Australian Government

BUILDING OUR FUTURE

Woolgoolga to Ballina Pacific Highway upgrade

Draft urban design and landscape plan

NSW MAKING IT HAPPEN

Maclean to Devils Pulpit Sections 5 and 6

Prepared for:

Roads & Maritime

PACIFIC COMPLETE

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Beca

SECTIONS 5 and 6

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EXECUTIVE SUMMARY

Woolgoolga to Ballina Pacific Highway Upgrade

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 Pacific Highway Woolgoolga to Ballina (W2B) project will upgrade approximately 155 kilometres of highway and comprises of the final stretch in the full duplication of the Pacific Highway from Hexham to the Queensland border. The project is approved as State Significant Infrastructure (SSI) under Part 5.1 of the New South Wales *Environmental Planning and Assessment Act 1979*. The project is also approved under the Commonwealth *Environment Protection and Biodiversity Act 1999*.

The project is divided into four portions, with each portion subdivided into sections:

- Glenugie Upgrade to Maclean (Sections 3 and 4) – Portion A
- Maclean to Devils Pulpit (Sections 5, 6 and 6A) – Portion B, excluding the new bridge over the Clarence River at Harwood
- Devils Pulpit Upgrade to Richmond River (Sections 7, 8 and 9) – Portion C
- Richmond River to Ballina Bypass (Sections 10 and 11) – Portion D
- Bridge over Clarence River at Harwood – Portion E
- Richmond River Bridge – Portion F

Purpose

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 UDLP is required to be prepared and implemented before the start of permanent built works and/or landscaping.

The draft UDLP develops the mitigation and management measures identified in the Woolgoolga to Ballina Environmental Impact Statement (EIS) and 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 presents an integrated and detailed urban design and landscape design package specific to Portion B, comprising:

- Maclean to Iluka Road – Section 5
- Iluka Road to Devils Pulpit – Section 6.

The new bridge over the Clarence River at Harwood will be delivered as a separate design package.

Urban design approach

The draft UDLP is prepared in relation to the *Woolgoolga to Ballina Communications and Stakeholder Engagement Strategy*. It is also prepared in accordance with the landscape and urban design guidelines, principles and strategies presented in the following documents:

- *Pacific Highway Urban Design Framework* (Roads and Maritime 2013)
- Pacific Highway Upgrade Woolgoolga to Ballina EIS, particularly
  - Main Volume 1B, Chapter 11: Urban design, landscape character and visual impact
  - *Working paper: Urban design report, landscape character and visual impact assessment* (Hassell 2012)
- *Beyond the Pavement – urban design policy procedures and design principles* (Roads and Maritime 2014).

Additionally, the landscape and urban design presented in this UDLP responds to the requirements of:

- Project Approval Notice dated 14 August 2014. Modification 2 of the Project Approval is dated 7 October 2015
- *Woolgoolga to Ballina Project Development Services Brief* (the Design Brief) Rev A, November 2015
- *Upgrading the Pacific Highway Design Guidelines* (the Design Guidelines), March 2015
- Relevant Roads and Maritime design guidelines and practice notes.

Urban design vision, objectives and principles

The *Pacific Highway Urban Design Framework* (Roads and Maritime 2013) established the following vision for the Pacific Highway:

> *'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.'*

The *Pacific Highway Urban Design Framework* (Roads and Maritime 2013) also identified six urban design objectives to facilitate the achievement of the vision. These are:

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

Subsequently, the W2B EIS established the following urban design principles to guide the development of the W2B upgrade:

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

Figure i-1: (left) *Pacific Highway Urban Design Framework 2013* (right) *Beyond the Pavement*

Context

The study area for Maclean to Iluka Road – Section 5 and Iluka Road to Devils Pulpit – Section 6 is located in the Northern Rivers region of New South Wales. From Maclean to Iluka Road, the study area is strongly characterised by the Clarence River and the agricultural landscape of the lower Clarence Floodplain, while from Iluka Road to Devils Pulpit, it is characterised by the undulating forested landscape of the lower foothills of the Richmond Range. The highway provides access to the adjoining villages of Harwood and Woombah, as well as the towns of Yamba and Iluka on the coast. The town of Maclean is located on the Clarence River immediately southwest of the Maclean to Devils Pulpit study area.

The highway traverses a landscape with significant biodiversity values, including:

- Diverse native vegetation communities, including Endangered Ecological Communities
- Habitat for threatened fauna species, including koalas; regional fauna connectivity corridors
- Regionally significant wetlands
- Class 1 aquatic habitats of the Clarence River and its tributaries.

A number of national parks, state forests, state conservation areas and nature reserves are located adjacent, or in close proximity, to the highway between Maclean and Devils Pulpit.

Chapter 5 of this report provides a detailed discussion of the key environmental, urban and cultural factors and values of the Maclean to Devils Pulpit (Sections 5 and 6) study area. In accordance with the Minister's Conditions of Approval D20, it also identifies landscape and urban design opportunities, constraints and design principles in response to those factors and values for the Maclean to Devils Pulpit (Sections 5 and 6) study area.

The highway upgrade

The Maclean to Iluka Road (Sections 5 and 6) portions of the Pacific Highway Woolgoolga to Ballina (W2B) Upgrade extend over approximately 29.8 km from Maclean (about 46 km north of Grafton) to the Devils Pulpit Upgrade (about 58 km south of Ballina). The highway is to be upgraded to a four lane dual carriageway configuration (two lanes in each direction) with the potential to widen to six lanes in the future.

Maclean to Iluka Road is a technically challenging portion of the W2B project as it spans the Clarence River and surrounding floodplains. Key features include:

- Interchanges at Yamba Road, Harwood, and Iluka Road
- Several local road connections
- Split carriageways and the retention of the existing highway as the new southbound carriageway on Chatsworth Island, Harwood Island and south of the Clarence River
- A new rest area.

As the highway is situated on the Clarence River floodplain, substantial earthworks and numerous new bridges are necessary to achieve the required flood immunity for the upgraded highway. This includes a large cutting south of Mororo Road, which will provide about 1 million cubic metres of fill to facilitate an overall earthworks balance for the Maclean to Iluka Road (Sections 5 and 6) portion of the W2B highway upgrade.

Figure i-2: Artist's impression of highway upgrade through agricultural floodplain on Harwood Island and Chatsworth Island (refer to Chapter 6).

Landscape and urban design concept

The landscape and urban design concept for Maclean to Iluka Road (Sections 5 and 6) is developed in direct response to the Pacific Highway urban design vision and objectives established by the *Pacific Highway Urban Design Framework* (Roads and Maritime 2013), and the project-wide urban design principles established in the W2B EIS. These are discussed in Chapter 4 of this report.

Two additional landscape and urban design principles specific to the Maclean to Iluka Road (Sections 5 and 6) study area are identified in direct response to the specific environmental, cultural and scenic values of the local landscape context. These are:

- To celebrate the 'big landscape' that is the Clarence River floodplain
- To maintain the integrity of existing ecological systems.

From the road users' perspective, the highway upgrade is characterised by the wide, flat, open landscape of the Clarence River Floodplain, which is strongly contrasted with the adjacent forested hills north of the Clarence River North Arm and south of the Clarence River. The landscape and urban design concept aims to reinforce the existing experience of landscape contrasts by:

- Maintaining expansive views from the highway as it traverses the agricultural floodplain between the Maclean Pinnacle and Iluka Road
- Extensive revegetation in the forested areas north and south of the floodplain to maintain the visual enclosure of the highway
- Extensive roadside revegetation throughout the Maclean to Iluka Road (Sections 5 and 6) study area to support biodiversity values such as:
  - Existing vegetation communities, particularly Endangered Ecological Communities
  - Threatened fauna species and their habitat
  - Regional fauna connectivity corridors.

The landscape and urban design concept recognises that the highway interchanges are important place markers along the highway journey that provide an opportunity to signify the specific environmental and cultural values of the communities they support. The landscape and urban design concepts for the three interchanges between Maclean and Devils Pulpit (Sections 5 and 6) respond to their particular local contexts.

The Yamba interchange includes:

- Distinctive marker plantings to create memorable arrival and departure experiences for interchange
- Roadside plantings of locally distinctive tree species along the entry and exit ramps that reference the distinctive street trees of Maclean and Yamba
- Extensive revegetation of Swamp Oak swamp forest and paperbark swamp forest to reinforce the existing vegetation adjacent to the interchange
- Distinctive grid plantings to mark the approaches to the Harwood Bridge and new bridge over the Clarence River.

The Harwood interchange includes:

- Distinctive grid plantings to mark the approach to the Harwood Bridge
- Distinctive grid plantings flanking the approach to the new bridge over the Clarence River, which serve to both screen the nearby residences and to mark the bridge approach for highway users
- Roadside plantings of distinctive local tree species along the on off ramps and local access roads

The Iluka interchange includes:

- Distinctive marker plantings to create memorable arrival and departure experiences for interchange
- Extensive revegetation using Grey Gum – Grey Ironbark forest species to reinforce the existing forest vegetation surrounding the interchange site. The forest revegetation also provides habitat for threatened fauna species identified in the vicinity of the Iluka interchange.

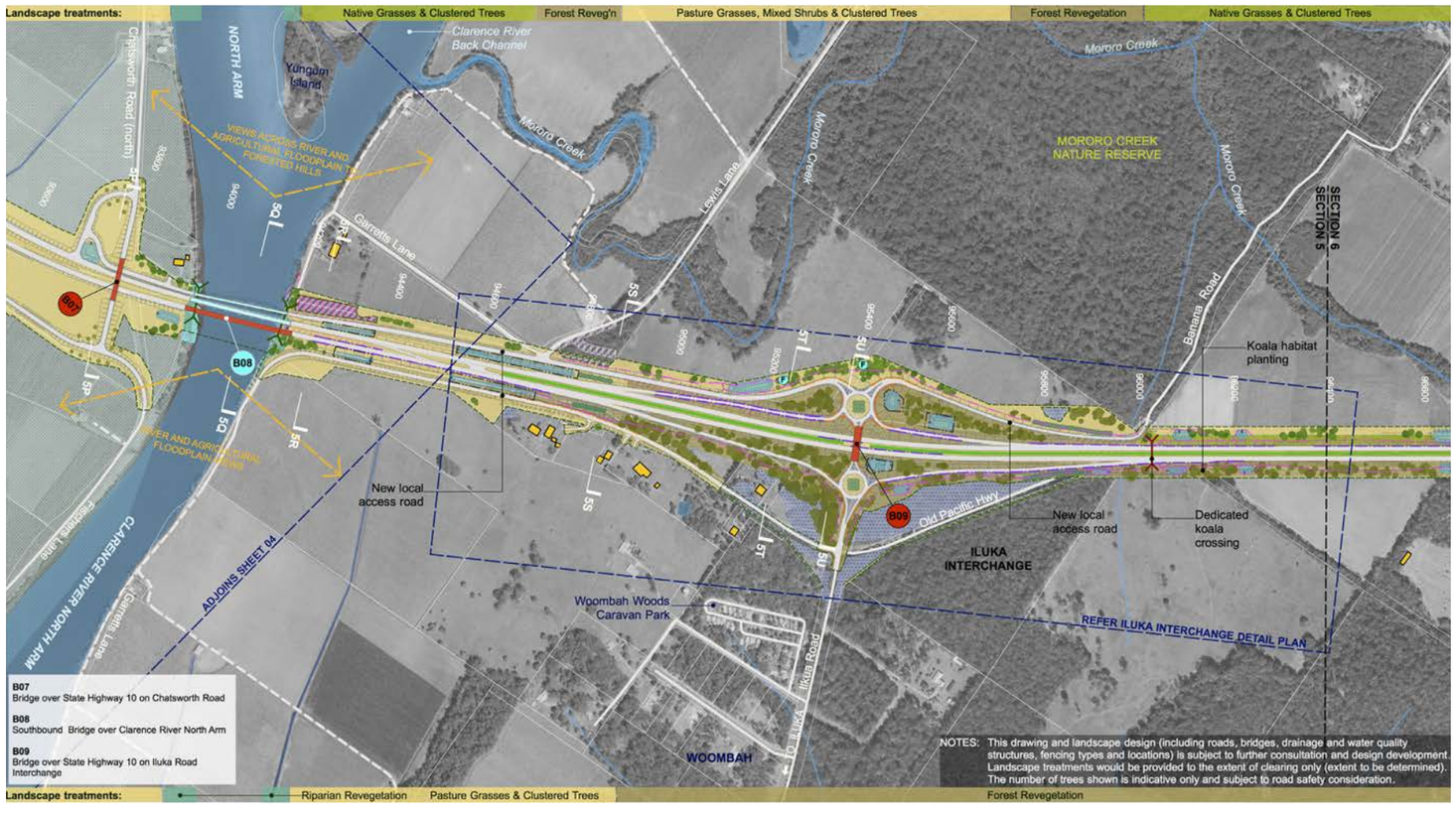

Figure i-3: Landscape and urban design concept plan – at Iluka interchange (refer to Chapter 6)

Figure i-4: Artist's impression of Iluka interchange (refer to Chapter 6)

Landscape character and visual impacts

The draft UDLP re-assesses the impact of the W2B upgrade between Maclean and Devils Pulpit (Sections 5 and 6) on the landscape character precincts and key views identified in the W2B EIS.

The EIS identified ten landscape character precincts between Maclean and Devils Pulpit (Sections 5 and 6). Assessment of the impact of the detailed design concept on these precincts found that there has been no change to the character impacts identified for these precincts at the EIS stage.

The EIS assessed the visual impact of the highway upgrade on 15 key viewpoints identified in Sections 5 and 6. Assessment of the impact of the detailed design concept on these key views has found no change in the visual impacts identified at the EIS stage for 13 of the key views. Of the two key views where impacts have changed:

- Viewpoint 32B has a moderate visual impact, decreasing from a moderate to high impact at the EIS stage
- Viewpoint 34 has a moderate to low visual impact, increasing from a low impact at the EIS stage.

Overall, the detailed design concept for between Maclean and Devils Pulpit (Sections 5 and 6) will have similar landscape character and visual impacts as the EIS concept.

The mitigation measures recommended in the EIS are incorporated into the design presented in the draft UDLP. Additional mitigation measures are also incorporated into the detailed design in response to modifications to the highway design. The additional mitigation measures include:

- Replacement of proposed permanent architectural headlight screens with vegetation screens
- Development of a project-wide bridge strategy to achieve consistent visual expression of the many bridges across the W2B upgrade
- Revegetation to the cut faces and the base of cutting at Mororo Road to achieve a forest outcome.

The landscape and urban design concept strategy and details, including the mitigation measures, are described in Chapters 6, 7 and 8 of this draft UDLP.

Figure i-5: Artist's impression of northbound approach to the new Bridge over the Pacific Highway at Chatsworth Road (refer to Chapter 6)

Figure i-6: Artist's impression of Northbound approach to Iluka interchange (refer to Chapter 6)

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

GLOSSARY

Bioregion	Classification of Australia's landscape into 89 distinct bioregions based on climate, geology, landform and native vegetation and species information. The W2B 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 25-100mm 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 that 100mm at approximately 500mm above ground are considered frangible.
Native Grasses	Grass species that are native to Australia.
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, shrub or tree species.
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.
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.
Natural soils	Soils remaining insitu 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 weed	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. **Pots** are containers with rigid walls, which are identified by their diameter in mm. **Bags** are containers with flexible or woven walls, which are identified by their volume in litres.
Reconstruction	The practice of revegetating areas where the soil profile has been 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 40-50mm or 75mm. Includes individual containers as well as trays, and may have proprietary names.

ABBREVIATIONS

ABJV	Arcadis Beca Joint Venture
CEMP	Construction Environmental Management Plan
CH	Chainage – location reference along the highway alignment
DEC	NSW Department of Environment and Conservation – subsequently DECC
DECC	NSW Department of Environment Climate Change and Water – now OEH
EIS	Environmental Impact Statement
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth)
Roads and Maritime	NSW Roads and Maritime Services
RTA	NSW Roads and Traffic Authority – now Roads and Maritime Services
OEH	NSW Office of Environment and Heritage
PC	Pacific Complete
SEPP	State Environmental Planning Policy
SEWPAC	Department of Sustainability, Environment, Water, Population and Communities
SPIR	Submissions/Preferred Infrastructure Report
TSC Act	*Threatened Species Conservation Act 1995*
UDLP	Urban Design and Landscape Plan
W2B	Pacific Highway Woolgolga to Ballina Upgrade
W2BPA	Woolgoolga to Ballina Planning Alliance

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1. INTRODUCTION

Chapter contents

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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 1-1: Upgrading the Pacific Highway – status of dual carriageway, June 2016 (source: Roads and Maritime)

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 (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 (refer Figure 1-2).

- 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.

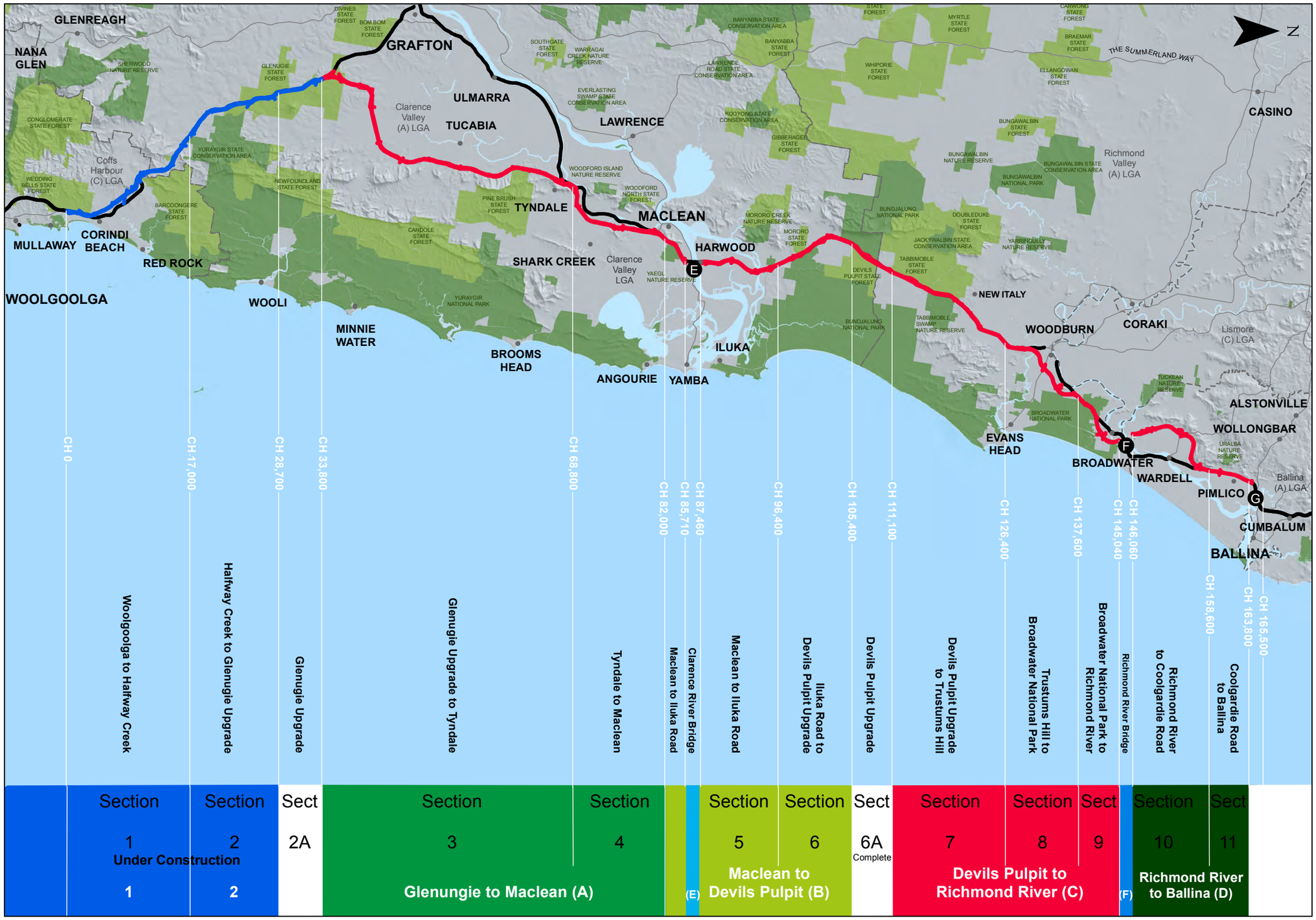


Figure 1-2: Pacific Highway Woolgoolga to Ballina upgrade portion map (source: Roads and Maritime)

1.4 PURPOSE OF THIS PLAN

This plan has been developed to address the requirements of the Minister's Conditions of Approval (MCoA) D20 and present an integrated urban design for the Woolgoolga to Ballina project. This plan specifically addresses Maclean to Devils Pulpit (Sections 5 and 6) and demonstrates commitment to the mitigation and management measures identified in the Woolgoolga to Ballina Environmental Impact Statement (EIS),the Submissions/Preferred Infrastructure Report (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.

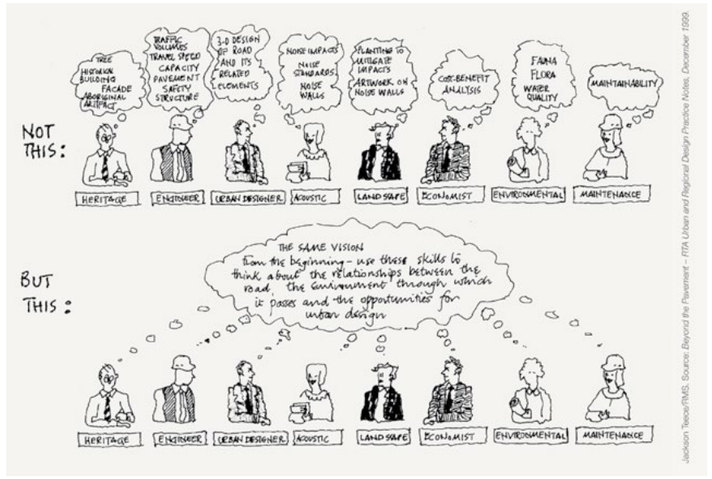


Figure 1-3: The project design team
(source: *Beyond the Pavement* (Roads and Maritime 2014))

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*, RMS, 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.

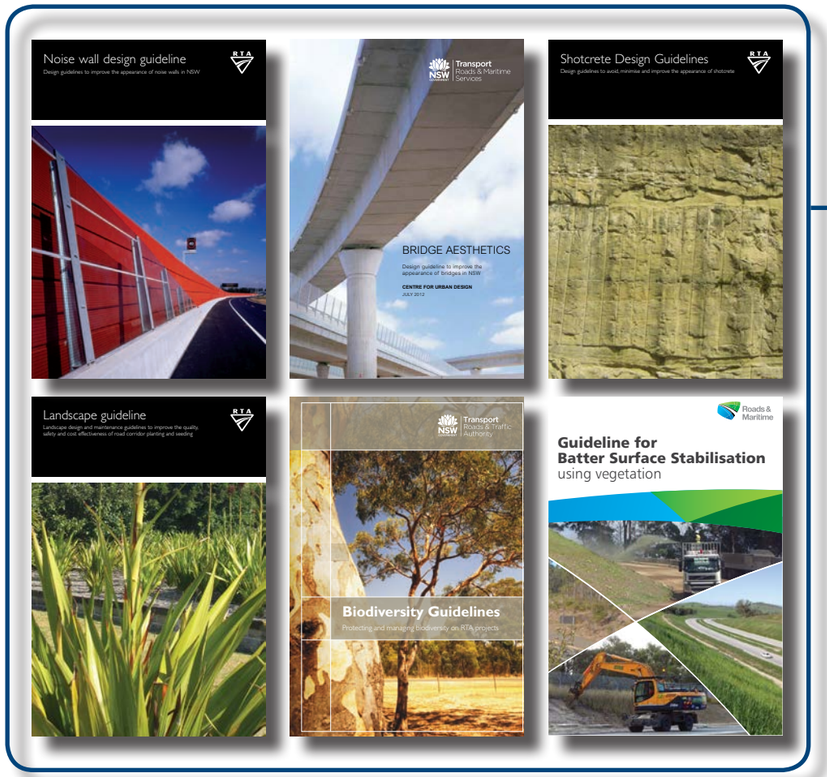
Approval documents:

- 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 2012
- *Woolgoolga to Ballina Urban Design Report Landscape Character & Visual Impact Assessment*, Roads and Maritime 2012
- *The Woolgoolga to Ballina – Pacific Highway Upgrade – EIS Working Paper – Biodiversity Assessment*, Roads and Maritime 2012
- *Upgrading the Pacific Highway – Design Guidelines*, March 2015

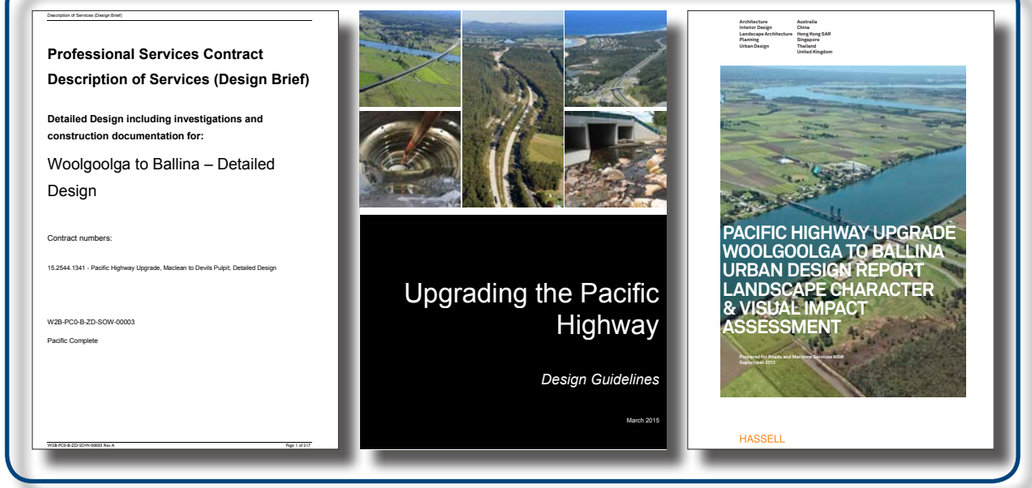
Guidelines documents:

- *Guideline for Batter Surface Stabilisation using vegetation*, RMS, April 2015
- *Environmental Impact Assessment Practice Note: Guidelines for Landscape Character and Visual Impact Assessment* ("EIA No4 Guidelines"), Roads and Maritime, March 2013
- Soils for Landscape and Garden Use, Australian Standards AS 4419
- Composts, Soil Conditioners and Mulches, Australian Standards AS 4454
- Roads and Maritime construction specifications including R178 Vegetation and R179 Planting

- *Beyond the Pavement – Urban Design Policy, Procedures and Design Principles*, Roads and Maritime 2014
- *Bridge Aesthetics – design guideline to improve the appearance of bridges in NSW*, Roads and Maritime, July 2012
- *Landscape Guidelines*, Roads and Maritime, April 2008
- *Shotcrete Design Guidelines*, Roads and Maritime, March 2016
- *Noise Wall Design Guidelines*, Roads and Maritime, March 2016
- *Biodiversity Guidelines – Protecting and Managing Biodiversity*, RTA, September 2011.



ROADS AND MARITIME URBAN DESIGN GUIDELINES



WOOLGOOLGA TO BALLINA DOCUMENTS

1.7 DOCUMENT STRUCTURE

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

Table 1-1: Structure and content of the UDLP – Maclean to Devils Pulpit (Sections 5 and 6)

TITLE		DESCIRIPTION
Chapter 1	**Introduction**	Provides a broad overview of the project and identifies the purpose and structure of the draft 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 the draft UDLP. To be completed after the public exhibition and stakeholder consultation period.
Chapter 4	**Project wide urban design landscape objectives and principles**	Describes the project wide urban design and landscape objectives and principles.
Chapter 5	**Contextual analysis**	Describes contextual analysis and associated landscape and urban design principles specific to Maclean to Devils Pulpit (Sections 5 and 6).
Chapter 6	**Landscape and urban design principles for Maclean to Devils Pulpit (Sections 5 and 6)**	Provides an overview of the Maclean to Devils Pulpit (Sections 5 and 6) highway design and describes the landscape and urban design principles and strategies specific to Maclean to Devils Pulpit (Sections 5 and 6).
Chapter 7	**Landscape and urban design for Maclean to Devils Pulpit (Sections 5 and 6)**	Describes the landscape and urban design concept specific to Maclean to Devils Pulpit (Sections 5 and 6). This chapter includes urban design and landscape drawings that present the integrated landscape and urban design solutions. This chapter also includes a landscape character and visual impact assessment that describes the impacts of the highway upgrade between Maclean to Devils Pulpit (Sections 5 and 6) at draft Detailed Design stage on the landscape character precincts and key views identified in the EIS. The assessment at draft Detailed Design is compared to the EIS assessment. This chapter also identifies additional properties potentially affected by the project between Maclean to Devils Pulpit (Sections 5 and 6). It provides a visual assessment and mitigation measures for those properties.
Chapter 8	**Landscape and urban design concept detail for Maclean to Devils Pulpit (Sections 5 and 6)**	Detailed descriptions of all urban and landscape design elements for Maclean to Devils Pulpit (Sections 5 and 6)
Chapter 9	**Conclusion**	Summary of design outcomes
Chapter 10	**Bibliography**	Catalogue of referenced and cited documents

2. COMPLIANCE WITH ENVIRONMENTAL APPROVAL DOCUMENTS

Chapter contents

2.1 MINISTERS 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).

Ministerial Condition of Approval (MCoA) D20 relates to the preparation of a 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 2-1.

Table 2-1: Ministerial Condition of Approval D20

MINISTERIAL CONDITION OF APPROVAL D20	DOCUMENT REFERENCE
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 outlined in the EIS, and the revegetation principles outlined 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:	This document
a) Identification of design principles and standards based on:	N/A
(i) local environmental values	Chapter 5
(ii) heritage values	Chapter 5
(iii) urban design context	Chapter 5
(iv) sustainable design and maintenance	Chapter 6
(v) community amenity and privacy	Chapters 7 and 8
(vi) relevant design standards and guidelines	Chapters 5, 7 and 8
(vii) the urban design objectives outlined in Section 4.2 of the EIS *Working Paper—Urban Design Landscape Character and Visual Impact*.	Chapters 5, 6, 7 and 8
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.	Chapters 5, 8 and 8
c) A description of locations along the corridor directly or indirectly impacted by the construction of the SSI (e.g. 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.	Chapters 6, 7 and 8
d) Take into account appropriate roadside plantings and landscaping in the vicinity of heritage items and ensure no additional heritage impacts.	Chapters 6 and 7
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 timeframes for rehabilitation works, procedures for monitoring success of regeneration or revegetation, and corrective actions should regeneration or revegetation not conform to the objectives adopted.	Chapter 6
f) Location and design treatments for any associated footpaths and cyclist elements, 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.	Chapters 7 and 8
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.	Chapter 7
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.	Chapters 6 and 7
i) Strategies for progressive landscaping and other environmental controls such as erosion and sedimentation controls, drainage and noise mitigation.	Chapter 8
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.	Chapter 8
k) Evidence of consultation with the relevant council and community on the proposed urban design and landscape measures prior to its finalisation.	Chapter 3

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 A-1 and Table A-2 in Appendix A of this document outlines compliance with relevant environmental mitigation measures related to landscape and urban design specific to Maclean to Devils Pulpit (Sections 5 and 6).

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 2-2 identifies EIS landscape strategies related to landscape and urban design specific to Maclean to Devils Pulpit (Sections 5 and 6). For locations of the viewpoints please refer to Chapter 7.

Table 2-2: Compliance with EIS landscape and urban design requirements

EIS COMPLIANCE	DOCUMENT REFERENCE
11.4.1 Urban Design and Landscape Strategy • Retain the strong contrasting experience of driving through forest and open agricultural land as a feature of the Pacific Highway experience • Acknowledge and highlight the small and medium sized coastal towns that mark progress along the coastal Pacific Highway journey • Highlight numerous minor and major creek and river crossings across the Pacific Highway journey over the coastal floodplains • Acknowledge and preserve the natural and cultural landscapes and landmarks identified along the full length of the Pacific Highway journey.	Chapter 6 and 7
Viewpoint mitigation measures for EIS viewpoints located in Sections 5 and 6	Chapter 7

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. Table 2-3 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 2-3: Vegetation and landscape design principles for connectivity measures identified in the Biodiversity Connectivity Strategy

DESIGN PRINCIPLE	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.	Chapter 6, 7 and 8
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	Chapter 7 and 8
Roadside plantings in emu crossing zones 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 *Gahnia*, *Lomandra* and *Dianella* spp. represent food plants for emus and may attract them to the road edge and should avoid being planted.	Not applicable. No emu habitat identified in Sections 5 and 6.
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 Casuarina. 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 emus to the crossing zone	Not applicable. No emu habitat identified in Sections 5 and 6.
Plantings around dedicated and combined underpasses is to ensure that entrances to the structure do no obscure the structure and provide a clear line of sight	Chapter 7 and 8
It is important for landscaping at entrances not to intrude / shadow the window of the entrances	Chapter 7 and 8
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.	Chapter 7 and 8

2.5 URBAN DESIGN AND LANDSCAPE COMPLIANCE WITH THE 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.

The Threatened Species Management Plans for the Woolgoolga to Ballina project, and their applicability to the section, are outlined in the following Table 2-4.

Table 2-4: Threatened Species Management Plans applicable to Portion B

THREATENED SPECIES MANAGEMENT PLAN	APPLICABLE TO SECTION 5 & 6
Coastal emu management plan (RMS 2015)	No
Koala management plan (RMS 2016)	**Yes**
Rainforest communities and threatened rainforest plants management plan (RMS 2015)	No
Threatened flora management plan (RMS 2015)	**Yes**
Flora Translocation Strategy (RMS 2016)	**Yes**
Threatened fish management plan (RMS 2015)	**No**
Threatened frog management plan (RMS 2015)	**Yes**
Threatened glider management plan (RMS 2015)	**Yes**
Threatened invertebrate management plan	No
Threatened mammal management plan (RMS 2015)	**Yes**

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 Maclean and Devils Pulpit (Sections 5 and 6). Appendix A provides further details about compliance with specific urban design and landscape requirements that are included in these management plans.

3. CONSULTATION

Chapter contents

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3.1 OVERVIEW

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 signage (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

3.2 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.

3.3 STAKEHOLDER CONSULTATION

Agency stakeholders identified in the Woolgoolga to Ballina Communications and Stakeholder Engagement Strategy were invited 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.

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4. PROJECT WIDE URBAN DESIGN AND LANDSCAPE OBJECTIVES AND PRINCIPLES

Chapter contents

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Figure 4-1: View south over Chatsworth Island and Harwood Island from the Clarence River North Arm (source: Pacific Complete).

4.1 VISION

The *Pacific Highway Urban Design Framework* (Roads and Maritime 2013) has established the following vision for the Pacific Highway:

'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 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.

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.

4.5 PROJECT WIDE URBAN DESIGN AND LANDSCAPE 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

- Reinstate 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 reinstate 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.

4.6 URBAN DESIGN AND LANDSCAPE STRATEGIES SPECIFIC TO MACLEAN TO DEVILS PULPIT (SECTIONS 5 AND 6)

Refer to Chapter 6 of this report for the Maclean to Devils Pulpit (Sections 5 and 6) specific landscape and urban design strategies outlined in the project EIS *Working paper: Urban design report, landscape character and visual impact assessment* (Hassell, 2012).

4.7 LANDSCAPE OUTCOMES

The landscape works to be carried out as part of the W2B upgrade will take time to develop as the new vegetation is established and grows. Consequently the visual character of the landscape works will also change over time.

Refer to Chapter 8.10 for images illustrating this change over time.

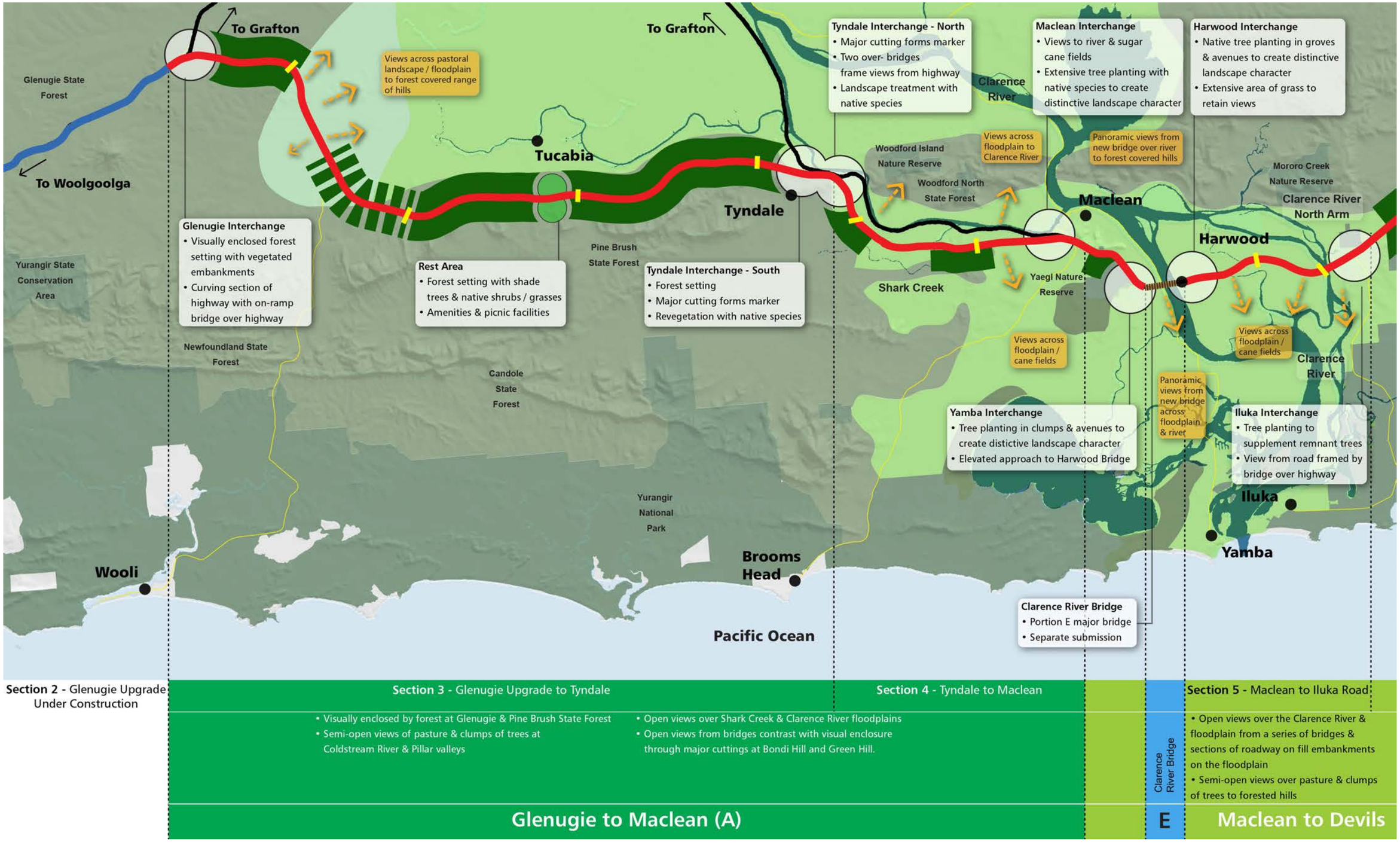
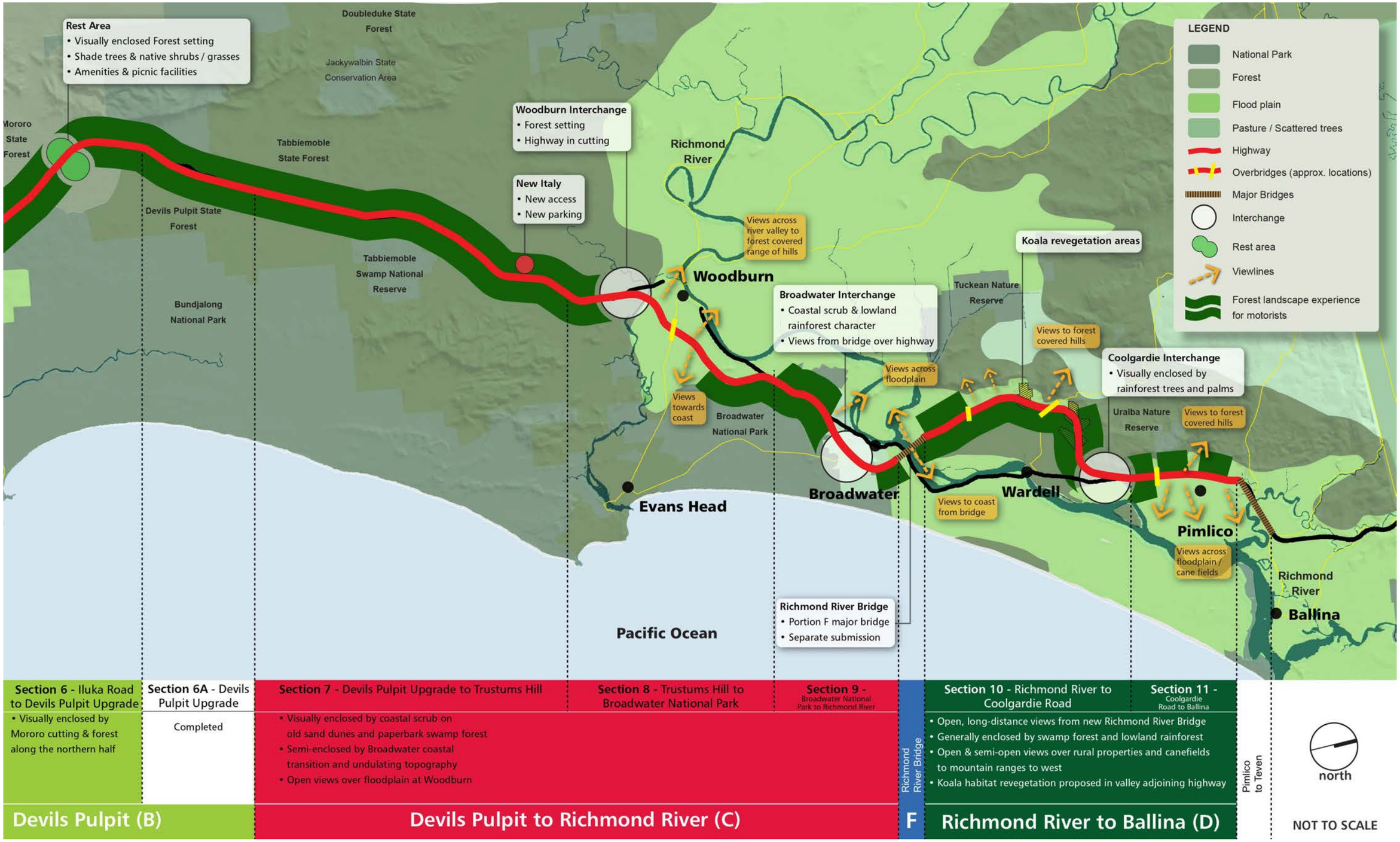


Figure 4-2: W2B landscape and urban design strategy plan (2 sheets; source: Pacific Complete)


Rest Area
• Visually enclosed Forest setting
• Shade trees & native shrubs / grasses
• Amenities & picnic facilities
Doubleduke State Forest
Jackywalbin State Conservation Area
Mororo State Forest
Tabbiemoble State Forest
Devils Pulpit State Forest
Bundjalong National Park
Tabbiemoble Swamp National Reserve
Woodburn Interchange
• Forest setting
• Highway in cutting
New Italy
• New access
• New parking
Richmond River
Views across river valley to forest covered range of hills
Woodburn
Broadwater Interchange
• Coastal scrub & lowland rainforest character
• Views from bridge over highway
Koala revegetation areas
Tuckean Nature Reserve
Views to forest covered hills
Views across floodplain
Coolgardie Interchange
• Visually enclosed by rainforest trees and palms
Views towards coast
Broadwater National Park
Uralba Nature Reserve
Views to forest covered hills
Evans Head
Broadwater
Wardell
Views to coast from bridge
Pimlico
Views across floodplain / cane fields
Richmond River
Ballina
Richmond River Bridge
• Portion F major bridge
• Separate submission
Pacific Ocean
LEGEND
National Park
Forest
Flood plain
Pasture / Scattered trees
Highway
Overbridges (approx. locations)
Major Bridges
Interchange
Rest area
Viewlines
Forest landscape experience for motorists
Section 6 - Iluka Road to Devils Pulpit Upgrade
• Visually enclosed by Mororo cutting & forest along the northern half
Section 6A - Devils Pulpit Upgrade
Completed
Section 7 - Devils Pulpit Upgrade to Trustums Hill
Section 8 - Trustums Hill to Broadwater National Park
Section 9 - Broadwater National Park to Richmond River
• Visually enclosed by coastal scrub on old sand dunes and paperbark swamp forest
• Semi-enclosed by Broadwater coastal transition and undulating topography
• Open views over floodplain at Woodburn
Richmond River Bridge
Section 10 - Richmond River to Coolgardie Road
Section 11 - Coolgardie Road to Ballina
• Open, long-distance views from new Richmond River Bridge
• Generally enclosed by swamp forest and lowland rainforest
• Open & semi-open views over rural properties and canefields to mountain ranges to west
• Koala habitat revegetation proposed in valley adjoining highway
Pimlico to Teven
north
NOT TO SCALE
Devils Pulpit (B)
Devils Pulpit to Richmond River (C)
F
Richmond River to Ballina (D)

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5. CONTEXTUAL ANALYSIS

This chapter provides a discussion of the study area's key environmental, urban and cultural factors that affect the design of the Maclean to Devils Pulpit (Sections 5 and 6) portion of the Pacific Highway upgrade.

The purpose of this contextual analysis is to understand the individual aspects that make up the landscape character of the study area and to identify broad scale landscape and urban design opportunities, constraints and design principles that apply to the Maclean to Devils Pulpit (Sections 5 and 6) portion of the project.

Chapter contents

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5.1 LOCATION

The Maclean to Devils Pulpit (Sections 5 and 6) portion of the Woolgoolga to Ballina Pacific Highway Upgrade (W2B) extends over approximately 29.8 km from Maclean (about 46 km north of Grafton) to the Devils Pulpit Upgrade (about 58 km south of Ballina). It consists of the following W2B Upgrade sections, as defined in the EIS:

- Maclean to Iluka Road, Mororo – Section 5
- Iluka Road to Devils Pulpit – Section 6.

It does not include the new bridge over the Clarence River at Harwood, which is delivered as a separate design package.

The majority of this portion is located within the Clarence Valley local government area, with the northernmost 860 metres located within the Richmond Valley local government area. The traditional owners of the land on which the project is located are the Yaegl and the Bundjalung peoples. This portion of the highway upgrade spans two Local Aboriginal Land Councils (LALCs): Yaegl LALC in the south and Bogal LALC in the north.

The Maclean to Devils Pulpit (Sections 5 and 6) portion of the highway upgrade is located in the Northern Rivers region of New South Wales. Maclean to Iluka Road (Section 5) is strongly characterised by the Clarence River and the agricultural landscape of the lower Clarence Floodplain, while Iluka Road to Devils Pulpit (Section 6) is characterised by the undulating forested landscape of the lower foothills of the Richmond Range. The highway provides access to the villages of Harwood, on the northern banks of the Clarence River, and Woombah just east of the Iluka Road intersection. The town of Maclean is located on the Clarence River immediately southwest of the Maclean to Devils Pulpit (Sections 5 and 6) study area.

A number of national parks, state forests, state conservation areas and nature reserves occur within and in close proximity to the project between Maclean to Devils Pulpit (Sections 5 and 6). These are:

- Yaegl Nature Reserve
- Chatsworth Hill State Conservation Area
- Mororo Creek Nature Reserve
- Mororo State Forest
- Bundjalung National Park
- Devils Pulpit State Forest
- Bundjalung State Conservation Area.

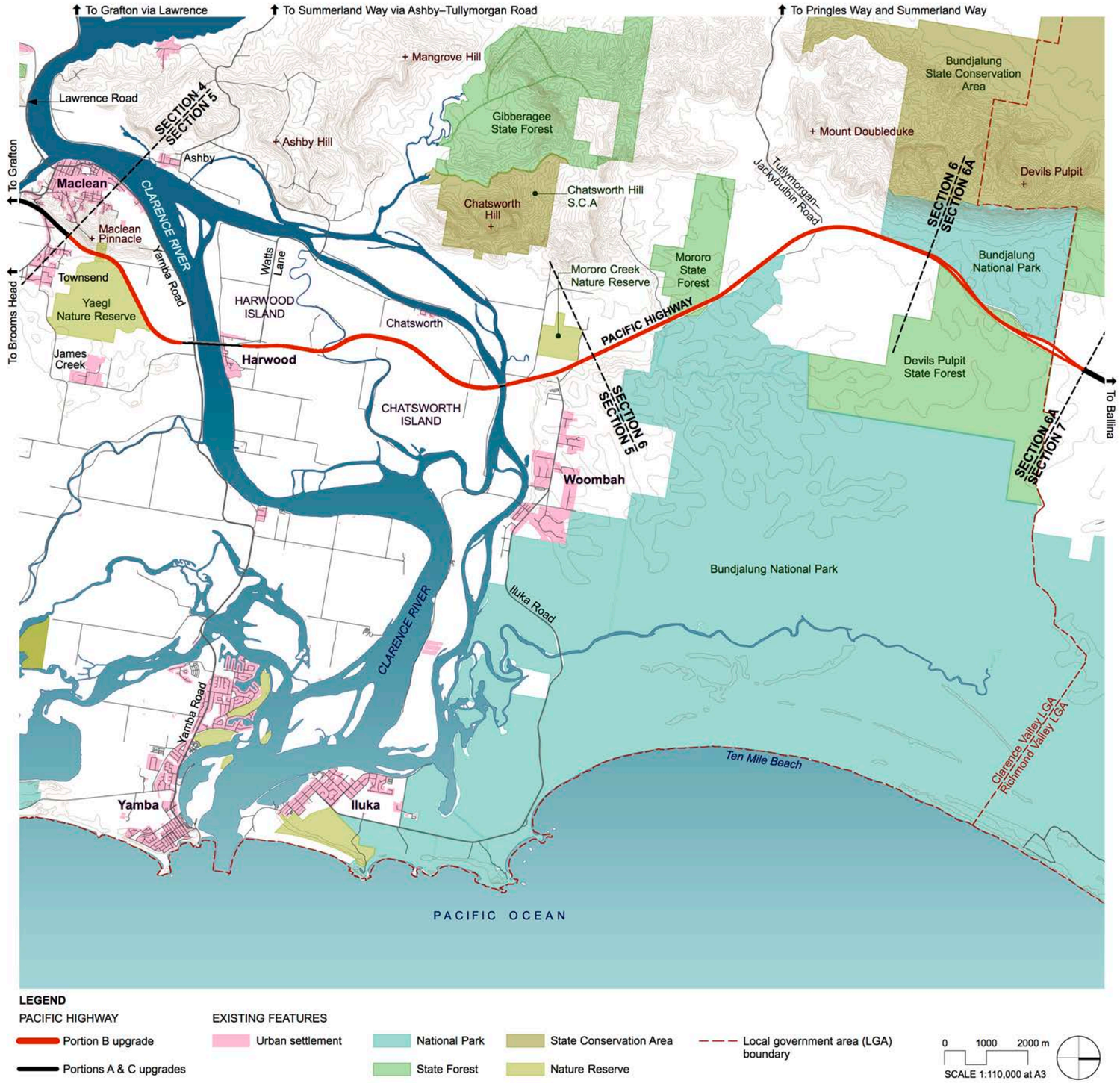


Figure 5-1: Sections 5 and 6 location

5.2 BIOREGION AND ECOSYSTEMS

The W2B project is located wholly within the NSW North Coast (NNC) Bioregion. This bioregion is one of the most diverse in NSW, with complex soil and vegetation patterns resulting from complex interactions of substrate, topographic and climatic variation (W2BPA 2012b).

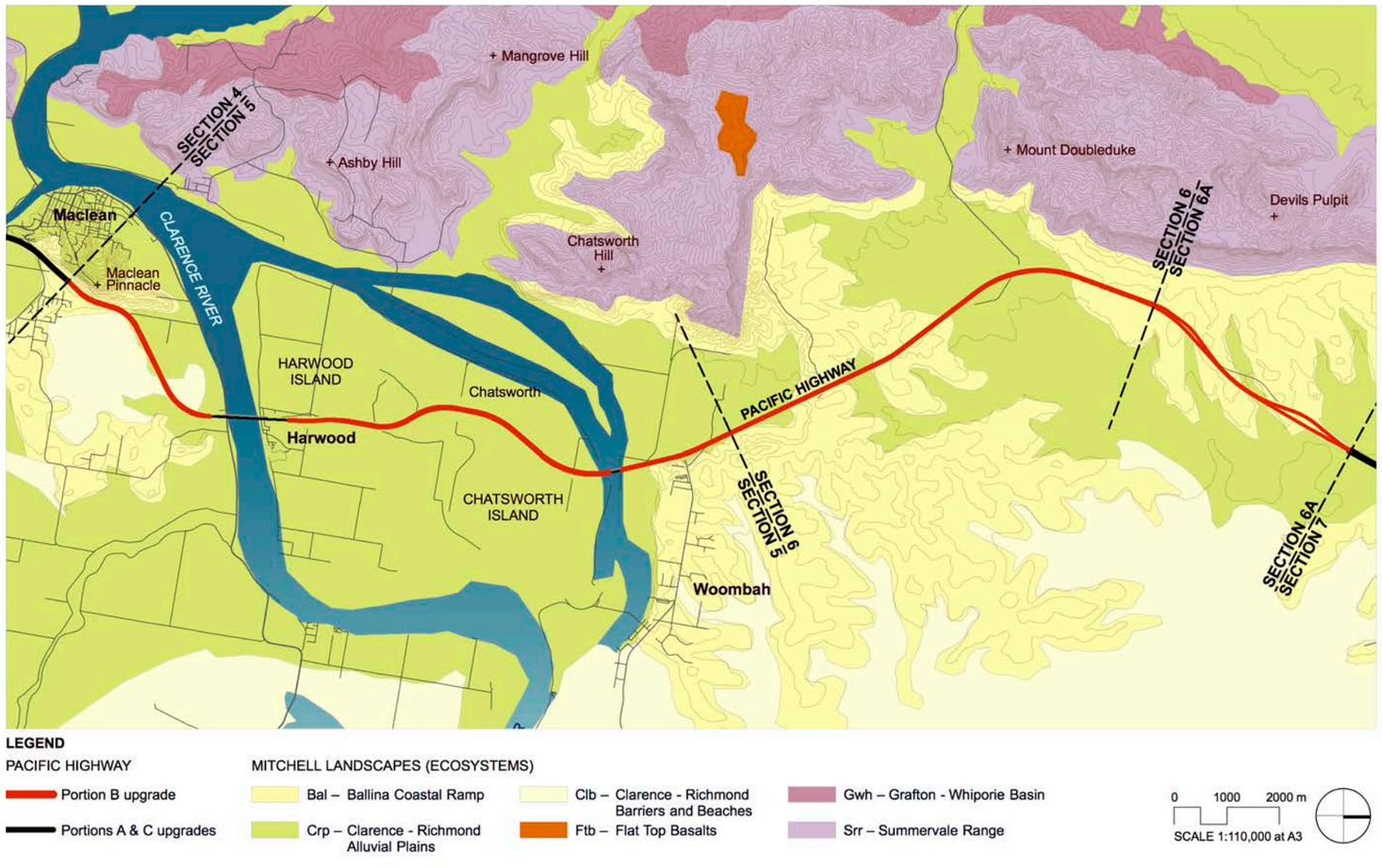
Within the NNC Bioregion, the Maclean to Devils Pulpit (Sections 5 and 6) portion of the project traverses three ecosystems (Mitchell landscapes) described in the NSW Landscapes coverage map (Mitchell 2003):

- Ballina Coastal Ramp (Bal) in the southern part of Section 5 before the Clarence River and southern and northern parts of Section 6
- Clarence - Richmond Alluvial Plains (Crp) in the majority of Section 5 and the central part of Section 6
- Clarence - Richmond Barriers and Beaches (Clb) in a relatively small and isolated area at the Yaegl Nature Reserve and wetlands south of the Clarence River in Section 5.

The key relevant landscape characterics of the three landscape types, as described by Mitchell (2003) are:

- Ballina Coastal Ramp (Bal):
  - Coastal ranges and low hills on early Jurassic sub-horizontal coarse felspathic sandstone, lithic sandstone, claystone and coal measures, general elevation 25 to 100m, local relief 50m
  - Yellow and brown texture-contrast soils on slopes and dark grey clays along valley floor streamlines
  - Dry hardwood forest of Spotted Gum, Blackbutt, Large-fruited Blackbutt, with grasses and burrawang
  - Limited areas of subtropical closed forest on higher quality soil and littoral closed forest on alluvium and sand dunes.
- Clarence - Richmond Alluvial Plains (Crp):
  - Wide valleys, channels, floodplains, terraces and estuaries of the Clarence and Richmond rivers and other coastal streams on Quaternary alluvium, general elevation 0 to 50 metres, local relief 15 metres
  - Deep brown earths and structured brown clay on floodplains. Terrace with yellow texture-contrast soil containing ironstone concretions.
  - Extensively cleared valley floors supporting forest of Cabbage Gum, Forest Red Gum, Broad-leaved Apple, River Oak, Silky Oak, Rough- barked Apple, Native Teak, Coastal Grey Box, Pink Bloodwood, Spotted Gum, Grey Ironbark, Broad-leaved Paperbark, Blackwood and Black She-oak.
  - Salt marsh, mangrove communities and paperbark freshwater swamps in the estuaries.
- Clarence - Richmond Barriers and Beaches (Clb):
  - Beaches, dunes, swamps and lagoons on Quaternary coastal sands, with inner and outer barrier dune sequences, general elevation 0 to 25 m, local relief to 10 m.
  - Back barrier swamps and plains with gradational dark coloured loamy sand, peaty podsol and acid peat with Broad-leaved Paperbark, Swamp Oak, Swamp Mahogany, Forest Red Gum, Red Bloodwood, Pink Bloodwood, Coast Banksia, and Rough-barked Apple on better drained sites.

Figure 5-2: Mitchell Landscapes (ecosystems) of the study area



5.3 GEOLOGY

The Maclean to Devils Pulpit (Sections 5 and 6) portion of the project traverses the geological sequence of the Clarence-Moreton Basin, an extensive Mesozoic age sedimentary basin extending from southern Queensland to the NSW North Coast and comprising sedimentary rocks about 2.5 to 4 kilometres thick (W2BPA 2012c).

The study area is underlain by three geological units (Geological Survey of NSW, 1970) that closely correspond to the Mitchell landscapes:

- Walloon Coal Measures formation (Jw) underlies the Ballina Coastal Ramp landscape type. It comprises shale, sandstone and coal of the Jurassic Period
- Quaternary undifferentiated alluvial deposits (Qa) underlie the Clarence - Richmond Alluvial Plains landscape type. They include sand, silt, clay and gravel; some residual and colluvial deposits
- Quaternary marine, barrier and estuarine sediments (Qx) underlie the Clarence - Richmond Barriers and Beaches landcape type.

5.3.1 Design principles for Maclean to Devils Pulpit

- Views to geological landmarks are incorporated into the highway alignment wherever possible in order to reinforce a sense of place to the highway experience.
- The design of cuttings aims to maintain steep faces wherever possible in order to minimise the footprint of the highway upgrade.
- The design aims to retain a natural rock finish to the cuttings, wherever possible, in order to maintain a visual connection to the geological character of the local area.
- Where rock material exposed during construction cannot be cut to steeper grades, batters are flattened out and in some instances revegetated. Generally, the cut rock faces remain exposed regardless of slope.

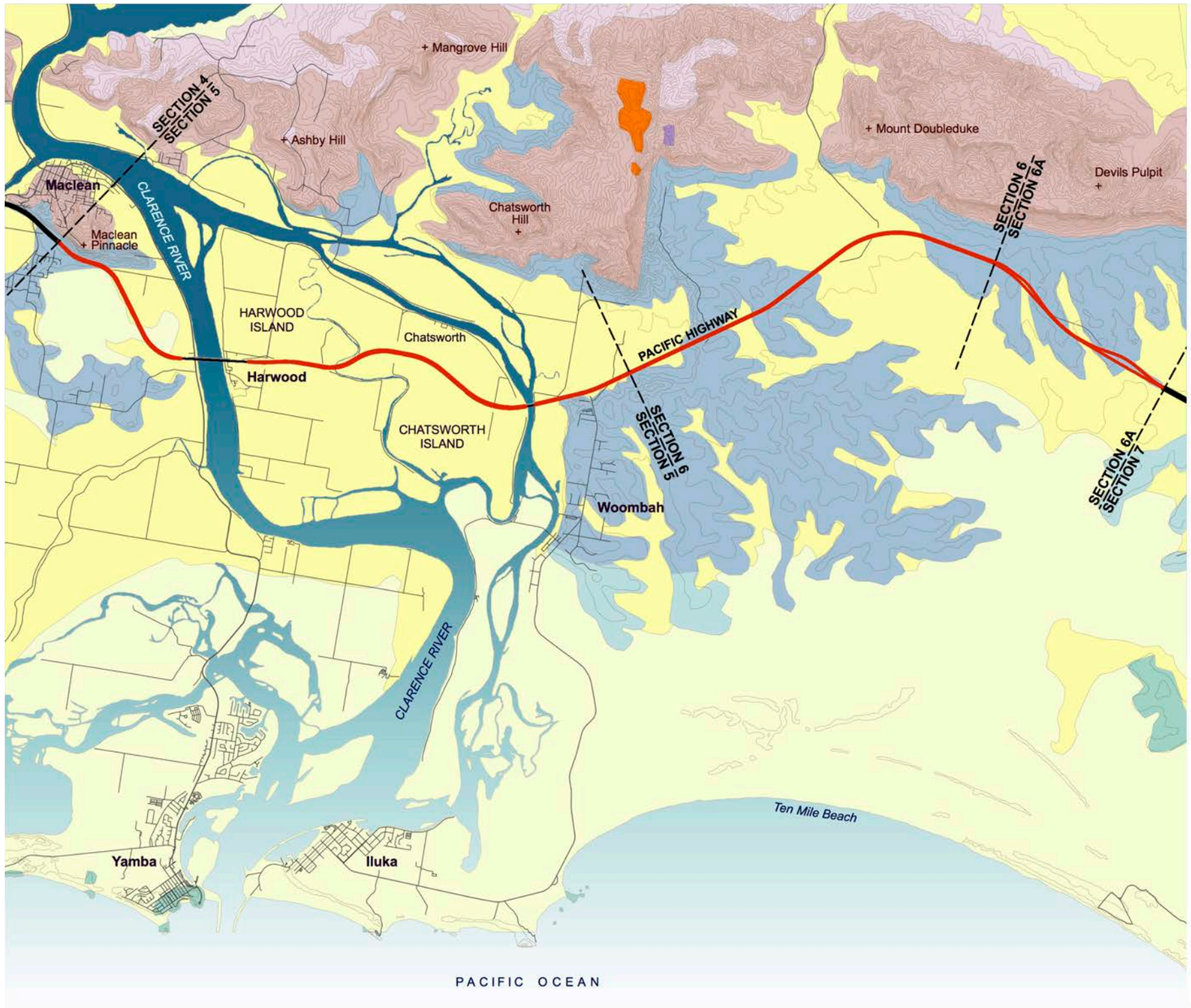


Figure 5-3: Geology of the study area

5.4 SOILS

The geological landscape types of the study area have a direct relationship to the overlying topsoils, with:

- The alluvial plains producing relatively stable sandy/ silty/ gravelly topsoils with low fertility
- The higher ground producing more erosive sandy or stiff clays with higher fertility.

The Maclean to Devils Pulpit (Sections 5 and 6) portion of the project traverses eight soil landscape types identified in the *Soil Landscapes of the Woodburn 1:100,000 Sheet* (Morand 2001). These are (in order of prevalence):

- Alluvial
- Erosional
- Transferral
- Aeolian
- Swamp
- Stagnant alluvial
- Estuarine
- Disturbed terrain.

Most soils encountered on the project, apart from those modified through agricultural practices, will be shallow, low in pH and therefore more suited to native vegetation.

Soft soils occur between Maclean and Iluka Road (Section 5) and are currently being treated with a pre-loaded surcharge.

5.4.1 Design principles for Maclean to Devils Pulpit

- Weed-free topsoil from cleared areas is stripped and reused in revegetation areas. Depending on the location from which it has been sourced, the topsoil may require amelioration to suit the intended revegetation species.
- Soil survey, testing and analysis within each soil and vegetation type is being undertaken across the study area to determine the soil amelioration requirements, if any, for successful revegetation.

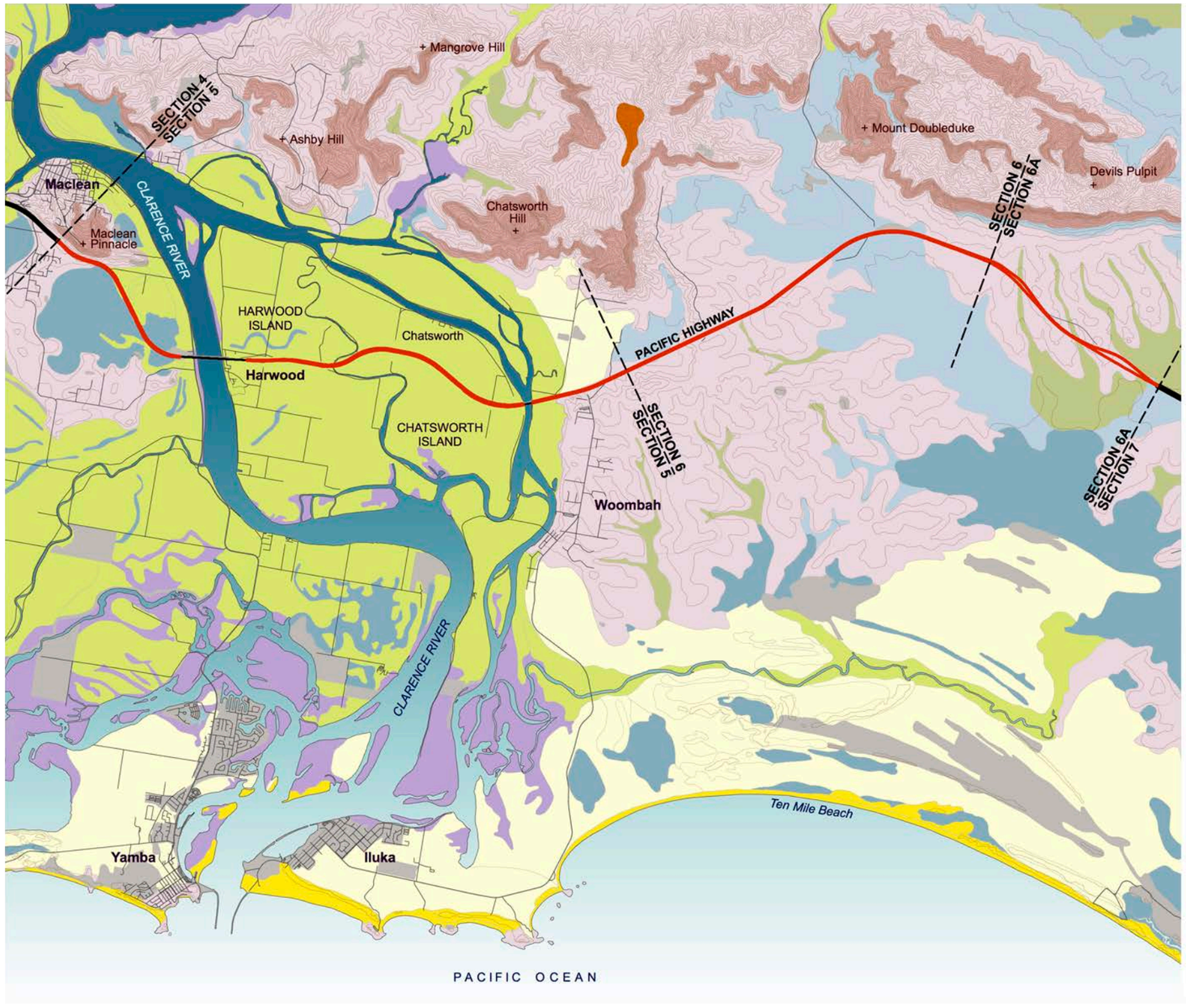


Figure 5-4: Soil landscapes of the study area

5.5 LANDFORM AND TOPOGRAPHY

The Maclean to Devils Pulpit (Sections 5 and 6) portion of the project traverses two distinctive topographies:

- Maclean to Iluka Road (Section 5) is comprised of the low, mostly level alluvial terrain of the Clarence River floodplain and delta, with elevations generally between one and five metres
- Iluka Road to Devils Pulpit (Section 6) is located north of the Clarence River North Arm, rises gradually from the floodplain to gently undulating terrain comprising the eastern footslopes of the Richmond Range to an elevation of approximately 30 metres.

