - Red Bloodwood heathy open forest	V17 Swamp Mahogany swamp forest	Freshwater wetlands on coastal floodplains (EEC)	Swamp oak floodplain forest on coastal floodplains (EEC)	
Existing bridges	Property boundary	V2 Black Bean - Weeping Lily Pilly riparian rainforest	V6 Flooded Gum - Bruch Box moist forest	V10 Paperbark swamp forest	V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest	V18 Swamp Oak swamp forest	Lowland rainforest on coastal floodplains (EEC)	Swamp sclerophyll forest on coastal floodplains (EEC)	
Existing road	Nearby building	V3 Blackbutt - Bloodwood dry heathy open forest	V7 Forest Red Gum - Swamp Box	V11 Pink Bloodwood - Tallwood moist open forest	V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	V19 Turpentine moist open forest	Subtropical coastal floodplain forest on coastal floodplains (EEC)		
Key views to surrounding landscape		V4 Coastal floodplain sedge/lands, rushlands and fortilands	V8 Grey Gum - Grey Ironbark open forest	V12 Scribbly Gum - Needlebark Stringybark heathy open forest	V16 Swamp Box swamp forest	Keata habitat			

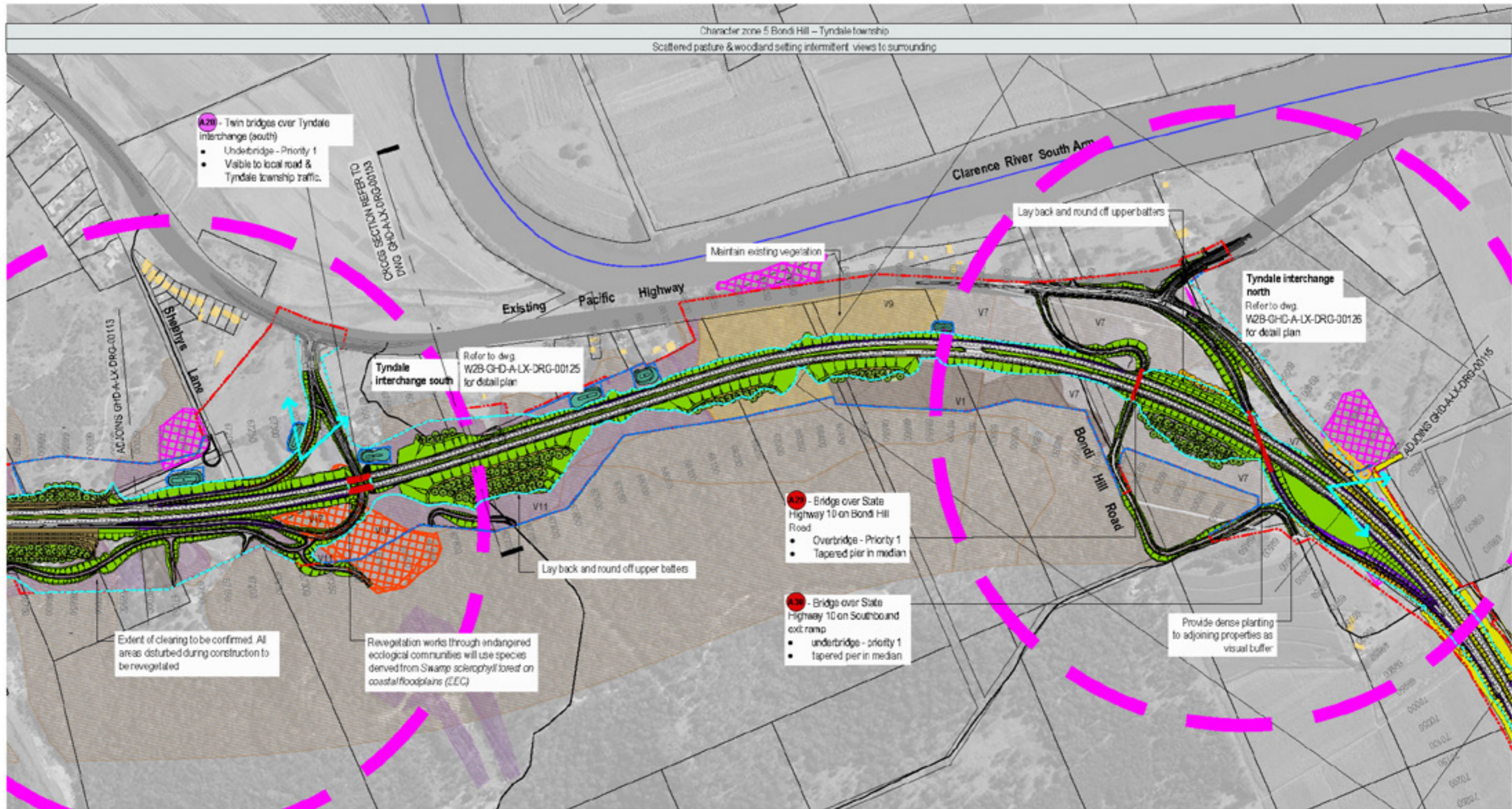
Drawing and design subject to further development, number of trees/elements shown is indicative only. Fence locations, types and shared path locations are to be confirmed, and subject to further design development. Landscape at maturity approximately 15 years.

SECTION 3

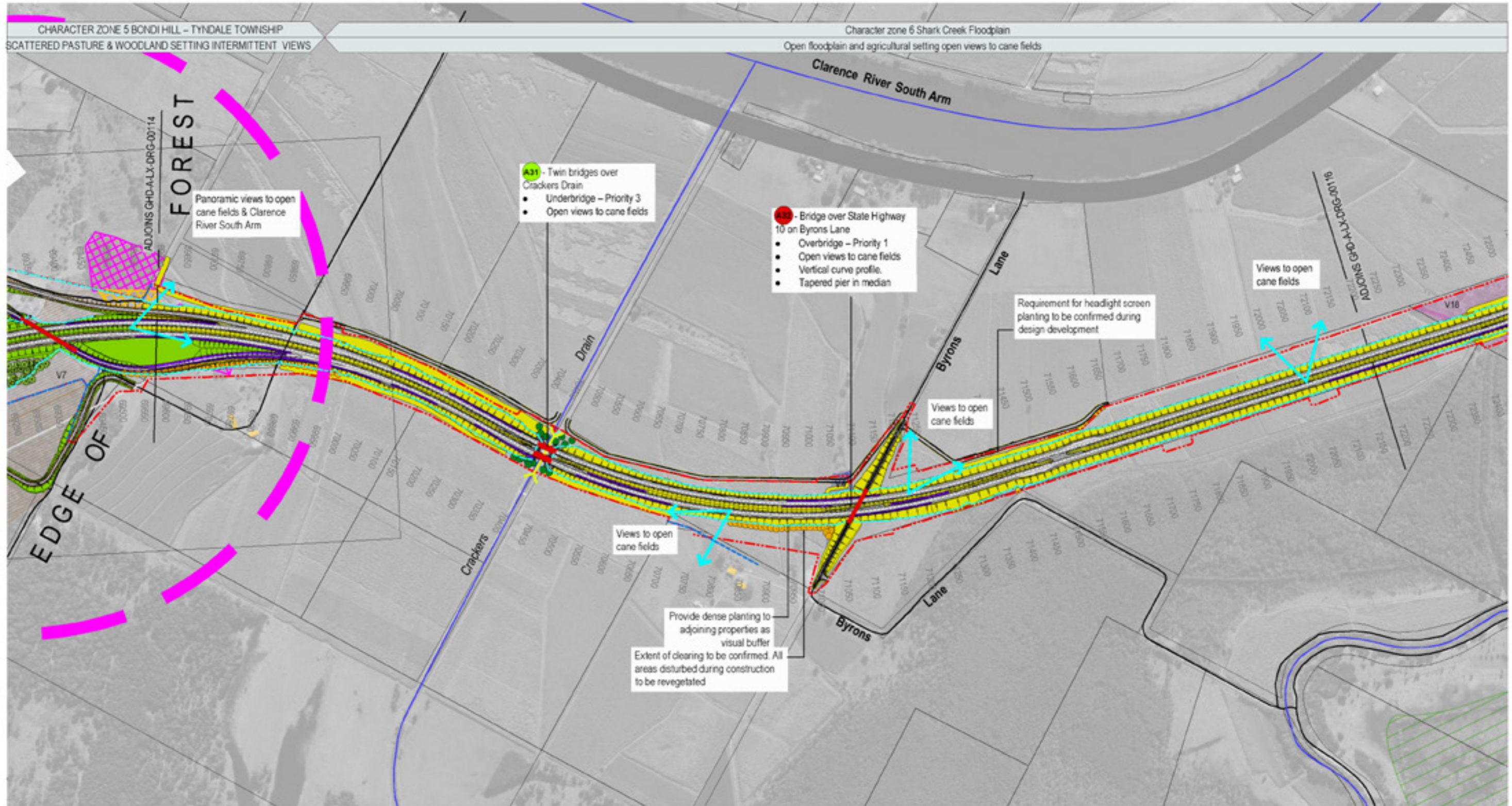
Urban design and landscape concept plan

W2B-GHD-A-LX-DRG-00113



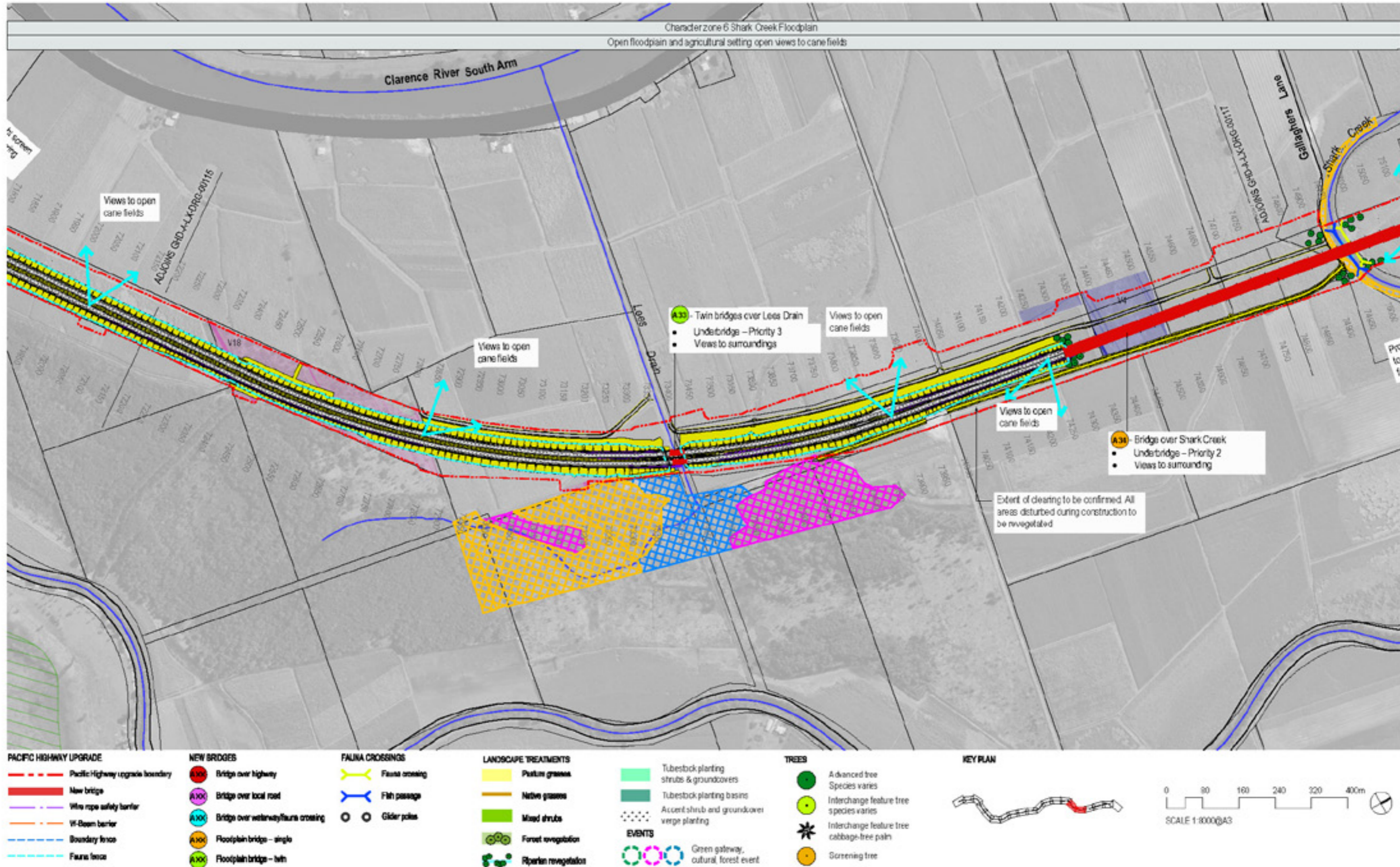


Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.

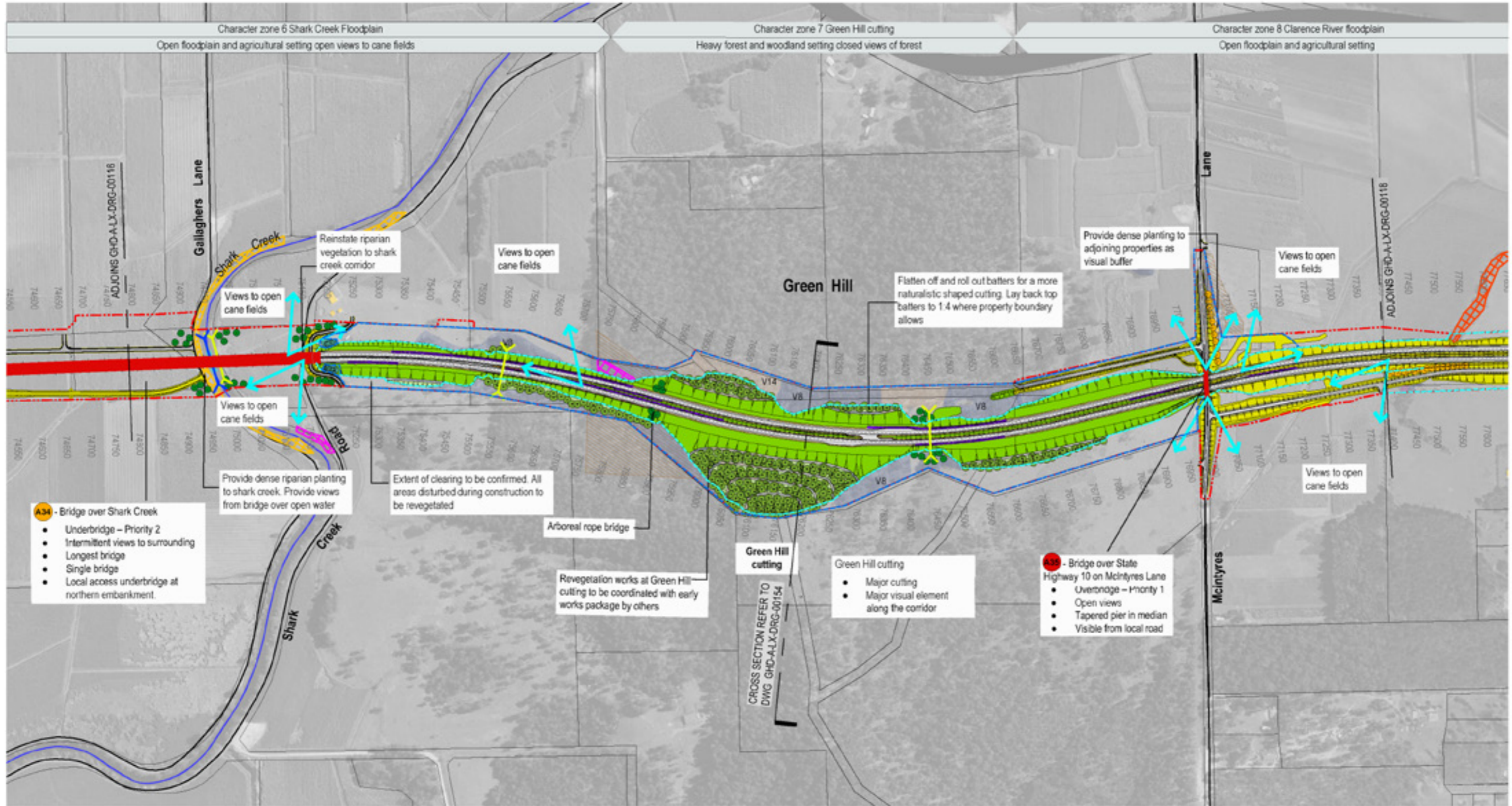


LEGEND		EXISTING VEGETATION COMMUNITIES		EEC	
Existing Pacific Highway	Watercourse	V1 Angophora robur shrubby forest and woodland	V5 Coastal freshwater meadows and forblands of lagoons and wetlands	V9 Narrow-leaved Ironbark dry open forest	Freshwater wetlands on coastal floodplains (EEC)
Existing bridges	Property boundary	V2 Black Bean - Weeping Lily Pilly riparian rainforest	V6 Flooded Gum - Brush Box moist forest	V10 Paperbark swamp forest	Swamp oak floodplain forest on coastal floodplains (EEC)
Existing road	Nearby building	V3 Blackbutt - Bloodwood dry healthy open forest	V7 Forest Red Gum - Swamp Box	V11 Pink Bloodwood - Tallwood moist open forest	Lowland rainforest on coastal floodplains (EEC)
Key views to surrounding landscape		V4 Coastal floodplain sedgelands, rushlands and forblands	V8 Grey Gum - Grey Ironbark open forest	V12 Scribbly Gum - Needletark Stringybark healthy open forest	Swamp sclerophyll forest on coastal floodplains (EEC)
				V13 Scribbly Gum - Red Bloodwood healthy open forest	Subtropical coastal floodplain forest on coastal floodplains (EEC)
				V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest	Koala habitat
				V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	
				V16 Swamp Box swamp forest	
				V17 Swamp Mahogany swamp forest	
				V18 Swamp Oak swamp forest	
				V19 Turpentine moist open forest	

Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.

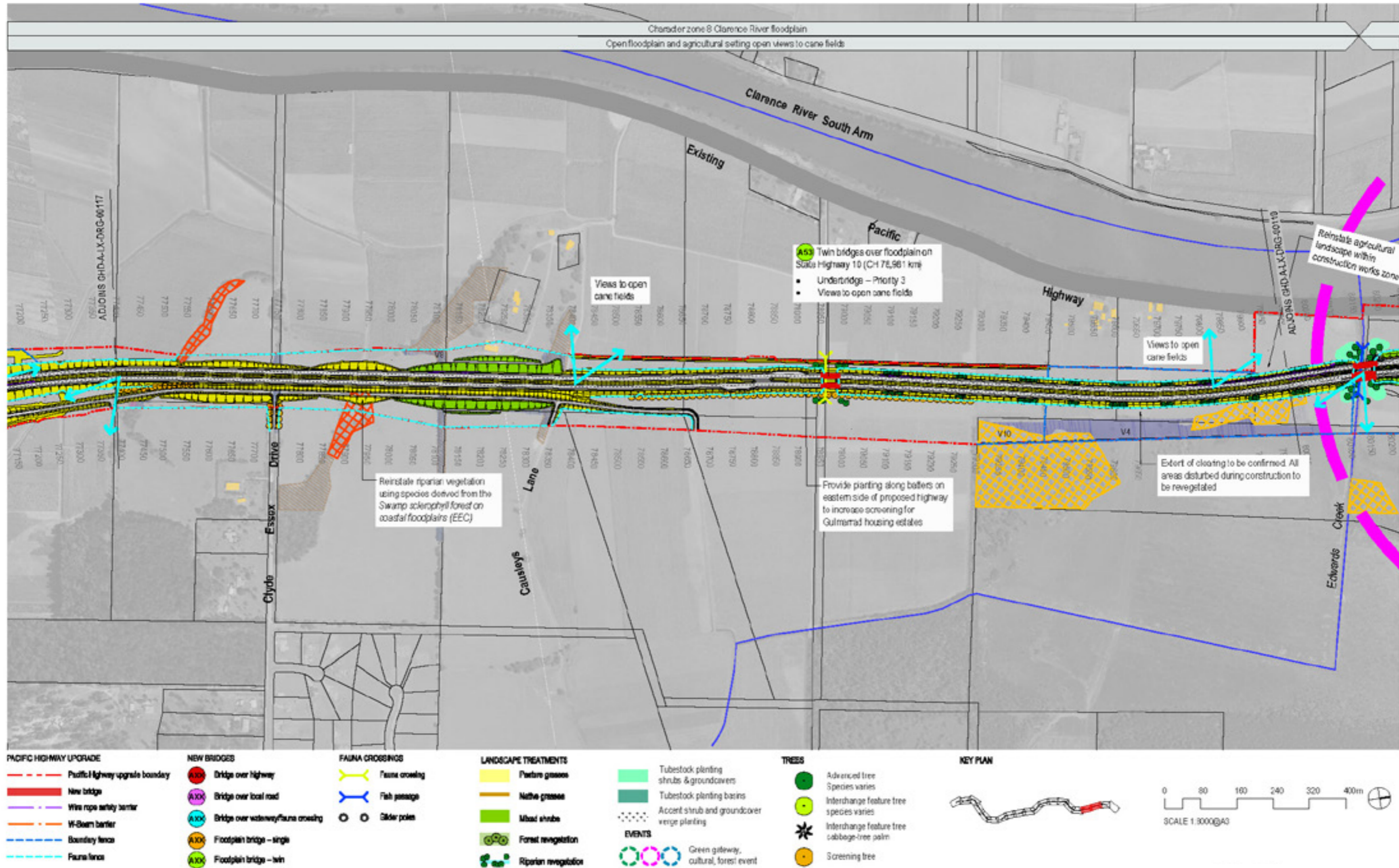


Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.

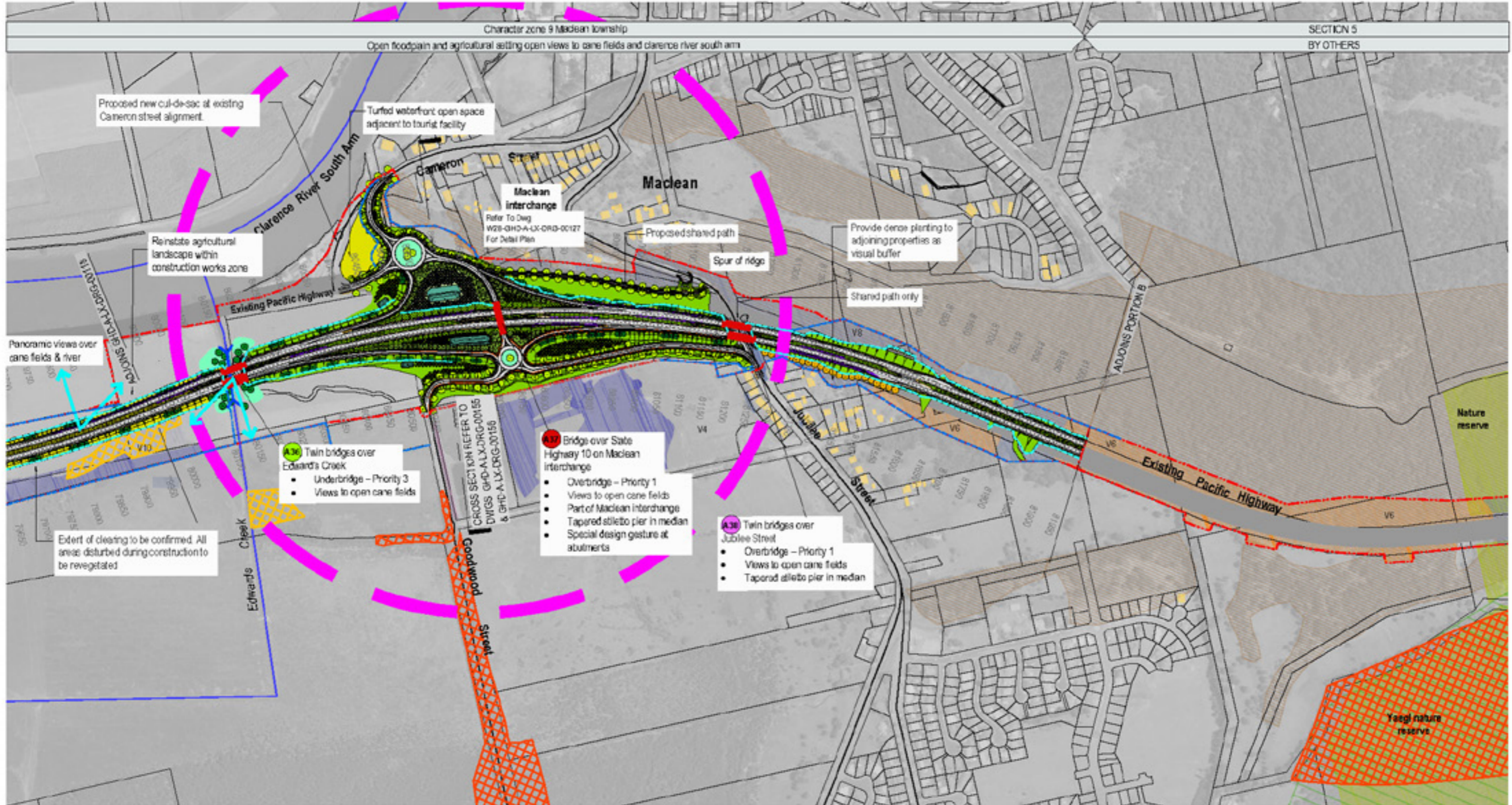


LEGEND		EXISTING VEGETATION COMMUNITIES		EEC	
Existing Pacific Highway	Watercourse	V1 Angophora robur shrubby forest and woodland	V5 Coastal freshwater meadows and forlands of lagoons and wetlands	V13 Scribbly Gum - Red Bloodwood healthy open forest	Freshwater wetlands on coastal floodplains (EEC)
Existing bridges	Property boundary	V2 Black Bean - Weeping Lilly Pilly riparian rainforest	V6 Flooded Gum - Brush Box moist forest	V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest	Lowland rainforest on coastal floodplains (EEC)
Existing road	Nearby building	V3 Blackbutt - Bloodwood dry healthy open forest	V7 Forest Red Gum - Swamp Box	V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	Subtropical coastal floodplain forest on coastal floodplains (EEC)
	Key views to surrounding landscape	V4 Coastal floodplain sedge/lands, rushlands and forlands	V8 Grey Gum - Grey Ironbark open forest	V16 Swamp Box swamp forest	Swamp oak floodplain forest on coastal floodplains (EEC)
		V9 Narrow-leaved Ironbark dry open forest	V10 Paperbark swamp forest	V17 Swamp Mahogany swamp forest	Swamp sclerophyll forest on coastal floodplains (EEC)
		V11 Pink Bloodwood - Tallowood moist open forest	V12 Scribbly Gum - Needlebark Stringybark healthy open forest	V18 Swamp Oak swamp forest	
				V19 Turpentine moist open forest	
				Koala habitat	

Drawing and design subject to further development, number of trees/elements shown is indicative only. Fence locations, types and shared path locations are to be confirmed, and subject to further design development. Landscape at maturity approximately 15 years.



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Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.



EXISTING FEATURES		EXISTING VEGETATION COMMUNITIES				EEC			
Existing Pacific Highway	Watercourse	V1 Angophora robust shrubby forest and woodland	V5 Coastal freshwater meadows and fens/lagoons and wetlands	V9 Narrow-leaved Ironbark dry open forest	V13 Scribbly Gum - Red Bloodwood healthy open forest	V17 Swamp Mahogany swamp forest	Freshwater wetlands on coastal floodplains (EEC)	Swamp oak floodplain forest on coastal floodplains (EEC)	
Existing bridges	Property boundary	V2 Black Bean - Weeping Lily Pilly riparian rainforest	V6 Flooded Gum - Brush Box moist forest	V10 Paperbark swamp forest	V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest	V18 Swamp Oak swamp forest	Lowland rainforest on coastal floodplains (EEC)	Swamp sclerophyll forest on coastal floodplains (EEC)	
Existing road	Nearby building	V3 Blackbutt - Bloodwood dry heathy open forest	V7 Forest Red Gum - Swamp Box	V11 Pink Bloodwood - Tallwood moist open forest	V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	V19 Turpentine moist open forest	Subtropical coastal floodplain forest on coastal floodplains (EEC)		
	Key views to surrounding landscape	V4 Coastal floodplain sedgelands, rushlands and forblands	V8 Grey Gum - Grey Ironbark open forest	V12 Scribbly Gum - Needletark Stringybark healthy open forest	V16 Swamp Box swamp forest	Koala habitat			

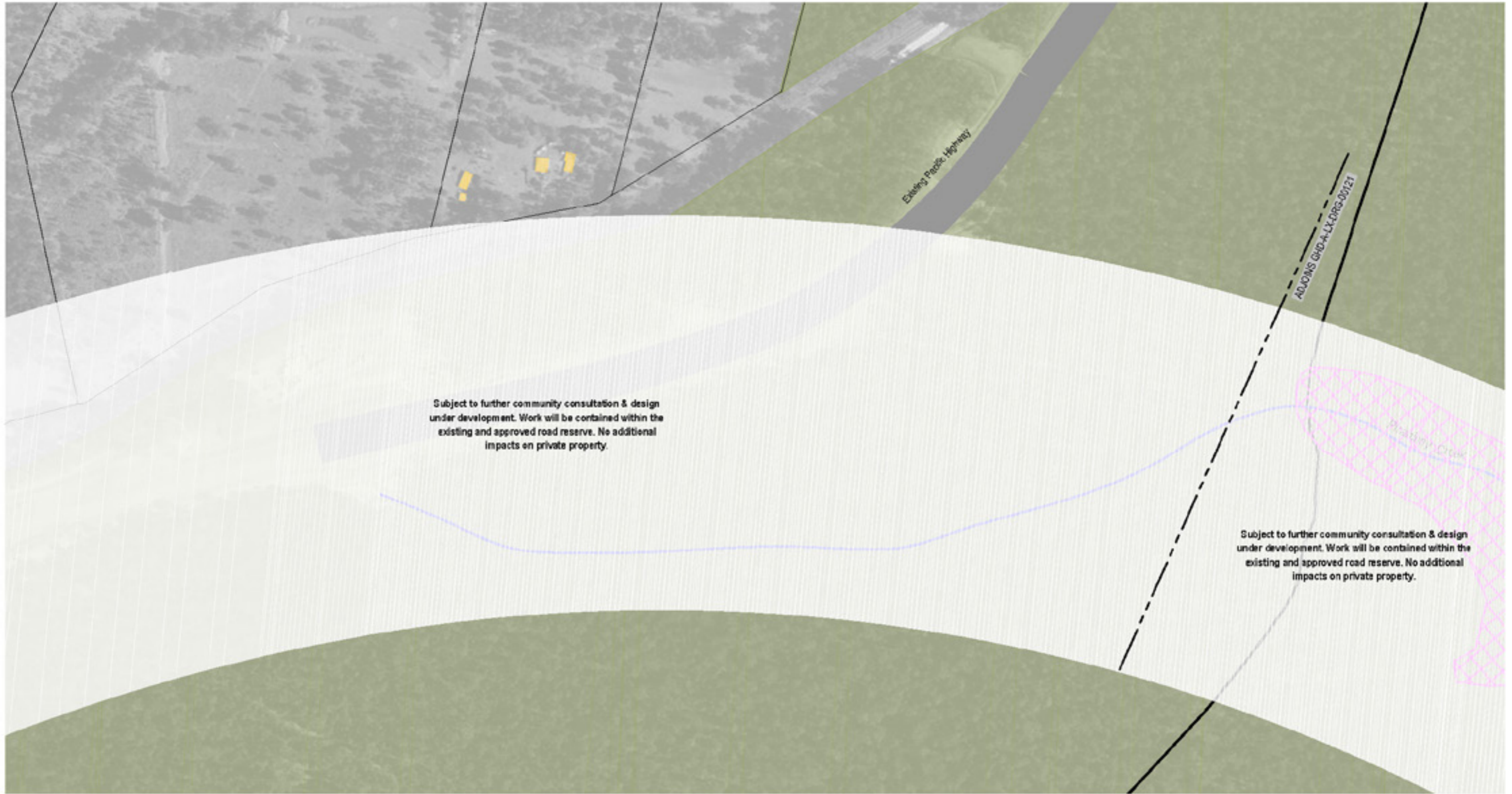
Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.



- |   |  |   |   |  |  |
|---|--|---|---|--|--|
| <p><b>PACIFIC HIGHWAY UPGRADE</b></p> <ul style="list-style-type: none"> <li><span style="color: red;">- - -</span> Pacific Highway upgrade boundary</li> <li><span style="color: red;">—</span> New bridge</li> <li><span style="color: purple;">- - -</span> Wire rope safety barrier</li> <li><span style="color: orange;">- - -</span> W-beam barrier</li> <li><span style="color: blue;">- - -</span> Boundary fence</li> <li><span style="color: cyan;">- - -</span> Fauna fence</li> </ul> | <p><b>NEW BRIDGES</b></p> <ul style="list-style-type: none"> <li><span style="color: red;">●</span> Bridge over highway</li> <li><span style="color: purple;">●</span> Bridge over local road</li> <li><span style="color: cyan;">●</span> Bridge over waterway/fauna crossing</li> <li><span style="color: orange;">●</span> Floodplain bridge - single</li> <li><span style="color: green;">●</span> Floodplain bridge - twin</li> </ul> | <p><b>FAUNA CROSSINGS</b></p> <ul style="list-style-type: none"> <li><span style="color: yellow;">—</span> Fauna crossing</li> <li><span style="color: blue;">—</span> Fish passage</li> <li><span style="color: black;">●</span> Glider poles</li> </ul> | <p><b>LANDSCAPE TREATMENTS</b></p> <ul style="list-style-type: none"> <li><span style="color: yellow;">▨</span> Pasture grasses</li> <li><span style="color: orange;">▨</span> Native grasses</li> <li><span style="color: green;">▨</span> Mixed shrubs</li> <li><span style="color: darkgreen;">▨</span> Forest revegetation</li> <li><span style="color: forestgreen;">▨</span> Riparian revegetation</li> </ul> | <p><b>EVENTS</b></p> <ul style="list-style-type: none"> <li><span style="color: lightgreen;">▨</span> Tubestock planting shrubs &amp; groundcovers</li> <li><span style="color: teal;">▨</span> Tubestock planting basins</li> <li><span style="color: lightblue;">▨</span> Accent shrub and groundcover verge planting</li> <li><span style="color: lightblue;">○</span> Green gateway, cultural, forest event</li> </ul> | <p><b>TREES</b></p> <ul style="list-style-type: none"> <li><span style="color: green;">●</span> Advanced tree Species varies</li> <li><span style="color: yellowgreen;">●</span> Interchange feature tree species varies</li> <li><span style="color: black;">✱</span> Interchange feature tree cabbage-tree palm</li> <li><span style="color: orange;">●</span> Screening tree</li> </ul> |
|---|--|---|---|--|--|



Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.



Subject to further community consultation & design under development. Work will be contained within the existing and approved road reserve. No additional impacts on private property.

Subject to further community consultation & design under development. Work will be contained within the existing and approved road reserve. No additional impacts on private property.

