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Woolgoolga to Ballina Pacific Highway upgrade

Urban design and landscape plan

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Glenugie to Maclean Sections 3 and 4

Woolgoolga to Ballina Pacific Highway upgrade

Urban design and landscape plan

Prepared for

Cover image
Existing view: oblique aerial of Maclean and Clarence River South Arm looking north-west
Source: Pacific Complete.

SECTION 3 and 4 W2B-GHD-A-LX-RPT-00001 FDD

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Executive summary

Background

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

GHD, BG&E and CM^{+} are undertaking the detailed design between Glenugie and Maclean. Pacific Complete have undertaken supplementary detailed design at Glenugie Link, Tyndale (noise wall) and in other areas of the project during construction. The report is updated to reflect the updated information. This section of the project encompasses Glenugie to Tyndale – Section 3 and Tyndale to Maclean – Section 4.

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

Purpose of this Plan and Minister's Conditions

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

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

The specific requirements of MCoA D20 and where they are addressed in this UDLP are outlined in Table 2-1.

Reference documents

Key reference documents include:

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

Refer to Figure 2.

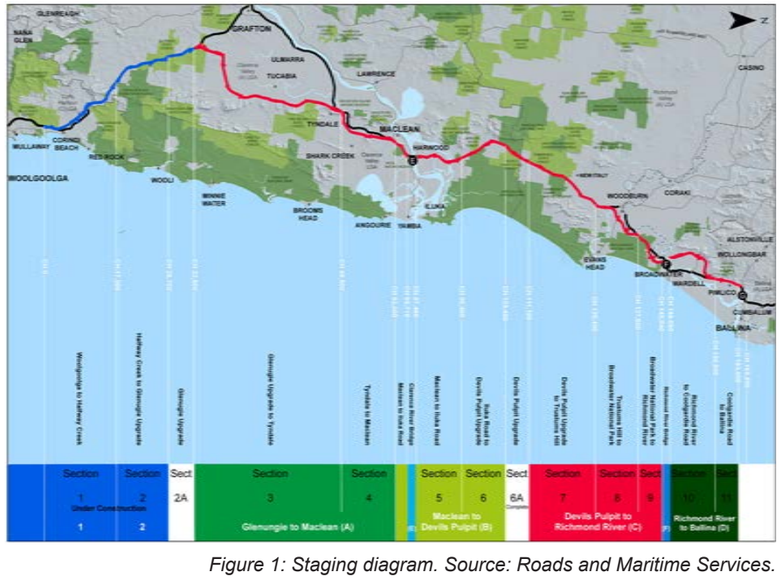

Figure 1: Staging diagram. Source: Roads and Maritime Services.