The Maclean Pinnacle, which separates the Pacific Highway from the town of Maclean, is a locally distinctive topographic landmark that rises steeply out of the floodplain to an elevation of 130 metres.

To the west of the Clarence River North Arm, the land rises steeply from the floodplain to form forested hills. These hills create a distinctive backdrop to views west across the floodplain on Harwood and Chatsworth Islands. Ashby Hill (120 metres) and Chatsworth Hill (220 metres) are local topographic landmarks west of the Clarence River North Arm.

Devils Pulpit (240 metres), a crest in the eastern ridge of the Richmond Range, is located to the west of the Pacific Highway at the northern end of the Maclean to Devils Pulpit (Sections 5 and 6) portion of the project.

5.5.1 Design principles for Maclean to Devils Pulpit

- The distinctive landform and topography, together with the extensive sugar cane plantations, makes this area highly recognisable. The relationship between the highway alignment and the existing terrain is carefully considered to ensure that the essential qualities of the topographic experience are preserved for the road user
- Urban design input has informed the design of structures, particularly bridges, in order to ensure that they are sensitively integrated with their surroundings
- The design of the cuttings and fill embankments is carefully considered in order to integrate them with the form and character of the existing terrain
- At Mororo, substantial earthworks are required to provide additional fill material for embankments. The Mororo cutting is designed to integrate with the existing landform and allow for extensive revegetation.

5.6 HYDROLOGY AND DRAINAGE

The Maclean to Devils Pulpit (Sections 5 and 6) portion of the project is located within the catchment of the Clarence River, which comprises 56 sub-catchments and a large coastal floodplain surrounded by higher elevations. The rivers and creeks provide a broad range of habitat for a wide diversity of aquatic, animal and plant species as well as supporting a range of ecological processes.

5.6.1 Key waterways and catchments

Maclean to Iluka Road (Section 5) is located within the lower Clarence River Floodplain. Downstream of Maclean, the Clarence River splits into the main river and the North Arm. The two waterways surround an extensive floodplain of river islands. Between the Clarence River and the North Arm, the highway traverses the two largest islands – Harwood Island and Chatsworth Island – which are separated by a narrow tidal channel called the Serpentine Channel. Agricultural landuse, particularly sugarcane plantations, dominate the lower Clarence Floodplain. A network of cane drains convey local runoff from the agricultural fields to the Clarence River, North Arm and Serpentine Channel.

North of Iluka Road, the highway traverses the eastern edge of the Mororo Creek floodplain but does not cross Mororo Creek itself. North of Mororo, the highway alignment enters the Tabbimoble Creek catchment, which includes the Tabbimoble Overflow. Mororo Creek and Tabbimoble Creek are sub-catchments of the Clarence River and predominately flow through forest, as well as some rural and agricultural land use. No buildings have been identified within either the Mororo Creek or Tabbimoble Creek floodplains.

The lower Clarence Floodplain experiences regular inundation. At times, major flooding can last several days or weeks and inundate some 500 square kilometres due to the large catchment size. Peak flood levels in the 20 year ARI event along the Pacific Highway vary from 2.90 metres at Harwood to 2.55 metres at Chatsworth Island (W2BPA 2012d).

5.6.1 Wetlands

The project traverses four wetland catchments that have been as being significant under:

- State Environmental Planning Policy No 14 – Coastal Wetlands (SEPP14), which aims to protect coastal wetlands
- Department of Sustainability, Environment, Water, Population and Communities (SEWPAC), which identifies nationally important wetlands in its *Directory of Important Wetlands*.

No internationally important wetlands listed under the Ramsar Convention are located between Maclean and Devils Pulpit. The following Table 5-1 summarises the significant SEPP 14 and SEWPAC wetlands located within or near the Maclean to Devils Pulpit (Sections 5 and 6) portion of the project. None are impacted by the project.

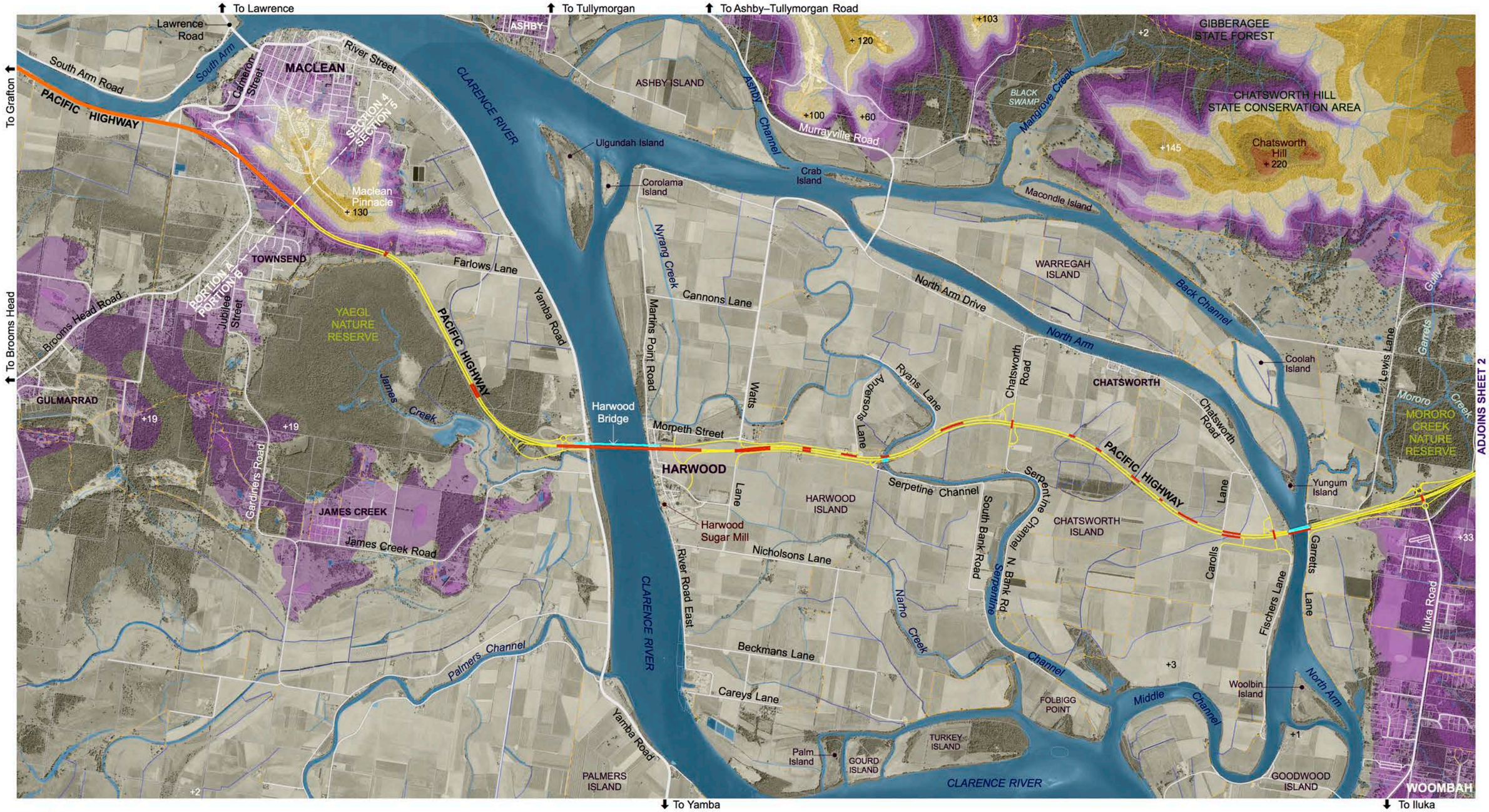
Table 5-1: SEPP 14 and SEWPAC Wetlands

SECTION	SEPP 14 ID	WETLAND NAME & LOCATION	SEWPAC
5	220a	Yaegl Nature Reserve. Adjoins project boundary.	No
5	153c	No name. Located between Clarence River North Arm and Back Channel. Crosses project boundary.	No
6	153a	No name. Located on Tabbimoble Creek. Does not intersect project boundary.	No
6	153	Bundjalung National Park Does not intersect project boundary.	Yes

5.6.1 Design principles for Maclean to Devils Pulpit

- The highway alignment between Maclean and Iluka Road (Section 5) is designed for 20 year ARI flood immunity – except where the existing Pacific Highway is retained as the southbound carriageway, which has a 5 year ARI flood immunity with contra flow arrangements to either side
- The highway alignment between Iluka Road and Devils Pulpit (Section 6) is designed for 100 year ARI flood immunity
- The design includes:
  - Four new bridges that duplicate existing bridges over waterways
  - A number of new floodplain bridges to assist with flood mitigation on the lower Clarence River Floodplain between Maclean and Iluka Road (Section 5)
  - Numerous culverts under the highway to assist with flood mitigation between Maclean and Devils Pulpit (Sections 5 and 6).
- The design of bridges and culverts responds to hydrological requirements as well as other ecological considerations such as fauna passage
- Scour protection (rock armouring and soft scour) is included at locations assessed to be susceptible to scour erosion, including bridge abutments, piers, and embankments
- Appropriate revegetation has been included to assist with erosion protection along the banks of waterways and at other erosion sensitive locations.

Figure 5-5: Topography and landform (2 sheets)



LEGEND

EXISTING FEATURES
- Existing road
- Existing vehicular track
- Waterway / water body

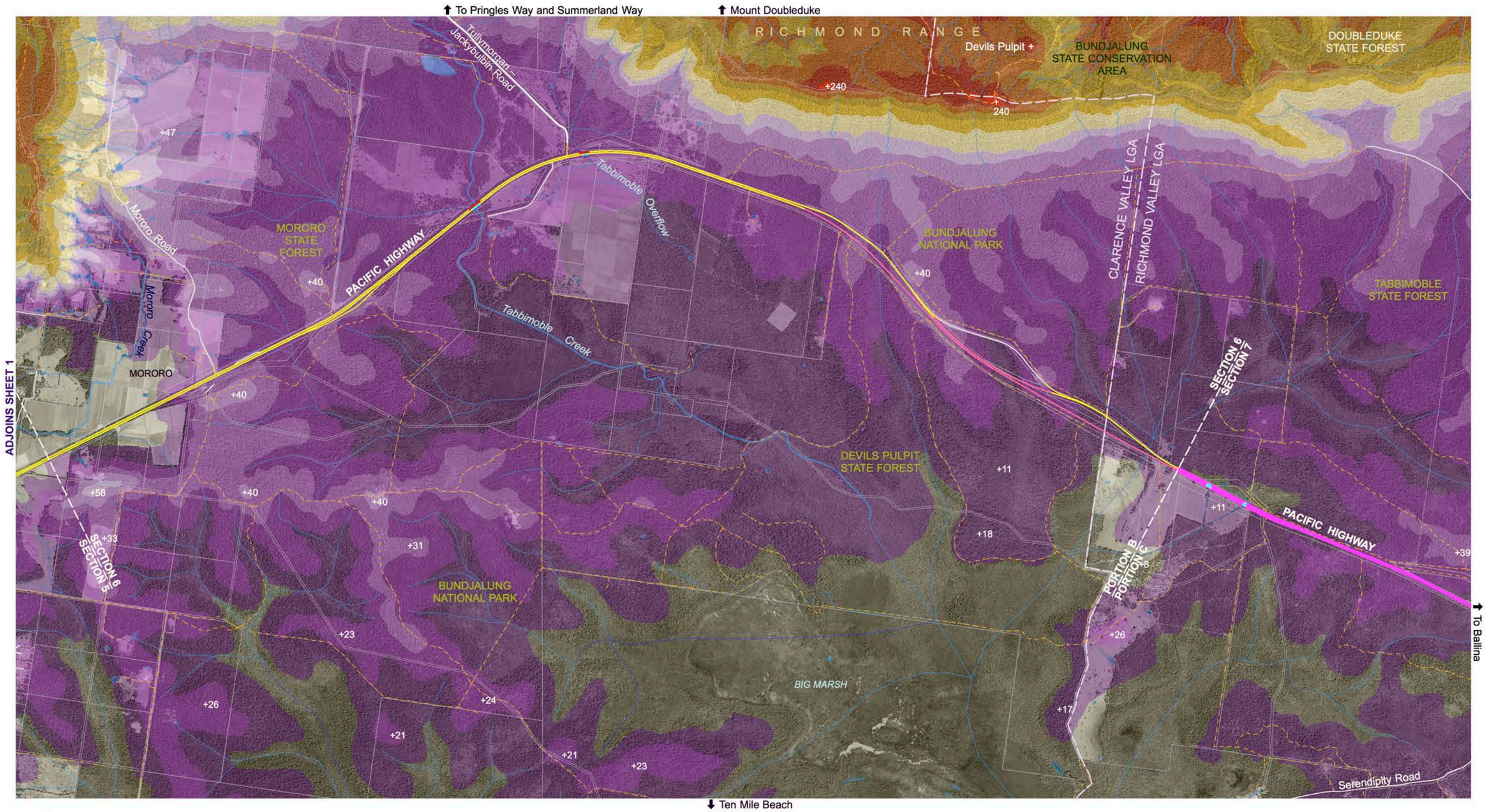
PACIFIC HIGHWAY
- Portion B upgrade
- Existing upgraded Pacific Highway
- Portion A upgrade
- Portion C upgrade
- Existing bridge
- New bridge

TOPOGRAPHY OF THE STUDY AREA

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250+ Metres above sea level

0 500 1000 m
SCALE 1:40,000 at A3

Sheet 1 of 2



LEGEND

EXISTING FEATURES
- Existing road
- Existing vehicular track
- Waterway / water body

PACIFIC HIGHWAY
- Portion B upgrade
- Existing upgraded Pacific Highway
- Portion A upgrade
- Portion C upgrade

- Existing bridge
- New bridge

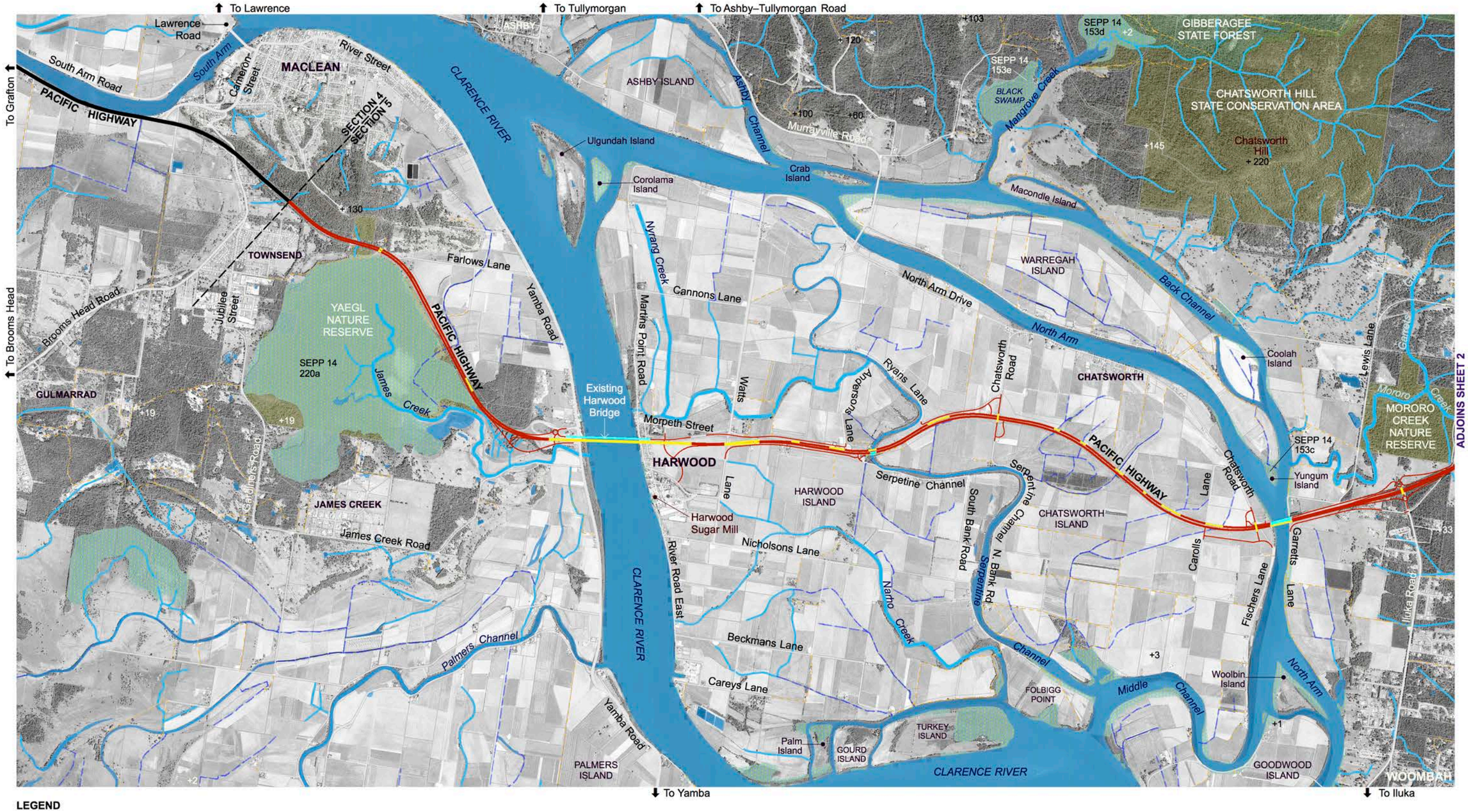
TOPOGRAPHY OF THE STUDY AREA

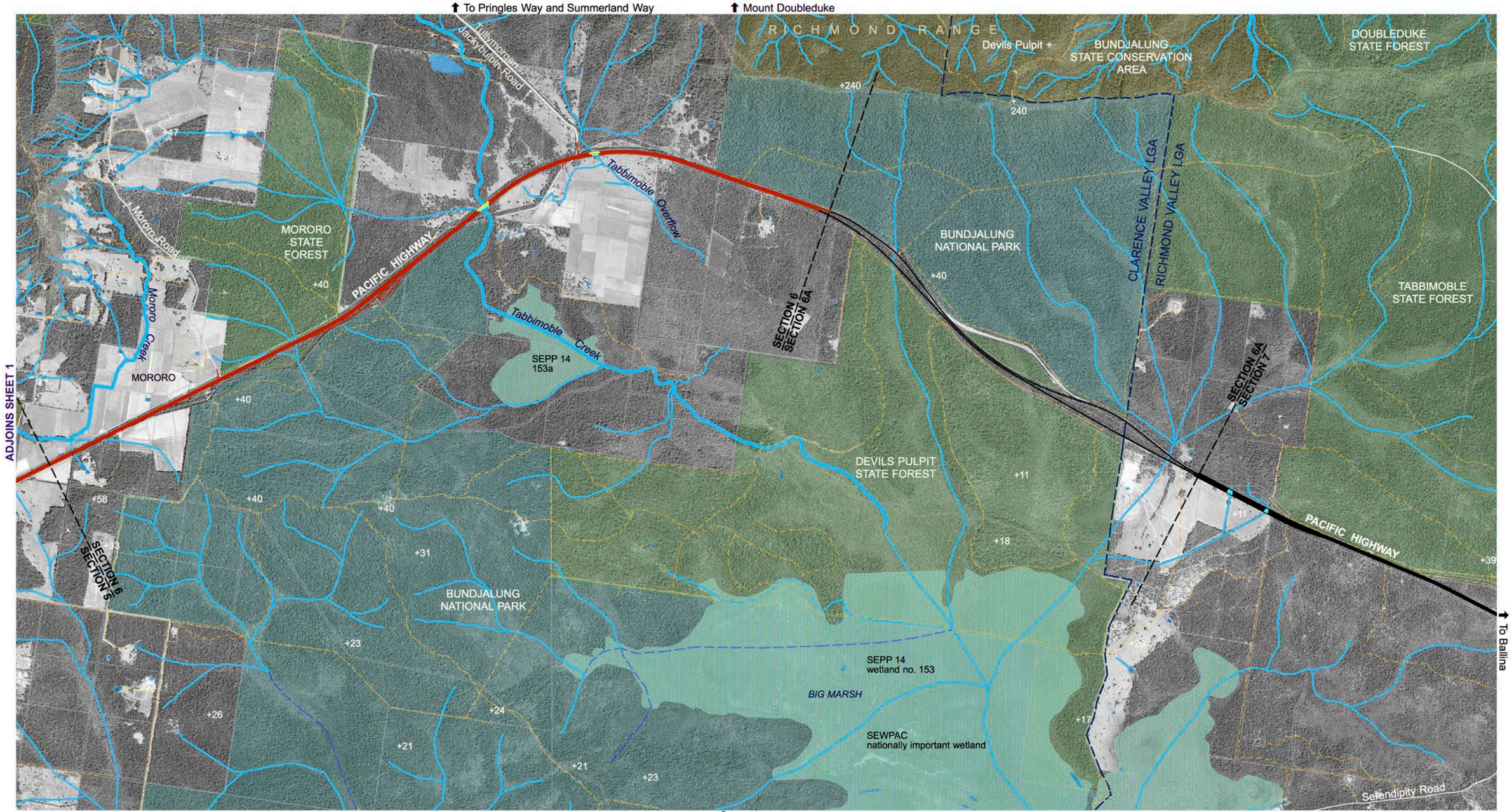
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250+ Metres above sea level

0 500 1000 m
SCALE 1:40,000 at A3

Sheet 2 of 2

Figure 5-6: Hydrology (2 sheets)





LEGEND

EXISTING FEATURES
- Existing road
- Existing vehicular track

PACIFIC HIGHWAY
- Highway upgrade Maclean to Devils Pulpit (Sections 5 & 6)
- Adjacent sections of highway upgrade
- Existing upgraded Pacific Highway
- Existing bridge
- New bridge

OPEN SPACE
- National Park
- State Forest
- State Conservation Area
- Nature Reserve

HYDOLOGY
- Waterway / water body
- Canal drain
- SEPP 14 & Nationally important wetlands (refer drawing label for wetland ID)

0 500 1000 m
SCALE 1:40,000 at A3

Sheet 2 of 2

5.7 FLORA

5.7.1 Vegetation communities

Vegetation surveys conducted for the project have identified 18 vegetation communities (biometric vegetation types) within the project boundary or within the immediate vicinity of the project between Maclean and Devils Pulpit (Sections 5 and 6) (W2BPA 2012b). These communities, and their associated formations are:

- Dry sclerophyll forests:
  - Blackbutt - bloodwood dry heathy open forest on sandstones of the northern North Coast
  - Grey Gum - Grey Ironbark open forest of the Clarence lowlands of the North Coast
  - Scribbly Gum - Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast
  - Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast
  - Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast.
- Wet sclerophyll forests:
  - Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast
  - Red Mahogany open forest of the coastal lowlands of the North Coast
  - Tallowwood dry grassy forest of the far northern ranges of the North Coast.
  - .
- Forested wetlands:
  - Coastal floodplain sedgelands, rushlands, and forblands
  - Paperbark swamp forest of the coastal 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.
- Grassy woodlands:
  - Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast
  - Narrow-leaved Red Gum woodlands of the lowlands of the North Coast.
- Saline wetlands:
  - Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregions
  - Saltmarsh complex of the North Coast.
- Rainforests:
  - White Booyong - Fig subtropical rainforest of the North Coast

5.7.1 Endangered ecological communities

Five threatened ecological communities, as defined by the *Threatened Species Conservation Act 1995* (TSC Act) have been mapped within or adjacent to the project boundary between Maclean and Devils Pulpit (Sections 5 and 6). All five have been classified by the TSC Act to be endangered. The following Table 5-2 provides a summary of these communities.

Table 5-2: Endangered ecological communities (EEC) mapped in Sections 5 & 6

EEC NAME	BIOMETRIC TYPE	TSC ACT	SECTION
Coastal Saltmarsh of the NSW North Coast	Saltmarsh complex	Endangered	5
Freshwater Wetlands on Coastal Floodplains	Coastal floodplain sedgelands, rushlands, and forblands.	Endangered	5
Subtropical Coastal Floodplain Forest on Coastal Floodplains	Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast. Narrow-leaved Red Gum woodlands of the lowlands of the North Coast.	Endangered	5 and 6
Swamp Oak Floodplain Forest on Coastal Floodplains	Swamp Mahogany swamp forest of the coastal lowlands of the North Coast.	Endangered	5
Swamp Sclerophyll Forest on Coastal Floodplains	Paperbark swamp forest of the coastal lowlands of the North Coast.	Endangered	5 and 6

Additionally, the Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregions community is protected under the *Fisheries Management Act* 1994. This community has been mapped in Section 5.

5.7.1 Threatened flora species

Targeted threatened flora surveys were undertaken in 2014 as part of the *Threatened Flora Management Plan* (RMS et al. 2015a). Six threatened flora species were mapped within or adjacent to the project boundary between Maclean and Devils Pulpit (Sections 5 and 6). The following Table 5-3 provides a summary of the species mapped, and their status under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or the TSC Act.

Table 5-3: Endangered and threatened flora mapped in Sections 5 & 6

SPECIES	COMMON NAME	TSC ACT	EPBC ACT	SECTION
Cyperus aquatilis	Water Nutgrass	Endangered		6
Lindsaea incisa	Slender Screw Fern	Endangered	Endangered	6
Maundia triglochinoides	Maundia	Vulnerable		6
Prostanthera cineolifera	Singleton Mint Bush	Vulnerable	Vulnerable	6
Rotala tripartita		Endangered		6
Persicaria elatior	Tall knotweed	Vulnerable		5

The *Flora Translocation Strategy* (RMS 2015) determined that the translocation of the following threatened species was feasible: Singleton Mint Bush, Water nutgrass and Tall knotweed (assuming seed and/or above ground plant material is available.

5.7.1 Design principles for Maclean to Devils Pulpit

- Clearing of native vegetation is avoided or minimised wherever possible
- Roadside revegetation mixes are consistent with adjacent existing plant communities
- Endangered Ecological Communities and fauna connectivity corridors are connected with additional revegetation within the project works
- Targeted revegetation of disturbed areas adjoining in situ threatened flora in accordance with the *Threatened Flora Management Plan* (RMS et al. 2015a)
- Translocation of suitable species in accordance with the *Flora Translocation Strategy* (RMS 2015).

5.8 FAUNA

5.8.1 Fauna

A number of threatened fauna species or their habitats have been identified in, or adjoining the highway corridor between Maclean and Devils Pulpit (Sections 5 and 6). These are summarised in the following Table 5-4.

Table 5-4: Threatened species (or their habitat) that occur in Sections 5 & 6

SPECIES	COMMON NAME	TSC ACT	EPBC ACT
Phascolarctos cinereus	Koala	Vulnerable	Vulnerable
Petaurus norfolcensis	Squirrel glider	Vulnerable	
Petaurus australis	Yellow-bellied glider	Vulnerable	
Potorous tridactylus	Long-nosed Potoroo	Vulnerable	Vulnerable
Aepyprymnus rufescens	Rufous Bettong	Vulnerable	
Phascogale tapoatafa	Brush-tailed phascogale	Vulnerable	
Litoria brevipalmata	Green-thighed Frog	Vulnerable	
Nannoperca oxleyana *	Oxleyan Pygmy Perch	Endangered	Endangered
Miniopterus australis	Little Bent-wing bat	Vulnerable	
Miniopterus schreibersii oceanensis	Eastern Bent-wing bat	Vulnerable	
Myotis macropus	Southern Myotis	Vulnerable	

* Note that Oxleyan Pygmy Perch habitat occurs downstream of the highway corridor between Maclean and Devils Pulpit; it does not occur within or adjoining the corridor.

Koala

The Woombah/Iluka Important Koala Population (Clarence Valley Council 2010) is located in between Maclean and Devils Pulpit (Sections 5 and 6). The approximate distribution of this population extends from CH 94,000 to CH 102,000, north of the Clarence River North Arm.

The Woombah/Iluka Important Koala Population appears to be represented by only few individuals and little detailed information is available about its distribution and status. Potential koala habitat is associated with most vegetation communities mapped north of the Clarence River North Arm, due to the presence of primary Koala feed trees such as Swamp Mahogany, Tallowwood and Forest Red Gum.

Gliders

Targeted surveys for the Squirrel glider and Yellow-bellied glider were undertaken in May 2014 (Sandpiper Ecological 2014). No threatened gliders were recorded between Maclean and Devils Pulpit (Sections 5 and 6). However, dry forest vegetation communities within the adjoining Mororo State Forest were determined to support high quality potential habitat for these species.

Terrestrial mammals

Targeted surveys undertaken in October 2014 found the following:

- One Long-nosed Potoroo was recorded near the intersection of the Pacific Highway and Iluka Road, in addition to breeding and foraging habitat
- Rufous Bettong was not identified. However the species was previously recorded within Mororo Creek Nature Reserve
- Brush-tailed Phascogale was not identified. However the species was previously recorded two kilometres east of CH 96,400.

Green-thighed Frog

Green-thighed Frog was identified during targeted surveys carried out in January and February 2015. Potential foraging and dispersal habitat was also identified adjoining both sides of the existing Pacific Highway north of the Clarence River North Arm.

Oxleyan Pygmy Perch

Targeted pre-construction surveys (GeoLINK 2013, 2014) did not identify Oxleyan Pygmy Perch in any waterways intersecting the Maclean to Devils Pulpit (Sections 5 and 6) portion of the project.

Known Oxleyan Pygmy Perch habitat does not occur between Maclean and Devils Pulpit (Sections 5 and 6). In accordance with the *Threatened Fish Management Plan* (RMS et al. 2015e), no specific Oxleyan Pygmy Perch connectivity structures are required for between Maclean and Devils Pulpit (Sections 5 and 6).

However, the *Threatened Fish Management Plan* (RMS et al. 2015e) identified Tabbimoble Creek as an Oxleyan Pygmy Perch management area. This places restrictions on construction activity within the management area as outlined in the *Threatened Fish Management Plan*.

Microbat

Microbat surveys were undertaken as part of the *Microbat Management Plan Sections 3-11* (GeoLINK 2015). Seven roost locations, including one culvert and six bridges, were identified between Maclean and Devils Pulpit (Sections 5 and 6). None of these roosts are proposed to be removed.

5.8.1 Fauna connectivity

Between Maclean and Iluka Road (Section5), the highway traverses the Clarence River and its floodplain, from which native vegetation has been largely cleared for agriculture. Intact fauna habitat is generally limited to Yaegl Nature Reserve and the narrow and fragmented riparian corridors associated with the Clarence River, Serpentine Channel and Clarence River North Arm.

Between Iluka Road and Devils Pulpit (Section 6) the highway transects a large expanse of native vegetation that provides intact habitat for a wide range of fauna. The vegetation is located within and adjacent to the highway corridor – within Mororo State Forest, Mororo Creek Nature Reserve, Bundjalung National Park and Devils Pulpit State Forest.

The Maclean to Devils Pulpit (Sections 5 and 6) study area intersects with a number of key habitats and movement corridors identified from the Key Habitats and Corridors project (DEC 2003) and Climate Change Corridors project (DECC 2007). These projects identified regional key fauna habitats and linking habitat corridors, including current corridor locations and corridors likely to become important in the face of future climate change. The conservation corridors intersecting the Maclean to Devils Pulpit (Sections 5 and 6) study area are summarised in the following Table 5-5.

Table 5-5: Fauna corridors that intersect with Sections 5 & 6

REGIONAL CORRIDOR	LOCATION	FOCAL SPECIES
Mororo – Gibberage key corridor	Crosses Section 6. Connects to several other corridors and key habitats contained within Mororo State Forest, Mororo Creek Nature Reserve, Bundjalung National Park and Devils Pulpit State Forest.	Yellow-bellied Glider

REGIONAL CORRIDOR	LOCATION	FOCAL SPECIES
Illuka - Richmond Range OEH climate change corridor – moist corridor	Crosses Section 6	Grey-headed Flying-fox Whiptail Wallaby
Lower Clarence OEH climate change corridor – coastal corridor	Crosses Sections 5 and 6	Wetland waterbirds Emu
Broadwater - Bungawalbin OEH climate change corridor – coastal corridor	Crosses northern end of Section 6	Koala Emu
Richmond Range - Bungawalbin OEH climate change corridor – dry corridor	Intersects western side of Section 6	Squirrel Glider Spotted-tailed Quoll

5.8.1 Design principles for Maclean to Devils Pulpit

- Fauna connectivity structures, including fauna fencing and revegetation, have been designed in collaboration with the Environment team, including ecologists. Refer to chapters 6 and 7 of this report for more detail.
- The detailed design of the fauna connectivity structures, including fauna fencing and revegetation, is informed by the requirements specified in the following threatened species management plans relevant to Maclean to Devils Pulpit (Sections 5 and 6):
  - *Threatened Frog Management Plan* (RMS et al. 2015b)
  - *Threatened Glider Management Plan* (RMS et al. 2015c)
  - *Threatened Mammal Management Plan* (RMS et al. 2015d)
  - *Threatened Fish Management Plan* (RMS et al. 2015e)
  - *Koala Management Plan* (RMS et al. 2016)
  - *Threatened Glider Aerial Crossings Targeted Surveys: Section 3 and 11* (Sandpiper Ecological 2014)
  - *Microbat Management Plan Sections 3-11* (GeoLINK 2015)
- Clearing of native vegetation associated with the highway corridor is minimised in order to maintain the connectivity of existing habitats and minimise habitat fragmentation
- Remnant vegetation is retained between the project boundary and the clearing boundary where feasible and reasonable
- Plant species for revegetation around fauna connectivity structures are consistent with the surrounding natural habitat. Revegetation is designed to attract native fauna species to the structures and not obstruct views, overshadow or disguise the entrance to a structure.

Figure 5-7: OEH climate change corridors – moist

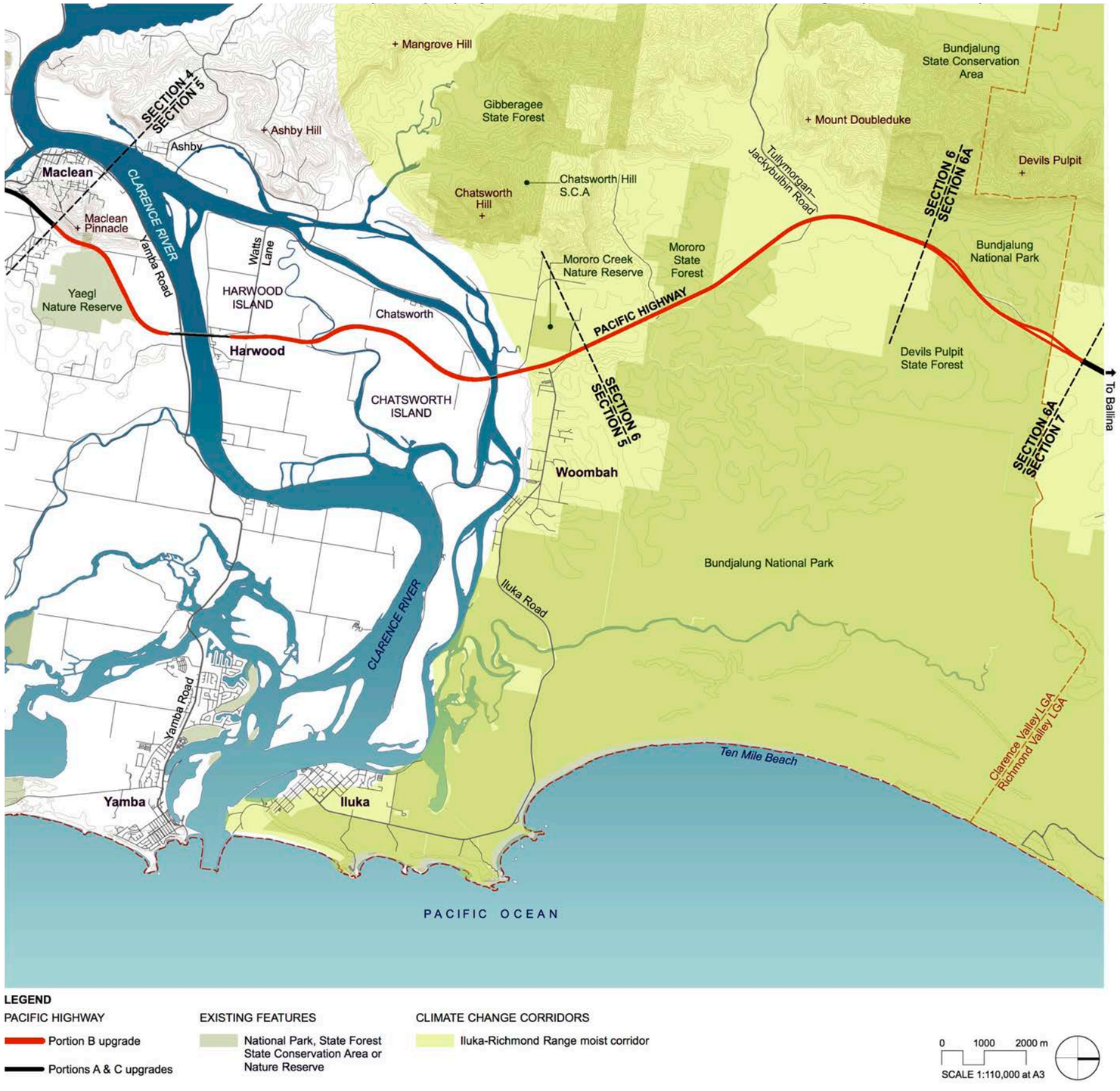


Figure 5-8: OEH climate change corridors – coastal and dry

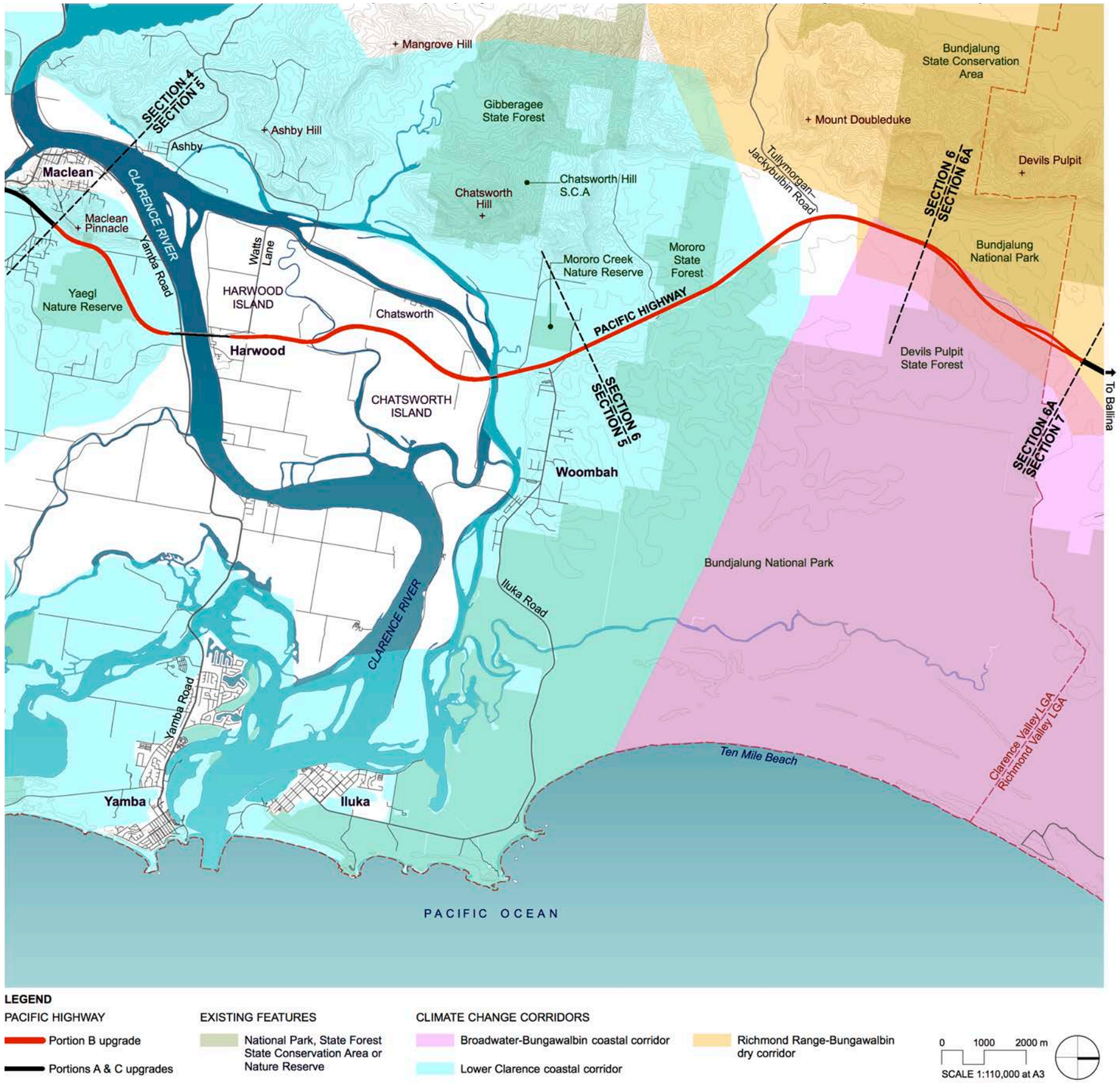
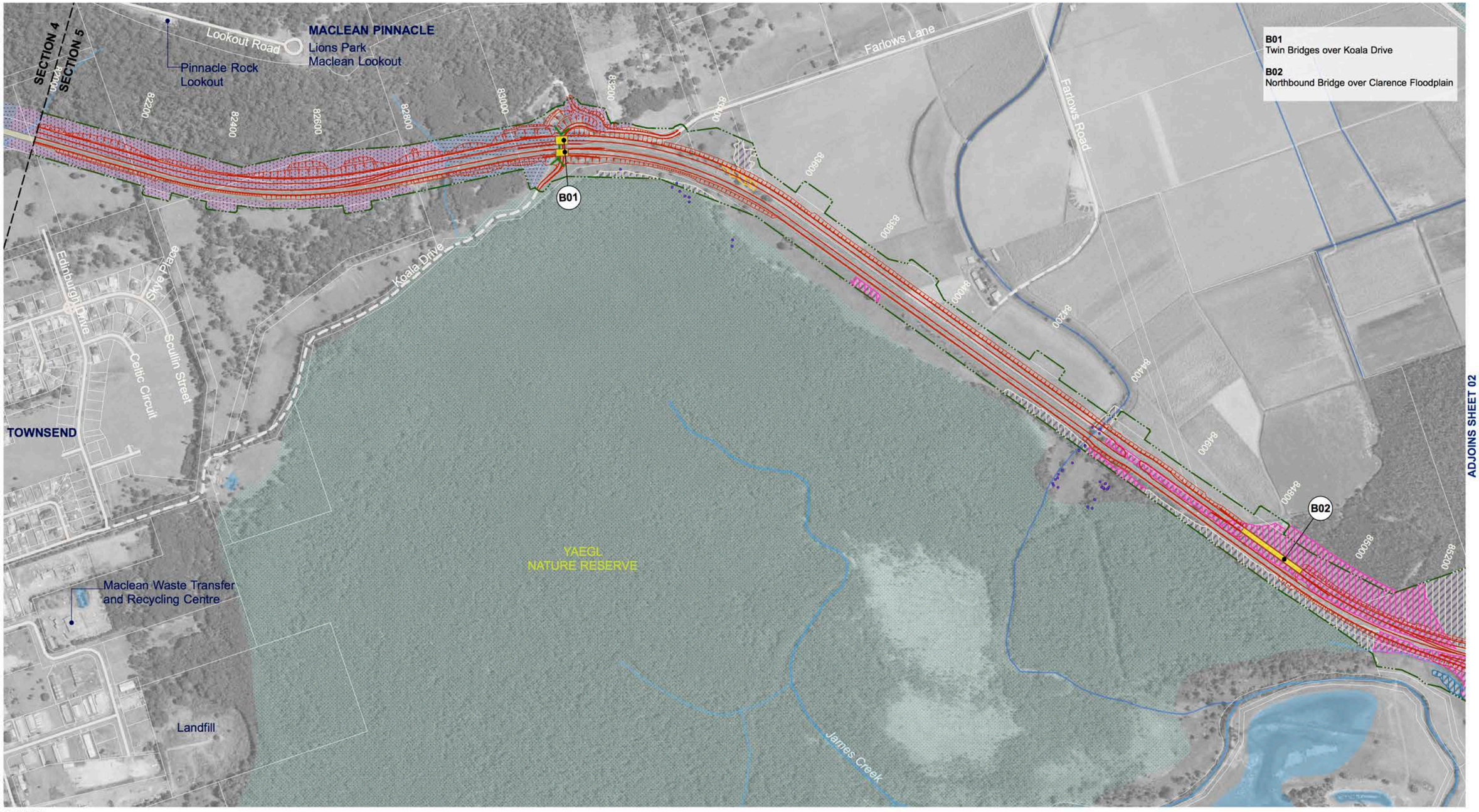
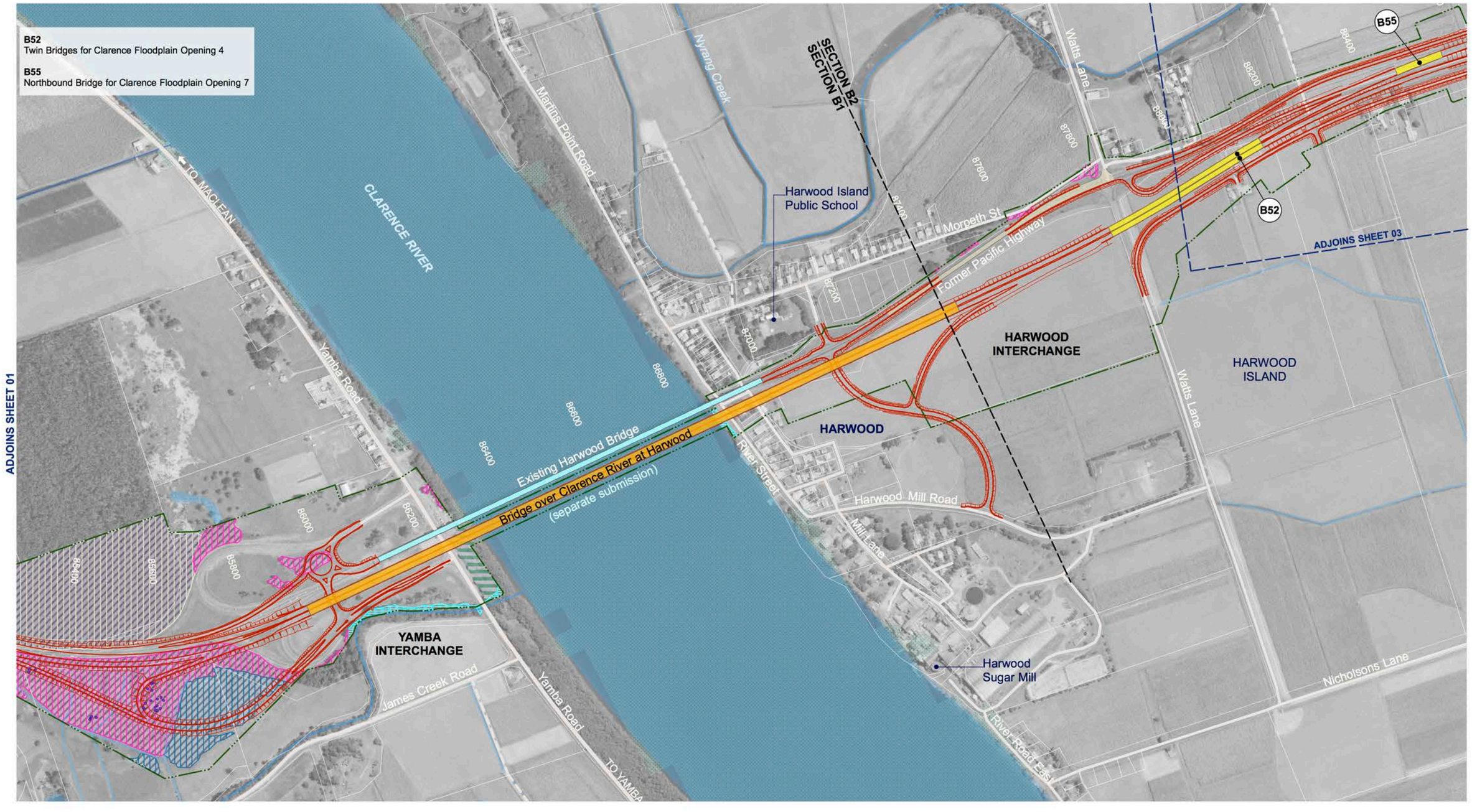


Figure 5-9: Existing vegetation, threatened flora and fauna connectivity (10 sheets)





ENDANGERED ECOLOGICAL COMMUNITIES – TSC Act 1995

- Coastal Saltmarsh in the NSW North Coast
- Freshwater Wetlands on Coastal Floodplains of the NSW N. Coast
- Subtropical Coastal Floodplain Forest of the NSW North Coast
- Swamp Oak Floodplain Forest of the NSW North Coast
- Swamp Sclerophyll Forest of the NSW North Coast

PROTECTED VEGETATION

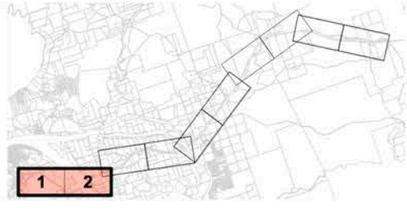
- SHR - High Conservation Old Growth Forest
- SEWPAC & SEPP 14 Wetlands
- Fisheries Management Act 1994

THREATENED FLORA SPECIES

- *Cyperus aquatilis* Water nutgrass
- *Lindsaea incisa* Slender screw fern
- *Maundia triglochinoides* Maundia
- *Persicaria elatior* Tall knotweed
- *Prostanthera cineolifera* Singleton mint bush
- *Rotala triparta* —

FAUNA CROSSINGS

- Fauna culvert (dedicated or combined)
- Fauna crossing under bridge
- Glider poles
- Frog pond (indicative location)



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Sheet 1-2 of 10

B56
Northbound Bridge for Clarence Floodplain Opening 8

B04
Northbound Bridge at Serpentine Channel

B59
Northbound Bridge for Clarence Floodplain Opening 11

B05
Bridge over Pacific Highway on Serpentine Channel Road North

Serpentine Channel
Ryans Lane
Andersons Lane
Chatsworth Road (South)
Serpentine Channel
North Bank Road
Serpentine Channel
Serpentine Channel South Bank Road
CHATSWORTH ISLAND
HARWOOD ISLAND
CHATSWORTH ISLAND
HARWOOD ISLAND
New local access road
New local access road
New local access road
Existing local access bridge
Existing Serpentine Channel Bridge
B05
B59
B04
B56
B55
B52
ADJOINS SHEET 02
ADJOINS SHEET 04
88600
88800
89000
89200
89400
89600
89800
90000
90200
90400
90600
90800
91000
91200

Note: Targeted consultation will be undertaken for flooding at detailed design stage.

LEGEND

EXISTING FEATURES
- Existing highway
- Existing bridge
- Existing road
- Existing vehicular track
- Waterway / water body

HIGHWAY UPGRADE
- Approved project boundary
- Roadworks between Maclean and Devils Pulpit (Sections 5 & 6)
- New bridge (BXX)
- New Clarence River bridge (subject of a separate submission)

VEGETATION COMMUNITIES – MAPPED WITHIN THE PROJECT CORRIDOR

Dry sclerophyll forests
- Blackbutt - Bloodwood dry heathy open forest
- Grey Gum - Grey Ironbark open forest
- Spotted Gum - Grey Box - Grey Ironbark open forest
- Spotted Gum - Grey Ironbark - Pink Bloodwood open forest

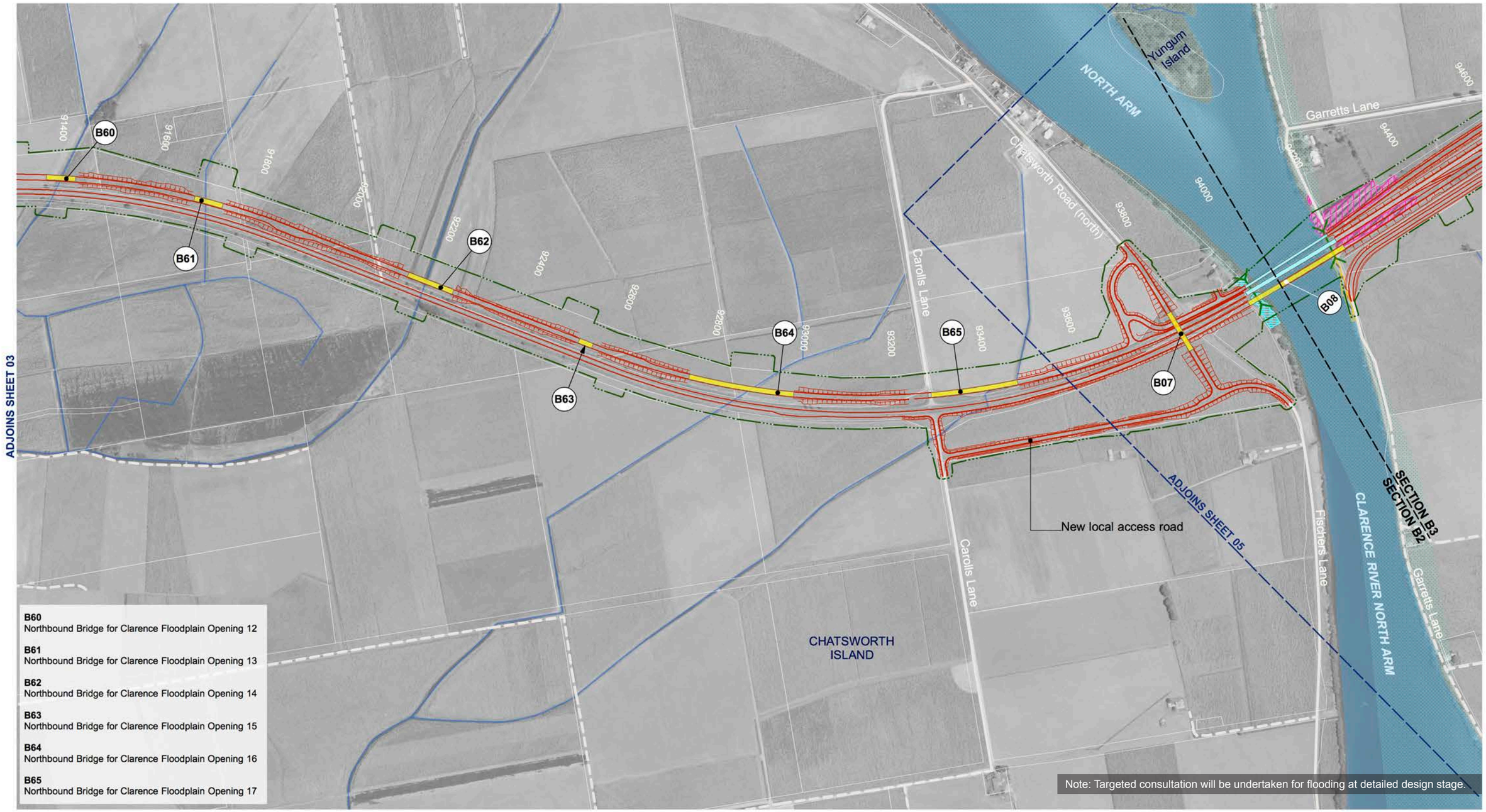
Wet sclerophyll forests
- Flooded Gum - Brush Box moist open forest
- Red Mahogany open forest
- Tallowwood dry grassy forest

Forested wetlands
- Coastal Floodplain sedgelands, rushlands and forblands
- Swamp Oak swamp forest
- Paperbark swamp forest

Grassy woodlands
- Forest Red Gum - Swamp Box
- Narrow-leaved Red Gum woodlands

Saline wetlands
- Mangrove - Grey Mangrove low closed forest
- Saltmarsh complex

Rainforest
- White Booyong - Fig subtropical rainforest

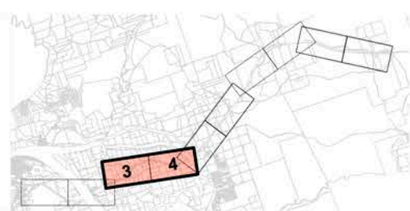


ENDANGERED ECOLOGICAL COMMUNITIES – TSC Act 1995
- Coastal Saltmarsh in the NSW North Coast
- Freshwater Wetlands on Coastal Floodplains of the NSW N. Coast
- Subtropical Coastal Floodplain Forest of the NSW North Coast
- Swamp Oak Floodplain Forest of the NSW North Coast
- Swamp Sclerophyll Forest of the NSW North Coast

PROTECTED VEGETATION
- SHR - High Conservation Old Growth Forest
- SEWPAC & SEPP 14 Wetlands
- Fisheries Management Act 1994

THREATENED FLORA SPECIES
- *Cyperus aquatilis* Water nutgrass
- *Lindsaea incisa* Slender screw fern
- *Maundia triglochinoides* Maundia
- *Persicaria elatior* Tall knotweed
- *Prostanthera cineolifera* Singleton mint bush
- *Rotala triparta* —

FAUNA CROSSINGS
- Fauna culvert (dedicated or combined)
- Fauna crossing under bridge
- Glider poles
- Frog pond (indicative location)



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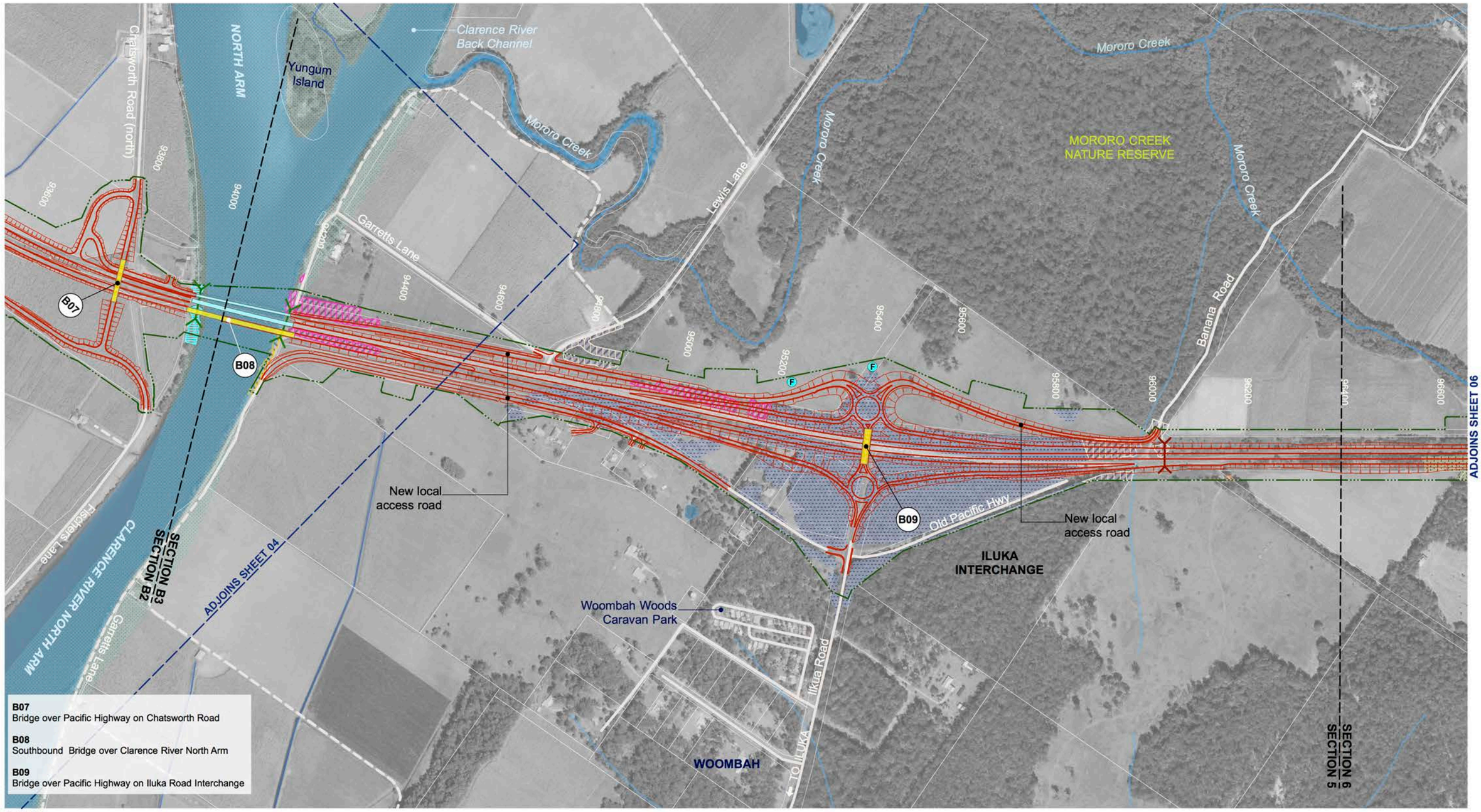
Sheet 3-4 of 10



LEGEND

EXISTING FEATURES
- Existing highway
- Existing bridge
- Existing road
- Existing vehicular track
- Waterway / water body

HIGHWAY UPGRADE
- Approved project boundary
- Roadworks between Maclean and Devils Pulpit (Sections 5 & 6)
- New bridge (BXX)
- New Clarence River bridge (subject of a separate submission)

VEGETATION COMMUNITIES – MAPPED WITHIN THE PROJECT CORRIDOR

Dry sclerophyll forests
- Blackbutt - Bloodwood dry heathy open forest
- Grey Gum - Grey Ironbark open forest
- Spotted Gum - Grey Box - Grey Ironbark open forest
- Spotted Gum - Grey Ironbark - Pink Bloodwood open forest

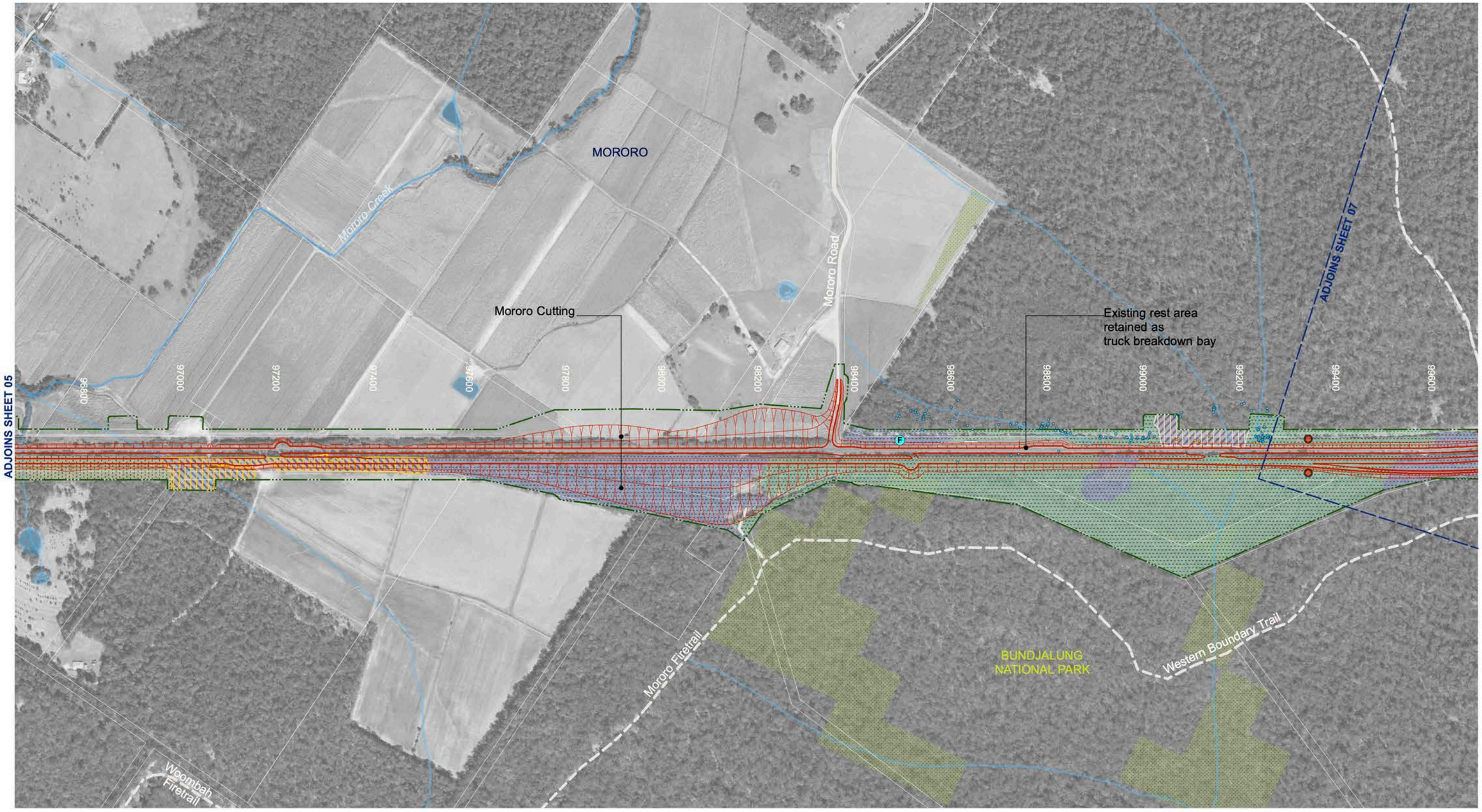
Wet sclerophyll forests
- Flooded Gum - Brush Box moist open forest
- Red Mahogany open forest
- Tallowwood dry grassy forest

Forested wetlands
- Coastal Floodplain sedgelands, rushlands and forblands
- Swamp Oak swamp forest
- Paperbark swamp forest

Grassy woodlands
- Forest Red Gum - Swamp Box
- Narrow-leaved Red Gum woodlands

Saline wetlands
- Mangrove - Grey Mangrove low closed forest
- Saltmarsh complex

Rainforest
- White Booyong - Fig subtropical rainforest



ENDANGERED ECOLOGICAL COMMUNITIES – TSC Act 1995

- Coastal Saltmarsh in the NSW North Coast
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- Swamp Sclerophyll Forest of the NSW North Coast