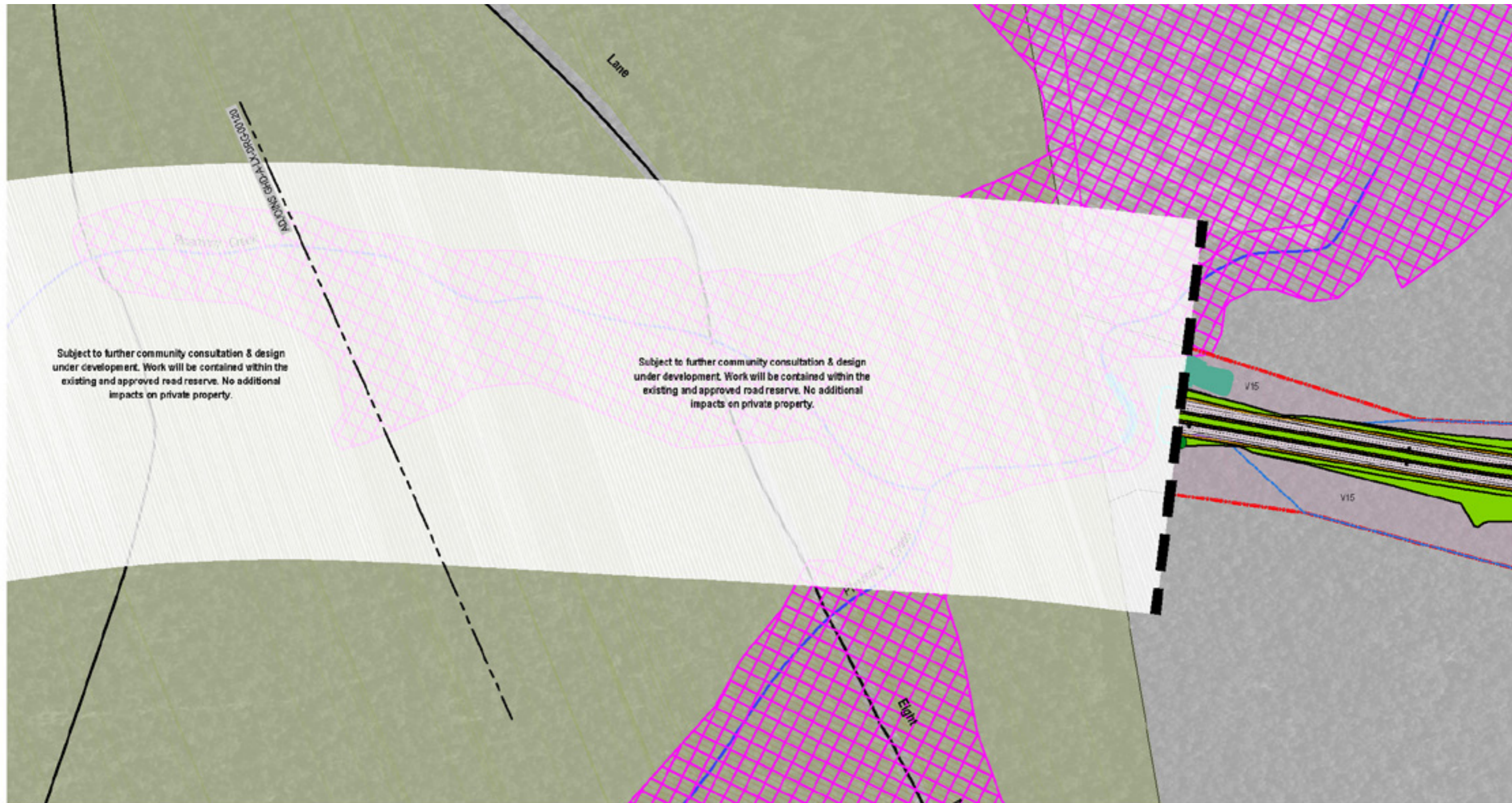
PACIFIC HIGHWAY UPGRADE	NEW BRIDGES	FAUNA CROSSINGS	LANDSCAPE TREATMENTS	EVENTS	TREES
Pacific Highway upgrade boundary	Bridge over highway	Fauna crossing	Pasture grasses	Tubestack planting shrubs & groundcovers	Advanced tree Species varies
New bridge	Bridge over local road	Fish passage	Native grasses	Tubestack planting basins	Interchange feature tree species varies
Wire rope safety barrier	Bridge over waterway/fauna crossing	Fish passage	Mixed shrubs	Accent shrub and groundcover verge planting	Interchange feature tree cabbage-tree palm
W-Beam barrier	Floodplain bridge - single	Glider poles	Forest revegetation	Green gateway, cultural, forest event	Screening tree
Boundary fence	Floodplain bridge - twin		Riparian revegetation		
Fauna fence					



Drawing and design subject to further development, number of trees/elements shown is indicative only. Fence locations, types and shared path locations are to be confirmed, and subject to further design development. Landscape at maturity approximately 15 years.

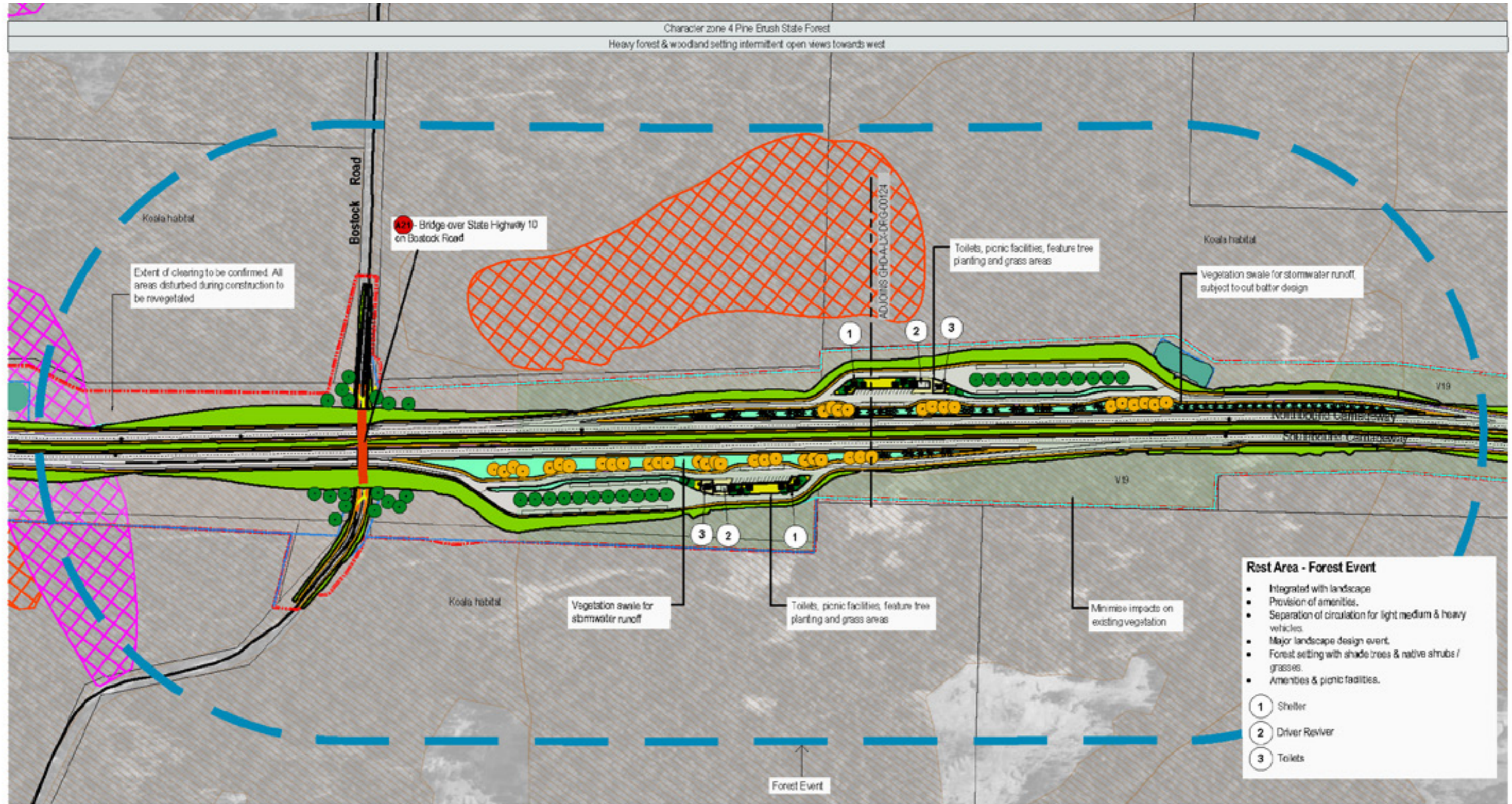
**SECTION 3** Glenugie interchange south W2B-GHD-A-LX-DRG-00121



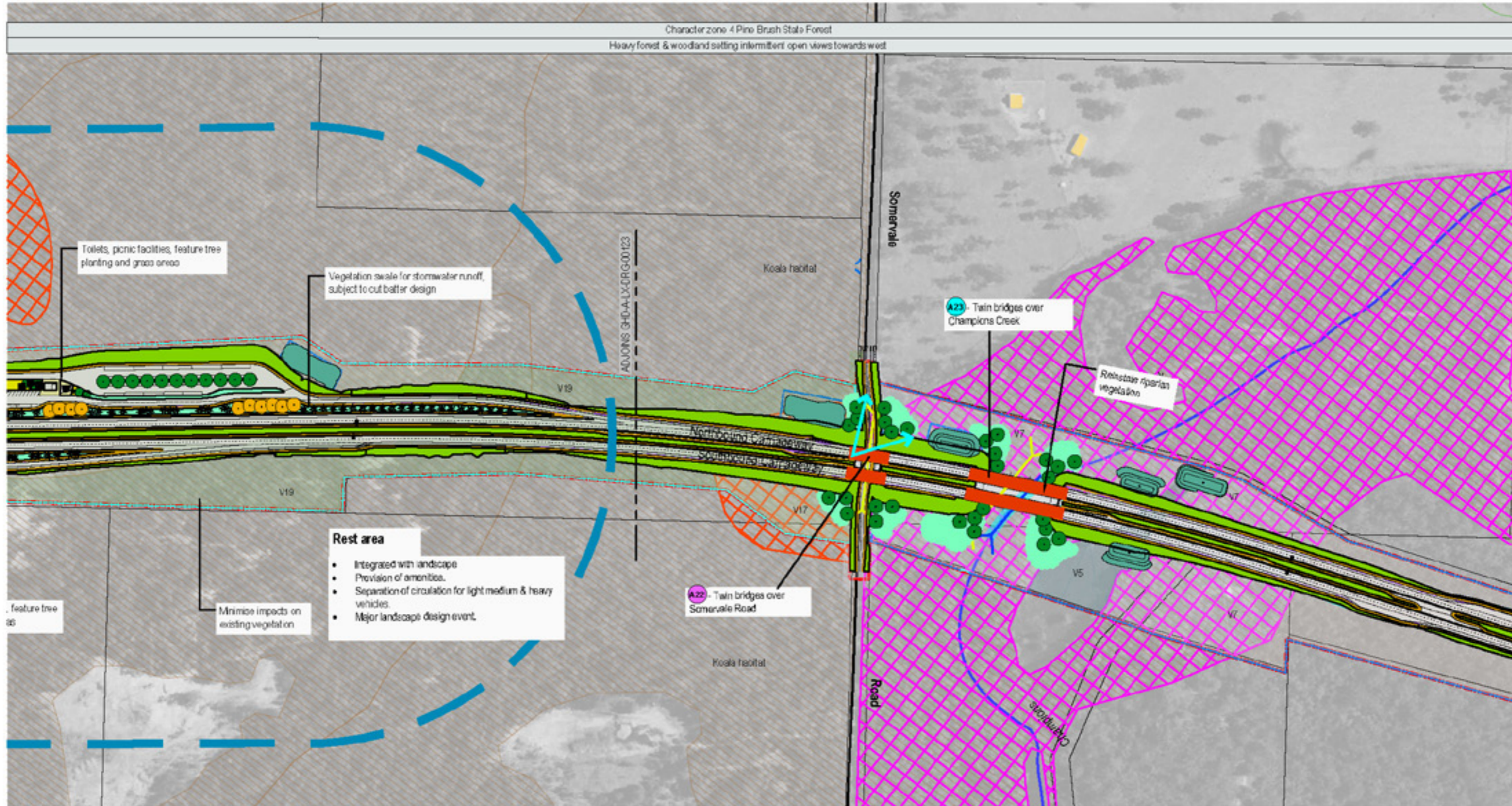


LEGEND		EXISTING VEGETATION COMMUNITIES				EEC			
Existing Pacific Highway	Watercourse	V1 Angophora robur shrubby forest and woodland	V5 Coastal freshwater meadows and forislands of lagoons and wetlands	V9 Narrow-leaved Ironbark dry open forest	V13 Scibbly Gum - Red Bloodwood healthy open forest	V17 Swamp Mahogany swamp forest	Freshwater wetlands on coastal floodplains (EEC)	Swamp oak floodplain forest on coastal floodplains (EEC)	
Existing bridges	Property boundary	V2 Black Bean - Weeping Lilly Pilly riparian rainforest	V6 Flooded Gum - Brush Box moist forest	V10 Paperbark swamp forest	V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest	V18 Swamp Oak swamp forest	Lowland rainforest on coastal floodplains (EEC)	Swamp sclerophyll forest on coastal floodplains (EEC)	
Existing road	Nearby building	V3 Blackbutt - Bloodwood dry healthy open forest	V7 Forest Red Gum - Swamp Box	V11 Pink Bloodwood - Tallwood moist open forest	V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	V19 Turpentine moist open forest	Subtropical coastal floodplain forest on coastal floodplains (EEC)		
	Key views to surrounding landscape	V4 Coastal floodplain sedgelands, rushlands and forblands	V8 Grey Gum - Grey Ironbark open forest	V12 Scibbly Gum - Needlebark Stringybark healthy open forest	V16 Swamp Box swamp forest	Koala habitat			

Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.

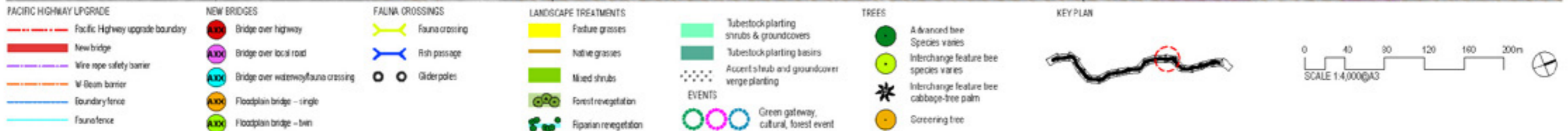
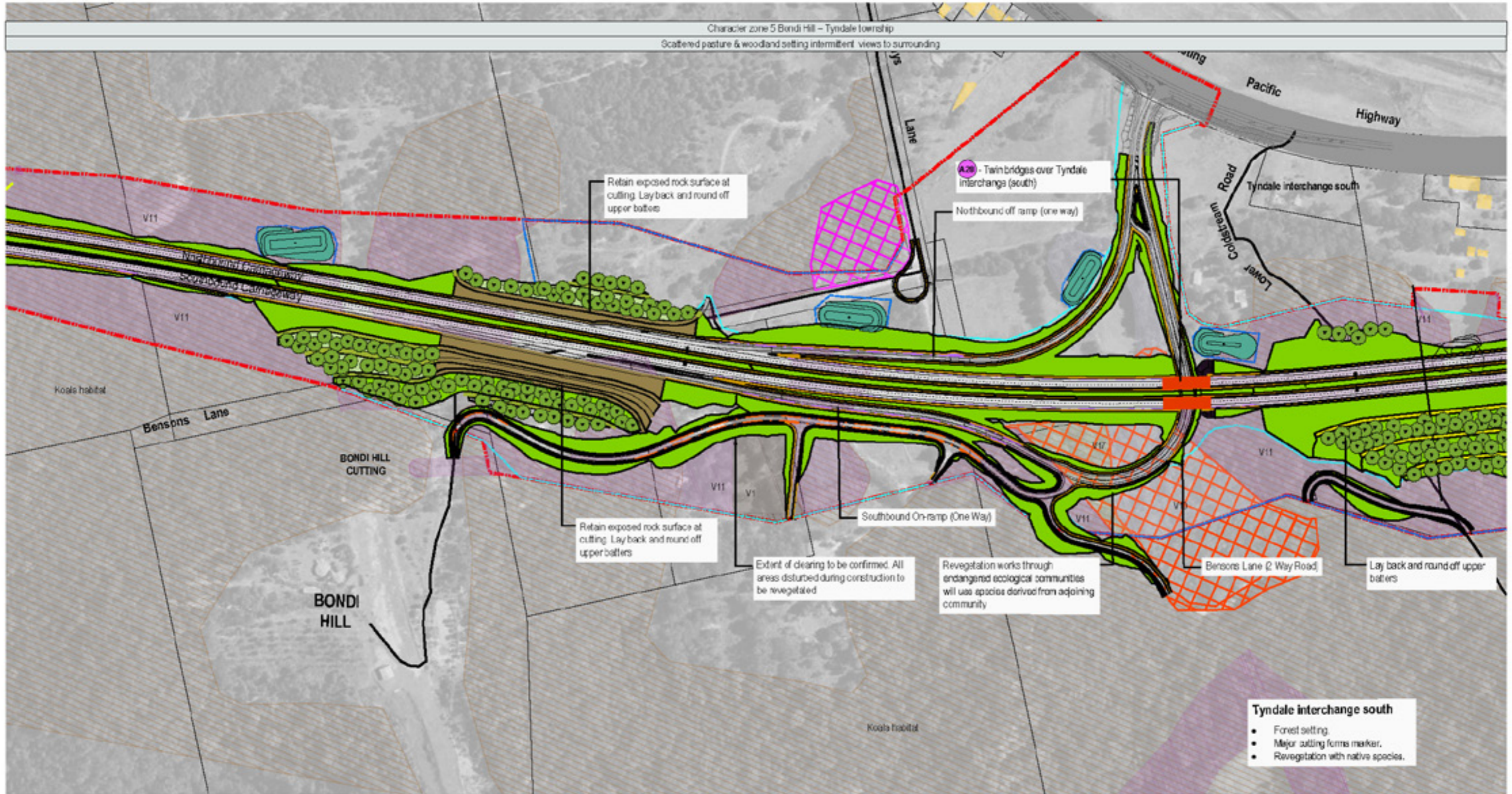


Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.

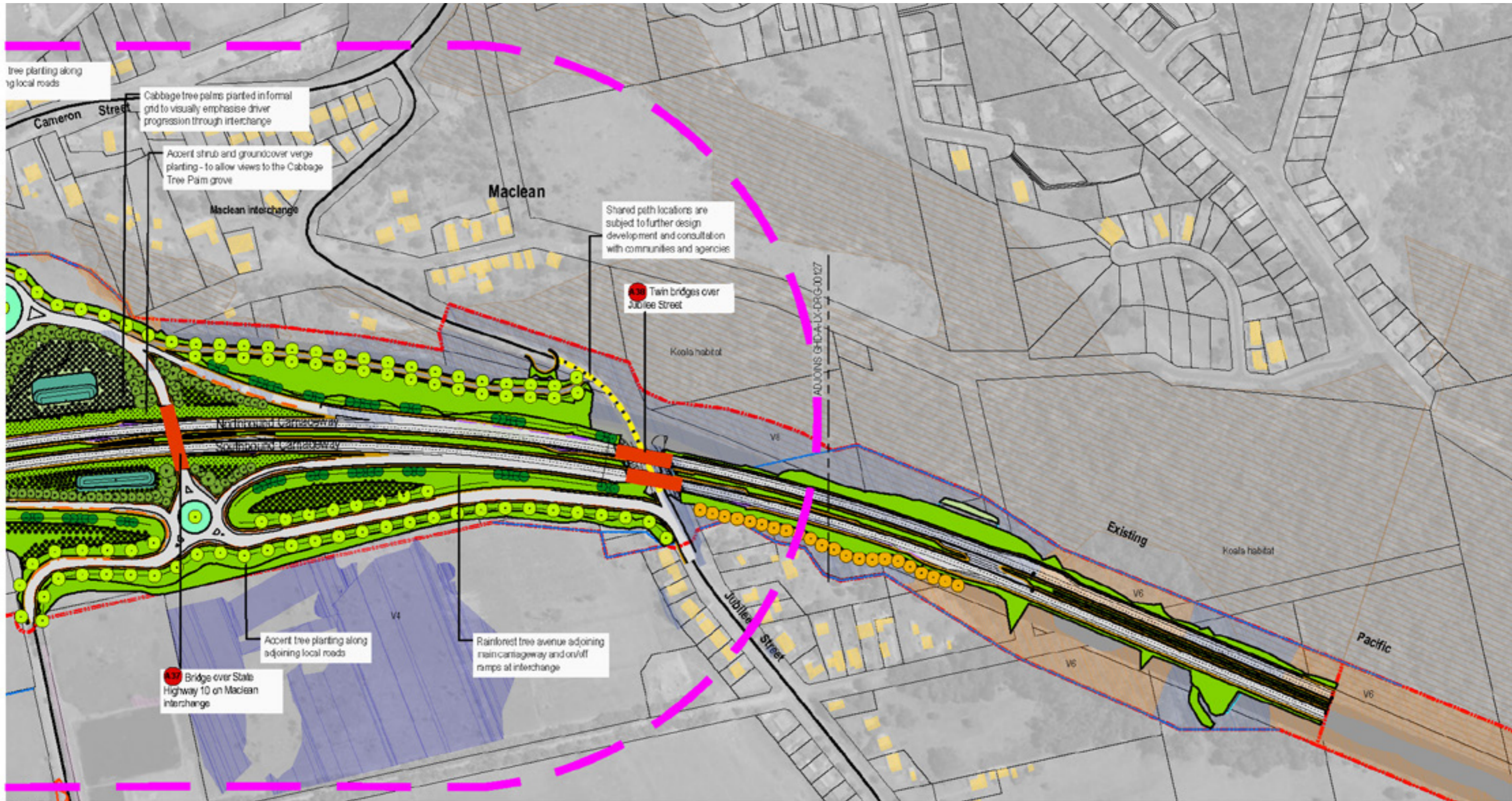


EXISTING FEATURES		EXISTING VEGETATION COMMUNITIES		EEC	
Existing Pacific Highway	Watercourse	V1 Angophora robust shrubby forest and woodland	V5 Coastal freshwater meadows and forblands of lagoons and wetlands	Y13 Scribbly Gum - Red Bloodwood heathy open forest	Freshwater wetlands on coastal floodplains (EEC)
Existing bridges	Property boundary	V2 Black Bean - Weeping Lilly Pilly riparian rainforest	V6 Flooded Gum - Brush Box moist forest	Y14 Spotted Gum - Grey Box - Grey Ironbark dry open forest	Swamp oak floodplain forest on coastal floodplains (EEC)
Existing road	Nearby building	V3 Blackbutt - Bloodwood dry heathy open forest	V7 Forest Red Gum - Swamp Box	Y15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	Lowland rainforest on coastal floodplains (EEC)
	Key views to surrounding landscape	V4 Coastal floodplain sedgelands, nulllands and forblands	V8 Grey Gum - Grey Ironbark open forest	Y16 Swamp Box swamp forest	Subtropical coastal floodplain forest on coastal floodplains (EEC)
				Y17 Swamp Mahogany swamp forest	Koala habitat
				Y18 Swamp Oak swamp forest	
				Y19 Turpentine moist open forest	

Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.

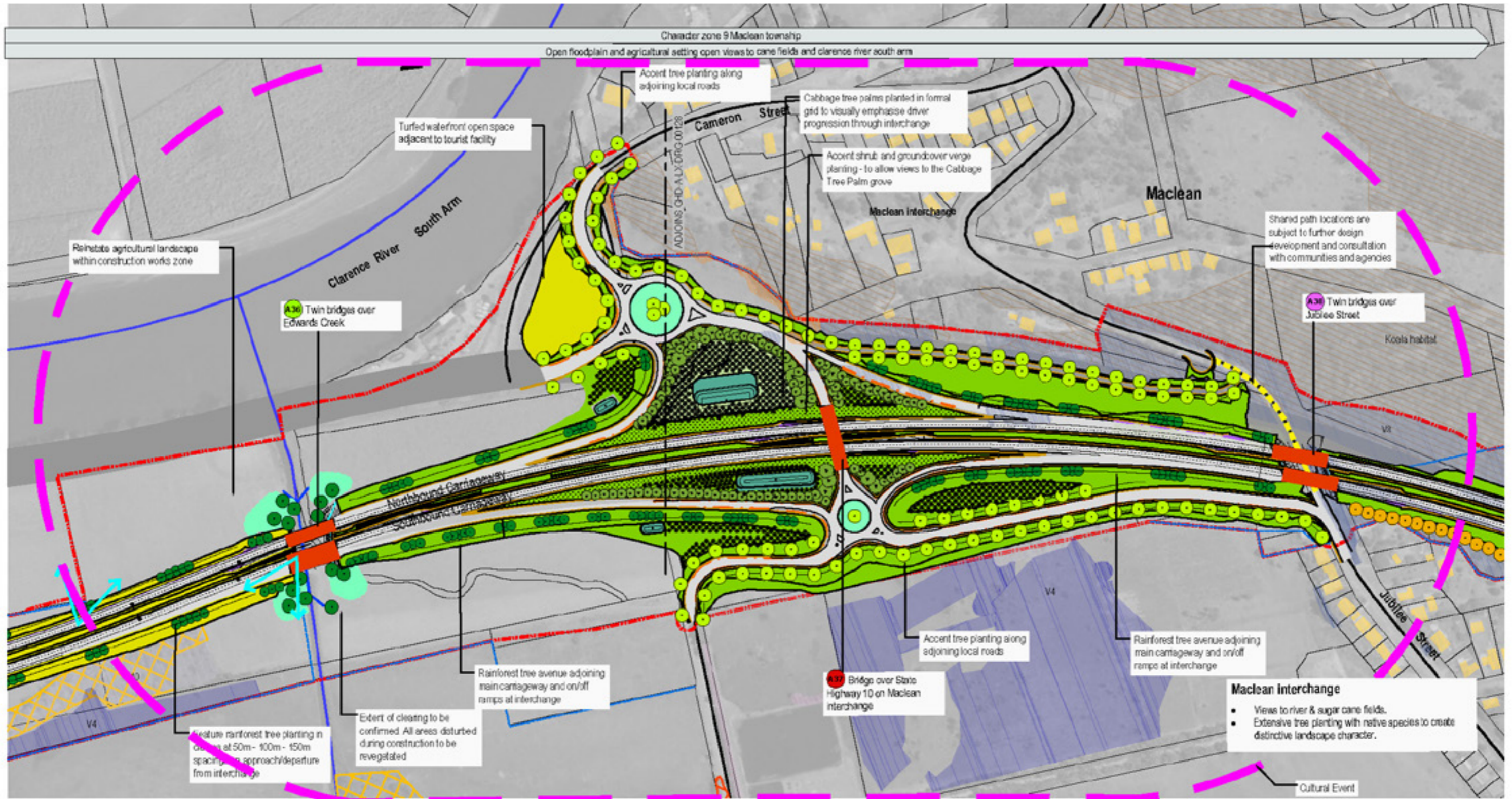


Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.



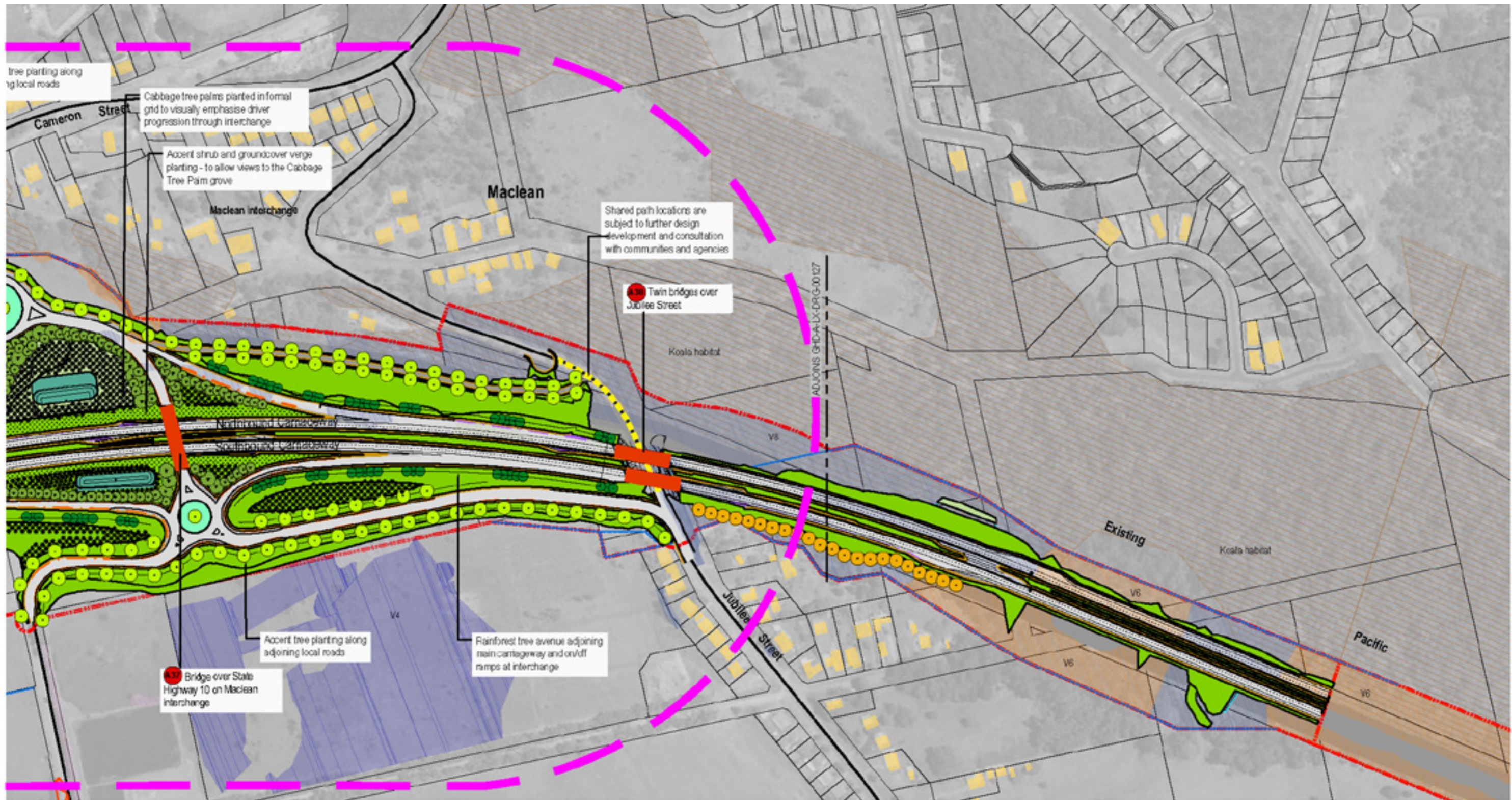
LEGEND		EXISTING VEGETATION COMMUNITIES		EEC	
Existing Pacific Highway	Watercourse	V1 Angophora robusta shrubby forest and woodland	V5 Coastal freshwater meadows and forblands of lagoons and wetlands	E1 Freshwater wetlands on coastal floodplains (EEC)	E6 Swamp oak floodplain forest on coastal floodplains (EEC)
Existing bridges	Property boundary	V2 Black Bean - Weeping Lilly Pilly riparian rainforest	V6 Flooded Gum - Brush Box moist forest	E2 Lowland rainforest on coastal floodplains (EEC)	E7 Swamp sclerophyll forest on coastal floodplains (EEC)
Existing road	Nearby building	V3 Blackbutt - Bloodwood dry healthy open forest	V7 Forest Red Gum - Swamp Box	E3 Subtropical coastal floodplain forest on coastal floodplains (EEC)	E8 Swamp Mahogany swamp forest
Key views to surrounding landscape		V4 Coastal floodplain sedgelands, rushlands and forblands	V8 Grey Gum - Grey Ironbark open forest	E9 Swamp Oak swam forest	E10 Turpentine moist open forest
		V5 Coastal freshwater meadows and forblands of lagoons and wetlands	V9 Narrow-leaved Ironbark dry open forest	E11 Koala habitat	
		V6 Flooded Gum - Brush Box moist forest	V10 Paperbark swamp forest		
		V7 Forest Red Gum - Swamp Box	V11 Pink Bloodwood - Tallowood moist open forest		
		V8 Grey Gum - Grey Ironbark open forest	V12 Scribbly Gum - Needlebark Stringybark healthy open forest		
			V13 Scribbly Gum - Red Bloodwood healthy open forest		
			V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest		
			V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest		
			V16 Swamp Box swamp forest		

Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.



PACIFIC HIGHWAY UPGRADE	NEW BRIDGES	FAUNA CROSSINGS	LANDSCAPE TREATMENTS	TREES	KEY PLAN
Pacific Highway upgrade boundary	Bridge over highway	Fauna crossing	Pasture grasses	Advanced tree Species varies	
New bridge	Bridge over local road	Fish passage	Native grasses	Interchange feature tree species varies	
Wire rope safety barrier	Bridge over waterway/fauna crossing	Girder poles	Mixed shrubs	Interchange feature tree cabbage-tree palm	
W-beam barrier	Floodplain bridge - single		Forest revegetation	Screening tree	
Boundary fence	Floodplain bridge - twin		Riparian revegetation		
Fauna fence					

Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.



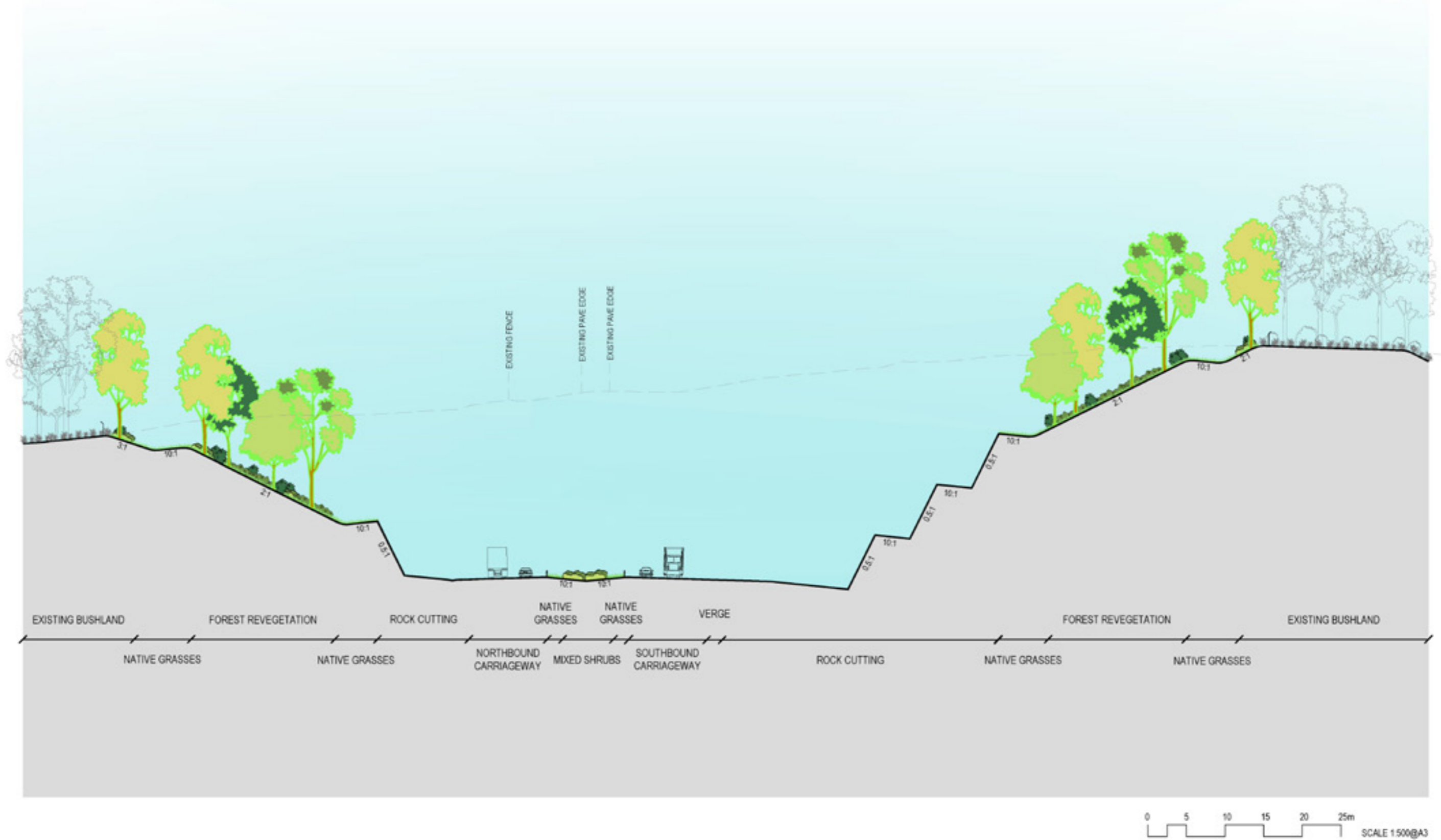
EXISTING FEATURES		EXISTING VEGETATION COMMUNITIES				EEC			
Existing Pacific Highway	Watercourse	V1 Angophora robust shrubby forest and woodland	V5 Coastal freshwater meadows and forlands of lagoons and wetlands	V9 Narrow-leaved Ironbark dry open forest	V13 Scribbly Gum - Red Bloodwood healthy open forest	V17 Swamp Mahogany swamp forest	Freshwater wetlands on coastal floodplains (EEC)	Swamp oak floodplain forest on coastal floodplains (EEC)	
Existing bridges	Property boundary	V2 Black Bean - Weeping Lilly Pilly riparian rainforest	V6 Flooded Gum - Brush Box moist forest	V10 Paperbark swamp forest	V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest	V18 Swamp Oak swamp forest	Lowland rainforest on coastal floodplains (EEC)	Swamp sclerophyll forest on coastal floodplains (EEC)	
Existing road	Nearby building	V3 Blackbutt - Bloodwood dry healthy open forest	V7 Forest Red Gum - Swamp Box	V11 Pink Bloodwood - Tallwood moist open forest	V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	V19 Turpentine moist open forest	Subtropical coastal floodplain forest on coastal floodplains (EEC)		
	Key views to surrounding landscape	V4 Coastal floodplain sedgelands, rushlands and forlands	V8 Grey Gum - Grey Ironbark open forest	V12 Scribbly Gum - Needlebark Stringybark healthy open forest	V16 Swamp Box swamp forest	Koala habitat			

Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.