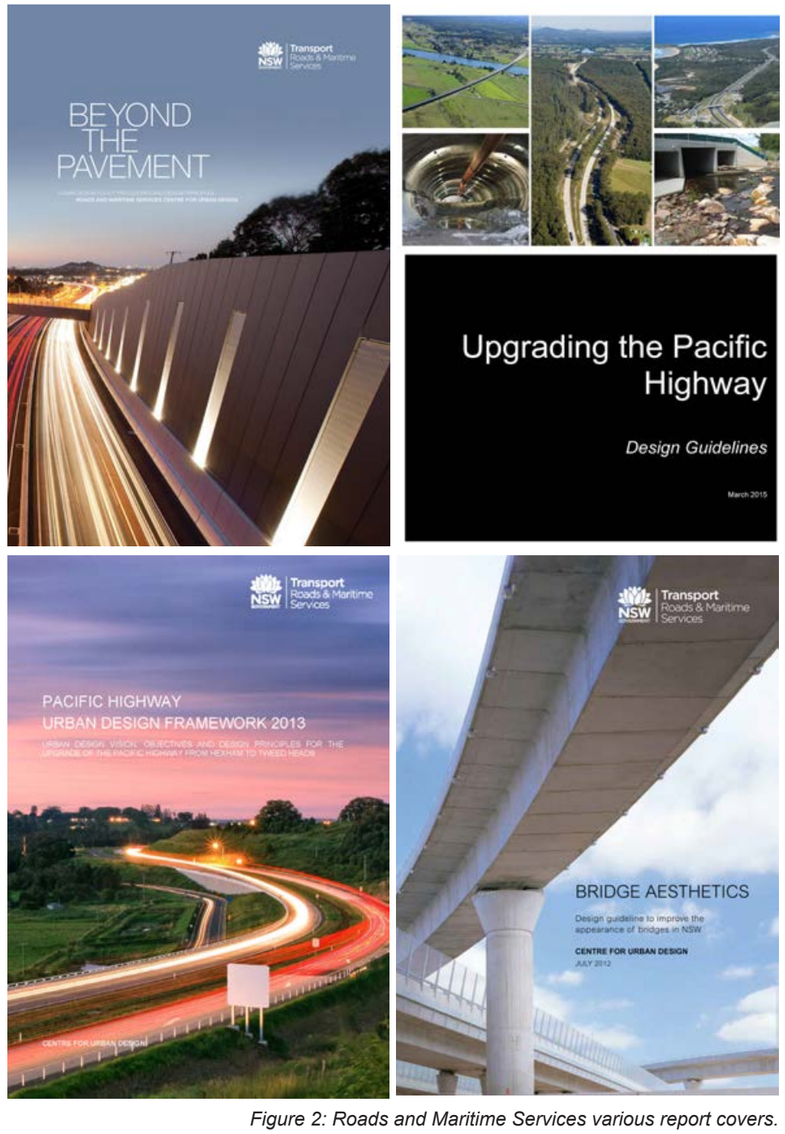

Figure 2: Roads and Maritime Services various report covers. Source: Roads and Maritime Services.

Vision Statement

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

Urban design objectives

The Pacific Highway urban design objectives are to:

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

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

Additional objectives include:

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

Refer to Chapter 4 for details.

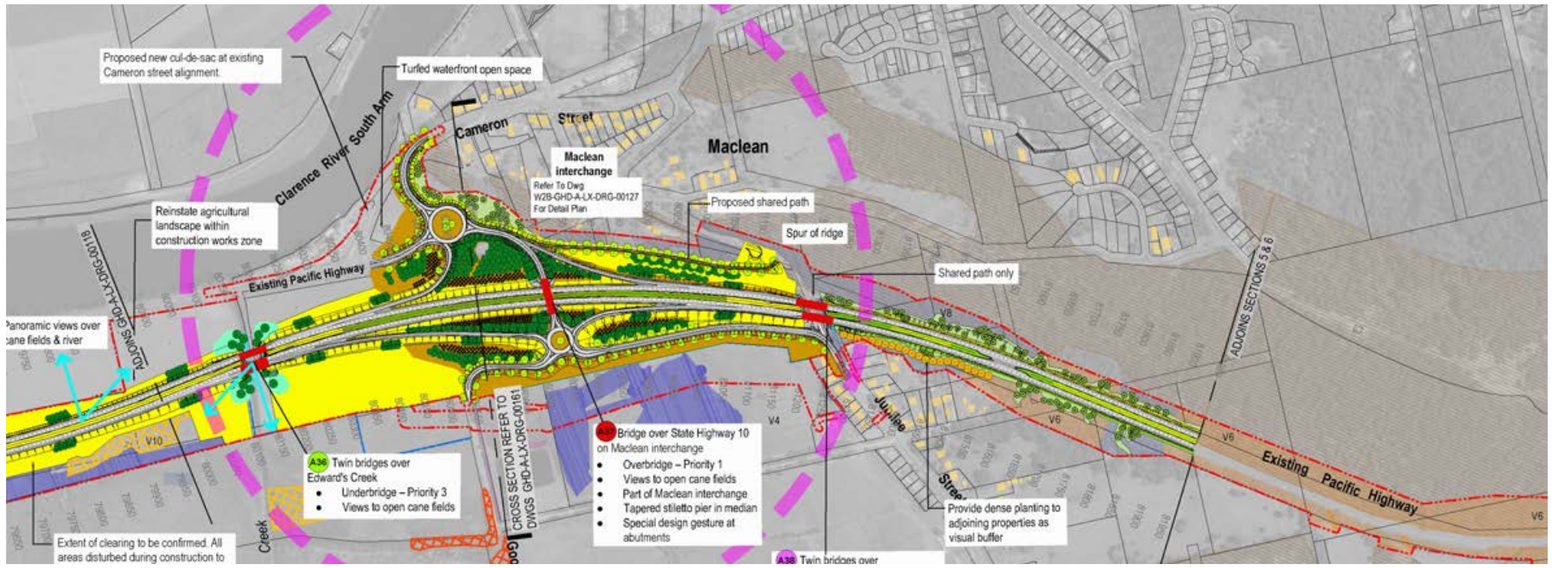

Figure 3: Part of typical urban design and landscape plan.