PROTECTED VEGETATION

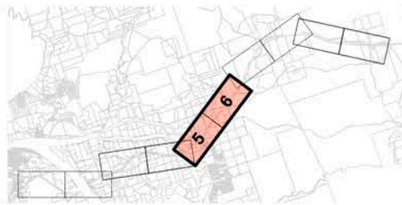
- SHR - High Conservation Old Growth Forest
- SEWPAC & SEPP 14 Wetlands
- Fisheries Management Act 1994

THREATENED FLORA SPECIES

- *Cyperus aquatilis* Water nutgrass
- *Lindsaea incisa* Slender screw fern
- *Maundia triglochinoides* Maundia
- *Persicaria elatior* Tall knotweed
- *Prostanthera cineolifera* Singleton mint bush
- *Rotala triparta* —

FAUNA CROSSINGS

- Fauna culvert (dedicated or combined)
- Fauna crossing under bridge
- Glider poles
- F Frog pond (indicative location)



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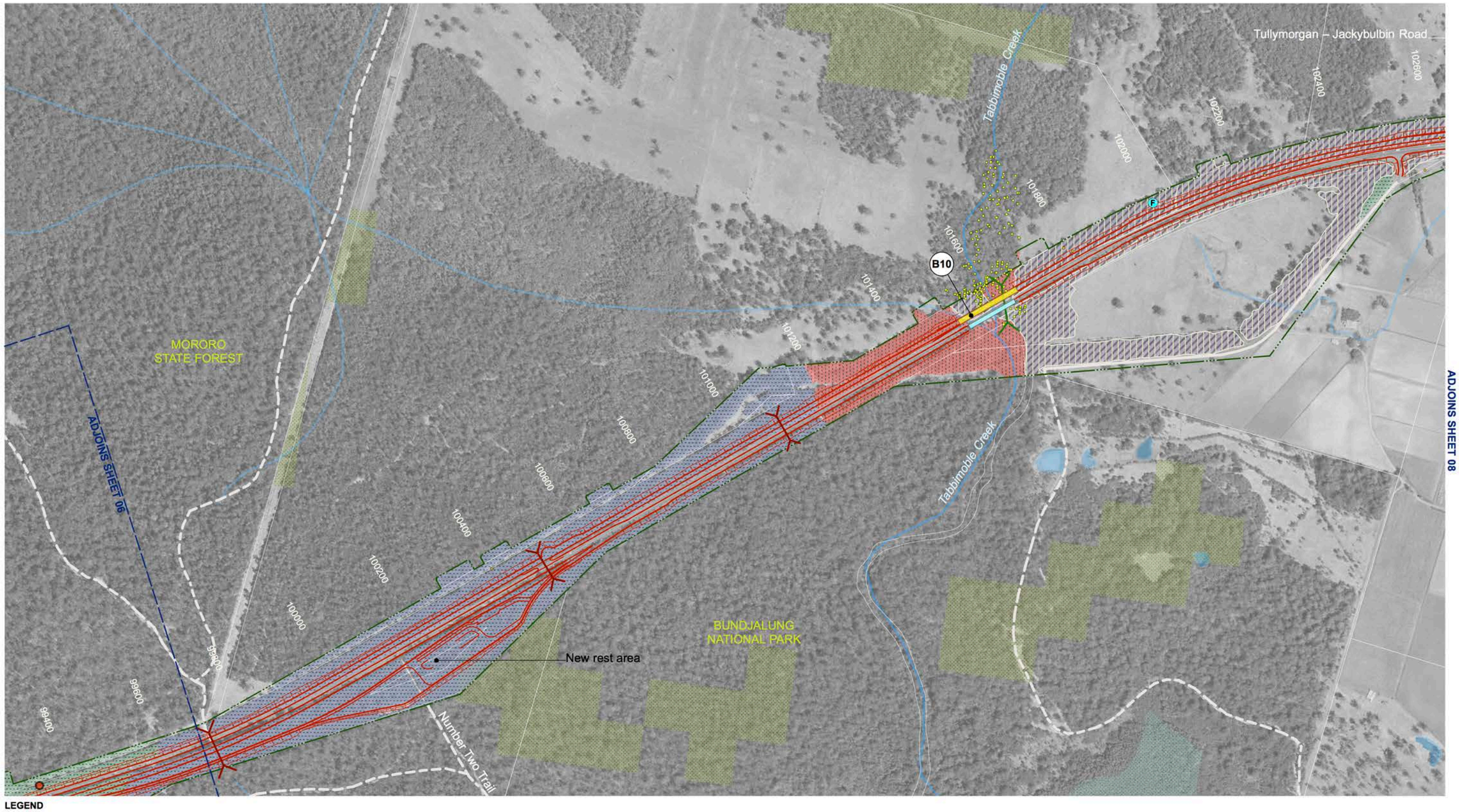

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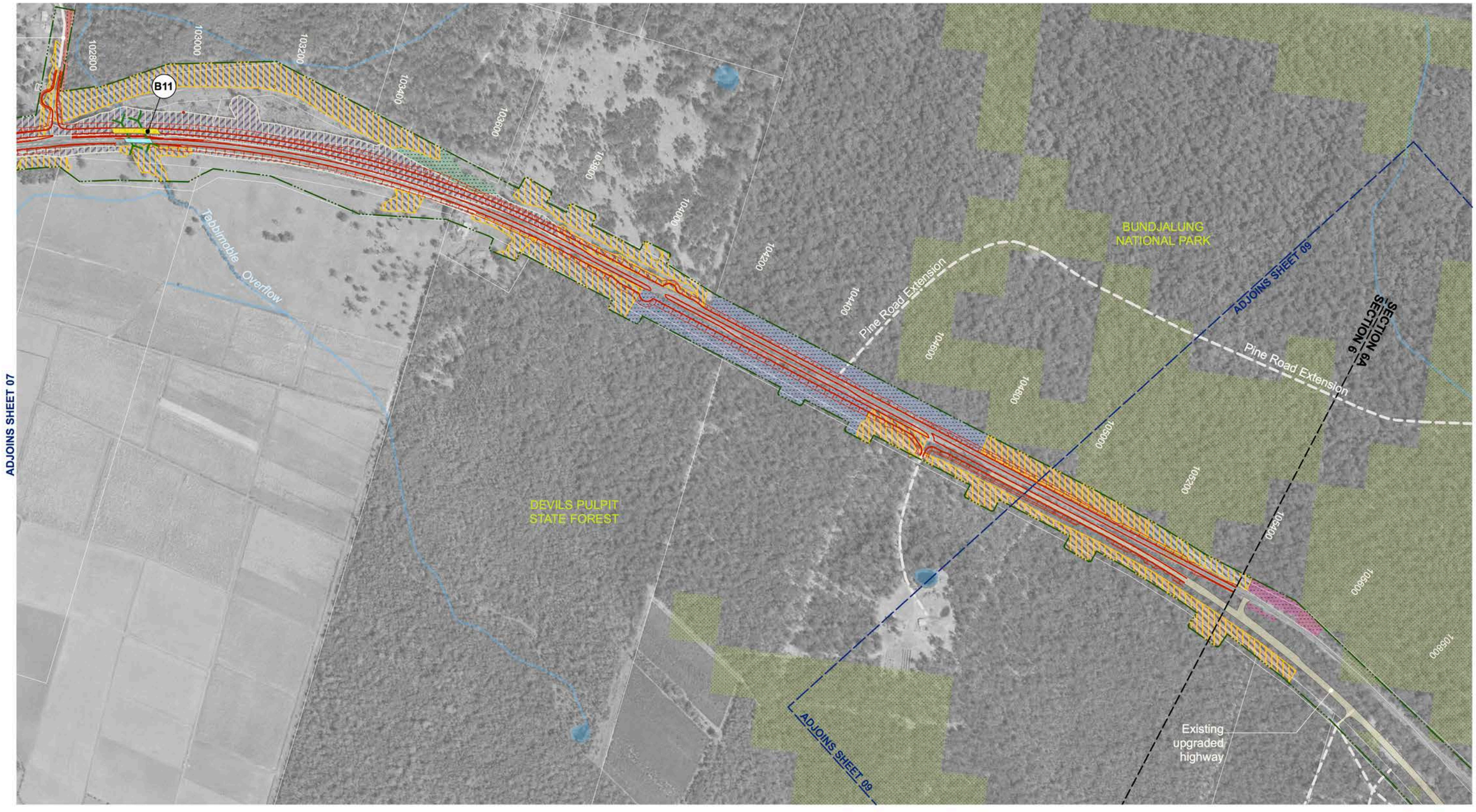
- White Booyong - Fig subtropical rainforest



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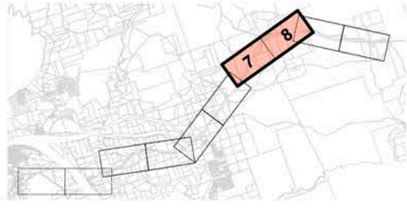

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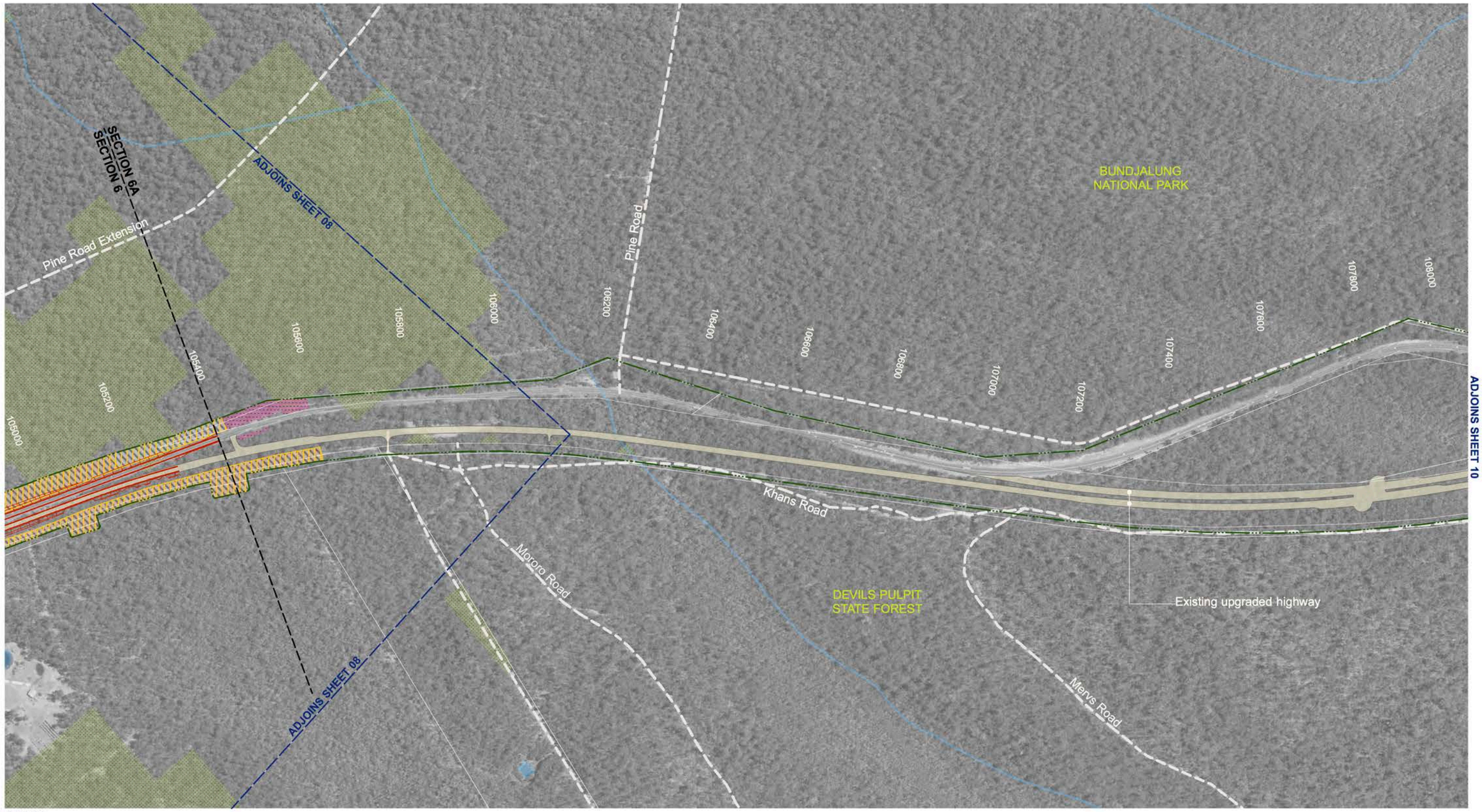
Sheet 7-8 of 10



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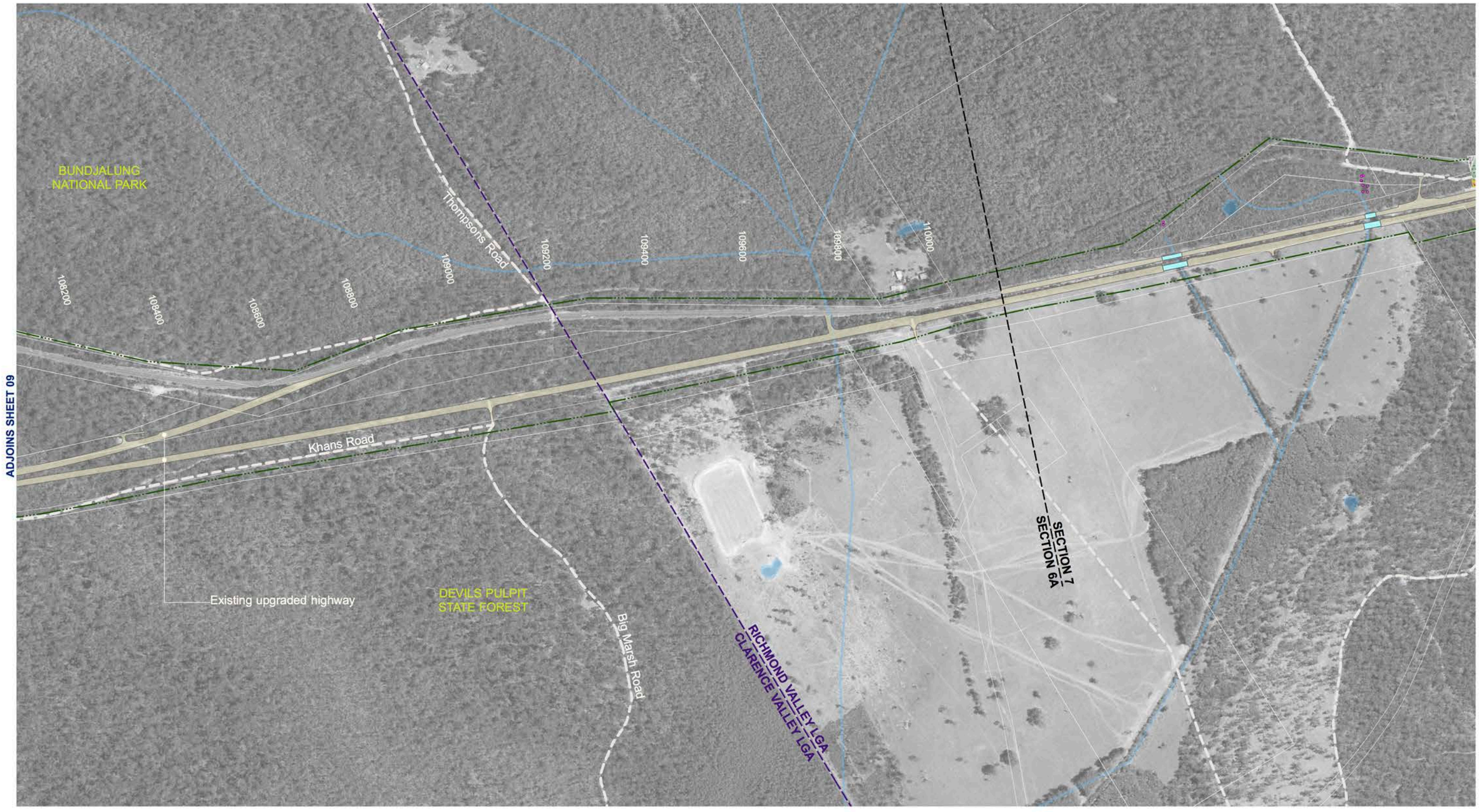

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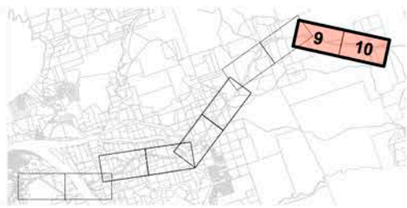

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Sheet 9-10 of 10

5.9 HERITAGE

5.9.1 Aboriginal heritage

The study area was originally occupied by two groups of Aboriginal people (Brooke et al. 2012a):

- The Yaegl (Yaygir) people, who occupied the lower Clarence River
- The Bundjalung people, who inhabited the region north of the Clarence River.

The Clarence River separated these two Aboriginal groups, who were associated with distinctly different languages. On Friday 12 August 1799, Matthew Flinders recorded an Aboriginal settlement at the mouth of the Clarence River (Piper 1982, in Brooke et al. 2012a). He described large dome shaped bark huts, baskets, nets and other evidence that suggested that the Aboriginal people of the area utilised the rich terrestrial and aquatic habitats as a source of food and shelter.

Whilst there is the potential for a rich and highly valued Aboriginal history throughout the study area, there are few known Aboriginal sites in the vicinity of the highway corridor. The areas likely to contain these archaeological sites include the Clarence River floodplain; however, post-contact disturbance has largely removed evidence of these sites.

Aboriginal cultural heritage assessment of the study area between Maclean and Devils Pulpit (Sections 5 and 6) was undertaken for the W2B EIS (Brooke et al. 2012a & 2012b). The assessment identified:

- No potential archaeological deposits (PAD) within or near the project corridor between Maclean and Devils Pulpit (Sections 5 and 6).
- One Aboriginal cultural place within 200 metres of Section 5 (Maclean to Iluka Road). The Birrugan and Mindi spiritual sites have high social significance to the Aboriginal communities of North Coast NSW due to the spiritual and cultural importance of the creation stories associated with them. There are no direct or indirect impacts to these sites.
- One Aboriginal site within 200 metres of the project boundary within Section 6 (Iluka Road to Devils Pulpit). The site is an isolated artefact located south of Tabbimoble Creek and is situated within the project boundary. Following is a summary of the assessment outcomes for this site:
  - The integrity of the site is low as it has been heavily disturbed by post-contact land use practices. The overall significance of the site was assessed to be low at the local level.
  - The highway upgrade works would directly impact the entire site
  - The mitigation strategy recommends that all previously recorded artefacts be recovered and removed off-site.

5.9.1 Non-aboriginal heritage

The arrival of Europeans to the North Coast in the 1830s-40s was primarily to source timber for the expanding colony. This had an immediate impact on the Aboriginal way of life and brought about conflict. The area was initially logged for cedar and later hardwoods like mahogany and tallowood. Small settlements were developed and the timber transported on the Richmond and Clarence Rivers or by bullock carts. Once the land was cleared, agriculture commenced – initially focussing on maize, sugar cane and later dairying. The influx of new settlers in the 1860s created a hierarchy of towns, villages and hamlets. Maclean was laid out in 1862 and Harwood was established to service sugar cane farming and milling operations.

Due to the low expenditure and rapidity of these early activities, the legacy of historical development has little in the way of physical evidence apart from in the larger towns. However the vast clearing of land is an important early colonial legacy in itself.

Local heritage listed items

Nine sites in the vicinity of the highway have been identified in the *Clarence Valley Local Environment Plan* (LEP) *2011* as having local significance. All are located between Maclean and Iluka Road (Section 5). The following Table 5-6 provides a summary of these heritage items, including impacts and mitigation measures identified in the W2B EIS *Historical (non-Aboriginal) Heritage Assessment* (W2BPA 2012a).

Table 5-6: Local heritage listed items and impact mitigation

ITEM NO	ITEM NAME	IMPACT	MITIGATION
13	'Highfield' residence, James Creek	Not impacted	N/A
14	James Creek residence, James Creek	Not impacted	N/A
15	Harwood School and residence, Harwood	Not impacted	N/A
16	Harwood School, Harwood	Not impacted	N/A
17	Harwood Tram Tracks, Old Pacific Highway road reserve, Harwood	Physical damage due to construction traffic on Petticoat Lane Tram Tracks section	Protective covering
18	Harwood Water Brigade Hall, Harwood	Not impacted	N/A
19	Harwood War Memorial, Harwood	Not impacted	N/A
32	Harwood Heritage Conservation Area	Demolition of Convent building. Refer item 21 at potential heritage items.	Archival photographic recording, relocation of building.
37	River Street trees, Harwood	Not impacted	N/A

Potential heritage items

The W2B EIS *Historical (non-Aboriginal) Heritage Assessment* (W2BPA 2012a) identified two additional sites as having potential local significance that are not listed in the Clarence Valley LEP. The following table provides a summary of these potential heritage sites, including impacts and mitigation measures identified.

Table 5-7: Potential local heritage items and impact mitigation

ITEM NO	ITEM NAME	IMPACT	MITIGATION
20	Harwood Bridge	Visual	Design to NSW Roads and Maritime Services' *Bridge Aesthetics* guidelines
21	Convent 12 River Street, Harwood	Entire site demolished	Archival photographic recording, relocation of building.

The highway itself is an important record of movement in the area and its existing route was created from local roads in operation from around 1895. A continuous route was formed in 1909, while the highway itself was formalised in 1928 and was known as the 'North Coast Road'.

5.9.1 High Conservation Old Growth Forest

High Conservation Old Growth Forest is of state heritage significance and is listed on the State Heritage Register. Old growth forest is mature eucalypt forest showing few signs of human disturbance. The remains of examples of old growth forests in the study area are rare due to the initial European settlers' focus on timber getting and land clearing for agriculture, pastoralism and townships. High Conservation Old Growth Forest represents the best examples remaining of the forests that pre-date European settlement.

High Conservation Old Growth Forest occurs in multiple locations throughout between Iluka Road and Devils Pulpit (Section 6), occasionally adjoining the project boundary at the Bundjalung National Park and Devils Pulpit State Forest.

5.9.1 Design principles for Maclean to Devils Pulpit

- The study area between Maclean and Devils Pulpit (Sections 5 and 6) has only limited physical remnants of cultural heritage. The identified sites are carefully considered and adverse physical impacts have been avoided or minimised wherever possible
- Where impacts to heritage items are unavoidable, those impacts are mitigated in accordance with the requirements of the EIS and *Aboriginal Cultural Heritage Assessment* (Brooke et al. 2012a & 2012b) or *Historical (non-Aboriginal) Heritage Assessment* (W2BPA 2012a) as appropriate
- Where High Conservation Old Growth Forest is located within the project boundary, the design aims to avoid or minimise the clearing of vegetation wherever possible
- Impacts or potential impacts to High Conservation Old Growth Forest are mitigated in accordance with the measures described in the *Historical (non-Aboriginal) Heritage Assessment* (W2BPA 2012a)
- Areas previously cleared for agricultural or grazing activities offer expansive views; these views are incorporated into the landscape and urban design to enhance the motorist's experience.

5.10 LAND USE AND COMMUNITIES

5.10.1 Land use

Land use in the area since European settlement in the 1830s to 1840s has consisted primarily of timber getting and later agriculture, pastoralism and fisheries. Before this, the region supported populations of Aboriginal people living in productive floodplain habitats.

Between Maclean and Devils Pulpit (Sections 5 and 6), agricultural land that the highway traverses is identified as regionally significant farmland by the *Northern Rivers Farmland Protection Project* (W2BPA 2012e). The majority of this is cropping land used for sugar cane growing (with a small area used for soya bean growing) on Harwood Island, Chatsworth Island, north of Clarence River North Arm and south of Mororo. Grazing land also occurs – mainly to the north around Iluka Road, as well as Mororo and Jacky Bulbin Flat.

Forested lands make up a large proportion of the area north of Clarence River North Arm. This includes Mororo Creek Nature Reserve, Bundjalung National Park, Bundjalung State Conservation Area and Devils Pulpit State Forest. Yaegl Nature Reserve is located east of the highway near Townsend, south of the Clarence River.

5.10.1 Communities

Located west of the Pacific Highway, Maclean is the main township of the area and is located immediately southwest of Section 5 (Maclean to Iluka Road). It is linked by an underpass of the highway at Jubilee Street to the smaller residential areas of Townsend and Gulmarrad to the southeast. James Creek, a small residential area, is located to the east of Yaegl Nature Reserve and is accessed via James Creek Road from Yamba Road or Jubilee Street.

There are three settlements located north of the Clarence River between Maclean and Iluka Road (Section 5). The village of Harwood is located on both sides of the Pacific Highway on the northern bank of the Clarence River and is dominated by the Harwood Sugar Mill on its eastern edge. The village of Woombah is located east of the highway on Iluka Road. The small rural hamlet of Chatsworth is located on the western side of Chatworth Island, on the Clarence River North Arm.

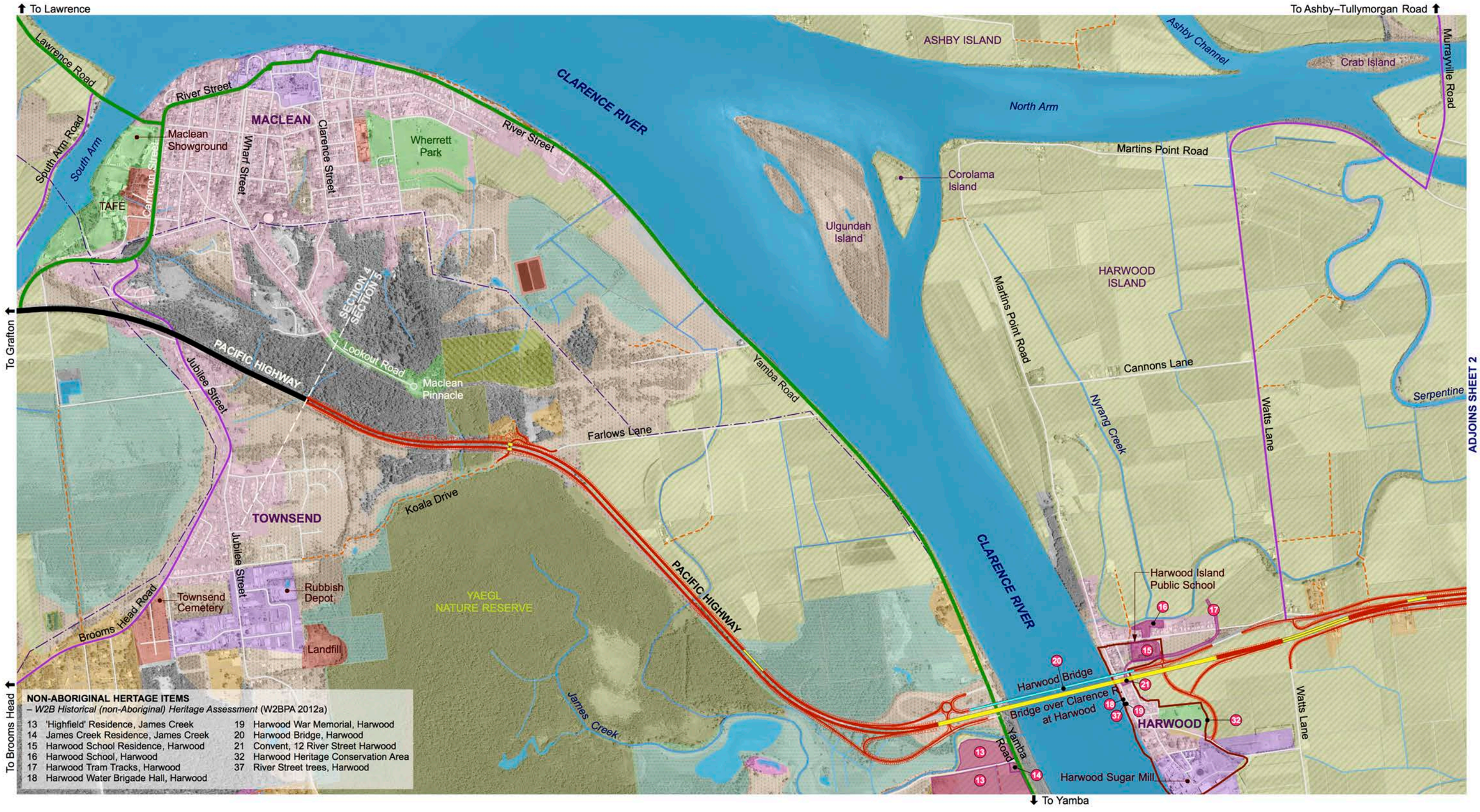
There are no settlements located between Iluka Road and Devils Pulpit (Section 6).

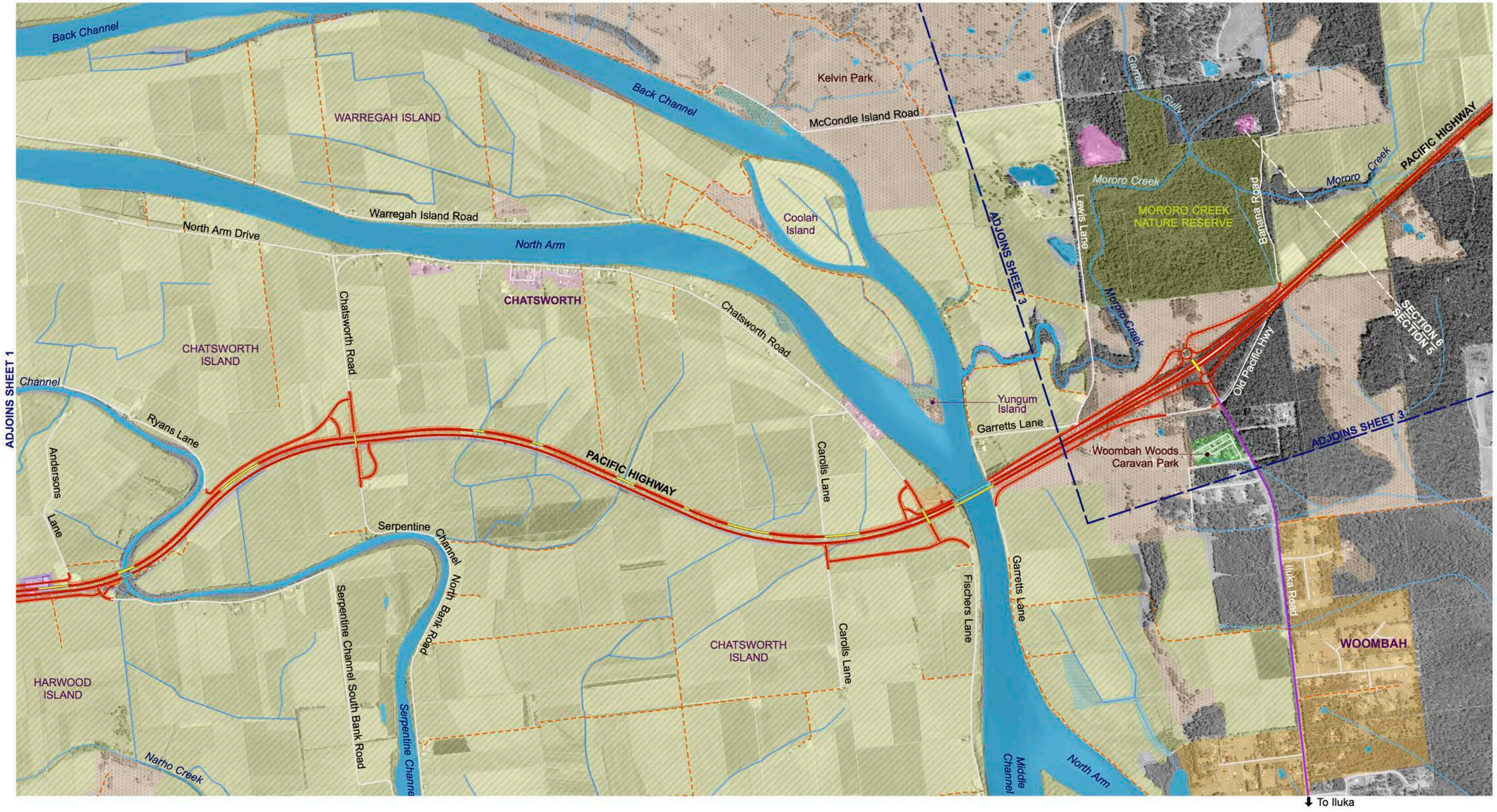
Townsend, Gulmarrad and James Creek have been identified as urban growth areas by the *Mid North Coast Regional Strategy* (NSW Department of Planning 2009) and the *Maclean Urban Catchment Local Growth Management Strategy* (Clarence Valley Council 2011). Townsend has been identified for proposed future employment lands, while Gulmarrad and James Creek are proposed future urban release areas. The proposed total population is 10,000 people by 2031, almost double the current population. It is anticipated that the highway upgrade would support the development potential of these areas by improving access to a major transport corridor. All three growth areas are located to the east of Section 5 (Maclean to Iluka Road) and are accessed from Maclean via Brooms Head Road. The nearest interchange with the upgraded highway would be at Maclean (Goodwood Street, south), which is located in the Tynedale to Maclean (Section 4) part of the project.

5.10.1 Design principles for Maclean to Devils Pulpit

- Maintaining and enhancing local and regional connectivity are important considerations in relation to land use and communities. Any areas of residual land resulting from the upgrade works are carefully integrated, and are revegetated where appropriate with consideration given to proposed/ future land uses.

Figure 5-10: Land use, communities and non-Aboriginal heritage (4 sheets)





LEGEND

ROAD NETWORK
- Regional road
- Main road
- Local road
- Vehicular track

PACIFIC HIGHWAY
- Highway upgrade Maclean to Devils Pulpit (Sections 5 & 6)
- Existing upgraded Pacific Highway
- Adjacent sections of highway upgrade
- Existing bridge
- New bridge

OPEN SPACE
- National Park
- State Forest
- State Conservation Area
- Nature Reserve
- Private agreement conservation
- Public park
- Wetland
- Waterway / water body

URBAN LANDUSE
- Residential
- Rural residential
- Commercial / industrial
- Special uses

RURAL LANDUSE
- Cropping
- Grazing
- Horticulture
- Quarrying / mining

EXISTING FEATURES
- Heritage Conservation Area
- Heritage listed item (non-Aboriginal)
- High Conservation Old Growth Forest (State Heritage Register)
- Electricity transmission line

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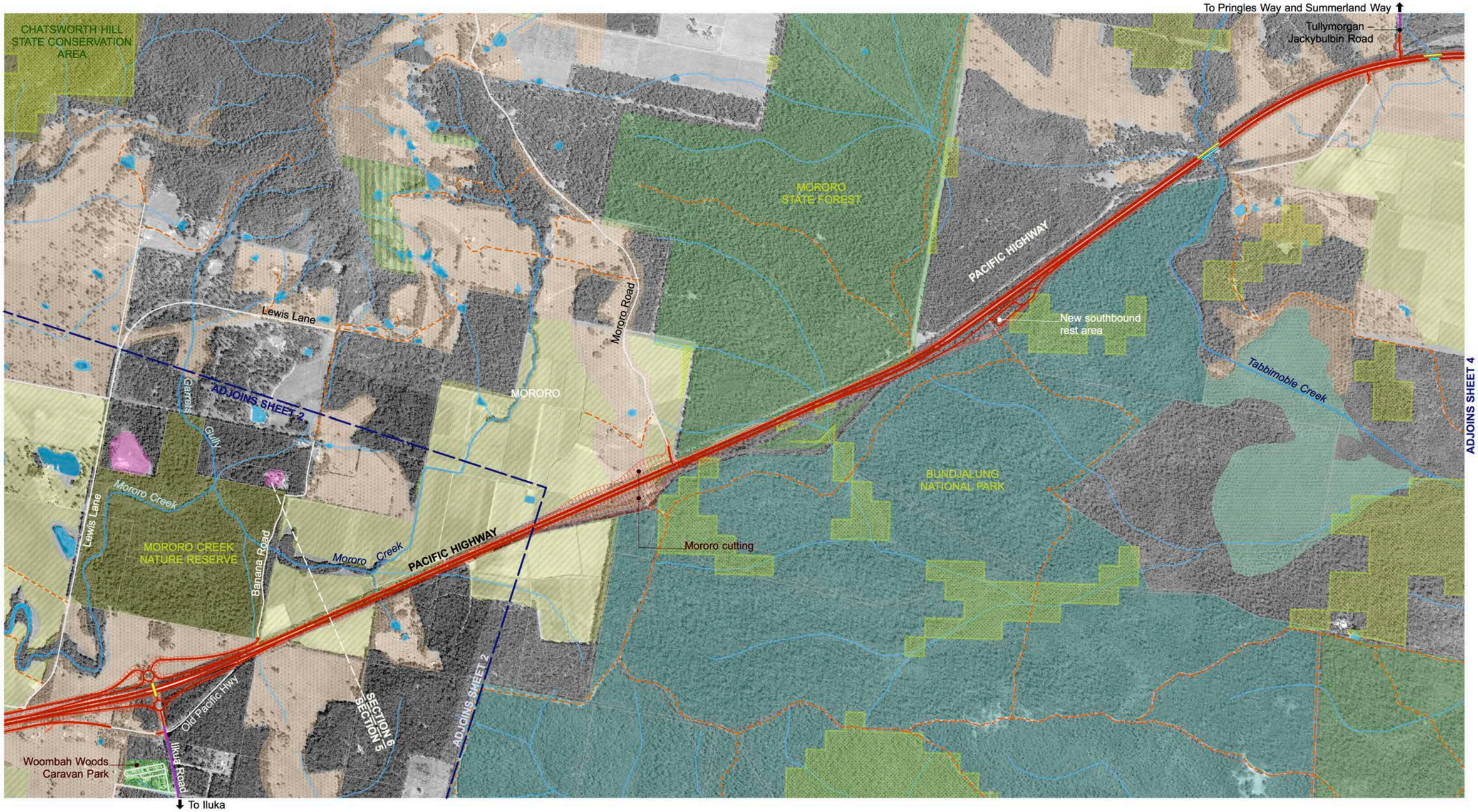
Sheet 2 of 4



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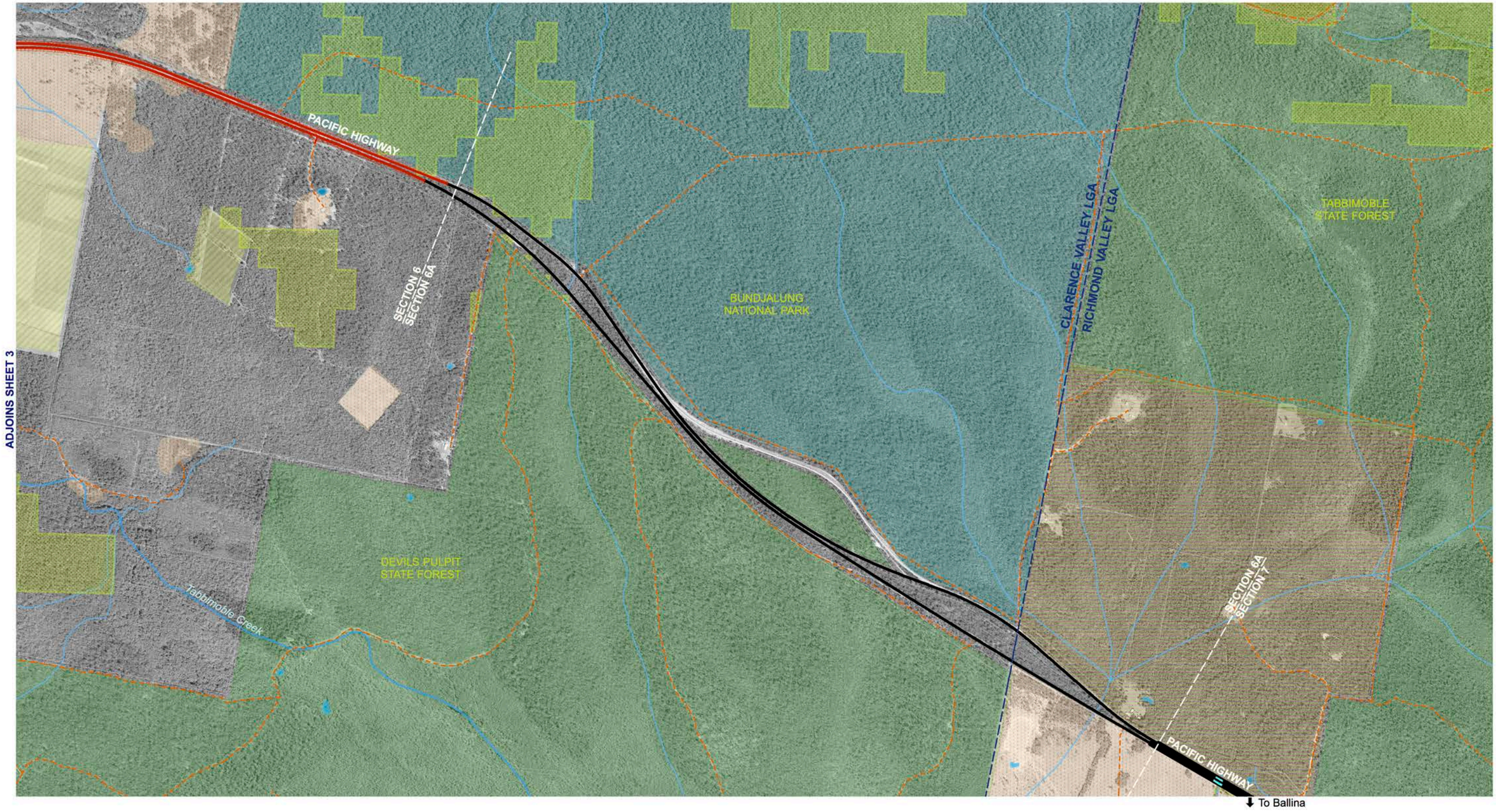

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Sheet 4 of 4

5.11 TRANSPORT NETWORK

The Pacific Highway and the North Coast Railway Line form the primary land transport corridors connecting Sydney to Brisbane via the eastern seaboard of New South Wales. The highway is the major road freight, tourist and commercial link in the region and is the principal road access between the towns and villages along its route. Summerland Way is the only other regional road connection, linking Grafton to Casino and the Bruxner Highway which heads east to Ballina via Lismore. Both Ballina and Grafton are serviced by domestic airports, with Ballina having the most regular services.

This highway between Maclean and Devils Pulpit (Sections 5 and 6) provides access to a number of tourist destinations on the coast, such as Yamba, Angourie and Iluka, as well as local access to the villages and properties within the floodplain and in the adjoining ranges. The key regional and main roads in the area are:

- Yamba Road, which provides access from the highway to Yamba and Maclean from an interchange at the southern end of Harwood Bridge
- Watts Lane, the main road that connects Harwood to the Summerland Way, via the hinterland ranges west of the Clarence River
- Iluka Road, the main road that provides access to Iluka
- Tullymorgan-Jackybulbin Road, a main road located north of Mororo Road in Section 6, also provides access to the Summerland Way.

Local roads and adjoining properties currently directly access the highway between Maclean and Devils Pulpit (Sections 5 and 6). There are currently no footpaths on the highway. The Coastline Cycleway is a planned regional cycle connection along the coast. The Pacific Highway is designated as an alternative regional cycle route, with connections to the Coastline Cycleway via Yamba Road and Iluka Road.

5.11.1 Design principles for Maclean to Devils Pulpit

- The highway upgrade will improve safety by reducing the number of intersections and controlled access points, including major interchanges at Yamba Road, Harwood and Iluka Road
- The local road network is improved with new access roads that increase connectivity within the local road network
- A continuous regional cycle connection along the highway is provided on the shoulders of the upgraded highway, with connections to the local road network at the Yamba Interchange, Harwood Interchange and Iluka Interchange
- Footpaths are provided on Bridge B05 (Serpentine Channel Road North) and Bridge B09 (Iluka Road).

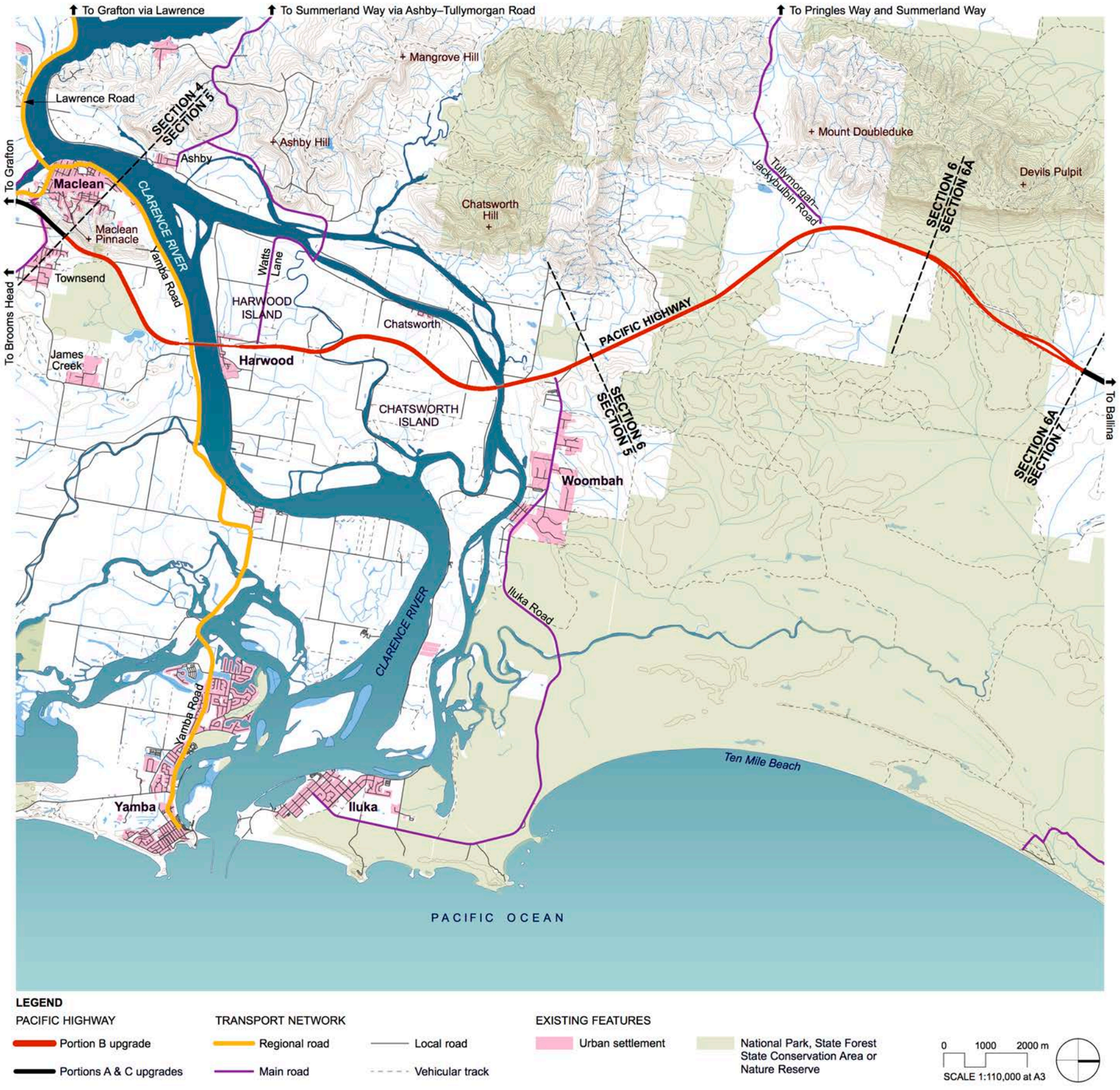


Figure 5-11: Regional transport network

5.12 CULTURAL AND SCENIC VALUES

The study area from Maclean to Devils Pulpit (Sections 5 and 6) is comprised of two reasonably distinct areas as a result of the combinations of landscape types, land uses and the impact of human activity. The area south of Iluka Road is characterised by the 'big' landscape of the Clarence River floodplain with its extensive sugar cane plantations, set off to a backdrop of forested ranges to the north and west. The area north of Iluka Road consists of a gently undulating and generally heavily forested landscape. As a result, views of the surrounding landscape experienced by the road user will be driven by these landscape types and cultural influences.

Heading north, the highway traverses a well vegetated road corridor that provides glimpses of the broad floodplain to the north. After the highway rises over a small crest and crosses over the existing Farlows Lane bridge, it emerges from the forest, revealing expansive views over the flat agricultural land to the north and west. Following a final small stretch through forest, the first glimpses of the Harwood Bridge truss are available as the highway traverses a flat area with a parkland character.

As the highway crosses Harwood Bridge, panoramic views are available and are particularly spectacular looking along the Clarence River in both directions. There are also middle distance views to Harwood, dominated by the Harwood Sugar Mill and smoke stack. For the next seven kilometres, the views are expansive over the sugar cane plantations on the floodplain to the mountain ranges in the west and north. These views vary according to the growth and harvesting patterns of the sugar cane with a slight sense of enclosure as the sugar can reaches its full height of about 4 metres just before harvest. The open landscape is interspersed by tree planting associated with buildings, irrigation channels and the Serpentine Channel crossing.

Continuing north, the highway crosses the Clarence River North Arm via the Mororo Bridge, offering good views along the river in both directions. Beyond the river, middle distance views to adjoining undulating agricultural land are revealed and concealed according to roadside tree planting. North of Mororo Road, the highway is generally enclosed by dense roadside vegetation associated with the forested areas on both sides of the highway.

Within the Clarence River floodplain on Harwood and Chatsworth Islands, the upgraded highway would be visible to middle distance viewers due to the road being built on embankment for flood immunity. The new overbridges at Serpentine Channel Road North and Chatsworth Road would also be visually prominent. Much of the upgrade would have limited visibility as it is enclosed by woodland or forest, although the increased footprint may be visible to those at higher elevations such as Maclean Lookout.

The combination of natural and cultural qualities, in particular the sugar cane plantations on the floodplain, establishes a unique identity to the area. These values have a special meaning and provide a sense of place for the local residents, as well as tourists and those passing through.

5.12.1 Design principles for Maclean to Devils Pulpit

- Careful consideration is given to the relationship between the form and character of the upgraded highway alignment, its associated structures and earthworks, and the form and character of the existing landscape
- As the highway would be visible from numerous locations, the overall highway upgrade is designed to 'fit' visually with the surrounding landscape character as much as possible through appropriate alignment, earthworks and planting
- Refer to Chapter 7 for a visual impact assessment of the upgrade.

Plate 5-1: Agricultural land of the floodplain south of the Clarence River

Plate 5-2: Harwood Bridge crossing of the Clarence River

Plate 5-3: Soya bean paddock with houses and exotic tree planting at the Watts Lane intersection

Plate 5-4: View over sugar cane plantations to the Richmond Range

Plate 5-5: Undulating, forested landscape character in north of Mororo

5.13 LANDSCAPE CHARACTER

The Roads and Maritime *Guideline for Landscape Character and Visual Impact Assessment* (RMS 2013) provides the following definition of landscape character:

> *'The combined quality of built, natural and cultural aspects that make up an area and provide its unique sense of place.'*

The W2B EIS identified eleven sections as a convenient way to package the project into manageable areas for landscape character assessment. Within these sections, 54 landscape character precincts were identified. Two sections and part of a third section fall within the Maclean to Devils Pulpit (Sections 5 and 6) study area and contain ten landscape character precincts as illustrated in Figure 5-12. These are:

- Maclean to Iluka Road, Mororo – Section 5
  - 25 - Maclean Pinnacle
  - 26 - Yaegl Nature Reserve
  - 27 - Clarence River floodplain
  - 28 - Ashby
  - 29 - Harwood township
  - 30 - Chatsworth Hill
  - 31 - Mororo Creek Valley
- Iluka Road to Devils Pulpit – Section 6
  - 31 - Mororo Creek Valley
  - 32 - Bundjalung National Park
  - 33 - Jacky Bulbin Flat
  - 34 - Tabbimoble floodways.

Maclean to Iluka Road (Section 5) is characterised by the wide flat Clarence River floodplain with its extensive sugar cane plantations, set off to a backdrop of forested ranges to the north and west. Iluka Road to Devils Pulpit (Section 6) consists of a gently undulating and generally heavily forested landscape.

Following is a discussion of the character of each character precinct. Refer to Chapter 7 of this report for an assessment of the impact of the highway upgrade on the existing landscape character precincts.

5.13.1 Landscape character precinct 25 – Maclean Pinnacle

This precinct separates the township of Maclean from the Pacific Highway, which skirts the eastern edge of the precinct. Moderate slopes, vegetated with Tallowood dry grassy forest, combine with forest on the eastern side of the highway, to provide a sense of enclosure whilst driving. There are views from the highway through the forest to the floodplain to the north. Maclean Pinnacle rises to 128 metres above the floodplain and contains the Maclean Scenic Lookout, providing extensive views over the Clarence River floodplain to the coast.

5.13.2 Landscape character precinct 26 – Yaegl Nature Reserve

Yaegl Nature Reserve is located on the Lower Clarence Floodplain, predominately to the east of the Pacific Highway. It consists of Floodplain Paperbark Forest and an area of coastal saltmarsh and is listed as an endangered ecological community. The reserve is on the eastern side of the Pacific Highway, which, along with vegetation on the western side within precinct 25, encloses the highway until it emerges from these zones just south of Harwood Bridge where there are short distance views over the floodplain on the southern bank of the Clarence River. The precinct sits within the James Creek Catchment and Palmers Channel Catchment.

Plate 5-6: View north of Maclean Pinnacle to the centre, with Yaegl Nature Reserve to the right (source: Pacific Complete)

5.13.3 Landscape character precinct 27 – Clarence River floodplain

The Clarence River floodplain precinct is a large area covering much of Harwood and Chatsworth Islands and a number of smaller islands as well as the southern banks of the Clarence River and the northern banks of the North Arm. The area is predominately open and flat, with much of its landuse consisting of agriculture including sugar cane and soya beans. Widespread views are available from the highway over the agricultural land, terminating with the forested ranges to the west. Rural residential dwellings with their associated tree planting are scattered over the precinct, providing a vertical element to the generally flat, homogenous landscape. However, views are impacted by the growing cycle of the sugar cane. Riparian vegetation is found on the banks of the Clarence River, Serpentine Channel and North Arm.

Plate 5-7: View north in landscape character precinct 27, travelling on the Pacific Highway with the Richmond Range in the background

Plate 5-8: Landscape character precinct 27 is open and flat with predominately agricultural land use

5.13.4 Landscape character precinct 28 – Ashby

The Ashby precinct is located on the heavily vegetated mountain ranges on the western side of the Clarence River. The area is characterised by undulating, forested ridges and slopes with rural residential dwellings located along the roads running through the associated valleys. Views to the highway from the roads and dwellings are generally limited by topography and vegetation.

Plate 5-9: View from the eastern edge of landscape character precinct 28 over grazing land

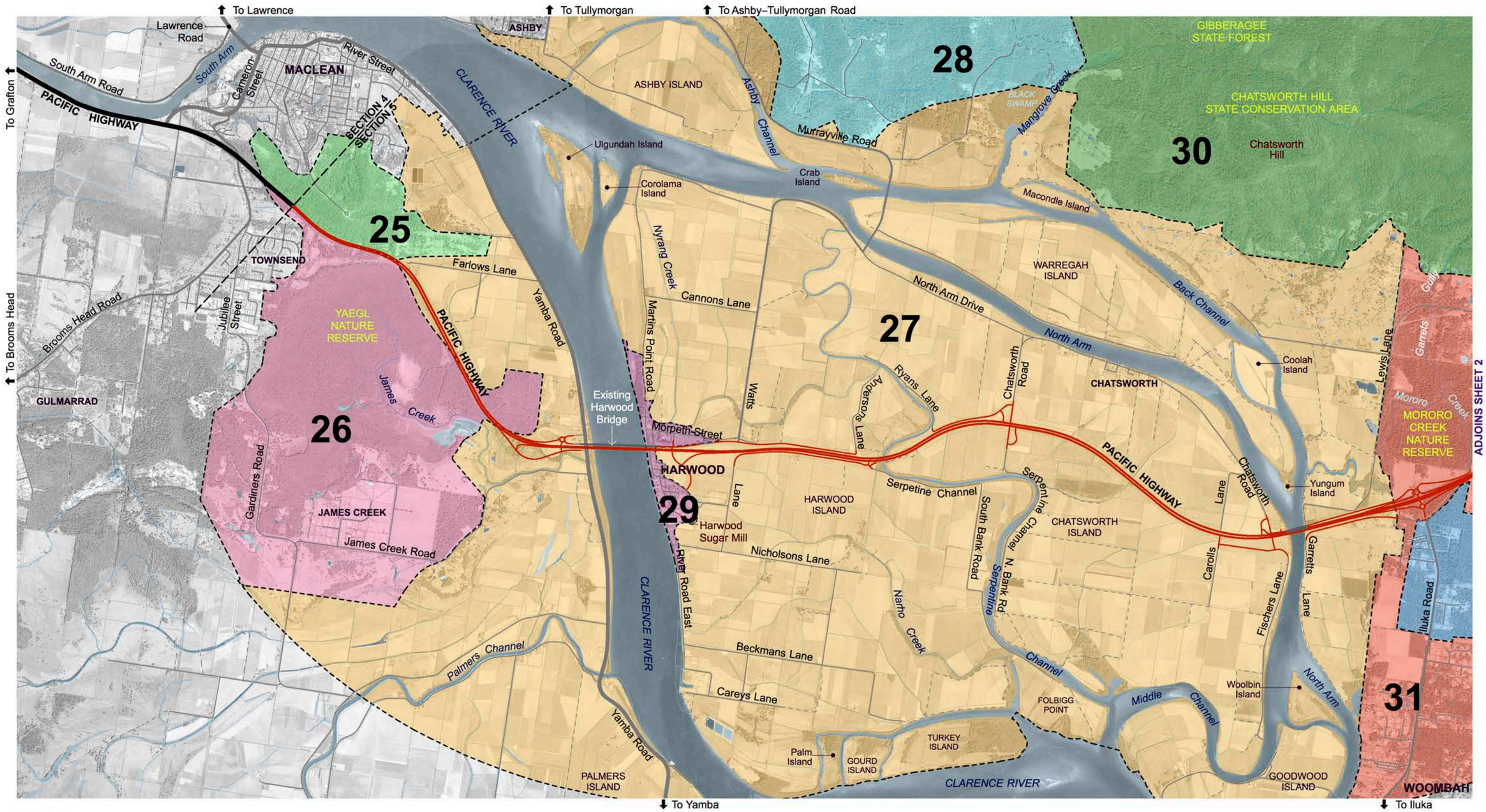
Plate 5-10: Harwood Sugar Mill dominates the skyline at Harwood

5.13.5 Landscape character precinct 29 – Harwood township

Harwood is located on the northern shore of the Clarence River, on both sides of the Harwood Bridge. Harwood is dominated by the Harwood Sugar Mill on the eastern edge of the town, a large industrial complex consisting of refinery buildings, a large storage building and a smoke stack. Single storey residential dwellings line River Street on the foreshore as well as Morpeth Road that run parallel to the highway. The town also contains a number of commercial buildings and a primary school. The town has a strong edge, transitioning abruptly from residential lots to agricultural land. Views from within the town are dominated by the Harwood Sugar Mill smoke stack and Harwood Bridge. The town also has a number of historic items of local significance.

Plate 5-11: View south to Harwood township, Harwood Bridge and the Clarence River (source: Pacific Complete)

Figure 5-12: Landscape Character Zones (2 sheets)



LEGEND

EXISTING FEATURES
- Existing road
- Existing vehicular track

PACIFIC HIGHWAY
- Highway upgrade Maclean to Devils Pulpit (Sections 5 & 6)
- Existing upgraded Pacific Highway
- Adjacent sections of highway upgrade

LANDSCAPE CHARACTER ZONES
- Landscape Zone 25
- Landscape Zone 26
- Landscape Zone 27
- Landscape Zone 28
- Landscape Zone 29
- Landscape Zone 30
- Landscape Zone 31
- Landscape Zone 32
- Landscape Zone 33
- Landscape Zone 34

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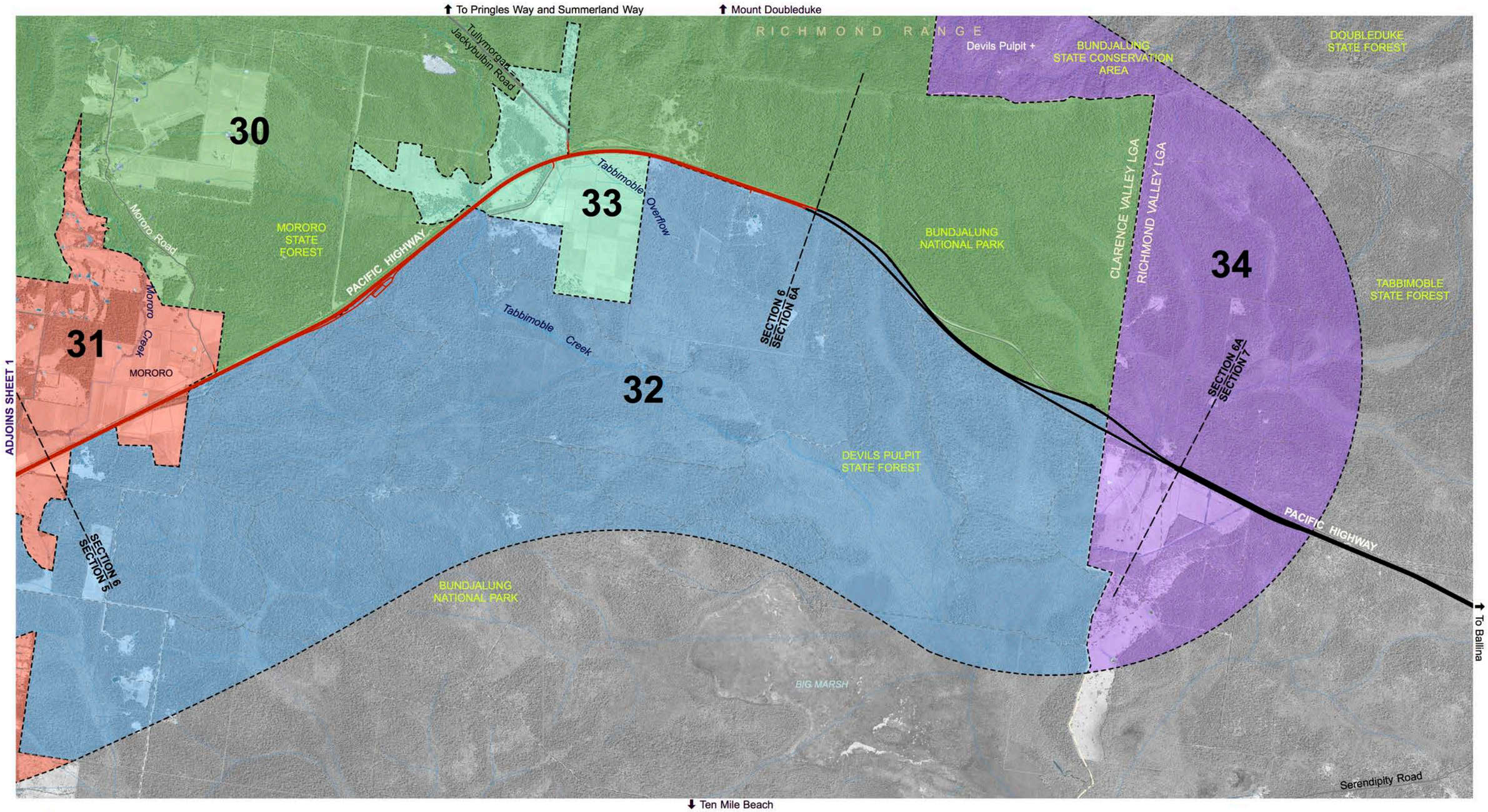
Sheet 1 of 2



LEGEND

EXISTING FEATURES
- Existing road
- Existing vehicular track

PACIFIC HIGHWAY
- Highway upgrade Maclean to Devils Pulpit (Sections 5 & 6)
- Existing upgraded Pacific Highway
- Adjacent sections of highway upgrade

LANDSCAPE CHARACTER ZONES
- Landscape Zone 25
- Landscape Zone 26
- Landscape Zone 27
- Landscape Zone 28
- Landscape Zone 29
- Landscape Zone 30
- Landscape Zone 31
- Landscape Zone 32
- Landscape Zone 33
- Landscape Zone 34

0 500 1000 m
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Sheet 2 of 2

5.13.8 Landscape character precinct 30 – Chatsworth Hill

The Chatsworth Hill precinct, to the west of the Clarence River Back Channel, is characterised by heavily vegetated forest on steep to undulating topography with strong ridgelines. The area is largely undeveloped, and this, combined with the topography and dense vegetation, minimises views to the highway.

Plate 5-12: View over the sugar cane fields to the Chatsworth Hill precinct

Plate 5-13: View south travelling on the Pacific Highway towards Iluka Road in landscape character precinct 31

5.13.6 Landscape character precinct 31 – Mororo Creek Valley

This precinct is located on the gently undulating land north of the Clarence River North Arm. The landscape consists of open agricultural land used for grazing, sugar cane and other crops, enclosed by heavily vegetated Floodplain Paperbark Forest that is listed as an endangered ecological community, part of the Mororo Creek Nature Reserve. Rural residential dwellings are found scattered throughout the precinct. Mororo Creek flows through the forested and agricultural areas.

Plate 5-14: View over Mororo Creek (source: Pacific Complete)

5.13.7 Landscape character precinct 32 – Bundjalung National Park

The highway in this precinct traverses Bundjalung National Park, Mororo State Forest, Devils Pulpit State Forest and Bundjalung State Conservation area, constituting a majority of Iluka Road to Devils Pulpit (Section 6). The precinct is generally heavily forested on gently undulating land; however, there are small areas of land cleared for grazing with associated residences. The roadside vegetation generally encloses the highway, and this directs views along the highway to the mountain ranges in the north and the skyline to the south.

Plate 5-15: Dense roadside vegetation gives a sense of enclosure travelling through landscape character precinct 32

Plate 5-16: View north travelling on the Pacific Highway through Bundjalung National Park

5.13.9 Landscape character precinct 33 – Jacky Bulbin Flat

This precinct consists of a large cleared area bounded by Bundjalung National Park and Devils Pulpit State Forest to the east and Mororo State Forest and Bundjalung State Conservation Area to the west of the highway. This land is used for grazing and cropping and includes a number of scattered rural residential dwellings. The highway is generally enclosed by trees, however, in contrast to the heavily vegetated forested areas to the south and north, glimpses of the wider landscape can be had through areas of sparse vegetation and at the crossings over Tabbimoble Creek and Tabbimoble Overflow.

Plate 5-17: View south travelling on the Pacific Highway through landscape character precinct 33

Plate 5-18: View north travelling on the Pacific Highway through landscape character precinct 34 at the Devils Pulpit upgrade

5.13.10 Landscape character precinct 34 – Tabbimoble Floodways

The southern half of the Tabbimoble Floodways precinct is located within the Devils Pulpit upgrade. This section of highway is separated, with each carriageway generally enclosed by woodland vegetation. The highway character opens up where the two lane divided carriageways join. Dense vegetation continues to the west, however, sparse roadside vegetation to the east allows views over the cleared pastures.

Plate 5-19: The expansive Clarence River floodplain is enclosed by the Richmond Ranges (source: Pacific Complete)

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6. DESIGN OBJECTIVES, PRINCIPLES AND STRATEGY FOR MACLEAN TO DEVILS PULPIT

Chapter contents

6.1 URBAN DESIGN AND LANDSCAPE OBJECTIVES AND PRINCIPLES

6.1.1 Project wide urban design and landscape objectives, principles and strategies

Chapter 4 of this report details the urban design and landscape objectives for the wider Pacific Highway Upgrade program that were defined in the *Pacific Highway Urban Design Framework* (RMS, 2013). It also summarises the specific Woolgoolga to Ballina urban design and landscape principles and strategies that were defined in the W2B EIS and the EIS *Working paper: Urban design report, landscape character and visual impact assessment* (Hassell, 2012), which were incorporated into the concept design and mitigation strategies recommended for the project.