## 7.2 Cross sections

Cross sections are illustrated at the following locations to indicate design for different scenarios, such as cuts, fills and rest areas.

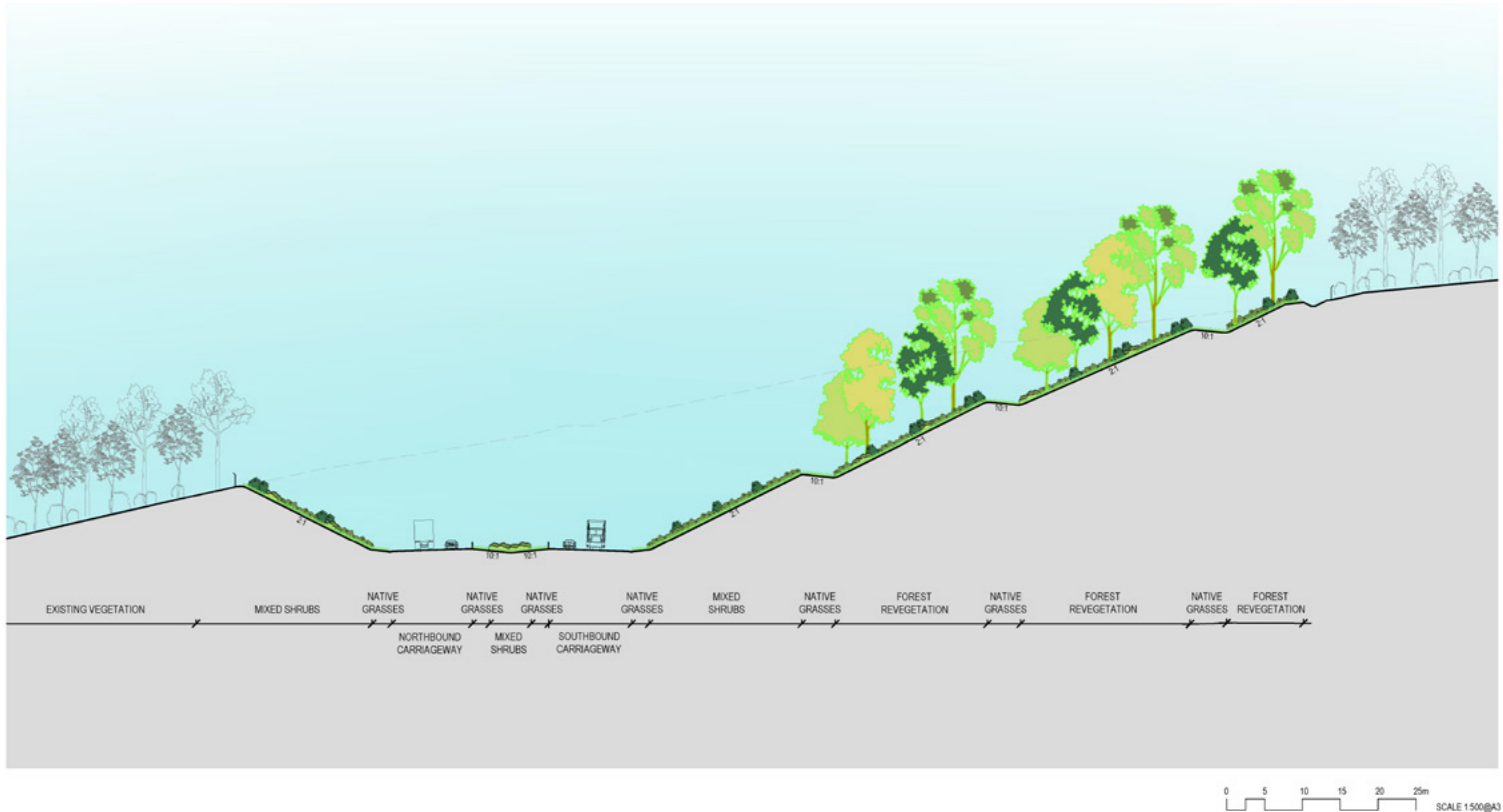




Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.

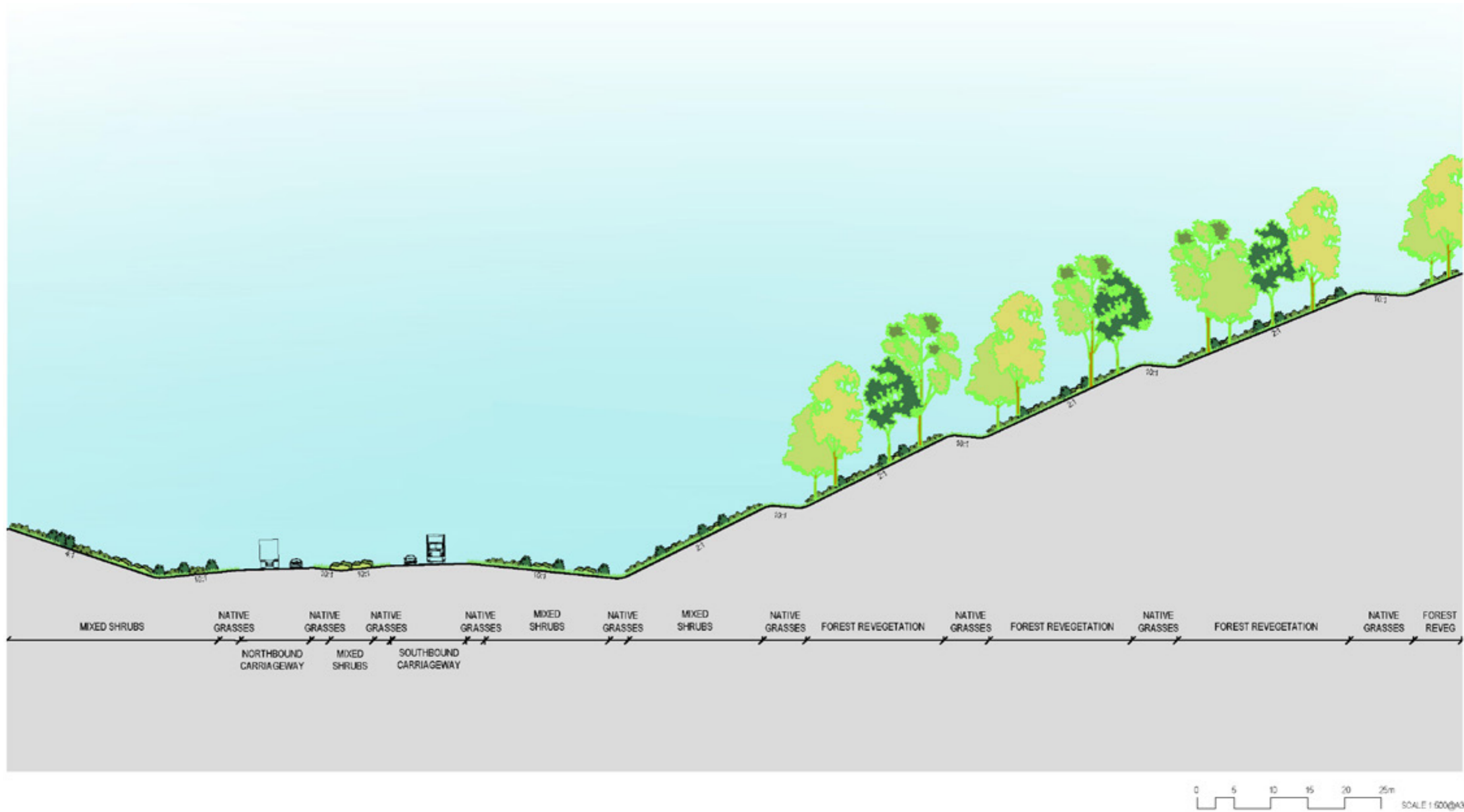
**SECTION 3** Cross section at Bondi Hill

Work in progress  
W2B-GHD-A-LX-DRG-00150



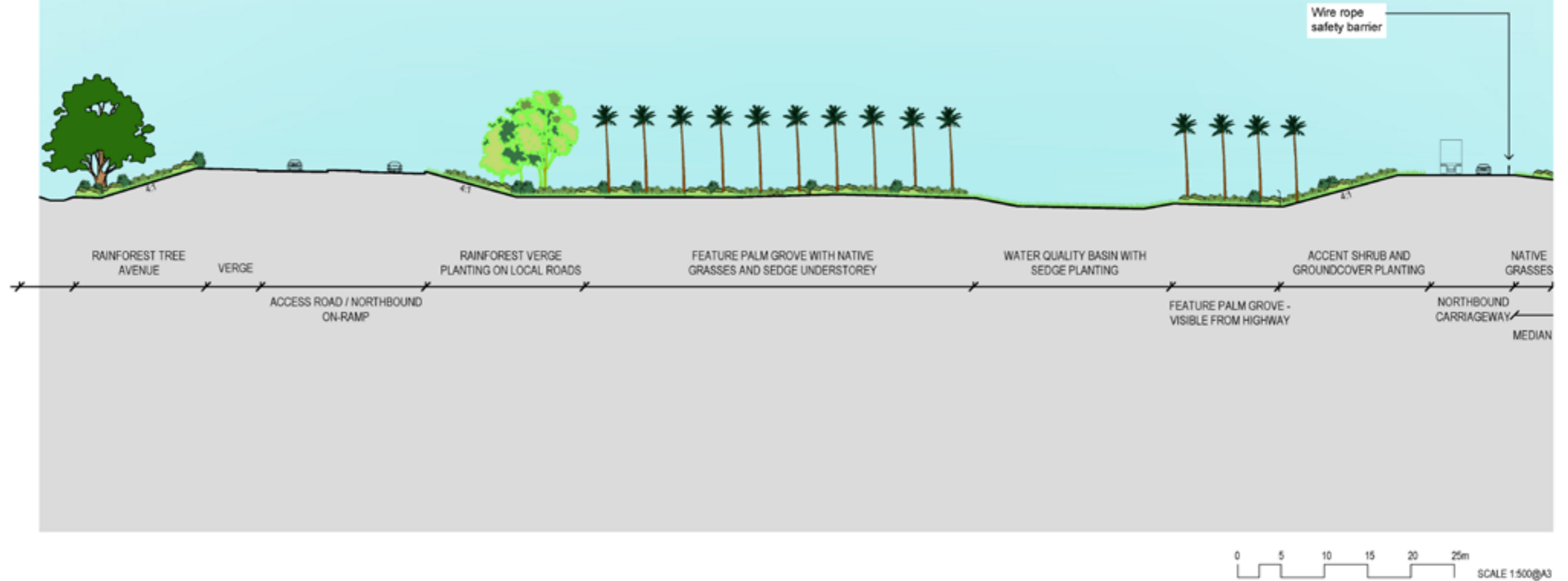
Drawing and design subject to further development, number of trees/elements shown is indicative only. Fence locations, types and shared path locations are to be confirmed, and subject to further design development. Landscape at maturity approximately 15 years.

**SECTION 4** Cross section at Tyndale interchange north W2B-GHD-A-LX-DRG-00151



Drawing and design subject to further development, number of trees/elements shown is indicative only. Fence locations, types and shared path locations are to be confirmed, and subject to further design development. Landscape at maturity approximately 15 years.

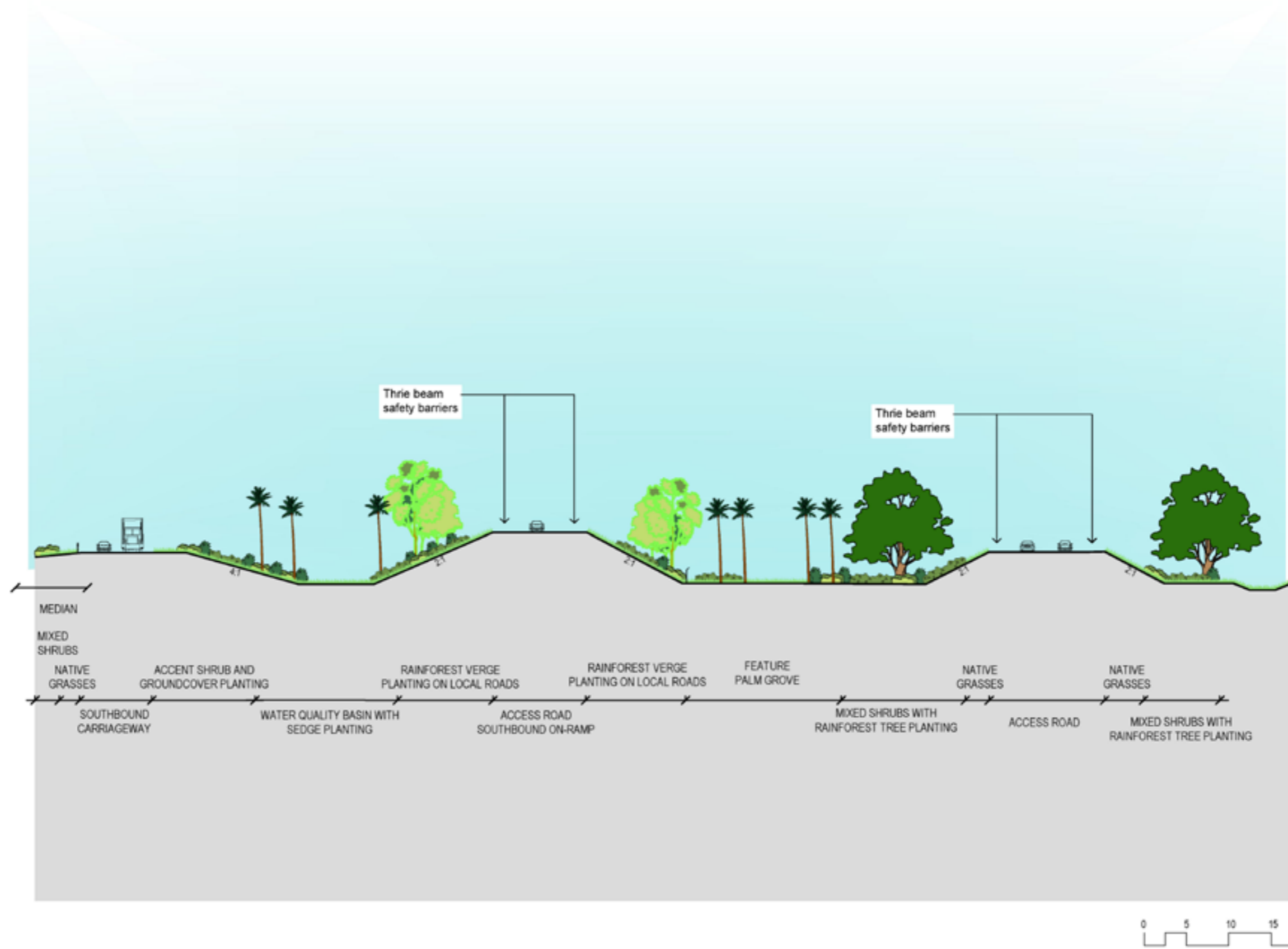
SECTION 4 Cross section at Green Hill W2B-GHD-A-LX-DRG-00152



Drawing and design subject to further development, number of trees/elements shown is indicative only. Fence locations, types and shared path locations are to be confirmed, and subject to further design development. Landscape at maturity approximately 15 years.

**SECTION 4** Cross section through Maclean interchange 1

W2B-GHD-A-LX-DRG-00153



Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Fence locations, types and shared path locations are to be confirmed, and subject to further design development.  
Landscape at maturity approximately 15 years.

**SECTION 4** Cross section through Maclean interchange 2 W2B-GHD-A-LX-DRG-00154

### 7.3 Summary of landscape monitoring and management

Refer to Chapter 9.10.

## 7.4 Visual impact assessment including mitigation

This chapter provides a summary of the visual impacts of the highway upgrade compared to the EIS and SPIR design. The landscape character assessment relates to the built, natural and cultural aspects that makes a place unique, while the visual impact assessment is intended to identify design improvements that can address adverse impacts either through design integration or as mitigation measures.

This chapter summarises the visual impact assessment for the project, based on the same systematic methodology utilised in the EIS Volume 1B *Chapter 11 Urban Design, Landscape Character and Visual Impact* and the *Working Paper Volume 5 Urban Design, Landscape Character and Visual Impact + Historical (non-Aboriginal) Heritage* by Hassell. The visual assessment systematically provides both qualitative and quantitative visual assessment of the route. A review of the findings has been undertaken through a site visit and assessment of surrounding conditions.

The visual assessment measures visual effect (scale of infrastructure x visual exposure) against the visual sensitivity of the location (number of viewers and location relationship), this results in the visual impact assessment based on a quantitative ranking system. The summary of the key high and moderate-high impact areas has been included in this chapter and located on the plan of the alignment.

The Summary Visual Assessment provides a comparative analysis on an overall basis. Detailed information has been included from the Urban Design Report Landscape Character and Visual Impact Assessment to provide a fuller picture of the findings.

A site visit review of this assessment has been undertaken to confirm the findings of the assessment and the urban design team has confirmed the outcomes noted below.

The visual assessment comparison includes impacts on landscape character and key views and is based on the impact assessment grading matrix (Figure 61-63 and Drawing 6).

		MAGNITUDE					
		High	High to Moderate	Moderate	Moderate to low	Low	Negligible
SENSITIVITY	High	High Impact	High Impact	Moderate - high	Moderate - high	Moderate	Negligible
	High to Moderate	High Impact	Moderate - high	Moderate - high	Moderate	Moderate	Negligible
	Moderate	Moderate - high	Moderate - high	Moderate	Moderate	Moderate - low	Negligible
	Moderate to low	Moderate - high	Moderate	Moderate	Moderate - low	Moderate - low	Negligible
	Low	Moderate	Moderate	Moderate - low	Moderate - low	Low Impact	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

Figure 61: Landscape character and visual impact grading matrix.



Figure 62: Agricultural setting with open views.



Figure 63: Forest setting with intermittent view of pastureland.



Drawing and designs subject to further development.

W2B-GHD-A-LX-DRG-00006  
Visual assessment viewpoints plan



#### 7.4.1 Landscape character impacts

The following landscape character ratings were determined in the EIS. A comparison between the EIS and the current design is included.

##### Glenugie to Tyndale – Section 3

In Glenugie to Tyndale – Section 3, the project will follow a new alignment between Eight Mile Lane and Tyndale. In this section, there are several areas considered to be of unique scenic quality, including rivers that would be subject to extensive embankments. This would result in an aggregate impact on the landscape character of the project section of moderate-high. Features of the project in Glenugie to Tyndale – Section 3 include:

- Bridges over the Coldstream River (combined 690 metres long)
- Bridges over the Pillar Valley Creek (combined 400 metres long)
- Embankments near Tyndale (10 to 11 metres high)
- Cuttings just east of Tyndale (up to 40 metres deep).

##### Tyndale to Maclean – Section 4

In Tyndale to Maclean – Section 4, the project would introduce new infrastructure in the landscape, however, views would be seasonally obstructed by sugarcane plantations. The impacts would be greatest where the road is in cutting through Green Hill near McIntyres Lane, as the cutting would be visible from the floodplain and scattered residences. The overall impact of this section of the project on the landscape would be moderate. Features of the project in Tyndale to Maclean – Section 4 include:

- Bridge over Shark Creek (865 metres long)
- Embankments near Tyndale (up to six metres high)
- Interchange at Maclean
- A cutting at Green Hill (24 metres deep).

Refer to Table 7

Table 7: Landscape character impacts in sections 3 and 4.

Precinct	Magnitude	Sensitivity	Impact	Impact
08 Glenugie State Forest	Low New corridor through foothills of State Forest Low embankments and low cuttings within existing corridor.	Low Woodland and grazing. Limited residences, good absorption capacity.	Low	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
09 Glenugie pasture	Negligible P09 is outside the road corridor.	Negligible Views limited by vegetation and landform.	Negligible	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
10 Grafton Airport/ Pheasant Creek	Moderate New road corridor generally along existing local roads. Some areas of embankment required.	Low Woodland with pastureland. Limited residences. Good absorption capacity.	Moderate – Low	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
11 Coldstream River/Sandy Crossing	Moderate/High There are a number of large bridge structures crossing the Coldstream River and Pillar Valley Creek.	Moderate This is an area of high landscape quality. Extensive views towards the north and south.	Moderate – High	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
12 Pillar Valley	Moderate Moderate embankments and cuttings within a new road corridor.	Moderate The foothills of the Pillar Valley are wooded and have absorption capacity.	Moderate	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.

Precinct	Magnitude	Sensitivity	Impact	Impact
13 Coldstream River/ swampland	Negligible P13 is outside the road corridor.	Low Scenic views toward swamplands from the corridor.	Negligible	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
14 Tucabia township	Negligible P14 (Tucabia) is outside the road corridor.	Negligible The project would not be visible from the township of Tucabia.	Negligible	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
15 Upper Coldstream	Negligible P15 is outside the road corridor.	Moderate Some views to Coldstream River Valley possible.	Negligible	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
16 Pine Brush State Forest	Moderate Cuttings and embankments hidden in the foothills.	Moderate Woodland foothills with scattered cleared areas.	Moderate	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
17 South Arm floodplain	Negligible P17 is outside the road corridor.	Low Mosaic of cane plantations and farmland.	Negligible	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
18 Tyndale township	High Large cuttings up to 22 metres of significant length.	High Cutting would be visible from Tyndale.	High	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.

Precinct	Magnitude	Sensitivity	Impact	Impact
19 Bondi Hill	High Large cuttings up to 22 metres of significant length.	High Cutting would be visible from Tyndale.	High	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
<b>SECTION 4 (Shark Creek) landscape character impacts</b>				
Precinct	Magnitude	Sensitivity	Impact	Impact
17 South Arm floodplain	Moderate Embankments across the floodplain up to six metres.	Moderate Interruption of existing pattern of sugarcane plantations and ownership patterns.	Moderate	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
20 Woodford Island	Negligible P17 is outside the road corridor.	Moderate Woodford Island is an elevated area with views over the road corridor.	Negligible	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
21 Shark Creek	Moderate Large bridge (865 metres) across Shark Creek with large approach embankments.	Low Shark Creek is generally cleared with limited riparian vegetation. Sugarcane plantations up to the edge of the creekline.	Moderate- Low	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
22 Green Hill	Moderate Large cutting through Green Hill.	Moderate Green Hill is an elevated area within flat floodplain and is visible from a distance.	Moderate	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
23 Gulmarrad township	Low Embankments across the floodplain up to about three metres.	Low Gulmarrad township is disconnected from the road work through vegetation, distance and topography.	Low	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.

Precinct	Magnitude	Sensitivity	Impact	Impact
24 Maclean/ Townsend township	Moderate A new interchange would be required at Maclean however this would be within close proximity to the existing road corridor.	Moderate-Low Upgrade of existing road infrastructure.	Moderate	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
25 Maclean Pinnacle	Low Limited infrastructure required. Small embankments within the existing road corridor.	Low Upgrade of existing road infrastructure.	Low	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.

The overall impact rating as identified in the EIS for Section 3 is Moderate-High and Moderate in Section 4. The overall impact ratings on the current design will be the same as the EIS impact ratings.

### 7.4.2 Impacts on key views

Visual impact ratings were determined in the EIS based on 75 key viewpoints. Of these viewpoints, eight are located in Sections 3 and 4 (refer to Drawing 6). Only the viewpoints with Moderate-high and High visual impacts are included in the comparison between EIS/SPIR and current design.

These are:

- Viewpoint 9 – Old Six Mile Road, Glenugie
- Viewpoint 10 – Avenue Road, Glenugie
- Viewpoint 17 – Pine Brush Forest, Tucabia
- Viewpoint 18 – Pacific Highway, Tyndale
- Viewpoint 20B – Cane fields, Tyndale (north)
- Viewpoint 20C – Byrons Lane, Tyndale
- Viewpoint 24A – Ferry Park, Maclean
- Viewpoint 24B - Schwonberg Street, Townsend.

The results of the EIS assessment have been reviewed and re-assessed below in accordance with Roads and Maritime impact grading matrix (refer to Figure 61), taking into consideration the design amendments between the EIS and concept design.

#### **Viewpoint 9 – Old Six Mile Road, near Wants Lane (Foreground view)**

##### **Description**

Foreground view looking north-west from Old Six Mile Road, near Wants Lane and corner of Avenue Road.

##### **EIS assessment**

The viewpoint was assessed to have moderate to low sensitivity as a small number of residents will experience direct and repeated changed foreground views.

The EIS concept was assessed to have high magnitude as new infrastructure will be on fill embankment in an agricultural setting, requiring vegetation removal. This gave an overall visual impact of moderate-high.

##### **Visual impact Assessment**

The current design will not change the sensitivity rating assessed in the EIS, which will remain high. The magnitude rating will remain as high as the current design is similar to the EIS concept. The overall visual impact will remain high.

#### **Viewpoint 10 – Avenue Road**

##### **Description**

Middle ground view looking south from The Avenue, near Wants Lane

##### **EIS Assessment**

The viewpoint was assessed to have moderate sensitivity as a small number of residents and local road users will experience long duration and/or repeated views.

The EIS concept was assessed to have moderate-high magnitude as new infrastructure will be on fill embankment in an agricultural setting, requiring vegetation removal. This gave an overall visual impact of moderate-high.

##### **Visual Impact Assessment**

The current design will not change the sensitivity rating assessed in the EIS, which will remain moderate. The magnitude rating will remain as moderate-high as the current design is similar to the EIS concept. The overall visual impact will remain moderate-high.

#### **Viewpoint 17 – Pine Brush Forest**

##### **Description**

Foreground view of rest area looking west from local road.

##### **EIS Assessment**

The viewpoint was assessed to have high sensitivity as few vehicles will use the property access and the will remove a highly sensitive area of State Heritage register high Conversation Value Old Growth Forest. The EIS concept was assessed to have moderate-high magnitude as new infrastructure will be in a natural setting, requiring major tree removal and the cutting will reduce visibility. This gave an overall visual impact of high.

##### **Visual impact assessment**

The current design has changed the location of the rest area to about seven kilometres south of the EIS location between Bostock Road and Somervale Road (as mentioned in the SPIR). However the design will not change the sensitivity rating assessed in the EIS, as it is still located in a similar landscape precinct and will remain high.

The magnitude rating will remain as moderate-high as the current design is similar to the SPIR concept. The overall visual impact will remain high.

### Viewpoint 18 – Pacific Highway, Tyndale

#### Description

Foreground, ground view looking south from existing Pacific Highway, north of Tyndale township.

#### EIS assessment

The viewpoint was assessed to have high sensitivity as a large number of residents and local road users will experience long duration and/or repeated views of a changed foreground, and will be visible to a high number of existing highway motorists. The EIS concept was assessed to have high magnitude as new infrastructure will be in a natural setting, requiring tree removal and earthworks and a large cutting into Bondi Hill. This gave an overall visual impact of high.

#### Visual impact assessment

The current design will not change the sensitivity rating assessed in the EIS, which will remain moderate. The magnitude rating will remain as high as the current design is similar to the EIS concept. The overall visual impact will remain high.

### Viewpoint 20B – Cane fields, Tyndale (north)

#### Description

Foreground ground view from cane fields, looking north.

#### EIS assessment

The viewpoint was assessed to have moderate sensitivity as nearby residents will experience repeated and long-duration views. The EIS concept was assessed to have high magnitude as significant new infrastructure will be in an agricultural setting with minor filling and disturbance to vegetation. This gave an overall visual impact of moderate-high.

#### Visual impact assessment

The current design will not change the sensitivity rating assessed in the EIS, which will remain moderate. The magnitude rating will remain as high as the current design is similar to the EIS concept. The overall visual impact will remain moderate-high.

### Viewpoint 24B – Schwonberg Street, Townsend

#### Description

Foreground ground view from Schwonberg Street, looking northwest.

#### EIS assessment

The viewpoint was assessed to have moderate sensitivity as a low number of residents on Schwonberg and Jubilee Streets will experience long duration and/or repeated views. The EIS concept was assessed to have moderate magnitude as new infrastructure is typical of existing infrastructure. This gave an overall visual impact of moderate-high.

#### Visual impact assessment

The current design will not change the sensitivity rating assessed in the EIS, which will remain moderate. The magnitude rating will remain as high as the current design is similar to the EIS concept. The overall visual impact will remain moderate-high.

## 8.0 Detailed responses for urban and landscape design

### 8.1 Structures

#### 8.1.1 Interchanges

Interchanges (and rest areas) provide the opportunity for placemaking and wayfinding for the project. They also enhance the driver experience and the relationship of the upgraded highway to its surroundings, providing a lateral connectivity to the region. As the alignment is in a new location and will form the first major intrusion of large scale man-made elements into that environment, a key objective of the project will be to ensure the seamless integration of the upgrade and interchanges with the landform and the landscape (Figure 64).

Sections 3 and 4 have three interchanges and two rest areas in the following locations:

- Glenugie
- Tyndale
- Maclean.

#### **Glenugie interchange**

Glenugie interchange comprises two half interchanges; Glenugie interchange south (Glenugie) and north (Eight Mile Lane), located nominally 1.5 kilometres apart.



Figure 64: Pacific Highway looking north at Glenugie.

**Glenugie interchange south**

Subject to further community consultation and design development.

**Glenugie interchange north - Eight Mile Lane interchange**

Subject to further community consultation and design development.



Figure 65: Location of Eight Mile Lane interchange near proposed overbridge.





Figure 66: Oblique aerial view of the Glenugie region.



Figure 67: Oblique aerial view of the Glenugie region.

### Tyndale interchange

Tyndale interchange comprises two half interchanges; Tyndale interchange south (at Tyndale township) and north (north of Bondi Hill Road), located about two kilometres apart and near to the Clarence River South Arm and existing Pacific Highway (Figures 68 to 74).

### Tyndale interchange south

This grade separated half interchange occurs north of Tyndale at Bondi Hill. The existing Pacific Highway at Tyndale township is located between the town and river, with the town located along the river. The cutting will be a prominent feature of the interchange experience.

The interchange occurs just to the north of the town proper. It provides a northbound off ramp at surface level and a southbound on ramp that crosses below the main carriageways, as an underbridge. These two ramps join at the existing Pacific Highway at an upgraded intersection. A major cutting is required for this portion of the interchange where Bensons Lane currently crosses the ridgeline. This cutting will be a prominent feature of the interchange experience.

Just to the south of the southern portion of the interchange a small creek and footbridge is located. A pedestrian path connects these to the town's main street and provides a link to the post office further to the north.

The interchange will impact on the forest setting of Bondi Hill and mitigation measures are being considered to manage this impact.

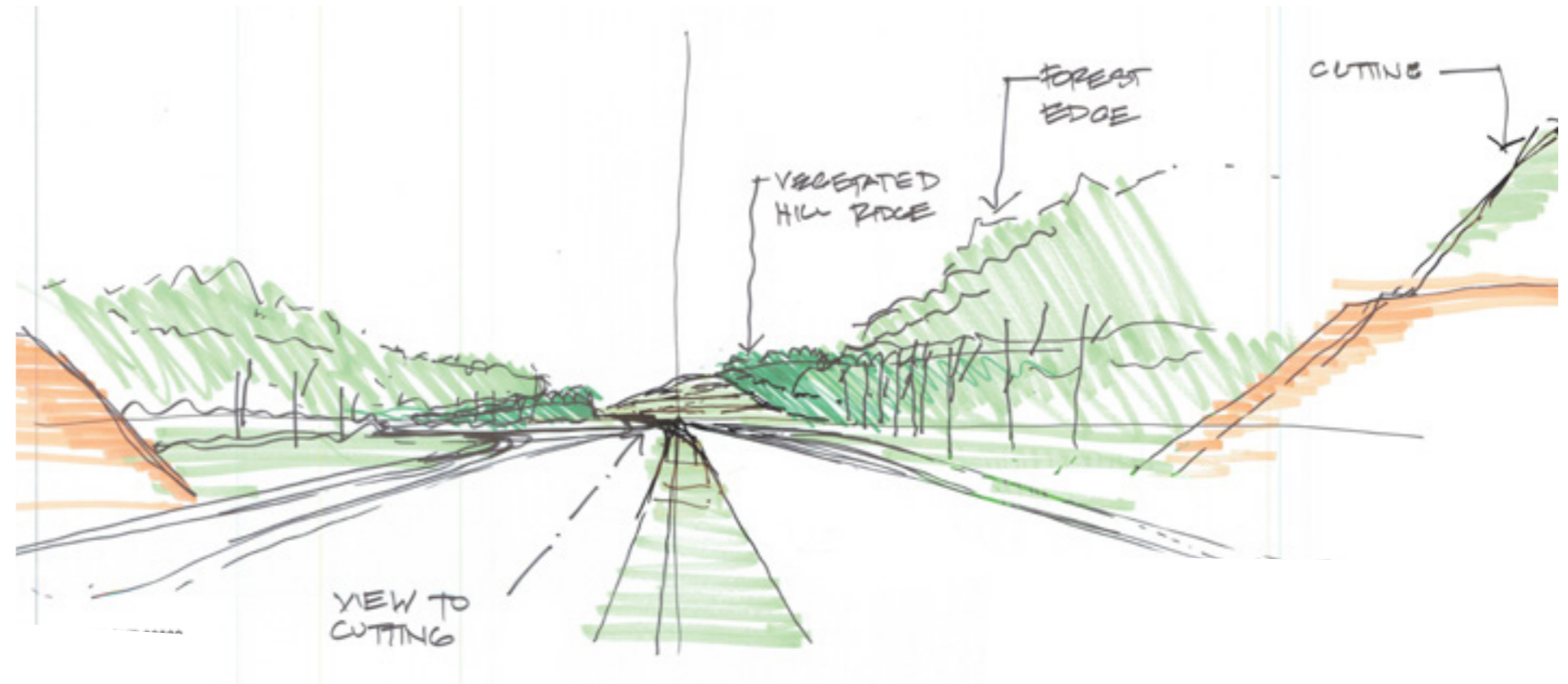


Figure 68: Tyndale interchange south looking north.