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

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

Refer to Chapter 4 and Chapter 8 for details.

Key project elements described in Chapter 6.1 include:

- There are 43 bridges including:
  - Overbridges at Eight Mile Lane, Old Six Mile Lane, Avenue Road, Wooli Road, Bostock Road, Quarry Access Road, Crowley's Road, Bondi Hill Road, Byrons Lane, McIntyres Lane and property access overbridges. These complete the consistent appearance of overbridges on the Pacific Highway (Figure 8)
- A number of twin bridges over creeks and existing roads to maintain local lateral connectivity including Somervale Road, Mitchell Road and Jubilee Street, high quality local road bridges (Figure 9)
- Special bridges at Tyndale southbound exit ramp and Shark Creek have a slightly different aesthetic configuration to the other bridges on the project
- Feature interchanges at Glenugie, Tyndale and Maclean to alert road users to opportunities beyond the Pacific Highway (Figures 6 and 7)
- Two rest areas consistent with other facilities along the Pacific Highway (Figure 5)
- A significant number of fauna crossings to allow movement of fauna across the Pacific Highway (Figure 10).

Figure 4: Glenugie southbound entry ramp.

Figure 5: Eight Mile Lane Overbridge.

- Major cuttings at Bondi Hill, Tyndale, and Green Hill which are utilised to improve road geometry (Figure 7)
- An integrated suite of road safety furniture such as bridges, retaining structures that are consistent with other Pacific Highway road furniture
- Dense vegetation of riparian creek corridors and at operational water quality control ponds to improve water quality, enhancing valuable habitat and increasing biodiversity (Figure 10).

Key design outcomes

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

- Integration of earthworks with batter rounding throughout the project to blend with the surrounding
- Integration of potential landscape/spoil mounds into the earthworks design based on principles established
- Development of appropriate topsoil management measures
- Reinforcement of the landscape setting of the area to ensure that the interchange is fully integrated into the local area and is not intrusive
- Revegetation of areas affected by Endangered Ecological Communities (EEC) with species derived from adjoining community.

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

Glenugie interchange

The Glenugie interchange marks an important directional change in the Pacific Highway from north-south to east west. The interchange is also a major marker approximating the entry/exit area for the southern border of the Northern Rivers Region of NSW.

The interchange comprises two half interchanges with grade separated crossings for local roads and ramp connections. The interchange is located about sixteen kilometres southeast of Grafton.

Glenugie southern interchange

Key design outcomes for the southern interchange include:

- The existing forest cover will be retained to the maximum extent possible by minimising the clearing footprint.
- Landscape revegetation will be integrated with the surrounding forest setting primarily by seeding with indigenous species
- A landscape cultural marker will be created at the start of the interchange by planting rows of Red Ash (*Alphitonia excelsa*)
- The bridge over the main carriageway carrying the south bound on-ramp will form a gateway marker for motorists (Figure 4).

Glenugie northern interchange (Eight Mile Lane)

Key design northern interchange include:

- The existing forest cover will be retained to the maximum extent possible by minimising the clearing footprint.
- Landscape revegetation will be integrated with the surrounding forest setting primarily by seeding with indigenous species and tree planting to signal the intersection approach
- The Eight Mile Lane bridge over the main carriageway will form a gateway marker for motorists.

Motorists will experience the sunlight-filled space of the interchange defined by the tall eucalyptus forest as they pass through it (Figure 5).

Figure 6: View of rest area from Pacific Highway upgrade.