Those project wide urban design and landscape objectives, principles and strategies continue to inform the concept and detailed design development of the Maclean to Devils Pulpit (Sections 5 and 6) portion of the highway upgrade.

6.1.2 Urban design and landscape objectives and principles specific to Maclean to Devils Pulpit

Further urban design and landscape objectives and principles have been developed specifically for the Maclean to Devils Pulpit (Sections 5 and 6) portion of the project, in response to the detailed highway design and a detailed assessment of the existing landscape character.

The urban design objectives and principles specific to Maclean to Devils Pulpit (Sections 5 and 6) are:

Objective: To celebrate the 'big landscape' that is the Clarence River floodplain

Design principles:

- Minimise the physical and visual intrusion of road-related elements on the local landscape
- Minimise roadside tree planting to allow views to the wider floodplain
- Ensure the highway recedes into the landscape by minimising the height of fill embankments, within hydrological constraints
- Integrate vertical elements, such as overbridges, with appropriate landscape treatments.

Objective: To maintain the integrity of existing ecological systems

Design principles:

- Minimise the physical footprint of the highway upgrade, including during the construction stages
- Minimise the impact of the highway upgrade on native vegetation
- Connect Endangered Ecological Communities and regional fauna corridors with appropriate revegetation within the project works
- Avoid the introduction of environmental weeds
- Implement comprehensive water quality control measures
- Provide safe and effective highway crossings for native fauna
- Maintain the integrity of indigenous plant communities and topsoils
- Maintain the ecological functionality and long-term sustainability of revegetated areas.

6.1.3 Urban design and landscape principles relating to environmental factors and cultural values

Chapter 5 of this report provides an overview and assessment of the key environmental, urban and cultural factors that affect the design of the Maclean to Devils Pulpit (Sections 5 and 6) portion of the project.

Refer to Chapter 5 for the urban design and landscape principles identified in response to the environmental, urban and cultural values identified between Maclean and Devils Pulpit (Sections 5 and 6), which are presented under each topic.

6.2 HIGHWAY DESIGN

6.2.1 Overview

The Maclean to Devils Pulpit (Sections 5 and 6) portion of the Highway upgrade extends over approximately 29.8 km from Maclean, about 46 km north of Grafton, to the end of the Devils Pulpit Upgrade, about 58 km south of Ballina. It is to be upgraded to a four-lane dual carriageway (two lanes in each direction) with the potential to widen to six lanes in the future.

Maclean to Devils Pulpit consists of the EIS project Sections 5 and 6.

The upgrade passes through the following local government areas:

- Clarence Valley Council
- Richmond Valley Council.

The upgrade also passes through or adjacent to the following reserves:

- Yaegl Nature Reserve
- Chatsworth Hill State Conservation Area
- Mororo Creek Nature Reserve
- Mororo State Forest
- Bundjalung National Park
- Devils Pulpit State Forest
- Bundjalung State Conservation Area.

6.2.2 Road alignment

The general design approach for the road alignment design includes:

- 'M' Class motorway standard from the southern extent of Section 5 (Maclean to Iluka Road) at Maclean to the Harwood Interchange at Watts Lane
- 'A' Class arterial road standard from the Harwood Interchange at Watts Lane to the northern extent of Section 6 (Iluka Road to Devils Pulpit)at Tabbimoble State Forest
- Maclean to Iluka Road (Section 5) includes a split carriageway across utilising large sections of the existing Pacific Highway as the new southbound carriageway
- Iluka Road to Devils Pulpit (Section 6) closely follows the existing highway, with small deviations made to meet current design standards of road gradient and curvature.

The alignment is located within environmentally sensitive areas, flood prone land and soft soils. The following strategies have been adopted in response to those constraints:

- Maclean to Iluka Road (Section 5) has a 20 ARI flood immunity, except:
  - 5 ARI flood immunity where the existing Pacific Highway is retained as the southbound carriageway
- Iluka Road to Devils Pulpit (Section 6) has a 100 ARI flood immunity
- Significant flood mitigation measures including large box culverts and floodplain bridges
- Large areas of soft soil preloading from Maclean to Chatsworth Island (which is currently underway).

Lane configuration

The highway upgrade consists of two northbound and two southbound lanes separated by a median that varies in width. Generally, provision is made for a 12 metre wide depressed median, however this is increased at some locations due to physical constraints of the natural environment, sight-line requirements or due to fauna connectivity requirements.

Cross section and road space allocation

The highway geometry has been designed with a two lane, dual (divided) carriageway (ie a total of four lanes of 3.5 metres) to a posted speed of:

- 110 kilometres per hour for the M Class section
- 100 kilometres per hour for the A Class section.

Provisions have been made in the current design for an additional lane in each direction for future widening to six lanes.

The upgraded highway would have two lanes in each direction, each 3.5 metres wide with 2.5 metre wide shoulders.

Interchanges

Three grade separated interchanges are included from Maclean to Devils Pulpit (Sections 5 and 6). All are located between Maclean and Iluka Road (Section 5) as follows:

- Yamba Interchange – south of Yamba Road, Maclean
- Harwood Interchange – south of Watts Lane, Harwood
- Iluka Interchange – Iluka Road, Mororo

Rest areas

The rest areas for this portion of the upgrade are all provided between Iluka Road and Devils Pulpit (Section 6):

- Northbound – CH 98,600 to CH 98,700 (existing rest area to be retained as truck breakdown bay)
- Southbound – CH 100,100 to CH 100,475.

The new rest area next to southbound lanes at CH 100,100 to CH 100,475 would incorporate toilet blocks, picnic shelters and waste bins.

Local road and property access

The design approach for the highway upgrade with respect to access management and the management of conflict points (such as existing intersections) includes the following principles:

- Separated interchanges at major connections - Yamba Road, Harwood and Iluka Road
- All other intersections on-grade. Right turn out not permitted - movement facilitated by left-turn/ U-turn in designated locations on the service road
- Property access generally to be via service road - left-in/left-out only. Right turn out not permitted
- Provision of U-turn facilities in Section 6 for property access
- Integrate the access requirements of pedestrians and cyclists with those of other road users.

The proposal to utilise the existing highway as a local service road would enable safe and efficient access to the upgraded highway. The proposal minimises the need for, and length of, backtracking for motorists' access to and from the upgraded highway. Wherever possible, intersections with the upgraded highway would be limited to left turn movements only.

Bicycle and pedestrian facilities

Continuous bicycle access along the highway will be provided in the form of a 2.5 metre nearside shoulder, which meets Austroads guidelines.

In accordance with the requirements of the EIS and SPIR, cyclists and pedestrians would be catered for within:

- A suitable width shoulder adjacent to the traffic lane at the Yamba interchange underpass
- A shared path on the Iluka interchange overpass bridge.

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

6.2.3 Road Elements

Road elements are categorised as follows:

- **Structures** - including bridges and retaining walls that are necessary to achieve the road alignment within its surroundings
- **Earthworks formations** - including cuttings and embankments that are necessary to achieve the road alignment within its surroundings
- **Drainage and water quality structures** - including basins and open channels that are necessary in order to sensitively drain the works and ensure safe operation of the highway
- **Fauna crossings** - to provide continuity of fauna connections across the highway corridor
- **Road Furniture** - such as safety barriers, fences, signs and noise attenuation walls that are necessary for the effective operation of the highway.

Road elements approach

The general approach to the design of road elements is to satisfy the functional requirements for the safe and efficient operation of the highway while also being appropriate to their location. In all cases, the design and implementation of the road elements would need to satisfy the requirements of Austroads and Roads and Maritime design guidelines and practice notes.

It is also important that, in their detailed resolution, the visual expression of the road elements is true to their function as items of contemporary highway infrastructure. Respect for the character of the local area will not be achieved by the appropriation of stylistic cues or fashions from another era, but through sensitive consideration of the location, placement and scale of the new elements.

The following approach has been taken for the design of road elements:

- Integration of the highway with the surrounding landscape
- Simplicity in the design expression of the elements relating to the highway, in order to allow the existing natural and cultural landscapes to provide the primary interest to the motoring experience
- Practicality for ease of construction and reduced long-term maintenance
- Site specific design that acknowledges and responds to the character of the local area, while not necessarily replicating existing features
- Consistency with the overall Pacific Highway, by using elements that are identifiably part of the highway experience in this region
- Integrity to the materials and method of construction in the final finish and appearance of the road elements
- Sustainability in the choice of materials and resources.

Structures

The key distinguishing structures between Maclean and Devils Pulpit (Sections 5 and 6) are the nineteen new bridges that are required to support the road upgrade. The following Table 6-1 summarises these bridges (from south to north).

Table 6-1: New bridges between Maclean and Devils Pulpit

BRIDGE NO	BRIDGE REFERENCE
B01	Twin bridges over Koala Drive
B02	Northbound bridge over Clarence Floodplain
	Bridge over Clarence River at Harwood *
B52	Twin bridges for Clarence Floodplain Opening 4
B55	Northbound bridge for Clarence Floodplain Opening 7
B56	Northbound bridge for Clarence Floodplain Opening 8
B04	Northbound bridge over Serpentine Channel
B59	Northbound bridge for Clarence Floodplain Opening 11
B05	Bridge over Pacific Highway at Serpentine Channel North Bank Rd
B60	Northbound bridge for Clarence Floodplain Opening 12
B61	Northbound bridge for Clarence Floodplain Opening 13
B62	Northbound bridge for Clarence Floodplain Opening 14
B63	Northbound bridge for Clarence Floodplain Opening 15
B64	Northbound bridge for Clarence Floodplain Opening 16
B65	Northbound bridge for Clarence Floodplain Opening 17
B07	Bridge over Pacific Highway at Chatsworth Road
B08	Southbound bridge over Clarence River North Arm
B09	Bridge over Pacific Highway at Iluka Road Interchange
B10	Northbound bridge over Tabbimoble Creek
B11	Northbound bridge over Tabbimoble Creek Overflow

* In addition to the above bridges, the project includes a major new bridge over the Clarence River at Harwood (downstream of the existing Harwood Bridge). While the new bridge is located between Maclean and Devils Pulpit, it is subject to a separate submission. The design for Maclean to Devils Pulpit includes the northern and southern tie-ins for the new bridge over the Clarence River at Harwood.

Note that flood modelling studies are subject to detailed design development and consultation with communities. The bridge designs may change as a result of these consultations.

Earthworks formations

Significant earthworks are required to achieve the road alignment design. The majority of Maclean to Devils Pulpit (Sections 5 and 6) would be constructed on fill embankments in order to achieve the flood immunity requirements across the Clarence River floodplain. The 20 year ARI flood immunity required for the new northbound carriageway in Section 5 results in fill embankments approximately 3 metres high to elevate the highway.

Soft ground treatment is currently underway at:

- CH 87,250 to CH 91,100
- CH 92,900 to CH 93,650.

The treatment proposed is embankment fill with a pre-loaded surcharge to achieve the design settlement over a period of 2.5 years.

Mororo Cut borrow site

To facilitate overall earthworks balance between Maclean and Devils Pulpit (Sections 5 and 6), the design includes a large cutting just south of Mororo Road, which would generate approximately 1 million cubic metres of fill. Excavated material from the Mororo cutting will be used as fill material in other areas wherever suitable and where cost effective.

Surplus spoil

In the event that there is a surplus of fill material at the completion of earthworks operations on site, the Mororo cutting is identified as a suitable end site surplus material. The surplus fill material would be placed in the cutting, spread evenly to avoid an artificial mounded appearance, and revegetated.

Drainage and water quality structures

Road drainage generally consists of three key elements; cross drainage, longitudinal drainage and water quality treatment. Urban design and landscape design considerations in relation to these elements includes: alignment, visibility, lining materials, minimisation of disturbance to existing vegetation and opportunities and techniques for revegetation.

Cross drainage transfers existing stormwater flows across the new carriageway using bridges and culverts. The cross drainage of the upgraded highway is being designed for a 1 in 100 year storm event. The cross drainage for local roads including the local service road is being designed for a one in ten year storm event. This generally results in higher road levels in relation to the existing landscape, larger fill embankments and larger culverts. The additional fill required has been sourced by increasing the depth of cut batters elsewhere in the project.

Longitudinal drainage is used to drain stormwater from the road pavement and is designed for a one in ten year storm event. This system consists of piped and open channel systems to direct water to new water treatment facilities (generally in the form of detention basins and grassed swales). Flows in excess of the drainage capacity will pass off the roadway directly or via the cross-drainage to downstream areas following the natural topography.

Water treatment basins are provided in order to collect and treat runoff from the upgraded highway. Water treatment basins detain stormwater runoff allowing suspended sediments and nutrients to fall out prior to it being discharged downstream. Water would be further treated for suspended sediments and nutrients by the use of grassed swales and channels.

Fauna connectivity structures

The following Table 6-2 outlines the fauna connectivity structures that are included between Maclean and Devils Pulpit (Sections 5 and 6) in accordance with the requirements set out in the W2B EIS.

Table 6-2: Fauna crossings between Maclean and Devils Pulpit

CHAINAGE	STRUCTURE
N/A	**SECTION 5**
83,100	Fauna underpass combined with Bridge B01 – Koala Drive
89,350	Fish crossing and incidental fauna passage under Bridge B04 – Bridge over Serpentine Channel
94,000	Fish crossing and combined fauna underpass (both banks) combined with Bridge B08 – Bridge over Clarence River North Arm
95,400	Compensatory green thighed frog pond
95,300 - 95,500	Compensatory green thighed frog pond
96,020	Dedicated fauna underpass culvert
N/A	**SECTION 6**
98,500 - 101,500	Compensatory green thighed frog pond
99,290 - 99,375	Glider poles
99,730	Dedicated fauna underpass culvert
100,480	Combined fauna underpass culvert
101,080	Dedicated fauna underpass culvert
101,600	Fish crossing and combined fauna underpass at Bridge B10 – Bridge over Tabbimoble Creek (north bank only)
102,000 - 102,700	Compensatory green thighed frog pond
102,870	Fish crossing and combined fauna underpass at Bridge B11 – Bridge over Tabbimoble Overflow (both banks)

Fauna fencing

Fauna fencing is used to exclude fauna from roads and to guide animals towards connectivity structures such as underpasses. Fauna fencing is typically used to exclude koalas and macropods from the road corridor, but is also effective in excluding other medium to large sized mammals.

The following Table 6-3 outlines the location and extents of fauna fencing provided between Maclean and Devils Pulpit (Sections 5 and 6).

Table 6-3: Fauna fencing locations between Maclean and Devils Pulpit

SECTION	START CHAINAGE	END CHAINAGE	TARGET SPECIES
5	82,000	82,500	General mammal fence
5	82,500	85,900	General mammal fence
5	94,700	95,200	Koala fence
5	95,200	95,800	Koala and Green-thighed Frog fence (combined)
5	95,800	97,900	Koala fence
6	97,900	98,000	Koala/mammal fence
6	98,000	101,700	Mammal/Phascogale fence (combined)
6	101,700	101,900	Mammal/Phascogale fence (combined)
6	101,900	102,000	Phascogale fence
6	102,000	102,100	General mammal fence
6	102,200	102,600	Green-thighed frog fence

Road furniture

Road lighting

General road lighting is not required on the upgrade. Where lighting has been required it has been designed in accordance with AS4282-1997.

Intersection / Interchange lighting

Lighting at intersections and interchanges is provided where required in accordance with current Austroads and Roads and Maritime standards, guidelines and requirements.

Bridge Lighting

Bridge lighting is not required between Maclean and Devils Pulpit (Sections 5 and 6).

Roadside barriers

Safety barriers are provided in accordance with current Austroads and Roads and Maritime standards, guidelines and requirements. These measures would include:

- Wire rope safety barrier is used generally where a barrier is required
- Medium performance barriers with twin rails are provided on overbridges to maximise views for the highway user to the surrounding landscape
- Regular performance solid concrete barriers are provided on underbridges and floodplain bridges, except where medium performance bridges are required to meet the relevant standards. A single cyclist grab rail is provided on barriers adjacent to the nearside shoulder only, to provide additional protection for cyclists
- Where medium performance barriers are required on underbridges and floodplain bridges, twin rails are provided to maximise views for the highway user to the surrounding landscape.

Signage

Signage categories include regulatory, warning, tourist, services and directional signs. All signage would be designed in accordance with current Austroads and Roads and Maritime standards, guidelines and requirements.

Noise barriers

Noise impact assessment for the detailed design has shown that noise attenuation walls are not required between Maclean and Devils Pulpit (Sections 5 and 6).

Noise modelling studies are subject to detailed design development and consultation with communities. Details of the noise mitigation strategy may change as a result of consultation.

6.3 ANCILLARY FACILITIES

The highway upgrade will require ancillary facilities to support the construction activities associated with the project. The Project Approval defines Ancillary Facility as:

> *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 Minister's Conditions of Approval (MCoA) D21, 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 onsite
- 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 construction works, in addition to locations adjacent to or separate to the construction activities. As outlined in the

MCoA definitions all ancillary facilities are temporary and can only be used for the Woolgoolga to Ballina project. MCoA B76 of the Project Approval outlines the rehabilitation requirements of these sites:

> *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*

6.3.1 Borrow sites

The project will also require that a number of borrow sites will be used to source material for construction of the project. For the Maclean to Devils Pulpit (Sections 5 and 6) portion of the project, the borrow site is the Mororo Cut just south of Mororo Road.

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.

6.3.2 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 adjacent 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:

1. Land owned by Roads and Maritime for the purposes of the project
2. 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.

6.3.3 Ancillary and borrow site rehabilitation principles

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

6.3.4 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 construction operations.

1. On RMS 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. Where appropriate the revegetation will to enhance wildlife habitat values. The rehabilitation works are to include maintenance until the vegetation is well established.
2. On RMS owned sites used for the extraction of construction material the rehabilitation works may include disposal of soil material classified as ‘unsuitable’ generated by the highway works, 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.
3. On privately owned land the rehabilitation works will be in accordance with an agreement to be reached with the property owner. The rehabilitation works are to meet all relevant environmental requirements.

6.4 SUSTAINABLE DESIGN AND MAINTENANCE

Ecologically Sustainable Development (ESD) has been defined by the Australian Government (1992) as ‘using, conserving and enhancing the community’s resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased’. The key principles of sustainable development include:

- The precautionary principle
- Intergenerational equity
- Biodiversity and ecological diversity
- Improved economic valuation including environmental factors.

The Maclean to Devils Pulpit – Sections 5 and 6 (Portion B) Urban Design and Landscape Plan has been developed in accordance with the *Portion B Sustainability Action Plan* (ABJV 2016). The key objectives identified in the Sustainability Action Plan that related to urban design and landscape are:

- Minimise water use
- Maintain the integrity and quality of the ecological environment through appropriate planning during detailed design
- Maintain the integrity and quality of the cultural environment through appropriate planning during detailed design
- Urban design and landscape – identify design principles and standards for sustainable design and maintenance.

6.4.1 Sustainable design and maintenance principles

The Maclean to Devils Pulpit – Sections 5 and 6 (Portion B) Urban Design and Landscape Plan outlines numerous urban design and landscape principles that address sustainable design an maintenance. These principles relate to:

- Revegetation of the project works to maintain biodiversity, the integrity of existing vegetation communities and fauna connectivity
- Roadside plantings to enhance and frame views and connect with the cultural values of the surrounding agricultural floodplain landscape
- Use of indigenous plant species and low maintenance drought tolerant non-native species for the revegetation works.

Refer to Chapter 5, Chapter 6.5, Chapter 7 and Chapter 8.9 in this report for more detail.

6.5 URBAN DESIGN AND LANDSCAPE STRATEGY FOR MACLEAN TO DEVILS PULPIT

6.5.1 Overview

An integrated design approach has been adopted for the highway upgrade between Maclean and Devils Pulpit (Sections 5 and 6) in order to ensure that the best possible urban design outcomes are achieved. This integration has been achieved through multidisciplinary teams working collaboratively to resolve design problems, as well as regular consultation with the urban designers of the other Sections of the Woolgoolga to Ballina Upgrade.

This approach has enabled a urban design and landscape strategy to be developed that feeds outcomes and values into the overall detail design for the upgrade. As a result, urban design has directly influenced key engineering aspects of the design, including: bridges, cuttings and embankments, and drainage. The urban and landscape design strategy will continue to influence the development of the highway upgrade as it proceeds through detailed design and construction.

The landscape design responds to the existing landscape character and vegetation communities and defines a methodology for revegetation of the upgrade. This methodology involves the utilisation of several techniques in order to provide a vegetative cover to all surfaces impacted by the works.

Urban design and landscape design work in combination in order to provide a dialogue with the existing landscape, a consistency of visual outcomes along the upgrade and to provide a consistency with other upgrade projects along the Pacific Highway as well as the other Woolgoolga to Ballina project sections.

6.5.2 EIS urban design and landscape strategy

The EIS *Working paper: Urban design report, landscape character and visual impact assessment* (Hassell, 2012), identified specific urban design and landscape strategies for Maclean to Devils Pulpit (Sections 5 and 6) of the project. These 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.

The EIS urban design and landscape strategies for Maclean to Devils Pulpit (Sections 5 and 6) are listed below:

Maclean to Iluka Road (Section 5)

- Revegetate batters and any other disturbed areas with local forest species along the interface with the Yaegl Nature Reserve in accordance with the concept plan
- Reinstate park landscape to the landscape areas adjacent the bridge approaches south of the Clarence River
- Reinstate agricultural land uses adjacent the project in the Clarence River floodplain
- Limit roadside planting within the Clarence River floodplain, unless otherwise noted (such as the Clarence River bridge approach). Retain existing open views
- Provide a sense of arrival to Harwood on the approach from the south and the north. Develop avenue street tree planting using landmark tree species in accordance with the proposed landscape design. Configure batters, soil profiles, drainage and barrier designs to accommodate tree planting at the top of batters
- Use tree planting to screen the bridge abutments and undercroft spaces in accordance with the concept design at the bridge crossing over the Clarence River
- Minimise the need for and, if necessary, mitigate the visual impact of acoustic walls on the bridge over the Clarence River and in Harwood. Use transparent structures that are carefully integrated with the bridge design
- Provide planting to detail design around the interchange at Harwood Provide tree planting on local approaches to major overpasses, specifically at Chatsworth Road and Carrolls Lane
- Provide new amenity street tree planting along the existing highway, at Harwood adjacent the new bridge
- Bridges at Clarence River North Arm are to allow views to the surrounding landscape

Iluka Road to Devils Pulpit (Section 6)

- Heavily vegetate the interchange at Iluka Road using local species
- Supplement the existing forest character with additional forest tree planting to reinforce the closed driving experience through the Bundjalung National Park and Mororo State Forest
- Ensure occasional pasture views are retained in areas between Bunjalung National Park and Mororo State Forest

6.5.3 Landscape strategy for Maclean to Devils Pulpit

The landscape design strategy for Maclean to Devils Pulpit (Sections 5 and 6) comprises planting and revegetation – including planting, seeding and bushland reconstruction techniques that are necessary to stabilise the works and integrate the upgrade with the surrounding environment.

Design approach

Planting and revegetation design integrates the project works with the surrounding landscape, thereby mitigating the potential visual and environmental impact of the upgrade. The following revegetation methods will be utilised:

- Seeding
- Planting
- Bushland reconstruction.

The planting and revegetation design also aims to minimise the potential ecological impacts of the highway upgrade by:

- Stabilising earthworks to prevent erosion
- Reinforce existing habitats and ecological corridors through revegetation of substantial areas and species selection.

6.5.4 General landscape design principles

The landscape revegetation and planting techniques will be utilised according to the following landscape principles:

- Provide a well vegetated road corridor that integrates the highway with the surrounding landscape and provide motorists with a ‘sense of place’ along the highway journey.
- Strike a balance between screening the highway from the sensitive views from surrounding areas and maintaining key vistas from the highway to the surrounding landscape
- Revegetation or planting of all areas affected by highway construction work through existing forested areas
- Revegetation of residual land affected by the highway upgrade that is not viable for redevelopment. The type of revegetation would be determined by a combination of surrounding landscape character and proximity of existing ecological habitats and wildlife corridors
- Use of bushland reconstruction as a revegetation technique for off-line sections of highway that pass through dense bushland
- Provision of planting in highway medians in some locations to minimise the visual scale of the highway and contribute to road safety through the screening of headlight glare from oncoming traffic
- Revegetation of outside verges wherever possible to minimise the visual scale of the highway, and of roadside cuttings and retaining walls
- Limit planting along the Clarence River floodplain, particularly on Harwood and Chatsworth Islands, to allow the highly recognisable sugar cane plantation landscape to dominate
- Provision of distinctive tree planting to alert motorists before and on arrival to major interchanges
- Revegetation or turfing of low side verges to allow better stabilisation and capturing of sediment and nutrient washing off the carriageway before it enters drainage structures.

6.5.5 Visual screening

A number of key views were identified in the EIS which, for the most part, related to the new Clarence River bridge. As part of the detailed design, the views associated with local residents near the highway were assessed (refer to Chapter 8), and recommendations provided in order to minimise the degree of visual change to these dwellings. The following strategy has been devised for visual screening:

- Existing vegetation that currently screens dwellings from the highway have been retained where feasible
- Where screen planting is required, tube stock trees have been used to supplement seeding, to provide a short term impact while seeding establishes
- Minimum 75 litre plant containers have been used to screen dwellings next to the new Clarence River bridge at Harwood
- Tubestock planting has been provided in medians and at local roads where headlight screening is required.

6.5.6 Heritage zones

As described in Chapter 5, there is minimal evidence of Aboriginal heritage sites between Maclean and Devils Pulpit (Sections 5 and 6); therefore, any interpretation using planting has been avoided.

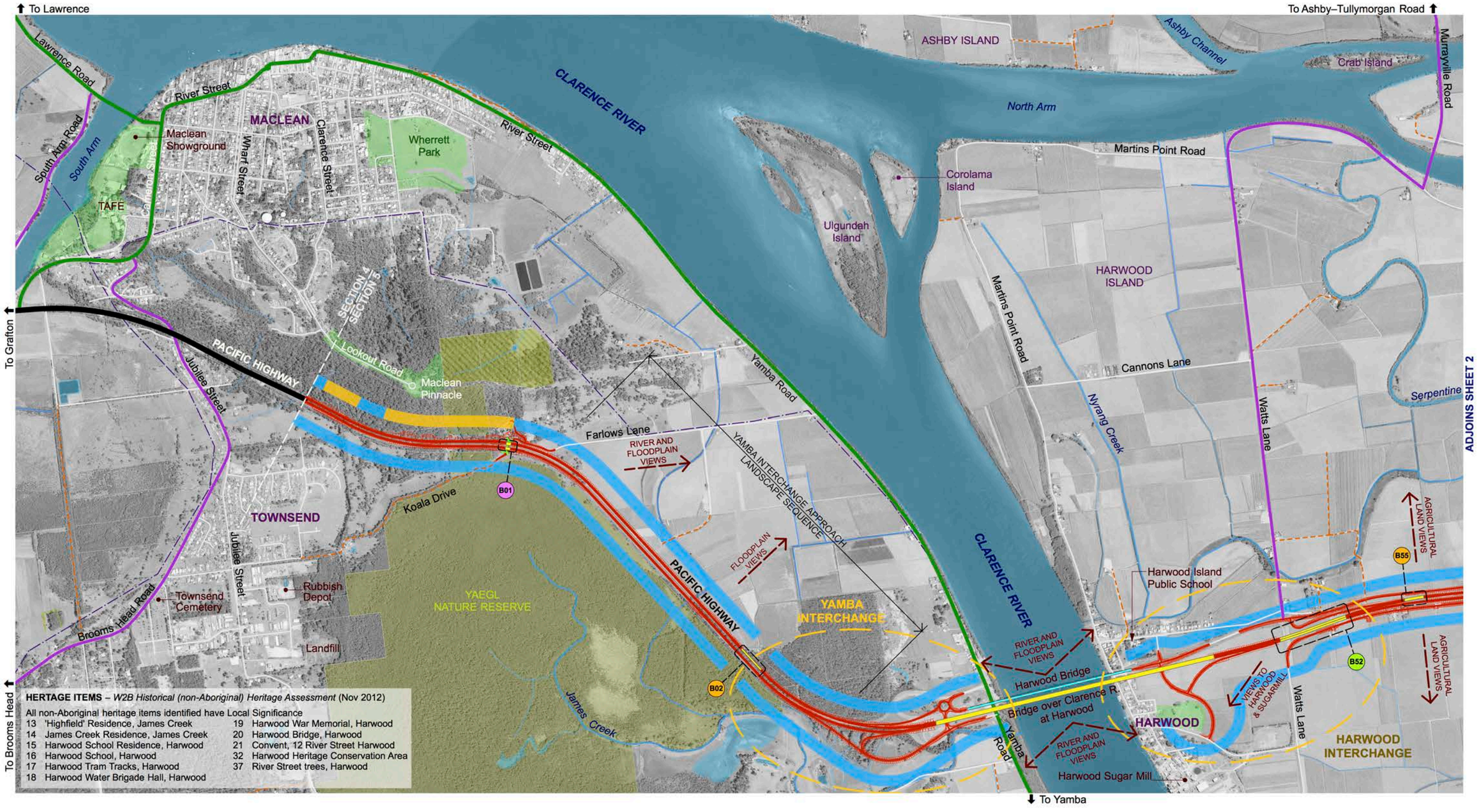
Parts of Harwood have been identified as being within the Harwood Conservation Zone. Semi formal planting has been provided, using 75 litre size Spotted Gum, to screen the new Clarence River bridge from adjacent heritage buildings. Street tree planting around the Harwood interchange have been selected to match other street trees in the region.

Tram tracks on Petticoat Lane are located within the project boundary. They will be covered with soil for protection, with seeded pasture grasses applied above. The Spotted Gum screen planting will not be planted within five metres either side of the tracks.

6.5.7 Urban design and landscape strategy plan for Maclean to Devils Pulpit (Sections 5 and 6)

Figure 6-1 provides an overview of the urban design and landscape strategy for Maclean to Devils Pulpit (Sections 5 and 6).

Figure 6-1: Maclean to Devils Pulpit (Sections 5 and 6) urban design and landscape strategy overview (4 sheets)



HERTAGE ITEMS – *W2B Historical (non-Aboriginal) Heritage Assessment* (Nov 2012)

All non-Aboriginal heritage items identified have Local Significance

13	'Highfield' Residence, James Creek	19	Harwood War Memorial, Harwood
14	James Creek Residence, James Creek	20	Harwood Bridge, Harwood
15	Harwood School Residence, Harwood	21	Convent, 12 River Street Harwood
16	Harwood School, Harwood	32	Harwood Heritage Conservation Area
17	Harwood Tram Tracks, Harwood	37	River Street trees, Harwood
18	Harwood Water Brigade Hall, Harwood		

LEGEND

EXISTING FEATURES
- Waterway / water body
- Heritage item (Non Aboriginal)
- Key views from Highway to surrounding landscape

OPEN SPACE
- National Park
- State Forest
- State conservation Area
- Nature Reserve
- Private agreement conservation
- Public park

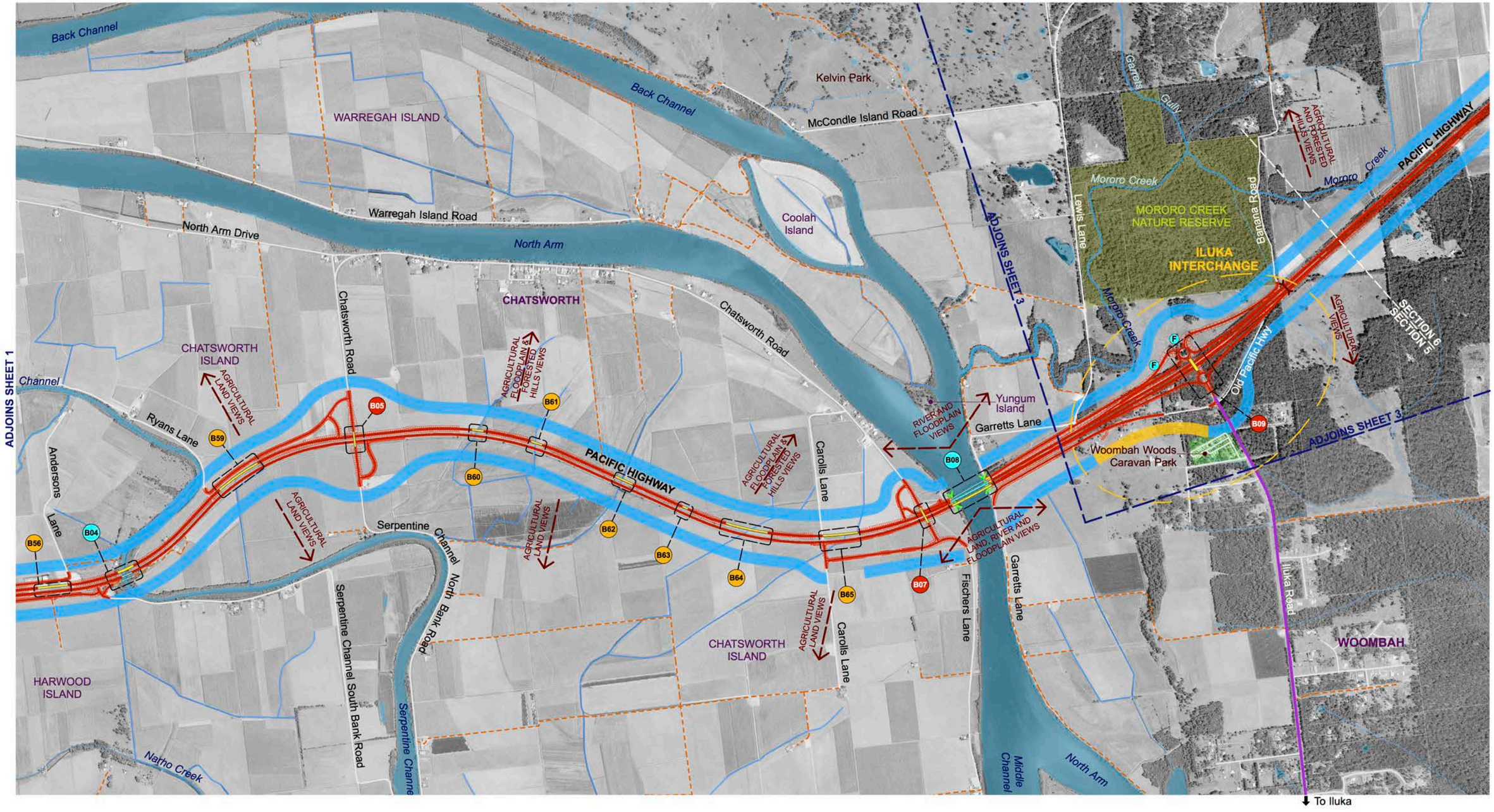
ROAD NETWORK
- Regional road
- Main road
- Local road
- Vehicular track

PACIFIC HIGHWAY
- Highway upgrade Maclean to Devils Pulpit (Sections 5 & 6)
- Existing upgraded Pacific Highway
- Adjacent sections of highway upgrade
- Existing bridge
- New bridge
- Cut batter
- Fill batter

BRIDGE IDENTIFICATION NUMBER
- BXX Bridge over Pacific Highway
- BXX Bridge over local road
- BXX Bridge over waterway
- BXX Floodplain bridge – single
- BXX Floodplain bridge – twin

FAUNA CROSSINGS
- Dedicated fauna culvert
- Combined bridge and fauna crossing
- Glider Poles
- F Frog pond (indicative location)

0 250 500 m



LEGEND

EXISTING FEATURES
- Waterway / water body
- Heritage item (Non Aboriginal)
- Key views from Highway to surrounding landscape

OPEN SPACE
- National Park
- State Forest
- State conservation Area
- Nature Reserve
- Private agreement conservation
- Public park

ROAD NETWORK
- Regional road
- Main road
- Local road
- Vehicular track

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- Highway upgrade Maclean to Devils Pulpit (Sections 5 & 6)
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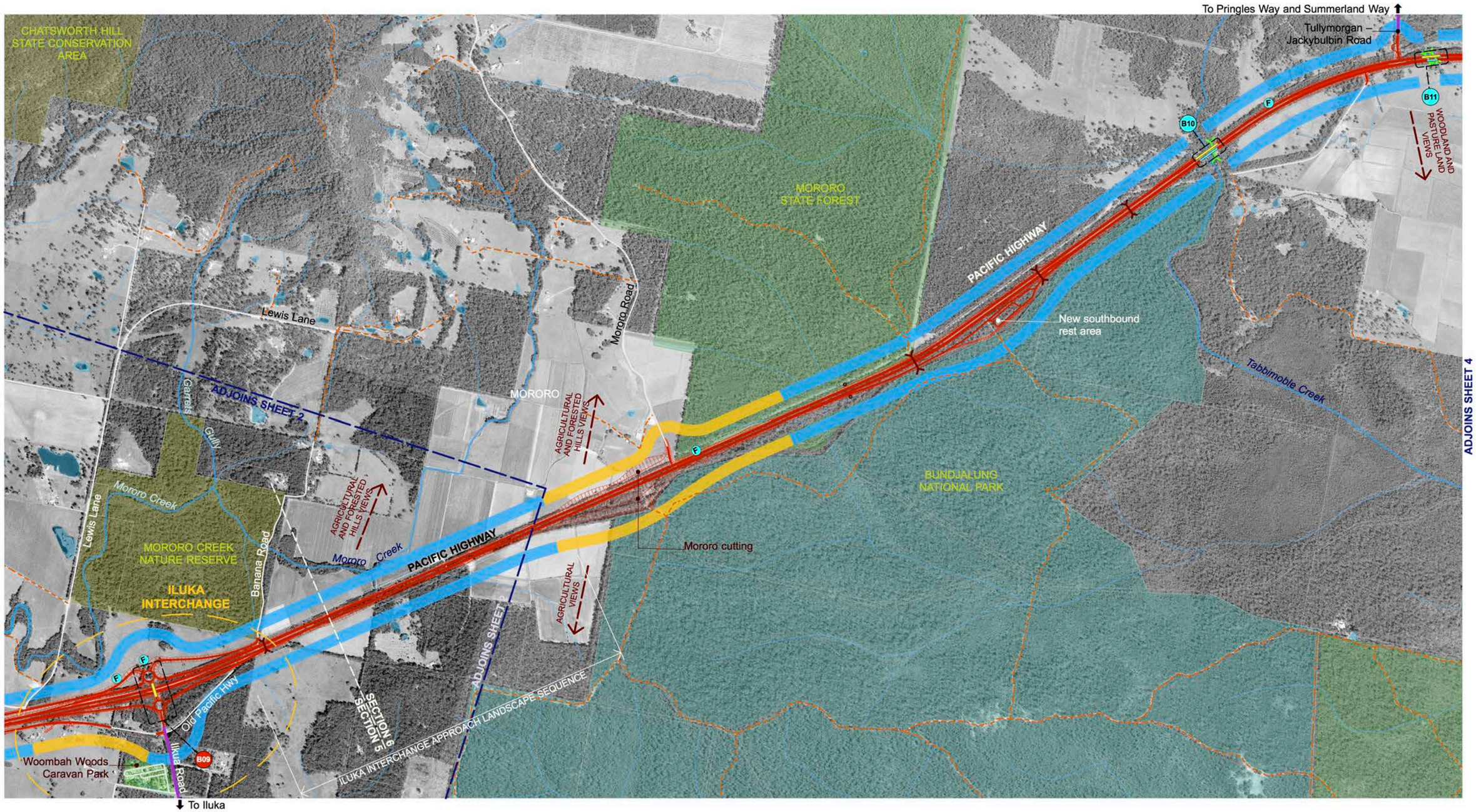
- F Frog pond (indicative location)

0 250 500 m

Figure 6-1: Maclean to Devils Pulpit (Sections 5 and 6) urban design and landscape strategy overview (4 sheets)



LEGEND

EXISTING FEATURES
- Waterway / water body
- Heritage item (Non Aboriginal)
- Key views from Highway to surrounding landscape

OPEN SPACE
- National Park
- State Forest
- State conservation Area
- Nature Reserve
- Private agreement conservation
- Public park

ROAD NETWORK
- Regional road
- Main road
- Local road
- Vehicular track

PACIFIC HIGHWAY
- Highway upgrade Maclean to Devils Pulpit (Sections 5 & 6)
- Existing upgraded Pacific Highway
- Adjacent sections of highway upgrade
- Existing bridge
- New bridge
- Cut batter
- Fill batter

BRIDGE IDENTIFICATION NUMBER
- Bridge over Pacific Highway
- Bridge over local road
- Bridge over waterway
- Floodplain bridge – single
- Floodplain bridge – twin

FAUNA CROSSINGS
- Dedicated fauna culvert
- Combined bridge and fauna crossing
- Glider Poles
- Frog pond (indicative location)

0 250 500 m

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7. URBAN DESIGN AND LANDSCAPE DESIGN FOR MACLEAN TO DEVILS PULPIT

Chapter contents

7.1 URBAN DESIGN AND LANDSCAPE

7.1.1 Overview

The landscape and urban design concept for Maclean to Devils Pulpit (Sections 5 and 6) has been developed in direct response to the project wide objectives and principles, as well as those specific to Maclean to Devils Pulpit (Sections 5 and 6).

This section provides an overview of the key components of the Maclean to Devils Pulpit (Sections 5 and 6) landscape and urban design concept, and their relationship with the road alignment and road elements, as they would be experienced when travelling from south to north along the Pacific Highway Upgrade.

From the road users' perspective, the highway upgrade is characterised by the wide, flat, open landscape of the Clarence River Floodplain, which is strongly contrasted with the adjacent forested hills to the north and south. As such, the Maclean to Devils Pulpit (Sections 5 and 6) landscape and urban design concept can be described in three parts:

- Maclean to Clarence River – forested hills to agricultural floodplain
- Harwood Island and Chatsworth Island – agricultural floodplain
- Clarence River North Arm to Devils Pulpit – agricultural floodplain to forested hills.

Guiding documents

The landscape and urban design concept for Maclean to Devils Pulpit (Sections 5 and 6) has been developed in accordance with the requirements of:

- *Upgrading the Pacific Highway Design Guidelines* (March 2015)
- *Pacific Highway Upgrade Woolgoolga to Ballina SPIR* (2013)
- *Pacific Highway Upgrade Woolgoolga to Ballina EIS* (2012)
  - Main Volume 1B, Chapter 11: Urban design, landscape character and visual impact
- Roads and Maritime policy and guideline documents, including but not limited to:
  - *Beyond the Pavement* – urban design policy procedures and design principles(2014)
  - *Bridge aesthetics* – design guideline to improve the appearance of bridges in NSW (2012)
  - *Landscape guidelines* (RTA, 2008)
  - *Guideline for batter surface stabilisation using vegetation* (2015).

7.2 MACLEAN TO CLARENCE RIVER

7.2.1 Overview

The Maclean to Devils Pulpit (Sections 5 and 6) portion of the W2B project commences at CH 82,000 as the highway descends the western slopes the Maclean Pinnacle to the floodplain south of the Clarence River. The project adjoins or passes through three landscape character precincts defined in the EIS:

- 25: Maclean Pinnacle
- 26: Yaegl Nature Reserve
- 27: Clarence River Floodplain.

The highway upgrade closely follows the alignment of the existing Pacific Highway with small deviations made to meet current design standards of road gradient and curvature. From the highway users' perspective, there are two distinct landscape experiences south of the Clarence River:

- The moderate slopes of the Maclean Pinnacle to Farlows Lane
- The flat floodplain from Farlows Lane to the Clarence River.

7.2.2 Maclean Pinnacle to Farlows Lane

The new northbound carriageway is primarily cut into the western hillside of Maclean Pinnacle, while the southbound carriageway is generally elevated on fill. The cuttings along the northbound carriageway reach up to 13 metres in height, with a gradient of 2H:1V. The gradient of the fill embankments along the southbound carriageway is generally 4H:1V, with intermittent variations to 2H:1V. A median of at least 12 metres width separates the two carriageways.

At Farlows Lane, the highway is supported on new twin bridges: bridge B01 – Twin Bridges over Koala Drive. Bridge B01 replaces the existing Farlows Lane Overbridge. The new twin bridges span a realigned section of Koala Drive that connects to Farlows lane, providing an access track for the Yaegl Nature Reserve and agricultural properties. The unsealed track and adjoining vegetated swale provides fauna passage under the highway.

Landscape and urban design

The highway is currently enclosed by forest on both sides from the Maclean Pinnacle to Farlows Lane. The landscape and urban design concept is to reinstate the current landscape experience through forest revegetation on both sides of the highway, using plant species from the adjoining vegetation communities. A dense shrub landscape is provided in the median to visually separate the two carriageways, reinforce the sense of enclosure and screen headlight glare from oncoming traffic.

7.2.3 Farlows Lane to the Clarence River

North of bridge B01 (Twin Bridges over Koala Drive), the highway traverses the flat landscape of the Clarence River Floodplain to the southern banks of the Clarence River. The highway forms a sweeping right hand curve as it enters the floodplain from the foothills of the Maclean Pinnacle. This is followed by a straight section of approximately 1.4 kilometres length before the highway forms a sweeping left hand curve on approach to the Yamba Interchange and the new bridge over the Clarence River on the eastern side of Harwood Bridge.

The highway upgrade between Farlows Lane and the Clarence River is to be built entirely on fill embankments generally up to 5 metres high, except at the southern approach to the new Clarence River bridge where the embankment reaches approximately 8.8 metres height at the bridge abutment. At CH 84,770 (refer Figure 7-9) the northbound carriageway is supported on Bridge B02 – northbound bridge over Clarence Floodplain. The 150 metres long bridge facilitates flood mitigation on the floodplain.

The current landscape experience from the highway between Farlows Lane and the Clarence River is defined to the west primarily by sweeping views across the agricultural floodplain, which are occasionally filtered by intermittent groups of trees, to the forested hills beyond the Clarence River. The roadside groups of trees will to be cleared to facilitate the roadworks. To the east, the highway is defined by the coastal forest of the Yaegl Nature Reserve. From bridge B02 north to the Clarence River, the highway is enclosed on both sides by coastal forest.

Landscape and urban design

The landscape and urban design concept is to reinstate the existing landscape experience. This will be done with forest revegetation where the highway currently adjoins forest, using plant species from the adjoining vegetation communities. Where the highway currently adjoins agricultural land, the revegetation works will consist of pasture grasses to maintain existing views to the agricultural fields and forested hills to the west. A dense shrub landscape is provided in the median to visually separate the two carriageways, reinforce the sense of enclosure and screen headlight glare from oncoming traffic.

7.2.4 Yamba Interchange design

North of bridge B02 the highway enters the sweeping left hand curve that forms the southern approach to the new Clarence River bridge as well as an interchange with Yamba Road on the southern bank of the Clarence River. Yamba Road is a regional road that provides access to Maclean to the south-west and Yamba to the east.

The Yamba Interchange includes:

- Entry and exit ramps on the southbound carriageway connecting to the existing western 'T' intersection on Yamba Road
- A northbound exit ramp that connects to a new roundabout on the western side of the highway
- A new roundabout on the western side of the highway connecting the northbound exit ramp with:
  - A new local access road, under the first span of the new bridge, to the southbound highway entry/exit road on the eastern side of the highway
  - The existing western 'T' intersection on Yamba Road
  - The existing Harwood Bridge, which becomes a local road connection.

Landscape and urban design

The landscape and urban design for the Yamba Interchange is to provide distinctive maker tree plantings alongside the northbound carriageway from approximately 2 kilometres south of the interchange, in order to visually signify and reinforce the approach to the interchange.

Northbound arrival experience

The design for the interchange arrival sequence from the south includes (refer Figure 7-9, Figure 7-10 and Figure 7-11) :

- A small grid planting of Cook Pine (*Araucaria columnaris*) just north of Farlows Lane at appromimately CH 83,400 to signal 2 kilometres from the Yamba Interchange
- Roadside planting of Hills Weeping Fig (*Ficus microcarpa var. hillii*) starting at 200 metre spacing at CH 83,600 and gradually decreasing to 20 metre spacing at CH 84,800
- A medium sized grid planting of Cook Pine (*Araucaria columnaris*) at CH 84,400 to signal 1 kilometre from the Yamba Interchange
- From CH 84,800 the highway is defined on both sides by coastal forest. From here, the roadside plantings of Hills Weeping Fig (*Ficus microcarpa var. hillii*) would be at 20 metre spacings that would continue to the interchange
- A large grid planting of Cook Pine (*Araucaria columnaris*) at the start of the northbound exit ramp, at approximately CH 85,400.
- Roadside groupings of Tuckeroo (*Cupaniopsis anacardioides*) to define the northbound exit ramp, connection to Yamba Road and connection to the existing Harwood Bridge
- Grid planting of Cook Pine (*Araucaria columnaris*) within the new roundabout and roadside planting of Norfolk Island Pines (*Araucaria heterophylla*) around the outside of the roundabout.

Southbound departure experience

The design for the southbound departure sequence includes:

- A large grid planting of Cook Pine (*Araucaria columnaris*) alongside the highway, starting at the southern abutment of the new Clarence River bridge
- Roadside groupings of Tuckeroo (*Cupaniopsis anacardioides*) to define the eastern side of the southbound exit ramp
- A large grid planting of Cook Pine (*Araucaria columnaris*) to define the inside curve of the southbound exit ramp as it joins the entry/exit road to Yamba Road.

Southbound arrival experience

The design for the southbound highway entry sequence includes:

- Roadside groupings of Tuckeroo (*Cupaniopsis anacardioides*) to define both sides of the entry/exit road to Yamba Road and the southbound entry ramp
- Roadside planting of Norfolk Island Pines (*Araucaria heterophylla*) on Yamba Road on the eastern side of the new Clarence River bridge
- Roadside planting of Norfolk Island Pines (*Araucaria heterophylla*) on the southbound entry/exit road at the intersection with the local access road under the new Clarence River bridge.

Tree species selection

The signature tree species selections reference the natural and cultural landscapes of the area in the following ways:

- The Cook Pine is currently being introduced as a signature tree species in Yamba
- The Hills Weeping Fig is a large rainforest tree of appropriate scale for roadside planting next to grazing land
- The Tuckeroo is a distinctive native tree that can be found throughout the region
- The Norfolk Island Pine is a predominant street tree species in Yamba and have been used to define key intersections on the route to Yamba within the interchange.

7.2.5 The Clarence River

A new dual carriageway bridge over the Clarence River is proposed immediately east of the existing Harwood Bridge. The new bridge over the Clarence River is not within the scope of Maclean to Devils Pulpit – Sections 5 and 6 and will be designed through a separate contract.

As part of the highway upgrade, the existing Harwood Bridge would be retained as a local road connection.

7.2.6 New Clarence River bridge

The new Clarence River bridge is the subject of a separate design report. Included in this report is an artist's impression of the proposed Clarence River Bridge (refer to Figure 7-3).

Figure 7-1: Artist's impression of northbound approach to Yamba interchange

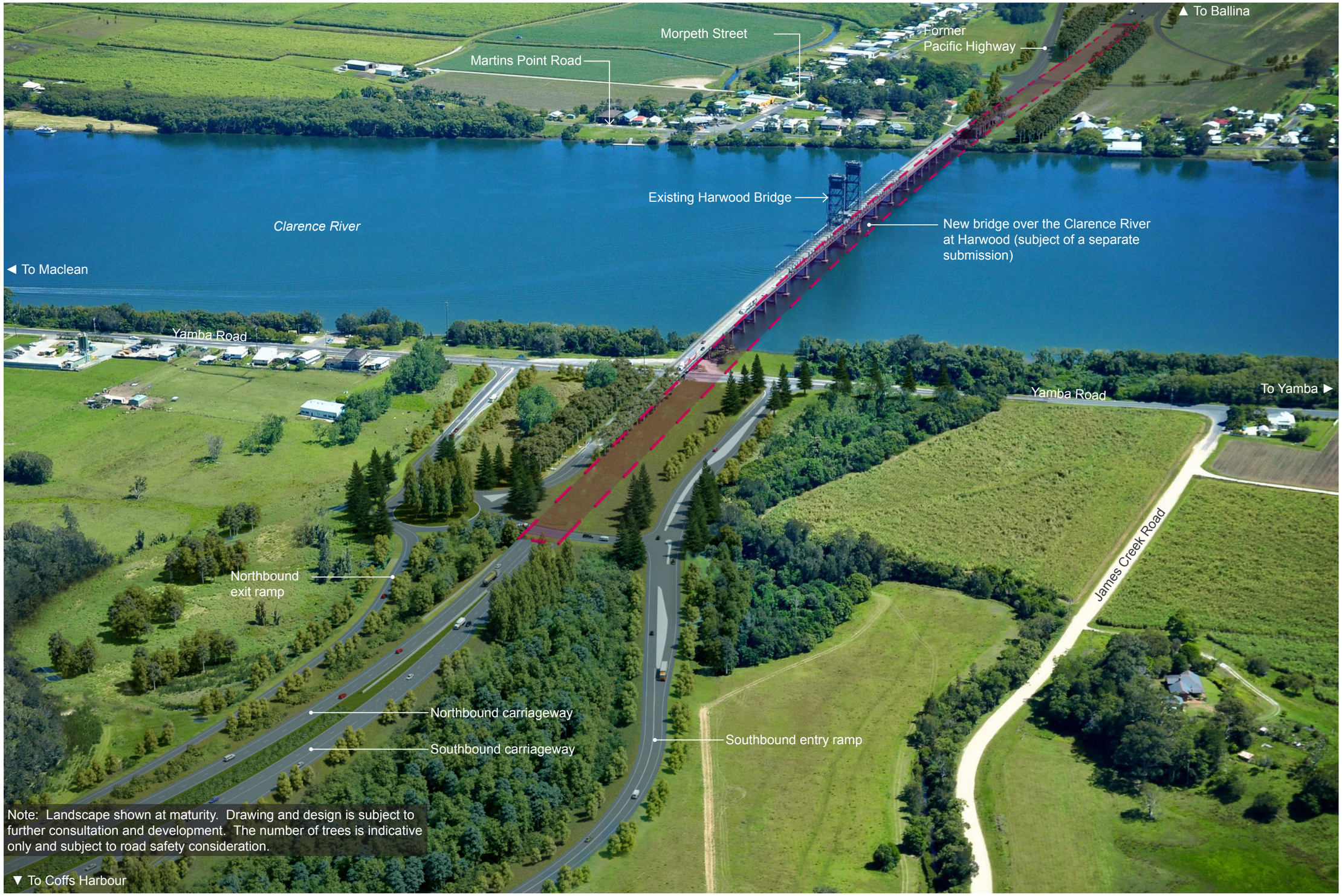

Figure 7-2: Artist's impression of Yamba interchange

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Figure 7-3: Artist's impression of new bridge over Clarence River at Harwood. Subject to further consultation and design development; subject to a separate submission (source: AFJV and Roads and Maritime).

7.3 HARWOOD ISLAND AND CHATSWORTH ISLAND

7.3.1 Overview

North of the Clarence River the highway upgrade crosses the wide flat agricultural floodplain landscape of Harwood Island and Chatsworth Island to reach the Clarence River North Arm. The highway passes through one landscape character precinct defined in the EIS:

- 27: Clarence River Floodplain.

The length of highway between the Clarence River and the Clarence River North Arm is approximately 7.1 kilometres, which is singularly characterised by the vast flat agricultural landscape of sugar cane fields. The only exceptions to this consistent landscape experience are encountered at:

- Harwood, a small township located on either side of the Pacific Highway at northern banks of the Clarence River
- The Serpentine Channel, which separates Harwood Island in the south from Chatsworth Island in the north. The Serpentine Channel is encountered on the highway approximately one third of the distance from the Clarence River to the Clarence River North Arm. It is defined by riparian vegetation along its banks that provide a strong visual contrast to the surrounding agricultural fields.
- Riparian vegetation on the southern banks of the Clarence River North Arm, which marks the northern end of Chatsworth Island.

The highway upgrade across Harwood Island and Chatsworth Island duplicates the alignment of the existing Pacific Highway, which would be retained as the new southbound carriageway. The new northbound carriageway would be built entirely on fill embankment approximately three metres high, except:

- Where bridges have been provided for flood mitigation and over the Serpentine Channel.
- Between CH 88,500 and the Clarence River (refer Figure 7-9 and Figure 7-11), where both carriageways would deviate from the existing highway alignment on the northern approach to the new bridge over the Clarence River.

With the exception of the new bridge over the Clarence River, the highway upgrade incorporates thirteen new bridges on Harwood Island and Chatsworth Island. These include:

- Two twin floodplain bridges that support both carriageways individually
- Nine single floodplain bridges on the northbound carriageway
- Two local road bridges over the highway
- One northbound bridge over the Serpentine Channel (the existing Serpentine Channel bridge is retained for the southbound carriageway)

From south to north, the bridges are encountered in the following order:

- On Harwood Island:
  - B52 – Twin bridges for Clarence Floodplain Opening 4
  - B55 – Northbound bridge for Clarence Floodplain Opening 7
  - B56 – Northbound bridge for Clarence Floodplain Opening 8
- Over Serpentine Channel, connecting Harwood Island with Chatsworth Island:
  - B04 – Northbound bridge over Serpentine Channel
- On Chatsworth Island
  - B59 – Northbound bridge for Clarence Floodplain Opening 11
  - B05 – Bridge over Pacific Highway at Serpentine Channel North Bank Road
  - B60 – Northbound bridge for Clarence Floodplain Opening 12
  - B61 – Northbound bridge for Clarence Floodplain Opening 13
  - B62 – Northbound bridge for Clarence Floodplain Opening 14
  - B63 – Northbound bridge for Clarence Floodplain Opening 15
  - B64 – Northbound bridge for Clarence Floodplain Opening 16
  - B65 – Northbound bridge for Clarence Floodplain Opening 17
  - B07 – Bridge over Pacific Highway at Chatsworth Road

Landscape and urban design

The landscape and urban design is to celebrate the ‘big landscape’ that is the Clarence River floodplain at Harwood Island and Chatsworth Island. This is done by limiting tree planting in order to allow the highly recognisable sugar cane plantation landscape to dominate the visual experience from the highway. The revegetation works on Harwood Island and Chatsworth Island would consist of pasture grasses to maintain views across the agricultural floodplain, except in the following situations:

- Shrub planting would be provided in the median where required for headlight screening
- Riparian revegetation at the Serpentine Channel using plant species from the adjacent vegetation communities
- Roadside tree planting at overbridge B05 alongside Chatsworth Road (south) and Serpentine Channel North Bank Road
- Roadside tree planting at overbridge B07 alongside Chatsworth Road (north)
- Riparian revegetation at the south bank of the Clarence River North Arm using plant species from the adjacent vegetation communities.

7.3.2 Harwood Interchange design

At approximately 700 metres north of Watts Lane, the new carriageways deviate from the existing highway alignment on the northern approach to the new bridge over the Clarence River. In the vicinty of Watts Lane, the highway is supported by Bridge B52 – Twin bridges for Clarence Floodplain Opening 4, a new 370 metre long pair of bridges over Watts Lane. The northern abutment for the new bridge over the Clarence River is located about 355 metres south of Bridge B52. The southbound exit ramp begins at approximately CH 87,650 (refer Figure 7-9) to connect with a new local access road between the existing Pacific Highway and Mill Road. The former Pacific Highway is retained as a local road between the existing Harwood Bridge and Watts Lane.

The current landscape experience from the highway at the Harwood Interchange is characterised by views to rural residential properties in Harwood township and the existing Harwood Bridge, the primary built landmark that distinguishes the local area. Located to the east of the interchange, the chimney stack of the Harwood Sugar Mill is also a prominent built landmark that can be seen from the southbound carriageway but primarily from Harwood Bridge. The Harwood Island Public School is located adjacent to the existing Pacific Highway and immediately south of the new local access road to Mill Road.

Landscape and urban design

The landscape and urban design for the Harwood Interchange is to provide distinctive avenue planting south of Watts Lane to visually signify and reinforce the approach to Harwood Bridge, and to screen the new bridge on the northern banks of the river from the properties within Harwood (screen planting to the new bridge is subject to a separate submission).

Driver experience

The design for the highway sequence in both directions includes:

- Roadside planting of Australian Teak (*Flindersia australis*) on both sides of the highway south of Watts Lane to alert motorists to the upcoming Clarence River crossing and southbound exit road to Harwood
- Roadside groupings of Tuckeroo (*Cupaniopsis anacardioides*) on both sides of the highway north of Bridge B52 identifies the northbound entry onto the highway from Watts Lane and provides the first formalised tree planting on the floodplain for southbound motorists, alerting them to the upcoming town of Harwood
- Roadside groupings of Blueberry Ash (*Elaeocarpus reticulatis*) on the new road linking Morpeth Street to Mill Road.

Tree species selection

The signature tree species selections reference the natural and cultural landscapes of the area in the following ways:

- The Australian Teak provides a striking avenue with its rounded habit and glossy leaves
- The Tuckeroo is a distinctive native tree that can be found throughout the region
- The Blueberry Ash is a small street tree common to the area and has been used to reinforce the entry into Harwood whilst still allowing views into and out of the town.

Figure 7-4: Artist's impression of highway upgrade through agricultural floodplain on Harwood Island and Chatsworth Island

Figure 7-5: Artist's impression of northbound approach to Bridge B07 – Bridge over Pacific Highway at Chatsworth Road

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7.4 CLARENCE RIVER NORTH ARM TO DEVILS PULPIT

7.4.1 Overview

North of the Clarence River North Arm the highway upgrade traverses a landscape that varies between cropping and grazing land to dense forest. The highway passes through six landscape character precincts defined in the EIS:

- 27: Clarence River Floodplain
- 30: Chatsworth Hill
- 31: Mororo Creek Valley
- 32: Bundjalung National Park
- 33: Jackybulbin Flat
- 34: Tabbimoble.

The highway upgrade closely follows the alignment of the existing Pacific Highway with small deviations made to meet current design standards of road gradient and curvature until the Devils Pulpit Upgrade. From the highway users' perspective, there are three distinct landscape experiences north of the Clarence River North Arm:

- The undulating agricultural land from Mororo Bridge to Mororo Road.
- The enclosed forest from Mororo Road to the Devils Pulpit Upgrade
- The split carriageways through forest of the Devils Pulpit Upgrade.

7.4.2 Mororo Bridge to Mororo Road

North of bridge B08 (southbound bridge over Clarence River North Arm), the highway traverses the flat floodplain landscape of the northern banks of the Clarence River North Arm. The highway has a slight left curve to the approach and exit of the Iluka Interchange, before continuing straight for about 2.2 kilometres to Mororo Road. New service roads are located on both sides of the highway, linking Iluka Road to Garretts Lane on the eastern side and Iluka Road and Chatsworth Road, via the existing Mororo Bridge northbound lanes, on the western side.

The highway upgrade will be built predominately on low fill embankments, generally with gradients of 4H:1V. Cuttings are required next to the southbound lanes at the Iluka Interchange and between CH 97,500 and 98,500, known as the Mororo cut, to generate fill for other areas between Maclean and Devils Pulpit (Sections 5 and 6).

The current road user experience is of a highway traversing undulating agricultural and forested land where views are revealed and concealed according to roadside tree planting. North of the North Arm crossing at Mororo Bridge, motorists travel through an existing stand of native trees, announcing the crossing. The highway continues along the floodplain, providing extensive views over grazing land to the east and sugar cane plantations terminating on the forested hills of the Richmond Ranges to the west. Rising out of the floodplain, the highway traverses dense bushland on both sides of Iluka Road, emerging into a more agricultural landscape south of Mororo Road. Here, roadside vegetation of different densities either screens, filters, or reveals the grazing land beyond the road corridor.

Landscape and urban design

Much of the existing roadside planting will be removed for the roadworks. The landscape and urban design replicates existing the experience by providing targeted tree planting in groups to allow views into the wider landscape and retain a sense of openness before entering the densely vegetated forest to the north. Tree species would be selected from adjoining vegetation communities. The understorey would consist of pasture grasses to maintain consistency with the adjoining agricultural landscape. Dense native planting would be provided along the Old Pacific Highway service road to screen visually sensitive local residents.

Where existing forest adjoins the eastern side highway, between CH 96,800 and CH 97,200 revegetation with trees, shrubs and groundcovers using species from the Tallowwood dry grassy woodland vegetation community will be provided. Dense shrub planting will be provided in the median to visually separate the carriageways and screen headlight glare. Native grasses will be used where views are desired, at U-turn facilities and where screening from headlight glare is required.

The wide area between the highway and the toe of the Mororo cut will be heavily vegetated with dry sclerophyll forest species.

7.4.3 Mororo Road to Devils Pulpit Upgrade

From Mororo Road to the Devils Pulpit Upgrade at CH 105,400 (refer Figure 7-9) the highway is enclosed by the heavily vegetated Mororo State Forest, Bundjalung National Park and Devils Pulpit State Forest.

The highway veers to the left before it sweeps to the right at CH 101,600 to the tie-in with the upgrade. The highway traverses two new northbound bridges: Bridge B10 over Tabbimoble Creek and Bridge B11 over Tabbimoble Overflow. A new southbound rest area will be provided between CH100,100 and CH 100,475 (refer Figure 7-9), and the existing northbound rest area at CH 98,600 to CH 98,700 (refer Figure 7-9) will be retained as a truck breakdown bay. The majority of the upgrade will be built on low embankments with gradients at 4H:IV.

The existing highway experience is one of enclosure as the highway traverses dense bushland on slightly undulating topography and sweeping curves contrasting greatly from the openness of the floodplain. Views are generally confined to the highway corridor, except around Jackybulbin flat where sparse roadside vegetation allows filtered views to grazing land on the eastern side of the highway.

Landscape and urban design

The landscape and urban design concept will reinstate the existing landscape experience. Forested areas will be revegetated with tree, shrub and ground cover species of the adjoining vegetation communities. Roadside trees removed around Jackybulbin Flat will be replaced with groupings of trees allowing views into the grazing land, a distinctive contrast to the surrounding native reserves.

Dense shrub planting will be provided in the median to visually separate the carriageways and screen headlight glare. Native grasses will be used where views are desired, at U-turn facilities and where screening from headlight glare is not required.

The southbound rest area has been designed to minimise its impact on the High Conservation Old Growth Forest. The layout provides for a toilet block, picnic shelters, pedestrian paths and shade tree planting. Screen planting will be provided between the rest area and the highway whilst still providing filtered views from the highway to acknowledge the presence of the rest area.

7.4.4 Iluka interchange design

Iluka Road is located approximately 1.2 kilometres north of the bridge over the Clarence River North Arm. Iluka Road provides access to the village of Woombah approximately 500 metres east of the Pacific Highway, the town of Iluka on the northern banks of the Clarence River, and Woody Head on the coast.

The Iluka Road interchange includes:

- Entry and exit ramps on the northbound and southbound carriageways
- Bridge B09 – Iluka Road overbridge

- A new roundabout on the western side of the highway connecting:
  - The northbound exit ramp and entry ramp
  - A new local access road connecting Lewis Lane, Garretts Lane and the existing northbound bridge over the Clarence River North Arm and Chatsworth Road
  - A new local access road connecting to Banana Road to the north
  - The new Iluka Road overbridge (B09)
- A new roundabout on the eastern side of the highway connecting:
  - The southbound exit ramp and entry ramp
  - The new Iluka Road overbridge (B09) and Iluka Road.

Landscape and urban design

The landscape and urban design for the Iluka Road Interchange is to enhance the bushland character of this interchange referencing its location amongst extensive national parks and state forests.To achieve this, all areas impacted by the construction of the interchange would be heavily vegetated with dry sclerophyll forest species. Permanent drainage basins are located within the interchange islands, however, tree planting will be provided on the surrounding batter slopes to screen the basins. Distinctive marker tree plantings would be provided to visually signify the approach to the interchange from both directions.