Key design outcomes include:

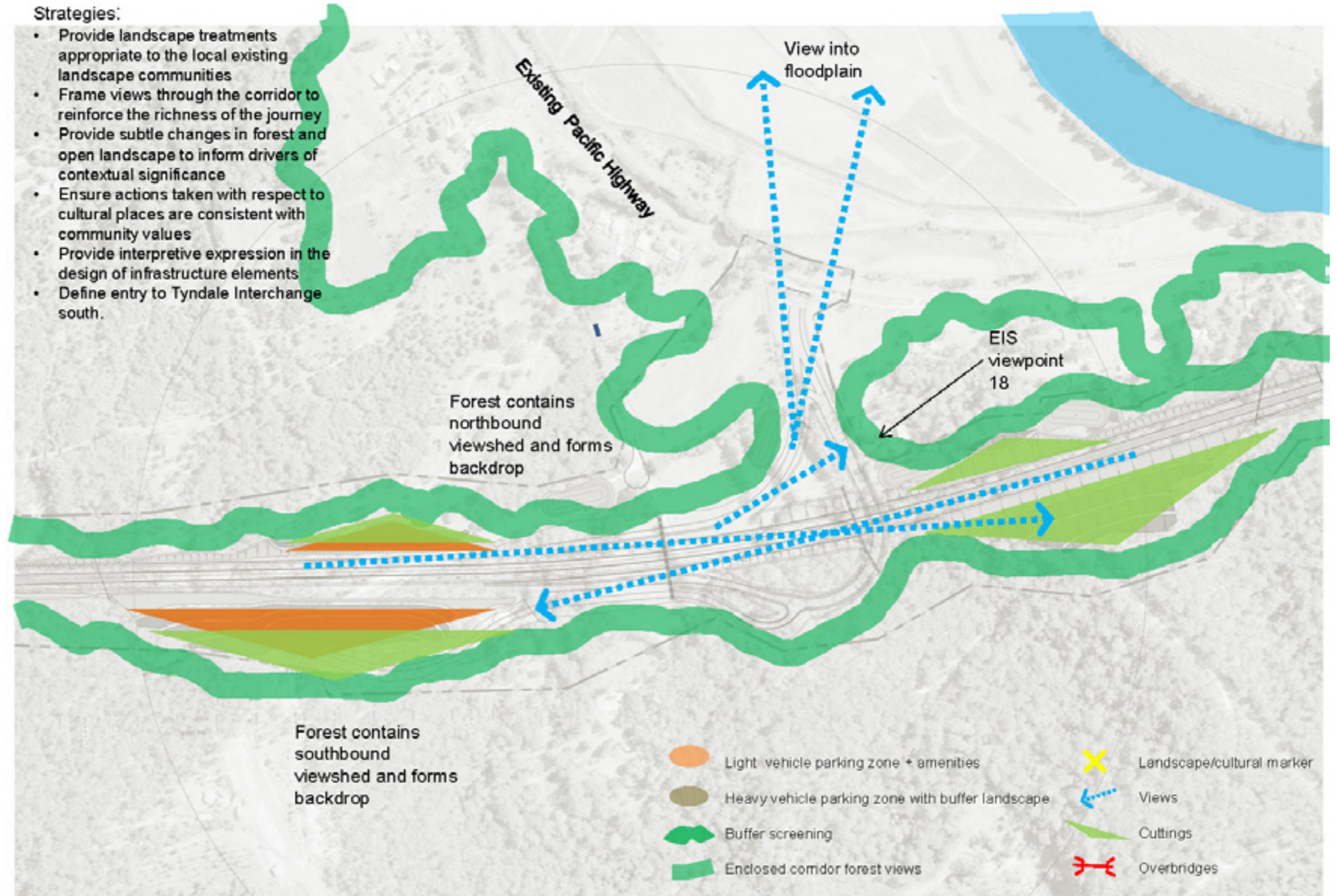
- Reinforcement of the landscape setting to ensure that the interchange is fully integrated into the local area and is not overly intrusive
- Optimisation of open space to provide additional landscape
- Proposed water quality control ponds at the interchange used to enhance the gateway experience
- The underbridge, with its landscape treatments, provides a backdrop to Bondi Hill for drivers exiting the interchange along the southbound carriageway
- Landscape treatments and wayfinding signage signal the link to Grafton and Grafton airport
- Improved connectivity across the Pacific Highway upgrade intersections maintain cohesiveness of the town
- Enhancement of the creek's riparian corridor where it is within project boundaries
- Undertake landscape treatments reinforce the link between the town and the river
- Landscape treatments and batter rounding in large cuts to seamlessly integrate with the surrounding environment
- Revegetation of areas affected by EEC with species obtained from the adjoining community
- Retain exposed rock surface at the bottom steep batters of cuts where landscaping is not possible
- Use architecturally treated shotcrete with a rough finish that mimics the stone texture to minimise the difference in appearance between the shotcrete and the exposed rock face.



Figure 69: Location of proposed alignment at Tyndale interchange south from Pacific Highway.

Strategies:

- Provide landscape treatments appropriate to the local existing landscape communities
- Frame views through the corridor to reinforce the richness of the journey
- Provide subtle changes in forest and open landscape to inform drivers of contextual significance
- Ensure actions taken with respect to cultural places are consistent with community values
- Provide interpretive expression in the design of infrastructure elements
- Define entry to Tyndale Interchange south.



NOTE: Alignment shown is indicative only. NTS.

Figure 70: Tyndale interchange south design principles diagram.

### Tyndale interchange north

This grade separated half interchange occurs to the north of Bondi Hill Road. It provides a northbound off ramp at grade level and a southbound off ramp to the existing Pacific Highway from the north. The southbound exit takes the form of a flyover ramp that crosses the main carriageways connecting to the existing Pacific Highway along with the northbound entry ramp, at a realigned and upgraded intersection. It may be possible to get glimpses of the river from the southbound exit ramp where it crosses the main alignment.

One of the most significant features of this portion of the interchange is the major cutting into Bondi Hill, located just to the south of the southbound existing ramp. Bondi Hill Road also passes over the main carriageways at this location and is realigned to cross the highway in a perpendicular relationship. This cutting will be visible to both Bondi Hill Road and the main carriageways. It will also likely be visible from the existing Pacific Highway (Figure 74).

Key design features include:

- Reinforcement of the area's landscape setting to ensure the interchange is fully integrated into the local area and is not overly intrusive
- Optimisation of open space to provide additional landscape
- Proposed water quality control ponds at the interchange are used to enhance the gateway experience
- Recognise that views from overbridges will be a feature of the experience of arrival and departure from Tyndale
- The underbridge, with its landscape treatments provides a backdrop to Bondi Hill for drivers exiting the interchange along the southbound carriageway
- The interchange signals the link to Grafton and Grafton airport through landscape treatments and wayfinding signage
- Improved connectivity across the Pacific Highway upgrade intersections will maintain cohesiveness of the town
- Enhancement of the riparian corridor of the creek where it is within project boundaries
- Landscape treatments to reinforce the link between the town and river
- Landscape treatments and batter rounding in large cuts to seamlessly integrate with the surrounding environment

- Revegetated areas affected by EEC with species obtained from the adjoining community
- Retention of exposed rock surface at the bottom steep batters of cuts where landscaping is not possible
- Use of architecturally treated shotcrete with a rough finish that mimics the stone texture to minimise the difference in appearance between the shotcrete and the exposed rock face
- Landscape treatment in verge near steep cut areas.

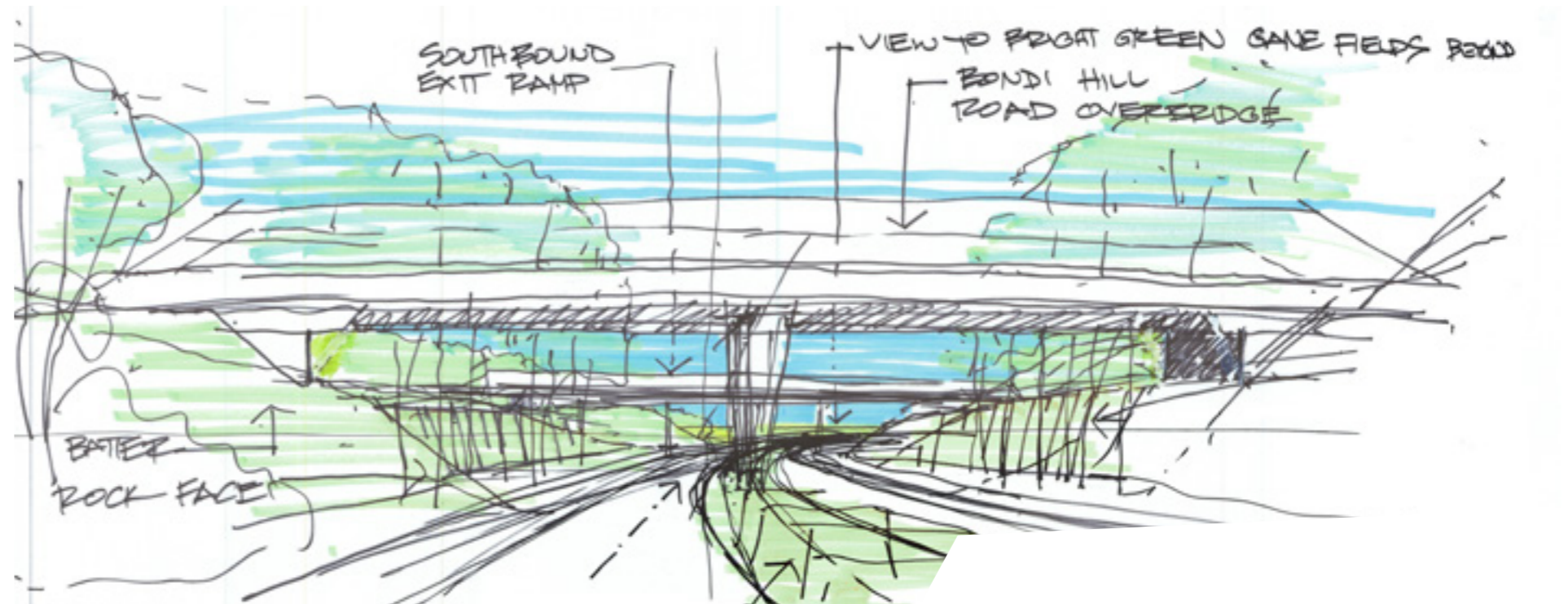
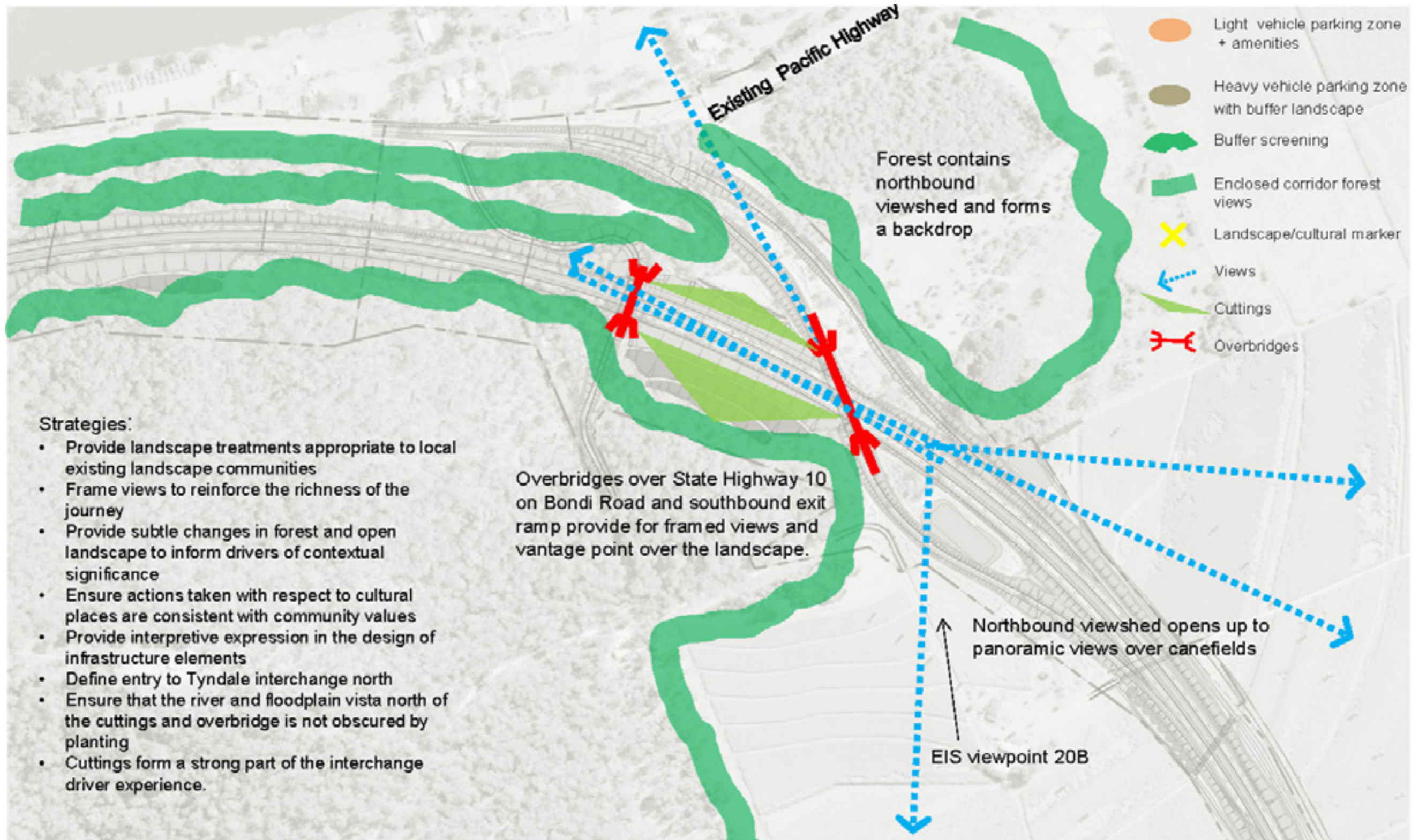


Figure 71: Sketch of Tyndale interchange north looking north.



NOTE: Alignment shown is indicative only. NTS.

Figure 72: Tyndale interchange north principles diagram.



Drawing and design subject to further development, number of trees/elements shown is indicative only. Landscape shown at full maturity.

Figure 73: Oblique aerial view of Tyndale interchange south looking north-east. Oblique aerial base from Pacific Complete.





Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Landscape shown at full maturity.

Figure 74: Oblique aerial view of Tyndale interchange north looking north. Oblique aerial base from Pacific Complete.

### Maclean interchange

Maclean has a strong relationship with the river and this is borne out by both the town's structure and cultural history. Maclean provides one of two river crossings to Woodford Island. The second crossing point is about 16 kilometres to the south at Cowper. The interchange is located just to the south of the town within an agricultural area near Ferry Park (Figure 78).

This full interchange will provide for north-south movements in all directions and will require the realignment of a number of local roads. It is here that the existing Pacific Highway joins the upgraded portion and no longer runs as a local scenic road on its own. The interchange consists of two roundabouts, one located to the west of the main carriageways and one located to the east. As the interchange is located in low lying agricultural lands, it is built on embankments to ensure appropriate gradients are maintained.

The western roundabout is located at Goodwood Street between Cameron Street and links the existing Pacific Highway to the upgraded section. Both Cameron Street and the link from the overbridge through the western roundabout provide a strong gateway experience to Maclean.

The eastern roundabout is located further to the north and provides links to Goodwood Street and Jubilee Street. A two way overbridge links both roundabouts. Given the need to raise the ground level for both the main carriageways and the overbridge, expansive views will be available from the overbridge to agricultural lands to the south and to the river. This will be a key part of the arrival and exit experience for drivers travelling in a southbound direction along the Pacific Highway upgrade.

Although the interchange is elevated, it is located along the southern side of the town's topography and from a distance will be seen as part of that topographic feature. Minor cuttings are required along the hill, however, the landscape tree cover of the hill will remain largely intact.

Jubilee Street that currently passes below the existing Pacific Highway to connect to Maclean will remain operational. A new link to the eastern roundabout will be provided to improve access for residents from Townsend and Gulmarrad. The interchange will be visible from the current overlook at Jubilee Street near Hillcrest Road.

The interchange will transform the quiet agricultural setting of this location and mitigation measures are being considered to manage this impact.

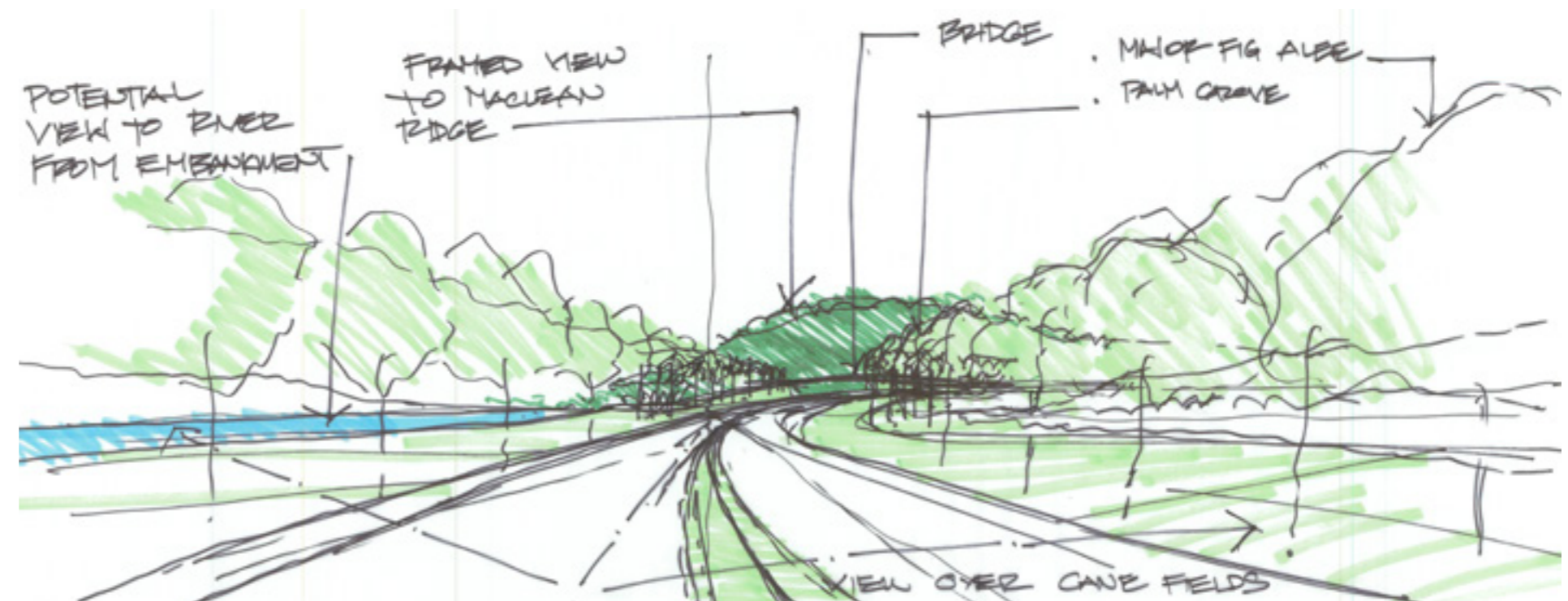


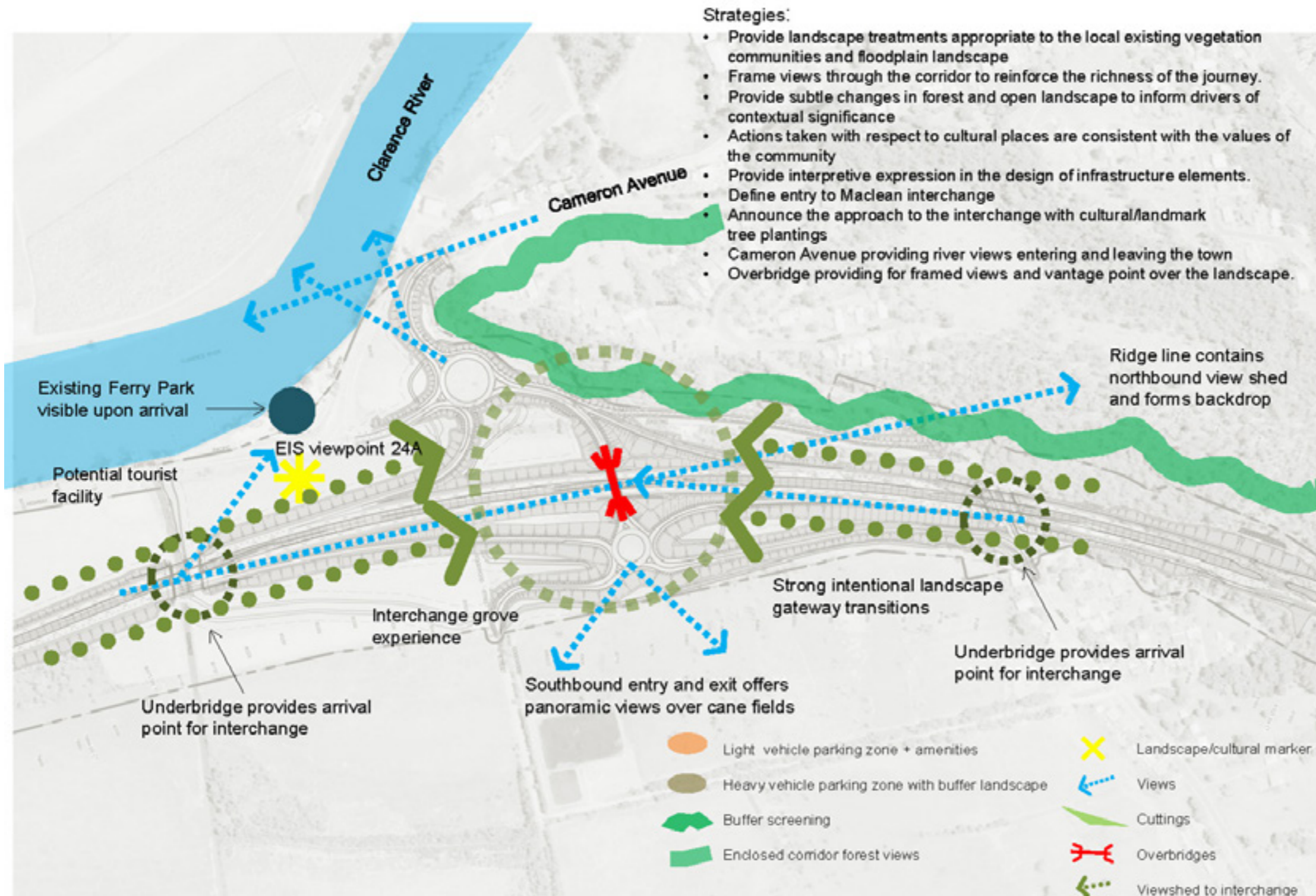
Figure 75: Sketch of Maclean interchange looking north.

Key design outcomes include:

- Reinforcement of the area's landscape setting to ensure the interchange is fully integrated with the local area and is not overly intrusive
- Additional gateway landscape at waterfront open space
- Views from overbridges will be a feature of the arrival and departure experience from Maclean for southbound drivers through feature landscape
- Accent tree planting along local roads
- Improved connectivity across the Pacific Highway upgrade intersections to maintain cohesiveness
- A shared path between Cameron Street and Jubilee Street
- Enhanced opportunities to use the interchange to highlight the cultural heritage of the town, featuring its relationship to the river and reinforcing the Cameron Street and Goodwood Street gateways.



Figure 76: Oblique aerial enlargement view of Maclean interchange looking north. Oblique aerial base from Pacific Complete.



NOTE: Alignment shown is indicative only. NTS.

Figure 77: Maclean interchange design principles diagram.



Figure 78: Oblique aerial view of Maclean interchange looking north. Oblique aerial base from Pacific Complete.

### 8.1.2 Bridges including throw screens and detailed elements

There several types of bridges in the project, they include:

- Overbridges
- Twin bridges (underbridges)
- Special bridges.

Refer to Figures 79-89.

#### Overbridges

The overbridges are designed to be a family of similar bridges seen along the Pacific Highway. The overbridges mostly cross the mainline carriageways and form a visible part of the driver experience along the route.

Key design features include:

- Two span bridges with tapered median piers in both directions (10:1 in transverse and 30:1 in longitudinal) to create consistency with other Pacific Highway bridges in the region
- Tapered piers used for bridge deck widths less or equal to 10 metres, Stiletto piers used for bridge deck widths greater than 10 metres that allow greater sightlines through the bridge structure
- Curved tapered end throw screens that form signatures of the architectural design
- Superstructure comprise mainly Super-T's
- Spill through abutments provide an open feel to the bridge
- Simple abutment wing walls providing a clean aesthetic for these overbridge structures, emphasising the spanning qualities and creating a dynamic composition
- Rock with pitching in grout infill treatment to abutments
- Medium performance barrier (twin safety rails) that maximises viewing opportunities from the bridge
- Maintenance access stairs located on the trailing side of the mainline carriageway in the direction of travel. Access to the bench from top of bridge
- Long skirt parapets for bridges of equal depth on both sides of the overbridge that have exposed drainage to conceal them
- Short skirt parapets of equal depth on both sides of the overbridge on all other bridges where there is no exposed drainage
- Landscape treatments at the abutments to strengthen lateral connections.

#### Twin bridges

Twin bridges span watercourses, local roads and/or fauna crossings. Mostly, these bridges will be less visible to the public and will mostly be designated as priority three bridges. All twin bridges are underbridges.

Key design features include:

- Single or multi-span bridges with circular piers and tapered headstocks
- Precast plank & super-T bridges
- Smaller bridges form single spans with open spill through abutments
- Loose rock facing treatments to abutments
- Regular performance barrier (single safety rail) which maximises viewing opportunities from the bridge
- Short skirt parapets of equal depth on both sides of the overbridge
- Maintenance access stairs located on the departure side of the bridge along the mainline carriageways in the direction of travel
- Access to the bench either from top of bridge or bottom of bridge
- Feasibility of access to bridge maintenance bench from the bottom of bridge is currently being assessed as part of the maintenance access strategy
- Landscape treatment at the abutments and in the undercroft to cater to fauna crossing requirements to strengthen lateral connections.

### Special bridges

Special bridges are classified to be those which have a different arrangement to the normal overbridges and underbridges, due to their lengths, geometries and spanning configurations.

Three bridges, (two overbridges and one underbridge) are categorised as special bridges:

- Overbridge over State Highway 10 at Glenugie southbound entry ramp
- Overbridge over State Highway 10 at Tyndale southbound exit ramp
- Bridge over Shark Creek.

### Bridge over State Highway 10 on Glenugie southbound entry ramp

Subject to further community consultation and design development.

### Bridge over State Highway 10 on southbound exit ramp

This bridge occurs at the Tyndale interchange north and will be highly visible to drivers as it spans a major cutting at Bondi Hill. It crosses over the main carriageways with three circular column supports in the median and along the verges. The current design provides for an integrated headstock that allows the bridge deck to float over the structure as it reaches across the main carriageways.

### Bridge over Shark Creek

The bridge at Shark Creek occurs in Tyndale to Maclean – Section 4 in the northern portion of the project. The Shark Creek bridge spans around 865 metres across the creek and flood plain, forming the largest bridge on the project. It will be visible across the sugarcane fields and from local roads. The structure of this bridge has simple round columns and tapered headstock supporting the road deck. The decking is made up of 1500 millimetre deep Super – T girders. To minimise impacts on the environment, a key feature of this bridge is that the northbound and southbound carriageways are joined into a single crowned deck. This allows the headstock support to be essentially horizontal. As with other underbridges, a single rail parapet will be employed to allow for greater panoramic views from the highway. Drainage is provided through scuppers in the bridge deck.

The following bridges are included to illustrate the different scenarios for overbridges, underbridges (including fauna crossings) and special bridges:

- Twin bridges at Pillar Valley 4
- Twin bridges over Mitchell Road
- Bridge over State Highway 10 on Bostock Road
- Twin bridges over Tyndale interchange (South)
- Bridge over State Highway 10 on Bondi Hill Road
- Bridge over State Highway 10 on Southbound exit ramp
- Bridge over State Highway 10 on Byrons Lane
- Bridge over Shark Creek
- Bridge over State Highway 10 on Maclean interchange
- Twin bridges over Jubilee Street
- Twin bridges over combined fauna drainage 1.

### Hierarchy of bridges, ranking and visual impacts

All bridges form a 'family' of structures that have a consistent approach across all sections, detailing, shapes and finishes. In order to provide a cost effective and visually attractive solution to bridge design along the Woolgoolga to Ballina upgrade, a series of detailed parameters are developed to respond to bridge visibility.

An investigation being undertaken to identify priority for addressing visual outcomes of the bridges. These elements cross the main carriageways, span local waterways and local roads and are sometimes combined into longer contiguous structures, such as at Shark Creek and are visible within the landscape.

In Table 8, the bridges are ordered from south to north and include all bridges in Sections 3 and 4. Bridges with Priority 1 (High) and 2 (Medium) rankings in the table below are afforded similar design consideration. Detailing across these bridges will generally be similar however Priority 2 bridges may have simpler detailing and achieve an attractive outcome through careful application of landscape screening. The ranking is associated with the scale and visibility of the bridge only.

Headstocks and tapered stiletto piers are assessed across all bridges to ensure that consistent dimensioning across all portions can be achieved.

Stiletto piers are proposed on Jubilee Street bridge, as although it is an underbridge, it is perceived as part of the Maclean interchange with the same aesthetic.

Curved bridges are carefully considered to ensure that positions of precast elements and railings provide an aesthetically acceptable outcome that features visual continuity and flowing lines.

### Bridge visibility

Bridge visibility is considered for all bridges in the project regardless of whether they occur as overbridges or underbridges.

### Definitions for visibility

#### Visible bridges

- Bridges visible from the main carriageways of the upgraded Pacific Highway
- Bridges visible from surrounding areas such as local roads, settlement areas or other areas with frequent public occupancy such as sportfields and recreation areas
- May be given priority 1 High or Priority 2, Medium.

#### Non-visible bridges

- Bridges not generally visible to the general public including those in bush and agricultural areas with limited access to the general public
- Generally considered Priority 3 Low
- All fauna crossings are considered non-visible bridges with a Priority 3, Low ranking.

Table 8: Detail design parameters

Parameter	Visible Bridges	Non-visible Bridges	Non-visible Bridges
Priority Ranking	1 High	2 Medium	3 Low
Bridge Type	Generally overbridges	Generally underbridges at local roads	Generally underbridges
Bridge drainage	Concealed	Concealed	Visible
Near overland drainage	Landscape or natural outcome	Landscape or natural outcome	Landscape or natural outcome preferred.
Maintenance stair finish (upward from roadway to bridge)	Local stone	Local stone	Concrete – broom finish
Maintenance stair finish (downward from overbridge)	Concrete – broom finish	Concrete – broom finish	Concrete – broom finish
Maintenance stair return under wing wall	Yes	No	No
Spill through material	Rock pitching in grout	Rock pitching in grout	Rock facing
Skirt depth	Long	Long	Short
Wing wall	Perpendicular	Perpendicular	Perpendicular
Column Type	Tapered stiletto Tapered blade walls	Round or rectangular	Round or rectangular
Headstock	Precast concrete integrated type	Precast concrete integrated type	Precast concrete separate headstock

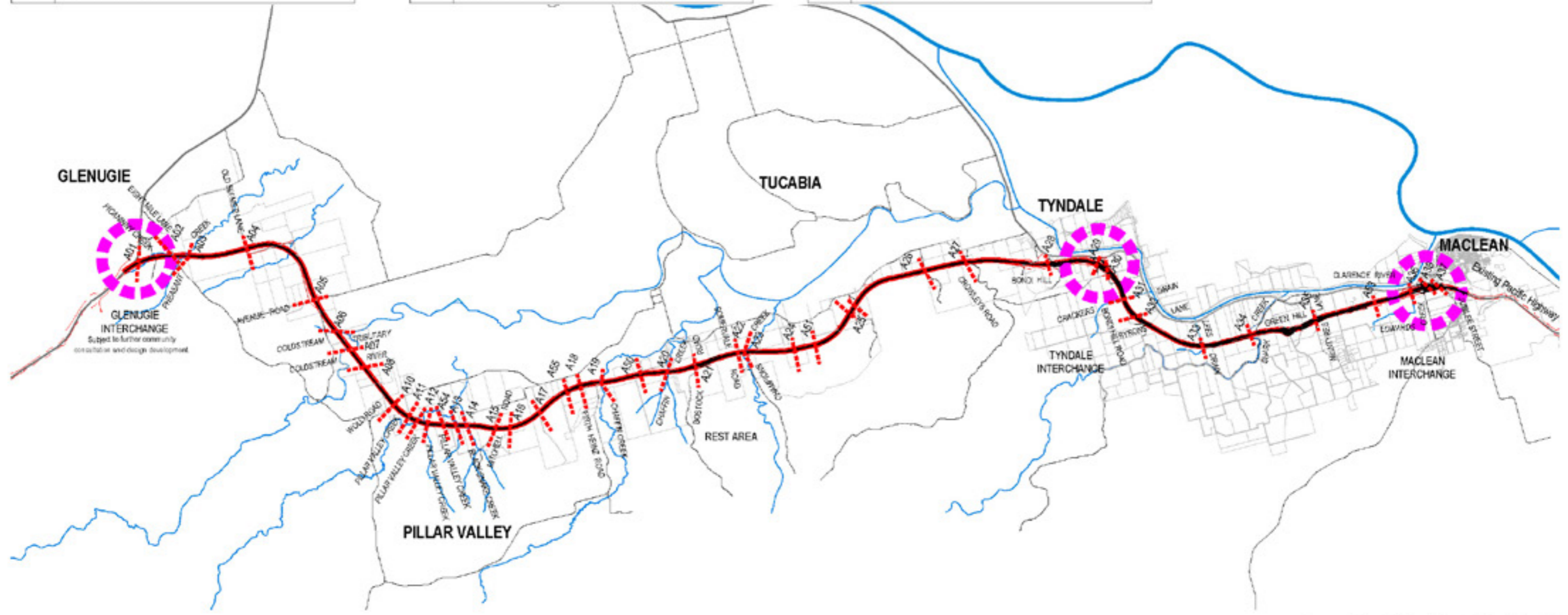


A01	Bridge over State Highway 10 on Glenugie Southbound on ramp
A02	Bridge over State Highway 10 on Eight Mile Lane
A03	Twin bridges over Pheasant Creek
A04	Bridge over State Highway 10 on Old Six Mile Road
A05	Bridge over State Highway 10 on Avenue Road
A06	Twin bridges over Coldstream River 1
A07	Twin bridges over Coldstream River 2
A08	Twin bridges over Coldstream River 3
A09	Bridge over State Highway 10 on Wool Road
A10	Twin bridges at Pillar Valley 1
A11	Twin bridges at Pillar Valley 2

A12	Twin bridges at Pillar Valley 3
A13	Twin bridges at Pillar Valley 4
A14	Twin bridges at Pillar Valley 5
A15	Twin bridges over Mitchell Road
A16	Twin bridges north of Pillar Creek 1
A17	Twin bridges north of Pillar Creek 2
A18	Bridge over State Highway 10 on Firth Heinz Road
A19	Twin bridges over Chaffin Creek
A20	Twin bridges north of Chaffin Creek
A21	Bridge over State Highway 10 on Boslock Road
A22	Twin bridges over Somervale Road

A23	Twin bridges over Champions Creek
A24	Twin bridges north of Champions Creek
A25	Twin bridges over Quarry Access Road
A26	Bridge over State Highway 10 on property access road
A27	Bridge over State Highway 10 on Crowleys Road
A28	Twin bridges over Tyndale interchange (south)
A29	Bridge over State Highway 10 on Bondi Hill Road
A30	Bridge over State Highway 10 on Southbound off ramp
A31	Twin bridges over Crackers Drain
A32	Bridge over State Highway 10 on Byrns Lane
A33	Twin bridges over Lees Drain

A34	Bridge over Shark Creek
A35	Bridge over State Highway 10 on McIntyres Lane
A36	Twin bridges over Edwards Creek
A37	Bridge over State Highway 10 on Maclean interchange
A38	Twin bridges over Jubilee Street
A39	Twin bridges over combined fauna drainage 1
A40	Twin bridges over combined fauna drainage 2
A41	Twin bridges over floodplain on State Highway 10
A42	Twin bridges for additional Emu crossing 1
A43	Twin bridges for additional Emu crossing 2



Drawing and design subject to further development.