Figure 7: Tyndale interchange south

Rest areas

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

- Provision of a distinct forest experience with subtle changes to the forest landscape to mark entries (Figure 6)
- Reduction of visual impacts from the Bostock Road overbridge by providing an elegant design and integration of the bridge into the overall driver experience
- Furnishings located appropriately to encompass *Crime Prevention Through Environmental Design* (CPTED) issues (Figure 6).

Tyndale interchange south

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

- Landscape treatments at underbridges frames the backdrop of Bondi Hill for drivers travelling through the interchange to join the southbound carriageway (Figure 7)
- Landscape treatments and batter rounding in the large cuts that integrate into the surrounding environment
- Revegetation of areas affected by EEC with species from adjoining community (Figure 7)
- A new noise wall to screen properties at Tyndale from the new Pacific Highway, on the cut and at the neighbourhood side of the wall, screen planting has been provided.

Tyndale interchange north

Key design outcomes are described in Chapter 8.1.1 and include:

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

Figure 8: Maclean interchange – aerial view looking north.

Figure 9: Maclean overbridge looking north.

Maclean interchange

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

- Accent tree planting along local roads (Figure 8)
- Improved connectivity across the Pacific Highway upgrade intersections to maintain the cohesiveness of the town. A shared path is provided between Cameron Street and Jubilee Streets
- The interchange is used to highlight the cultural heritage of the town featuring its relationship to the river and reinforcing the Cameron Street and Goodwood Street as gateways (Figure 8).

Overbridges

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

- Two span bridges with tapered median piers in both directions
- Tapered piers used for bridge deck spans less or equal to 10 metres
- Stiletto piers used for bridge deck spans greater than 10 metres that allows for greater sightlines through the bridge structure (Figure 9).

Twin bridges/underbridges

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

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

Special bridges

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

Landscape treatment will be provided at abutments of all bridges.

Figure 10: Twin bridges over combined fauna and drainage crossing.

Figure 11: Bridge over Shark Creek.

Consultation

The feedback and responses as a result of community, agency and stakeholder consultation on the urban design and landscape plan are addressed in the *Community Consultation Report for the Urban Design and Landscape Plans,* February 2017. The Community Consultation Report is prepared in accordance with the community and stakeholder engagement strategy for the project is contained in Appendix G of this report.

Extensive flood modelling has been undertaken for the upgrade. Roads and Maritime Services (Roads and Maritime) has re-formed flood focus groups for the Woolgoolga to Ballina Pacific Highway upgrade.
The groups exist for sections of the upgrade not currently in major work where the design is currently being finalised. The focus group meetings address the upgrade's flood impacts; review updated flood models and any changes as part of the detailed design development process; review the upgrade's proposed waterway structures, and review flood impact maps

Conclusion

The collaboration and employment of high quality standards set out in the key reference documents ensures an integrated approach to urban design. Well considered engineering also ensures high quality urban and landscape design outcomes for the project. The implementation of the mitigation measures proposed ensure that the significance of the social, cultural and ecological values are maintained or enhanced through the design initiatives provided. The report is submitted by the applicant Roads and Maritime Services for construction approval in accordance with MCoA D20.

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

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

Key strengths include:

- Transitioning across Glenugie forest foothills with multiple bridges to improve environmental outcomes and connectivity
- A feature design at Maclean interchange which provides a sense of arrival and departure to and from the town
- Developing a fauna connectivity strategy with the provision of fauna crossings to provide environmental sustainability and enhance biodiversity.

Feedback and responses as a result of community and stakeholder consultation are addressed in the submissions report, December 2016.