Northbound arrival experience

The arrival sequence from the south is limited by the short distance between Clarence River North Arm bridge crossing and the interchange, a distance of about 300m to the exit ramp. Marker planting is not provided south of the river, so as to not impact on the desired open character of the floodplain.

The design for the interchange arrival sequence from the south includes (refer Figure 7-9 and Figure 7-12):

- A single row of Spotted Gum (*Corymbia maculata*) on both sides of the highway from about CH 94,800 to CH 94,880.

Southbound arrival experience

The design for the interchange arrival sequence from the north includes (refer Figure 7-9 and Figure 7-12):

- A 200 metre long row of Spotted Gum (*Corymbia maculata*) just south of Mororo cut at CH 97,620 to signal about 2 kilometres from the Iluka Road Interchange
- A 200 metre long single row of Spotted Gum (*Corymbia maculata*) at the start of the southbound exit ramp.

Northbound departure experience

The design sequence for the interchange departure experience includes (refer Figure 7-9 and Figure 7-12):

- A 200 metre long single row of Spotted Gum (*Corymbia maculata*) starting at about CH 95,760 on the northbound entry ramp.

Interchange roundabouts

A grid of Spotted Gum (*Corymbia maculata*) will be provided in the two roundabouts, to reinforce the master planning.

Tree species selection

The signature tree species selection for the Iluka Interchange references a tree indigenous to the local area. The Spotted Gum (*Corymbia maculata*), with its distinctive trunk, will be geometrically planted to provide a striking marker to the interchange.

Koala feed trees are included in the roadside forest revegetation between the Iluka interchange and the Mororo cut to enhance the habitat values of this important Koala habitat area.

Figure 7-6: Artist's impression of Iluka interchange

Figure 7-7: Artist's impression of Northbound approach to Iluka interchange

Figure 7-8: Artist's impression of highway at Mororo Cut

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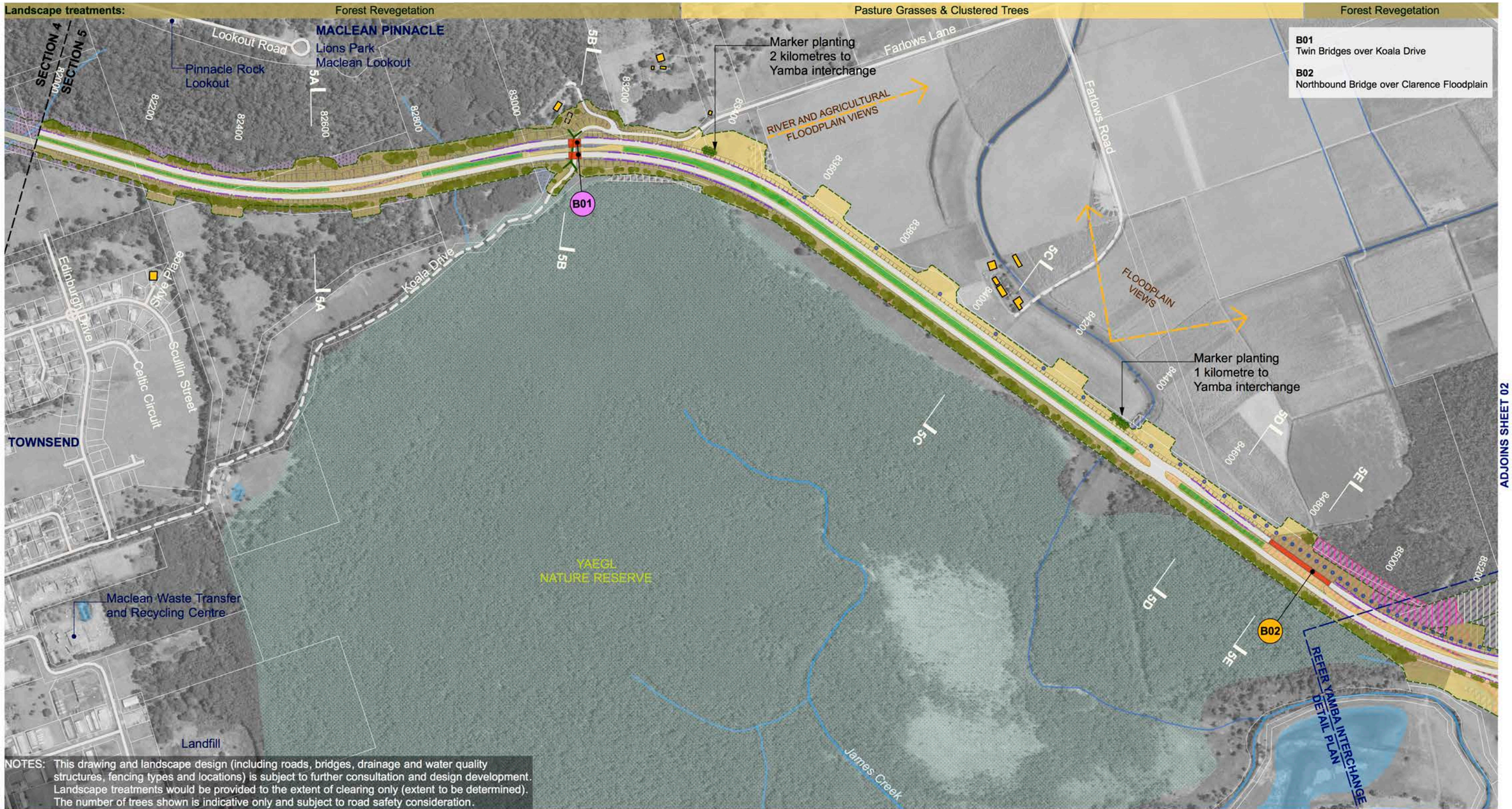
7.5 LANDSCAPE AND URBAN DESIGN CONCEPT DRAWINGS

The following pages contain the landscape and urban design concept drawings for the Maclean to Devils Pulpit (Sections 5 and 6) portion of the highway upgrade. It includes:

- Landscape and urban design concept plan at 1:8,000 scale (10 sheets)
- Detail plan of the Yamba Interchange at 1:2,500 scale (2 sheets)
- Detail plan of the Harwood Interchange at 1:2,500 scale
- Detail plan of the Iluka Interchange at 1:2,500 scale (2 sheets)
- Landscape and urban design cross sections showing the varying landscape conditions along the highway upgrade at 1:500 scale.

Figure 7-9: Landscape and urban design concept plan (10 sheets)



LEGEND

EXISTING FEATURES
- Existing highway
- Existing bridge
- Existing road
- Existing track
- Waterway / water body
- Property boundary
- Nearby building
- Key views to surrounding landscape

VEGETATION COMMUNITIES – MAPPED WITHIN THE PROJECT CORRIDOR
- Blackbutt - Bloodwood dry heathy open forest
- Grey Gum - Grey Ironbark open forest
- Spotted Gum - Grey Box - Grey Ironbark open forest
- Spotted Gum - Grey Ironbark - Pink Bloodwood open forest
- Flooded Gum - Brush Box moist open forest
- Red Mahogany open forest
- Tallowwood dry grassy forest
- Coastal Floodplain sedgelands, rushlands and forblands
- Swamp Oak swamp forest
- Paperbark swamp forest
- Forest Red Gum - Swamp Box
- Narrow-leaved Red Gum woodlands
- Mangrove - Grey Mangrove low closed forest
- Saltmarsh complex
- White Booyong - Fig subtropical rainforest

ENDANGERED ECOLOGICAL COMMUNITIES – TSC Act 1995
- Coastal Saltmarsh in the NSW North Coast
- Freshwater Wetlands on Coastal Floodplains of the NSW N. Coast
- Subtropical Coastal Floodplain Forest of the NSW North Coast
- Swamp Oak Floodplain Forest of the NSW North Coast
- Swamp Sclerophyll Forest of the NSW North Coast

PROTECTED VEGETATION
- SHR - High Conservation Old Growth Forest
- SEWPAC - SEPP 14 Wetlands
- Fisheries Management Act 1994


Landscape treatments: Forest Revegetation
Pasture Grasses & Feature Trees
Riparian Revegetation
Riparian Revegetation
Pasture Grasses & Feature Trees on approach to Harwood Bridge
B52
Twin Bridges for Clarence Floodplain Opening 4
B55
Northbound Bridge for Clarence Floodplain Opening 7
ADJOINS SHEET 01
TO MACLEAN
CLARENCE RIVER
Martins Point Road
Nyrang Creek
Harwood Island Public School
Morpeth St
Former Pacific Highway
Watts Lane
ADJOINS SHEET 03
HARWOOD INTERCHANGE
VIEWS TO HARWOOD & SUGAR MILL
HARWOOD ISLAND
HARWOOD
VIEWS ACROSS RIVER AND FLOODPLAIN TO FORESTED HILLS
Yamba Road
Existing Harwood Bridge
Bridge over Clarence River at Harwood (separate submission)
River Street
Harwood Mill Road
Mill Lane
REFER YAMBA INTERCHANGE DETAIL PLAN
REFER HARWOOD INTERCHANGE DETAIL PLAN
RIVER AND FLOODPLAIN VIEWS
YAMBA INTERCHANGE
James Creek Road
Harwood Sugar Mill
Nicholsons Lane
TO YAMBA
NOTES: This drawing and landscape design (including roads, bridges, drainage and water quality structures, fencing types and locations) is subject to further consultation and design development.
Targeted consultation will be undertaken for flooding at detailed design stage.
Landscape treatments would be provided to the extent of clearing only (extent to be determined).
The number of trees shown is indicative only and subject to road safety consideration.
Landscape treatments: Pasture Grasses, Forest Revegetation & Feature Trees
Pasture Grasses & Feature Trees on approach to Harwood Bridge
HIGHWAY UPGRADE
Clearing boundary
New bridge
New Clarence River bridge (separate submission)
Wire rope safety barrier
W-Beam barrier
Security fence
Fauna fence
Drainage basin
Building resumed
NEW BRIDGES
Bridge over highway
Bridge over local road
Bridge over waterway
Floodplain bridge – single
Floodplain bridge – twin
FAUNA CONNECTIONS
Fauna culvert (dedicated or combined)
Fauna crossing under bridge
Glider poles
Frog pond (indicative location)
LANDSCAPE TREATMENTS
Pasture grasses
Native grasses
Mixed shrubs
Forest revegetation
Riparian Revegetation
FEATURE TREES
Araucaria columnaris Cook Pine
Araucaria heterophylla Norfolk Island Pine
Corymbia maculata Spotted Gum
Cupaniopsis anacardioides Tuckeroo
Ficus microcarpa var 'Hillii' Hill's Fig
Flindersia australis Australian Teak
Elaeocarpus reticulatis Blueberry Ash
Clustered tree planting
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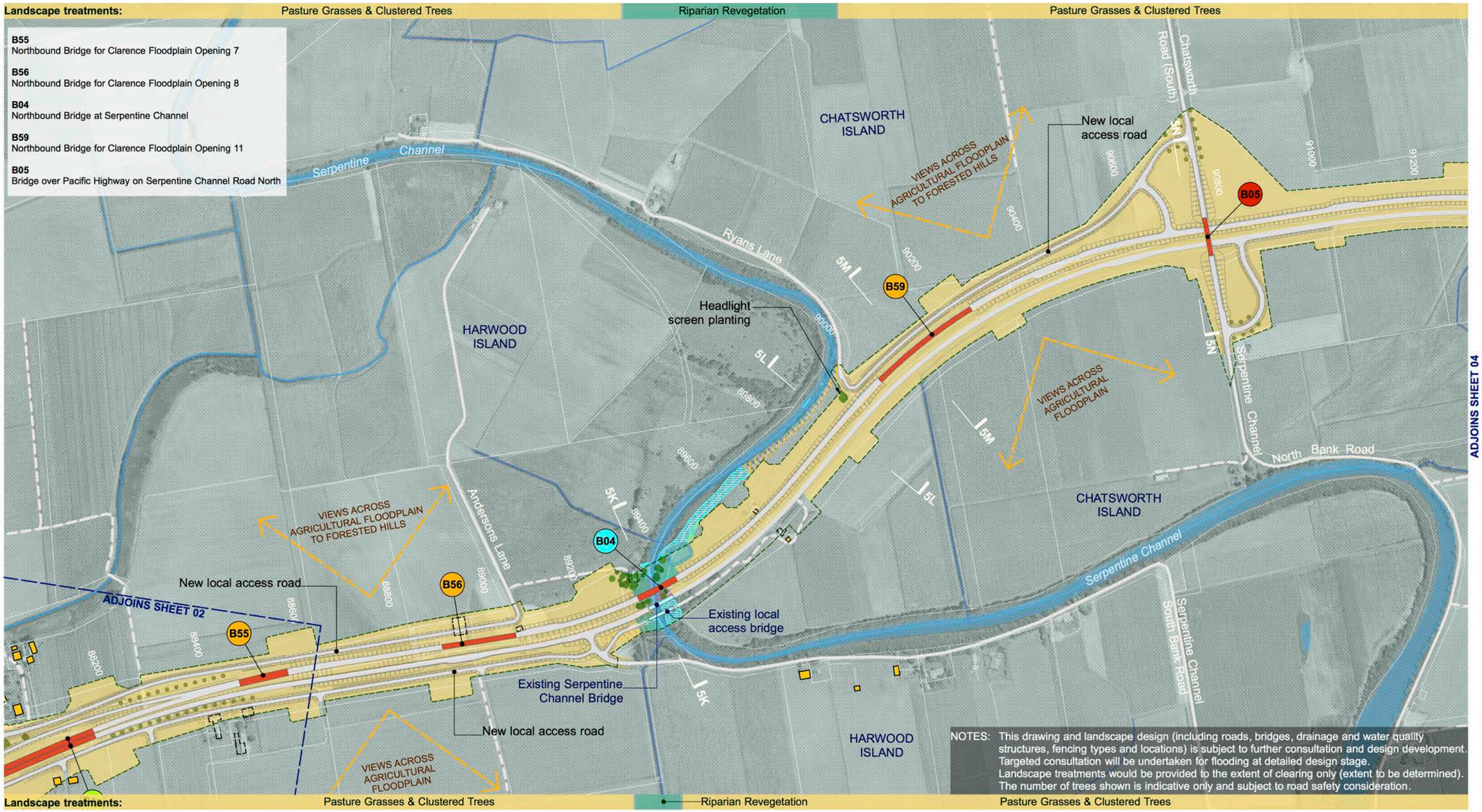

LEGEND

EXISTING FEATURES
- Existing highway
- Existing bridge
- Existing road
- Existing track
- Waterway / water body
- Property boundary
- Nearby building
- Key views to surrounding landscape

VEGETATION COMMUNITIES – MAPPED WITHIN THE PROJECT CORRIDOR
- Blackbutt - Bloodwood dry heathy open forest
- Grey Gum - Grey Ironbark open forest
- Spotted Gum - Grey Box - Grey Ironbark open forest
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- Flooded Gum - Brush Box moist open forest
- Red Mahogany open forest
- Tallowwood dry grassy forest
- Coastal Floodplain sedgelands, rushlands and forblands
- Swamp Oak swamp forest
- Paperbark swamp forest
- Forest Red Gum - Swamp Box
- Narrow-leaved Red Gum woodlands
- Mangrove - Grey Mangrove low closed forest
- Saltmarsh complex
- White Booyong - Fig subtropical rainforest

ENDANGERED ECOLOGICAL COMMUNITIES – TSC Act 1995
- Coastal Saltmarsh in the NSW North Coast
- Freshwater Wetlands on Coastal Floodplains of the NSW N. Coast
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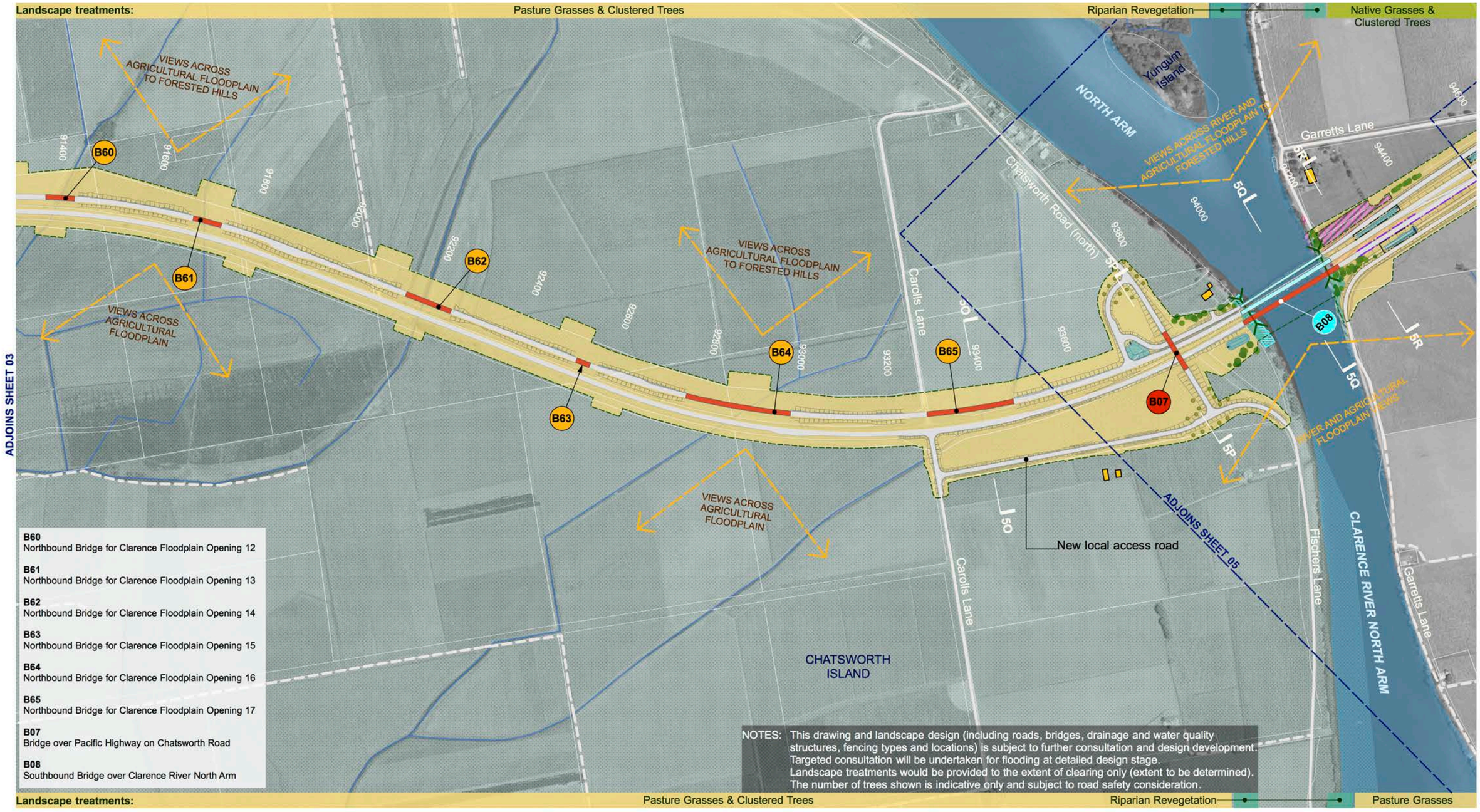
- Swamp Oak Floodplain Forest of the NSW North Coast
- Swamp Sclerophyll Forest of the NSW North Coast

PROTECTED VEGETATION
- SHR - High Conservation Old Growth Forest
- SEWPAC - SEPP 14 Wetlands
- Fisheries Management Act 1994



HIGHWAY UPGRADE
- Clearing boundary
- New bridge
- New Clarence River bridge (separate submission)
- Wire rope safety barrier
- W-Beam barrier
- Security fence
- Fauna fence
- Drainage basin
- Building resumed

NEW BRIDGES
- Bridge over highway
- Bridge over local road
- Bridge over waterway
- Floodplain bridge – single
- Floodplain bridge – twin

FAUNA CONNECTIONS
- Fauna culvert (dedicated or combined)
- Fauna crossing under bridge
- Glider poles
- Frog pond (indicative location)

LANDSCAPE TREATMENTS
- Pasture grasses
- Native grasses
- Mixed shrubs
- Forest revegetation
- Riparian Revegetation

FEATURE TREES
- *Araucaria columnaris* Cook Pine
- *Araucaria heterophylla* Norfolk Island Pine
- *Corymbia maculata* Spotted Gum
- *Cupaniopsis anacardioides* Tuckeroo
- *Ficus microcarpa var 'Hillii'* Hill's Fig
- *Flindersia australis* Australian Teak
- *Elaeocarpus reticulatis* Blueberry Ash
- Clustered tree planting

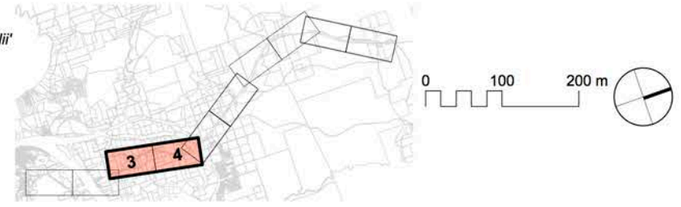
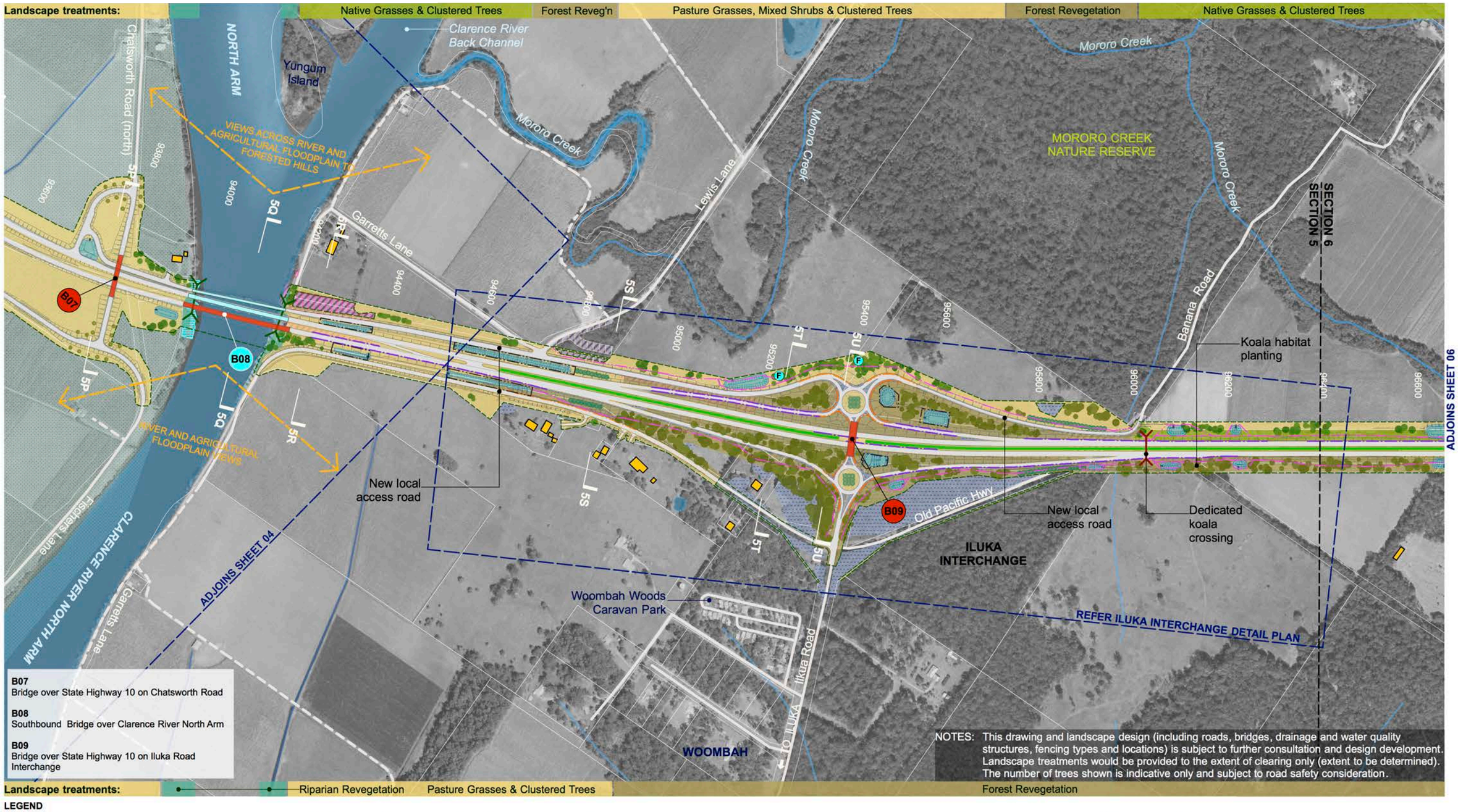


Figure 7-11: Landscape and urban design concept plan (10 sheets)



LEGEND

EXISTING FEATURES
- Existing highway
- Existing bridge
- Existing road
- Existing track
- Waterway / water body
- Property boundary
- Nearby building
- Key views to surrounding landscape

VEGETATION COMMUNITIES – MAPPED WITHIN THE PROJECT CORRIDOR
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- Forest Red Gum - Swamp Box
- Narrow-leaved Red Gum woodlands
- Mangrove - Grey Mangrove low closed forest
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- White Booyong - Fig subtropical rainforest

ENDANGERED ECOLOGICAL COMMUNITIES – TSC Act 1995
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- Swamp Oak Floodplain Forest of the NSW North Coast
- Swamp Sclerophyll Forest of the NSW North Coast

PROTECTED VEGETATION
- SHR - High Conservation Old Growth Forest
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- Fisheries Management Act 1994

HIGHWAY UPGRADE
- Clearing boundary
- New bridge
- New Clarence River bridge (separate submission)
- Wire rope safety barrier
- W-Beam barrier
- Security fence
- Fauna fence
- Drainage basin
- Building resumed

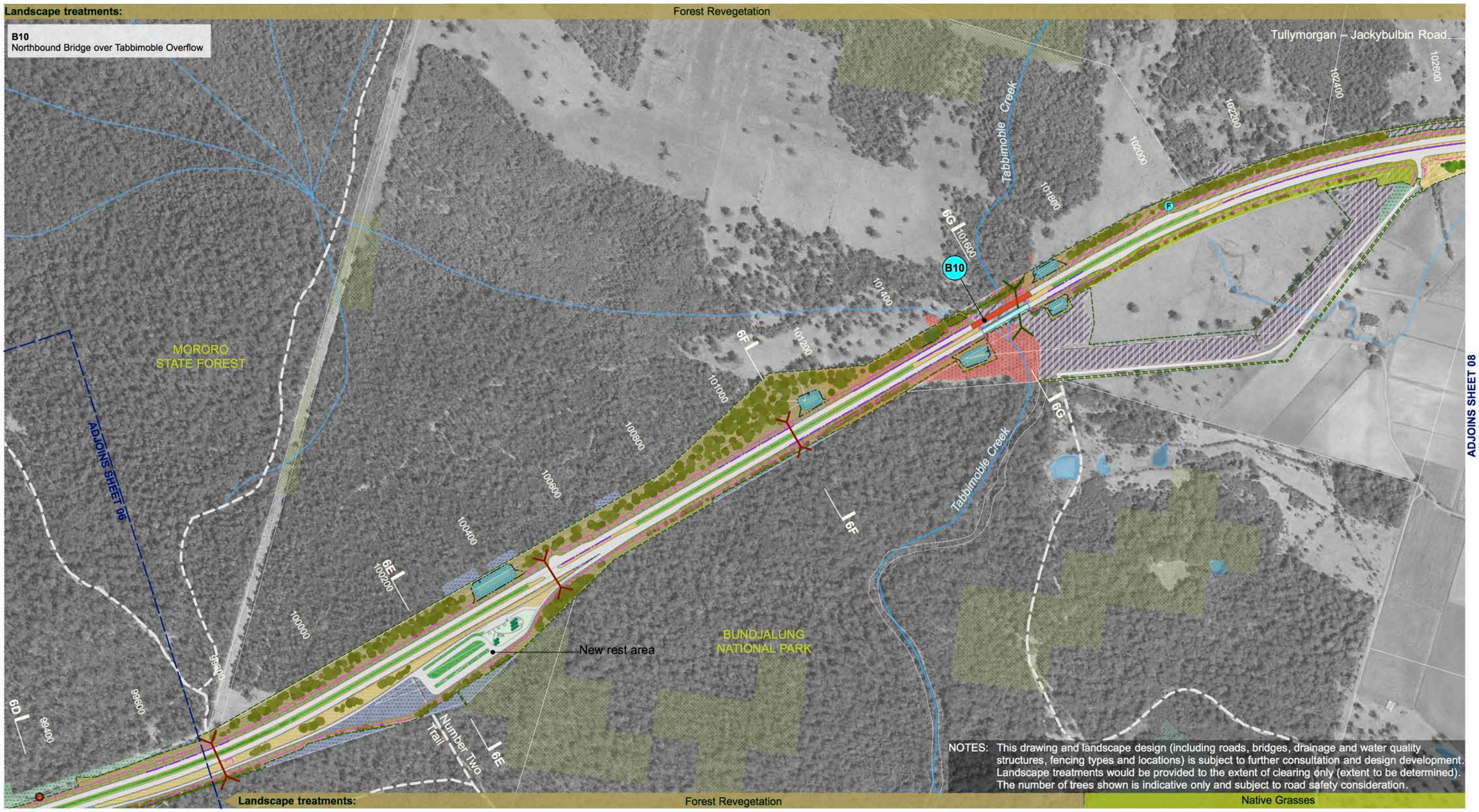
NEW BRIDGES
- Bridge over highway
- Bridge over local road
- Bridge over waterway
- Floodplain bridge – single
- Floodplain bridge – twin

FAUNA CONNECTIONS
- Fauna culvert (dedicated or combined)
- Fauna crossing under bridge
- Glider poles
- Frog pond (indicative location)

LANDSCAPE TREATMENTS
- Pasture grasses
- Native grasses
- Mixed shrubs
- Forest revegetation
- Riparian Revegetation

FEATURE TREES
- *Araucaria columnaris* Cook Pine
- *Araucaria heterophylla* Norfolk Island Pine
- *Corymbia maculata* Spotted Gum
- *Cupaniopsis anacardioides* Tuckeroo
- *Ficus microcarpa var 'Hillii'* Hill's Fig
- *Flindersia australis* Australian Teak
- *Elaeocarpus reticulatis* Blueberry Ash
- Clustered tree planting

Figure 7-11: Landscape and urban design concept plan (10 sheets)



LEGEND

EXISTING FEATURES

- Existing highway
- Existing bridge
- Existing road
- Existing track
- Waterway / water body
- Property boundary
- Nearby building
- Key views to surrounding landscape

VEGETATION COMMUNITIES – MAPPED WITHIN THE PROJECT CORRIDOR

- Blackbutt - Bloodwood dry heathy open forest
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- Swamp Sclerophyll Forest of the NSW North Coast

PROTECTED VEGETATION

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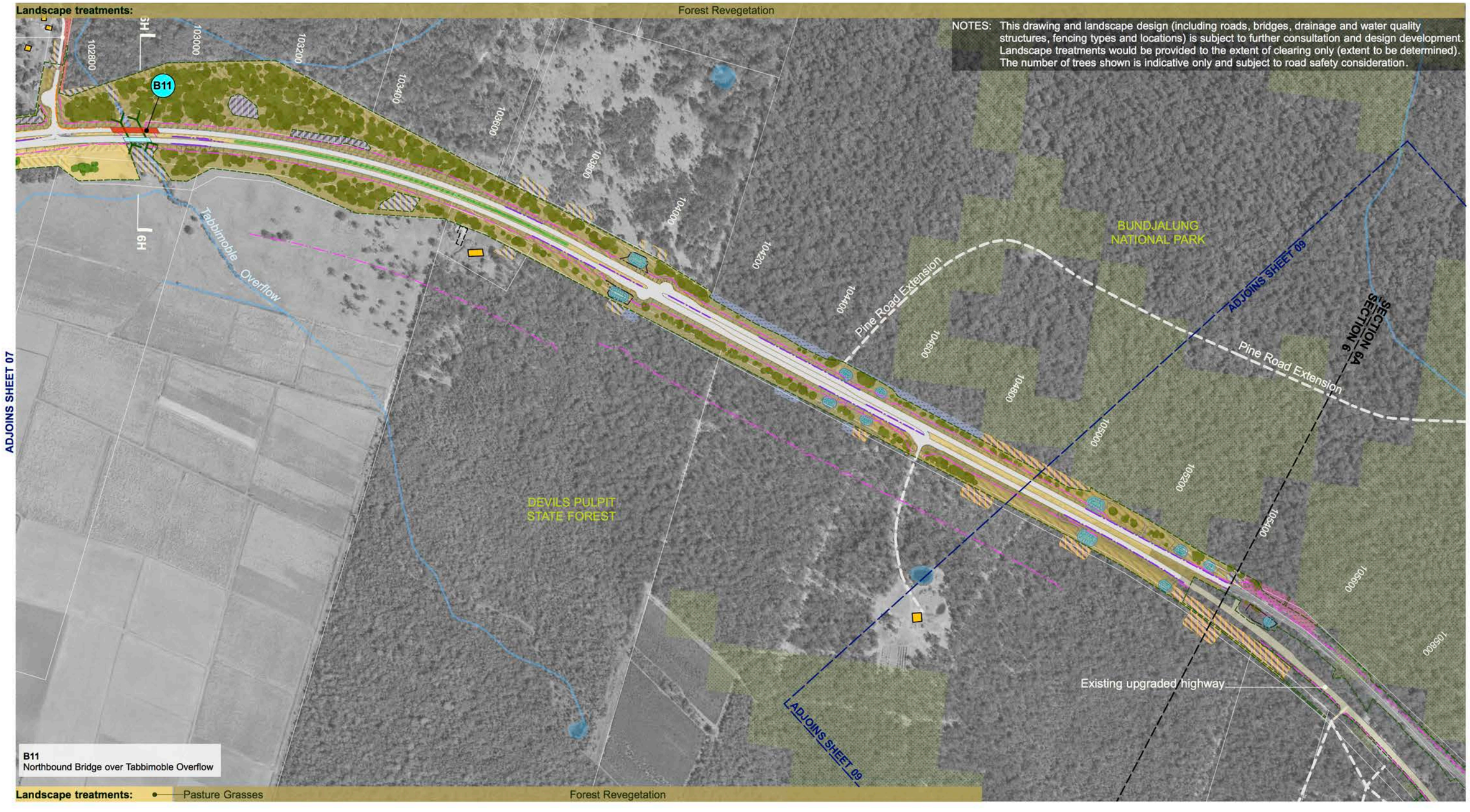
- Fisheries Management Act 1994



HIGHWAY UPGRADE
- Clearing boundary
- New bridge
- New Clarence River bridge (separate submission)
- Wire rope safety barrier
- W-Beam barrier
- Security fence
- Fauna fence
- Drainage basin
- Building resumed

NEW BRIDGES
- BXX Bridge over highway
- BXX Bridge over local road
- BXX Bridge over waterway
- BXX Floodplain bridge – single
- BXX Floodplain bridge – twin

FAUNA CONNECTIONS
- Fauna culvert (dedicated or combined)
- Fauna crossing under bridge
- Glider poles
- F Frog pond (indicative location)

LANDSCAPE TREATMENTS
- Pasture grasses
- Native grasses
- Mixed shrubs
- Forest revegetation
- Riparian Revegetation

FEATURE TREES
- *Araucaria columnaris* Cook Pine
- *Araucaria heterophylla* Norfolk Island Pine
- *Corymbia maculata* Spotted Gum
- *Cupaniopsis anacardioides* Tuckeroo
- *Ficus microcarpa var 'Hillii'* Hill's Fig
- *Flindersia australis* Australian Teak
- *Elaeocarpus reticulatis* Blueberry Ash
- Clustered tree planting

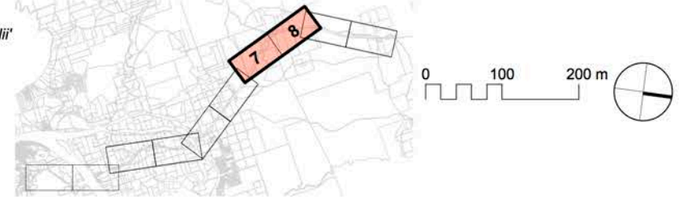
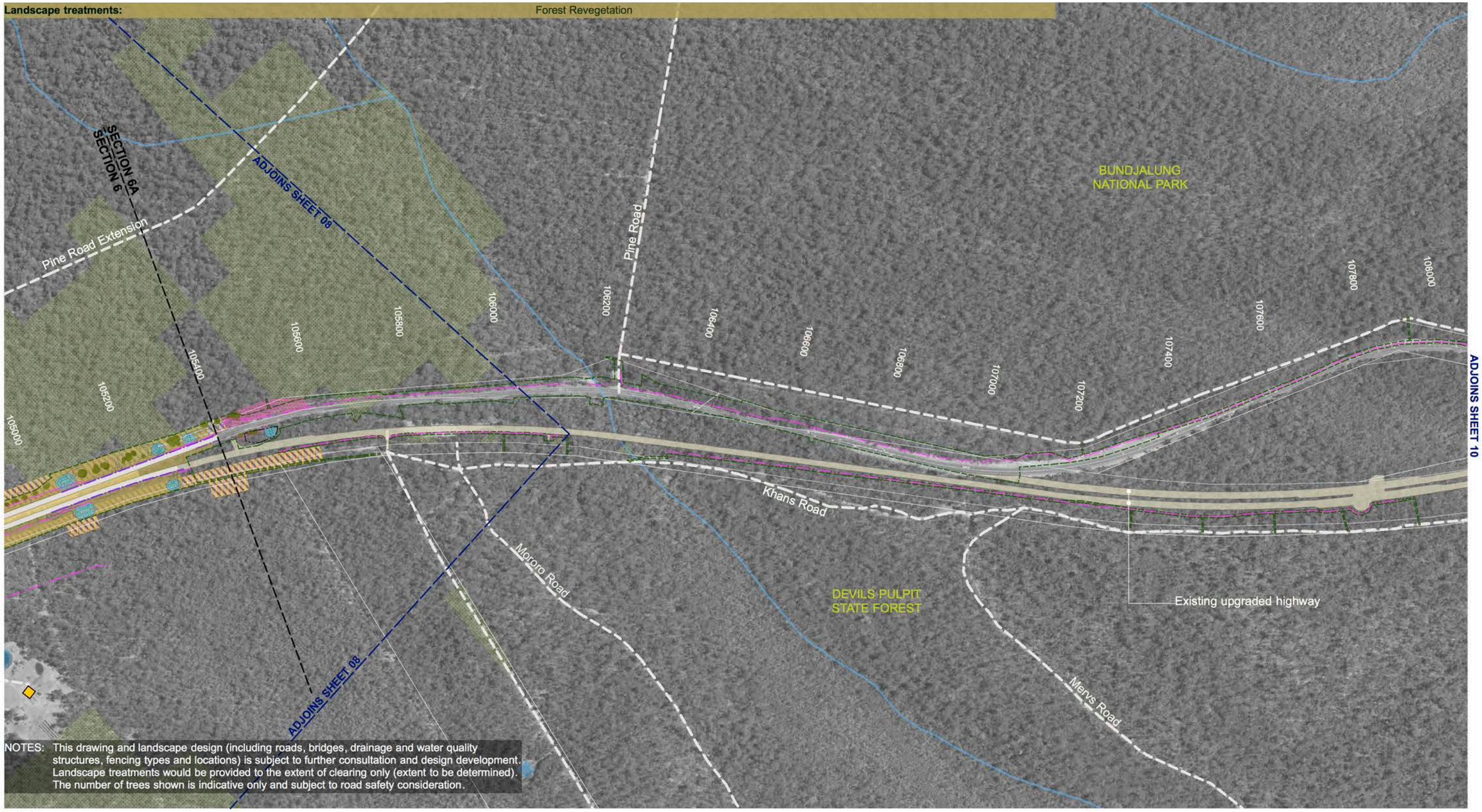


Figure 7-11: Landscape and urban design concept plan (10 sheets)



LEGEND

EXISTING FEATURES
- Existing highway
- Existing bridge
- Existing road
- Existing track
- Waterway / water body
- Property boundary
- Nearby building
- Key views to surrounding landscape

VEGETATION COMMUNITIES – MAPPED WITHIN THE PROJECT CORRIDOR
- Blackbutt - Bloodwood dry heathy open forest
- Grey Gum - Grey Ironbark open forest
- Spotted Gum - Grey Box - Grey Ironbark open forest
- Spotted Gum - Grey Ironbark - Pink Bloodwood open forest
- Flooded Gum - Brush Box moist open forest
- Red Mahogany open forest
- Tallowwood dry grassy forest
- Coastal Floodplain sedgelands, rushlands and forblands
- Swamp Oak swamp forest
- Paperbark swamp forest
- Forest Red Gum - Swamp Box
- Narrow-leaved Red Gum woodlands
- Mangrove - Grey Mangrove low closed forest
- Saltmarsh complex
- White Booyong - Fig subtropical rainforest

ENDANGERED ECOLOGICAL COMMUNITIES – TSC Act 1995
- Coastal Saltmarsh in the NSW North Coast
- Freshwater Wetlands on Coastal Floodplains of the NSW N. Coast
- Subtropical Coastal Floodplain Forest of the NSW North Coast
- Swamp Oak Floodplain Forest of the NSW North Coast
- Swamp Sclerophyll Forest of the NSW North Coast

PROTECTED VEGETATION
- SHR - High Conservation Old Growth Forest
- SEWPAC - SEPP 14 Wetlands
- Fisheries Management Act 1994

HIGHWAY UPGRADE
- Clearing boundary
- New bridge
- New Clarence River bridge (separate submission)
- Wire rope safety barrier
- W-Beam barrier
- Security fence
- Fauna fence
- Drainage basin
- Building resumed

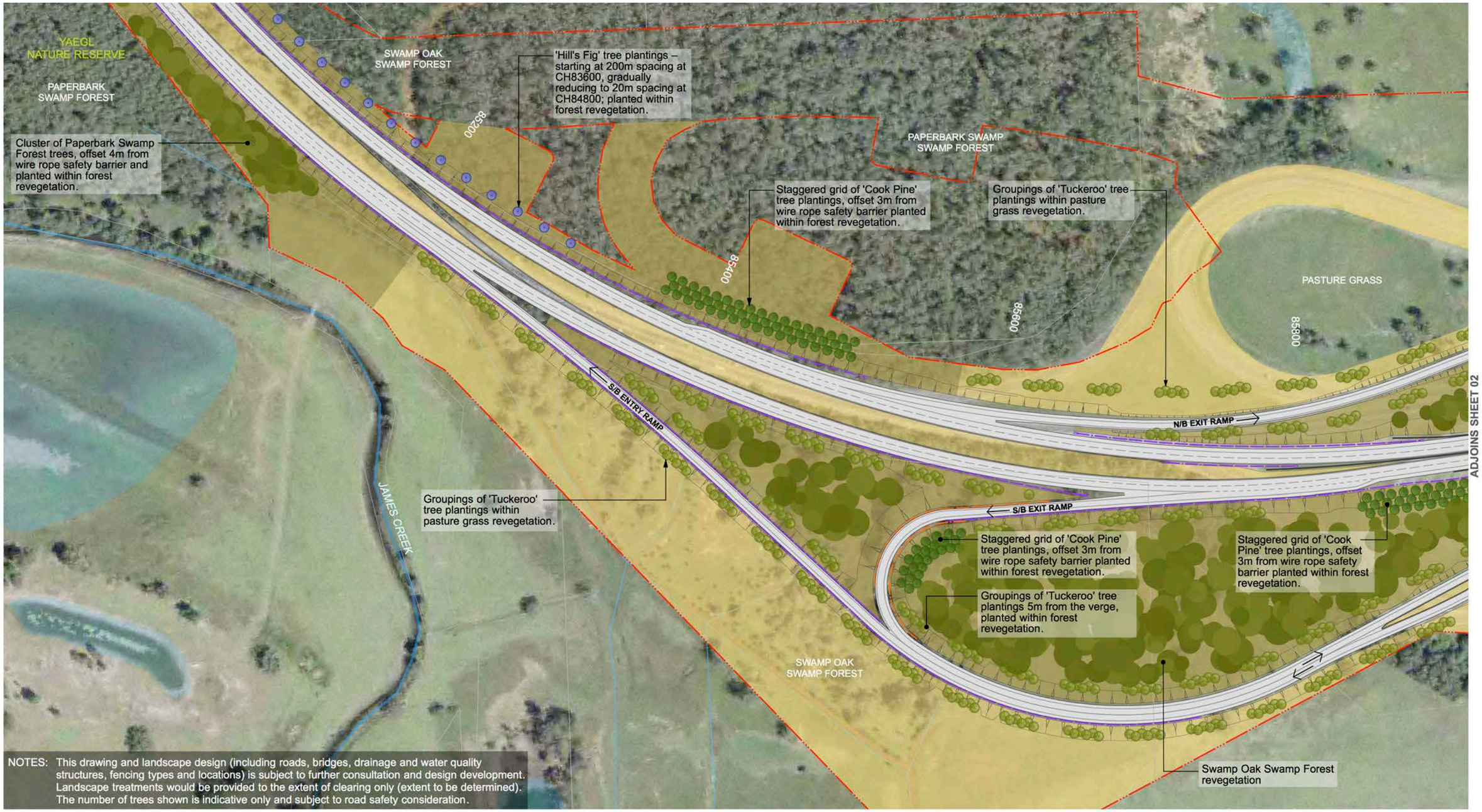
NEW BRIDGES
- Bridge over highway
- Bridge over local road
- Bridge over waterway
- Floodplain bridge – single
- Floodplain bridge – twin

FAUNA CONNECTIONS
- Fauna culvert (dedicated or combined)
- Fauna crossing under bridge
- Glider poles
- Frog pond (indicative location)

LANDSCAPE TREATMENTS
- Pasture grasses
- Native grasses
- Mixed shrubs
- Forest revegetation
- Riparian Revegetation

FEATURE TREES
- *Araucaria columnaris* Cook Pine
- *Araucaria heterophylla* Norfolk Island Pine
- *Corymbia maculata* Spotted Gum
- *Cupaniopsis anacardioides* Tuckeroo
- *Ficus microcarpa var 'Hillii'* Hill's Fig
- *Flindersia australis* Australian Teak
- *Elaeocarpus reticulatis* Blueberry Ash
- Clustered tree planting

Figure 7-10: Detail plan of Yamba interchange



LEGEND

EXISTING FEATURES
- Waterway / water body
- Property boundary

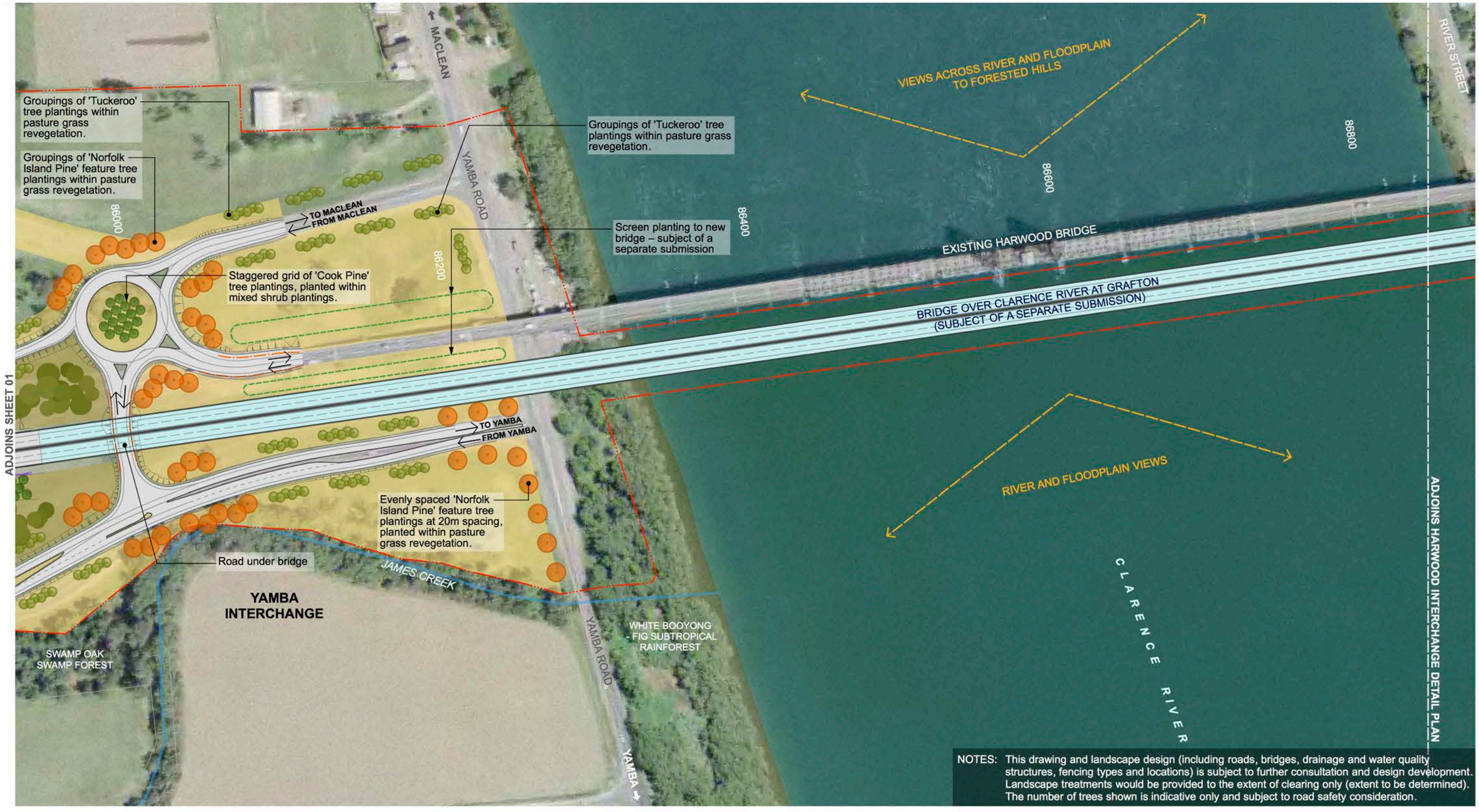
HIGHWAY UPGRADE
- Clearing boundary
- Wire rope safety barrier
- W-Beam barrier
- Dedicated fauna culvert
- Fauna fence
- Drainage basin

LANDSCAPE TREATMENTS
- Pasture grasses
- Native grasses
- Mixed shrubs
- Forest revegetation
- Riparian revegetation

FEATURE TREES
- *Araucaria columnaris* Cook Pine
- *Araucaria heterophylla* Norfolk Island Pine
- *Corymbia maculata* Spotted Gum
- *Cupaniopsis anacardioides* Tuckeroo
- *Ficus microcarpa var 'Hillii'* Hill's Fig
- *Flindersia australis* Australian Teak
- *Elaeocarpus reticulatis* Blueberry Ash
- Clustered tree planting

0 20 40 60 80 m
SCALE 1:2,500 at A3

Sheet 1 of 2



NOTES: This drawing and landscape design (including roads, bridges, drainage and water quality structures, fencing types and locations) is subject to further consultation and design development. Landscape treatments would be provided to the extent of clearing only (extent to be determined). The number of trees shown is indicative only and subject to road safety consideration.

LEGEND

EXISTING FEATURES
- Waterway / water body
- Property boundary

HIGHWAY UPGRADE
- Clearing boundary
- Wire rope safety barrier
- W-Beam barrier
- Dedicated fauna culvert
- Fauna fence
- Drainage basin

LANDSCAPE TREATMENTS
- Pasture grasses
- Native grasses
- Mixed shrubs
- Forest revegetation
- Riparian revegetation

FEATURE TREES
- *Araucaria columnaris* Cook Pine
- *Araucaria heterophylla* Norfolk Island Pine
- *Corymbia maculata* Spotted Gum
- *Cupaniopsis anacardioides* Tuckeroo
- *Ficus microcarpa var 'Hillii'* Hill's Fig
- *Flindersia australis* Australian Teak
- *Elaeocarpus reticulatis* Blueberry Ash
- Clustered tree planting

0 20 40 60 80 m
SCALE 1:2,500 at A3

Sheet 2 of 2

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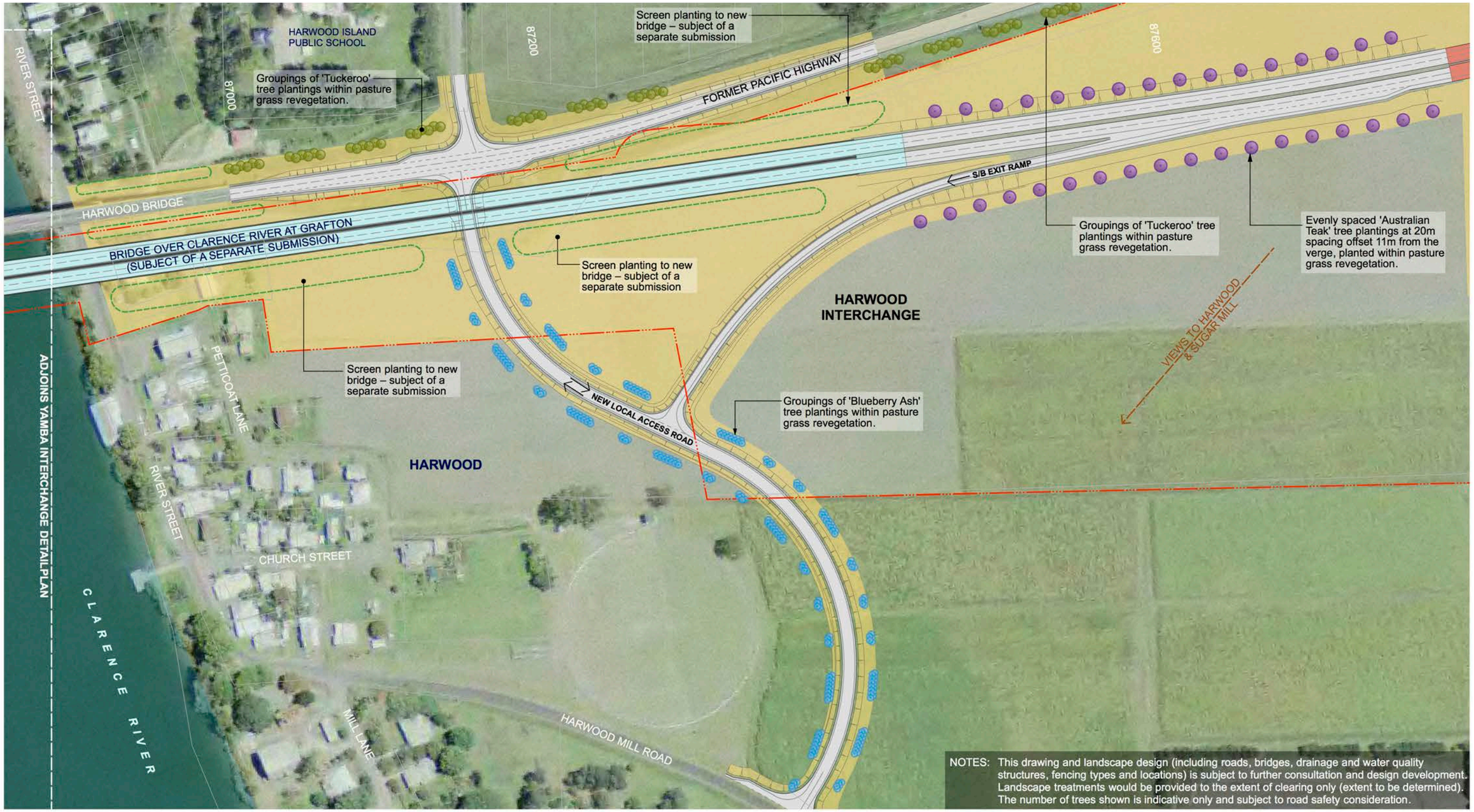
Figure 7-11: Detail plan of Harwood interchange



LEGEND

EXISTING FEATURES
- Waterway / water body
- Property boundary

HIGHWAY UPGRADE
- Clearing boundary
- Wire rope safety barrier
- W-Beam barrier
- Dedicated fauna culvert
- Fauna fence
- Drainage basin

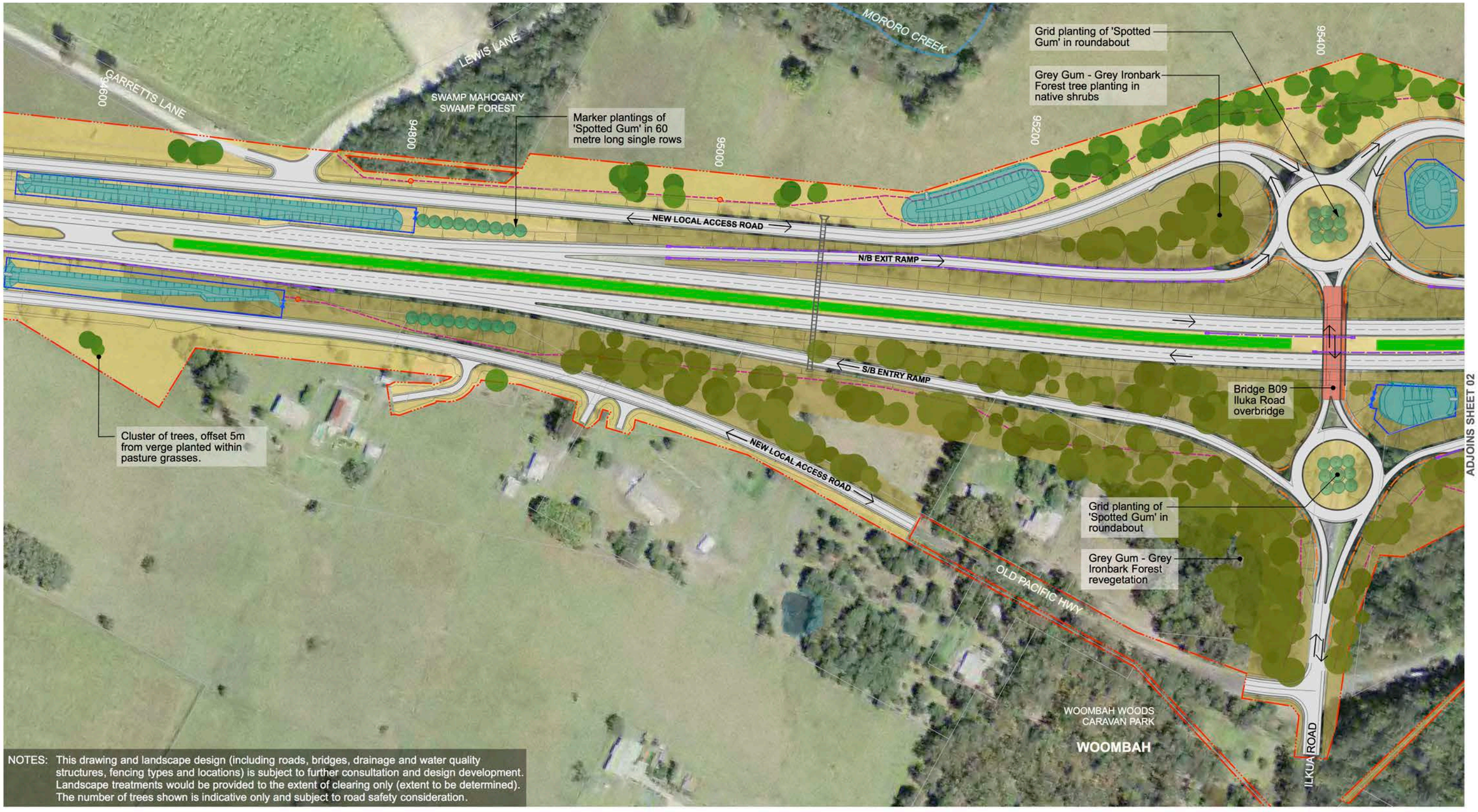
LANDSCAPE TREATMENTS
- Pasture grasses
- Native grasses
- Mixed shrubs
- Forest revegetation
- Riparian revegetation

FEATURE TREES
- *Araucaria columnaris* Cook Pine
- *Araucaria heterophylla* Norfolk Island Pine
- *Corymbia maculata* Spotted Gum
- *Cupaniopsis anacardioides* Tuckeroo
- *Ficus microcarpa var 'Hillii'* Hill's Fig
- *Flindersia australis* Australian Teak
- *Elaeocarpus reticulatis* Blueberry Ash
- Clustered tree planting

0 20 40 60 80 m
SCALE 1:2,500 at A3

Sheet 1 of 1

Figure 7-12: Detail plan of Iluka interchange



LEGEND

EXISTING FEATURES
- Waterway / water body
- Property boundary

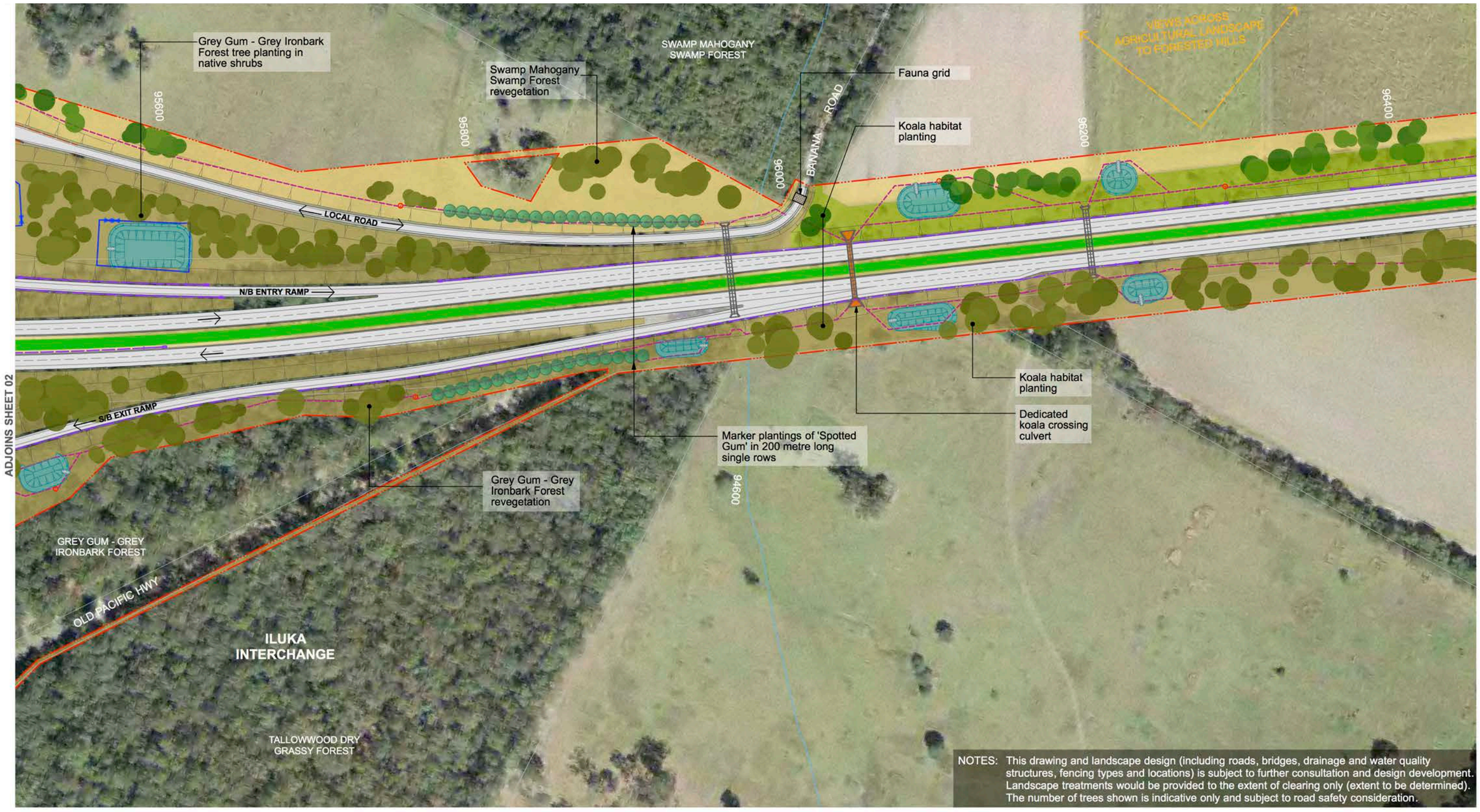
HIGHWAY UPGRADE
- Clearing boundary
- Wire rope safety barrier
- W-Beam barrier
- Dedicated fauna culvert
- Fauna fence
- Drainage basin

LANDSCAPE TREATMENTS
- Pasture grasses
- Native grasses
- Mixed shrubs
- Forest revegetation
- Riparian revegetation

FEATURE TREES
- *Araucaria columnaris* Cook Pine
- *Araucaria heterophylla* Norfolk Island Pine
- *Corymbia maculata* Spotted Gum
- *Cupaniopsis anacardioides* Tuckeroo
- *Ficus microcarpa var 'Hillii'* Hill's Fig
- *Flindersia australis* Australian Teak
- *Elaeocarpus reticulatis* Blueberry Ash
- Clustered tree planting

0 20 40 60 80 m
SCALE 1:2,500 at A3

Sheet 1 of 2



LEGEND

EXISTING FEATURES
- Waterway / water body
- Property boundary

HIGHWAY UPGRADE
- Clearing boundary
- Wire rope safety barrier
- W-Beam barrier
- Dedicated fauna culvert
- Fauna fence
- Drainage basin

LANDSCAPE TREATMENTS
- Pasture grasses
- Native grasses
- Mixed shrubs
- Forest revegetation
- Riparian revegetation

FEATURE TREES
- *Araucaria columnaris* Cook Pine
- *Araucaria heterophylla* Norfolk Island Pine
- *Corymbia maculata* Spotted Gum
- *Cupaniopsis anacardioides* Tuckeroo
- *Ficus microcarpa var 'Hillii'* Hill's Fig
- *Flindersia australis* Australian Teak
- *Elaeocarpus reticulatis* Blueberry Ash
- Clustered tree planting