W2B-GHD-A-LX-DRG-00005  
BRIDGES LOCATION PLAN



Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Landscape shown at full maturity.

Figure 79: Twin bridges at Pillar Valley 4 – looking east.



Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Landscape shown at full maturity.

Figure 80: Twin bridges over Mitchell Road - looking east.



Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Landscape shown at full maturity.

Figure 81: Typical view of fauna crossing bridge.



Drawing and design subject to further development, number of trees/elements shown is indicative only. Landscape shown at full maturity.

Figure 82: Bridge over State Highway 10 on Bostock Road - looking south.



Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Landscape shown at full maturity.

Figure 83: Twin bridges over Tyndale interchange (south) - looking east.



Drawing and design subject to further development, number of trees/elements shown is indicative only. Landscape shown at full maturity. Note: Barriers not shown.

Figure 84: Bridge over State Highway 10 on Bondi Hill Road - looking north.



Drawing and design subject to further development, number of trees/elements shown is indicative only. Landscape shown at full maturity. Note: Barriers not shown.

Figure 85: Tyndale interchange north overbridge - looking south.





Drawing and design subject to further development, number of trees/elements shown is indicative only. Landscape shown at full maturity. Note: Barriers are not shown.

Figure 86: Bridge over State Highway 10 on Byrons Lane - looking east.



Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Landscape shown at full maturity.

Figure 87: Twin bridges over Shark Creek - looking south from Shark Creek Road.



Drawing and design subject to further development. Number of trees/elements shown is indicative only. Landscape shown at full maturity.

Figure 88: Bridge over State Highway 10 on Maclean interchange - looking north.



Drawing and design subject to further development, number of trees/elements shown is indicative only.  
Landscape shown at full maturity.

Figure 89: Twin bridges over Jubilee Street - looking west from Jubilee Street.

## 8.2 Road corridor

### 8.2.1 Median and verge treatments

The landscape treatments in medians and verges are responsive to their surrounding context and provide a seamless integration between the existing environment and the highway as part of the road upgrade. Two types of treatments; pasture grasses and native shrubs are provided respectively to complement the forested and floodplain landscapes of the corridor.

Key features include:

- Two metres of pasture grass or native shrubs at the carriageway edge of medians and verges
- Four metres minimum of mixed shrubs in the median in forested areas where there are no views
- No tree planting in medians
- Low maintenance landscape
- Maintaining sightlines in the median
- Completing the visual integration of the roadway into surrounding landscape
- Demarcation of riparian crossings in median plantings to create visual continuity and habitat connectivity
- Establishment of a bold and attractive landscape for the enjoyment of road users, where relevant
- Planting of frangible species in clear zones for road user safety
- Maintenance of sightlines on curved and ridging sections of the road
- Screening of headlights from oncoming traffic for road user safety
- Reducing rubbish collecting by incorporating a two metre wide grassed mowing strip.

### 8.2.2 Rest areas

The Pacific Highway has two rest areas that are located along the northbound and southbound alignment between Bostock Road and Somervale Road. This location is about three kilometres to the east of Tucabia in heavily forested area and no connections from these local roads are envisaged to the upgraded highway. Somervale Road will pass below the main carriageways and Bostock Road will cross the main carriageways on an overbridge (Figures 90-92).

Each rest area will be a self-sufficient facility. The rest areas are located close to the crest of a hill to facilitate the decelerating to enter the rest areas. The rest areas are designed to accommodate both trucks (up to B-double) and cars and would provide:

- An area about 500-1000 metres long and 150 metres wide to accommodate drivers taking a break from their journey
- Merge and diverge lanes into the rest area
- Suitable parking and movement for B-double trucks
- Separation between heavy and light vehicles
- Toilet and water facilities to Roads and Maritime Pacific Highway standard design
- An area for maps and information signs.

The rest areas will be framed by the overbridge at Bostock Road and the earthworks required to create the level platforms for the facilities. These will form integral parts of the driver experience for these facilities. Taken together, both rest areas, the overbridge and earthworks of this assembly will create a singular opportunity for placemaking. The overall facilities grouping will present a more open experience than the surrounding forest and be within sight of the overbridge.

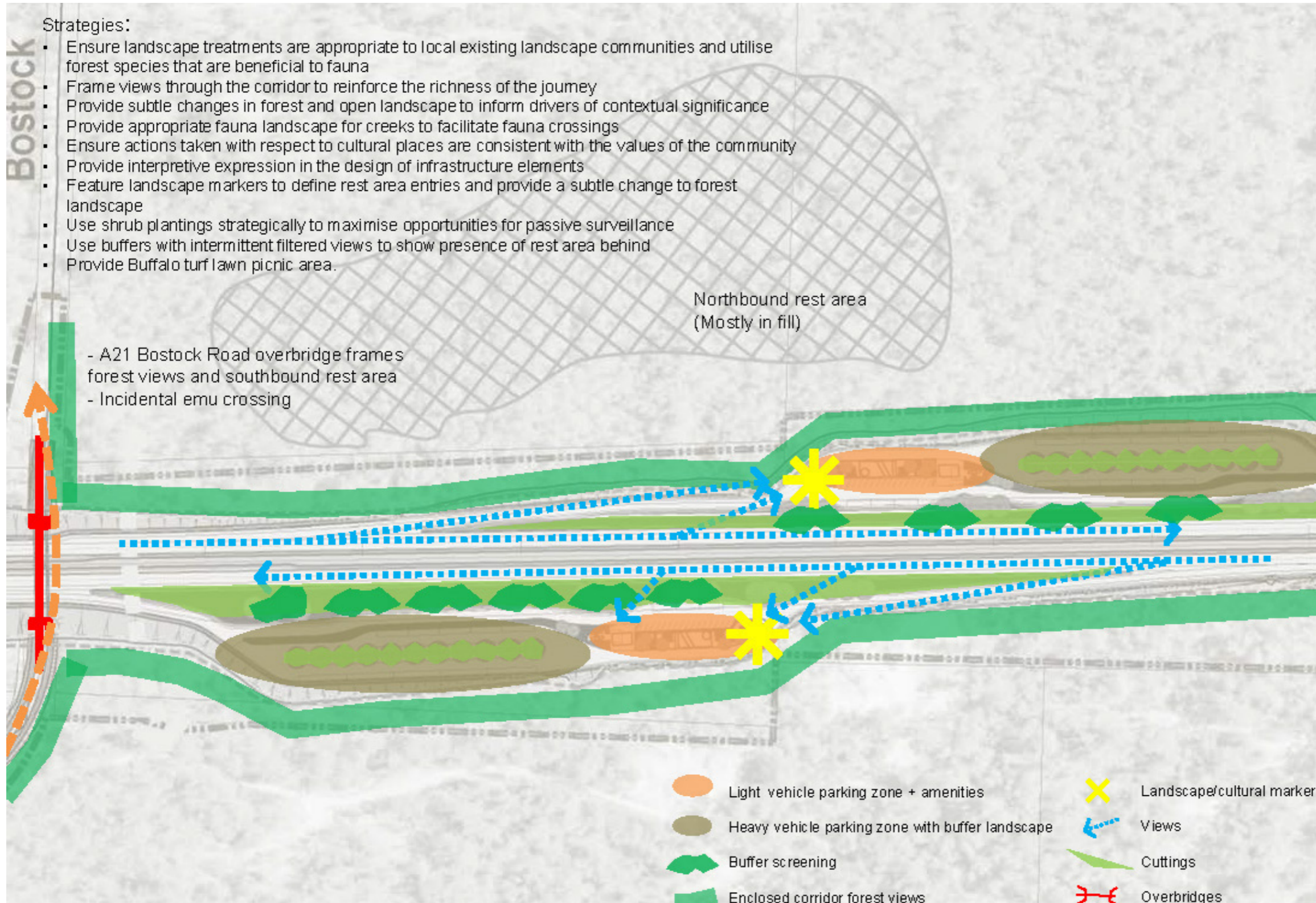
Standard Pacific Highway furnishings will be used to provide linear continuity with the rest of the Pacific Highway, while the landscape treatments will provide lateral integration with the surroundings.

The rest areas will transform the forest setting of this location and mitigation measures as identified in Chapter 1.5 of this report are considered to manage this impact.

Space for landscape treatments between roadways are assessed to maximise the replacement of forest canopy cleared as part of the earthworks required for the building of the rest area.

Key features include:

- Reinforcement of the area's landscape setting to ensure that the rest areas are fully integrated with the local area and are not overly intrusive
- Provision of a distinct forest experience with subtle changes to the forest landscape to mark entries etc.
- Integration of the bridge into the overall driver experience
- Reduction of visual impacts from the Bostock Road overbridge as the highway and rest areas will be highly visible to local road users, by providing a clean and elegant design
- Location of all furnishings are carefully considered to encompass Crime Prevention Through Environmental Design (CPTED) issues, accessibility and to capture views and vistas to distant mountains where visible
- Potential use of solar panels on shelters as a source of power for lighting
- Provision of other amenities such as bins etc.



NOTE: Alignment shown is indicative only. NTS.

Figure 90: Rest area principles diagram.



Drawing and design subject to further development, number of trees/elements shown is indicative only. Landscape shown at full maturity.

Figure 91: Rest area northbound looking north.



Drawing and design subject to further development, number of trees/elements shown is indicative only. Landscape shown at full maturity.

Figure 92: Rest area northbound looking north along main alignment.





Drawing and design subject to further development, number of trees/elements shown is indicative only. Landscape shown at full maturity. Any plantings will be subject to road safety considerations.

Figure 93: Rest area southbound looking south along main alignment.

### 8.2.3 Pedestrian and cyclist network

Pedestrian and cyclist facilities (shared path) are provided at the following locations:

- Maclean interchange
  - A shared path is provided near to the northbound on ramp at the Maclean interchange between Cameron Street and Jubilee Street, to ease connectivity and access to Maclean and Townsend.

Key design outcomes include:

- Aligning new structural elements where possible, with existing elements to reduce potential for hidden pockets of space to be created
- Providing sufficient visual distance at changes in directions of shared paths to avoid accidental contact with other users
- Maintaining lighting levels below structures
- Maintaining clear sight lines when vegetation is planted along pedestrian and shared paths
- Maintaining, where possible, sightlines that connect streets across the corridor.

Shared path locations are subject to further design development and consultation with communities and agencies.

### 8.2.4 Bus stops

Some regional services operate between Grafton, Maclean and Yamba and they can be accessed via the on and off ramps provided at the interchanges at these towns.

### 8.2.5 Heavy vehicle stopping bays

Heavy vehicle stopping bays are sealed areas and provide opportunities for heavy vehicles to stop near to the main carriageways in both directions of travel with safe entrances and exits while maintain the flow of through traffic. They are provided about every 2.5 kilometres along the entire upgrade in sections 3 and 4 with a total number of about 20 stops along both carriageways and some in the two rest areas.

Key design outcomes include:

- Provision of adequate site intersection site distances at the start of the approach taper of the stops
- Provision of landscape zones near to the stopping bays.

## 8.3 Furniture

### 8.3.1 Fences

Fences are an integral part of the road safety design and are provided to define boundaries for various users of the corridor and prevent access to dangerous areas.

Fencing types are proposed based on their location and relevance to the surrounding environment, based on Roads and Maritime standard drawings are used for the specific type proposed.

Key design outcomes include:

- Recessive in the environment to reduce their visual impact
- Do not obstruct major views
- Fence types are combined, where possible to use the predominant type that suits and is relevant to its immediate surrounding
- Fencing alignment design is based off the road alignment design
- A three metre clearance is provided at a minimum from drainage water quality control ponds batter toes to provide maintenance vehicle access
- Fauna fences are not to form an angle sharper than 135° on the property side of fencing
- Where possible existing fencing is utilised to minimise building requirements
- Fences are located appropriately to avoid the potential conflicts between motorists and fauna
- Planting provided to screen the elements where possible.

### Boundary fencing

Boundary fencing is provided along the edge of the corridors, mostly the stock proof types with concrete posts or chain wires. Boundary fences where utilised, will follow the project boundary unless otherwise specified by property owners. In forested areas they are replaced with fauna fencing. No boundary fencing is provided in canefield areas.

### Fauna fencing

Fauna fencing is provided to facilitate fauna crossings and minimise the risk of fauna becoming trapped on the highway side of the fauna fence. Various types of fauna fencing are provided, based on their requirements to cater for mammal, frog exclusion, phascogale, and emu exclusion.

### Other fencing

Fencing is provided to enclose water quality control ponds to restrict unauthorised public access and are based on certain spatial criteria. This fencing is provided as either an annexure to nearby fences or as a self-contained exclusion zone.

### 8.3.2 Headlight screening

No physical hard headlight screen is required for sections 3 and 4. One area in Glenugie to Tyndale – Section 3 is assessed to cause potential glare between the upgraded highway southbound carriageway and local road at Old Six Mile Lane, but will be treated through vegetated screening in the verge. Landscape treatments are provided in this area through planted trees shrubs and groundcover complimentary to the existing vegetation communities in the immediate environment.

### 8.3.3 Noise walls

There are no noise walls on the project. Noise mitigation issues are dealt by providing additional treatments to houses if required. However, investigations are currently being undertaken by engineers based on new noise modelling information to determine requirements for noise walls and check feasibility of possible mitigation.

Noise modelling studies are subject to detailed design development and consultation with communities.

### 8.3.4 Lighting

Lighting is provided at the interchanges, shared paths and rest areas by Roads and Maritime and Clarence Valley Council to approved standards. The light poles, about 12-15 metres high have a tapered profile and are made in galvanised steel with single goose neck outreach arms, and Roads and Maritime standard luminaire with aeroscreen shield to reduce light spill to nearby residents.

Key design outcomes include:

- Use of energy efficient systems and low maintenance lighting furniture
- Avoid conflict of vegetation under overhead lines with utilities
- Illumination of shared paths so they are directed towards the approaching persons face, about four lux or higher, to reduce CPTED issues
- Potential use of solar power systems and fittings, especially on top of the shelters to generate electricity for the project
- Placement of lighting elements so they do not obstruct major views.

### 8.3.5 Safety barriers

Safety barriers are provided to protect elements such as embankments, bridges and abutments, non-frangible lighting/signage posts and include the following types:

- G4 – W Beam – Used where there are tight radii in the alignment
- Type F – Used at approaches to bridges along the main alignment and at bridge transitions at the edges
- Wire rope safety barrier – at overbridge piers to reduce impact of vehicle hitting into the pier
- Medium performance barrier – used on bridge parapets on overbridges
- Regular performance barrier – used on bridge parapets on underbridges.

### 8.3.6 Signage

Signage is an important design component as it provides legibility and wayfinding to drivers and helps to reduce driver fatigue. The following types of signage and related furniture are proposed for the project:

- Roads and Maritime standard signage (directional, speed and warning signs)
- Variable message signs (VMS)
- Variable speed limit signs (VSLS)
- Changeable message signs (CMS) for moveable median
- Active traffic control system/dynamic signs
- Fixed digital speed cameras (FDSC) by Roads and Maritime
- High visual impact warning signs (HVIWS)
- Closed circuit television (CCTV)
- Overhead Overheight Laser Detectors
- Traffic control signals/red aspect traffic signals
- Emergency telephones
- Utility and service boxes or pillars.

Key design initiatives include:

- Sightlines to major signs are set back further from the edge of travel lanes
- Low planting and threshold areas around signs to allow ease of access for maintenance and maintain visibility
- Consideration of opportunities to provide tourist signage at town entries providing information about local communities, tourism information, history of the towns and scenic drives
- Signage located appropriately to avoid clutter and increase legibility, without obstructing major views
- Signage structures combined into single structure where possible to reduce the requirement for extra foundations, whilst ensuring they do not cause clutter.



Figure 94: View of Coldstream River from Wants Lane.

## 9.0 Planting

Key requirements of the landscape design are to:

- Respond to the context and character of the nearby landscape through which it passes and consider the driver's experience of the landscape along the whole of the road
- Maintain, enhance and/or ameliorate views including those available to motorists on the new alignment and for those who may be visually impacted by the highway
- Maintain vegetation safety clearances and other performance and safety requirements
- Provide a methodology for the successful establishment of vegetation.

The design adopts a holistic approach that encompasses the initial topsoil stripping, in order to achieve the best biodiversity and protection outcomes for the project.

The landscape design is focused upon matching the context and character of the landscape through which it passes, at the same time as being cognisant of the necessity to provide a cost effective method of establishing such a large tract of vegetation along Sections 3 and 4. A key element of the strategy is the management of topsoil and providing the right circumstances for natural regeneration. This is particularly important in forested areas where stored soil seed banks will be present within the existing topsoil, and can be preserved in the stripped topsoil to be returned, and where fringing trees and shrubs will disperse seed into the disturbed areas of the alignment.

In key locations tree species will be introduced by planting. Where such locations are next to the alignment, distance from the roadside will be maintained to ensure tall Eucalypts will not be located in positions where they will overhang the corridor. In areas where there are not safety clearances and on rehabilitated construction and ancillary sites, tree seed will be used in the seeding mixes. Plant species are specified in Planting and Seeding Schedules located in Appendix B.

The planting schedules include only indigenous species found in the extant vegetation communities. Vegetation community boundaries are indicated on the landscape plans. All proposed planting matches these communities. A palette of shrubs, groundcovers, tussocks, grasses and sedges from each community is also included for specific purposes such as visual screening at fauna crossings, for bank stabilisation, water quality basins and as ornamental feature planting at intersections and rest areas.

### Planting at interchanges

Planting at the interchanges, intersections and underpasses utilises a range of container sizes including super-advanced and semi-mature trees. Where appropriate, planting will be chosen and arranged to highlight the interchange and provide an appropriate landscape response that gives the interchanges a character which is different from the rest of the alignment, thereby creating a marker in the motorist's journey. These key locations are:

- Grafton intersection at Glenugie interchange
- Tyndale interchange
- Maclean interchange.

Glenugie interchange is located in an area of dense forest where formal arrangements of planting would be incongruous. So the design intent is to retain the dense forest character with informal plantings of Spotted Gum, Grey Ironbark and Pink Bloodwood set within a grassy understorey.

Tyndale interchange has large cuttings which will be revegetated with native species. Soon after passing through the cuttings, the motorist (heading north) will pass under an overbridge which will frame and then reveal a vista of the Clarence River and floodplain to the north. Planting to the northeast would screen this view and is therefore not recommended, however, advanced tree planting to the northeast of the highway will frame the view and also provide screening for nearby houses.



Figure 95: Native shrub seeded embankment with fringing Eucalypt trees. The seed from fringing trees will be released and germinate on the batter slopes as seen here on the Hunter Expressway.

### Planting at rest areas

The northbound and southbound rest areas, virtually identical in terms of their layout, occur within the Pine Brush State Forest characterised by an enclosed forest setting. The northbound rest area is situated wholly within a Swamp Mahogany swamp forest setting.

The southbound rest area is mostly within Turpentine moist forest with elements of Scribbly Gum – Needlebark Stringybark heathy, open forest to the south. The surrounding habitat for fauna at both locations is identified as high to very high value and suited to a range of threatened species, including forest dwelling species such as Rufous Bettong and hollow-dependent birds and mammals including Brush-tailed Phascogale, Squirrel Glider and threatened microbats. Species used for revegetating the rest area outside of the fauna fence will utilise species from these habitats.

Bostock Road overbridge immediately to the south of the southbound rest area will be designed to accommodate incidental emu crossing connecting habitat of the Clarence floodplain to the west with Yuragir National Park in the east.



Figure 96: Scribbly Gum.

Somervale Road to the north of the northbound rest area passes under the highway and will be designed as an incidental underpass crossing for emus and medium to large mammals including the Rufous Bettong.

Views beyond the rest area are restricted by the forest setting. So planting selected from nearby communities will be used to give the rest areas an attractive planting layout internally and a different character to the largely informal character of the rest of the alignment.

Several of these species are to be planted at advanced size for early visual effect and to provide shade from an early stage. The landscaped zone separating each main carriageway from its adjoining rest area is to be planted with native grasses and frangible mixed shrubs, planted in groups that will allow some measure of visual surveillance of the rest areas from the carriageways.

Between the shrub groupings are planted swathes of Swamp Lily, Mat Rush and Tall Sedge. Where space allows, super-advanced Cabbage Tree Palms will be planted in swales and will provide significant landscape markers that will identify the rest areas for motorists. The facilities areas are turfed with a Buffalo lawn and planted with local shade trees. Perimeter embankments are to be planted with Eucalypts in an informal pattern over native grasses. Within the rest areas, shrub planting will be strategically located in order to maximise opportunities for passive surveillance.

### 9.1 Existing vegetation and proposed landscaping

Due to the presence of EECs and other intact vegetation communities of good quality, it is imperative to minimise the construction footprint in order to maximise the retention of existing vegetation.

Retention of existing vegetation as close as possible to the carriageways will provide better biodiversity, visual and economic outcomes and will also help in the re-establishment of indigenous vegetation from the seed of fringing trees and shrubs.

The Construction Environment Management Plan (CEMP) prescribes the procedures to protect and maximise retention of existing vegetation requirements for the project.

The vegetation clearance distances used for the proposed landscaping are as follows:

- Fauna fencing – Where fauna fencing alone occurs, the construction footprint beyond the top of cuts will be restricted to 3.5 metres and beyond the toe of fills 3.5 metres
- Native tree and shrub seeding and planting stock is not used within three metres of fauna fences on the away from highway side and one metre on the highway side during the re-vegetation process. Native grasses or pasture grasses only are used in the vicinity of fauna fences for access and maintenance purposes.

The vegetation safety clearance distances used for the proposed landscaping are as follows:

- Where design speed of road is 60km/h or less – frangible vegetation only is used within three metres from the edge of the travel lane
- Where design speed of road is 80km/h – frangible vegetation only is used within five metres from the edge of the travel lane
- Where design speed of road is 100km/h – frangible vegetation only is used within nine metres from the edge of the travel lane
- Where design speed of road is 110km/h – frangible vegetation only is used within 11 metres from the edge of the travel lane
- Grasses only behind wire rope safety barrier within 1.7 metres from the face of the barrier (dynamic deflection zone)
- Two metres wide native or pasture grass strip at the carriageway edge of medians and verges
- Minimum four metres wide frangible shrubs in median when in forested areas (and where no views are available) or to mitigate headlight glare.

All other vegetation clearances will be compatible with the design criteria and requirements provided by the Roads and Maritime Landscape Guidelines. Note that where vegetation develops from soil-borne seed, non-frangible vegetation which germinates and establishes will need to be controlled by physical removal or mowing/slashing.

## 9.2 Vegetation communities

The majority of the vegetation communities represented within the project area present as relatively undisturbed forested areas. Planting and seeding schedules are devised based upon these vegetation communities and also through ground-truthing investigation by the design team. 17 vegetation communities are identified as occurring within Section 3 and 4 of the project alignment. Seven of these communities are listed as EEC's. Refer to Table 9.



Figure 97: Forest Red Gum Swamp Box Forest where the alignment crosses Wants Lane; an endangered ecological community.

Table 9: Endangered Ecological Communities (EEC's)

Vegetation Community	Threatened Ecological Community Type	Dominant Species	Landscape Features
<i>Angophora robur</i> shrubby forest and woodland on sandstones of the North Coast.	<i>Angophora robur</i> is listed as vulnerable. But the vegetation community is Non-EEC.	<ul style="list-style-type: none"> <li>• <i>Angophora robur</i></li> <li>• <i>A. woodsiana</i></li> <li>• <i>Corymbiagummifera</i></li> <li>• <i>C. intermedia</i>,</li> <li>• <i>Eucalyptus baileyi</i></li> <li>• <i>Banksia oblongifolia</i></li> <li>• <i>B. spinulosa</i> var. <i>collina</i></li> <li>• <i>Gompholobium pinnatum</i></li> <li>• <i>Lambertia formosa</i></li> <li>• <i>Leptospermum polygalifolium</i></li> <li>• <i>L. trinervium</i>.</li> </ul>	Open eucalypt forests to 25 metres with prominent sclerophyll shrub stratum and open groundcover of grasses and sedges. Coastal plains, hills and plateau with sandy loams derived from high-quartz sandstones of the Moreton geological basin.  In moderately high rainfall areas where they may occur at altitudes up to 400 metres.
Black Bean – Weeping Lilly Pilly riparian rainforest of the North Coast.	Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion (EEC).	<ul style="list-style-type: none"> <li>• <i>Castanospermum australe</i></li> <li>• <i>Waterhousia floribunda</i></li> <li>• <i>Glochidion ferdinandi</i></li> <li>• <i>Elaeocarpus obovatus</i></li> <li>• <i>Dysoxylum mollissimum</i></li> <li>• <i>Acmena smithii</i> minor</li> <li>• <i>Melaleuca linariifolia</i></li> <li>• <i>Crinum pedunculatum</i></li> <li>• <i>Phylidrum lanuginosum</i></li> <li>• <i>Schoenoplectus mucronatus</i></li> <li>• <i>Lomandra hystrix</i></li> <li>• <i>Oplismenus aemulus</i></li> <li>• <i>O. imbecillis</i>.</li> </ul>	Margin zones of the Clarence Watercourse north of Champions Creek.
Blackbutt – bloodwood dry heathy open forest on sandstones of the northern North Coast.	Non-EEC.	<ul style="list-style-type: none"> <li>• <i>Eucalyptus pilularis</i></li> <li>• <i>Corymbia gummifera</i></li> <li>• <i>Eucalyptus resinifera</i> ssp <i>hemilampra</i></li> <li>• <i>Banksia integrifolia</i> <i>Banksia spinulosa</i> <i>Pultenaea</i> spp</li> <li>• <i>Persoonia stradbokensis</i>.</li> </ul>	Open forest or woodland. On deep sands of old dune systems along the coast. This ecosystem is concentrated on the Clarence-Glenreagh sandstones from Mt Belmore east to the ocean. It is protected in Yuraygir National Park and Mount Neville Nature Reserve.
Narrow-leaved Ironbark dry open forest of the North Coast.	Non-EEC.	<ul style="list-style-type: none"> <li>• <i>Eucalyptus crebra</i></li> </ul>	North of Tyndale.

Vegetation Community	Threatened Ecological Community Type	Dominant Species	Landscape Features
Pink Bloodwood – Tallowwood dry moist open forest of the far northern ranges of the North Coast.	Non-EEC.	<ul style="list-style-type: none"> <li>• <i>Eucalyptus microcorys</i></li> <li>• <i>Corymbia intermedia</i>.</li> </ul>	Tall to very tall forest with a very mixed canopy which usually contains Tallowwood ( <i>Eucalyptus microcorys</i> ). On the exposed slopes of the Koreelah, McPherson and Main Camp ranges with extensions east to the Border and Tweed ranges.
Forest Red Gum – Swamp Box of the coastal lowlands of the North Coast.	Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion (EEC).	<ul style="list-style-type: none"> <li>• <i>Eucalyptus tereticornis</i></li> <li>• <i>Lophostemon suaveolens</i></li> <li>• <i>Imperata cylindrical</i></li> <li>• <i>Themeda triandra</i>.</li> </ul>	
Turpentine moist open forest of the coastal hills and ranges of the North Coast.	Non-EEC.	<ul style="list-style-type: none"> <li>• <i>Syncarpia glomulifera</i></li> <li>• <i>Elaeocarpus reticulatus</i></li> <li>• <i>Archirhodomyrtus beckleri</i></li> <li>• <i>Synoum glandulosum</i></li> <li>• <i>Blechnum cartilagineum</i></li> <li>• <i>Lomandra longifolia</i></li> <li>• <i>Dianella caerulea</i>.</li> </ul>	Mid-high to very tall open forest. Widespread on sheltered slopes and in gullies of the coastal hills and escarpment ranges.
Paperbark swamp forest of the coastal lowlands of the North Coast.	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (EEC).	<ul style="list-style-type: none"> <li>• <i>Melaleuca quinquinervia</i></li> <li>• <i>Livistona australis</i></li> <li>• <i>Melaleuca linariifolia</i></li> <li>• <i>Acacia longifolia</i></li> <li>• <i>Glochidion ferdinandi</i></li> <li>• <i>Leptospermum polygalifolium</i></li> <li>• <i>subsp. Polygalifolium</i></li> <li>• <i>Dianella caerulea</i></li> <li>• <i>Gahnia clarkei</i></li> <li>• <i>Gahnia sieberiana</i></li> <li>• <i>Imperata cylindrical var. major</i>.</li> </ul>	Swamp sclerophyll shrubland, woodland and forest dominated by paperbarks. On poorly drained sites that may remain waterlogged for considerable periods, and along creek banks.



Vegetation Community	Threatened Ecological Community Type	Dominant Species	Landscape Features
Swamp Mahogany swamp forest of the coastal lowlands of the North Coast.	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (EEC).	<ul style="list-style-type: none"> <li>• <i>Casuarina glauca</i></li> <li>• <i>Acmena Smithii</i></li> <li>• <i>Juncus usitatus</i></li> <li>• <i>Lomandra longifolia</i></li> <li>• <i>Melaleuca alternifolia</i></li> <li>• <i>Carex appressa</i>.</li> </ul>	Low to very tall woodland and forest. Widespread on poorly drained sites in coastal areas.
Coastal floodplains sedgeland, rushlands and forblands.	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East bioregions (EEC).	<ul style="list-style-type: none"> <li>• <i>Juncus usitatus</i></li> <li>• <i>Carex appressa</i></li> <li>• <i>Philydrum lanuginosum</i></li> <li>• <i>Lepironia articulata</i>.</li> </ul>	Swamps and lakes on the floodplain.
Grey Gum – Grey Ironbark open forest of the Clarence lowlands of the North Coast.	Non-EEC.	<ul style="list-style-type: none"> <li>• <i>Eucalyptus propinqua</i></li> <li>• <i>Eucalyptus siderophloia</i>.</li> </ul>	Tall to very tall dry forest with a mixed canopy. On sandstone and siliceous soils in the Clarence lowlands with a western extension through the southern Richmond Range inland to Ewingar State Forest and the Mann River.
Spotted Gum – Grey Ironbark – Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast.	Non-EEC.	<ul style="list-style-type: none"> <li>• <i>Corymbia maculata</i></li> <li>• <i>Eucalyptus paniculata</i></li> <li>• <i>Corymbia intermedia</i>.</li> </ul>	Tall to very tall grassy woodland and open forest. Occurs on lower slopes of the foothills and lowlands of the Clarence-Moreton Basin.
Scribbly Gum – Red Bloodwood heathy open forest of the coastal lowlands of the North Coast.	Non-EEC.	<ul style="list-style-type: none"> <li>• <i>Eucalyptus signata</i></li> <li>• <i>Corymbia gummifera</i></li> <li>• <i>Allocasuarina littoralis</i></li> <li>• <i>Banksia oblongifolia</i></li> <li>• <i>B.spinulosa</i></li> <li>• <i>Pultenaea myrtoides</i></li> <li>• <i>P.retusa</i></li> <li>• <i>Pimelea linifolia</i>.</li> </ul>	Medium forest dominated by Scribbly Gum with Red present as subdominants. There is a relatively dense heath understorey.
Scribbly Gum – Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast.	Non-EEC.	<ul style="list-style-type: none"> <li>• <i>Eucalyptus signata</i></li> <li>• <i>Eucalyptus planchoniana</i>.</li> </ul>	Open forest or woodland with a dense understorey of heath shrubs. Predominantly on coastal sands and sandstone from Kempsey to the Tweed River.

Vegetation Community	Threatened Ecological Community Type	Dominant Species	Landscape Features
Spotted Gum – Grey Box – Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast.	Non-EEC.	<ul style="list-style-type: none"> <li><i>Corymbia maculata</i></li> <li><i>Eucalyptus microcarpa</i></li> <li><i>Eucalyptus paniculata</i>.</li> </ul>	Open forest and woodland 25-35 metres tall with scattered shrubs and diverse continuous ground cover. Mainly confined to slopes and hills on low quartz sediments in the Clarence lowlands.
Swamp Box swamp forest of the coastal lowlands of the North Coast.	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (EEC).	<ul style="list-style-type: none"> <li><i>Lophostemon suaveolens</i></li> <li><i>Imperata cylindrical</i></li> <li><i>Themeda triandra</i>.</li> </ul>	Is distributed on high and low quartz sediments in the Clarence lowlands.
Swamp Oak swamp forest of the coastal lowlands of the North Coast.	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (EEC).	<ul style="list-style-type: none"> <li><i>Casuarina glauca</i></li> <li><i>Acmena smithii</i></li> <li><i>Cupaniopsis anacardioides</i></li> <li><i>Glochidion sumatranum</i></li> <li><i>Lophostemon suaveolens</i></li> <li><i>Callistemon salignus</i>.</li> </ul>	
Clearings.	The extent of topsoil in clearings necessitates an additional test location.		Generally pasture or cane fields on floodplains.

#### Cleared lands

Cleared lands also occur within the project area. To the south of sections 3 and 4 cleared lands are used for grazing, with occasional remnants of regenerating vegetation. To the north of sections 3 and 4 in the Clarence River floodplain, the most southerly occurrence of sugar cane growing is encountered with occasional regenerating pockets of wetland vegetation. The landscape treatment for cleared areas is typically to re-vegetate with pasture grasses or native grasses depending on the context, or to reinstate the agricultural land use such as sugar cane, with scattered tree planting where required to retain/ frame views to floodplains.

Tree planting proposed in pasture areas will match the former vegetation community type that would have occurred before clearing as evidenced from vegetation remnants.

Sedge planting for basins and channels will use species from the Coastal floodplains sedgelands, rushlands and forblands vegetation community.

Stripped topsoil from pasture areas must be quarantined from natural forest soils so that the weed seed contained in these soils is not returned to forest areas.

### 9.3 Impacted landscape

In addition to the roadside landscape there are other locations along the corridor directly or indirectly impacted by the construction of the project. These include temporary ancillary facilities, access tracks, watercourse crossings and other temporary work. The following details the strategies to progressively rehabilitate regenerate and/or revegetate these locations with the objective of promoting biodiversity outcomes and visual integration.

#### Landscape Mounds

Surplus spoil may be required to be incorporated along the alignment to prevent the need to cart material long distances from the site. The most likely use for excess spoil is in the form of landscaped mounds.

The landscape plans indicate possible sites for landscaped mounds. Areas identified on the plans which are earmarked for 'visual screening' will be investigated for mounding and additional soil depth during the detail design phase. The increased soil depths will improve growth and the earlier screening potential of plantings.

Surplus site topsoil won from stripping operations that is in excess of the requirements for revegetation work on the project will be used to topsoil landscape mounds. Where excess topsoil remains, it will be used to increase topsoil depths generally where there is no risk from erosion.

Under most circumstances the slope of stand-alone mounds will be a maximum 3H:1V for improved planting and seeding establishment and natural appearance. Where the mound is designed as a false-cut the slope can be consistent with the slope from which it extends. The radius at the top of the mound and transitions will be rounded to 10 metres minimum and up to 100 metres for the large mounds, where possible.

The shape of landscape mounds will be informal and respond to local conditions. Where possible, margins of mounds will be graded to blend with existing adjoining landform. Landscape mounds will be revegetated by seeding with selected native trees, shrubs and grasses supplemented at selected locations (and generally where in view from nearby properties) with direct planting of containerised trees.

Excess mulch will be used to mulch landscape mounds. Where excess remains, the general mulch depth will be increased to range from 75-100 millimetres. A small quantity of mulch will be stockpiled in discrete locations for use by the landscape maintenance crew in topping-up plantings with mulch to the specified depths.

#### Stockpile Sites

Stockpile sites may typically be required to store material including, but not limited to:

- Excavated material to be used in fill embankments and other design features
- Acid Sulphate Soils subject to treatment prior to reuse or disposal
- Excavated material unsuitable for reuse in the formation
- Excess concrete, pavement, rock, steel and other material stored for either future use in the project or prior to removal from site
- Topsoil, mulch, excess timber for landscaping and revegetation work.

The criteria used to determine the location of stockpiles and minimum mitigation measures are included in the project CEMP.