Contents

Executive summary i
List of tables ix
List of figures x
List of drawings xii
Glossary xiii
Abbreviations xv
1.0 Introduction 1
1.1 Background 1
1.2 Overview of the Woolgoolga to Ballina upgrade 3
1.3 Project type and staging 3
1.4 Purpose of this plan 4
1.5 Urban and landscape design methodology 4
1.6 Urban design guidance 4
1.8 Design development and representations 6
1.7 Document structure 6
2.0 Compliance with environmental approval documents 7
2.1 Minister's conditions of approval 7
2.2 Compliance with EIS and SPIR environmental mitigation measures and landscape strategies 9
2.3 Urban design and landscape compliance with the EIS 9
2.4 Urban design and landscape compliance with the EIS working paper - biodiversity 11
2.5 Urban design and landscape compliance with Threatened Species Management Plan 12
3.0 Consultation 13
3.1 Overview 13
3.2 Community consultation 13
3.3 Specific responses for each section of the project 14
3.4 Stakeholder consultation 14
4.0 Pacific Highway urban design, landscape objectives and principles 15
4.1 Vision 15
4.2 Pacific Highway design objectives 15
4.3 Urban design and landscape principles 15
4.4 Urban design and landscape strategy 15
5.0 Contextual analysis 19
5.1 Character zones 19
5.2 Land use and communities 22
5.3 Landform and hydrology 26
5.4 Flora and fauna 30
5.5 Heritage 30
5.6 Geology and soils 30
5.7 Key views 30
6.0 Design principles 39
6.1 Section 3 and 4 description 39
6.2 Urban design context 43
6.3 Local environmental values 48
6.4 Heritage values 48
6.5 Sustainable design and maintenance 49
6.6 Community amenity and privacy 49
6.7 Pedestrians, cyclists and shared paths 49
6.8 Temporary work, ancillary facilities, access tracks, watercourse crossings 51
6.9 Flood focus groups 52
6.10 Noise mitigation 52

7.0 Urban design and landscape plan **53**
7.1 Urban design and landscape concept plans 53
7.2 Cross sections 82
7.3 Summary of landscape monitoring and management 87
7.4 Visual impact assessment including mitigation 87
8.0 Detailed responses for urban and landscape design **95**
8.1 Structures 95
8.2 Road corridor 131
8.3 Furniture 140
9.0 Planting **143**
9.1 Existing vegetation and proposed landscaping 146
9.2 Vegetation communities 147
9.3 Impacted landscape 151
9.4 Landscape visual screening 152
9.5 Heritage zones 152
9.6 Disturbed landscape 152
9.7 Batter stabilisation planting 152
9.8 Seed application and establishment 153
9.9 Seed procurement 156
9.10 Monitoring and ecological establishment 156
10.0 Topsoil **157**
10.1 Topsoil management 157
10.2 Topsoil treatments 159
10.3 Mulches 161
11.0 Drainage and water quality **163**
11.1 Water quality control systems (including water quality treatment ponds) 163
11.2 Culverts 164
11.3 Creek rehabilitation 166
12.0 Fauna crossings **167**
12.1 Fauna connectivity 167
12.2 Fauna crossing structures 167
12.3 Frog ponds 172
13.0 Conclusion **173**
14.0 Bibliography **175**
Appendices **A-1**
A Schedule of finishes and materials A-1
B Planting and seeding schedules for sections 3 and 4 B-1
C Weed species list C-1
D SPIR environmental measures D-1
E Compliance with threatened species management plans E-1
F Landscape outcomes F-1
G Community Consultation Report for the Urban Design and Landscape Plan, February 2017 G-1
H Woolgoolga to Ballina Landscape Management Plan H-1
I Agency design review I-1