0 20 40 60 80 m
SCALE 1:2,500 at A3

Sheet 2 of 2

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

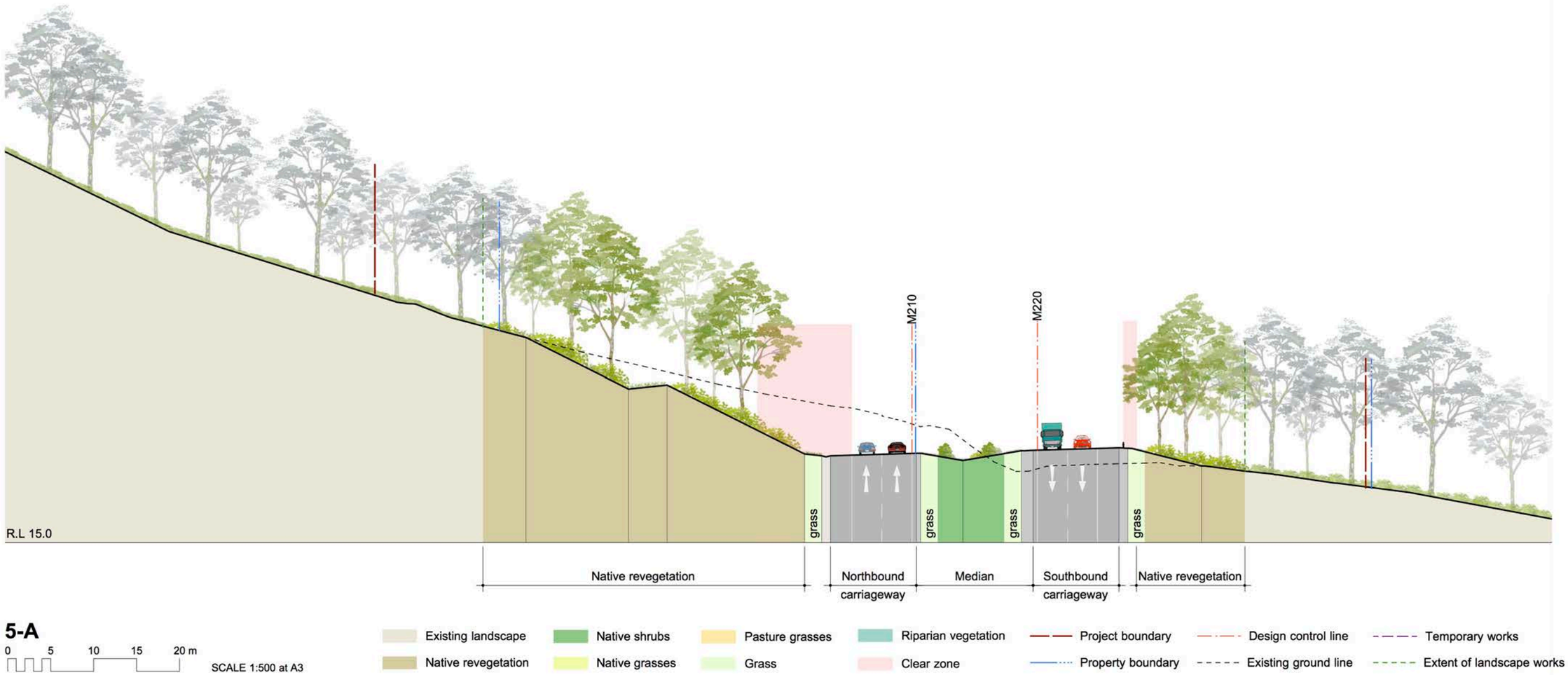


Figure 7-13: Section 5-A at Maclean Pinnacle

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

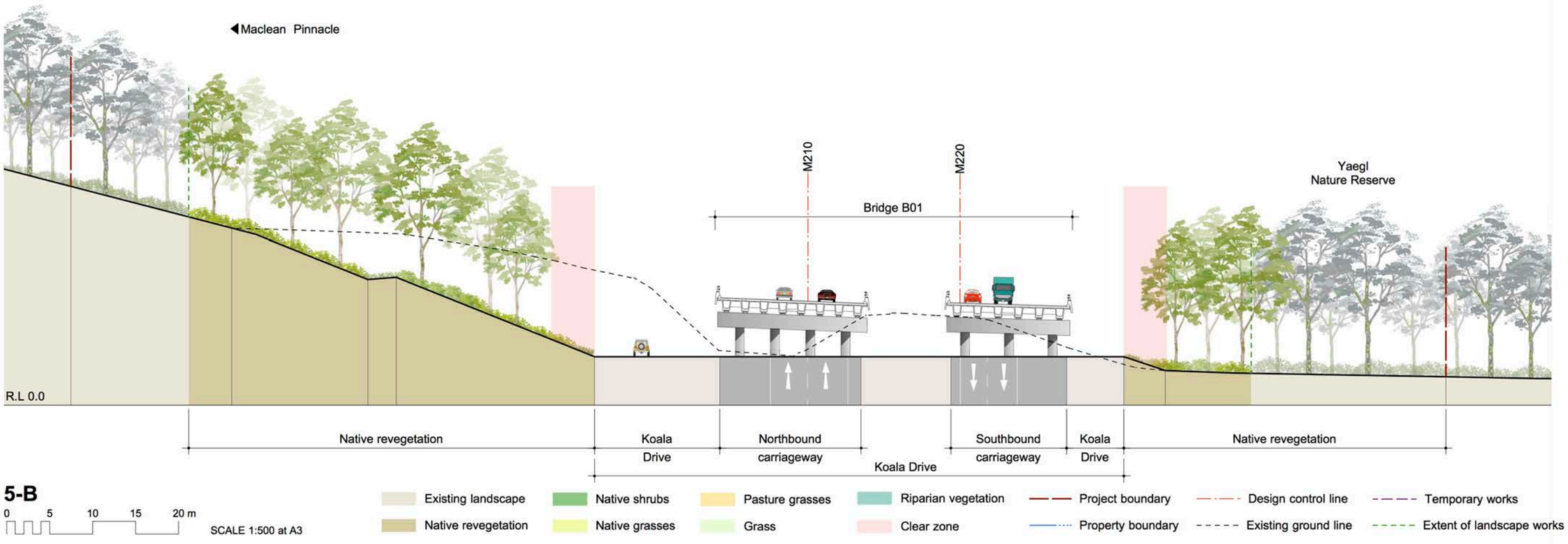


Figure 7-14: Section 5-B at Bridge B01 – Twin Bridges over Koala Drive

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

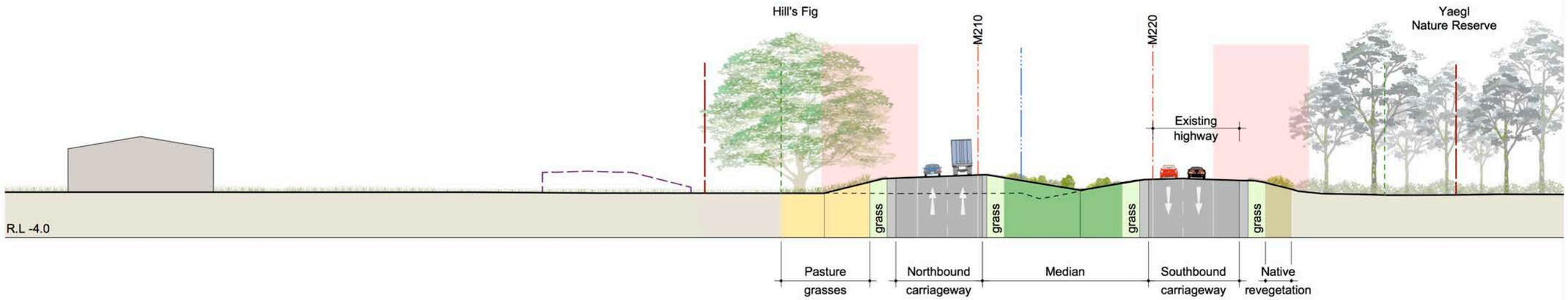


Figure 7-15: Section 5-C at Yaegl Nature Reserve and Clarence Floodplain

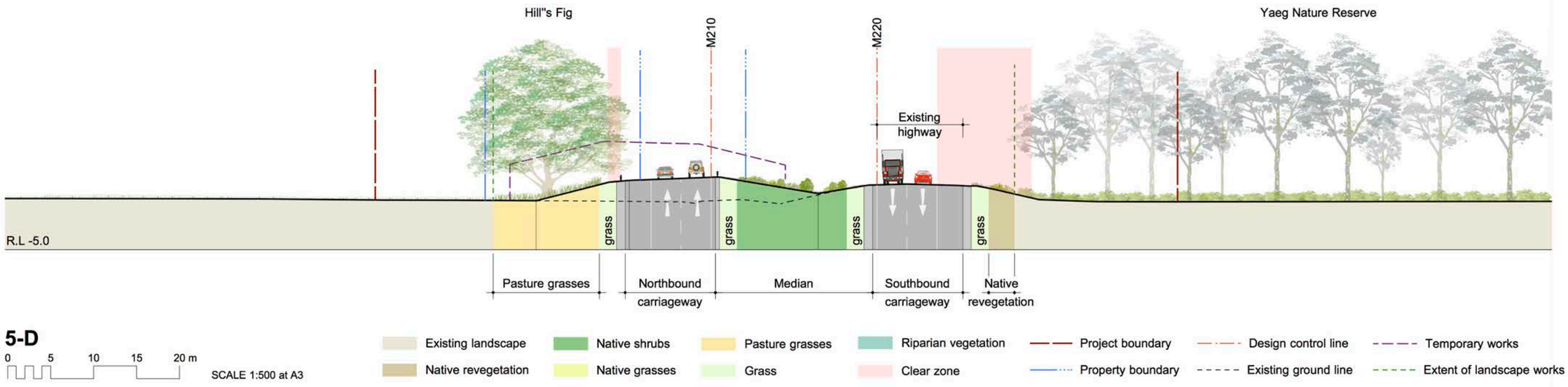


Figure 7-16: Section 5-D at Yaegl Nature Reserve and Clarence Floodplain

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

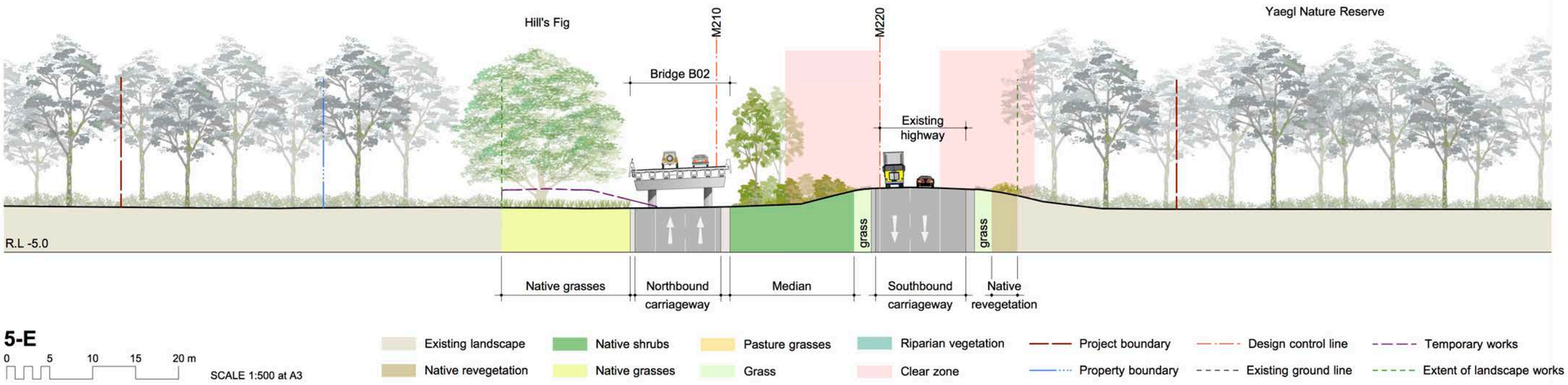


Figure 7-17: Section 5-E at Bridge B02 – Northbound Bridge over Clarence Floodplain

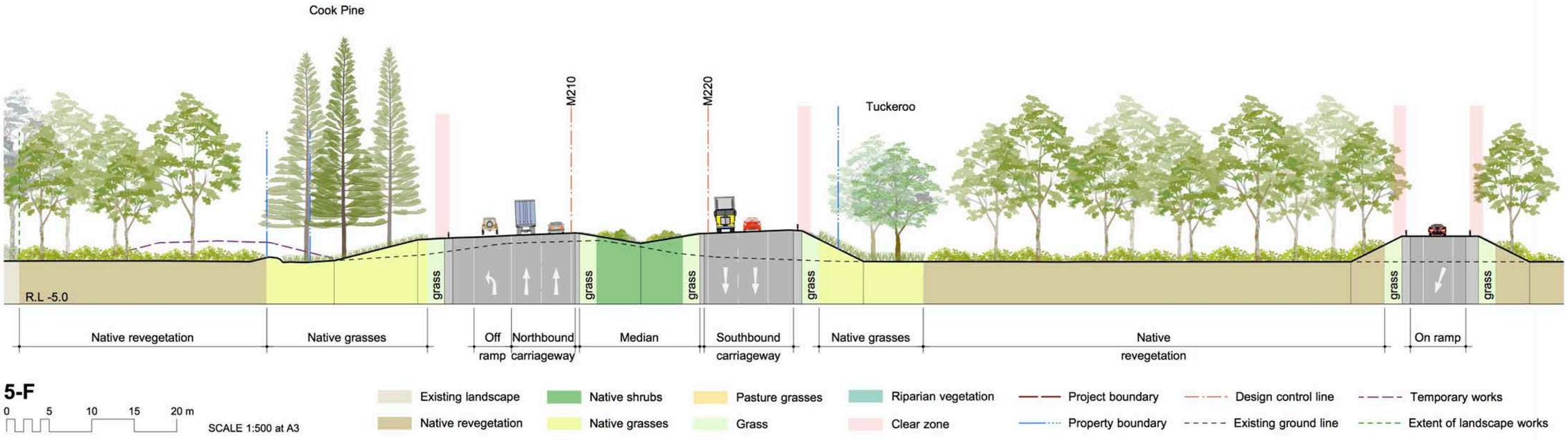


Figure 7-18: Section 5-F at Yamba interchange approach

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

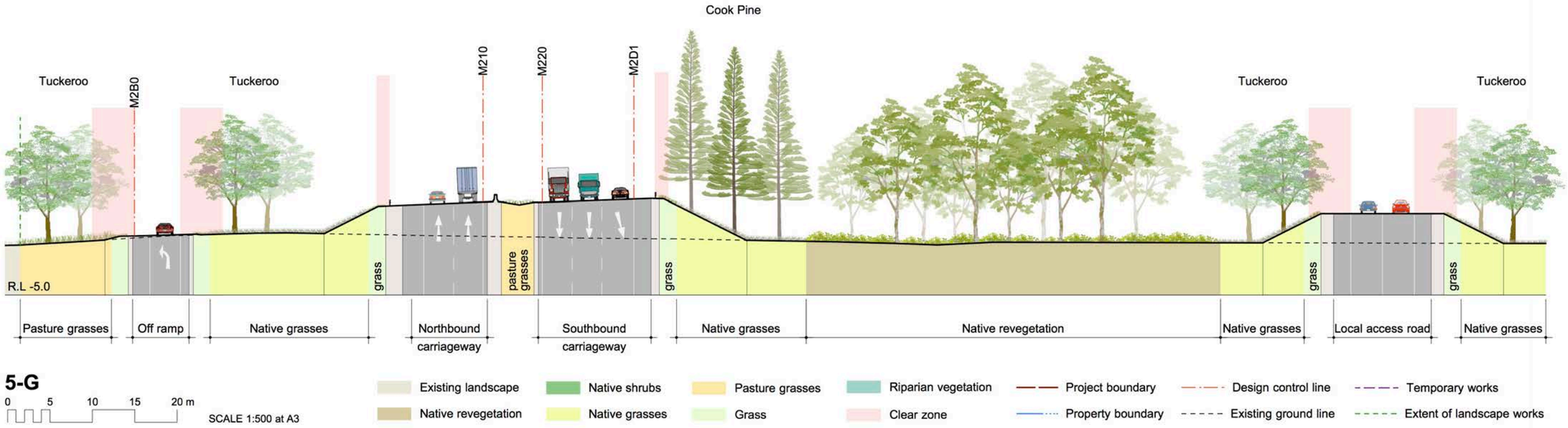


Figure 7-19: Section 5-G at Yamba interchange

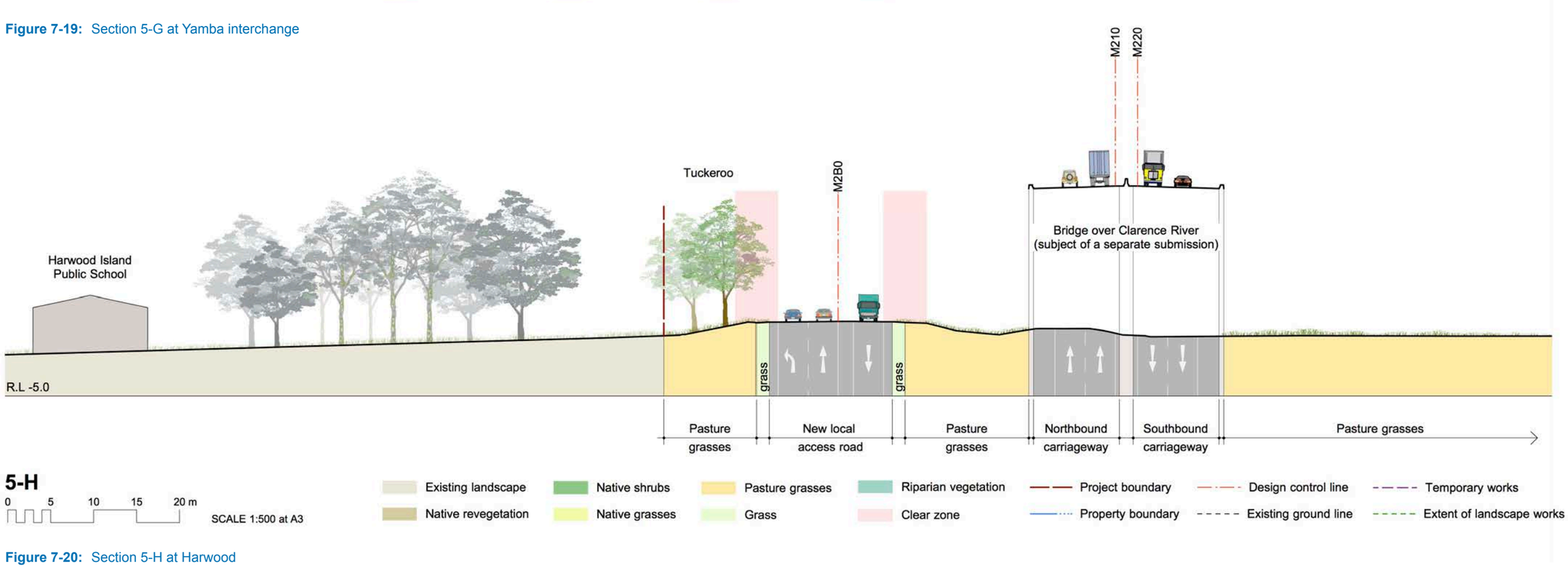


Figure 7-20: Section 5-H at Harwood

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

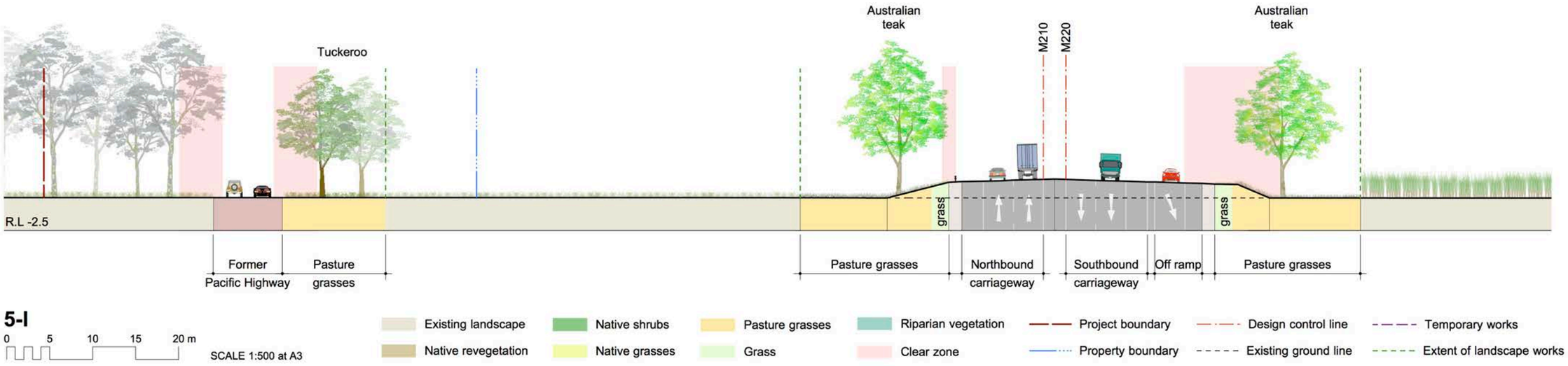


Figure 7-21: Section 5-I at Harwood interchange

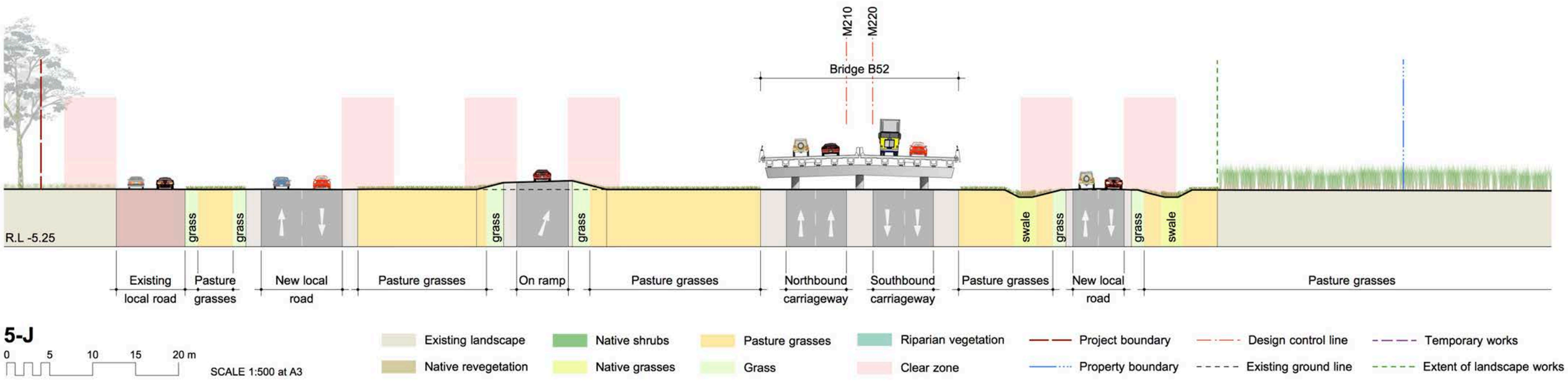


Figure 7-22: Section 5-J at Bridge B52 – Twin Bridges for Clarence Floodplain Opening 7

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

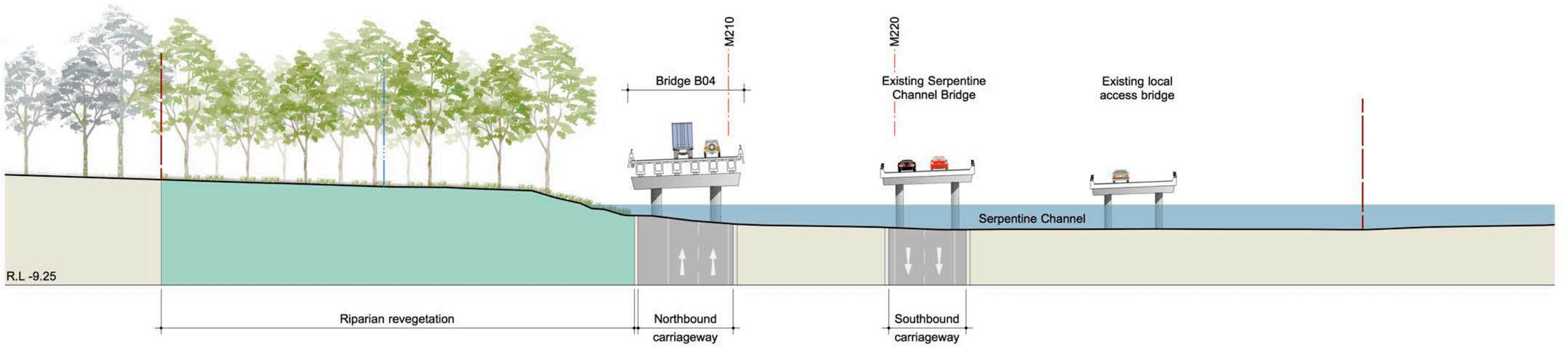


Figure 7-23: Section 5-K at Serpentine Channel

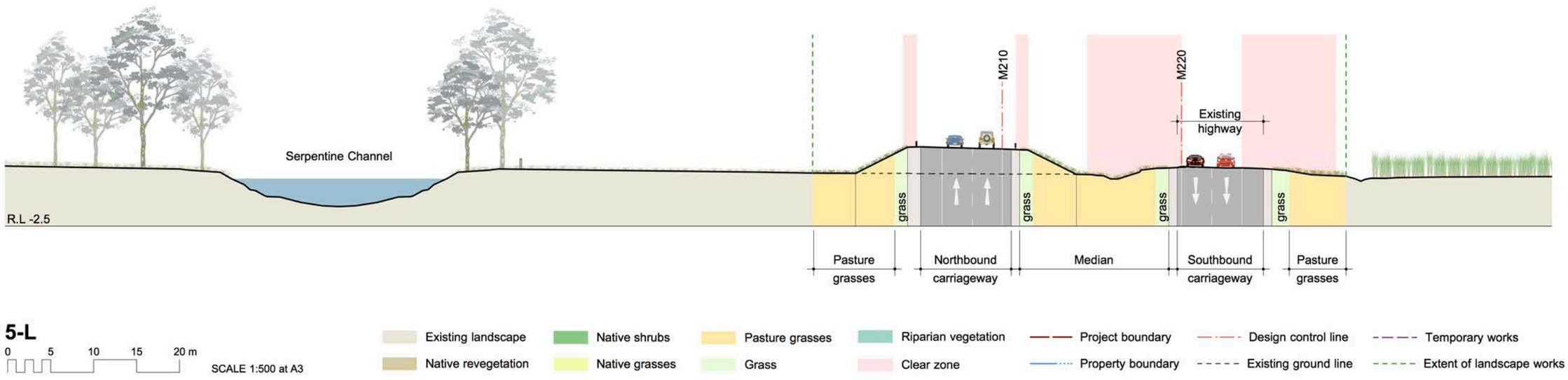


Figure 7-24: Section 5-L at Clarence Floodplain on Chatsworth Island

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

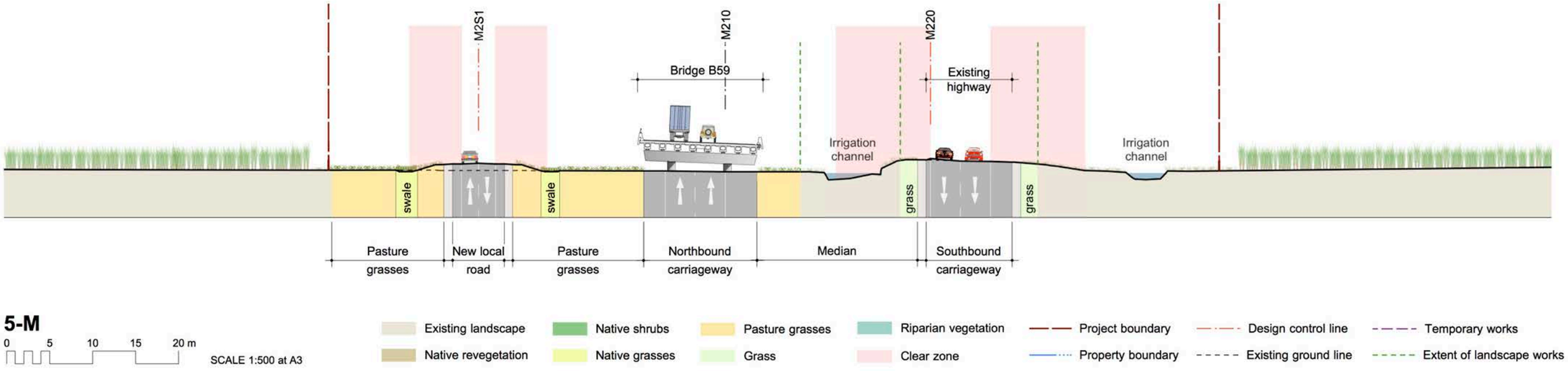


Figure 7-25: Section 5-M at Bridge B59 – Northbound Bridge for Clarence Floodplain Opening 11

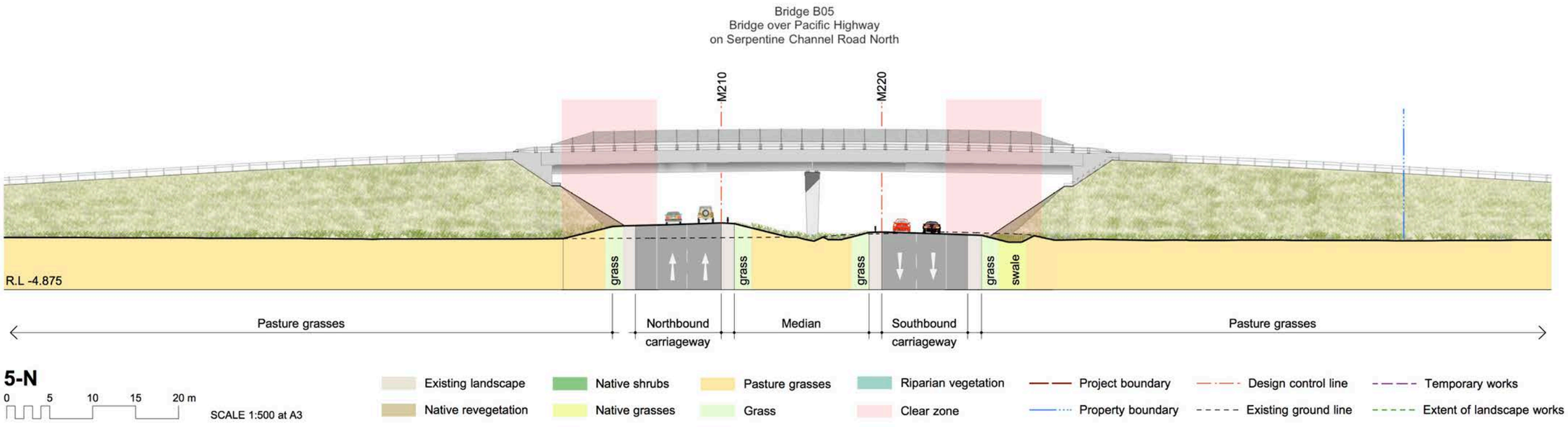


Figure 7-26: Section 5-N at Bridge B05 – Bridge over Pacific Highway at Serpentine Channel Road North

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

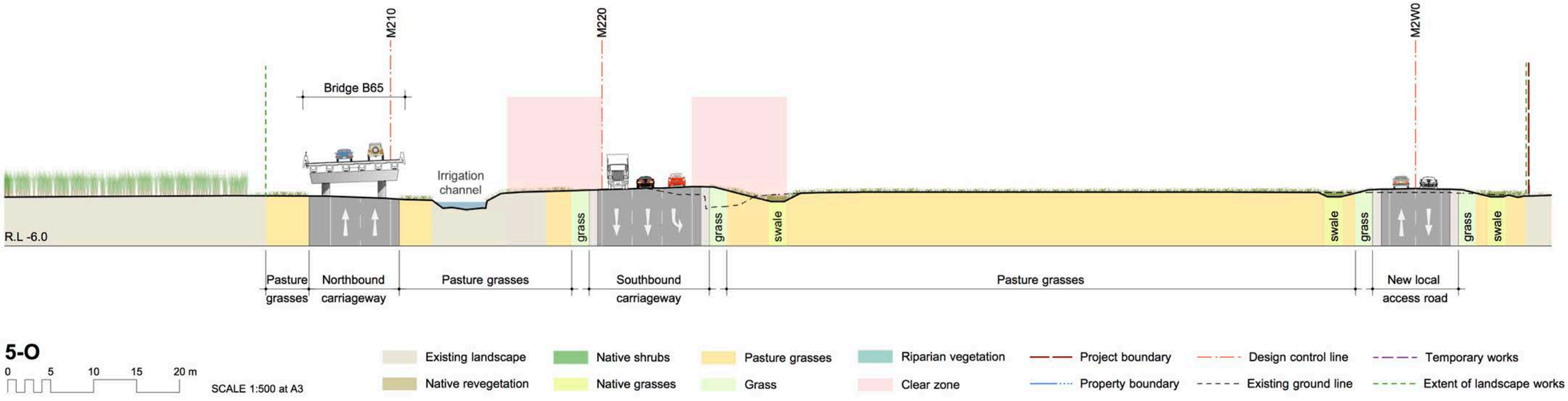


Figure 7-27: Section 5-O at Bridge B65 – Northbound Bridge for Clarence Floodplain Opening 17

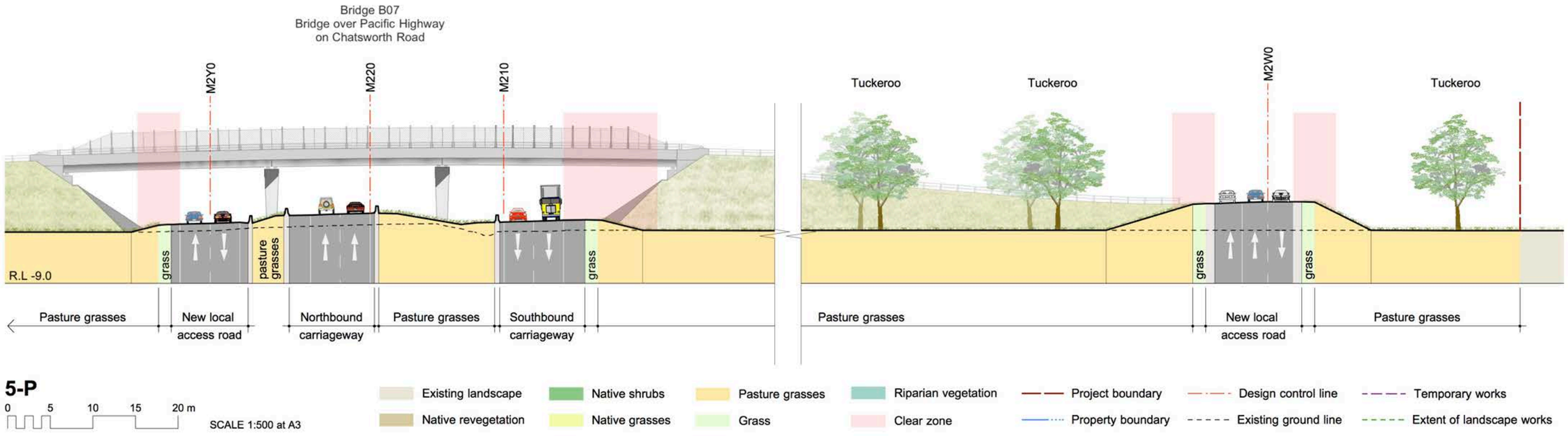


Figure 7-28: Section 5-P at Bridge B07 – Bridge over Pacific Highway at Chatsworth Road

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

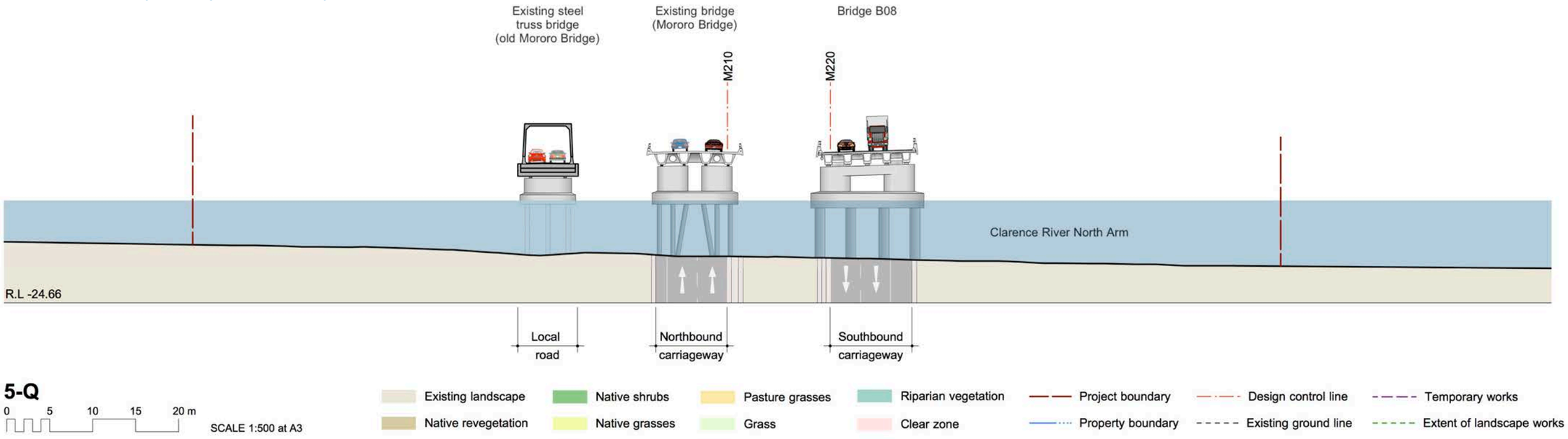


Figure 7-29: Section 5-Q at Bridge B08 – Southbound Bridge over Clarence River North Arm

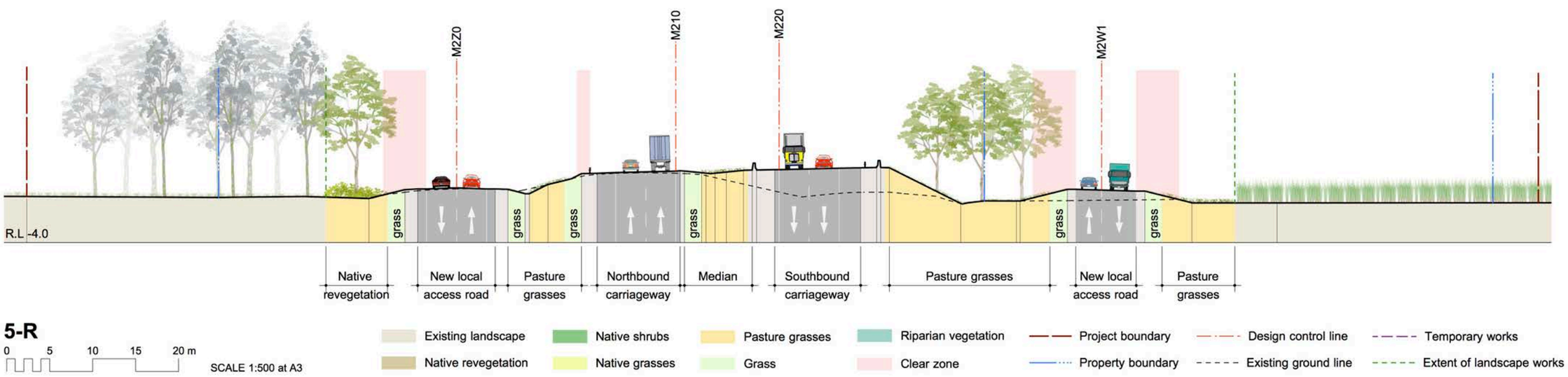


Figure 7-30: Section 5-R at Clarence Floodplain north of Clarence River North Arm

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

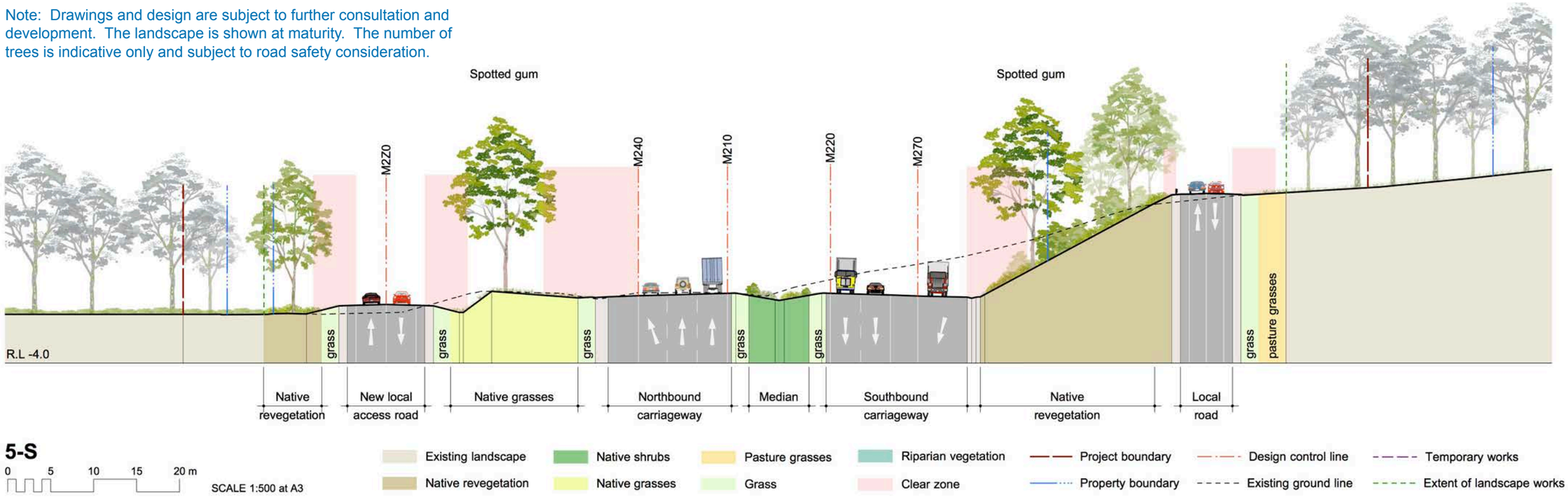


Figure 7-31: Section 5-S south of Iluka interchange

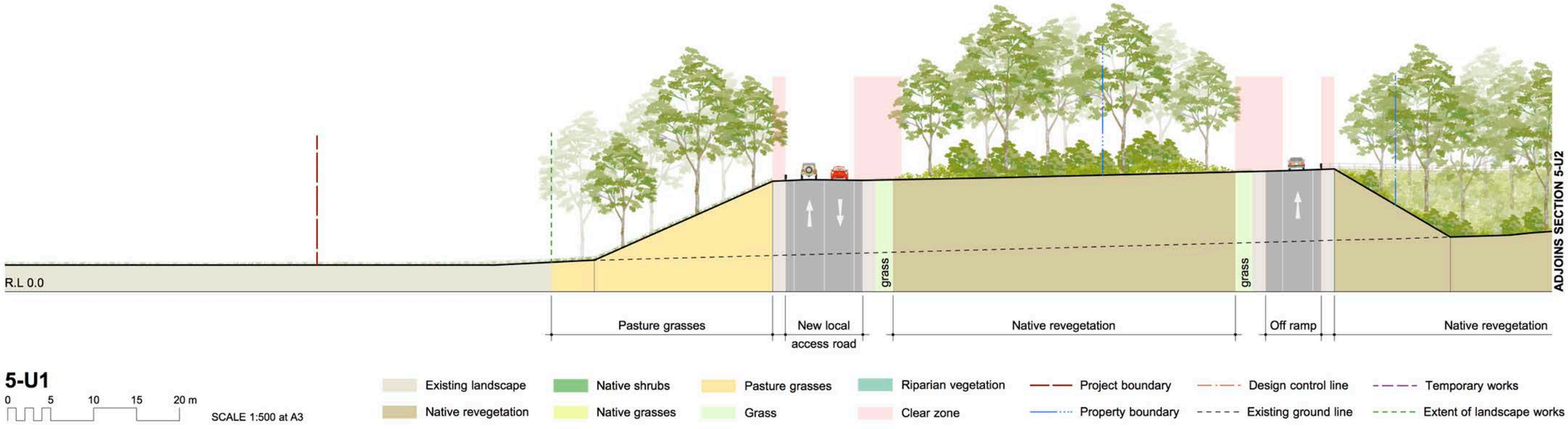


Figure 7-32: Section 5-U at Iluka interchange

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

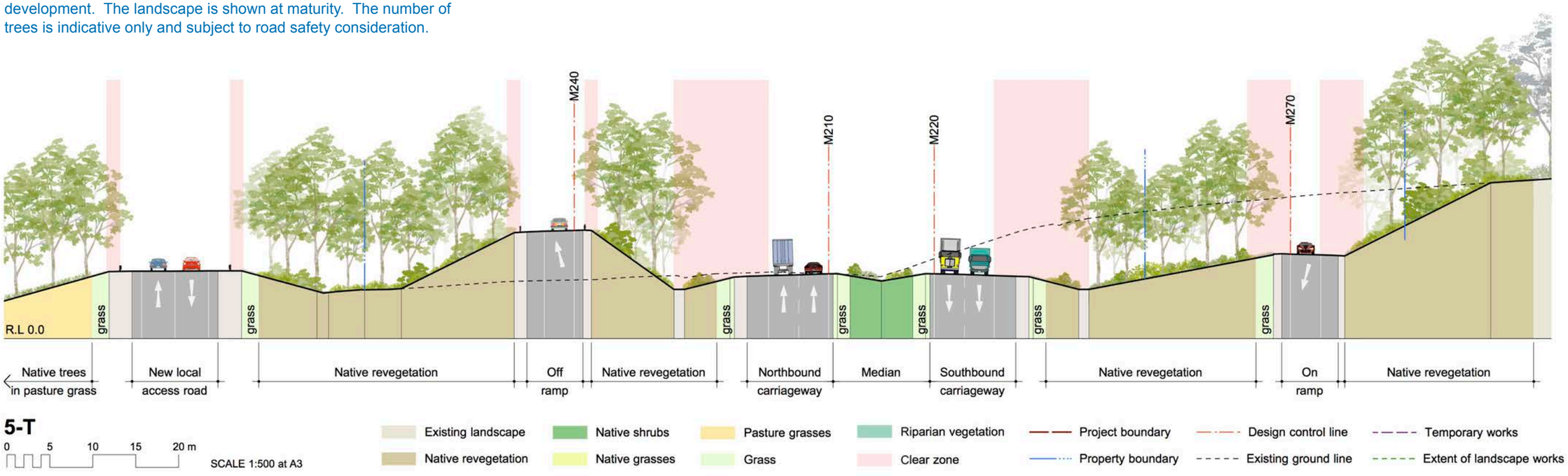
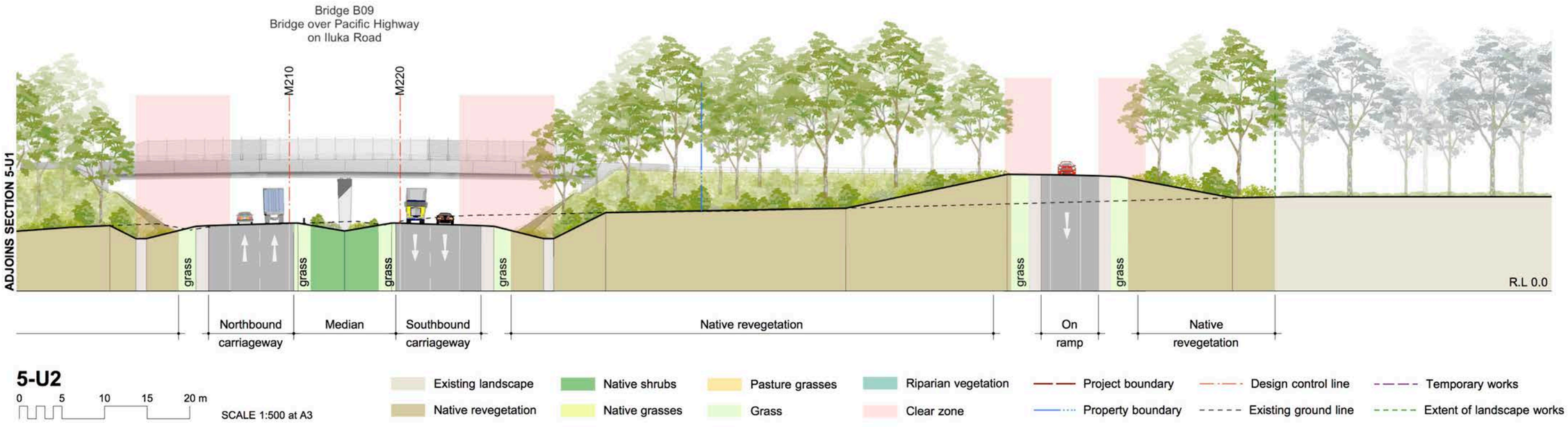


Figure 7-33: Section 5-T at southern approach to Iluka interchange



Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

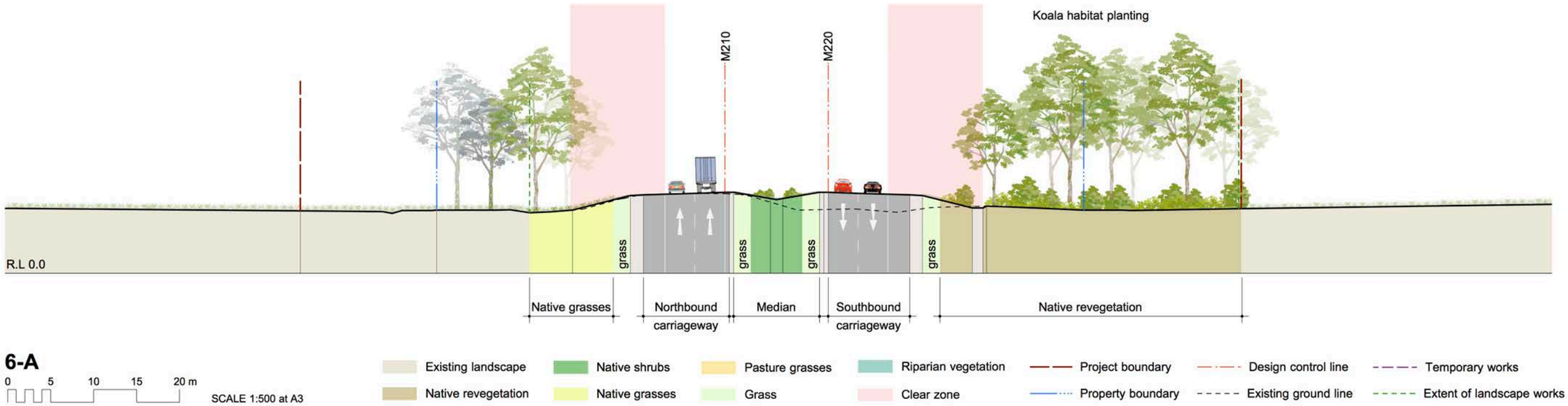


Figure 7-34: Section 6-A north of Iluka interchange

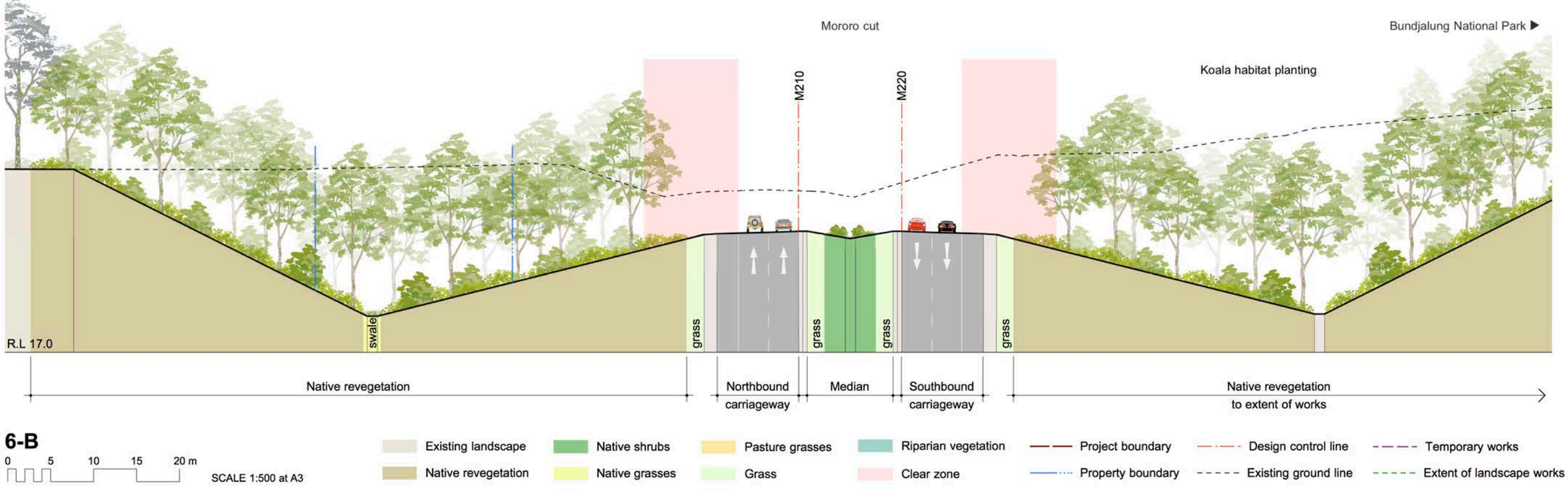


Figure 7-35: Section 6-B at Mororo cutting

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

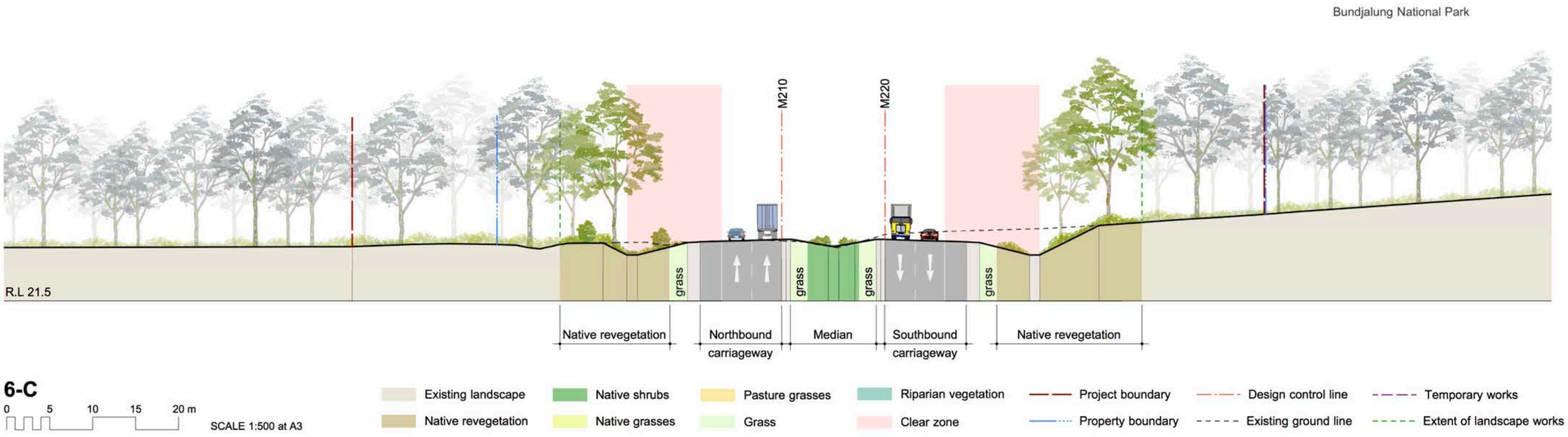


Figure 7-36: Section 6-C north of Mororo Road

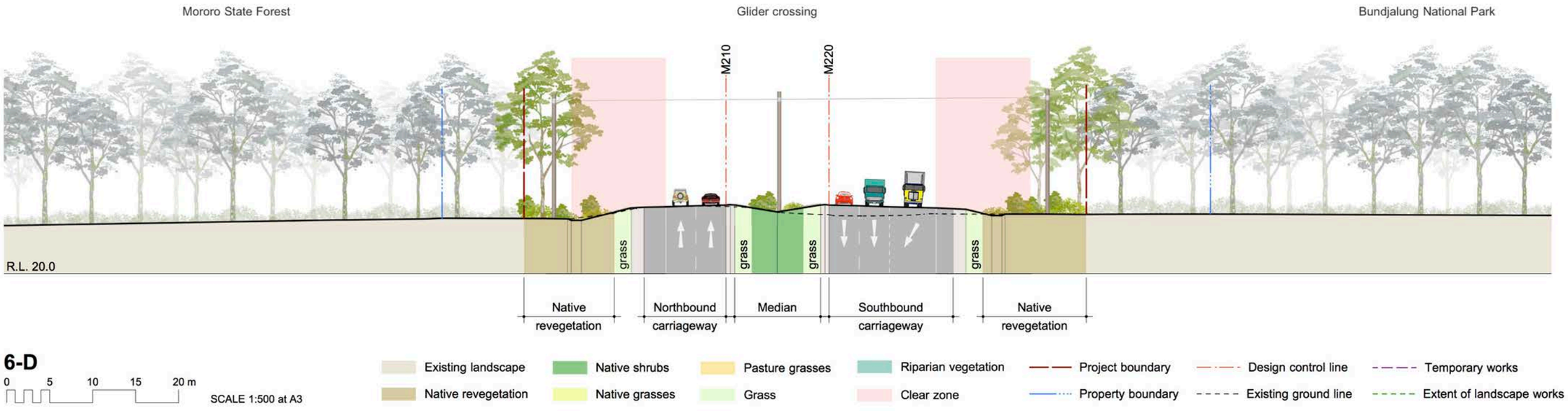


Figure 7-37: Section 6-D at glider crossing

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

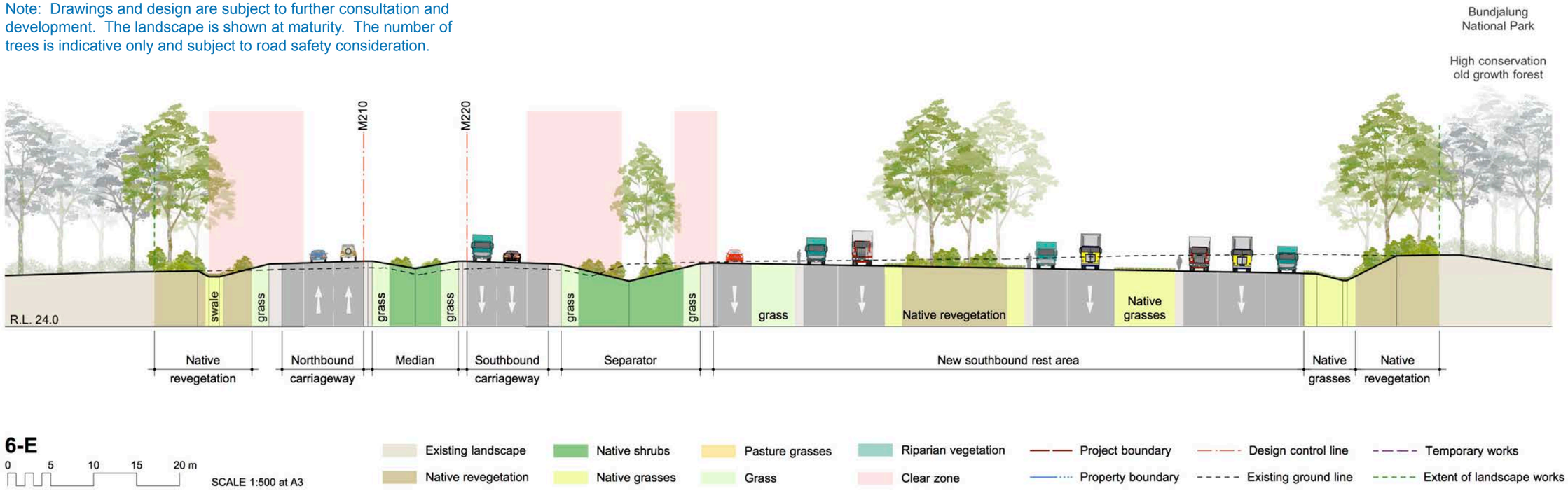


Figure 7-38: Section 6-E at southbound rest area

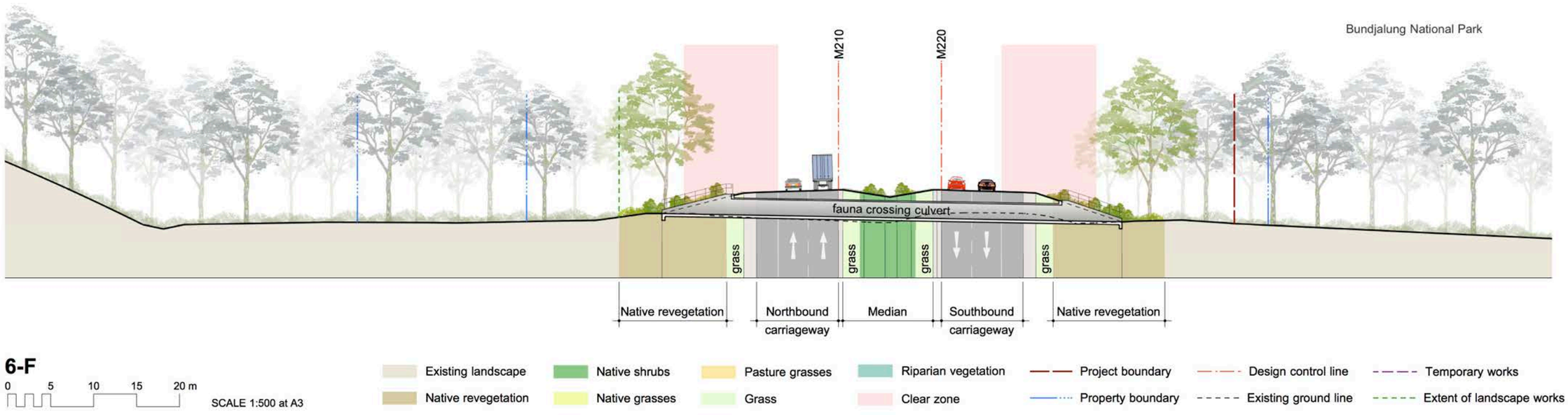


Figure 7-39: Section 6-F at typical fauna crossing culvert

Note: Drawings and design are subject to further consultation and development. The landscape is shown at maturity. The number of trees is indicative only and subject to road safety consideration.

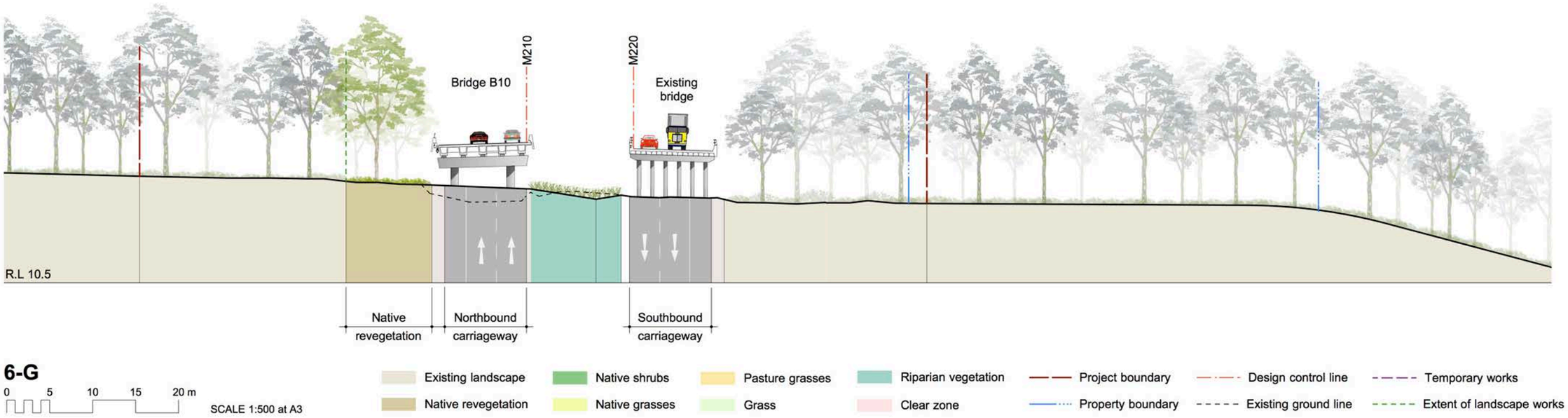


Figure 7-40: Section 6-G at Bridge B10 – Northbound bridge over Tabbimoble Creek

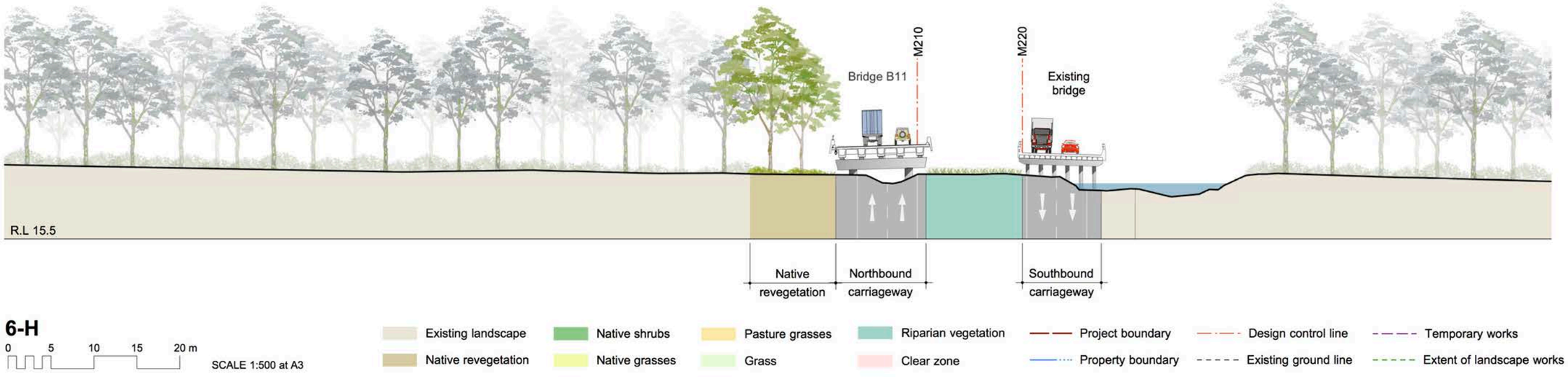


Figure 7-41: Section 6-H at Bridge B10 – Northbound bridge over Tabbimoble Overflow

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7.6 LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT

7.6.1 Overview

This landscape character and visual impact assessment provides a re-assessment of the impacts of the highway upgrade at detailed design stage on the character of a place and the views within that place as compared to the EIS 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 landscape character and visual impact assessment follows the *'Guideline for Landscape Character and Visual Impact Assessment'* (Roads and Maritime Services, 2013). It is consistent with the Roads and Maritime urban design process that addresses visual and character issues, both of which are key aspects for delivering good urban design outcomes.

7.6.2 Landscape character assessment

In landscape character assessment, magnitude refers to the type of highway upgrade and its compatibility with the character of the existing landscape. All anticipated elements of the highway upgrade, including the alignment, road infrastructure, ITS, planting, lighting, etc, are considered. The scale of elements (height, length), as well as its location or setting (within woodland, rural land, or over creek crossings), all have a bearing on the magnitude of the physical presence of the highway upgrade.

A high magnitude results if the highway upgrade is a major development or piece of road infrastructure and contrasts highly with the surrounding landscape, or entails heavy modification of the existing landscape. This would occur as a result of the large scale removal of existing vegetation. A moderate magnitude rating would result if the highway upgrade is moderately integrated into the landscape. A low magnitude rating would occur if the highway upgrade is of a small scale and integrates well into the landscape.

The magnitude impact rating also considers whether the highway upgrade has a positive or negative impact on the landscape character of the zone. For example, the upgrade may be of a large scale but may provide beneficial outcomes such as increased open space, enhancement of the areas 'sense of place', better connectivity and a safer road environment.

Sensitivity refers to how sensitive the character of the setting is to the proposed change. A judgement has been made as to the quality of the landscape, its cultural and historical importance to the community, scenic quality, and overall composition of the place and its inhabitants. The following sensitivity judgements have been used as the basis for this assessment:

- Places with high social, recreational, and historical significance to local residents have higher sensitivity
- Generally, water and natural environments are more highly valued than modified areas, though views over rolling farmland are still highly valued
- Areas of unique scenic quality have higher sensitivity
- A pristine environment would have greater sensitivity with less ability to absorb new elements in the landscape than modified landscapes or those areas with contrast and variety of landscape types.

Landscape character impact is the combination of the magnitude and sensitivity rating in accordance with the Impact Assessment Grading Matrix (refer to Figure 7-42).