#### Progressive rehabilitation

Several elements go together to make up the progressive establishment of re-vegetation across the project. These are:

- Staged implementation of the landscape installation. As sections of the earthworks are prepared, the section is prepared as soon as practical for topsoiling with topsoil containing a soil seedbank
- Where deemed necessary (where a soil seedbank is not present in the soil), native seeding will follow topsoiling in accordance with Roads and Maritime specifications
- All topsoiled areas are to be seeded after completion of soil preparation or, if delayed by the weather conditions, as soon as weather conditions permit
- Open drains are to be vegetated within seven days of excavation
- Use of cover crops for rapid stabilisation of bare soils. Cover crop may be applied separately or in conjunction with all other seeding mixes
- Planting is used where trees, shrubs and groundcovers are required for early landscape and visual effect and for early landscape establishment in fauna movement corridors and next to underpasses and below bridge structures and at creek-sides
- Maintenance inspection of plantings must be carried out and missing or dead plants must be replaced.

In addition to the above, the topsoil management procedures which are devised to maximise the retention and germination from the soil seedbank, will ensure that native seed is already contained in any topsoiled areas. Since disturbance favours germination of colonising plants we can expect that fast growing pioneer species will germinate rapidly from topsoiled areas.

Areas which receive erosive pressures such as vegetated channels, water quality basins and slopes steeper than 2H:1V, will have appropriate treatments installed in order to improve the establishment of the revegetation.

### 9.4 Landscape visual screening

Much of the southern part of Sections 3 and 4 have a low to moderate visual impact generally as a result of relatively few viewers being located in proximity to the proposed alignment. However the Visual Impact Study of the EIS identifies several areas along Glenugie to Tyndale – Section 3 and Tyndale to Maclean – Section 4 that have moderate to high impacts. Where existing retained vegetation does not provide sufficient screening, tree planting may be utilised to minimise the visual impact of the highway for nearby affected houses. Landscape mounding and additional soil depth will also be considered in these locations. The increased soil depths will improve growth and the earlier screening potential of plantings. Locations along the corridor at which screen planting will be provided include:

- Old Six Mile Road, near Wants Lane
- Avenue Road – crossing at Wants Lane
- Pine Brush Forest
- Pacific Highway, Tyndale
- Cane fields north of Tyndale (near houses)
- Byron Lane north of Tyndale
- Shark Creek Flood Plain
- Ferry Park Maclean.

Where it is identified that the proposed landscaping does not satisfy the visual screening requirements of nearby houses and businesses, at-receptor landscaping will be considered in consultation with the relevant landowner and if appropriate be implemented during the construction of the project.

### 9.5 Heritage zones

As identified in section 4.4.2, there are no direct impacts caused by the project upon non-Aboriginal heritage items. However several undisturbed Aboriginal sites are identified. At present, roadside plantings do not specifically address these sites, nor has the landscape design been assessed for their impact upon the sites. Consultation with the aboriginal representatives in the detail design stages of the project will be required to ensure that there are no additional heritage impacts caused by the landscape design.

### 9.6 Disturbed landscape

A description of disturbed areas is provided in section 9.3 for a description of the procedures for monitoring success of the regeneration and revegetation work of disturbed areas of the project, and any corrective actions, refer to section 9.10.

### 9.7 Batter stabilisation planting

Earthworks are a major determinant of the aesthetic quality of a rural highway. As noted in contextual analysis, this project is characterised by generally two types of landform; undulating terrain with forested rounded hills and ridges from Glenugie to Tyndale. The second landform type comprises the flat Clarence floodplain from Tyndale to Maclean.

In general, the earthworks are designed to integrate with the adjoining existing landforms, taking into account a range of factors including topography, corridor width, clearing limits and engineering requirements. However, in order to achieve safe grades, fill embankments and/or bridge structures are required over gullies and cut excavations through ridges. Significant benched cuts and high fills occur throughout Glenugie to Tyndale – Section 3 and Tyndale to Maclean – Section 4.

Particular attention is and will continue to be made to ensure that as far as possible the vertical and horizontal alignment of the new highway will be flowing and responsive to the landform along the route, to ensure a positive experience for drivers and viewers.

Details of the design and treatment of embankments and cuttings include:

- All vegetated fill batters are at a maximum slope of 2H:1V and 4H:1V where there is sufficient width within the corridor. At bridge abutments slopes are 1.5H:1V and these are finished in stone pitching or rock facing stabilising the slope. Where the edge of stone pitching transitions to planting, organic fibre mesh is used until the slope returns to 2H:1V
- Tops and bottoms of batters will be rounded and feathered into the nearby landform
- Cuttings are more visible than embankments to highway users and so require careful design
- Ends of larger cuttings will be rounded off and feathered into the nearby landform.

The top and bottom of batters will be rounded to blend the batters into the surrounding landform. Generally the rounding is a two metre radius but is increased to three metre radius at the top of low shallow fills and decreased to one metre at the top of high fills at the edge of the carriageway and high side of interchange entry/exit ramps.

The ends of batters in cuttings will be rounded and the batter progressively flattened for an approximate distance of 50 metres to blend the batters into the surrounding landform. The extent of roundings and transitions will be reduced or avoided as necessary where constraints such as the project boundary, clearing boundaries, all EEC's, existing forests, temporary basins, drainage channels and existing creeks are located in close proximity to cut batters.

Batter slopes will be stabilised with vegetation that has germinated from the topsoil soil seedbank or by seeding applied by hydromulching.

Where slopes transition up to 1.5H:1V organic fibre mesh is used in conjunction with seeding.

Where steeper cuts are required, exposed rock is the preferred finish where possible. Should stabilisation be required using shotcrete, this will be minimised as described in Roads & Maritime Services *Shotcrete Design Guideline*, March 2016.

The establishment of vegetation will refer to the Roads and Maritime Services *Guideline for Embankment Stabilisation with Vegetation*, 2015.

### 9.8 Seed application and establishment

Each of the vegetation communities has grass, groundcover and shrub species, which are common to most of the vegetation communities across Sections 3 and 4. Where these species can be germinated easily and are known to establish well from seed, they are used in seed mixes. Seed for embankment vegetation is usually selected from those vegetation communities where the influence of groundwater is low.

Tree seed of diagnostic tree species matched to the nearby vegetation community will be used in seed mixes beyond the safety clearance zones. Trees are also introduced through the opportunistic seeding from trees in the fringing forest vegetation of the alignment. Such seeding can be anticipated to occur at the top and bottom of embankments away from the road edge within the first two years following preparation of embankments.

The seed mixes are developed taking the following factors into consideration:

- Embankments (where the bulk of seeding is used) provide a different and more generic set of microclimatic factors than the surroundings and areas where planting is proposed
- The seed mixes must be calibrated to satisfy clearance requirements for safety (eg frangible and non-frangible), maintenance requirements (eg for mowing) and height requirements for safe sight clearance distances
- Many of the species from minority communities recorded along the alignment (eg Coastal floodplains sedgeland, rushlands and forblands) will not be suited for re-vegetation purposes on embankments where the microclimate for establishment is difficult.

Only seeds and plants known to be useful to the regeneration of disturbed ground are included in the seeding and planting mixes and are those known to be hardy, drought tolerant and to establish quickly from seed. For example, Acacia species are represented in the seed mix but are not included in planting mixes. Species that are more difficult to establish from seed and all tree species are included in planting only.

Other species that are not included in the seed mixes can be expected to recolonise disturbed areas with the application of correct topsoil management procedures. Such species include terrestrial orchids, ferns and native lilies, which can all regrow from vegetative parts, soil-borne seed and spore.

Seed mixes are developed for various purposes as summarised in Table 10.

Table 10: Seeding mixes.

Seed Mix	Description	Where Used
Native grass seed mix.	Contains indigenous native grass species where mowing/maintenance may be required. The mix contains species that are able to withstand infrequent mowing.	For medians, verges, fauna fence access and where sightlines must be maintained and to allow views within forested areas.
Native grasses, tussocks and sedges seed mix.	Contains indigenous native grass, tussocks and sedge species where mowing is not required. The mix contains sedges that will persist where moist patches or standing water occur.	For batters where views are to be maintained and in forested areas where groundcover is required.
Drainage channels seed mix.	Contains indigenous native grass, tussocks and sedge species. The mix contains sedges that will persist where moist patches or standing water occur and tussocks and grasses for the embankments of channels where conditions are drier.	Jute-mesh lined vegetated drainage channels.
Pasture grass seed mix.	The mix includes both Couch Grass and Carpet Grass with cover crop. Couch establishes rapidly and forms a thick sward of rhizomes, which will effectively resist erosion and is tolerant of saline and acidic soils and aluminium toxicity. Couch is regarded as a native and is prevalent in the adjoining paddocks, although it also occurs outside Australia. Carpet Grass is a naturalised species in the region and found in the nearby pasture, which establishes easily but is not aggressive.	For areas where grass cover is required in the north of Glenugie to Tyndale – Section 3 and Tyndale to Maclean – Section 4 where the alignment is next to pasture or sugar cane.

Seed Mix	Description	Where Used
Frangible shrubs seed mix.	Contains indigenous native grasses, sedges and frangible shrubs species from the extant vegetation communities.	For embankment areas within the safety clearance zone (up to 11 metres from the edge of carriageway) and where headlight glare minimisation is required in the median.
Median shrub mix.	A mix of low maintenance nature frangible shrubs for use in the medians.	Median - typically six metres wide.
Tree seed mix.	Contains indigenous native grasses, sedges, shrubs, small trees and tree species.  All tree seed mixes are specific to the vegetation communities in which they are applied.	For use on embankments beyond the safety clearance zone and for rehabilitating construction compounds, ancillary sites and other areas where safety clearances do not apply.
Cover crop seed mix.	A mix of fast growing annual grasses is to be applied to all disturbed areas of the site.	The purpose of the cover crop application is to stabilise the surface material, particularly batters, and to provide an effective barrier to erosion. Cover crop will also be used to minimise erosion and weed establishment on topsoil stockpiles. Cover crop is to be applied at the rate of 20kg/ha.

### 9.9 Seed collection

Many of the species recommended for seeding and planting may not be currently available. So it will be important to collect native seed in line with Roads and Maritime Technical Specification R176 Seed Collection. The native seed must be of local provenance where possible. The provenance of all seed must be provided by the seed supplier. Where provenance seed is not available, seed must be collected from areas where the habitat of the source area mostly closely matches that of the proposed location.

In all other respects, the specified activities outlined in R176 will be followed.

Roads and Maritime will prepare a seed collection program in consultation with a local ecologist to ensure there is sufficient quantity of seeds of the right species available, to complement commercially available seeds. Collection will commence throughout the clearing footprint prior to clearing in the first instance. The optimum time for collecting most useful species is late spring. Targeted species will be those listed in the seeding schedules. These are all hardy and fast growing species for use in re-vegetation. No seed collection will be carried out for species protected under the NPW Act Schedule 13.

Seeds collected during the pre-clearing period and throughout the design program may have an influence on the final planting and seeding schedules.

Seed collection, processing and storage should follow the NSW protocols contained in the Florabank Guidelines (Florabank Online).

### 9.10 Monitoring and ecological establishment

A Landscape Management Plan (LMP) will be prepared as part of the design documentation which details all landscape maintenance actions for the project and establishes the monitoring procedures to ensure that vegetation establishment has achieved the required benchmarks, and will propose remedial actions to be carried out where benchmarks are not met.

Monitoring of vegetated (seeded) areas will be conducted monthly by selection of several monitoring sites that represent the range of landscape types on the project. At each site the following will be recorded:

- Total species required
- Total species sown
- Total species found (observed)
- Target species germination rate (observed)
- Target seeded vegetation cover (observed)
- Percentage target seeded vegetation cover
- Percentage seeded vegetation cover (observed)
- Target weed cover
- Percentage weed cover (observed)
- Target unvegetated ground
- Percentage unvegetated ground (observed).

Typically, poor growth of vegetated areas is defined as less than 80 per cent cover of specified native plants after a period of six months. Where areas show poor growth they will generally be re-cultivated and re-seeded.

Monitoring of planted areas at each site will record:

- Total plants required
- Total plants planted (observed)
- Total plants found (observed)
- Target survival rate
- Percentage plant survival rate (observed)
- Target percentage plant cover
- Percentage plant/foilage cover (observed)
- Target weed cover
- Percentage weed cover (observed)
- Target unvegetated ground
- Percentage unvegetated ground (observed).

During the maintenance period for the project, missing or dead plants will be replaced by species of the same size and type unless the monitoring indicates that there are reasons to adjust the planting type.



Figure 98: Scribbly Gum (*Eucalyptus signata*) near the southbound rest area site.



# 10.0 Topsoil

## 10.1 Treatments

Topsoil treatments include:

- Ripping the subsoil or sub base (depth varies)
- Application of the site topsoil/composted mulch mix (depth varies)
- Application of seed mixes by hydroseeding, hydromulching or planting
- Application of rice straw mulch to a minimum 25 millimetres thickness over seeding (where hydroseeded)
- Application of 75 millimetres thick site-won or hardwood woodchip mulch (or rice or sugar cane straw mulch in riparian areas) where planting occurs.

Three main topsoil treatments are used, which include:

### Topsoil treatment 1: For bushland topsoil containing seed bank placed over cut/fill slopes

- Prepare batter slopes by ripping or roughening the surface to a depth of 100 millimetres using the tynes on a swivelling head excavator bucket, or by some other means, to form a loosened or roughened surface suitable for the application of topsoil
- During ripping, mix in any materials required by the soil testing into the upper 100 millimetres layer to the rates specified within the soil testing recommendations or geotechnical advisor. This may include the mixing of gypsum or any other suitable agent to prevent erosion of subsoil, if dispersivity is identified as an issue for the materials on the cut batter faces to be vegetated. Provide 'cleatmarks', 'dimples' or horizontal scores to cut and fill batters prior to topsoil application
- Apply A1 horizon site-won topsoil mixed with composted site mulch (as directed by the soil test results), to a minimum depth of 100 millimetres, but not more than 200 millimetres. Topsoil and mulch should have been previously ameliorated and any additional materials required by soil testing mixed at the stockpile
- Alternatively, apply A1 horizon topsoil to a minimum depth of 100 millimetres, but not more than 150 millimetres. Mix with windrowed composted site mulch by pushing up and down the prepared slope in order to achieve a reasonable mixing of the two and to achieve a minimum depth of 100 millimetres but not more than 200 millimetres

- Spread out the topsoil/composted mulch mix to an even surface but do not otherwise smooth or compact the surface
- Apply appropriate hydromulch seed mix (if no soil borne seed has germinated)
- For slopes steeper than 2H:1V and up to 1.5H:1V (eg transitions from bridge abutments to 2H:1V slopes) and for basins, vegetated swales and channels install organic fibre mesh as per the specification over final topsoil preparation and prior to seeding.

### Topsoil treatment 2: For planting and seeding areas

- Rip the subsoil to a depth of 300 millimetres. Do not smooth or compact the roughened subsoil surface prior to the application of topsoil
- Apply A1 horizon topsoil to a minimum depth of 150 millimetres
- Spread the topsoil but do not otherwise smooth or compact the surface except where pasture/native grass is to be applied
- Level and trim the surface flush with adjacent surfaces and roll to lightly compact
- Apply appropriate hydromulch seed mix or plant
- For tubestock: prepare 200x200x200 millimetre deep hole
- For advanced tree: prepare 600x600x450 millimetre deep hole
- For super advanced trees: prepare 600x600x600 millimetre deep hole
- Apply fertiliser at the rates as shown on the landscape drawings
- Install advanced trees/tubestock and backfill with topsoil to finish flush with ground level
- Apply mulch to a depth of 75 millimetres.

### Topsoil treatment 3: For pasture grasses and native grass seeding on medians, verges and cut/fill slopes

- Cultivate all areas to a depth of 150 millimetres. Do not smooth or compact the roughened subsoil surface prior to the application of topsoil
- Apply site-won topsoil to a minimum depth of 50-100 millimetres. Do not use composted site mulch
- Spread the topsoil, level and trim the surface flush with adjacent surfaces to provide an even finish and roll to lightly compact
- Apply appropriate grass seed mix via hydroseeding or hydromulching with fertiliser as shown on the landscape drawings and specification.

## 10.2 Topsoil management

Sections 3 and 4 traverse a vast extent of forested area (about 32 kilometres). The topsoils stripped from the formation will contain a seed bank species diversity that cannot be replicated by seeding, due to limitations on availability.

The best landscape outcome is to be achieved by re-applying site topsoil containing this intact soil-borne seed bank back to the locations from which it was stripped, within a time frame which ensures that most of the seed remains viable.

Natural regeneration ensures that foreign genotypes are not introduced to the existing vegetation communities and also that the species mix is maximised. Other benefits include reduced fertiliser requirements (excess fertiliser can run off and cause algal blooms and fish death in waterways). It also introduces indigenous species which are impractical to establish by other means, either because their seed is difficult to collect in quantity or to apply (Terrestrial Orchids, ferns and native lilies) or because they are opportunistic colonisers that will persist or colonise rapidly where conditions are favourable (Bracken Ferns, Blady Grass and Geebung species). These types of plants can be expected to re-colonise disturbed areas of the corridor rapidly with the application of correct topsoil management procedures.

There are five key aspects to the management of existing topsoil:

- Topsoil stripping to maintain the integrity of the topsoil from the existing vegetation communities
- Direct return of topsoil (where feasible)
- Topsoil management zones and stockpile management procedures
- Topsoil testing
- Topsoil and composted mulch amelioration.

Where the topsoil is to be stripped from intact bushland areas, it is to be separated by vegetation community type and referred to as Bushland Topsoils. Topsoil stripped from pasture areas and referred to as Landscape Topsoil, is to be stripped and stockpiled separately and quarantined from Bushland topsoils in order to prevent the spread of weeds.

Direct return is the procedure whereby site topsoil is returned to the batter location from which it was stripped either immediately or soon after formation. It is dependent on the construction staging and full commitment of construction staff to the re-vegetation process. Direct return will be implemented where construction staging allows.

Topsoil stockpile management and storage procedures are designed to ensure the survival of soil seedbank, microflora and microorganisms in the stockpile for the duration of the stockpile period and until it is returned to re-vegetation areas.

The stockpiles will be sized to maintain the viability of native seed with 2H:1V batter slopes. Large, clearly legible signs will be placed and maintained on each stockpile, nominating vegetation community type, soil horizon, collection area (eg by station) and date of stockpiling. No soils should be stockpiled for greater than 18 months where possible.

Topsoils will be tested in situ prior to stripping in accordance with Roads and Maritime specification R44 and within the stockpiles in accordance with Roads and Maritime project specific specification R178. Amelioration is to be carried out in accordance with the test result recommendations, prior to installation.

Topsoil management zones are derived from the vegetation community boundaries shown on the landscape plans, to ensure that the topsoil with stored seed from each vegetation community is returned to a location with the same vegetation community. In some instances the exact extent of a zone is rationalised in order to assist the stripping and reapplication. For instance a zone may be extended to the end of a batter if the distance to the end of a batter does not warrant a change in soil type (Figures 99-102).



Figure 99: Glenugie batter slope soon after completion showing germination from the soil seedbank.



Figure 100: Glenugie batter slope at the same location four years later.



Figure 101: Spotted Gum-Grey Ironbark-Pink Bloodwood Forest where the alignment crosses Six Mile Lane, a zone from which bushland topsoil will be stripped.



Figure 102: Landscape topsoils near Green Hill.

For the purposes of stockpile management for this project, soils have been classified into two types.

### Bushland topsoils

This includes topsoil stripped within mapped vegetation communities that have been cleared. Striped bushland topsoil is to be stockpiled and managed to retain their environmental integrity and preserve the soil seed bank. Topsoil from different vegetation communities is to be stockpiled separately where feasible.

Bushland topsoil is for reuse where native seeding and planting is specified on the landscape drawings and within vegetation community boundaries. Refer to Figure 103 which illustrates the procedure for handling bushland topsoils.

### Landscape topsoils

This includes topsoil stripped from existing pasture grass areas or where mapped in the *Weed Management Plan* as having a High Weed Density Abundance. Landscape topsoil may contain weed seeds and must be quarantined from bushland topsoils

Landscape topsoil is for re-use where pasture grasses are shown on the landscape drawings. Refer to Figure 104 which illustrates the procedure for handling landscape topsoils.

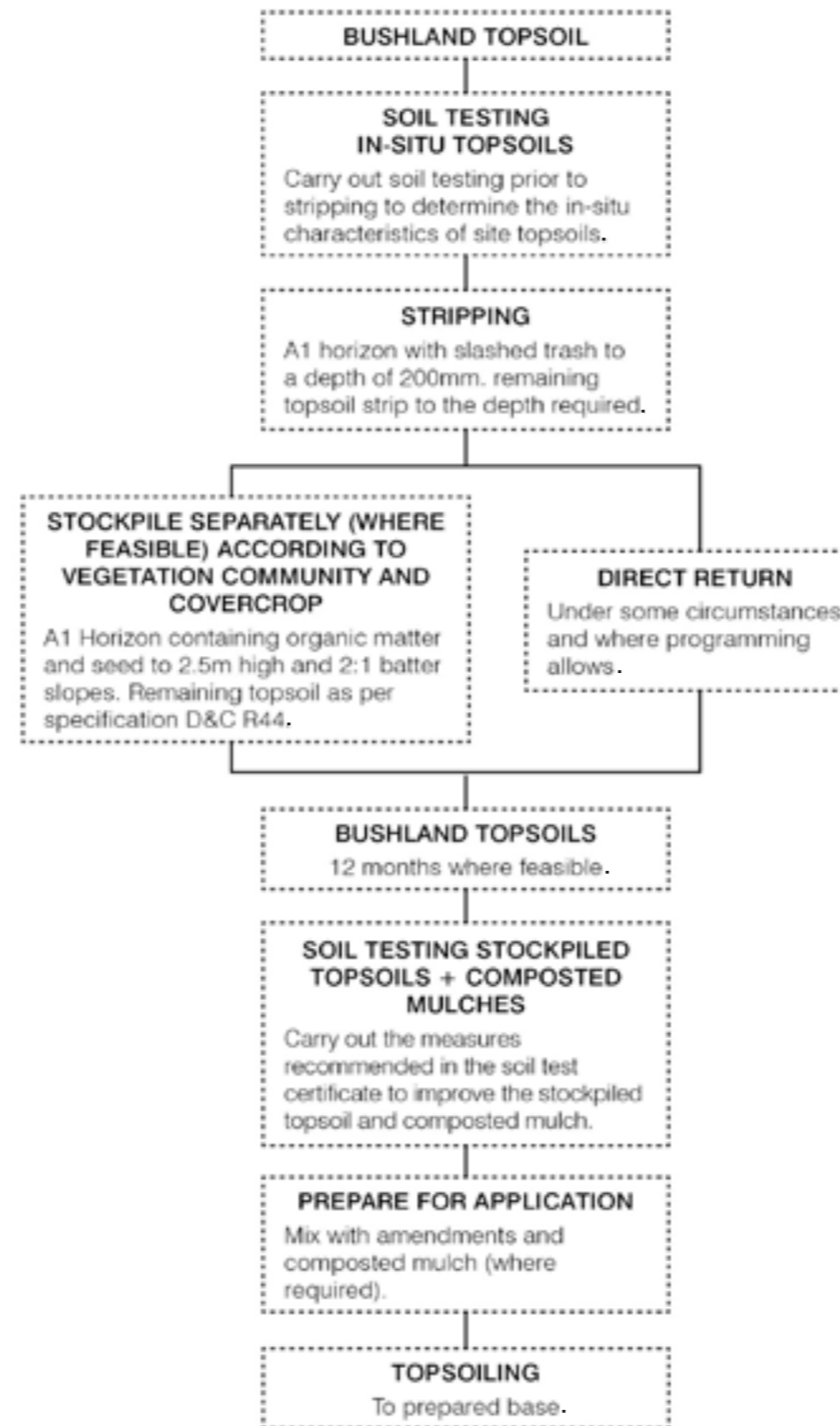


Figure 103: Bushland topsoil.

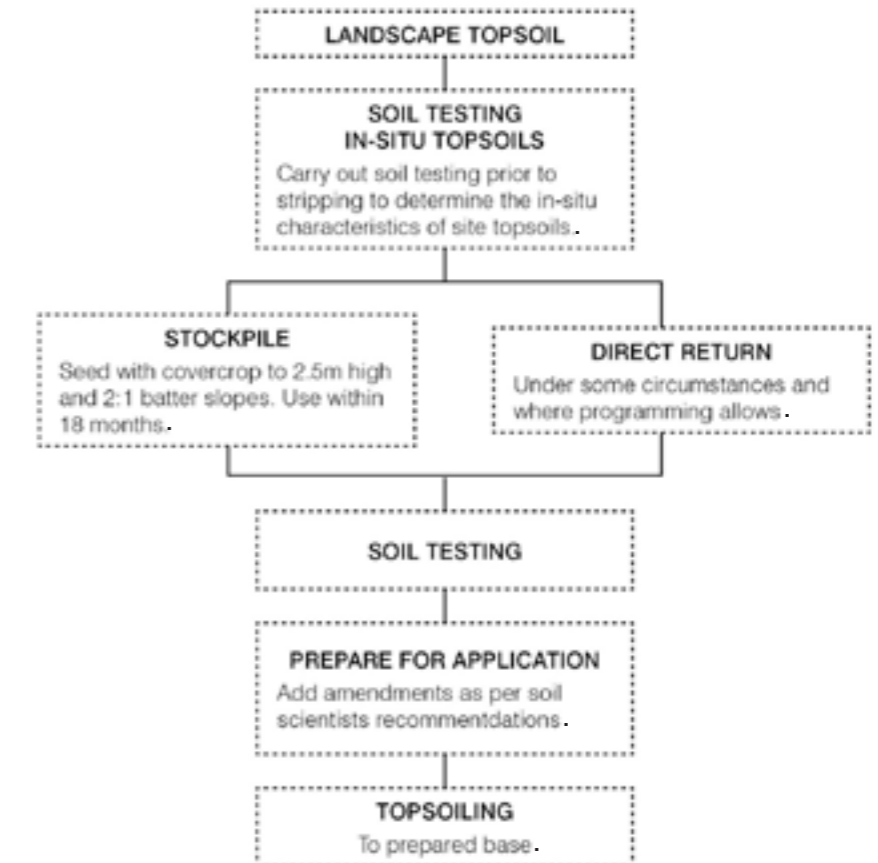


Figure 104: Landscape topsoil.

### 10.3 Mulch treatment

All planted areas are to have a surface layer of hardwood mulch sourced from site applied to a nominal minimum depth of 75 millimetres. Mulch is to be stockpiled for six months prior to use in order to reduce the impacts of nitrogen draw-down on soils and its effect on plantings (Figures 105-106).

#### Composted mulches

Composted mulches, derived from site-won mulch that has been windrowed for a minimum of six months in a manner to accelerate composting, will be mixed with site topsoil as shown on the landscape drawings. At a minimum, site topsoil mixed with composted site mulch is to be spread on batter slopes receiving runoff in order to increase its organic (carbon) content and to aid in erosion resistance on batters. The component of composted site mulches mixed with topsoils will be considered during the detailed design phase and will form part of the soil testing procedures with advice from the soil scientist conducting the testing. The general ratio of 75 per cent topsoil to 25 per cent composted site mulch will be applied but may be varied as advised by the soil scientist.

Composted site mulch is required to be ameliorated to raise the pH, improve the composting processing to reduce the nitrogen drawdown effect of the mulch, and to counter any major nutrient deficiencies that would inhibit germination. The soil scientist will provide advice as to soil and compost additives to render the mix suitable for growth of the proposed plant species.

Around riparian zones Straw Mulch (rice or sugar cane) will be used in lieu of site won mulch to prevent tannins from leaching into waterways.



Figure 105: Germination from the soil seedbank. Note mulch mixed with site topsoil.



Figure 106: Stockpile tub ground mulch.

## 11.0 Drainage and water quality

### 11.1 Water quality control systems (including water quality treatment ponds )

Water quality basins will be 'wet' basins with a fluctuating permanent depth. On occasions they will be dry when the water level drops following dry periods. The strategy for water quality treatment ponds is to prepare the margin zone of periodic wetting above and below the permanent water line for seeding. The water quality treatment ponds will be seeded over the crest and down to the maximum water line with native grass seed mix (which contains endemic sedge species seed). In addition, wetland plants from the Coastal floodplains sedgeland, rushlands and forblands vegetation community will be planted at the margins and across the floor of the water quality treatment ponds at a spacing of one plant/metre.

Note that a lower rate of planting is used for water quality treatment ponds because wetland and sedge species are opportunistic colonisers and will readily colonise a water quality treatment pond when conditions are favourable. It is recognised that basins must be pumped clean following the construction phase of the works and therefore basins may not be prepared and planted until their use as temporary construction basins is complete.

Where long steep batters lead into the basin inner batter, organic fibre mesh will be used to assist in controlling erosion on the 2H:1V sides.

The permanent water quality basins shape will be reviewed to provide a more informal shape where feasible in the SDD. Where basins remain rectangular in shape it is due to the constrained space between the road formation and the project boundary or due to clearing limits (Figure 107).



Figure 107: *Lepironia* wetlands off Woollli Road. Species from the wetland community will be used in re-vegetating water quality treatment ponds.

### 11.2 Culverts

Many of the drainage lines and creeks crossed by the alignment are intermittent and respond to seasonal rains. The culverts which allow drainage lines and creeks to cross under the road are often combined with fauna crossings. The typical landscape treatment for box culverts which combine drainage and fauna underpass in forest areas is provided in the landscape drawings.

Measures to assist the landscape establishment at combined fauna/drainage crossings include:

- Organic fibre mesh pinned to embankments 2H:1V or steeper, over 50-100 millimetres depth of additional topsoil through which tubestock macrophytes and tussocks are planted. The mesh is to cover the embankment to the top of the channel or to the extent of disturbed ground
- Site rocks of various size from 500-1000 millimetres in natural formation to assist holding down mesh and for scour protection where the new work interfaces with the existing creek channel (this treatment is for zones beyond scour protection and only where rocks occur in the natural creek bed)
- Beyond the zone of normal high water, the typical landscape zone of trees shrubs and groundcovers includes:
  - 100-200 millimetres additional topsoil if required
  - 75 millimetres mulch if planted
- Rice straw mulch is used in place of site-won tub-ground mulch in the proximity of riparian zones to prevent tannins from leaching into the waterways
- Planting of riparian vegetation species including plants such as *Lomandra hystrix* and sedges known to bind embankments and resist erosion at creek crossings will be planted directly adjacent to the scour protection both top and bottom
- Where scour protection is utilised at the egress to fauna culverts, *Lomandra hystrix* and sedge species will be planted at a low density to provide habitat amongst the scour rocks
- Fauna escape poles are located on the embankment out of the main channel and about two metres from the end of the headwall. A second pole is to be provided where existing trees are more than 10 metres from the first pole.

### 11.3 Creek rehabilitation

Creeks affected by the alignment will be rehabilitated to return the creek to their former or better condition and to maximise wildlife habitat connectivity. These include from south to north:

- Coldstream River
- Pillar Valley
- Pillar Creek
- Chaffin Creek
- Champions Creek
- Crackers Drain
- Lees Drain
- Shark Creek
- Edwards Creek.

Generally the creeks are to be restored with riparian species planted directly into the replaced creek bed material and on embankments which are topsoiled. In detail design the extent of planting under bridges (where there is no access to natural rainfall and low-light conditions) will be assessed.

### Creek re-alignments

Where creek crossings are re-aligned to allow the construction of bridges, the channels will be returned to at least their pre-construction condition. Generally the creeks are to be restored with riparian species planted directly into the replaced creek bed material and on embankments which are topsoiled. Seeding will not be used within the flood extent. The full extent of the low-flow channel and riparian benches are to be lined with organic fibre mesh or mat. Rock beaching will be incorporated to prevent erosion on the embankments facing the direction of flow.

If appropriate to the situation, site-won felled timber logs with root wads will be buried into the bank in combination with bracing boulders. For details of species to be used refer to the plant schedules (Figure 108).



Figure 108: Chaffin Creek.

## 12.0 Fauna crossings

### 12.1 Fauna connectivity

In the first instance, planting at fauna crossings will match the existing vegetation community at the location of the crossing. The final selection of species to be established at each fauna crossing will then be confirmed with the project ecologist and species added or deleted as advised.

Fauna passages and flood relief structures in the floodplain will be planted to re-establish habitat connectivity in locations where patches of remnant native vegetation occur. Fauna passages and flood relief structures provide the ideal location to connect habitat and often in locations where patches were previously isolated. For example at Lees Drain (CH 73,450) and Shark Creek Road (CH 75,150) Tree species will match the former vegetation community type that occurred prior to clearing as evidenced from vegetation remnants. Depressions on the floodplain associated with or near watercourses will use sedge species from the Coastal floodplains sedgelands, rushlands and forblands vegetation community.

### 12.2 Fauna crossing structures

The design of fauna crossing structures has incorporated the following principles:

- Plantings of appropriate native species that provide habitat for threatened mammals and species consistent with that of the adjacent habitat to attract fauna and landscaping of the habitat corridor approach, not consisting of all rock and not consisting of scour protection
- Strategic revegetation with appropriate native species is to be undertaken to enhance landscape connections to culverts and combined underpasses and to link current isolated patches with potential habitat for threatened species
- Unobstructed views to, and through the underpass, and strategic tree plantings for fauna refuge. For effective connectivity, the four metre passage should consist of a natural substrate with refuge areas (scattered rocks, logs)
- Appropriate shelter for wildlife to encourage use and reduce risk of predation.

The design of emu crossings has incorporated the following principles:

- Immediate revegetation of emu crossing zones after the completion of the construction activity with the aim to have an established cover crop within three months of the completion of each bridge
- Ground cover crops such as soybean, oats, lablab or rye grass are to be used initially on disturbed ground around the approaches to the bridges, attracting emus to the crossing zones as these species represent known food plants
- Sterile cover crops are to be used as these are non-native species and these areas are to be monitored and progressively replaced with native food plants
- Height and density of vegetation are not to obscure the crossing structures and provide a clear open line of sight
- Roadside plantings in emu habitat are not to be undertaken within the first 10 metres of the road edge unless there is fauna exclusion fencing in place or as part of the exclusion barrier
- Common landscape species such as *Lomandra* and *Dianella ssp.* are not to be used in roadside landscaping in emu habitat as they represent food plants for emus and attract them to the road edge

- Final landscape plantings under dedicated and combined bridges in emu zones (including the approaches) are to be planted with native grasses or low groundcovers suitable to the location
- Dense plantings of trees and shrubs including low trees such as Acacia or Casuarina are to be avoided
- Revegetation in roadside areas disturbed during construction need to be restored to the original habitat type at each location (excluding first 10 metres of the road edge unless there is fauna exclusion fencing in place or as part of the exclusion barrier).

The landscape design in the vicinity of glider poles has incorporated the following principles:

- The placement of suitable tree species around structures so that over time (eg 20–40 years), trees can replace artificial structures in both directions. (gliders are likely to prefer natural trees to cross, therefore re-vegetation is desirable)
- Vegetation likely to provide prospect for predators in the vicinity of the base of the glider poles is not to be used
- Retain large existing trees in the road verge or median wherever possible and revegetate in proximity to the structures with suitable trees and shrubs
- Strategic planting is to be undertaken to enhance connectivity and provide guidance to glider crossing zones and targeted structures
- Strategic planting of glider food sources on both sides of the structures should be provided to encourage gliders to the structures and away from the road. Species selected for planting at fauna crossing structures will be confirmed.

The environmental design requirements for koalas include:

- The use of primary and secondary koala food trees in those areas that will not cause a road safety traffic hazard
- Primary, secondary and supplementary koala food trees are shown to be effective in restoring habitat for koalas.





### 12.3 Frog ponds

Multiple populations of the vulnerable Green-thighed Frog extend over most of the project corridor. Frog breeding ponds are required for this species and will typically be constructed as shown in Figures 109-111. The final location and construction of each pond will be supervised by the project ecologist and undertaken in consultation with Roads and Maritime.

Grasses and sedges from the Coastal floodplains sedgelands, rushlands and forblands vegetation community will be planted to provide habitat and refuge from predators on the margins of the ponds.