List of tables

Table number	Description	Page number
Table 1-1	Structure and context of the Urban Design and Landscape Plan – Glenugie to Maclean (sections 3 and 4)	6
Table 2-1	Ministerial Conditions of Approval (D20)	7
Table 2-2	Compliance with EIS urban design and landscape requirements	9
Table 2-3	Viewpoint mitigation measures related to urban design and landscape compliance with EIS applicable to sections 3 and 4	10
Table 2-4	Vegetation and landscape design principles for connectivity measures identified in the Biodiversity Connectivity Strategy	11
Table 2-5	Threatened Species Management Plans applicable to sections 3 and 4	12
Table 6-1	Cyclist and pedestrian facilities for the Woolgoolga to Ballina upgrade	50
Table 7-1	Landscape character impacts in sections 3 and 4	89
Table 8-1	Detail design parameters	115
Table 9-1	Vegetation communities in the project area	147
Table 9-2	Sections 3 and 4 – Seed mixes and corresponding vegetation communities	154
Table B-1	Sections 3 and 4 Glenugie interchange and Picaninny Creek planting schedule – planting derived from the Spotted Gum – Grey Ironbark – Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast	B-1
Table B-2	Sections 3 and 4 – Maclean interchange and median planting schedule	B-1
Table B-3	Sections 3 and 4 northbound rest area planting schedule – planting derived from the Swamp Mahogany swamp forest	B-1
Table B-4	Sections 3 and 4 southbound rest area planting schedule - planting derived from the Turpentine moist open forest and Scribbly Gum – Needlebark Stringybark - Red Bloodwood heathy open forest	B-2
Table B-5	Sections 3 and 4 Black Snake Creek planting schedule – derived from the Black Bean – Weeping Lilly Pilly riparian rainforest of the North Coast	B-2
Table B-6	Sections 3 and 4 headlight/visual screening planting schedule	B-2
Table B-7	Sections 3 and 4 water quality treatment ponds planting schedule	B-3
Table B-8	Sections 3 and 4 creek realignments planting schedule	B-3
Table B-9	Sections 3 and 4 frog ponds planting schedule	B-3
Table B-10	Sections 3 and 4 fauna crossings planting schedule	B-4
Table B-11	Sections 3 and 4 frangible seed mix - Dry Sclerophyll Forest	B-4
Table B-12	Sections 3 and 4 frangible seed mix - Forested Wetland	B-4
Table B-13	Sections 3 and 4 non-frangible native tree mix - Wet Sclerophyll Forest	B-5
Table B-14	Sections 3 and 4 non-frangible native tree mix - Dry Sclerophyll Forest	B-5
Table B-15	Sections 3 and 4 non-frangible native tree mix - Forested Wetland	B-6
Table B-16	Sections 3 and 4 non-frangible native tree mix - Grassy Woodland	B-6
Table B-17	Sections 3 and 4 functional seed mixes	B-6
Table D-1	SPIR environmental measures	D-1
Table E-1	Mitigation measures related to landscape and urban design applicable to sections 3 and 4	E-1

List of figures

Figure number	Description	Page number
Figure 1	Staging diagram	i
Figure 2	Roads and Maritime Services various report covers	i
Figure 3	Part of typical urban design and landscape plan	ii
Figure 4	Glenugie southbound Entry Ramp	iii
Figure 5	Eight Mile Lane Overbridge	iii
Figure 6	View of rest area from Pacific Highway upgrade	iv
Figure 7	Tyndale interchange south	iv
Figure 8	Maclean interchange – aerial view looking north	v
Figure 9	Maclean overbridge looking north	v
Figure 10	Twin bridges over combined fauna and drainage crossing	vi
Figure 11	Bridge over Shark Creek	vi
Figure 12	Status of dual carriageway – October 2016	1
Figure 13	Staging diagram	2
Figure 14	Methodology process diagram	4
Figure 15	Approval document	5
Figure 16	Covers of reference documents	5
Figure 17	Urban design and landscape strategy diagram	16,17
Figure 18	Existing view: oblique aerial of proposed Tyndale interchange north	18
Figure 19	Ulmarra view from Coldstream Street looking east	22
Figure 20	Tucabia view from Cordini Street looking east	22
Figure 21	Tyndale view from Sheehys Lane looking north	23
Figure 22	Townsend view from Jubilee Street looking west	23
Figure 23	Shark Creek character	26
Figure 24	Chaffin Creek character	26
Figure 25	Existing view: oblique aerial looking east to Tucabia with Clarence Peak in background	27
Figure 26	Glenugie Peak looking north along existing Pacific Highway near Glenugie	27
Figure 27	Coldstream/Pillar Valley character	27
Figure 28	Maclean lookout view looking east	27
Figure 29	Major ridges and peaks	27
Figure 30	Enclosed forest driver experience	30
Figure 31	Open valley driver experience	30
Figure 32	Existing view: oblique aerial of Maclean township looking north-west and surrounding context	43
Figure 33	Existing Pacific Highway near Glenugie	44
Figure 34	Glenugie	44
Figure 35	Grafton town centre	44
Figure 36	Grafton town centre	44
Figure 37	Ulmarra town centre	44
Figure 38	Ulmarra town centre	44
Figure 39	Maclean town centre	44
Figure 40	Maclean town centre	44
Figure 41	Cordini Street, Tucabia looking west	45
Figure 42	Tucabia Village, Cordini Street looking west	45
Figure 43	View of Tyndale from existing Pacific Highway	45
Figure 44	View of proposed Tyndale interchange south	45
Figure 45	Jubilee Street looking west to existing Pacific Highway	45
Figure 46	Townsend	45
Figure 47	Brooms Head Road, Gulmarrad looking north	45
Figure 48	View of alignment from Sheehans Lane, near Gulmarrad	45
Figure 49	Existing view: forest setting zone	46
Figure 50	Existing view: pasture scattered woodland setting zone	46
Figure 51	Existing view: open agricultural setting zone	46
Figure 52	Landscape character and visual impact grading matrix	87
Figure 53	Agricultural setting with open views	87
Figure 54	Forest setting with intermittent view of pastureland	87
Figure 55	Pacific Highway looking north at Glenugie	95
Figure 56	Glenugie interchange south sketch	96
Figure 57	Location of Eight Mile Lane interchange near proposed overbridge	97
Figure 58	Glenugie interchange north	97
Figure 59	Tyndale interchange south, looking north	98
Figure 60	Location of proposed alignment at Tyndale interchange south from Pacific Highway	99
Figure 61	Tyndale interchange south design principles diagram	100
Figure 62	Tyndale noise wall plan	101
Figure 63	Tyndale noise wall highway elevation	102
Figure 64	Tyndale noise wall neighbourhood elevation	103
Figure 65	Sketch of Tyndale interchange north looking north	104
Figure 66	Tyndale interchange north principles diagram	105
Figure 67	Oblique aerial view of Tyndale interchange south looking north–east	106
Figure 68	Oblique aerial view of Tyndale interchange north looking north	107
Figure 69	Sketch of Maclean interchange looking north	108
Figure 70	Oblique aerial, enlargement view of Maclean interchange looking north	109