7.6.3 Key views assessment

The potential visual impact of the highway upgrade is assessed in relation to a number of key viewpoints. Locations and directions of chosen viewpoints are representative of the range of viewpoints both within the visual catchment of the highway upgrade.

Magnitude of change to existing views refers to the nature and scale of the highway upgrade, and the extent and proximity of the view to it. Magnitude represents the contrast in scale, form and type of highway upgrade to the location and context to which it is to be placed.

A high magnitude results if the highway upgrade is of a major scale and is considered out of scale or uncharacteristic of the existing visual character, or if there is considerable modification to the existing landscape. A moderate magnitude would result if the highway upgrade is prominent but not considered to be substantially uncharacteristic with the existing visual character. A low magnitude results if there is minimal alteration to the existing view and the highway upgrade is of a scale and nature that is consistent with the existing visual character.

Sensitivity is the measure of the visual importance of the view and is dependent on:

- Distance between viewer and the highway upgrade
- The category of viewer, for example, resident, worker, shopper, open space user
- The elements of the highway upgrade that are visible
- Importance of the view, for example, identified in tourist guides, static or moving viewpoint, do people deliberately seek the view.

Visual sensitivity includes the consideration of the perceived cultural and historical values of the visual environment and the elements within it.

Generally, viewers with the highest sensitivity include:

- Residents who have existing attractive views that will be affected by the highway upgrade
- Users of public open space where their attention is focused on the visual landscape, for example, lookouts or other scenic natural areas

7.7 LANDSCAPE CHARACTER IMPACTS

- Communities that place high cultural and historical significance on the visual landscape.

Viewers with the lowest sensitivity are most likely to be:

- Employees focused on their work
- Motorists whose attention is focused on driving.

Visual impact is the combination of the magnitude and sensitivity rating in accordance with the Impact Assessment Grading Matrix (refer to Figure 7-42).

SENSITIVITY \ MAGNITUDE	High	Moderate	Low	Negligible
High	High	High-Moderate	Moderate	Negligible
Moderate	High-Moderate	Moderate	Moderate-Low	Negligible
Low	Moderate	Moderate-Low	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Figure 7-42: Impact assessment grading matrix

The Impact Assessment Grading Matrix, adopted from *Guideline for Landscape Character and Visual Impact Assessment* (Roads and Maritime 2013), is used in both the landscape character and key views assessments. The matrix illustrates how magnitude and sensitivity ratings are combined to achieve an overall impact rating.

Note: The EIS referenced an earlier edition of the Impact Assessment Grading Matrix produced in the *Guideline for Landscape Character and Visual Impact Assessment* (RTA 2009).

As discussed in Chapter 5, ten landscape character precincts were identified in the EIS (refer to Figure 5-12). The landscape character of these precincts was also described in Chapter 5. The results of the EIS assessment have been reviewed and re-assessed below for the Detailed design stage in accordance with Roads and Maritime Impact Assessment Grading Matrix (refer to Figure 7-42), taking into consideration the design amendments between the EIS and detailed design stages. The results are summarised in Table 7-1

7.7.1 Landscape Character Precinct 25 – Maclean Pinnacle

EIS Assessment

The precinct was assessed to have Low sensitivity as it is an upgrade of existing road infrastructure, and the project to be of Low magnitude due to the limited infrastructure required, including small embankments within the existing road corridor. The overall impact on the landscape character of this precinct was Low.

Detailed design changes

The construction and operational changes in precinct 25 include:

- Realignment and formalisation of Koala Drive to connect with Farlows Lane.

Landscape Character Assessment

The detailed design design would not change the sensitivity rating assessed in the EIS, which would remain Low. The detailed design changes are not sufficient to change the magnitude rating which would remain Low. Therefore, the overall Landscape Character Impact would remain Low.

7.7.2 Landscape Character Precinct 26 – Yaegl Nature Reserve

EIS Assessment

The precinct was assessed to have Moderate sensitivity as it is an upgrade of existing road infrastructure along the edge between Yaegl Nature Reserve and sugar cane plantations. The project was assessed to be of Low magnitude due to the low embankments required, giving an overall Moderate to Low impact on the landscape character of this precinct.

Detailed design changes

The construction and operational changes in precinct 26 include:

- Realignment and formalisation of Koala Drive to connect with Farlows Lane.

Landscape Character Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Moderate. The detailed design changes are not sufficient to change the magnitude rating which would remain Low. Therefore, the overall Landscape Character Impact would remain Moderate to Low.

7.7.3 Landscape Character Precinct 27 – Clarence River Floodplain

EIS Assessment

The precinct was assessed to have Moderate sensitivity as it is a floodplain with extensive sugar cane plantations with seasonal variations. The project was assessed to be of High magnitude due to the consistant 3 m embankment within existing road corridor across floodplain, new overpasses with associated embankments and new bridge crossing over the Clarence River. The overall impact on the landscape character of this precinct was Moderate to High.

Detailed design changes

The construction and operational changes in precinct 27 include:

- Cycle access on the shoulders of the upgraded highway, including bridges
- A new two-way cycle path on Yamba Road providing dedicated pedestrian and cyclist access to Harwood Bridge.
- Cycle access to the northbound carriageway, adjacent to the roundabout at the western side of the interchange
- Cycle access from the southbound carriageway, with a connection under the project to link with Harwood Bridge
- Cycle connection under the first span of the proposed bridge
- Removal of the Carrols Lane intersection with the highway
- Relocation of the overpass approximately 500 metres north to provide a connection from a realigned section of Chatsworth Road to Fischers Lane
- Local access road to the east of the highway connecting Carrols Lane to Fischers Lane
- Removal of Watts Lane intersection with the highway
- Existing highway becomes a local access road connecting to Watts Lane
- Local access road on the western side of the highway between Watts Lane and Andersons Lane
- On-ramp to the northbound carriageway from Watts Lane
- Local access road on the eastern side of the highway from Watts Lane to Serpentine Channel South Bank Road
- Exit-ramp from the southbound carriageway to the local access road between Mill Road and the former Pacific Highway
- Removal of the Carrols Lane intersection with the highway
- Relocation of the overpass approximately 500 metres north to provide a connection from a realigned section of Chatsworth Road to a realigned section of Fischers Lane
- Local access road to the east of the highway upgrade connecting Carrols Lane to Fischers Lane
- Local access road connecting the southbound carriageway to the Carrols Lane-Fischers Lane access road
- Local access road to the west of the highway upgrade connecting Chatsworth Road with the northbound carriageway
- Local access road connecting the Chatsworth Road access road to the westernmost bridge over the North Arm (which would become a local road)
- The new bridge over the Clarence River is subject to a separate submission and is not part of the scope of this draft UDLP.

Landscape Character Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Moderate. The detailed design changes, while extensive, are generally minor in nature and involve modification of access road layouts. Despite the new bridge not being included in the detailed design scope for this draft UDLP, it is expected that its design will be similar in scale to the EIS design; therefore, the magnitude rating which would remain High. As such, the overall Landscape Character Impact would remain Moderate to High.

7.7.4 Landscape Character Precinct 28 – Ashby

EIS Assessment

The precinct was assessed to have High sensitivity as it is includes wooded ridges and foothills with views across the floodplain. The project was assessed to be of Negligible magnitude as it is outside of the road corridor. The overall impact on the landscape character of this precinct was Negligible.

Detailed design changes

The construction and operational changes in precinct 28 include:

- None.

Landscape Character Assessment

The detailed design design would not change the sensitivity rating assessed in the EIS, which would remain High. The detailed design changes are not sufficient to change the magnitude rating which would remain Negligible. Therefore, the overall Landscape Character Impact would remain Negligible.

7.7.5 Landscape Character Precinct 29 – Harwood Township

EIS Assessment

The precinct was assessed to have High sensitivity as it contains a small residential township with senstive heritage items. The project was assessed to be of High magnitude as it includes the bridge crossing over Clarence River with associated embankments. The overall impact on the landscape character of this precinct was High.

Detailed design changes

The construction and operational changes in precinct 29 include:

- Local access road under the new Clarence River bridge, between Mill Road and the former Pacific Highway immediately north of Harwood Island Public School
- Existing highway becomes a local access road connecting to Watts Lane
- Exit-ramp from the southbound carriageway to the local access road between Mill Road and the former Pacific Highway
- The new bridge over the Clarence River subject to a separate submission and is not part of the scope of this report.

Landscape Character Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain High. The detailed design changes are not sufficient to change the magnitude rating and despite the new bridge not being included in the detailed design scope for this draft UDLP, it is expected that its design will be similar in scale to the EIS design. Therefore, the magnitude rating which would remain High. As such, the overall Landscape Character Impact would remain High.

7.7.6 Landscape Character Precinct 30 – Chatsworth Hill

EIS Assessment

The precinct was assessed to have High sensitivity as it is includes wooded ridges and foothills with views across the floodplain. The project was assessed to be of Negligible magnitude as it is outside of the road corridor. The overall impact on the landscape character of this precinct was Negligible.

Detailed design changes

The construction and operational changes in precinct 30 include:

- None.

Landscape Character Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain High. The detailed design changes are not sufficient to change the magnitude rating which would remain Negligible. Therefore, the overall Landscape Character Impact would remain Negligible.

7.7.7 Landscape Character Precinct 31 – Mororo Creek Valley

EIS Assessment

The precinct was assessed to have Low sensitivity as it is an upgrade of existing road infrastructure within agricultural areas with roadside vegetation. The project was assessed to be of Low magnitude due to the low embankments required, giving an overall Low impact on the landscape character of this precinct.

Detailed design changes

The construction and operational changes in precinct 31 include:

- Alteration of the vertical alignment of the highway upgrade between CH97,500 and CH98,500 to deepen the road cuttings on either side of the highway
- The base of the cuttings would be set back up to 37 metres from the highway to widen the cuttings and increase the amount of excavated material
- The deeper and wider cuttings would generate approximately one million cubic metres of additional fill material required for the project.

Landscape Character Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Low. The detailed design changes would have a moderate magnitude impact initially, however, extensive revegetation of the cutting and to the wide setback at the base of the

cutting would reduce this impact over time to Low. Therefore, the overall Landscape Character Impact would remain Low.

7.7.8 Landscape Character Precinct 32 – Bundjalung National Park

EIS Assessment

The precinct was assessed to have Low sensitivity as it includes a variety of landscape units with good absorption capacity. The project was assessed to be of Low magnitude due to the low embankments required, giving an overall Low impact on the landscape character of this precinct.

Detailed design changes

The construction and operational changes in precinct 32 include:

- Alteration of the vertical alignment of the highway upgrade between CH97,500 and CH98,500 to deepen the road cuttings on either side of the highway
- The base of the cuttings would be set back up to 37 metres from the highway to widen the cuttings and increase the amount of excavated material
- The deeper and wider cuttings would generate approximately one million cubic metres of additional fill material required for the project.

Landscape Character Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Low. The detailed design changes would have a moderate magnitude impact initially, however, extensive revegetation of the cutting and to the wide setback at the base of the cutting would reduce this impact over time to Low. Therefore, the overall Landscape Character Impact would remain Low.

7.7.9 Landscape Character Precinct 33 – Jackybulbin Flat

EIS Assessment

The precinct was assessed to have Low sensitivity as it includes a variety of landscape units with good absorption capacity. The project was assessed to be of Low magnitude due to it being an upgrade of existing road infrastructure with areas of small cut and embankments. The overall impact on the landscape character of this precinct was Low.

Detailed design changes

The construction and operational changes in precinct 33 include:

- None.

Landscape Character Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Low. The detailed design changes are not sufficient to change the magnitude rating which would remain Low. Therefore, the overall Landscape Character Impact would remain Low.

7.7.10 Landscape Character Precinct 34 – Tabbimoble Floodways

EIS Assessment

The precinct was assessed to have Low sensitivity as it is an upgrade of enclosed vegetated road corridor. The project was assessed to be of Moderate magnitude due to low embankments required as well as bridge structures over the Tabbimoble floodways. The overall impact on the landscape character of this precinct was Moderate to Low.

Detailed design changes

The construction and operational changes in precinct 34 include:

- None.

Landscape Character Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Low. The detailed design changes are not sufficient to change the magnitude rating which would remain Moderate. Therefore, the overall Landscape Character Impact would remain Moderate to Low.

7.7.11 Summary of landscape character impacts

Overall, the detailed design is considered to have a similar impact on landscape character as the EIS concept. There are a number of changes between the designs, the most noticeable being the:

- Removal of the Watts Lane overpass bridge (landscape character precinct 27)
- Removal of the Carrolls Lane overpass bridge (landscape character precinct 27)
- Additional of a new overpass bridge at Chatsworth Road (landscape character precinct 27)
- New cutting at Mororo (landscape character precinct 32).

The changes within landscape character precinct 27 are similar in nature, and within the overall scale of the project within this large precinct, are not deemed sufficient to increase or decrease the magnitude rating assessed in the EIS. While the Mororo cutting would have an increased magnitude impact initially, extensive revegetation of the cutting and to the wide setback at the base of the cutting would reduce this impact over time, therefore, the magnitude rating would not change for landscape character precinct 32.

A summary of the EIS and detailed design impact assessment is presented in Table 7-1.

Table 7-1: Landscape character impact summary

LANDSCAPE CHARACTER PRECINCT	EIS SENSITIVITY	DETAILED DESIGN SENSITIVITY	EIS MAGNITUDE	DETAILED DESIGN MAGNITUDE	EIS IMPACT RATING	DETAILED DESIGN IMPACT RATING
25. Maclean Pinnacle	Low	*No change*	Low	*No change*	**Low**	***No change***
26. Yaegl Nature Reserve	Moderate	*No change*	Low	*No change*	**Moderate to Low**	***No change***
27. Clarence River floodplain	Moderate	*No change*	High	*No change*	**Moderate to High**	***No change***
28. Ashby	High	*No change*	Negligible	*No change*	**Negligible**	***No change***
29. Harwood township	High	*No change*	High	*No change*	**High**	***No change***
30. Chatsworth Hill	High	*No change*	Negligible	*No change*	**Negligible**	***No change***
31. Mororo Creek Valley	Low	*No change*	Low	*No change*	**Low**	***No change***
32. Bundjalung National Park	Low	*No change*	Low	*No change*	**Low**	***No change***
33. Jackybulbin Flat	Low	*No change*	Low	*No change*	**Low**	***No change***
34. Tabbimoble floodways	Low	*No change*	Moderate	*No change*	**Moderate to Low**	***No change***

7.8 IMPACTS ON KEY VIEWS

Visual impact ratings were determined in the EIS based on 75 key viewpoints. Of these viewpoints, 15 are located between Maclean and Iluka Road (Section 5) and one is located between Iluka Road and Devils Pulpit (Section 6) (refer to Figure 7-43). These are:

- Maclean to Iluka Road, Mororo (Section 5)
  - Viewpoint 26A - Yamba Road, Harwood
  - Viewpoint 26B - Yamba Road, Harwood
  - Viewpoint 27A - Palmers Channel bridge, Yamba Road
  - Viewpoint 27B - South Bank Road, Palmers Channel
  - Viewpoint 28 - Public Jetty, Clarence River, Harwood
  - Viewpoint 29 - End Harwood Road, Harwood
  - Viewpoint 30 - Corner Cannons Lane & River Street, Harwood
  - Viewpoint 31 - Ashby Heights
  - Viewpoint 32A - Watts Lane (east)
  - Viewpoint 32B - Watts Lane (west)
  - Viewpoint 33 - North Arm Drive
  - Viewpoint 34 - Fischers Lane, Iluka
  - Viewpoint 35 - Garretts Lane, Iluka
  - Viewpoint 36A - Pacific Highway, Iluka
  - Viewpoint 36B - Old Pacific Highway, Iluka
- Iluka Road to Devils Pulpit (Section 6)
  - Viewpoint 36C - Tabbimoble.

The results of the EIS assessment have been reviewed and re-assessed below for the detailed design stage in accordance with Roads and Maritime impact grading matrix (refer to Figure 7-42), taking into consideration the design amendments between the EIS and detailed design stage. The results are summarised in Table 7-2.

Plate 7-20: Viewpoint 26A – Yamba Road, Harwood

7.8.1 Viewpoint 26A – Yamba Road, Harwood

Description

Foreground view north-east near the public boat ramp and next to residential dwellings, Yamba Road, South Harwood.

EIS Assessment

The viewpoint was assessed to have Moderate to High sensitivity around the local heritage listed existing Harwood bridge and many local residents and motorists would have repeated access to this view. The EIS concept was assessed to have Moderate to Low magnitude as the new elevated bridge would be visible, however, existing vegetation would screen much of it in the view. This gave an overall visual impact of Moderate.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Moderate to High. While the new bridge is not part of the detailed design scope for this draft UDLP, it will be constructed at the same time as these works and is assessed in a separate submission. The new bridge scale will be similar to the EIS concept, therefore the magnitude rating would remain the Moderate to Low. The overall visual impact would remain Moderate.

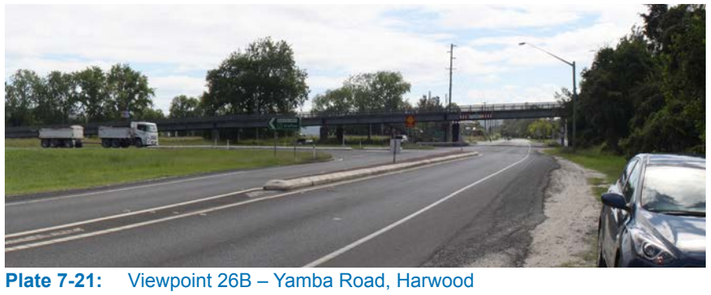


Plate 7-21: Viewpoint 26B – Yamba Road, Harwood

7.8.2 Viewpoint 26B – Yamba Road, Harwood

Description

Middle ground view west along Yamba Road, Harwood (south) on the riverbank.

EIS Assessment

The viewpoint was assessed to have Moderate to High sensitivity around the local heritage listed existing Harwood bridge and many local residents and motorists would have repeated access to this view. The EIS concept was assessed to have Moderate to High magnitude as the new bridge and fill embankments would dominate the view. This gave an overall visual impact of Moderate to High.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Moderate to High. While the new bridge is not part of the detailed design scope for this draft UDLP, it will be constructed at the same time as these works and is assessed in a separate submission. The new bridge scale will be similar to the EIS concept, therefore the magnitude rating would remain the Moderate to Low. The overall visual impact would remain Moderate to High.

Plate 7-22: Viewpoint 27A – Palmers Channel bridge, Yamba Road, Harwood

7.8.3 Viewpoint 27A – Palmers Channel bridge, Yamba Road, Harwood

Description

Distant view north-west across agricultural land near Palmers Channel Bridge, Yamba Road, Harwood.

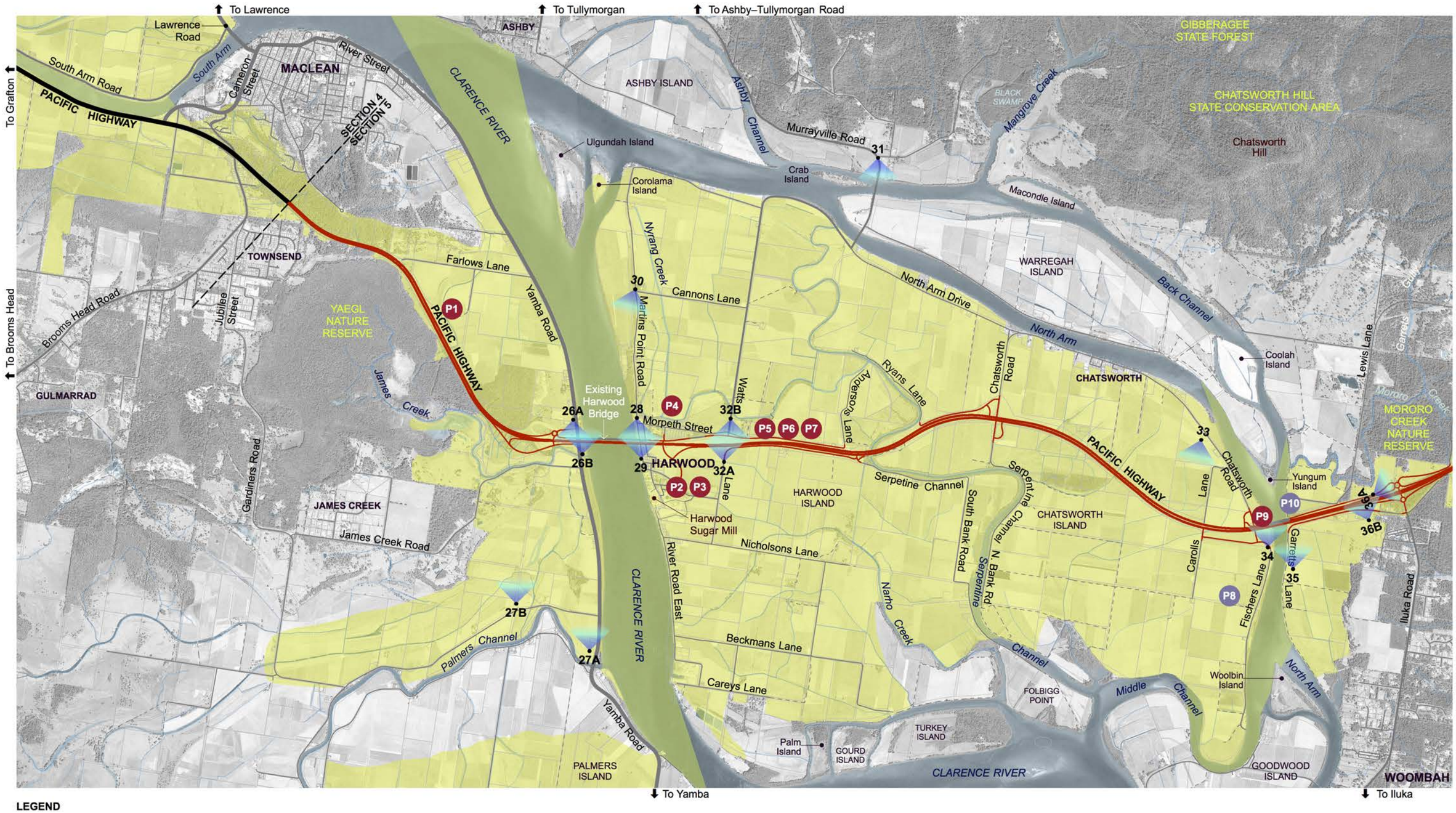
EIS Assessment

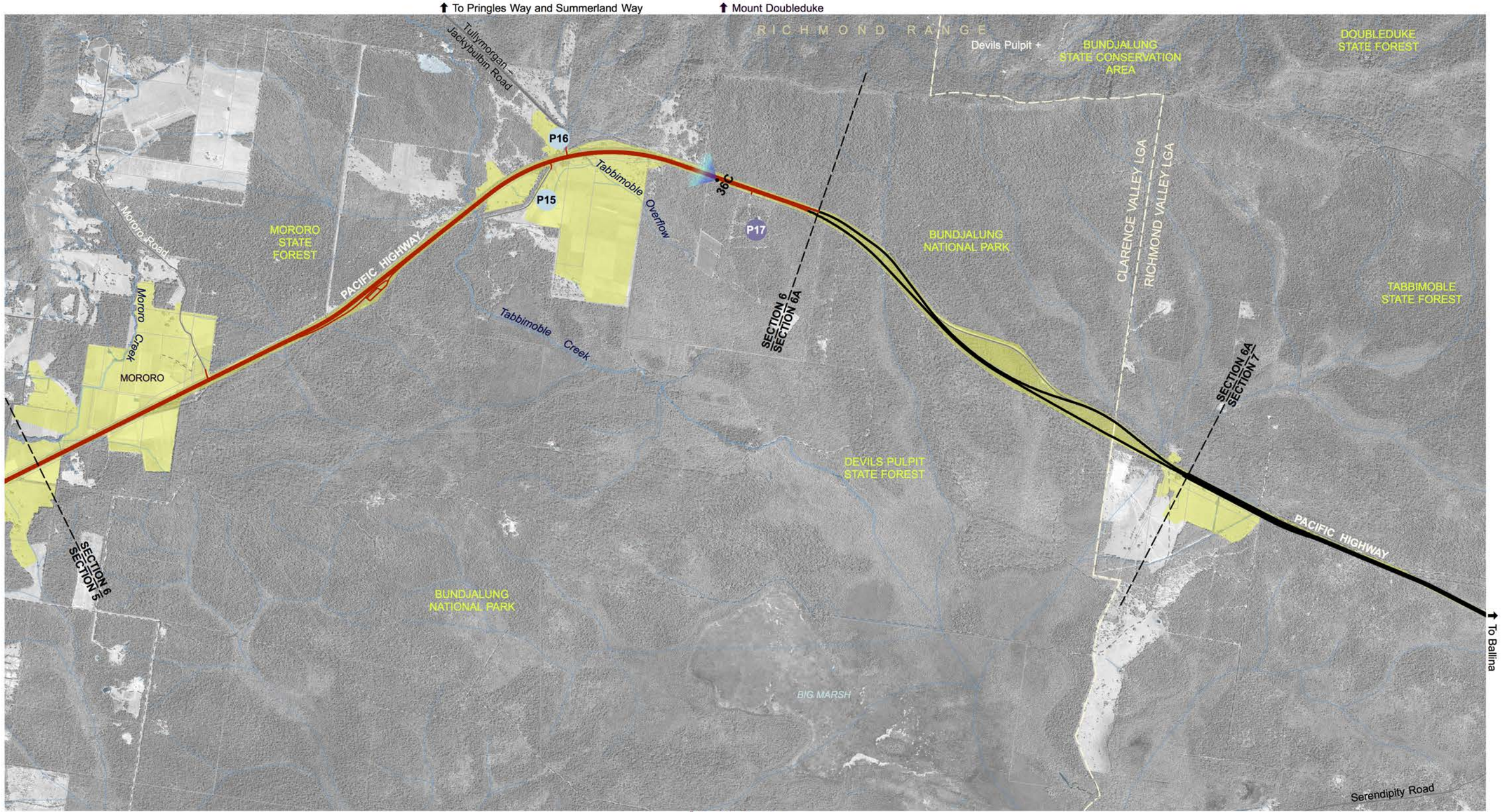
The viewpoint was assessed to have Moderate sensitivity as a moderate number of local people would have long duration or repeated access to the changed view. The EIS concept was assessed to have Low magnitude as the new bridge would only impact a small portion of the overall landscape view. This gave an overall visual impact of Moderate to Low.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Moderate. While the new bridge is not part of the detailed design scope for this draft UDLP, it will be constructed at the same time as these works and is assessed in a separate submission. The new bridge scale will be similar to the EIS concept, therefore the magnitude rating would remain the Low. The overall visual impact would remain Moderate to Low.

Figure 7-43: Location of key viewpoints





LEGEND

EXISTING FEATURES
- Existing road
- Existing vehicular track

PACIFIC HIGHWAY
- Highway upgrade Maclean to Devils Pulpit (Sections 5 & 6)
- Existing upgraded Pacific Highway
- Adjacent sections of highway upgrade

EIS VIEW MAPPING
- Visual Envelope Map
- Viewpoint

KEY VIEWPOINTS – PROPERTY IMPACT ASSESSMENT
- PX High impact – open views
- PX Moderate impact – filtered views with some vegetation
- PX Low impact – views screened by vegetation

0 500 1000 m
SCALE 1:40,000 at A3

Sheet 2 of 2

Plate 7-23: Viewpoint 27B – South Bank Road, Palmers Channel

7.8.4 Viewpoint 27B – South Bank Road, Palmers Channel

Description

Distant view north-west over sugar cane plantations, South Bank Road, Palmer Channel.

EIS Assessment

The viewpoint was assessed to have Moderate sensitivity for a low number of residents and local people who will have long duration and/or repeated access to a changed foreground view. The EIS concept was assessed to have Low magnitude as the new elevated bridge would intercept the horizon in this view, however, it would impact only a small portion of the view. This gave an overall visual impact of Moderate to Low.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Moderate. While the new bridge is not part of the detailed design scope for this draft UDLP, it will be constructed at the same time as these works and is assessed in a separate submission. The new bridge scale will be similar to the EIS concept, therefore the magnitude rating would remain the Low. The overall visual impact would remain Moderate to Low.

Plate 7-24: Viewpoint 28 – Public Jetty, Clarence River, Harwood

7.8.5 Viewpoint 28 – Public Jetty, Clarence River, Harwood

Description

Foreground view south-east from a public jetty on the Clarence River, Harwood.

EIS Assessment

The viewpoint was assessed to have High sensitivity due to the local heritage listed existing Harwood bridge with many local residents having repeated access to this changed view in a highly scenic setting. The EIS concept was assessed to have High magnitude due to the major new elevated bridge infrastructure at an existing bridge crossing. This gave an overall visual impact of High.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain High. While the new bridge is not part of the detailed design scope for this draft UDLP, it will be constructed at the same time as these works and is assessed in a separate submission. The new bridge scale will be similar to the EIS concept, therefore the magnitude rating would remain the High. The overall visual impact would remain High.

Plate 7-25: Viewpoint 29 – End Harwood Road, Harwood

7.8.6 Viewpoint 29 – End Harwood Road, Harwood

Description

Middle ground view south-west, end of Harwood Road, Harwood on the foreshore opposite residential dwellings.

EIS Assessment

The viewpoint was assessed to have High sensitivity around the local heritage listed existing Harwood bridge and Harwood Heritage Conservation Area with many local residents having repeated access to this changed view in a highly scenic setting. The EIS concept was assessed to have High magnitude due to the major new elevated bridge infrastructure at an existing bridge crossing. This gave an overall visual impact of High.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain High. While the new bridge is not part of the detailed design scope for this draft UDLP, it will be constructed at the same time as these works and is assessed in a separate submission. The new bridge scale will be similar to the EIS concept, therefore the magnitude rating would remain the High. The overall visual impact would remain High.

Plate 7-26: Viewpoint 30 – Corner Cannons Lane and River Street, Harwood

7.8.7 Viewpoint 30 – Corner Cannons Lane and River Street, Harwood

Description

Distant view east over sugar cane plantations from the intersection of Cannons Lane and River Street, Harwood,

EIS Assessment

The viewpoint was assessed to have Low sensitivity as a low number of local residents/ motorists would have repeated access to this changed view. The EIS concept was assessed to have Low magnitude due to the distance of the new elevated bridge structure and it only impacting a small portion of the overall landscape view. This gave an overall visual impact of Low.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Low. While the new bridge is not part of the detailed design scope for this draft UDLP, it will be constructed at the same time as these works and is assessed in a separate submission. The new bridge scale will be similar to the EIS concept, therefore the magnitude rating would remain the Low. The overall visual impact would remain Low.

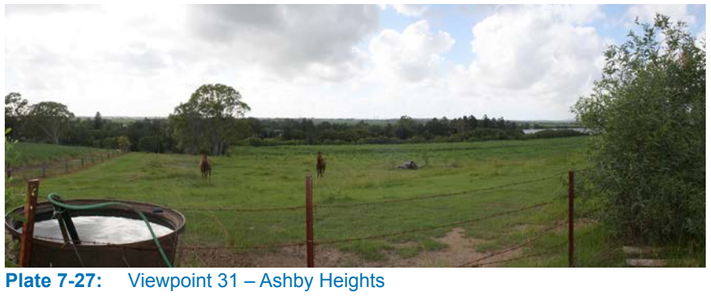


Plate 7-27: Viewpoint 31 – Ashby Heights

7.8.8 Viewpoint 31 – Ashby Heights

Description

Distant view over grazing land next to rural residential dwellings, Murrayville Road, Ashby Heights.

EIS Assessment

The viewpoint was assessed to have Low sensitivity as a low number of people/ motorists would have long duration or repeated access to this changed view. The EIS concept was assessed to have Low magnitude due to the distance of the upgrade in an agricultural setting. This gave an overall visual impact of Low.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Low. The detailed design will be similar to the EIS concept, therefore the magnitude rating would remain the Low due to the distance of the upgrade. The overall visual impact would remain Low.

Plate 7-28: Viewpoint 32A - Watts Lane (East)

7.8.9 Viewpoint 32A - Watts Lane (East)

Description

Foreground view looking west along Watts Lane, Harwood, on the eastern side of the highway next to sugar cane plantations.

EIS Assessment

The viewpoint was assessed to have Moderate to High sensitivity for a low number of residents with a changed foreground view in this location. The EIS concept was assessed to have Moderate to High magnitude due to the major new elevated overpass and service road causing considerable disturbance to the existing agricultural landscape. This gave an overall visual impact of Moderate to High.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Moderate to High. The detailed design works replace the elevated overpass and roundabout, removing through access along Watts Lane. The highway would be elevated about 3 m above the existing ground level on twin bridges, obstructing the lower section of the view beyond. The changes would be consistent with the current Moderate to High magnitude rating. Therefore, the overall visual impact would remain Moderate to High.

Plate 7-29: Viewpoint 32B – Watts Lane (West)

7.8.10 Viewpoint 32B – Watts Lane (West)

Description

Foreground view looking east along Watts Lane, Harwood, on the western side of the highway next to sugar cane plantations and near farm sheds and rural residential dwellings.

EIS Assessment

The viewpoint was assessed to have Moderate sensitivity for residents of a few homes with long duration views. Many motorists on the highway would have fleeting views of the change. The EIS concept was assessed to have High magnitude due to the considerable disturbance to the existing agricultural landscape with the addition of a new highway overpass, associated roundabouts and service roads. The considerable elevation of the overpass (9 metres) makes it highly prominent in the flat floodplain landscape. New embankments are squeezed around existing homes located at the intersection. This gave an overall visual impact of Moderate to High.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Moderate. The detailed design works replace the elevated overpass and roundabout, removing through access along Watts Lane. The highway would be elevated about 3 metres above the existing ground level on twin bridges, however, the majority of the bridge would be screened by the existing trees, buildings and sugar cane prior to harvest. The changes would reduce the magnitude rating to Moderate. Therefore, the overall visual impact would be Moderate.

Plate 7-30: Viewpoint 33 - North Arm Drive (source: Hassell)

7.8.11 Viewpoint 33 - North Arm Drive

Description

Middle ground view east over sugar cane plantations from North Arm Drive, Chatsworth.

EIS Assessment

The viewpoint was assessed to have Moderate to Low sensitivity as the changed view would be repeatedly visible from a low number of local residences and from local streets. The EIS concept was assessed to have High to Moderate magnitude as the upgrade, interchange and associated service road would be located on a low embankment traversing the floodplain at considerable distance from this viewpoint. This gave an overall visual impact of Moderate.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Moderate to Low. The detailed design works replace the elevated overpass and service roads, removing through access along Carrolls Lane. The highway would be elevated about 3 metres above the existing ground level on three northbound bridges between CH 92, 200 and CH 93,000 and twin bridges at this location at Carrolls Lane. The interchange and service roads occur at Chatwsorth Road which would be obscured from this viewpoint. The changes would be consistant with the current Moderate magnitude rating. Therefore, the overall visual impact would be remain Moderate

Plate 7-31: Viewpoint 34 – Fischers Lane, Iluka

7.8.12 Viewpoint 34 – Fischers Lane, Iluka

Description

Foreground view west over sugar cane plantations from Fischers Lane on the southern bank of the Clarence River North Arm, Iluka.

EIS Assessment

The viewpoint was assessed to have Low sensitivity as the changed view would be repeatedly visible from a low number of local residences and from local streets. The EIS concept was assessed to have Low magnitude as the upgrade would be located on a low embankment within existing an infrastructure corridor from a middle ground vantage point. Views of the proposed bridge structure would be generally screened by riparian vegetation. This gave an overall visual impact of Low.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Low. The detailed design works move the interchange north from Carrolls Lane to Chatsworth Road making it a dominant feature in the middle ground of the view. The upgrade includes the Chatsworth Road overbridge and associated embankments and a re-routed Fischers Lane, as well as the highway on a low embankment. The changes would increase the magnitude rating to Moderate, giving an overall visual impact of Moderate to Low.

Plate 7-32: Viewpoint 35 – Garretts Lane, Iluka

7.8.13 Viewpoint 35 – Garretts Lane, Iluka

Description

Middle ground view west over the Clarence River North Arm from Garretts Lane, Iluka, next to sugar cane plantations on the northern bank of the river.

EIS Assessment

The viewpoint was assessed to have Moderate to Low sensitivity as the changed view in a scenic setting would be repeatedly visible from a low number of local residences and from local streets. The EIS concept was assessed to have Low magnitude as the new bridge infrastructure is at an existing bridge crossing comprising a similar character and scale to the existing development in a scenic river location. This gave an overall visual impact of Moderate to Low.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Moderate to Low. The detailed design works are relatively unchanged compared to the EIS from this view, with the existing foreshore vegetation obscuring views to the Chatsworth Road interchange. Therefore the magnitude rating would remain Low and the overall visual impact rating would remain Moderate to Low.

Plate 7-33: Viewpoint 36A – Pacific Highway, Iluka

7.8.14 Viewpoint 36A – Pacific Highway, Iluka

Description

Foreground view north on the existing highway, Iluka towards the Iluka Road intersection. There is moderate roadside vegetation with grazing land beyond.

EIS Assessment

The viewpoint was assessed to have Moderate to Low sensitivity as the changed view would be available to motorists using the highway. The EIS concept was assessed to have High to Moderate magnitude as it would be a major upgrade of existing infrastructure and a new elevated overpass woould be proposed. This gave an overall visual impact of Moderate.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Moderate to Low. The detailed design works are relatively unchanged compared to the EIS from this view, however, the amount of tree planting may be restricted in some locations due to drainage requirements, but would not be sufficient to change the magnitude rating of High to Moderate. Therefore, the overall visual impact rating would remain Moderate.

Plate 7-34: Viewpoint 36B – Old Pacific Highway, Iluka

7.8.15 Viewpoint 36B – Old Pacific Highway, Iluka

Description

Foreground view west from the Old Pacific Highway, Iluka through roadside vegetation to the existing highway. Rural residential dwellings are located on the eastern side of the Old Pacific Highway.

EIS Assessment

The viewpoint was assessed to have High sensitivity as the changed view would be repeatedly visible to a moderate number of local residents from their homes and from local streets. The EIS concept was assessed to have High magnitude as the loss of roadside vegetation would open up views of the additional road infrastructure and elevated overpass to local residents in close proximity to development. Some screening from existing vegetation is possible and will reduce the magnitude rating if retained. This gave an overall visual impact of High.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain High. The detailed design works are relatively unchanged compared to the EIS from this view, therefore, the magnitude rating would remain High, giving a High overall visual impact.

Plate 7-35: Viewpoint 36C – Tabbimoble

7.9.12 Viewpoint 36C – Tabbimoble

Description

Foreground view south along the existing Pacific Highway, through roadside vegetation to the existing highway. There is dense roadside vegetation on both sides of the highway.

EIS Assessment

The viewpoint was assessed to have Low sensitivity as the upgrade would be generally well screened by existing forest vegetation and mostly visible only to motorists using the highway. The EIS concept was assessed to have Low magnitude as the onsiderable additional disturbance to the existing native woodland would create a much wider corridor through the forest, however, the new infrastructure would be typical of infrastructure already in place at this location. This gave an overall visual impact of High.

Visual Impact Assessment

The detailed design would not change the sensitivity rating assessed in the EIS, which would remain Low. The detailed design works are relatively unchanged compared to the EIS from this view, therefore, the magnitude rating would remain Low, giving a Low overall visual impact.

7.9 VISUAL IMPACT ON NEARBY HOUSES

In addition to the key views, the visibility of the project to nearby houses along the corridor (that were not considered in the EIS) was assessed. At the time of writing, it was not possible to inspect individual properties, therefore a desktop assessment was undertaken using aerial photography and views to properties from the highway.

The assessment takes into consideration the screening effect of vegetation not impacted by the project, vegetation cleared by the project, and sugarcane fields that have seasonal impacts on visibility. The location of these properties is shown in Figure 7-43.

7.9.1 Property 1

Distance to highway: 80 metres

Foreground views over grazing and agricultural land to the highway. Existing trees next to the house filter views.

Visual impact: High

The northbound carriageway is on a low fill embankment and the southbound carriageway is on the existing highway alignment and partially screened by median vegetation. Individual Hill's Fig planting at 125m centres next to the northbound carriageway alert motorists to the upcoming Yamba Interchange and allow views over the floodplain, however, do not provide screening to the property.

7.9.2 Properties 2 and 3

Distance to highway: 35 metres

Foreground views to the existing Harwood Bridge. Existing trees next to property two partially screen the existing bridge.

Visual impact: High

A staggered triple row of Spotted Gum will be planted on the western side of the existing bridge to provide additional screening as the trees mature over time.

7.9.3 Property 4

Distance to highway: 40 metres

Foreground views to the existing Harwood Bridge. Existing trees partially screen the northern end of the bridge.

Visual impact: High

The existing trees will be retained. A row of Spotted Gum will be planted on the western side of the existing bridge to provide additional screening as the trees mature over time.

7.9.4 Properties 5, 6 and 7

Distance to highway: 20 metres

Foreground views over the existing highway. Existing trees partially screen the highway from property seven.

Visual impact: High

The upgraded former Pacific Highway which becomes a local road, entry and exit ramps and bridge B52 will all be highly visible to the east of these dwellings. The existing vegetation between the properties and the highway. New native tree planting will be provided at the intersection of the former Pacific Highway and Watts Lane which will provide moderate screening of the project from these dwellings.

7.9.5 Property 8

Distance to highway: 275 metres

Mid distance views to the highway over agricultural land. Sugarcane fields provide seasonal screening.

Visual impact: Moderate

A new road linking Fischers Lane and Carrolls Lane, the upgraded highway and Chatsworth Road overbridge B07 will be visible from the dwelling. Tree planting at the intersection of the link road and Chatsworth Road will provide minimal screening of the overbridge, while native tree planting on both sides of the highway between the bridge and Clarence River North Arm will provide screening to this section of the project.

7.9.6 Property 9

Distance to highway: 40 metres

Foreground views to the highway with screening of the existing Mororo Bridge by existing riparian planting.

Visual impact: High

The upgraded highway, Chatsworth Road overbridge B07 and a new link road between the highway and Chatsworth Road will be highly visible from this dwelling. Screen planting will be provided along the eastern boundary of the property and the riparian planting on the southern bank of Clarence River North Arm will be re-established.

7.9.7 Property 10

Distance to highway: 130 metres

Mid distance views over agricultural land on the northern bank of Clarence River North Arm. Vegetation next to the highway screens the dwelling.

Visual impact: Moderate

The existing roadside vegetation will be removed as part of the project. Replacement native planting will provide screening to this dwelling as they mature over time.

7.9.8 Property 11, 12, 13, 14

The visibility of these dwellings is covered by Viewpoint 36B.

7.9.9 Property 15

Distance to highway: 300 metres

Long distance views over agricultural land. The dwelling is surrounded by scattered native trees and screened from the highway by dense roadside vegetation.

Visual impact: Low

Some roadside vegetation will be removed for the project, however, this will be replaced with native species. The existing retained trees will provide sufficient screening of the project from this dwelling.

7.9.10 Property 16

Distance to highway: 150 metres

Foreground views over rural and heavily vegetation land. The dwelling is surrounded by small stands of native trees and screened from the highway by dense native vegetation.

Visual impact: Low

Some roadside vegetation along the highway and Jackybulbin Road will be removed for the project and to provide a turnaround facility on Jackybulbin Road. The existing retained planting will screen the project from the dwelling. New planting along Jackybulbin Road will screen the turnaround facility.

7.9.11 Property 17

Distance to highway: 75 metres

Foreground views. The dwelling is bordered by Devils Pulpit State Foest on two sides with views to agricultural land to the south. It is screen from the highway by roadside vegetation.

Visual impact: Moderate

Some roadside planting will be removed for the project, however, this will be replaced. The remaining vegetation, along with the replacement planting will provide the same level of screening that currently exists.

7.10 SUMMARY OF VISUAL IMPACTS

7.10.1 Summary of visual impacts

Overall, the detailed design is considered to have a similar impact on key views as the EIS concept. For two viewpoints there is an change in the magnitude rating for the detailed design assessment. These are:

- Viewpoint 32B Watts Lane (west), where the removal of the Watts Lane overbridge and replacement with the highway alignment elevated about 3 m above the existing ground level on twin bridges, reduces the magnitude rating from Moderate to High to Moderate
- Viewpoint 34 Fischers Lane, Iluka, where the new Chatsworth Road overbridge and associated embankments and a re-routed Fischers Lane are proposed and increase the magnitude rating from Low to Moderate.

A summary of the EIS and detailed design impact assessment is presented in Table 7-2.

A number of residential dwellings are located in close proximity to the highway with varying degrees of visibility to the highway depending of the the amount of vegetation next to the highway or around the dwelling. Where roadside vegetation will be removed for the project near these dwellings, it will be replaced with native species. In other locations where there is currently no screen planting, for example, Property 9, it will be provided within the road corridor. At Property 1, no roadside screen planting will be provided in order to maintain good quality views over the floodplain and to maintain the integrity of the marker planting.

Table 7-2: Key viewpoints summary

VIEWPOINT	EIS SENSITIVITY	DETAILED DESIGN SENSITIVITY	EIS MAGNITUDE	DETAILED DESIGN MAGNITUDE	EIS IMPACT RATING	DETAILED DESIGN IMPACT RATING
26A. Yamba Road, Harwood	Moderate to High	*No change*	Moderate to Low	*No change*	**Moderate**	***No change***
26B. Yamba Road, Harwood	Moderate to High	*No change*	Moderate to High	*No change*	**Moderate to High**	***No change***
27A. Palmers Channel bridge, Yamba Road	Moderate	*No change*	Low	*No change*	**Moderate to Low**	***No change***
27B. South Bank Road, Palmers Channel	Moderate	*No change*	Low	*No change*	**Moderate to Low**	***No change***
28. Public Jetty, Clarence River, Harwood	High	*No change*	High	*No change*	**High**	***No change***
29. End Harwood Road, Harwood	High	*No change*	High	*No change*	**High**	***No change***
30. Cnr Cannons Lane & River Street	Low	*No change*	Low	*No change*	**Low**	***No change***
31. Ashby Heights	Low	*No change*	Low	*No change*	**Low**	***No change***
32A. Watts Lane (east)	Moderate to High	*No change*	Moderate to High	*No change*	**Moderate to High**	***No change***
32B. Watts Lane (west)	Moderate	*No change*	High	*Moderate*	**Moderate to High**	***Moderate***
33. North Arm Drive	Moderate to Low	*No change*	Moderate	*No change*	**Moderate**	***No change***
34. Fischers Lane, Iluka	Low	*No change*	Low	*Moderate*	**Low**	***Moderate to Low***
35. Garretts Lane, Iluka	Moderate to Low	*No change*	Low	*No change*	**Moderate to Low**	***No change***
36A. Pacific Highway, Iluka	Moderate to Low	*No change*	Moderate to High	*No change*	**Moderate**	***No change***
36B. Old Pacific Highway, Iluka	High	*No change*	High	*No change*	**High**	***No change***
36C. Tabbimoble	Low	*No change*	Low	*No change*	**Low**	***No change***

7.11 VISUAL MITIGATION STRATEGY

7.11.1 Mitigation recommended during concept design

The *Landscape Character and Visual Impact Assessment* report (Hassell, 2012) undertaken during the EIS outlined specific mitigation measures provided at every vantage point to seek to ensure that areas assessed at high impact were properly and appropriately considered at design and implementation stages.

In summary, mitigation recommended for viewpoints within Sections 5 and 6, excluding those related to the new Clarence River bridge, are shown in Table 7-3.

Table 7-3: Mitigation measures recommended in the EIS

	Viewpoints where applicable															
MITIGATION MEASURE	**VP26A**	**VP26B**	**VP27A**	**VP27B**	**VP28**	**VP29**	**VP30**	**VP31**	**VP32A**	**VP32B**	**VP33**	**VP34**	**VP35**	**VP36A**	**VP36B**	**VP36C**
Minimise loss of existing screen/riparian trees	•															
Minimise the loss of existing riparian vegetation as much as possible		•	•	•	•	•	•									
Provide screen planting to the new elevated approach road embankment in accordance with the concept design		•														
Plant dense low grasses/ ground covers on fill batters								•	•		•	•	•			
Reinstate agricultural land where possible								•	•		•	•	•			
Reinstate riparian vegetation where possible								•			•	•	•			
Minimise loss of existing trees									•		•	•	•			
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 dense screen to nearby homes										•						
Highlight the highway and over pass routes with formal tree planting										•						
Prepare detail landscape design in accordance with the landscape concept strategy										•						
Consider filling between service roads and highway to reduce height of embankments										•						
Retain existing Araucaria which is prominent in the existing landscape										•						
Minimise the depth of the bridge deck													•			
Provide new screen and forest planting along the alignment of the project (including on/off ramps, service roads) in accordance with the concept design														•	•	
Revegetate between the interchange at Iluka Road and existing homes located on the east side in accordance with the concept design														•	•	
Retain existing vegetation wherever possible to provide a natural screen to the project															•	
Plant local forest trees on fill batters																•
Reinstate the forest edge where applicable																•

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8. URBAN DESIGN AND LANDSCAPE CONCEPT DETAIL

Following are descriptions of the landscape and urban design elements that have been developed during the detailed design stage for the project-wide structures, road furniture and planting. These elements would be refined as the detailed design progresses.

Chapter contents

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8.1 OVERVIEW

An integrated design approach has been adopted for the upgrade in order to ensure that the best possible outcomes are achieved. This integration is achieved through multidisciplinary teams and urban design and landscape design teams across the project sections regularly collaborating to resolve design problems as opposed to working in isolation. This approach has enabled landscape and urban design solutions to be developed that feeds outcomes and values into the overall design for the upgrade. As a result, urban design has directly influenced key engineering aspects of the road design and bridges.

The project responds to the existing landscape character and vegetation communities and defines a methodology for revegetation of the upgrade. This methodology involves the utilisation of several techniques, which aim to provide a vegetative cover to all surfaces impacted by the works and work in tandem with soft engineering and drainage design to stabilise the works. The landscape and urban design and landscape response follows on from the urban design principles and objectives developed and aims to identify specific direction for the upgrade.

The following description of landscape and urban design elements expands on the following topics:

- Structures
- Earthworks formations
- Drainage and water quality
- Road corridor
- Furniture
- Fauna crossings
- Topsoil
- Planting.

8.2 STRUCTURES

8.2.1 Bridges

Maclean to Devils Pulpit (Sections 5 and 6) includes twenty new bridges to support the highway upgrade. Urban design input has been integrated into the bridge structural design process in order to ensure that the requirements of the following have been achieved:

- *Upgrading the Pacific Highway Design Guidelines* (March 2015)
- *Pacific Highway Upgrade Woolgoolga to Ballina SPIR* (2013)
- *Pacific Highway Upgrade Woolgoolga to Ballina EIS* (2012)
  - Main Volume 1B, Chapter 11: Urban design, landscape character and visual impact

Additionally, urban design for the bridges has been undertaken in accordance with the key Roads and Maritime design policies and guidelines:

- *Beyond the Pavement* – urban design policy procedures and design principles (2014)
- *Bridge aesthetics* – design guideline to improve the appearance of bridges in NSW (2012)

8.2.2 Urban design approach for bridges

The overarching urban design approach to the bridge design has been:

- To design the visual expression of the bridges to be simple, streamlined and elegant in order to allow the surrounding landscape character to predominate
- To develop a consistent language to typical bridge elements in order to visually unify the bridges along the project
- To be consistent with the urban design of bridges in the adjoining sections of the Pacific Highway upgrade.

Urban design coordination has been undertaken across all W2B project sections to ensure a consistent approach to the design and detailing for all bridges across the project.

8.2.3 Typical bridge elements

Standard details have been developed for typical bridge elements in order to unify the visual expression of bridges across the entire W2B project.

Parapets

Simple, unarticulated precast concrete parapets have been adopted for all bridges to unify the visual expression of bridge superstructures across the entire W2B project.

Barriers

Two types of bridge barriers have been adopted for all W2B project bridges:

- Medium performance barriers with twin rails for all overbridges and other bridges where required to meet safety standards
- Regular performance solid concrete barriers for all floodplain bridges. A single cyclist grab rail is provided on barriers adjacent to the nearside shoulder only, to provide additional protection for cyclists.

Overbridge elements

Bridges over the Pacific Highway are visually prominent features of the highway journey from the motorists' perspective. Standard details have been developed for the following key elements specific to overbridges:

Piers

- 'Stiletto' piers, being portal type piers tapered in both directions, with integrated headstocks for all overbridges of 10 metres width or greater
- Blade piers, tapered in both directions, with integrated headstocks, for all overbridges less than 10 metres width.

Between Maclean and Devils Pulpit (Sections 5 and 6), bridges B05 and B07 would have blade piers and bridge B09 would have 'stiletto' piers.

Barriers and safety screens

All overbridges would include:

- Medium performance barriers with twin rails
- Curved throw screens with tapered ends, consistent with throw screens on other overbridges in adjoining sections of the Pacific Highway upgrade.

Abutments

- Abutment wing walls on all overbridges would be vertical
- Abutment embankments under all overbridges would be finished with a paved surface using local stone
- Abutment maintenance access platforms and stairs for all overbridges would be concrete.

8.2.4 Bridge types between Maclean and Devils Pulpit

The nineteen new bridges between Maclean and Devils Pulpit (Sections 5 and 6) have been categorised into five distinctive types:

- Overbridges (bridges over the Pacific Highway)
- Highway bridges over waterways
- Highway bridges over local roads
- Single highway bridges over floodplain
- Twin highway bridges over floodplain

The urban design aim for the five bridge types is to visually unify the bridges within each type in order to create recognisable 'families' of bridges. To this end, the following approaches have been adopted:

- To utilise consistent visible structural elements (such as girders, piers and headstocks), wherever possible and practical
- To develop a consistent language for visible bridge elements common to bridges within each group.

Notwithstanding the above, wherever new bridges duplicate existing bridges in highly visible locations, the urban design approach has been to match the key visible bridge elements (such as piers, parapets, barriers) of the existing bridge wherever possible.

Refer to Table 8-1 for a summary of the urban design assessment of the bridges between Maclean and Devils Pulpit. Note that flood modelling studies are subject to detailed design development and consultation with communities. The bridge designs may change as a result of these consultations.

Refer to Chapter 7 for urban design and landscape cross sections that illustrate the various bridge design types.

Table 8-1: Maclean to Devils Pulpit (Sections 5 and 6) bridge urban design summary

Bridge number	Bridge reference	Project section	Bridge start (chainage on highway)	Bridge deck length (metres)	Number of spans	Deck width between barriers	Medium performance barrier with twin rails	Regular performance barrier with cyclist grab rail (nearside)	Fauna connection	Footpath	Landscape context				Visibility of the bridge to the public or residents
											Forest	Agriculture	Floodplain	Riparian	
B01	Twin bridges over Koala Drive	5	83,098.475 (NB) 83,097.420 (SB)	24.9	1	16.5 (NB) 13.4 (SB)	•		•		•	•			Low
B02	Northbound bridge over Clarence Floodplain	5	84,770	150	8	10.5		•			•	•	•		Low
	New Bridge over the Clarence River at Harwood	N/A	85,925	1,350	SUBJECT OF A SEPARATE SUBMISSION										
B52	Twin bridges for Clarence Floodplain Opening 4	5	87,785 (NB) 87,792.200 (SB)	370	19	10.5 (NB) 10.5 (SB)		•				•	•		Moderate
B55	Northbound bridge for Clarence Floodplain Opening 7	5	88,479.296	100	5	14.5		•				•	•		Moderate
B56	Northbound bridge for Clarence Floodplain Opening 8	5	89,062.045	160	8	10.5		•				•	•		Moderate
B04	Northbound bridge over Serpentine Channel	5	89,318.395	80	3	12.2	•		•			•	•	•	Moderate
B59	Northbound bridge for Clarence Floodplain Opening 11	5	90,010	240	12	13.2		•				•	•		Low
B05	Bridge over Pacific Highway at Serpentine Channel North Bank Road	5	90,767.666 (bridge centreline)	62.99	2	9	•					•	•		High
B60	Northbound bridge for Clarence Floodplain Opening 12	5	91,319.296	120	6	11.6		•				•	•		Low
B61	Northbound bridge for Clarence Floodplain Opening 13	5	91,687	60	3	11.6		•				•	•		Low
B62	Northbound bridge for Clarence Floodplain Opening 14	5	92,157	100	5	10.5		•				•	•		Low
B63	Northbound bridge for Clarence Floodplain Opening 15	5	92,537	40	2	11		•				•	•		Low
B64	Northbound bridge for Clarence Floodplain Opening 16	5	92,777	220	11	10.5		•				•	•		Low
B65	Northbound bridge for Clarence Floodplain Opening 17	5	93,230	220	11	10.5		•				•	•		Low
B07	Bridge over Pacific Highway at Chatsworth Road	5	93,831 (bridge centreline)	72.16	3	9	•					•	•		High
B08	Southbound bridge over Clarence River North Arm	5	93,985	216.6	8	10.5	•		•					•	High
B09	Bridge over Pacific Highway at Iluka Road Interchange	5	95,411.376 (bridge centreline)	57.6	2	14	•			•	•	•			High
B10	Northbound bridge over Tabbimoble Creek	6	101,548.520	100	5	10.5		•	•		•			•	Low
B11	Northbound bridge over Tabbimoble Creek Overflow	6	102,853.616	60	3	10.5		•	•		•			•	Low

KEY: ● Overbridge ● Bridge over waterway ● Bridge over local road ● Twin bridge over floodplain ● Bridge over floodplain

8.3 EARTHWORKS FORMATIONS

Structures and earthworks formations are required to reconcile the new highway levels with existing ground levels. The types of earthworks formations required for this project are:

- Fill embankments - where the new highway would be situated above the existing ground, requiring the road to be elevated
- Cuttings - where the new highway would be situated below the existing ground, requiring excavation.

While it is preferable in principle to build the new highway as close to the existing ground levels as possible, in practice this has not been possible in several locations. Instead, the design requires the highway to be either above or below the existing ground levels for much of the project length due to:

- The minimum geometric requirements for the horizontal and vertical road alignment to meet the relevant design standards for the highway upgrade
- The undulating shape of the existing terrain
- The requirement to achieve a minimum 20 year ARI flood immunity in Section 5
- The need to balance cut and fill volumes, which has resulted in the large cutting just south of Mororo Road, between CH 97,500 and 98,500, which would generate approximately 1 million cubic metres of fill.

The following responses to landform have been incorporated in the design:

- Where the existing landform is relatively flat and space permits, for example, across the Clarence River floodplain, a flatter embankment profile (4H:1V or flatter for embankments up to 2.5 m in height) has been provided to better fit with the surrounding landform
- Where the existing landform is steep or where space is limited, steeper embankments (2H:1V for embankments greater than 2.5 m in height, with safety barriers) have been provided to minimise extent
- Cuttings within bushland areas, except Mororo Cut, are generally 2H:1V to minimise extent of clearing.

Landscape treatments for earthworks formations are discussed in Chapter 8.9 of this report.

8.4 DRAINAGE AND WATER QUALITY

The highway upgrade is situated within, and has the potential to affect, the sensitive subcatchments of the Clarence River. Two types of water quality design is necessary: temporary erosion and sediment (ERSED) controls during construction; and permanent water quality treatment requirements for the ongoing operation of the highway.

Due to the low lying nature of the floodplain environment, a large number of basins are required to treat the construction area during all stages of the work. Additionally, a large number of drainage channels are required to manage the flow of surface water across the project area. The basins are connected by a series of open swales and pipes, which often require a large amount of earthworks and landform remodelling - often in conjunction with other landscape formations such as fill embankments.

8.4.1 Vegetated swales

Vegetated swales and channels will be provided wherever gradients allow. The design has maximised the use of vegetated channels, which assists in both the cleaning of water but also in the integration of the drainage with its landscape context. The vegetated nature of these drains ensures velocities are reduced and the potential for sediment and pollutant removal is maximised.

8.4.2 Concrete lined channels

Concrete lined channels have been avoided where possible. Where they are to be used, the concrete will be coloured and/or heavily roughened so that the resulting darker colour better integrates with the surrounding landscape. Concrete lined channels within the median will not be visible.

8.4.3 Water quality basins

Water quality basins have been located to minimise the loss of native vegetation and fauna habitat and to minimise their visual impact to road users and local residents. Permanent basins will be planted with appropriate native riparian species to aid in the filtration of stormwater, therefore avoiding adverse impacts on the existing downstream biodiversity of wetlands and creek systems.

Water quality basins have been designed and shaped so that they integrate with the existing landscape character. Within bushland areas, native tree and/ or shrub planting will screen basins from the roadway. In the open agricultural landscape, the water quality basins have been designed and shaped so that they would resemble farm dams.

Security fencing around basins will be minimised wherever feasible, in particular around basins in agricultural areas, in order to maintain the existing ‘open’ landscape character.

8.4.4 Culverts

A large number of drainage culverts are required beneath the highway between Maclean and Devils Pulpit. The culverts are designed to not be visible from the highway and, wherever possible, they are screened from the surrounding landscape by vegetation.

8.5 ROAD CORRIDOR

8.5.1 Median and verge treatments

The landscape treatments to the median and verge respond to the landscape character of the area in which the highway is located. These treatments are described on the urban design and landscape concept drawings in Chapter 7.

8.5.2 Rest areas

The design of the rest area will seek to provide an environment that is inviting and attractive to motorists, encouraging them to take breaks on their journey along the highway. The rest area is located in a heavily vegetated forest setting, part of which is listed as High Conservation Old Growth Forest. The landscape design will ensure that the rest area is fully integrated into the existing whilst still providing filtered views from the highway to acknowledge the presence of the rest area. The footprint of the rest area have been reduced during the design process, allowing the retention of a large area of forest.

The landscape design will include:

- Picnic shelters located within a lawn area with scattered native tree planting to provide a park-like atmosphere
- Concrete paths linking the light vehicle and truck carpark areas with the picnic shelters and toilet block, providing safe circulation access around the rest area
- Tree planting to the carpark islands to provide shade for vehicles
- The opportunity to provide landscape marker planting to denote the entry to the rest area.

8.5.3 Pedestrian and cycle network

The main alignment highway design allows for safe cycle passage via a 2.5 metre wide nearside shoulder throughout.

Cyclist provisions also exist in the form of 2 metre wide shoulders for all entry and exit ramps, and for local road connections around the Yamba interchange, Harwood interchange underpass, Chatsworth Road overpass, Serpentine Channel Road overpass, and Iluka overpass. A cycle ramp will be provided at the connection to the existing Clarence River Bridge to provide a safe transition for cyclists up and onto the existing 1.8 metre wide separated shared path on the bridge. A shared pedestrian and cycle path is provided on the Iluka overpass bridge.

Note that shared path locations are subject to further design development and consultation with communities and agencies.

There are no formal pedestrian-only footpaths provided along the highway upgrade between Maclean and Devils Pulpit (Sections 5 and 6).

8.5.4 Bus stops

Bus stops have been allowed for at the following locations:

- Within the existing rest area between CH 98,600 to CH 98,700
- A bus layby area on Tullymorgan-Jackybulbin Road near CH 102,700.

Within these locations, any bus shelters will be located to ensure good visibility for pedestrians and approaching buses. Native planting will be provided outside of clear zones where required, for shade and pedestrian amenity.

Plate 8-1: Picnic shelters at the Hunter Expressway westbound rest area

8.5.5 Heavy vehicle stopping bays

Heavy vehicle stopping bays are located at the following locations:

NORTHBOUND	CH 84,550, CH 89,125, CH 90,425 (offside), CH 91,050, CH 91,900 (offside), CH 92,650, CH 98,600
SOUTHBOUND	CH 84,450, CH 88,950, CH 90,600, CH 93,000

The majority of the heavy vehicle stopping bays are located on the open floodplain, therefore, planting is limited to pasture grasses to maintain the desired landscape character of the area and views over the agricultural landscape to the forested hills beyond. For the bays located next to existing forest, at CH 84,450 and CH 98,600, native planting will be provided outside of clear zones where required, for shade and pedestrian amenity.

8.6 FURNITURE

Road furniture comprise ancillary items necessary for the effective operation of the highway. Road furniture is presented in a separate package; however, urban design input has been provided for the following road furniture items in order to mitigate visual impact and where possible compliment the existing landscape character:

- Fencing
- Headlight screening
- Lighting
- Safety barriers
- Bus stop shelters.

8.6.1 Fencing

A number of fence types have been incorporated into the design between Maclean and Devils Pulpit (Sections 5 and 6). These are described below.

Boundary fencing

Boundary fencing is generally located along the project boundary except when the site boundary is adjacent and parallel to a local road corridor where the fence is located on the local road boundary. Fences comprise either prestressed concrete posts or hardwood posts with three or five strand barbed wire or an alternative stock proof fence panel.

Fauna fencing

Fauna fencing will be installed to exclude fauna from roads and guide animals towards crossing structures such as underpasses. Fauna fencing consists of:

- Mammal fencing
- Koala fencing
- Phascogale fencing
- Green-thighed frog fencing
- Fencing at glider poles.

Fauna fences will be set back from the road edge to minimise impact of these fences on the visual environment of the road corridor. Fauna fencing adopts the Roads and Maritime standard floppy top fence. Refer to Table 6-3 for a summary of the fauna fencing locations and extents between Maclean and Devils Pulpit (Sections 5 and 6).

Security fencing

Security fencing has been designed around drainage basins deemed to be accessible by the general public in order to prohibit unauthorised entry. These fences are to be 1.8 metre high DN40 galvanised posts with chain link panels

In general, the following urban design inputs have been provided to minimise the visual impact of fences:

- Fences would only be provided around selected water quality basins to prevent unauthorised entry. There would be no fences around basins in agricultural areas as they are not in keeping with the existing character
- Fauna and boundary fences may be combined in certain locations to reduce the amount of fencing.

Planting requirements for fauna fencing are provided in Chapter 8.7.

8.6.2 Headlight screening

Headlight glare requires mitigation in certain circumstances to reduce light glare to oncoming highway traffic, local road traffic and local residents.

The detailed design has avoided permanent headlight screens between Maclean and Devils Pulpit (Sections 5 and 6). In particular, headlight screens across the Clarence River floodplain have been avoided in order to retain views and maintain the existing agricultural character of the landscape.

Where space permits, the landscape treatment is composed of a vegetated landform (mound) with frangible shrub planting at sufficient density to provide effective headlight screening. Temporary headlight screens would be provided if planting does not provide adequate screening at the time of opening. If temporary headlight screens are required, they would be:

- Simple, plain structures in their form and utilise durable materials and dark recessive colours in general
- Designed and detailed, including their texture, materials, finishes and colour, to be consistent, contextual and have interesting forms.

Frangible shrub planting in the highway median on bends is provided to mitigate headlight glare, whilst also contributing to the landscape character and integrating the project into the existing landscape.

Figure 8-1: Example of combined Koala and Phascogale fence

Figure 8-2: Example of combined Koala and Frog fence

8.6.3 Lighting

Lighting will be provided at the Yamba, Harwood and Iluka interchanges. At the Iluka interchange, luminaires have been chosen to provide a similar lighting environment to the existing situation. Lighting is not provided on the main carriageway.

8.6.4 Safety Barriers

Safety barriers along the roadside generally consist of wire rope safety barriers (WRSB), G4 W beam barriers or Type F safety barriers. Every effort has been made to eliminate hazards that necessitate the need for barriers. This has been achieved by:

- Changing fill embankments from 2H:1V to 4H:1V
- Relocating non-frangible objects outside of the clear zone
- Changing the design of the hazard to make it non-hazardous, eg use of a frangible post instead of a non-frangible post.

Wire rope safety barriers

Wire rope safety barriers are the preferred type of road safety barrier as they allow for visual connections from the highway to the local landscape. WRSB would be used in the following situations:

- On fill embankments of 2H:1V grade, higher than 2 m above natural ground
- In the median where widths are less than 11 m between edge lines
- To protect non-frangible objects located in the clear zone
- Where there is a significant level difference between carriageways.