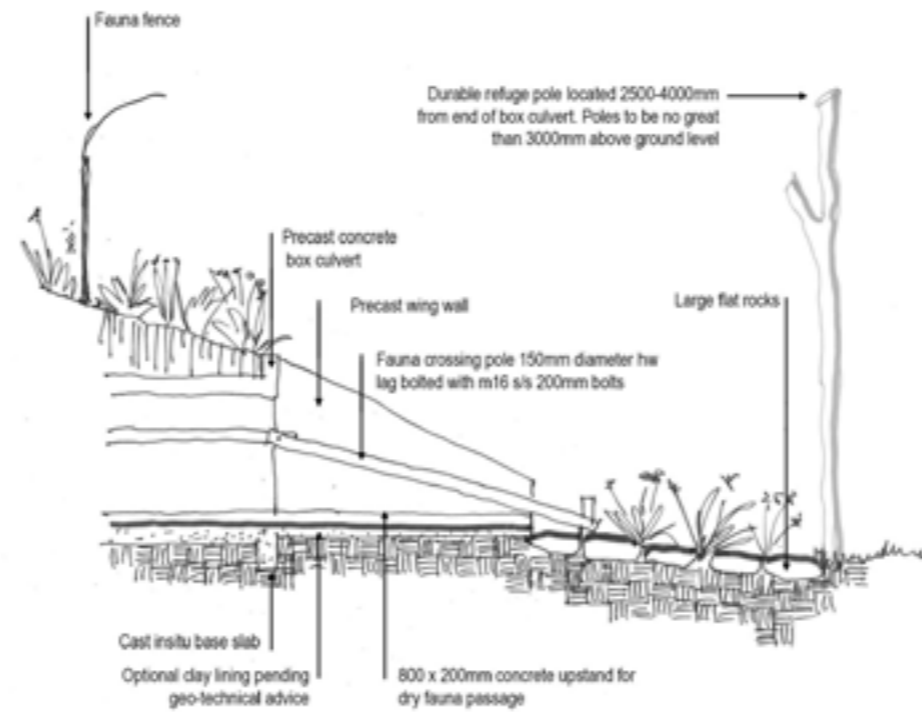


Figure 109: Indicative landscape treatment surrounding green thighed frog breeding ponds.

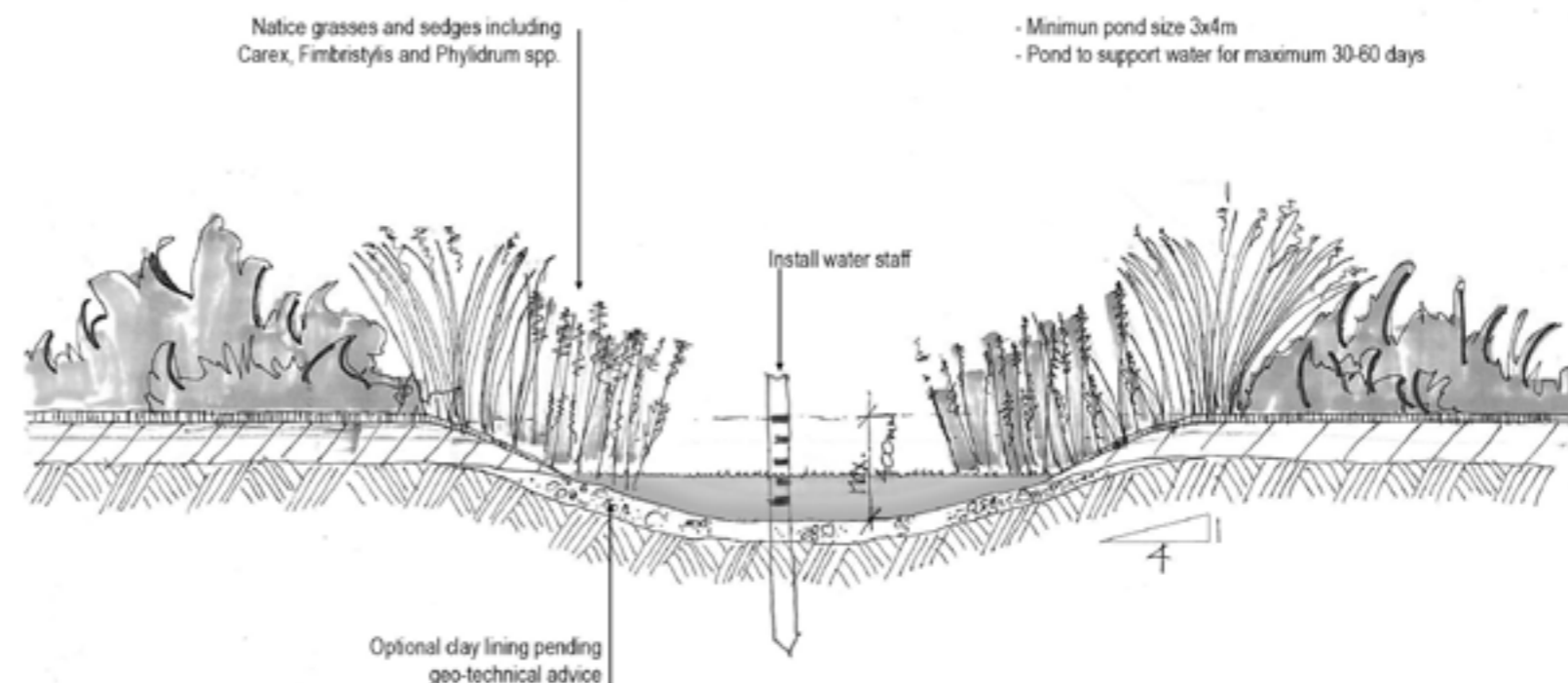


Figure 110: Typical landscape treatment for combined box culvert fauna passage - section.

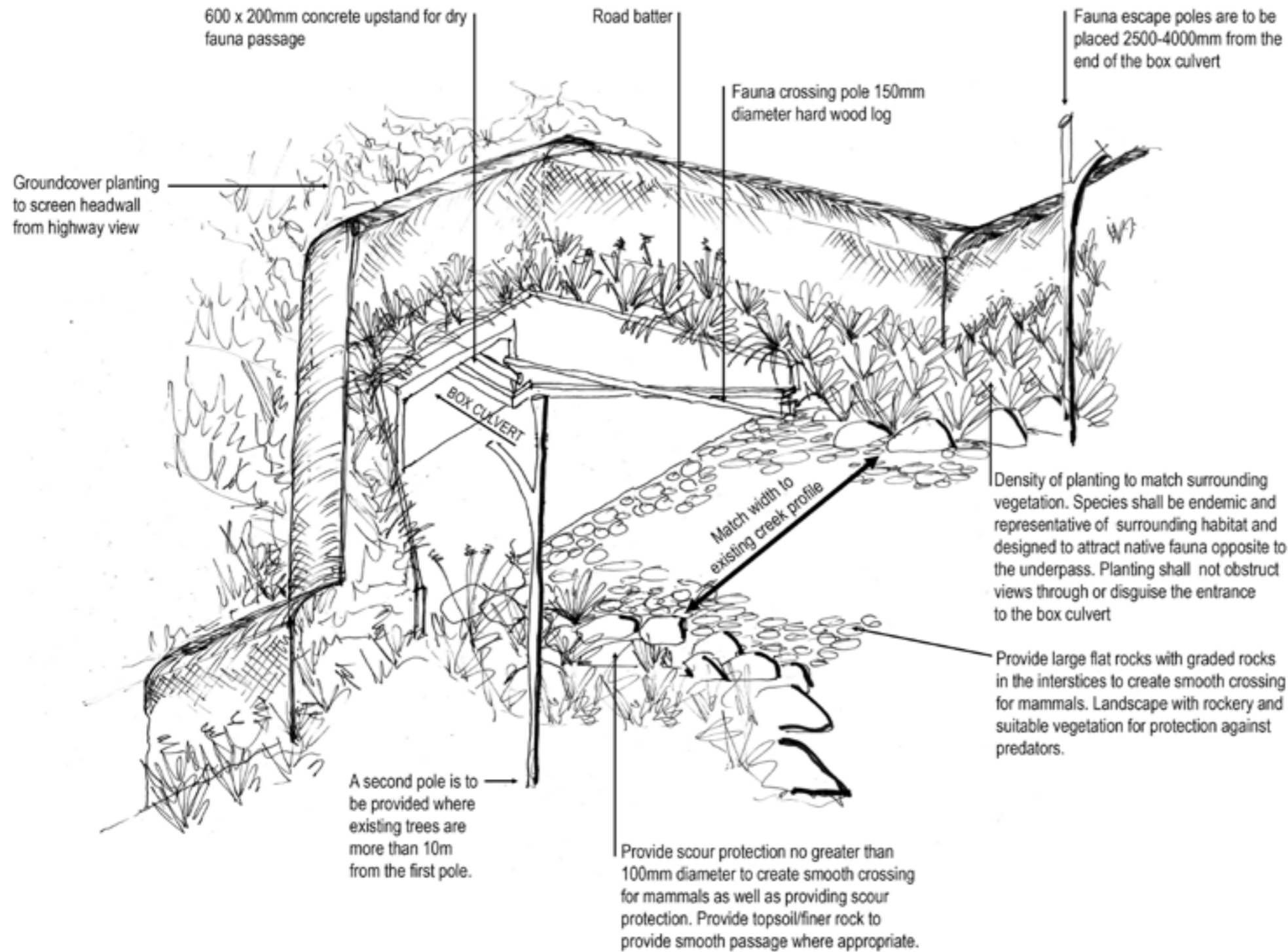


Figure 111: Typical landscape treatment for combined box culvert fauna crossing - sketch.

## 13.0 Conclusion

The collaboration and employment of high quality standards set out in the key reference documents ensures an integrated approach to urban design. Well considered engineering also ensures a high quality urban and landscape design outcome for the project. The implementation of the mitigation measures proposed ensures that the significance of social, cultural and ecological values are maintained or enhanced through the design initiatives provided.



Figure 112: Oblique aerial looking north of Tyndale interchange with Green Hill in foreground and Maclean interchange in background. Source: Pacific Complete

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# Appendices

## A Schedule of finishes and materials

Finishes, materials and colours provide an identity for the project. They enhance the experience of both the road user and the local community. This report section covers project:

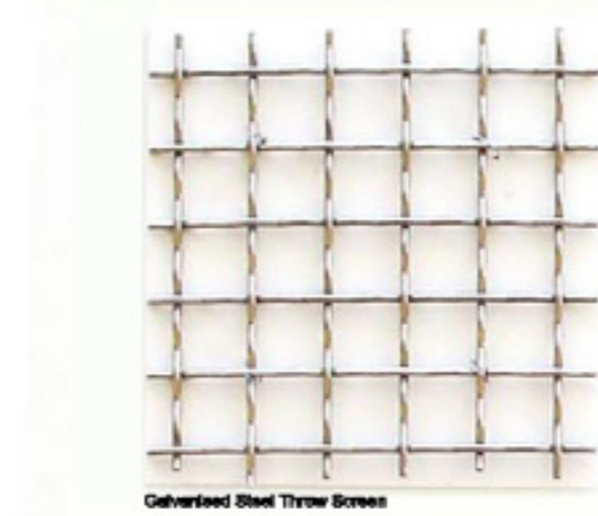
- Materials and finishes
- Colours
- Anti-graffiti strategy.

All materials used on the project will be manufactured, stored and applied in accordance with relevant current Australian Standards, and manufacturer's specifications or instructions. Issues of durability, material specifications, primers, bond coats and warranties are considered while choosing materials.

### Design principles

Materials, finishes and colour selections have an important urban and landscape design role. Beyond durability, they add interest and aesthetic appeal to a project and help to reduce the visual impact of the road project on the environment.

The strategy for selecting materials and finishes acknowledges that infrastructure projects are subject to harsh environmental conditions. The best long term outcome, in terms of both maintenance and appearance, results from selecting materials whose untreated finish works in design terms and maintains its initial appearance over time.



Galvanized Steel Throw Screen



Concrete Precast Panels



Asphalt



Galvanized Mild Steel



## B Planting and seeding schedules for sections 3 and 4

All planting and seeding tables are subject to further development, including confirmation that seeds are commercially available.

Table 1: Sections 3 and 4 Glenugie interchange and Picaninny Creek planting schedule – planting derived from the Spotted Gum – Grey Ironbark – Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast.

Botanical Name	Common Name
<b>Feature Trees</b>	
<i>Corymbia variegata</i>	Spotted Gum
<i>Eucalyptus propinqua</i>	Grey Gum
<i>Allocasuarina torulosa</i>	Forest She Oak
<b>Shrubs, groundcovers, tussocks, grasses and sedges</b>	
<i>Melaleuca nodosa</i>	Ball Honey-myrtle
<i>Sannantha similis</i>	Tall Baeckea
<i>Hardenbergia violaceae</i>	False Sarsaparilla
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Philydrum lanuginosum</i>	Woolly Waterlily
<i>Baloskion tetraphyllum</i>	Tassel Cord Rush
<i>Gahnia aspera</i>	Rough Saw-sedge
<i>Ficinia nodosa</i>	Knobby Club Rush
<i>Themeda australis</i>	Kangaroo Grass

Table 2: Sections 3 and 4 – Maclean interchange and median planting schedule.

Botanical Name	Common Name
<b>Feature Trees</b>	
<i>Acmena smithii</i>	Lilly Pilly
<i>Argyrodendron actinophyllum</i>	Black Booyong
<i>Castanospermum australe</i>	Black Bean
<i>Dysoxylum mollissimum</i>	Red Bean
<i>Elaeocarpus obovatus</i>	Blueberry Ash
<i>Euroschinus falcatus</i>	Ribbonwood
<i>Ficus superba</i> var. <i>henniana</i>	Deciduous Fig
<i>Harpullia pendula</i>	Tulipwood
<i>Livistona australis</i>	Cabbage Tree Palm
<i>Polyscias elegans</i>	Celerywood
<b>Shrubs, groundcovers, tussocks, grasses and sedges</b>	
<i>Alpinia caerulea</i>	Native Ginger
<i>Acmena smithii</i> var. <i>minor</i>	Lilly Pilly
<i>Sannantha similis</i>	Tall Baeckea
<i>Crinum pedunculatum</i>	Swamp Lily
<i>Doodia aspera</i>	Common Rasp Fern
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Philydrum lanuginosum</i>	Woolly Waterlily
<i>Baloskion tetraphyllum</i>	Tassel Cord Rush
<i>Schoenoplectus mucronatus</i>	Bog Bulrush
<i>Themeda australis</i>	Kangaroo Grass
<i>Oplismenus imbecilis</i>	Creeping Beard Grass

Table 3: Sections 3 and 4 northbound rest area planting schedule – planting derived from the Swamp Mahogany swamp forest.

Botanical Name	Common Name
<b>Trees</b>	
<i>Eucalyptus planchoniana</i>	Needlebark Stringybark
<i>Elaeocarpus obovatus</i>	Blueberry Ash
<i>Elaeocarpus reticulatus</i>	Blueberry Ash
<i>Eucalyptus resinifera</i> subsp. <i>hemilampra</i>	Red Mahogany
<i>Eucalyptus robusta</i>	Swamp Mahogany
<i>Eucalyptus signata</i>	Scribbly Gum
<i>Livistona australis</i>	Cabbage Tree Palm
<i>Lophostemon suaveolens</i>	Swamp Mahogany
<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark
<i>Melaleuca quinquenervia</i>	Brod-leaved Paperbark
<i>Melaleuca sieberi</i>	Sieber's Paperbark
<i>Synoum glandulosum</i>	Scentless Rosewood
<b>Shrubs, groundcovers, tussocks, grasses and sedges</b>	
<i>Alpinia caerulea</i>	Native Ginger
<i>Acmena smithii</i> var. <i>minor</i>	Lilly Pilly
<i>Banksia oblongifolia</i>	Fern-leaved Banksia
<i>Callistemon salignus</i>	Bottlebrush
<i>Leptospermum polygalifolium</i> subsp. <i>Polygalifolium</i>	Tantoon
<i>Melaleuca nodosa</i>	Prickly-leaved Paperbark
<i>Crinum pedunculatum</i>	Swamp Lily
<i>Doodia aspera</i>	Common Rasp Fern
<i>Dianella caerulea</i>	Blue Flax-Lily
<i>Gahnia clarkei</i>	Tall Saw-sedge
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Philydrum lanuginosum</i>	Woolly Waterlily
<i>Baloskion tetraphyllum</i>	Tassel Cord Rush
<i>Schoenoplectus mucronatus</i>	Bog Bulrush
<i>Themeda triandra</i>	Kangaroo Grass
<i>Microlaena stipoides</i>	Wallaby Grass



Table 4: Sections 3 and 4 southbound rest area planting schedule - planting derived from the Turpentine moist open forest and Scribbly Gum – Needlebark Stringybark - Red Bloodwood heathy open forest.

Botanical Name	Common Name
<b>Trees</b>	
<i>Elaeocarpus reticulatus</i>	Blueberry Ash
<i>Livistona australis</i>	Cabbage Tree Palm
<i>Synoum glandulosum</i>	Scentless Rosewood
<i>Corymbia gummifera</i>	Red Bloodwood
<i>Eucalyptus planchoniana</i>	Needlebark Stringybark
<i>Eucalyptus signata</i>	Scribbly Gum
<i>Allocasuarina littoralis</i>	Black She Oak
<i>Syncarpia glomulifera</i>	Turpentine
<b>Shrubs, groundcovers, tussocks, grasses and sedges</b>	
<i>Alpinia caerulea</i>	Native Ginger
<i>Acmena smithii var. minor</i>	Lilly Pilly
<i>Archirhodomyrtus beckleri</i>	Rose Myrtle
<i>Banksia oblongifolia</i>	Fern-leaved Banksia
<i>Banksia spinulosa</i>	Hairpin Banksia
<i>Callistemon salignus</i>	Willow Bottlebrush
<i>Leptospermum polygalifolium subsp. Polygalifolium</i>	Tantoon
<i>Melaleuca nodosa</i>	Prickly-leaved Paperbark
<i>Crinum pedunculatum</i>	Swamp Lily
<i>Doodia aspera</i>	Common Rasp Fern
<i>Dianella caerulea</i>	Blue Flax-Lily
<i>Gahnia clarkei</i>	Tall Saw-sedge
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Philydrum lanuginosum</i>	Woolly Waterlily
<i>Baloskion tetraphyllum</i>	Tassel Cord Rush
<i>Schoenoplectus mucronatus</i>	Bog Bulrush
<i>Themeda triandra</i>	Kangaroo Grass
<i>Microlaena stipoides</i>	Wallaby Grass

Table 5: Sections 3 and 4 Black Snake Creek planting schedule – derived from the Black Bean – Weeping Lilly Pilly riparian rainforest of the North Coast.

Botanical Name	Common Name
<b>Trees</b>	
<i>Castanospermum australe</i>	Black Bean
<i>Dysoxylum mollissimum</i>	Red Bean
<i>Elaeocarpus obovatus</i>	Blueberry Ash
<i>Waterhousia floribunda</i>	Weeping Lilly Pilly
<b>Shrubs, groundcovers, tussocks, grasses and sedges</b>	
<i>Acmena smithii minor</i>	Lilly Pilly
<i>Crinum pedunculatum</i>	Swamp Lily
<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark
<i>Carex appressa</i>	Tall Sedge
<i>Cordyline stricta</i>	Narrow-leaved Palm-lily
<i>Dianella caerulea</i>	Blue Flax-Lily
<i>Doodia aspera</i>	Common Rasp Fern
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Microlaena stipoides</i>	Wallaby Grass
<i>Oplismenus aemulus</i>	Creeping Shade Grass
<i>Oplismenus imbecilis</i>	Creeping Beard Grass
<i>Philydrum lanuginosum</i>	Woolly Waterlily
<i>Schoenoplectiella mucronata</i>	Bog Bulrush

Table 6: Sections 3 and 4 headlight/visual screening planting schedule.

Botanical Name	Common Name
<i>Elaeocarpus reticulatus</i>	Blueberry Ash
<i>Waterhousia floribunda</i>	Weeping Lilly Pilly
<i>Acmena smithii</i>	Lilly Pilly
<i>Acmena smithii minor</i>	Lilly Pilly
<i>Callistemon salignus</i>	Willow Bottlebrush
<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark
<i>Lomandra hystrix</i>	Spiny Head Mat Rush

Table 7: Sections 3 and 4 water quality treatment ponds planting schedule.

Botanical Name	Common Name
<i>Ficinia nodosa</i>	Knobby Club-rush
<i>Juncus usitatus</i>	Common Rush
<i>Philydrum lanuginosum</i>	Woolly Waterlily
<i>Schoenoplectus mucronatus</i>	Bog Bulrush
<i>Iperionia articulata</i>	Grey Sedge

Table 8: Sections 3 and 4 creek realignments planting schedule.

Botanical Name	Common Name
<b>Trees - As per vegetation community in which the creek is located - indicative species shown</b>	
<i>Casuarina glauca</i>	Swamp Oak
<i>Acmena smithii</i>	Lilly Pilly
<i>Eucalyptus tereticornis</i>	Forest Red Gum
<i>Lophostemon suaveolens</i>	Swamp Box
<i>Corymbia gummifera</i>	Red Bloodwood
<i>Eucalyptus planchoniana</i>	Bastard Tallowood
<i>Eucalyptus signata</i>	Scribbly Gum
<b>Shrubs, groundcovers, tussocks, grasses and sedges</b>	
<i>Acmena smithii minor</i>	Lilly Pilly
<i>Crinum pedunculatum</i>	Swamp Lily
<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark
<i>Carex appressa</i>	Tall Sedge
<i>Cordyline stricta</i>	Narrow-leaved Palm-lily
<i>Dianella caerulea</i>	Blue Flax-Lily
<i>Doodia aspera</i>	Common Rasp Fern
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Microlaena stipoides</i>	Wallaby Grass
<i>Oplismenus imbecilis</i>	Creeping Beard Grass
<i>Philydrum lanuginosum</i>	Woolly Waterlily
<i>Schoenoplectiella mucronata</i>	Bog Bulrush

Table 9: Sections 3 and 4 frog ponds planting schedule.

Botanical Name	Common Name
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Philydrum lanuginosum</i>	Woolly Waterlily
<i>Baloskion tetraphyllum</i>	Tassel Cord Rush
<i>Carex appressa</i>	Tall Sedge
<i>Schoenoplectus mucronatus</i>	Bog Bulrush
<i>Themeda australis</i>	Kangaroo Grass
<i>Oplismenus imbecilis</i>	Creeping Beard Grass

Table 10: Sections 3 and 4 fauna crossings planting schedule

Botanical Name	Common Name
<b>Trees as per vegetation community in which the crossing is located - indicative species shown</b>	
<i>Eucalyptus planchoniana</i>	Needlebark Stringybark
<i>Corymbia gummifera</i>	Red Bloodwood
<i>Eucalyptus signata</i>	Scribbly Gum
<i>Allocasuarina littoralis</i>	Black She Oak
<i>Corymbia variegata</i>	Spotted Gum
<i>Eucalyptus paniculata</i>	Grey Ironbark
<i>Eucalyptus pilularis</i>	Blackbutt
<i>Eucalyptus resinifera ssp hemilampra</i>	Red Mahogany
<i>Eleocharis reticulatus</i>	Blueberry Ash
<i>Corymbia intermedia</i>	Pink Bloodwood
<i>Eucalyptus tereticornis</i>	Forest Red Gum
<i>Lophostemon suaveolens</i>	Swamp Mahogany
<i>Melaleuca sieberi</i>	Sieber's Paperbark
<i>Melaleuca quinquenervia</i>	Brod-leaved Paperbark
<b>Shrubs, groundcovers, tussocks, grasses and sedges</b>	
<i>Alpinia caerulea</i>	Native Ginger
<i>Acmena smithii var. minor</i>	Lilly Pilly
<i>Sannantha similis</i>	Tall Baeckea
<i>Crinum pedunculatum</i>	Swamp Lily
<i>Doodia aspera</i>	Common Rasp Fern
<i>Carex appressa</i>	Tall Sedge
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Philydrum lanuginosum</i>	Woolly Waterlily
<i>Baloskion tetraphyllum</i>	Tassel Cord Rush
<i>Schoenoplectus mucronatus</i>	Bog Bulrush
<i>Themeda australis</i>	Kangaroo Grass
<i>Oplismenus imbecilis</i>	Creeping Beard Grass

Table 11: Seed Mix Type A1 – sections 3 and 4 *Angophora robur* shrubby forest Seeding Mix.

This seed mix is for use in areas mapped as *Angophora robur* shrubby forest and woodland on sandstones of the North Coast.

Botanical Name	Common Name
<b>Tree seed mix</b>	
<i>Aristida vagans</i>	Three-awned Spear Grass
<i>Austrodanthonia fulva</i> var. <i>fulva</i>	Wallaby Grass
<i>Austrostipa scabra</i>	Speargrass
<i>Bothriocloa macra</i>	Red-leg Grass
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Chloris truncata</i>	Windmill Grass
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Imperata cylindrica</i>	Blady Grass
<i>Lomandra longifolia</i>	Mat Rush
<i>Themeda triandra</i>	Kangaroo Grass
<i>Acacia complanata</i>	Flat-stemmed Wattle
<i>Banksia oblongifolia</i>	Fern-leaved Banksia
<i>Banksia spinulosa</i> var. <i>collina</i>	Hill Banksia
<i>Gompholobium pinnatum</i>	Pinnate Wedge Pea
<i>Gahnia sieberana</i>	Red-fruit Saw-sedge
<i>Phyllanthus hirtellus</i>	Thyme Spurge
<i>Hardenbergia violacea</i>	Native Sarsaparilla
<i>Lambertia formosa</i>	Mountain Devil
<i>Leptospermum trinervium</i>	Paperbark Teatree
<i>Persoonia tenuifolia</i>	Fine-leaf Geebung
<i>Angophora robur</i>	Sandstone Rough-barked Apple
<i>Angophora woodsiana</i>	Smudgy Apple
<i>Corymbia gummifera</i>	Red Bloodwood
<i>Corymbia intermedia</i>	Pink Bloodwood
<i>Eucalyptus baileyi</i>	Baileys Stringybark
<i>Banksia oblongifolia</i>	Fern-leaved Banksia
<i>Banksia spinulosa</i> var. <i>collina</i>	Hill Banksia
<i>Lambertia formosa</i>	Mountain Devil

Botanical Name	Common Name
<i>Leptospermum polygalifolium</i>	Tantoon
<i>Leptospermum trinervium</i>	Paperbark Teatree

Table 12: Seed Mix Type A2 -sections 3 and 4 Blackbutt – Bloodwood dry heathy open forest seeding mix.

This seed mix is for use in areas mapped as Blackbutt – bloodwood dry heathy open forest on sandstones of the northern North Coast.

Botanical Name	Common Name
<b>Tree seed mix</b>	
<i>Acacia brownii</i>	Heath Wattle
<i>Acacia falcata</i>	Wattle
<i>Acacia myrtifolia</i>	Red-stemmed Wattle
<i>Acacia suaveolens</i>	Sweet Wattle
<i>Aristida vagans</i>	Three-awned Spear Grass
<i>Austrodanthonia fulva var. fulva</i>	Wallaby Grass
<i>Austrostipa scabra</i>	Speargrass
<i>Banksia ericifolia</i>	Heath Banksia
<i>Banksia oblongifolia</i>	Fern-leaved Banksia
<i>Banksia spinulosa</i>	Hairpin Banksia
<i>Bothriochloa macra</i>	Red Grass
<i>Breynia oblongifolia</i>	Coffee Bush
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Chloris truncata</i>	Windmill Grass
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Daviesia ulicifolia</i>	Gorse Bitter Pea
<i>Dianella caerulea</i>	Flax Lily
<i>Dodonaea triquerta</i>	Hop Bush
<i>Gahnia aspera</i>	Rough Saw-sedge
<i>Gompholobium pinnatum</i>	Pinnate Wedge Pea
<i>Hardenbergia violaceae</i>	False Sarsaparilla
<i>Imperata cylindrica</i>	Blady Grass
<i>Indigofera australis</i>	Austral Indigo
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Lomandra longifolia</i>	Mat Rush
<i>Melaleuca nodosa</i>	Ball Honey-myrtle
<i>Ozothamnus diosmifolius</i>	Rice Flower
<i>Persoonia stradbokensis</i>	Geebung
<i>Pultenaea spinosa</i>	Spiny Bush-Pea
<i>Pultenaea villosa</i>	Hairy Bush-Pea
<i>Sannantha similis</i> ( <i>Baeckea virgata</i> )	Tall Baeckea

Botanical Name	Common Name
<i>Themeda triandra</i>	Kangaroo Grass
<i>Eucalyptus pilularis</i>	Blackbutt
<i>Corymbia gummifera</i>	Red Bloodwood
<i>Eucalyptus resinifera ssp hemilampra</i>	Red Mahogany
<i>Banksia integrifolia</i>	Coast Banksia

Table 13: Seed Mix Type A3 sections 3 and 4 Grey Ironbark – Grey Gum open forest – Grey Ironbark – Pink Bloodwood – Tallowwood moist open forest – Narrow-leaved Ironbark dry open forest seeding mix.

This seed mix is for use in areas mapped as Grey Gum - Grey Ironbark open forest, Narrow-leaved ironbark dry open forest of the Clarence lowlands of the North Coast and Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the North Coast.

Botanical Name	Common Name
<b>Tree seed mix</b>	
<i>Acacia brownii</i>	Heath Wattle
<i>Acacia falcata</i>	Wattle
<i>Acacia irrorata</i>	Green Wattle
<i>Acacia myrtifolia</i>	Red-stemmed Wattle
<i>Acacia suaveolens</i>	Sweet Wattle
<i>Allocasuarina torulosa</i>	Forest She Oak
<i>Archirodomyrtus beckleri</i>	Rose Myrtle
<i>Aristidia vagans</i>	Three-awned Spear Grass
<i>Austrodanthonia fulva var. fulva</i>	Wallaby Grass
<i>Austrostipa scabra</i>	Speargrass
<i>Bothriochloa macra</i>	Red Grass
<i>Breynia oblongifolia</i>	Coffee Bush
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Chloris truncata</i>	Windmill Grass
<i>Corymbia intermedia</i>	Pink Bloodwood
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Daviesia ulicifolia</i>	Gorse Bitter Pea
<i>Desmodium rhytidophyllum or varians</i>	Tick trefoil
<i>Dianella caerulea</i>	Flax Lily
<i>Dodonaea triquerta</i>	Hop Bush
<i>Entolasia stricta</i>	Wiry Panic
<i>Eucalyptus acmenoides</i>	White Mahogany
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark
<i>Eucalyptus microcorys</i>	Tallowwood
<i>Eucalyptus propinqua</i>	Grey Gum
<i>Eucalyptus siderophloia</i>	Grey Ironbark
<i>Gahnia aspera</i>	Rough Saw-sedge
<i>Glycine clandestina</i>	

Botanical Name	Common Name
<i>Gompholobium pinnatum</i>	Pinnate Wedge Pea
<i>Hardenbergia violacea</i>	Native Sarsasparilla
<i>Hibbertia scandens</i>	Climbing Guinea Flower
<i>Imperata cylindrica</i>	Blady Grass
<i>Indigofera australis</i>	Austral Indigo
<i>Lepidosperma laterale</i>	Variable Saw-sedge
<i>Lohostemon confertus</i>	Brush Box
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Lomandra longifolia</i>	Mat Rush
<i>Melaleuca nodosa</i>	Ball Honey-myrtle
<i>Ozothamnus diosmifolius</i>	Rice Flower
<i>Polyscias elegans</i>	Celerywood
<i>Pultenaea spinosa</i>	Spiny Bush-Pea
<i>Pultenaea villosa</i>	Hairy Bush-Pea
<i>Sannantha similis(Baekkea virgata)</i>	Tall Baeckea
<i>Themeda triandra</i>	Kangaroo Grass
<i>Vernonia cinerea</i>	Daisy

Table 14: Seed Mix Type A4 sections 3 and 4 – Forest Red Gum – Swamp Box seeding mix.

This vegetation community is an EEC (Subtropical Coastal Floodplain Forest on Coastal Floodplains). This seed mix is for use in areas mapped as Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast and Swamp Box Swamp Forest of the coastal lowlands of the North Coast.

Botanical Name	Common Name
<b>Tree seed mix</b>	
<i>Aristidia vagans</i>	Three-awned Spear Grass
<i>Austrodanthonia fulva var. fulva</i>	Wallaby Grass
<i>Austrostipa scabra</i>	Speargrass
<i>Bothriochloa macra</i>	Red-leg Grass
<i>Eucalyptus tereticornis</i>	Forest Red Gum
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Chloris truncata</i>	Windmill Grass
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Dianella caerulea</i>	Flax Lily
<i>Gahnia aspera</i>	Rough Saw-sedge
<i>Hardenbergia violacea</i>	False Sarsaparilla
<i>Imperata cylindrica</i>	Blady Grass
<i>Indigofera australis</i>	Austral Indigo
<i>Lomandra longifolia</i>	Mat Rush
<i>Callistemon salignus</i>	Willow Bottlebrush
<i>Lohostemon suaveolens</i>	Swamp Box
<i>Themeda triandra</i>	Kangaroo Grass

Table 15: Seed Mix Type A5 sections 3 and 4 – Turpentine moist open forest seeding mix.

This seed mix is for use in areas mapped as Turpentine moist open forest of the coastal hills and ranges of the North Coast vegetation community.

Botanical Name	Common Name
<b>Tree seed mix</b>	
<i>Acacia brownii</i>	Heath Wattle
<i>Acacia falcata</i>	Wattle
<i>Acacia myrtifolia</i>	Red-stemmed Wattle
<i>Acacia suaveolens</i>	Sweet Wattle
<i>Aristida vagans</i>	Three-awned Spear Grass
<i>Austrodanthonia fulva var. fulva</i>	Wallaby Grass
<i>Austrostipa scabra</i>	Speargrass
<i>Bothriochloa macra</i>	Red Grass
<i>Breynia oblongifolia</i>	Coffee Bush
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Chloris truncata</i>	Windmill Grass
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Daviesia ulicifolia</i>	Gorse Bitter Pea
<i>Dianella caerulea</i>	Flax Lily
<i>Dodonaea triquetra</i>	Hop Bush
<i>Gahnia aspera</i>	Rough Saw-sedge
<i>Gompholobium pinnatum</i>	Pinnate Wedge Pea
<i>Hardenbergia violaceae</i>	False Sarsaparilla
<i>Imperata cylindrica</i>	Blady Grass
<i>Indigofera australis</i>	Austral Indigo
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Lomandra longifolia</i>	Mat Rush
<i>Melaleuca nodosa</i>	Ball Honey-myrtle
<i>Ozothamnus diosmifolius</i>	Rice Flower
<i>Pultenaea spinosa</i>	Spiny Bush-Pea
<i>Pultenaea villosa</i>	Hairy Bush-Pea
<i>Sannantha similis</i> ( <i>Baeckea virgata</i> )	Tall Baeckea

Botanical Name	Common Name
<i>Themeda triandra</i>	Kangaroo Grass
<i>Elaeocarpus reticulatus</i> ,	Blueberry Ash
<i>Archirhodomertus beckleri</i>	Rose Myrtle
<i>Synoum glandulosum</i>	Scentless Rosewood
<i>Syncarpia glomulifera</i>	Turpentine Tree
<i>Syncarpia glomulifera</i>	Turpentine Tree

Table 16: Seed Mix Type A6 sections 3 and 4 Paperbark swamp forest and Swamp Mahogany Swamp Forest seeding mix.

These vegetation communities are EEC's (Freshwater Wetlands on Coastal Floodplains) or (Swamp Sclerophyll Swamp Forest on Coastal Floodplain). This seed mix is for use in areas mapped as Paperbark swamp forest or Swamp Mahogany swamp forest of the coastal lowlands of the North Coast.