G4 W beam safety barriers

G4 W beam safety barriers are only used where it is not possible to use WRSB, for example:

- Approaches to some structures
- Embankments at interchanges where radii are less than 200 metres
- Entry ramps, access road, property accesses and where local roads adjoin the main alighnment.

Type F safety barriers

Type F safety barriers are used only where it is not possible to obtain sufficient clearances for dynamic deflection, for example:

- Bridge approaches.

8.6.5 Bus stop shelters

The provision for bus shelters will be determined following consultation with Clarence Valley Council.

8.7 FAUNA CONNECTIVITY

Fauna connectivity structures have been provided in accordance with the environmental requirements for the Maclean to Devils Pulpit (Sections 5 and 6) portion of the highway upgrade. Refer to Table 8-2 for a summary of those fauna connections.

8.7.1 Revegetation for fauna connectivity

Revegetation for fauna connectivity would be provided in accordance with *Upgrading the Pacific Highway Design Guidelines* (2015). Methods for topsoiling, seeding and planting will be in accordance with the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects* (RTA 2011).

Revegetation near fauna connectivity structures

Revegetation near fauna connectivity structures (including bridge underpasses, dedicated fauna underpasses and combined fauna underpasses) will be undertaken as soon as practicable after clearing of existing vegetation, and within three months of completion of construction of the fauna crossing. The density of vegetation planting or seeding will match the surrounding natural habitat.

Vegetation planted or seeded within an approach to a fauna crossing will be provided in such a way as to:

- Not obstruct access to the underpass or bridge
- Be endemic and representative of the surrounding natural habitat
- Be designed to attract native fauna species to the structure, except where fauna exclusion fences are not present
- Not obstruct the views through, or disguise, the entrance to the underpass or bridge.

Revegetation near fauna fencing

Native tree and shrub seeding and planting stock will not be used within three metres of fauna fences during the revegetation process. The growth of vines and heavy vegetation / grass growth in and adjacent to fauna fences will be reduced.

Revegetation near frog fencing

Native shrub seeding and planting stock must not be will within one metre of frog fencing as part of any revegetation. The growth of vines and heavy vegetation / grass growth in and adjacent to frog fences will be reduced.

8.7.2 Revegetation specific to koalas

The culvert at CH 96,020 is a dedicated koala connectivity structure. Regevetation near this crossing structure will increase koala habitat in the area, focus on primary and secondary koala food trees and follow the general requirements for revegetation near fauna connectivity structures.

The revegetation works will include primary and secondary koala food trees in areas that would not cause a road safety traffic hazzard. Koala feed trees would not be planted between the fauna fence and the highway.

8.7.3 Revegetation specific to threatened gliders

Landscape works around crossing structures targeted for gliders will aim to retain as many existing large trees as possible and revegetate in proximity to the structure with suitable trees and shrubs.

Strategic revegetation would be undertaken to enhance connectivity through revegetation of lands within the road reserve prioritising the glider crossing zones, and targeted structures. Strategic planting will also guide threatened gliders to appropriate crossing points or discourage them away from the road (whichever is more suitable). Revegetation will also replace glider food sources to encourage usage on both sides of the structure and encourage gliders to the structure and away from the road.

Figure 8-3: Example of glider poles

Figure 8-4: Koala furniture and revegetation

Table 8-2: Fauna connectivity provisions between Maclean and Devils Pulpit (Sections 5 and 6)

CHAINAGE	PROJECT SECTION	TARGETED FAUNA	ADDITIONAL INFORMATION
Fauna connections at bridge structures			
83,100	Section 5	Small and medium terrestrial mammals	Bridge B01 – Twin bridges over Koala Drive Passage to be provided on unsealed track under bridge. 1 metre wide grass swale adjoins unsealed track; no dedicated passage next to track.
89,350	Section 5	Unspecified species	Bridge B04 – Northbound bridge over Serpentine Channel Incidental fauna passage.
94,000	Section 5	Unspecified species	Bridge B08 – Southbound bridge over Clarence River North Arm Dry passage located both banks of the Clarence River North Arm. Includes soft scour treatment and placement of mulch, rocks and ground timber.
101,600	Section 6	Small and medium terrestrial mammals	Bridge B10 – Northbound bridge over Tabbimoble Creek 48 metre wide dry passage located at northern bank and includes soft scour treatment and placement of mulch, rocks and ground timber.
102,870	Section 6	Small and medium terrestrial mammals	Bridge B11 – Northbound bridge over Tabbimoble Overflow Dry passage located on both northern and southern banks. Includes soft scour treatment and placement of mulch, rocks and ground timber.
Fauna underpass culverts			
96,020	Section 5	Small and medium terrestrial mammals, including koalas	Dedicated fauna underpass culvert. Includes koala poles in the culvert and refuge poles outside the culvert.
99,730	Section 6	Small and medium terrestrial mammals	Dedicated fauna underpass culvert. Includes a 'skylight' between the culverts, located between the highway and the on-ramp from the rest area adjacent to the southbound carriageway.
100,480	Section 6	Unspecified species	Combined fauna underpass and drainage culvert.
101,080	Section 6	Unspecified species	Dedicated fauna underpass culvert.
Fish crossings			
89,350	Section 5	Class 1 fish habitat	Bridge B04 – Northbound bridge over Serpentine Channel
94,000	Section 5	Class 1 fish habitat	Bridge B08 – Southbound bridge over Clarence River North Arm
101,600	Section 6	Class 1 fish habitat	Bridge B10 – Northbound bridge over Tabbimoble Creek
102,870	Section 6	Class 1 fish habitat	Bridge B11 – Northbound bridge over Tabbimoble Overflow
Glider poles			
99,290 – 99,375	Section 6	Yellow bellied glider and squirrel glider	The exact location of glider poles will be determined by the Project Ecologist at installation of the poles, following completion of clearing.
Frog ponds			
95,400	Section 5	Green thighed frog	Frog ponds would consist of a shallow scrape in the ground. The exact location of the pond(s) would be determined by the project ecologist upon completion of clearing. May include conversion of temporary water quality basins.
95,300 – 95,500	Section 5	Green thighed frog	
98,500 – 101,500	Section 6	Green thighed frog	
102,000 – 102,700	Section 6	Green thighed frog	

Figure 8-5: Example of fauna furniture at culvert

Figure 8-6: Example of fauna furniture inside culvert

8.8 TOPSOIL

8.8.1 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 or 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 as follows:

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 achieved 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 millimetres deep hole
- For advanced tree: prepare 600x600x450 millimetres deep hole
- For super advanced trees: prepare 600x600x600 millimetres 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.

8.8.2 Topsoil management

The highway upgrade traverses a vast extent of forested areas. 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 the full

commitment of construction staff to the 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 W2B 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.

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

Bushland topsoil

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.

Landscape topsoil

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.

8.8.3 Mulch treatment

All planted areas are to have a surface layer of hardwood mulch sourced from site applied to a nominal minimum depth of 75mm. Mulch is to be stockpiled for 6 months prior to use in order to reduce the impacts of nitrogen draw-down on soils and its effect on plantings.

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.

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8.9 PLANTING AND REVEGETATION

8.9.1 Existing vegetation

The vegetation communities along the upgrade corridor were identified in the *Woolgoolga to Ballina Biodiversity Assessment* (W2BPA 2012). Vegetation mapping has been used to determine locations of communities and to define a broad list of species. These vegetation communities are summarised in Table 8-3.

Species selection rationale

A series of planting and revegetation species palettes has been developed for Portion B, based on the vegetation mapping and broad species lists. The following considerations would determine the species lists for the project:

- Seeding and planting mix species would comprise species from the appropriate vegetation communities that are considered to perform better under the modified conditions. This would allow the establishment of more suitable conditions over time for more sensitive species to regenerate naturally
- The first pass of seed procurement is to be from cleared site areas, particularly from any trees that are being commercially sold for lumber. In Bushland Reconstruction areas seed heads can be retained for use in mulch material added to the topsoil medium
- Bushland Reconstruction areas would by default comprise species of local provenance due to the use of topsoil embedded with seed from adjacent native vegetation.

8.9.2 Species Lists

Table 8-4 to Table 8-9 identify the species lists from which revegetation mixes will be developed for the landscape works. These tables are based on the detailed vegetation mapping (refer Figure 5-9) within the approved project boundary, which outlines the locations of existing vegetation communities between Maclean and Devils Pulpit (Sections 5 and 6).

Refer to Appendix B for draft species lists for the landscape works between Maclean and Devils Pulpit (Sections 5 and 6).

Table 8-3: Vegetation communities

FORMATION		COMMUNITY/ ASSOCIATION		HABITAT AND SOILS
1	**Forested Wetlands**	1A	Swamp Mahogany swamp forest of the coastal lowlands of the North Coast	Low-lying wet depressions with poor drainage, near or on floodplains of creeks with permanent water or fringes of dams. Saline influences near the coast. Soils: Poorly drained, sandy or alluvial.
		1B	Swamp Oak swamp forest of the coastal lowlands of the North Coast	
		1C	Paperbark swamp forest of the coastal lowlands of the North Coast	
		1D	Swamp Box swamp forest of the coastal lowlands of the North Coast	
		1E	Coastal floodplain sedgelands, rushlands, and forblands	
		¬	Swamp Oak Floodplain Forest on Coastal Floodplains	
		¬	Swamp Sclerophyll Forest on Coastal Floodplains	
2	**Wet Sclerophyll Forest**	2A	Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	Broad, flat to slightly undulating floodplains. Soils: Deep, well-drained alluvial deposits. Typically modified by agricultural activities.
		2B	Red Mahogany open forest of the coastal lowlands of the North Coast	
		2C	Tallowwood dry grassy forest of the far northern ranges of the North Coast	
		¬	Subtropical Coastal Floodplain Forest on Coastal Floodplains	
3	**Dry Sclerophyll Forest**	3A	Blackbutt - bloodwood dry heathy open forest on sandstones of the northern North Coast	Sandstone ridges and upper slopes with areas of sandstone outcrops or slightly elevated flat plains above and adjoining floodplains. Soils: Well-drained, weathered sandstone or clays.
		3B	Grey Gum - Grey Ironbark open forest of the Clarence lowlands of the North Coast	
		3C	Scribbly Gum - Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast	
		3D	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast	
		3E	Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast	
4	**Grassy Woodland**	4A	Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast	Low poorly drained sites near coastal streams or swamps, or low quartz sediments. Soils: Coarse textured soils of fair to moderate fertility.
		4B	Narrow-leaved Red Gum woodlands of the lowlands of the North Coast	
5	**Rainforest**	5A	White Booyong - Fig subtropical rainforest of the North Coast	Low altitudes on fertile soils near the coast.
6	**Saline Wetlands**	6A	Mangrove - Grey Mangrove Low Closed Forest	Saline estuarine sediments of intertidal flats. Soils: Alluvial.
		6B	Saltmarsh complex of the North Coast	

Table 8-4: Forest Wetlands species

MIX TYPE	COMMUNITY/ ASSOCIATION	DOMINANT CANOPY SPECIES	OTHER CANOPY SPECIES	DOMINANT SHRUB SPECIES	GROUNDCOVER SPECIES	IMAGES
01	**FOREST WETLANDS**					
1A	Swamp Mahogany swamp forest of the coastal lowlands of the North Coast	*Casuarina glauca* (SSF) *Eucalyptus robusta* (SSF) *Eucalyptus resinifera* (SSF) *Eucalyptus tereticornis* *Melaleuca quinquenervia* (SSF) *Melaleuca nodosa* *Lophostemon sauveolens*	*Angophora subvelutina* *Corymbia intermedia* *Corymbia maculata* *Melaleuca linariifolia* (SSF) *Livistona australis*	*Acacia maidenii* *Baeckea frutescens* *Baloskion tetraphyllus* *Baumea arthrophylla* *Baumea rubiginosa* *Callistemon pachyphyllus* *Cordyline stricta* *Eleocharis spp.* *Glochidion ferdinandi* *Goodenia ovata* *Hibiscus diversifolius* *Leptospermum juniperinum* *Melaleuca ericifolia* *Melaleuca styphelioides* (SSF) *Melastoma affine* *Parsonsia straminea*	*Baumea juncea* *Blechnum camfieldii* *Blechnum indicum* *Enydra fluctuans* *Fimbristylis ferruginea* *Gahnia clarkei* *Hypolepis muelleri* *Ischaemum australe* *Juncus kraussii* *Sporadanthus interruptis* *Xanthorrhoea fulva*	 Left to right: *Eucalyptus robusta* (Swamp Mahogany), *Casuarina glauca* (Swamp She-oak), *Melaleuca quinquinervia* (Broad-leafed Paperbark).
1B	Swamp Oak swamp forest of the coastal lowlands of the North Coast					
1C	Paperbark swamp forest of the coastal lowlands of the North Coast					
1D	Swamp Box swamp forest of the coastal lowlands of the North Coast					
1E	Coastal floodplain sedgelands, rushlands, and forblands					
	Swamp Oak Floodplain Forest on Coastal Floodplains					
	Swamp Sclerophyll Forest on Coastal Floodplains					

Table 8-5: Wet Sclerophyll Forest species

MIX TYPE	COMMUNITY/ ASSOCIATION	DOMINANT CANOPY SPECIES	OTHER CANOPY SPECIES	DOMINANT SHRUB SPECIES	GROUNDCOVER SPECIES	IMAGES
02	**WET SCLEROPHYLL FOREST**					
2A	Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	*Lophostemon confertus* *Eucalyptus grandis* *Eucalyptus microcorys* *Eucalyptus resinifera subsp. hemilampra* *Eucalyptus resinifera subsp. resinifera*	*Angophora woodsiana* *Corymbia intermedia* *Eucalyptus acmenoides* *Eucalyptus pianchoniana* *Eucalyptus propinqua* *Eucalyptus siderophloia* *Syncarpia glomulifera*	*Acacia spp.* *Acmina smithii* *Allocasuarina littoralis* *Allocasuarina torulosa* *Archontophoenix cunninghamiana* *Banksia oblongifolia* *Breynia oblongifolia* *Cordyline stricta* *Cryptocarya microneura* *Cryptocarya rigida* *Dioscorea transversa* *Elaeocarpus reticulatis* *Endiandra sieberi* *Guioa semiglauca* *Leptospermum polygalifolium* *Melaleuca sieberi* *Persoonia stradbrokensis* *Pultenaea spp.* *Synoum glandulosum* *Syzigium oleosum* *Trochocarpa laurina* *Wilkiea huegeliana* *Xanthorrhoea fulva*	*Adiantum hispidulum* *Blechnum cartilagineum* *Cissus antacrtica* *Cissus hypoglauca* *Dianella caerulea* *Entolasia stricta* *Geitonoplesium cymosum* *Hardenbergia violacea* *Hibbertia scandens* *Imperata cylindrica var. major* *Ischaemum australe* *Lepyrodia scariosa* *Lomandra longifolia* *Morinda jasminoides* *Pratia purpurascens* *Ptilothrix deusta* *Smilax australis* *Smilax glyciphylla* *Themeda australis*	 Left to right: *Eucalyptus grandis* (Flooded Gum), *Eucalyptus microcorys* (Tallowwood), *Eucalyptus resinifera* (Red Mahogany).
2B	Red Mahogany open forest of the coastal lowlands of the North Coast					
2C	Tallowwood dry grassy forest of the far northern ranges of the North Coast					
	Subtropical Coastal Floodplain Forest on Coastal Floodplains					

Table 8-6: Dry Sclerophyll Forest species

MIX TYPE	COMMUNITY/ ASSOCIATION	DOMINANT CANOPY SPECIES	OTHER CANOPY SPECIES	DOMINANT SHRUB SPECIES	GROUNDCOVER SPECIES	IMAGES
03	**DRY SCLEROPHYLL FOREST**					
3A	Blackbutt - bloodwood dry heathy open forest on sandstones of the northern North Coast	*Corymbia gummifera* *Corymbia henryi* *Corymbia variegata* *Eucalyptus moluccana* *Eucalyptus pilularis* *Eucalyptus propinqua* *Eucalyptus siderophloia* *Eucalyptus signata*	*Angophora floribunda* *Angophora woodsiana* *Corymbia intermedia* *Eucalyptus baileyana* *Eucalyptus eugenioides* *Eucalyptus fibrosa* *Eucalyptus resinifera subsp. hemilampra* *Eucalyptus tereticornis* *Eucalyptus umbra* *Lophostemon suaveolens* *Syncarpia glomulifera*	*Acacia concurrens* *Acacia ulicifolia* *Allocasuarina littoralis* *Allocasuarina torulosa* *Alphitonia excelsa* *Banksia oblongifolia* *Banksia spp.* *Banksia spinulosa var. collina* *Breynia oblongifolia* *Gompholobium pinnatum* *Jacksonia scoparia* *Lambertia formosa* *Leptospermum polygalifolium* *Leptospermum spp.* *Leptospermum trinervium* *Leucopogon lanceolatus* *Lomatia silaifolia* *Melaleuca sieberi* *Persoonia stradbrokensis* *Persoonia tenuifolia* *Phyllanthus hirtellus* *Pimelea linifolia* *Pultenaea spp.* *Trochocarpa laurina* *Xanthorrhoea latifolia*	*Aristida vagans* *Baloskion tetraphyllum* *Cheilanthes sieberi subsp. sieberi* *Cymbopogon refractus* *Desmodium rhytidophyllum* *Dianella caerulea* *Dichondra repens* *Entolasia stricta* *Eragrostis brownii* *Eustrephus latifolius* *Glycine clandestina* *Goodenia hederacea* *Hardenbergia violacea* *Hibbertia vestita* *Imperata cylindrica var. major* *Jasminum suavissimum* *Lepidospermum laterale* *Lomandra longifolia* *Lomandra multiflora* *Oplismenus aemulus* *Panicum simile* *Pratia purpurascens* *Pteridium esculentum* *Themeda australis* *Vernonia cinerea*	 Left to right: *Eucalyptus moluccana* (Grey Box), *Eucalyptus pilularis* (Blackbutt), *Eucalyptus siderophloia* (Grey Ironbark).
3B	Grey Gum - Grey Ironbark open forest of the Clarence lowlands of the North Coast					
3C	Scribbly Gum - Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast					
3D	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast					
	Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast					

Table 8-7: Grassy Woodland species

MIX TYPE	COMMUNITY/ ASSOCIATION	DOMINANT CANOPY SPECIES	OTHER CANOPY SPECIES	DOMINANT SHRUB SPECIES	GROUNDCOVER SPECIES	IMAGES
04	**GRASSY WOODLAND**					
4A	Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast	*Eucalyptus seeana* *Eucalyptus tereticornis* *Lophostemon suaveolens*	*Angophora subvelutina* *Casuarina glauca* *Corymbia henryi* *Corymbia intermedia* *Eucalyptus amplifolia subsp. sessiliflora* *Eucalyptus siderophloia*	*Alphitonia excelsa* *Melaleuca quinquinervia* *Melaleuca sieberi* *Melaleuca styphelioides*	*Cymbopogon refractus* *Entolasia stricta* *Gahnia sieberi* *Imperata cylindrica var. major* *Ischaemum australe* *Lomandra longifolia* *Panicum simile* *Pratia purpurascens* *Schoenus apogon* *Themeda australis* *Vernonia cinerea*	 Left to right: *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus seeana* (Narrow-leaved Red Gum), *Lophostemon suaveolens* (Swamp Box).
4B	Narrow-leaved Red Gum woodlands of the lowlands of the North Coast					

Table 8-8: Rainforest species

MIX TYPE	COMMUNITY/ ASSOCIATION	DOMINANT CANOPY SPECIES	OTHER CANOPY SPECIES	DOMINANT SHRUB SPECIES	GROUNDCOVER SPECIES	IMAGES
05	**RAINFOREST**					
5A	White Booyong - Fig subtropical rainforest of the North Coast	*Ficus spp.* *Heritiera trifoliolatum*	*Archontophoenix cunninghamina* *Castanospermum australe* *Cryptocarya obovata* *Daphnandra micrantha* *Dendrocnide excelsa* *Dysoxylum fraserianum* *Dysoxylum muelleri* *Endiandra pubens* *Flindersia schottiana* *Sloanea australis* *Toona australis*	*Cordyline petiolaris* *Cyathea leichhardtiana* *Harpullia alata* *Linospadix monostachya* *Neolitsea dealbata* *Wilkiea austro-queenslandica*	*Adiantum formosum* *Elatostema reticulatum* *Helmholtzia glaberrima* *Lastreopsis spp.* *Pteris umbrosa*	 Left to right: *Heritiera trifoliolatum* (White Booyong), *Ficus spp.* (Fig).

Table 8-9: Saline Wetland species

MIX TYPE	COMMUNITY/ ASSOCIATION	DOMINANT CANOPY SPECIES	OTHER CANOPY SPECIES	DOMINANT SHRUB SPECIES	GROUNDCOVER SPECIES	IMAGES
06	**SALINE WETLANDS**					
6A	Mangrove - Grey Mangrove Low Closed Forest	*Avicennia marina var. australasica*	*Bruguiera gymnorrhiza* *Excoecaria agallocha*	*Aegiceras corniculatum*	*Juncus kraussii* *Sarcocomia quinqueflora subsp. quinqueflora* *Sporobolus virginicus* *Zoysia macrantha*	 Left to right: *Avicennia marina var. australasica* (Mangrove), *Aegiceras corniculatum* (River Mangrove), *Juncus kraussii* (Saltmarsh).
6B	Saltmarsh complex of the North Coast					

8.9.3 Landscape implementation

Landscape implementation methods have been developed to support the urban design objectives and mitigation measures recommended in the EIS and in order to restore the vegetative qualities of the place. Several treatments have been developed to suit the existing conditions and to integrate the upgrade with the surrounding landscape, thereby assisting to minimise the potential visual and environmental impact of the new works. Landscape treatments used on the upgrade would comprise three key methods. These are:

- Planting
- Revegetation (seeding)
- Bushland reconstruction.

8.9.4 Planting

Planting will be provided at a number of locations where an immediate impact is required. Tree planting would provide an important signifier of the approach to the Yamba, Harwood and Iluka Road interchanges and along the entry and exit ramps in these locations. Tree planting would also be provided on both sides of the elevated highway, north of the Clarence River. In these situations, potted stock would be 75 litres.

Tree planting will also be undertaken on fill batters (2H:1V or flatter) to supplement seeded areas. Planting would also be undertaken on headlight attenuation mounds and in some median areas to help control headlight glare. Other areas to be planted include areas adjacent to culverts and fauna crossing structures.

The use of planted species will help to provide short-term impact whilst other revegetation areas are establishing. Tubestock planting will be provided.

Stakes and Ties

Staking and plant guards will be provided for initial support and removed at completion of the maintenance period.

Stakes installed as a marker for locating plants and indicating performance may be provided as part of the ongoing maintenance strategy.

8.9.5 Revegetation

Seed collection

Seed will be sourced from within the NSW North Coast bioregion (as defined by the Interim Biogeographic Regionalisation for Australia).

Seed mixes

A number of different seed mixes has been developed to complement the existing vegetation communities adjoining the upgrade and would be designed for the various different surface types and locations.

Seeding techniques

A combination of seeding techniques will be employed:

- Hydromulching
- Drill/ broadcast seeding
- Compost blanket.

Hydromulching

Hydromulching consists of a mixture of seed, straw and bonding agent and will be sprayed over areas and batters (3H:1V or steeper) including drainage channels (refer Plate 6.18) in accordance with Roads and Maritime Specification R178.

Drill/ broadcast seeding

Drill/ broadcast seeding is to be used for median and roadside areas where slopes are flatter and a successful early strike rate for germination is required. Seeding rates for direct drill seeding will be in accordance with Roads and Maritime specification R178 as customised for the upgrade and will also depend on seed availability.

Compost blanket

Compost blanket comprises a bonding agent blended with site topsoil, organic fibres and local provenance seed, which is then sprayed over the batter surface as an integral layer. As with any seeding process time of year considerations are important to ensure the best growth outcome and to minimise re-spraying. Covercrop can be added to the mixture for initial growth and stabilisation whilst native seed may take longer to strike.

Covercrop

Cover crops, vegetation used to provide temporary batter surface stabilisation, will be used as a temporary stand-alone treatment during the temporary enabling works. They will also be used in association with native seed mixes as part of the permanent landscape outcome.

Cover crops will comprise approved species from Roads and Maritime specification R178 and take into consideration the seasonal nature of the species. The cover crop and native seed mix percentages have been calculated to ensure native seed germination and growth is not hindered.

8.9.6 Bushland Reconstruction

Bushland Reconstruction is a revegetation strategy that was employed on the Pacific Highway Glenugie upgrade (completed 2010) and has since been employed on other Roads and Maritime projects. The methodology been identified as a suitable revegetation methodology for the Woolgoolga to Ballina project due to its proximity to the Glenugie upgrade and similar landscape types. The enclosed nature of the forest affords an abundance of seed, which allows for native forest regeneration and establishment to occur naturally. There is also an availability of mulch material from clearing operations that can be incorporated into the topsoil medium.

By making use of natural regeneration and natural materials, the quantity of planting and seeding can be minimised and restricted to specific locations. It also means that the quantity of imported materials can also be reduced, which reduces project costs and reduces the reliance on the transportation of materials and resulting greenhouse emissions. Some construction processes may become less efficient, however these costs are outweighed by a reduced reliance on imported materials and more expensive revegetation techniques.

Design benefits

- Environmentally sustainable design approach, minimises carbon footprint through reduced transportation of materials
- Utilises seed already in topsoil, in forest environments, where new highway is offline (and generally low level of weed)
- Efficiency of delivery and cost savings
- Better visual and environmental integration with existing landscape.

8.9.7 Monitoring and ecological establishment

Roads and Maritime requirements for landscape maintenance are outlined in specifications R179 - Landscape Planting and R179/D - Landscape Management Plan. These specifications cover all the tasks necessary to promote the cost effective and consistent management of roadside landscape vegetation and areas of bushland reconstruction establised for the project. Landscape monitoring and maintenance will be undertaken during the works and post-completion and take the form of a holistic performance review and rectification process that includes the quality control, establishment, maintenance, monitoring and ongoing assessment of:

- Topsoiling, mulching and erosion control
- Planting and revegetation including bushland reconstruction
- Fertilising
- Pest control.

The landscape management program aims to maximise the performance and appearance of the upgrade, particularly at interchanges, overbridges and underpasses. Management will include replacement planting and revegetation due to failure, as well as removal of over dense vegetation or if species have germinated within offset areas.

Responsibilities

- Local Council
  - Local roads
  - Rest areas and public areas.
- Roads and Maritime
  - Main alignment corridor including medians
  - Water quality basins
- Stakeholders
  - Service corridors.
- Construction contractor
  - All areas during construction and for the post-construction maintenance period of two years.

Maintenance areas

Different areas of the upgrade have specific maintenance requirements due to visual and/ or performance expectations, as well as having different requirements based on the landscape treatment that was applied. The areas are broken down as follows:

- Cut batters
- Fill embankments
- Basins
- Fauna crossings

Maintenance regimes

Maintenance regimes will be divided into activities, as follows:

- Pruning of vegetation for safety (sight lines, overhanging branches, clearance to fencing etc)
- Management and removal of non-frangible vegetation (trees within safety offsets)
- Control of noxious weeds
- Rubbish removal
- Pests and diseases
- Watering
- Monitoring, auditing and reporting (measures ongoing performance).

8.10 LANDSCAPE OUTCOMES

The landscape works to be carried out as part of the W2B upgrade will take time to develop as the new vegetation is established and grows. Consequently the visual character of the landscape works will also change over time. These changes are illustrated by the following set of images (refer Plate 8-2 to Plate 8-9).

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.

Median revegetation

Plate 8-2: Ballina Bypass, February 2011

Plate 8-3: Ballina Bypass, January 2015

Seeding

Plate 8-4: Devils Pulpit rest area, August 2014

Plate 8-5: Devils Pulpit rest area, January 2015

Bushland reconstruction

Plate 8-6: Glenugie Upgrade, April 2011

Plate 8-7: Glenugie Upgrade, July 2012

Plate 8-8: Glenugie Upgrade, August 2013

Plate 8-9: Glenugie Upgrade, August 2014

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9. CONCLUSION

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9.1 CONCLUSION

This UDLP has been prepared to address the Minister's Condition of Approval (D20) for Maclean to Devils Pulpit (Sections 5 and 6) of the Pacific Highway Upgrade – Woolgoolga to Ballina. As part of this process the design has been developed to respond and address the key conditions and approval requirements.

The detailed design is a development of the original EIS design. In order to ensure that the project is consistent with the approval and to assist in the refinement of mitigations measures a revised assessment has been undertaken of both the landscape character and key viewpoints to confirm/validate or revise the assessment to reflect any changes that have occurred since the granting of approval.

The EIS identified ten landscape character precincts between Maclean and Devils Pulpit (Sections 5 and 6). Assessment of the impact of the detailed design concept on these precincts found that there has been no change to the character impacts identified for these precincts at the EIS stage.

The EIS assessed the visual impact of the highway upgrade on 15 key viewpoints identified in Sections 5 and 6. Assessment of the impact of the detailed design concept on these key views has found no change in the visual impacts identified at the EIS stage for 13 of the key views. Of the two key views where impacts have changed:

- Viewpoint 32B has a moderate visual impact, decreasing from a moderate to high impact at the EIS stage
- Viewpoint 34 has a moderate to low visual impact, increasing from a low impact at the EIS stage.

Overall, the detailed design concept for between Maclean and Devils Pulpit (Sections 5 and 6) will have similar landscape character and visual impacts as the EIS concept.

The report presents a plan, cross sections, illustrative perspectives and supporting text to illustrate the compliance and addressing of the key environmental conditions of the project. In doing so it:

- Clearly identifies the principles and standards adopted for the projects' urban and landscape design response
- Defines the vegetation communities that occur within the corridor and the revegetation strategies to be adopted in response to these
- Details the approach to the management and revegetation of ancillary facilities
- Addresses planting in relation to heritage constraints
- Integrates the revegetation of disturbed sites within the overall revegetation strategy
- Addresses the issue of local access including lighting and signage and path connectivity
- Address the visual impacts of the project through the adoption of a range of mitigation measures consistent with the EIS
- Defines the ongoing maintenance of the works to ensure it establishes and achieves the design intent
- Illustrates the involvement of community and Councils in the development of the plan.

The draft UDLP therefore is considered to comply with the conditions of consent as stipulated in D20 of the Minister's Conditions of Approval.

10. BIBLIOGRAPHY

10.1 BIBLIOGRAPHY

Arcadis Beca Joint Venture 2016, *W2B Pacific Highway Upgrade – Portion B Sustainability Action Plan*, report to Pacific Complete.

Brooke, J., Jenkins, R., Costello, A., Edmonds, V. & Goldfarb, A. 2012a, *Upgrading the Pacific Highway Woolgoolga to Ballina Upgrade: Working paper – Aboriginal Cultural Heritage Assessment, Iluka Road to Woodburn Section,* Roads and Maritime Services.

Brooke, J., Jenkins, R., Costello, A., Edmonds, V. & Goldfarb, A. 2012b, *Upgrading the Pacific Highway Woolgoolga to Ballina Upgrade: Working paper – Aboriginal Cultural Heritage Assessment, Wells Crossing to Iluka Road Section*, Roads and Maritime Services.

Clarence Valley Council 2010, *Draft Comprehensive Koala Plan of Management for the Ashby, Woombah & Iluka localities of the Clarence Valley LGA*.

Department of Environment and Climate Change (DECC) 2007, *Landscape selection process: key altitudinal, latitudinal and coastal corridors for response to climate change*, report prepared by the NSW Department of Environment and Climate Change for the Northern Rivers Catchment Management Authority.

Department of Environment and Conservation (DEC) 2003, *Key Habitats and Wildlife Corridors in North East New South Wales*, NSW Department of Environment and Conservation.

GeoLINK 2015, *Woolgoolga to Ballina Microbat Management Plan Sections 3-11*. Geological Survey of NSW 1970, *1:250,000 Geological Series* map, Sheet 56-7: Maclean, Geological Survey of NSW, Sydney.

Mitchell, P.B. 2003, *NSW Ecosystems database mapping unit descriptions*, unpublished report to the NSW National Parks and Wildlife Service, Hurstville.

Morand D.T. 2001, *Soil Landscapes of the Woodburn 1:100,000 Sheet* map and report, NSW Department of Land and Water Conservation, Sydney.

Roads and Maritime Services 2015, *Flora Translocation Strategy: Pacific Highway Upgrade Sections 3-11 excluding Early Works Soft Soil Treatment Areas – Woolgoolga to Ballina* (version 1).

Roads and Maritime Services, Aurecon, Sinclair Knight Merz and Amec Foster Wheeler 2015a, *Woolgoolga to Ballina Pacific Highway Upgrade: Threatened Flora Management Plan* (version 3).

Roads and Maritime Services, Aurecon, Sinclair Knight Merz and Amec Foster Wheeler 2015b, *Woolgoolga to Ballina Pacific Highway Upgrade: Threatened Frog Management Plan*.

Roads and Maritime Services, Aurecon, Sinclair Knight Merz and Amec Foster Wheeler 2015c, *Woolgoolga to Ballina Pacific Highway Upgrade: Threatened Glider Management Plan.*

Roads and Maritime Services, Aurecon, Sinclair Knight Merz and Amec Foster Wheeler 2015d, *Woolgoolga to Ballina Pacific Highway Upgrade: Threatened Mammal Management Plan*.

Roads and Maritime Services, Aurecon, Sinclair Knight Merz and Amec Foster Wheeler 2015e, *Woolgoolga to Ballina Pacific Highway Upgrade: Threatened Fish Management Plan*.

Roads and Maritime Services, Aurecon, Sinclair Knight Merz and Amec Foster Wheeler, 2016, *Woolgoolga to Ballina Pacific Highway Upgrade: Koala Management Plan*.

Sandpiper Ecological 2014, *Pacific Highway Upgrade - Woolgoolga to Ballina Threatened Glider Aerial Crossings Targeted Surveys: Sections 3 and 11*.

Scotts, D 2003, *Key habitats and corridors for forest fauna: A landscape framework for conservation in north-east New South Wales*, NSW National Parks and Wildlife Service, Hurstville.

Woolgoolga to Ballina Planning Alliance (W2BPA) 2012a, *Historical (non-Aboriginal) Heritage Assessment*, Roads and Maritime Services.

Woolgoolga to Ballina Planning Alliance (W2BPA) 2012b, *Working Paper: Biodiversity*, Roads and Maritime Services.

Woolgoolga to Ballina Planning Alliance (W2BPA) 2012c, *Working Paper: Groundwater*, Roads and Maritime Services.

Woolgoolga to Ballina Planning Alliance (W2BPA) 2012d, *Working Paper: Hydrology and Flooding*, Roads and Maritime Services.

Woolgoolga to Ballina Planning Alliance (W2BPA) 2012e, *Working Paper: Land use and Property*, Roads and Maritime Services.

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APPENDIX A

Chapter contents

A.1 URBAN DESIGN AND LANDSCAPE ENVIRONMENTAL MANAGEMENT MEASURES IDENTIFIED IN CHAPTER 5 OF THE SPIR

The following Table A-1 summarises the urban design and landscape environmental management measures identified in Chapter 5 of the Submissions/Preferred Infrastructure Report (SPIR) and identifies where these measures are addressed in this document.

Table A-1: Urban design and landscape environmental management measures identified in Chapter 5 of the SPIR

ISSUE	ID	ENVIRONMENTAL MANAGEMENT MEASURE	TIMING	DOCUMENT REFERENCE
Noise wall visual impacts	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	N/A There are no noise walls required between Maclean and Devils Pulpit (Sections 5 and 6)
Clarence River and Richmond River bridge impacts	UD2	Changes to the design of the Clarence and Richmond rivers bridges from this EIS, will require further visual assessment. Any changes will consider the principles identified in *Working Paper – Urban design, Landscape Character and Visual Impact* (Section 4.6.2), the performance criteria outlined in Chapter 5 of the EIS and funding arrangements.	Pre-construction	No. The new bridge over the Clarence River at Harwood is the subject of a separate submission
Landscaping and planting strategy	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	Chapters 6 and 7
Design of urban design features and road furniture	UD4	The built form of the project, including consideration of the height, bulk, scale, materials and finishes for: • Bridges • Retaining walls • Cuttings and embankments • Road barriers • Signage • Fences • Clear zones • Topsoil management. • Water quality control ponds. • Fauna crossing. • Place marking and cultural plantings. 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.	Pre-construction	Chapters 7 and 8
Shadowing	UD5	Further assessment will be undertaken of the impact of overshadowing on areas surrounding the project, particularly around Harwood Bridge, interchanges and overpasses near residential properties.	Pre-construction	Chapter 7 Note that assessment of the new bridge over the Clarence River at Harwood is limited in this document, as the new bridge over the Clarence River at Harwood is the subject of a separate submission
Visual impacts and viewpoints	UD6	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 is also to be considered.	Construction	Chapter 7
Construction visual impacts	UD7	Disturbed areas will be progressively revegetated throughout the construction period.	Construction	Chapters 6, 7 and 8

ISSUE	ID	ENVIRONMENTAL MANAGEMENT MEASURE	TIMING	DOCUMENT REFERENCE
Visual impacts of ancillary facilities	UD8	Where required, typical landscape treatments for ancillary facilities in forest areas will include: • Providing screen planting • Considering reinstatement of disturbed forest in heavily forested • 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 • Negotiating with private landowners, as applicable, to determine future treatments for other non-forested ancillary facility locations • Re-grading disturbed areas to achieve a sustainable and functional landform • Stabilising all surfaces in accordance with good engineering and environmental practice.	Construction	Chapter 6
Visual impacts of ancillary facilities	UD9	Typical landscape treatments for ancillary facilities in agricultural areas will include: • Considering returning remnant agricultural land to agricultural uses • Providing screen planting • Reinstating riparian vegetation through ancillary facilities, where practicable, in the open landscape • 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 • Re-grading disturbed areas to achieve a sustainable and functional landform • Stabilising all surfaces in accordance with good engineering and environmental practice.	Construction	Chapter 6
Visual impact of borrow sites	UD10	The extent of excavation and the landscaping strategy at borrow sites will be reviewed considering material requirements on the project and the visual impact on the resultant cuttings.	Pre-construction	Chapters 6, 7 and 8
Visual impact of borrow sites	UD11	Any backfilling of the Lang Hill and West of Wardell borrow sites will be undertaken with available surplus material from the project. Rehabilitation of the sites will be undertaken in accordance of the landscape strategy (UD3), design principles (UD5) and the intended future land use of the sites.	Construction	N/A Not part of Maclean to Devils Pulpit (Sections 5 and 6)
Visual impact of borrow sites	UD12	Any backfilling of the Eatons and Gibson borrow sites will be undertaken with available surplus material from the project. Landscaping on the site use indigenous species, including those species suitable for Koala. The landscaping will connect to the existing vegetation to the east of the project by a fauna land bridge to be constructed at station 147.6. Rehabilitation of the sites will be undertaken in accordance of the landscape strategy (UD3) and design principles (UD5).	Construction	N/A Not part of Maclean to Devils Pulpit (Sections 5 and 6)
Monitoring of landscaping and rehabilitation	UD13	Landscape and rehabilitation works will be monitored and remedial measures implemented where required until vegetation has stabilised.	Operation	Chapter 8
Earth mounds	UD14	The mounding profile of any earth mound will blend suitably into the existing landscape setting. Any mounding to be landscaped will be compacted in 1.5 metre layers with 1:3 maximum batter slopes where reasonable in consideration of constraints within the project corridor. Where feasible and reasonable, permanent mounds will be treated with ameliorants and overlaid with topsoil to minimum 150 millimetres to ensure suitable planting conditions are achieved.	Construction	N/A Not part of Maclean to Devils Pulpit (Sections 5 and 6)

A.2 ENVIRONMENTAL MANAGEMENT MEASURES IDENTIFIED IN CHAPTER 5 OF THE SPIR THAT ARE RELATED TO URBAN AND LANDSCAPE DESIGN

The following Table A-2 summarises the environmental management measures identified in Chapter 5 of the Submissions/Preferred Infrastructure Report (SPIR) that are related to urban and landscape design and are addressed by the Maclean to Devils Pulpit (Sections 5 and 6) portion of the project. It also identifies where these measures are addressed in the current document.

Table A-2: Environmental management measures identified in Chapter 5 of the SPIR that are related to urban and landscape design and addressed by the Maclean to Devils Pulpit (Sections 5 and 6) portion of the project

ISSUE	ID	ENVIRONMENTAL MANAGEMENT MEASURE	TIMING	DOCUMENT REFERENCE
Soils, sediment and water	SSW7	Exposed areas will be progressively rehabilitated. Methods will include permanent revegetation, or temporary protection with spray mulching or cover crops.	Construction	Chapters 6, 7 and 8
Soils, sediment and water	SSW9	All work potentially affecting wetlands will be undertaken in consideration of the requirements outlined in the *NSW Wetlands Management Policy 2010*.	Construction	Not applicable to UDLP. Refer to Water Quality design package.
Soils, sediment and water	SSW10	Topsoil, earthworks and other excess spoil material will be stockpiled and managed in accordance with Roads and Maritime *Stockpile Management Guidelines* (Roads and Maritime, 2011) and the "Management of Surplus Material" in Section 3.9 of the SPIR	Construction	Not applicable to UDLP. Refer to Alignment and Earthworks design package.
Soils, sediment and water	SSW11	Where reasonable and feasible, stockpiles will: • Not require removal of areas of native vegetation • Be located outside of known areas of weed infestation • Be located such that waterways and drainage lines are not directly or indirectly impacted	Construction	Not applicable to UDLP. Refer to Alignment and Earthworks design package.
Biodiversity	B3	All fauna connectivity structures will be developed in accordance with the design principles outlined in the Connectivity Strategy in Appendix A of the *Working paper – Biodiversity and the Supplementary Biodiversity Assessment* in Appendix J of the SPIR.	Pre-construction	Chapters 5, 7 and 8. For more detail, refer to the Fauna Connectivity design report.
Biodiversity	B5	Fauna exclusion fencing locations and design will be further developed in accordance with the design principles outlined in the Connectivity Strategy in Appendix A of the *Working paper – Biodiversity*.	Pre-construction and construction	Chapters 5, 7 and 8. For more detail, refer to the Fauna Connectivity design report.
Biodiversity	B12	A landscape management plan will be developed to provide specific details for the re-establishment of native vegetation on batters, cut faces, surrounding sediment basins and other areas disturbed during construction. This includes details for the appropriate removal and restoration of temporary creek crossings. The landscape management plan will be developed in line with Roads and Maritime *Biodiversity Guidelines* (RTA, 2011), the design principles identified in the Connectivity Strategy and the design principles in *Working paper – Urban design, landscape character and visual impact*.	Pre-construction	Chapter 8
Biodiversity	B13	Disturbance and clearing of vegetation will be minimised, particularly: • Avoiding and minimising vegetation removal wherever possible through the detailed design process • Placing water quality basins in the optimal location for treating surface runoff. During detailed design, the location of water quality treatment measures will consider minimising vegetation removal, particularly where there is the potential for threatened plant species, threatened fauna habitat or in identified regional wildlife corridors.	Pre-construction and construction	Chapters 5, 6, 7, and 8.
Biodiversity	B26	Woody debris and bushrock will be re-used on site for habitat improvement where possible and will be detailed in the landscape management plan in accordance with the Roads and Maritime *Biodiversity Guidelines* (RTA, 2011).	Construction	Chapter 8
Biodiversity	B40	Appropriate plant species will be incorporated into the rehabilitation of disturbed aquatic habitats and drains as a result of construction.	Construction	Chapter 8
Non-aboriginal heritage	HH22	Impacts on item 17: Harwood tram tracks,Harwood. The Petticoat Lane tram tracks section will have a protective covering placed over them, (eg a geo textile fabric and heavy duty metal sheeting or similar) to minimise impacts from construction in the area. The covering will be secured before construction and will remain in place until the end of construction.	Pre-construction and construction	Chapters 6 and 7
Traffic and transport	T&T13	The layout of the intersection at Yamba Road will be reviewed to better meet the needs of truck movements from Harwood Mill, where reasonable and feasible.	Pre-construction	Not applicable to UDLP. Refer to Alignment and Earthworks design package.

ISSUE	ID	ENVIRONMENTAL MANAGEMENT MEASURE	TIMING	DOCUMENT REFERENCE
Traffic and transport	T&T14	The need for a full interchange at Yamba Road will be investigated should traffic growth warrant it in the future and when funding is available.	Pre-construction	Not applicable to UDLP. Refer to Alignment and Earthworks design package.
Traffic and transport	T&T15	The need for a full interchange with south facing ramps at Watts Lane, Harwood will be investigated should traffic growth warrant it in the future and when funding is available.	Pre-construction	Not applicable to UDLP. Refer to Alignment and Earthworks design package.
Traffic and transport	T&T16	The need for the overpass and the arrangement of local access at Chatsworth Road will be reviewed at the detailed design stage depending on specific staging and delivery of the highway.	Pre-construction	Not applicable to UDLP. Refer to Alignment and Earthworks design package.
Traffic and transport	T&T17	The need for the overpass and arrangement of local access at Carrols Lane will be reviewed at the detailed design stage depending on specific staging and delivery of the highway.	Pre-construction	Not applicable to UDLP. Refer to Alignment and Earthworks design package.
Traffic and transport	T&T18	Connectivity between the shared user path from Harwood Bridge to Yamba Road would be reviewed to refine pedestrian and cyclist access	Pre-construction	Connectivity has been provided. Refer Chapter 7. For more detail, refer to Alignment and Earthworks design package.

A.3 MITIGATION MEASURES IDENTIFIED IN THE THREATENED SPECIES MANAGEMENT PLANS THAT ARE RELATED TO URBAN AND LANDSCAPE DESIGN

The following Table A-3 summarises the mitigation measures related to urban and landscape design stipulated in the threatened species management plans that are applicable to the area between Maclean and Devils Pulpit (Sections 5 and 6). It also identifies where these measures are addressed in the current document.

Table A-3: Mitigation measures identified in the threatened species management plans that are related to urban and landscape design and are applicable to Maclean to Devils Pulpit (Sections 5 and 6)

THREATENED SPECIES MANAGEMENT PLAN	MITIGATION MEASURE APPLICABLE URBAN AND LANDSCAPE DESIGN IN SECTIONS 5 & 6	DOCUMENT REFERENCE
Koala management plan	Koala fencing at the following locations: • CH 94700 – 95200 (koala fencing) • CH 95200 – 95800 (combined koala/frog fencing) • CH 95800 – 97900 (koala fencing) • CH 97900 – 98000 (combined koala/mammal fencing)	Chapters 6, 7 and 8 For more detail, refer to the Fauna Connectivity design report. Note that the locations and types of fencing may be adjusted in response to the detailed design.
	Mororo Cut (borrow site) Temporary Koala fencing on the eastern side of the existing Pacific Highway for a total length of 1.1km (CH 97,500 to 98,600)	Chapters 6, 7 and 8 For more detail, refer to the Fauna Connectivity design report
	Targeted koala connectivity structure (dedicated culvert) at CH 96150	Chapters 6, 7 and 8 For more detail, refer to the Fauna Connectivity design report. Note that the location of the connectivity structure has been adjusted to CH 96020 in response to the detailed design.
	Habitat revegetation using primary and secondary koala food trees that will not cause a road safety traffic hazard, specifically focussed around crossing structures and riparian corridors within the project boundary.	Chapters 7 and 8
Threatened flora management plan	Targeted weed management measures will be considered for each section of 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.	Chapter 8
	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 plantings will not impact on the species (e.g. will not compete for light or moisture) and are consistent with their habitat requirements.	Chapters 6, 7 and 8
	Seeds and other propagation material to be collected from threatened plants prior to clearing works.	Chapter 8
Flora Translocation Strategy	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.	Chapter 8
Threatened frog management plan	Identify exclusion zones, frog fencing and compensatory pond locations Install exclusion zones, temporary frog fencing prior to clearing Install compensatory ponds after clearing complete.	Chapters 6, 7 and 8 For more detail, refer to the Fauna Connectivity design report
Threatened glider management plan	Provision of glide poles in the vicinity of CH 99550, targeting Yellow-bellied Glider and Squirrel Glider.	Chapters 6, 7 and 8 For more detail, refer to the Fauna Connectivity design report
	Implementation of the UDLP that considers threatened glider population, habitat and revegetation of habitat areas, including strategic revegetation around crossing structures and in disturbed areas.	Chapters 7 and 8
Threatened mammal management plan	Permanent fauna exclusion fencing in the following locations: • CH 82500 - 85100 • CH 97900 - 101300 • CH 101300 - 101900	Chapters 6, 7 and 8 For more detail, refer to the Fauna Connectivity design report
	Fauna connectivity structures at the following locations: • CH 83100 (bridge over Koala Drive) • CH 93990 (bridge over Clarence River North Arm) • CH 99730 (reinforced concrete box culvert) • CH 100640 (reinforced concrete box culvert) • CH 101100 (reinforced concrete box culvert) • CH 101541 (bridge over Tabbimoble Creek)	Chapters 6, 7 and 8 For more detail, refer to the Fauna Connectivity design report. Note that the locations of the connectivity structures may be adjusted in response to the detailed design.

THREATENED SPECIES MANAGEMENT PLAN	MITIGATION MEASURE APPLICABLE URBAN AND LANDSCAPE DESIGN IN SECTIONS 5 & 6	DOCUMENT REFERENCE
	Disturbed known and potential habitat areas within the project are to be revegetated progressively through and at the end of the construction.	Chapters 7 and 8
	Revegetation around fauna connectivity structures using appropriate habitat species for the targeted threatened mammals.	Chapters 7 and 8
Threatened mammal management plan	Strategic revegetation would be undertaken to enhance connectivity through revegetation of lands within the road reserve and completed ancillary areas (where owned by Roads and Maritime). Priority for this road reserve revegetation should be given to: • Local or regional fauna corridors, SEPP 14 wetlands and environmental protection zones, particularly where these might provide seasonal foraging resources • Habitat for important populations • Areas that have been identified to have road kills of threatened mammal species • Cleared landscapes with limited connectivity, aiming to link current isolated patches with potential habitat for threatened mammals.	Chapters 7 and 8

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APPENDIX B

Chapter contents

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B.1 DRAFT TREE PLANTING SPECIES LISTS FOR MACLEAN TO DEVILS PULPIT

Note that all species listed in the following tables are subject to further design development including confirmation that plants are commercially available.

Table B-1: Feature trees at interchanges and approaches

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Araucaria columnaris	Cook Pine	75L and 25L
Araucaria heterophylla	Norfolk Island Pine	75L and 25L
Corymbia maculata	Spotted Gum	75L and 25L
Cupaniopsis anacardioides	Tuckeroo	75L and 25L
Ficus microcarpa var 'Hillii'	Hill's Fig	75L and 25L
Flindersia australis	Australian Teak	75L and 25L
Elaeocarpus reticulatis	Blueberry Ash	75L and 25L

Table B-2: Tree planting mix 1A – Swamp Oak swamp forest

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Casuarina glauca	Swamp Oak	Tubestock
Melaleuca quinquinervia	Broad-leaved Paperbark	Tubestock
Eucalyptus tereticornis	Forest Red Gum	Tubestock

Table B-3: Tree planting mix 1B – Paperbark swamp forest

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Melaleuca quinquinervia	Broad-leaved Paperbark	Tubestock
Melaleuca linariifolia	Snow-in-Summer	Tubestock
Melaleuca sieberi	Sieber's Paperbark	Tubestock
Melaleuca alternifolia	Narrow-leaved Paperbark	Tubestock
Melaleuca styphelioides	Prickly-leaved Paperbark	Tubestock
Melaleuca nodosa	Ball Honeymyrtle	Tubestock

Table B-4: Tree planting mix 2A – Flooded Gum - Tallowood - Brush Box moist open forest

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Eucalyptus grandis	Flooded Gum	Tubestock
Eucalyptus microcorys	Tallowwood	Tubestock
Lophostemon confertus	Brush Box	Tubestock
Syncarpia glomulifera	Turpentine	Tubestock
Corymbia intermedia	Pink Bloodwood	Tubestock

Table B-5: Tree planting mix 2B – Tallowood dry grassy forest

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Eucalyptus microcorys	Tallowwood	Tubestock
Eucalyptus acmenoides	Narrow-leaved White Mahogany	Tubestock
Corymbia intermedia	Pink Bloodwood	Tubestock
Eucalyptus propinqua	Small-fruited Grey Gum	Tubestock
Lophostemon confertus	Brush Box	Tubestock
Eucalyptus siderophloia	Grey Ironbark	Tubestock

Table B-6: Tree planting mix 3A – Blackbutt - Bloodwood dry heathy open forest

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Eucalyptus pilularis	Blackbutt	Tubestock
Corymbia gummifera	Red Bloodwood	Tubestock
Eucalyptus resinfera subsp. hemilampra	Red Mahogany	Tubestock

Table B-7: Tree planting mix 3B – Grey Gum - Grey Ironbark open forest

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Eucalyptus propinqua	Small-fruited Grey Gum	Tubestock
Eucalyptus siderophloia	Grey Ironbark	Tubestock
Corymbia variegata	Spotted Gum	Tubestock
Syncarpia glomulifera	Turpentine	Tubestock
Corymbia intermedia	Pink Bloodwood	Tubestock

Table B-8: Tree planting mix 4A – Forest red Gum - Swamp Box

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Eucalyptus tereticornis	Forest Red Gum	Tubestock
Lophostemon suaveolens	Swamp Box	Tubestock
Corymbia intermedia	Pink Bloodwood	Tubestock
Eucalyptus siderophloia	Grey Ironbark	Tubestock

B.2 DRAFT PLANT MIX SPECIES LISTS FOR MACLEAN TO DEVILS PULPIT

Note that all species listed in the following tables are subject to further design development including confirmation that plants are commercially available.

Table B-9: Plant mix 1 – Forest wetlands

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Shrubs		
Goodenia ovata	Hop Goodenia	Tubestock
Hibiscus diversifolius	Swamp Hibiscus	Tubestock
Leptospermum juniperinum	Prickly Tea-tree	Tubestock
Melaleuca ericifolia	Swamp Paperbark	Tubestock
Groundcovers		
Baumea rubiginosa	Soft Twig Rush	Tubestock
Blechnum indicum	Swamp Water Fern	Tubestock
Gahnia clarkei	Tall Saw-sedge	Tubestock
Hypolepis muelleri	Harsh Ground Fern	Tubestock
Ischaemum australe	Southern Grass	Tubestock
Juncus kraussii	Sea Rush	Tubestock

Table B-10: Plant mix 2 – Wet sclerophyll forest

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Shrubs		
Acacia spp.	Wattle	Tubestock
Acmena smithii	Lilly Pilly	Tubestock
Allocasuarina littoralis	Black She-oak	Tubestock
Allocasuarina torulosa	Forest Oak	Tubestock
Archontophoenix cunninghamina	Bangalow Palm	Tubestock
Banksia oblongifolia	Fern-leaved Banksia	Tubestock
Cordyline stricta	Slender Palm Lily	Tubestock
Elaeocarpus reticulatis	Blueberry Ash	Tubestock
Leptospermum polygalifolium	Tantoon	Tubestock
Melaleuca sieberi	Sieber's Paperbark	Tubestock
Persoonia stradbrokensis	Broad-leaved Geebung	Tubestock
Pultenaea spp.	Bush Pea	Tubestock
Syzigium oleosum	Blue Lilly Pilly	Tubestock
Groundcovers		
Adiantum hispidulum	Rough Maidenhair Fern	Tubestock
Blechnum cartilagineum	Gristle Fern	Tubestock
Cissus antarctica	Kangaroo Vine	Tubestock
Cissus hypoglauca	Water Vine	Tubestock
Dianella caerulea	Blue Flax-lily	Tubestock
Entolasia stricta	Wiry Panic	Tubestock
Hardenbergia violacea	False Sarsaparilla	Tubestock
Hibbertia scandens	Climbing Guinea Flower	Tubestock
Imperata cylindrica var. major	Blady Grass	Tubestock
Lomandra longifolia	Mat Rush	Tubestock
Smilax glyciphylla	Sweet Sarsaparilla	Tubestock
Themeda australis	Kangaroo Grass	Tubestock

Table B-11: Plant mix 3 – Dry schlerophyll forest

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Shrubs		
Acacia concurrens	Curracabah	Tubestock
Acacia ulicifolia	Prickly Moses	Tubestock
Allocasuarina littoralis	Black She-oak	Tubestock
Allocasuarina torulosa	Forest Oak	Tubestock
Banksia oblongifolia	Fern-leaved Banksia	Tubestock
Banksia spinulosa var. collina	Hill Banksia	Tubestock
Gompholobium pinnatum	Pinnate Wedge Pea	Tubestock
Leptospermum polygalifolium	Tantoon	Tubestock
Leptospermum trinervium	Flaky-barked Tea-tree	Tubestock
Leucopogon lanceolatus	Lance-leaved Beard Heath	Tubestock
Lomatia silaifolia	Crinkle Bush	Tubestock
Melaleuca sieberi	Sieber's Paperbark	Tubestock
Persoonia stradbrokensis	Broad-leaved Geebung	Tubestock
Pultenaea spp.	Bush Pea	Tubestock
Groundcovers		
Aristida vagans	Three-awned Speargrass	Tubestock
Cymbopogon refractus	Barbed Wire Grass	Tubestock
Dianella caerulea	Blue Flax-lily	Tubestock
Entolasia stricta	Wiry Panic	Tubestock
Eragrostis brownii	Brown's Lovegrass	Tubestock
Goodenia hederacea	Ivy Goodenia	Tubestock
Hardenbergia violacea	False Sarsaparilla	Tubestock
Imperata cylindrica var. major	Blady Grass	Tubestock
Lomandra longifolia	Mat-Rush	Tubestock
Lomandra multiflora	Many-flowered Mat-Rush	Tubestock
Panicum simile	Two-colour Panic	
Themeda australis	Kangaroo Grass	

Table B-12: Plant mix 4 – Grassy woodland

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Shrubs		
Alphitonia excelsa	Red Ash	Tubestock
Melaleuca quinquinervia	Broad-leaved Paperbark	Tubestock
Melaleuca sieberi	Sieber's Paperbark	Tubestock
Melaleuca styphelioides	Prickly-leaved Tea Tree	Tubestock
Groundcovers		
Cymbopogon refractus	Barbed Wire Grass	Tubestock
Entolasia stricta	Wiry Panic	Tubestock
Gahnia sieberiana	Red-fruit Saw-sedge	Tubestock
Imperata cylindrica var. major	Blady Grass	Tubestock
Lomandra longifolia	Mat-Rush	Tubestock
Panicum simile	Two-colour Panic	Tubestock
Themeda australis	Kangaroo Grass	Tubestock

Table B-13: Plant mix 5 – Rainforest

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Shrubs		
Cordyline petiolaris	Broad-leaved Palm Lily	Tubestock
Cyathea leichhardtiana	Prickly Tree Fern	Tubestock
Harpullia alata	Wing-leaved Tulip	Tubestock
Linospadix monostachya	Walking Stick Palm	Tubestock
Neolitsea dealbata	White Bolly Gum	Tubestock
Wilkiea austro-queenslandica	Smooth Wilkiea	Tubestock
Groundcovers		
Adiantum formosum	Giant Maidenhair	Tubestock
Elatostema reticulatum	Rainforest Spinach	Tubestock
Helmholtzia glaberrima	Stream Lily	Tubestock
Lastreopsis spp.	Shield Fern	Tubestock
Pteris umbrosa	Jungle Brake	Tubestock

Table B-14: Plant mix 6 – Saline wetlands

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Shrubs		
Aegiceras corniculatum	River Mangrove	Tubestock
Groundcovers		
Juncus kraussii	Sea Rush	Tubestock
Sarcocomia quinqueflora	Bearded Samphire	Tubestock
Sporobolus virginicus	Marine Couch	Tubestock
Zoysia macrantha	Prickly Couch	Tubestock

Table B-15: Plant mix 7 – Frangible shrubs

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Shrubs		
Banksia spinulosa var. collina	Hill Banksia	Tubestock
Callistemon citrinus 'Endeavour'	Endeavour Bottlebrush	Tubestock
Leptospermum polygalifolium	Tantoon	Tubestock
Groundcovers		
Lomandra longifolia	Mat Rush	Tubestock
Lomandra multiflora	Many-flowered Mat-Rush	Tubestock

Table B-16: Plant mix 8 – Creek banks

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Shrubs		
Melaleuca ericifolia	Swamp Paperbark	Tubestock
Leptospermum juniperinum	Prickly Tea-tree	Tubestock
Groundcovers		
Carex appressa	Tall Sedge	Tubestock
Gahnia clarkei	Tall Saw-sedge	Tubestock
Juncus usitatus	Common Rush	Tubestock
Lomandra longifolia	Mat-Rush	Tubestock
Lomandra multiflora	Many-flowered Mat-Rush	Tubestock

Table B-17: Plant mix 9A – Permanent water quality basins - ephemeral zone

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Grasses and sedges		
Carex appressa	Tall Sedge	Tubestock
Dianella caerulea	Blue Flax-lily	Tubestock
Ficinia nodosa	Knobby Club-rush	Tubestock
Gahnia clarkei	Tall Saw-sedge	Tubestock
Gahnia sieberiana	Red-fruit Saw-sedge	Tubestock
Juncus usitatus	Common Rush	Tubestock

Table B-18: Plant mix 9B – Permanent water quality basins - dry zone

BOTANICAL NAME	COMMON NAME	PLANT CONTAINER SIZE
Grasses and sedges		
Carex appressa	Tall Sedge	Tubestock
Gahnia sieberiana	Red-fruit Saw-sedge	Tubestock
Lomandra filiformis subsp. filiformis	Wattle Mat-Rush	Tubestock
Lomandra longifolia	Mat-Rush	Tubestock
Lomandra multiflora	Many-flowered Mat-Rush	Tubestock

B.3 DRAFT SEED MIX SPECIES LISTS FOR MACLEAN TO DEVILS PULPIT

Note that all species listed in the following tables are subject to further design development including confirmation that seeds are commercially available.

Table B-19: Seed mix 1 – Forest wetlands shrubs, groundcovers and grasses

BOTANICAL NAME	COMMON NAME
Shrubs	
Acacia maidenii	Maiden's Wattle
Baeckea frutescens	Weeping Baeckea
Callistemon pachyphyllus	Wallum Bottlebrush
Cordyline stricta	Slender Palm Lily
Glochidion ferdinandi	Cheese Tree
Goodenia ovata	Hop Goodenia
Hibiscus diversifolius	Swamp Hibiscus
Leptospermum juniperinum	Prickly Tea-tree
Melaleuca ericifolia	Swamp Paperbark
Groundcovers	
Baumea rubiginosa	Soft Twig Rush
Blechnum camfieldii	Eared Swamp Fern
Blechnum indicum	Swamp Water Fern
Gahnia clarkei	Tall Saw-sedge
Hypolepis muelleri	Harsh Ground Fern
Ischaemum australe	Southern Grass
Juncus kraussii	Sea Rush
Sporadanthus interruptis	Knotted Lepyrodia

Table B-20: Seed mix 2 – Wet sclerophyll forest shrubs, groundcovers and grasses

BOTANICAL NAME	COMMON NAME
Shrubs	
Acacia spp.	Wattle
Acmena smithii	Lilly Pilly
Allocasuarina littoralis	Black She-oak
Allocasuarina torulosa	Forest Oak
Archontophoenix cunninghamina	Bangalow Palm
Banksia oblongifolia	Fern-leaved Banksia
Cordyline stricta	Slender Palm Lily
Elaeocarpus reticulatis	Blueberry Ash
Leptospermum polygalifolium	Tantoon
Melaleuca sieberi	Sieber's Paperbark
Pultenaea spp.	Bush Pea
Syzigium oleosum	Blue Lilly Pilly
Groundcovers	
Adiantum hispidulum	Rough Maidenhair Fern
Blechnum cartilagineum	Gristle Fern
Cissus antarctica	Kangaroo Vine
Cissus hypoglauca	Water Vine
Dianella caerulea	Blue Flax-lily
Entolasia stricta	Wiry Panic
Hardenbergia violacea	False Sarsaparilla
Hibbertia scandens	Climbing Guinea Flower
Imperata cylindrica var. major	Blady Grass
Lomandra longifolia	Mat Rush
Smilax glyciphylla	Sweet Sarsaparilla
Themeda australis	Kangaroo Grass

Table B-21: Seed mix 3 – Dry sclerophyll forest shrubs, groundcovers and grasses

BOTANICAL NAME	COMMON NAME
Shrubs	
Acacia concurrens	Curracabah
Acacia ulicifolia	Prickly Moses
Allocasuarina littoralis	Black She-oak
Allocasuarina torulosa	Forest Oak
Banksia oblongifolia	Fern-leaved Banksia
Banksia spinulosa var. collina	Hill Banksia
Gompholobium pinnatum	Pinnate Wedge Pea
Lambertia formosa	Mountain Devil
Leptospermum polygalifolium	Tantoon
Leptospermum trinervium	Flaky-barked Tea-tree
Leucopogon lanceolatus	Lance-leaved Beard Heath
Lomatia silaifolia	Crinkle Bush
Melaleuca sieberi	Sieber's Paperbark
Pimelea linifolia	Slender Rice Flower
Pultenaea spp.	Bush Pea
Groundcovers	
Aristida vagans	Three-awned Speargrass
Cymbopogon refractus	Barbed Wire Grass
Entolasia stricta	Wiry Panic
Eragrostis brownii	Brown's Lovegrass
Goodenia hederacea	Ivy Goodenia
Hardenbergia violacea	False Sarsaparilla
Imperata cylindrica var. major	Blady Grass
Lomandra longifolia	Mat-Rush
Lomandra multiflora	Many-flowered Mat-Rush
Panicum simile	Two-colour Panic
Themeda australis	Kangaroo Grass

Table B-22: Seed mix 4 – Grassy woodland shrubs, groundcovers and grasses

BOTANICAL NAME	COMMON NAME
Shrubs	
Alphitonia excelsa	Red Ash
Melaleuca quinquinervia	Broad-leaved Paperbark
Melaleuca sieberi	Sieber's Paperbark
Melaleuca styphelioides	Prickly-leaved Tea Tree
Groundcovers	
Cymbopogon refractus	Barbed Wire Grass
Entolasia stricta	Wiry Panic
Gahnia sieberiana	Red-fruit Saw-sedge
Imperata cylindrica var. major	Blady Grass
Lomandra longifolia	Mat-Rush
Panicum simile	Two-colour Panic
Themeda australis	Kangaroo Grass

Table B-23: Seed mix 7 – Native grasses for medians and verges

BOTANICAL NAME	COMMON NAME
Shrubs	
Entolasia stricta	Wiry Panic
Imperata cylindrica var. major	Blady Grass
Lomandra longifolia	Mat-Rush
Lomandra multiflora	Many-flowered Mat-Rush
Themeda australis	Kangaroo Grass

Table B-24: Seed mix 8 – Pasture grasses

BOTANICAL NAME	COMMON NAME
Shrubs	
Coolabah oats	Coolabah Oats
Cymbopogon refractus	Barbed Wire Grass
Cynodon dactylon	Couch Grass
Eclipse rye	Eclipse Rye
Secale cereale 'Sterile'	Sterile Rye Corn
Tirifolium pratense	Red Clover

Table B-25: Seed mix 9 – Vegetated drainage swale

BOTANICAL NAME	COMMON NAME
Shrubs	
Carex appressa	Tall Sedge
Ficinia nodosa	Knobby Club-rush
Gahnia clarkei	Tall Saw-sedge
Gahnia sieberiana	Red-fruit Saw-sedge
Imperata cylindrica var. major	Blady Grass
Juncus usitatus	Common Rush

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