Botanical Name	Common Name
<b>Tree seed mix</b>	
<i>Aristida vagans</i>	Three-awned Spear Grass
<i>Austrodanthonia fulva var. fulva</i>	Wallaby Grass
<i>Austrostipa scabra</i>	Speargrass
<i>Bothriocloa macra</i>	Red-leg Grass
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Chloris truncata</i>	Windmill Grass
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Themeda triandra</i>	Kangaroo Grass
<i>Juncus usitatus</i>	Common Rush
<i>Ficinia nodosa</i>	Knobby Club Rush
<i>Imperata cylindrica var. major</i>	Blady Grass
<i>Philydrum lanuginosum</i>	Woolly Waterlily
<i>Schoenoplectus mucronatus</i>	Bog Bulrush
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Acacia longifolia</i>	Golden Wattle
<i>Carex appressa</i>	Tall Sedge
<i>Dianella caerulea</i>	Blue Flax-Lily
<i>Eucalyptus resinifera subsp. hemilampra</i>	Red Mahogany
<i>Eucalyptus robusta</i>	Swamp Mahogany
<i>Gahnia clarkei</i>	Saw Sedge
<i>Gahnia sieberiana</i>	Red-Fruit Saw-Sedge
<i>Glochidion ferdinandi</i>	Cheese Tree
<i>Imperata cylindrica var. major</i>	Blady Grass
<i>Leptospermum polygalifolium subsp. Polygalifolium</i>	Tantoon
<i>Livistona australis</i>	Cabbage Tree Palm
<i>Lophostemon suaveolens</i>	Swamp Mahogany

Botanical Name	Common Name
<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark
<i>Melaleuca nodosa</i>	Prickly-leaved Paperbark
<i>Melaleuca quinquenervia</i>	Brod-leaved Paperbark
<i>Melaleuca sieberi</i>	Sieber's Paperbark
<i>Melaleuca sieberi</i>	Sieber's Paperbark

Table 17: Seed Mix Type A7 sections 3 and 4 – Swamp Oak Swamp Forest seeding mix.

This vegetation community is an EEC (Swamp Oak Floodplain Forest on Coastal Floodplains). This seed mix is for use in areas mapped as Swamp Oak Swamp Forest.

Botanical Name	Common Name
<b>Tree seed mix</b>	
<i>Casuarina glauca</i>	Swamp Oak
<i>Acmena smithii</i>	Lilly Pilly
<i>Melaleuca alternifolia</i>	Narrow-leaved Paperbark
<i>Aristida vagans</i>	Three-awned Spear Grass
<i>Austrodanthonia fulva var. fulva</i>	Wallaby Grass
<i>Austrostipa scabra</i>	Speargrass
<i>Bothriocloa macra</i>	Red-leg Grass
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Chloris truncata</i>	Windmill Grass
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Carex appressa</i>	Tall Sedge
<i>Juncus usitatus</i>	Common Rush
<i>Lomandra hystrix</i>	Mat-rush
<i>Imperata cylindrica</i>	Blady Grass
<i>Themeda triandra</i>	Kangaroo Grass



Table 18: Seed Mix Type A8 sections 3 and 4 – Spotted Gum – Grey Ironbark – Pink Bloodwood - Grey Box seeding mix.

This seed mix is for use in areas mapped as Spotted Gum – Grey Ironbark – Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast and Spotted Gum – Grey Box – Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast vegetation communities.

Botanical Name	Common Name
<b>Tree seed mix</b>	
<i>Acacia irrorata</i>	Green Wattle
<i>Corymbia intermedia</i>	Pink Bloodwood
<i>Corymbia variegata</i>	Spotted Gum
<i>Eucalyptus microcarpa</i>	Grey Box
<i>Eucalyptus paniculata</i>	Grey Ironbark
<i>Eucalyptus propinqua</i>	Grey Gum
<i>Syncarpia glomulifera</i>	Turpentine
<i>Allocasuarina torulosa</i>	Forest She Oak
<i>Acacia brownii</i>	Heath Wattle
<i>Acacia falcata</i>	Wattle
<i>Acacia myrtifolia</i>	Red-stemmed Wattle
<i>Acacia suaveolens</i>	Sweet Wattle
<i>Aristida vagans</i>	Three-awned Spear Grass
<i>Austrodanthonia fulva var. fulva</i>	Wallaby Grass
<i>Austrostipa scabra</i>	Speargrass
<i>Bothriochloa macra</i>	Red Grass
<i>Breynia oblongifolia</i>	Coffee Bush
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Chloris truncata</i>	Windmill Grass
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Daviesia ulicifolia</i>	Gorse Bitter Pea
<i>Dianella caerulea</i>	Flax Lily
<i>Dodonaea triquerta</i>	Hop Bush
<i>Gahnia aspera</i>	Rough Saw-sedge
<i>Gompholobium pinnatum</i>	Pinnate Wedge Pea
<i>Hardenbergia violaceae</i>	False Sarsaparilla

Botanical Name	Common Name
<i>Imperata cylindrica</i>	Blady Grass
<i>Indigofera australis</i>	Austral Indigo
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Lomandra longifolia</i>	Mat Rush
<i>Melaleuca nodosa</i>	Ball Honey-myrtle
<i>Ozothamnus diosmifolius</i>	Rice Flower
<i>Pultenaea spinosa</i>	Spiny Bush-Pea
<i>Pultenaea villosa</i>	Hairy Bush-Pea
<i>Sannantha similis(Baekkea virgata)</i>	Tall Baekkea
<i>Themeda triandra</i>	Kangaroo Grass

Table 19: Seed Mix Type A9 sections 3 and 4 – Scribbly Gum – Needlebark Stringybark – Red Bloodwood heathy open forest seeding mix.

This seed mix is for use in areas mapped as Scribbly Gum - Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast and Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the North Coast.

Botanical Name	Common Name
<b>Tree seed mix</b>	
<i>Acacia brownii</i>	Heath Wattle
<i>Acacia falcata</i>	Wattle
<i>Acacia myrtifolia</i>	Red-stemmed Wattle
<i>Aristida vagans</i>	Three-awned Spear Grass
<i>Austrodanthonia fulva var. fulva</i>	Wallaby Grass
<i>Austrostipa scabra</i>	Speargrass
<i>Banksia oblongifolia</i>	Fern-leaved Banksia
<i>Banksia spinulosa</i>	Hairpin Banksia
<i>Bothriochloa macra</i>	Red Grass
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Chloris truncata</i>	Windmill Grass
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Daviesia ulicifolia</i>	Gorse Bitter Pea
<i>Dianella caerulea</i>	Flax Lily
<i>Gahnia aspera</i>	Rough Saw-sedge
<i>Gompholobium pinnatum</i>	Pinnate Wedge Pea
<i>Hardenbergia violaceae</i>	False Sarsaparilla
<i>Lomandra longifolia</i>	Mat Rush
<i>Melaleuca nodosa</i>	Ball Honey-myrtle
<i>Pimelia linifolia</i>	SlenderRice Flower
<i>Pultenaea myrtoides</i>	Bush-Pea
<i>Pultenaea retusa</i>	Notched Bush-Pea
<i>Sannantha similis</i> ( <i>Baekkea virgata</i> )	Tall Baekkea
<i>Themeda triandra</i>	Kangaroo Grass

Botanical Name	Common Name
<i>Eucalyptus planchoniana</i>	Needlebark Stringybark
<i>Corymbia gummifera</i>	Red Bloodwood
<i>Eucalyptus signata</i>	Scribbly Gum
<i>Allocasuarina littoralis</i>	Black She Oak
<i>Allocasuarina littoralis</i>	Black She Oak

Table 20: Seed Mix Type A10 sections 3 and 4 – frangible shrubs seeding mix.

This seed mix is for use in the following communities where frangible shrubs are required:

- Angophora robur Shrubby Forest
- Blackbutt - Bloodwood dry heathy open forest
- Grey Gum - Grey Ironbark open forest
- Pink Bloodwood - Tallowwood moist open forest
- Turpentine moist open forest
- Spotted Gum - Grey Ironbark - Pink Bloodwood open forest
- Spotted Gum - Grey Box - Grey Ironbark dry open forest
- Scribbly Gum - Needlebark Stringybark heathy open forest
- Scribbly Gum - Red Bloodwood heathy open forest.

Botanical Name	Common Name
<b>Frangible shrub seed mix</b>	
<i>Acacia brownii</i>	Heath Wattle
<i>Acacia complanata</i>	Flat-stemmed Wattle
<i>Acacia falcata</i>	Wattle
<i>Acacia myrtifolia</i>	Red-stemmed Wattle
<i>Aristida vagans</i>	Three-awned Spear Grass
<i>Austrodanthonia fulva var. fulva</i>	Wallaby Grass
<i>Austrostipa scabra</i>	Speargrass
<i>Banksia ericifolia</i>	Heath Banksia
<i>Banksia oblongifolia</i>	Fern-leaved Banksia
<i>Banksia spinulosa var. collina</i>	Hill Banksia
<i>Bothriocloa macra</i>	Red-leg Grass
<i>Breynia oblongifolia</i>	Coffee Bush
<i>Callistemon salignus</i>	Willow Bottlebrush
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Carex appressa</i>	Tall Sedge
<i>Chloris truncata</i>	Windmill Grass
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Daviesia ulicifolia</i>	Gorse Bitter Pea
<i>Dianella caerulea</i>	Flax Lily

Botanical Name	Common Name
<i>Dodonaea triquetra</i>	Hop Bush
<i>Ficinia nodosa</i>	Knobby Club Rush
<i>Gahnia aspera</i>	Rough Saw-sedge
<i>Gahnia sieberana</i>	Red-fruit Saw-sedge
<i>Gompholobium pinnatum</i>	Pinnate Wedge Pea
<i>Hardenbergia violaceae</i>	False Sarsaparilla
<i>Imperata cylindrica var. major</i>	Blady Grass
<i>Indigofera australis</i>	Austral Indigo
<i>Juncus usitatus</i>	Common Rush
<i>Lambertia formosa</i>	Mountain Devil
<i>Leptospermum polygalifolium</i>	Tantoon
<i>Leptospermum trinervium</i>	Paperbark Teatree
<i>Lomandra hystrix</i>	Spiny Head Mat Rush
<i>Lomandra longifolia</i>	Mat Rush
<i>Melaleuca nodosa</i>	Ball Honey-myrtle
<i>Ozothamnus diosmifolius</i>	Rice Flower
<i>Pultenaea spinosa</i>	Spiny Bush-Pea
<i>Pultenaea villosa</i>	Hairy Bush-Pea
<i>Sannantha similis (Baeckea virgata)</i>	Tall Baeckea
<i>Themeda triandra</i>	Kangaroo Grass

Table 21: Seed Mix Type A11 Sections 3 and 4 – vegetated drainage channels seeding mix.

This seed mix is for use in vegetated drainage channels (Jute Lined).

Botanical Name	Common Name
<b>Native grass seed mix</b>	
<i>Aristida vagans</i>	Three-awned Spear Grass
<i>Austrodanthonia fulva var. fulva</i>	Wallaby Grass
<i>Austrostipa scabra</i>	Speargrass
<i>Bothriocloa macra</i>	Red-leg Grass
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Chloris truncata</i>	Windmill Grass
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Dianella caerulea</i>	Blue Flax-Lily
<i>Ficinia nodosa</i>	Knobby Club-rush
<i>Imperata cylindrica var. major</i>	Blady Grass
<i>Juncus usitatus</i>	Common Rush
<i>Iperionia articulata</i>	Grey Sedge
<i>Philydrum lanuginosum</i>	Woolly Waterlily
<i>Schoenoplectus mucronatus</i>	Bog Bulrush
<i>Themeda triandra</i>	Kangaroo Grass
<i>Themeda triandra</i>	Kangaroo Grass

Table 22: Seed Mix Type A12 sections 3 and 4 – native grasses seeding mix.

This seed mix is for use in areas shown as native grasses where mowing may be required.

Botanical Name	Common Name
<b>Native grass seed mix</b>	
<i>Aristida vagans</i>	Three-awned Spear Grass
<i>Austrodanthonia fulva var. fulva</i>	Wallaby Grass
<i>Austrostipa scabra</i>	Speargrass
<i>Bothriocloa macra</i>	Red-leg Grass
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Chloris truncata</i>	Windmill Grass
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Imperata cylindrica var. major</i>	Blady Grass
<i>Themeda triandra</i>	Kangaroo Grass

Table 23: Seed Mix Type A13 sections 3 and 4 – native grasses seeding mix.

This seed mix is for use in the following communities where frangible shrubs are not used because they have an open understorey :

- Forest Red Gum – Swamp Box Forest
- Paperbark Swamp Forest
- Swamp Mahogany Swamp Forest
- Swamp Oak Swamp Forest and for other areas where mowing will not be necessary.

Botanical Name	Common Name
<b>Native grass seed mix</b>	
<i>Aristida vagans</i>	Three-awned Spear Grass
<i>Austrodanthonia fulva var. fulva</i>	Wallaby Grass
<i>Austrostipa scabra</i>	Speargrass
<i>Bothriocloa macra</i>	Red-leg Grass
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Chloris truncata</i>	Windmill Grass
<i>Cymbopogon refractus</i>	Barbed-wire Grass
<i>Themeda triandra</i>	Kangaroo Grass
<i>Carex appressa</i>	Tall Sedge
<i>Juncus usitatus</i>	Common Rush
<i>Lomandra hystrix</i>	Mat-rush
<i>Dianella caerulea</i>	Blue Flax-Lily
<i>Gahnia clarkei</i>	Saw Sedge
<i>Gahnia sieberiana</i>	Red-Fruit Saw-Sedge
<i>Imperata cylindrica var. major</i>	Blady Grass

Table 24: Seed Mix Type A14 sections 3 and 4 – pasture grasses seeding mix.

This seed mix is for use in areas mapped as landscape topsoil or wherever pasture grasses are shown.

Botanical Name	Common Name
<b>Pasture grass seed mix</b>	
<i>Cynodon dactylon</i>	Unhulled Couch
<i>Axonopus fissifolius</i>	Carpet Grass
<i>Echinochloa itilis (Sep-Mar) or Secale cereale (Apr-Aug)</i>	Japanese Millet or Rye Corn
<i>Lolium multiflorum (All Year)</i>	Eclipse Rye
<i>Trifolium pratense</i>	Red Clover

NOTE: Fertilizer to be Organic Slow release for natives (Low P) at rate of 250Kg/Ha.

NOTE: Rest area picnic lawns are to be turfed with Buffalo Turf Grass.

Table 25: Seed Mix Type A15 sections 3 and 4 – median shrubs seeding mix.

This seed mix is for use in the following communities where frangible shrubs are required:

- Angophora robur Shrubby Forest
- Blackbutt – Bloodwood dry heathy open forest
- Grey Gum – Grey Ironbark open forest
- Pink Bloodwood – Tallowwood moist open forest
- Turpentine moist open forest
- Spotted Gum – Grey Ironbark – Pink Bloodwood open forest
- Spotted Gum – Grey Box - Grey Ironbark dry open forest
- Scribbly Gum – Needlebark Stringybark heathy open forest
- Scribbly Gum – Red Bloodwood heathy open forest.

Botanical Name	Common Name
<b>Frangible shrub seed mix</b>	
<i>Acacia brownii</i>	Heath Wattle
<i>Acacia myrtifolia</i>	Red-stemmed Wattle
<i>Banksia oblongifolia</i>	Fern-leaved Banksia
<i>Banksia spinulosa var. collina</i>	Hill Banksia
<i>Breynia oblongifolia</i>	Coffee Bush
<i>Callistemon salignus</i>	Willow Bottlebrush
<i>Capillipedium spicigerum</i>	Scented-top Grass
<i>Carex appressa</i>	Tall Sedge
<i>Daviesia ulicifolia</i>	Gorse Bitter Pea
<i>Dianella caerulea</i>	Flax Lily
<i>Dodonaea triquetra</i>	Hop Bush
<i>Ficinia nodosa</i>	Knobby Club Rush
<i>Gahnia aspera</i>	Rough Saw-sedge
<i>Gahnia sieberana</i>	Red-fruit Saw-sedge
<i>Gompholobium pinnatum</i>	Pinnate Wedge Pea
<i>Indigofera australis</i>	Austral Indigo
<i>Kunzea capitata</i>	Pink Kunzea
<i>Lambertia formosa</i>	Mountain Devil
<i>Leptospermum trinervium</i>	Paperbark Teatree
<i>Lomandra hystrix</i>	Spiny Head Mat Rush

Botanical Name	Common Name
<i>Lomandra longifolia</i>	Mat Rush
<i>Melaleuca nodosa</i>	Ball Honey-myrtle
<i>Melaleuca thymifolia</i>	Thyme Honey-myrtle
<i>Ozothamnus diosmifolius</i>	Rice Flower
<i>Pultenaea spinosa</i>	Spiny Bush-Pea
<i>Pultenaea villosa</i>	Hairy Bush-Pea
<i>Sannantha similis</i> ( <i>Baeckea virgata</i> )	Tall Baeckea

Table 26: Cover crop seeding mix 3 for emu crossing zones.

Botanical Name	Common Name
<i>Echinochloa itilis</i> (Sep-Mar) or <i>Secale cereale</i> (Apr-Aug)	Japanese Millet or Rye Corn
<i>Lolium multiflorum</i> (All Year)	Eclipse/Crusader Rye
<i>Glycine max</i> <i>Avena sativa</i> <i>Lablab purpureus</i> "	Soybean Oats Lablab"
<i>Trifolium pratense</i>	Red Clover

NOTES:

Fertilizer to be Organic Slow release for natives (Low P) at rate of 250Kg/Ha

Eclipse/Crusader Rye and Red clover applied at the rate of 10kg per hectare respectively, must be incorporated into the mix all year round with either Japanese Millet or Rye Corn to provide a semi permanent cover.

Choose one of Soybean Oats or Lablab to include in the mix.

## C Weed species list

The following weeds are declared noxious weeds in the Clarence Valley Council region in which Woolgoolga to Ballina Sections 3 and 4 occur.

Weed control orders and weed control classes referred to here can be found in the Noxious Weeds Act 1993 No 1.

Noxious Weed List 2014 - Order No30.



NOXIOUS WEEDS OFFICE

The following weeds are declared noxious under Section 7 -Mixed Control Orders of the Noxious Weeds Act 1993 no 11. This list is generated from Order No. 30 published in the NSW Government Gazette no. 25, effective 28 February 2014 as declared under authority by the Executive Director, Biosecurity NSW - Department of Primary Industries.

Key to Weeds - each weed has been marked in particular font to demonstrate its presence or absence in the Council area - they are identified as per the examples below:

• Groundsel bush	- known to be present in the Council area
• Water lettuce	- have been found but are rarely encountered
• Siam weed	- not yet found in the Council area.

### Class 1 - State Prohibited Weeds

notifiable

Legal requirements for Noxious Weed Class:-

**The plant must be eradicated from the land and the land kept free of the plant.**

The control objective for this weed class is to prevent the introduction and establishment of those plants in NSW.

Characteristics (as per Section 8 (2) (a)): Class 1 noxious weeds are plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.

Anchored water hyacinth	<i>Elchornia azurea</i>
Black knapweed	<i>Centaurea nigra</i>
Boneseed	<i>Chrysanthemoides monilifera</i> subspecies <i>monilifera</i>
Bridal veil creeper	<i>Asparagus declinatus</i> (syn. <i>Asparagus crispus</i> , <i>Myrsiphyllum declinatum</i> )
Broomrapes	<i>Orobancha</i> spp. except <i>O. minor</i> and <i>O. cernua</i>
Chinese violet	<i>Asystasia gangetica</i> subspecies <i>micrantha</i>
Eurasian water milfoil	<i>Myriophyllum spicatum</i>
Frogbit/Spongeplant	<i>Limnobium laevigatum</i> and <i>L. spongia</i>
Hawflower	<i>Hieracium</i> species
Heteranthera/Kidneyleaf mud plaitain	<i>Heteranthera reniformis</i>
Horsetail	<i>Equisetum</i> species
Hydrocotyl/Water pennywort	<i>Hydrocotyle renunculoides</i>
Hymenachne and hybrids	<i>Hymenachne amplexicaulis</i>
Karoo thorn	<i>Acacia karoo</i>
Kochia	<i>Bassia scoparia</i> except <i>B. s. subtrichophylla</i>
Koster's curse/Clidemia	<i>Clidemia hirta</i>
Lagarosiphon	<i>Lagarosiphon major</i>
Mexican feather grass	<i>Nassella tenuissima</i> (also <i>Stipa tenuissima</i> )
Miconia	<i>Miconia</i> spp.
Mikania vine	<i>Mikania micrantha</i>
Mimosa	<i>Mimosa pigra</i>
Parthenium weed	<i>Parthenium hysterophorus</i>
Pond apple	<i>Annona glabra</i>
Prickly acacia	<i>Acacia nitida</i>
Rubbervine	<i>Cryptostegia grandiflora</i>
Senegal tea plant	<i>Gymnocoronis spilanthoides</i>
Siam weed	<i>Chromolaena odorata</i>
Spotted knapweed	<i>Centaurea stoebe</i> subspecies <i>australis</i> (syn. <i>Centaurea maculosa</i> )
Tropical soda apple	<i>Solanum elaeagnifolium</i>
Water caltrop	<i>Trapa</i> spp.
Water lettuce	<i>Pistia stratiotes</i>
Water soldier	<i>Stratiotes aloides</i>
Witchweed	<i>Striga</i> spp. except native <i>S. parviflora</i>
Yellow burrhead	<i>Limnorchis flava</i>

Noxious Weed List 2014 - Order No30.

### Class 2 - Regionally Prohibited Weeds

notifiable

Legal requirements for Noxious Weed Class:-

**The plant must be eradicated from the land and the land kept free of the plant.**

The control objective for this weed class is to prevent the introduction and establishment of those plants in parts of NSW.

Characteristics (as per Section 8 (2)(b)): Class 2 noxious weeds are plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.

Aleman grass	<i>Echinochloa polystachya</i>
Alligator Weed	<i>Alternanthera philoxeroides</i>
Asparagus fern	<i>Asparagus virgatus</i> (syn. <i>Protasparagus virgatus</i> )
Bellyache bush	<i>Jatropha gossypifolia</i>
Cecropia	<i>Cecropia</i> spp.
Climbing asparagus	<i>Asparagus africanus</i> (syn. <i>Protasparagus africanus</i> )
Grey willow	<i>Salix cinerea</i>
Hydrophila	<i>Hydrophila costata</i>
Long-leaf willow primrose	<i>Ludwigia longifolia</i>
Ming (Pom pom/zig zag)	<i>Asparagus macowanii</i> var. <i>zuluensis</i> (syn. <i>A. retrofractus</i> )
Paper mulberry	<i>Broussonetia papyrifera</i>
Sicklethorn	<i>Asparagus falcatus</i>

### Class 3 - Regionally Controlled Weeds - Part 1

Legal requirements for Noxious Weed Class:-

**The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed.**

The control objective for this weed class is to reduce the area and the negative impact of those plants in parts of NSW.

Characteristics (as per Section 8(2)(c)): Class 3 noxious weeds are plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.

Chinese celtis	<i>Celtis sinensis</i>
Cockspur coral tree	<i>Erythrina crista-galli</i>
East Indian hygrophila	<i>Hygrophila polysperma</i>
Honey locust	<i>Gleditsia triacanthos</i>
Mahonia/ Chinese holly	<i>Berberis lomanifolia</i> (syn. <i>Mahonia lomanifolia</i> )
Montpellier broom/Cape broom	<i>Genista monspessulana</i>
Mother-of-Millions	<i>Bryophyllum delaremontianum</i> , <i>Bryophyllum delagoense</i> , <i>Bryophyllum x houghtonii</i> , <i>Bryophyllum pinnatum</i> , <i>Bryophyllum prolifer</i>
White blackberry/Mysore raspberry	<i>Rubus niveus</i>

Noxious Weed List 2014 - Order No30.

**Class 3 – Regionally Controlled Weeds – Part 2**

**Legal requirements for Noxious Weed Class:-**

**The plant must be fully and continuously suppressed and destroyed.**

The control objective for this weed class is to reduce the area and the negative impact of those plants in parts of NSW.

Characteristics (as per Section 8(2)(c)): Class 3 noxious weeds are plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.

Broad-leaf pepper tree	<i>Schinus terebinthifolius</i>
Chinese tallow tree	<i>Triadica sebifera</i>
Giant devils fig	<i>Solanum chrysotrichum</i>
Giant rat's tail grass	<i>Sporobolus pyramidatus</i>
Green cestrum	<i>Cestrum parqui</i>
Groundsel bush	<i>Baccharis halimifolia</i>
Kudzu	<i>Pueraria lobata</i>
Mysore thorn	<i>Caesalpinia decapetala</i>
Salvinia	<i>Salvinia molesta</i>
Yellow bells	<i>Tecoma stana</i>

**Class 4 – Locally Controlled Weeds**

**Legal requirements for Noxious Weed Class:-**

**The growth of the plant must be managed in a manner that continuously inhibits its reproduction.**

**Note: Where indicated - # - The plant may not be sold, propagated or knowingly distributed (whole of NSW).**

The control objective for this weed class is to minimise the negative impact of those plants on the economy, community or environment of NSW.

Characteristics (as per Section 8 (2)(d)): Class 4 noxious weeds are plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.

Bathurst/ Noogoora burrs	<i>Xanthium</i> spp.
Bitou bush #	<i>Chrysanthemoides monilifera</i> subspecies <i>rotundata</i>
Black willow #	<i>Salix nigra</i>
Blackberry #	<i>Rubus fruticosus</i> aggregate spp. except cultivars
Camphor laurel #	<i>Cinnamomum camphora</i>
Cat's claw creeper	<i>Dolichandra unguis-cati</i> (syn. <i>Macfadyena unguis-cati</i> )
Chilean needle grass #	<i>Nassella neesiana</i>
Hamisia cactus #	<i>Hamisia</i> spp.
Lantana #	<i>Lantana</i> spp.
Madeira vine	<i>Anredera cordifolia</i>
Pampas grass	<i>Cortaderia</i> spp.
Prickly pear	<i>Cylindropuntia</i> spp.
Prickly pear	<i>Opuntia</i> spp. except <i>O. ficus-indica</i>
Privet (Broad leaf)	<i>Ligustrum lucidum</i>
Privet (Narrow leaf/Chinese)	<i>Ligustrum sinense</i>
Rhus tree #	<i>Toxicodendron succedaneum</i>
Serrated tussock #	<i>Nassella trichotoma</i>
St John's wort #	<i>Hypericum perforatum</i>
Water hyacinth #	<i>Eichhornia crassipes</i> (Class 2 elsewhere in state)

Noxious Weed List 2014 - Order No30.

**Note: Class 4 Weeds where # is only legal requirement:**

African boxthorn	<i>Lycium ferocissimum</i>
Arrowhead	<i>Sagittaria calycina</i> (syn. <i>S. montevidensis</i> )
Asparagus	<i>Asparagus</i> spp. (except those listed above)
Bridal creeper	<i>Asparagus asparagoides</i>
Climbing asparagus fern	<i>Asparagus plumosus</i> (syn. <i>Protasparagus plumosus</i> )
Fireweed	<i>Senecio madagascariensis</i>
Flax-leaf broom	<i>Genista linifolia</i>
Giant reed/ Elephant grass	<i>Arundo donax</i>
Ground asparagus	<i>Asparagus aethiopicus</i> (syn. <i>Protasparagus aethiopicus</i> )
Leafy elodea/Dense waterweed	<i>Egeria densa</i>
Lippia	<i>Phylla canescens</i>
Sagittaria	<i>Sagittaria platyphylla</i> (syn. <i>Sagittaria graminea</i> variety <i>platyphylla</i> )
Scotch broom/ English broom	<i>Cytisus scoparius</i> subspecies <i>scoparius</i>
Silver-leaf nightshade	<i>Solanum elaeagnifolium</i>
Willows	<i>Salix</i> species except <i>S. babylonica</i> , <i>S. x reichardii</i> , <i>S. x calodendron</i> , <i>S. cinerea</i> and <i>S. nigra</i>

**Class 5 – Restricted Plants**

notifiable

**Legal requirements for Noxious Weed Class:-**

**The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with.**

The control objective for this weed control class is to prevent the introduction of those plants into NSW, the spread of those plants within NSW or from NSW to another jurisdiction.

Characteristics (as per Section 8 (2)(e)):

Class 5 noxious weeds are plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.

African feather grass	<i>Cenchrus macrourum</i> (syn. <i>Pennisetum macrourum</i> )
African turnip weed	<i>Sisymbrium thellungii</i> and <i>S. runcinatum</i>
Annual ragweed	<i>Ambrosia artemisiifolia</i>
Artichoke thistle	<i>Cynara cardunculus</i>
Athel pine	<i>Tamarix aphylla</i>
Bear-skin fescue	<i>Festuca gauderi</i>
Burr ragweed	<i>Ambrosia confertiflora</i>
Cabomba	All <i>Cabomba</i> species except <i>C. furcata</i>
Cayenne snakeweed	<i>Stachytarpheta cayennensis</i>
Clockweed	<i>Oenothera curtiflora</i> (syn. <i>Gaura parviflora</i> )
Corn sowthistle	<i>Sonchus arvensis</i>
Dodder	<i>Cuscuta</i> spp. except <i>C. australis</i> , <i>C. tasmanica</i> and <i>C. victoriana</i>
Espartillo	<i>Amelichloa brachychaeta</i> , <i>Amelichloa caudata</i>
Fine-bristled burr grass	<i>Cenchrus brownii</i>
Fountain grass	<i>Cenchrus setaceum</i> (syn. <i>Pennisetum setaceum</i> )
Gallon's curse	<i>Cenchrus biflorus</i>
Gamba grass	<i>Andropogon gayanus</i>
Glaucous star thistle	<i>Carthamus glaucus</i>
Golden thistle	<i>Scalymus hispanicus</i>
Mexican poppy	<i>Argemone mexicana</i>
Mossman River grass	<i>Cenchrus echinatus</i>
Red rice	<i>Oryza rufipogon</i>
Smooth-stemmed turnip	<i>Brassica barrelieri</i> sub <i>oxymirna</i>
Soldier thistle	<i>Picnomon acarna</i>
Texas blueweed	<i>Helianthus ciliaris</i>
Yellow nutgrass	<i>Cyperus esculentus</i>

## D SPIR environmental measures

Table 1: SPIR environmental measures.

Issue	ID number	Previous number	Environmental management measure	Timing	Relevant	Applicable to sections 3 and 4
Noise wall visual impacts	UD1	UD1	If further noise modelling identifies that noise walls are required, further visual assessment address the visual implications of the change. Their location and design will be in accordance with the Noise Wall Design Guideline (RTA, 2007) and the principles identified in Working Paper – Urban design, Landscape Character and Visual Impact (Section 4.6.3).	Pre-construction	All	Investigations are currently underway by engineers based on new noise model to determine the requirements for noise walls. Noise modelling studies are subject to detailed design development and consultation with communities (Chapter 8.3.3).
Landscaping and planting strategy	UD3	UD3	The project will be carried out in accordance with the urban design and landscaping strategy, as identified in Section 11.4.1 of this EIS. Detailed landscape design for all project batters, and median planting areas will be developed in accordance with the Landscape Guidelines (RTA, 2008), the requirements of the Working Paper – Biodiversity (Section 5.2.2) and the landscape strategy to provide a robust, successful and effective planting design.	Pre-construction	All	The urban design concept plans are based on the strategies identified in the EIS and SPIR documents (Chapter 7).
Design of urban design features and road furniture	UD4	UD5	<p>The built form of the project, including consideration of the height, bulk, scale, materials and finishes for:</p> <ul style="list-style-type: none"> <li>• Bridges</li> <li>• Retaining walls</li> <li>• Cuttings and embankments</li> <li>• Road barriers</li> <li>• Signage</li> <li>• Fences</li> <li>• Clear zones</li> <li>• Topsoil management</li> <li>• Water quality control ponds</li> <li>• Fauna crossing</li> <li>• Place marking and cultural plantings.</li> </ul> <p>The project will be designed in accordance with the design principles identified in Working Paper – Urban Design, Landscape Character and Visual Impact, and relevant Roads and Maritime guidelines.</p>	Pre-construction	All	The design adopts a consistent approach to ensure all project elements are integrated in terms of their overall composition, materials and finishes (Chapter 9).



Issue	ID number	Previous number	Environmental management measure	Timing	Relevant	Applicable to sections 3 and 4
Visual impacts from viewpoints	UD6	UD7	Measures to mitigate visual impacts to viewpoints will be implemented, as identified in Table 11-42 and Working Paper – Urban Design, Landscape Character and Visual Impact. If any further viewpoints were identified during detailed design that have a moderate–high or high impact, screen planting also be considered.	Construction	All	An assessment with EIS and SPIR visual assessment is illustrated and a summary is provided (Chapter 6 and Chapter 7).
Visual impacts of ancillary facilities	UD8	UD9	Where required, typical landscape treatments for ancillary facilities in forest areas will include: <ul style="list-style-type: none"> <li>• Providing screen planting</li> <li>• Considering reinstatement of disturbed forest in heavily forested</li> <li>• Considering the importance of the visual landscape at each location and allowing restoration of important forest vegetation to prominent ridge lines or other landscape elements where feasible and reasonable.</li> <li>• Negotiating with private landowners, as applicable, to determine future treatments for other non-forested ancillary facility locations</li> <li>• Re-grading disturbed areas to achieve a sustainable and functional landform</li> <li>• Stabilising all surfaces in accordance with good engineering and environmental practice</li> </ul>	Construction	All	A strategy for dealing visual impacts is indicated in Chapter 6 and Chapter 7.
Visual impacts of ancillary facilities	UD9	UD10	Typical landscape treatments for ancillary facilities in agricultural areas will include: <ul style="list-style-type: none"> <li>• Considering returning remnant agricultural land to agricultural uses</li> <li>• Providing screen planting</li> <li>• Reinstating riparian vegetation through ancillary facilities, where practicable, in the open landscape</li> <li>• Considering the visual landscape at each ancillary facility and considering restoration of important forest vegetation to prominent ridge lines or other landscape elements where feasible and reasonable</li> <li>• Re-grading disturbed areas to achieve a sustainable and functional landform</li> <li>• Stabilising all surfaces in accordance with good engineering and environmental practice.</li> </ul>	Construction	All	A strategy for dealing visual impacts is indicated in Chapter 6 and Chapter 7.

## E Compliance with threatened species management plans

Table 1: Mitigation measures related to landscape and urban design applicable to Sections 3 and 4.

Threatened Species Management Plan Compliance	Mitigation measures related to landscape and urban design that are applicable to Sections 3 and 4	Threatened Species Management Plan Compliance	Mitigation measures related to landscape and urban design that are applicable to Sections 3 and 4
Threatened flora management plan.	<p>Targeted weed management measures will be considered for each section for the project where there are threatened plant species being managed in-situ. The 'weed management zones' will be clearly identified and targeted weed control methods will be described in the CEMP.</p> <p>Revegetation with native species reflective of the local area and pre-disturbed vegetation communities where possible will occur post construction. Revegetation design of areas adjacent to in-situ threatened plant populations will ensure the planting will not impact on the species (eg will not compete for light or moisture) and are consistent with their habitat requirements.</p> <p>Seeds and other propagation material to be collected from threatened plants prior to clearing work.</p>	Threatened frog management plan.	<p>Identify exclusion zones, frog fencing and compensatory pond locations.</p> <p>Install exclusion zones, temporary frog fencing prior to clearing.</p> <p>Install compensatory ponds after clearing complete.</p>
Threatened glider management plan.	<p>Provision of glide poles targeting Yellow-bellied Glider and Squirrel Glider (Chapter 7.1).</p> <p>Implementation of the UDLP that considers threatened glider population, habitat and revegetation of the habitat areas, including strategic revegetation around crossing structures and in disturbed areas.</p>	Coastal emu management plan.	<p>Permanent fauna exclusion fencing throughout Sections 3 and 4.</p> <p>Fauna connectivity structures throughout Sections 3 and 4.</p>
Threatened mammal management plan.	Please refer to Chapter 7.1.	Threatened mammal management plan.	<p>Disturbed known and potential habitat areas within the project are to be revegetated progressively through and at the end of construction.</p> <p>Revegetation around fauna connectivity structures using appropriate habitat species for the targeted threatened mammals.</p>
		Flora translocation strategy.	<p>Translocation of suitable threatened flora species (identified in the Strategy) to the identified receiving sites for the species within each project section. Seed collection, propagation and preparation of the receiving sites is to be in accordance with the guidelines set out in the strategy.</p>

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