Figure number	Description	Page number
Figure 71	Maclean interchange design principles diagram	110
Figure 72	Oblique aerial view of Maclean interchange looking north	112
Figure 73	Glenugie Southbound Entry Ramp	117
Figure 74	Eight Mile Lane Overbridge	118
Figure 75	Twin bridges at Pheasant Creek	119
Figure 76	Twin bridges at Pillar Valley 4 – looking east	120
Figure 77	Twin bridges over Mitchell Road - looking east	121
Figure 78	Typical view of fauna crossing bridge	122
Figure 79	Bridge over State Highway 10 on Bostock Road - looking south	123
Figure 80	Twin bridges over Tyndale interchange (south) - looking east	124
Figure 81	Bridge over State Highway 10 on Bondi Hill Road - looking north	125
Figure 82	Tyndale interchange north overbridge - looking south	126
Figure 83	Bridge over State Highway 10 on Byrons Lane - looking east	127
Figure 84	Twin bridges over Shark Creek - looking south from Shark Creek Road	128
Figure 85	Bridge over State Highway 10 on Maclean interchange - looking north	129
Figure 86	Twin bridges over Jubilee Street - looking west from Jubilee Street	130
Figure 87	Rest area principles diagram	133
Figure 88	Rest area northbound looking north	136
Figure 89	Rest area northbound looking north along main alignment	137
Figure 90	Rest area southbound looking south along main alignment	138
Figure 91	Vertical colourbond fauna fence	140
Figure 92	View of Coldstream River from Wants Lane	142
Figure 93	Native shrub seeded embankment with fringing Eucalypt trees. The seed from fringing trees will be released and germinate on the batter slopes as seen here on the Hunter Expressway	143
Figure 94	Scribbly Gum	145
Figure 95	Forest Red Gum Swamp Box Forest where the alignment crosses Wants Lane; an endangered ecological community	147
Figure 96	Glenugie batter slope soon after completion showing germination from the soil seedbank	158
Figure 97	Glenugie batter slope at the same location four years later	158
Figure 98	Spotted Gum-Grey Ironbark-Pink Bloodwood Forest where the alignment crosses Six Mile Lane, a zone from which bushland topsoil will be stripped	158
Figure 99	Landscape topsoils near Green Hill	158
Figure 100	Landscape topsoil	160
Figure 101	Germination from the soil seedbank	161
Figure 102	Stockpile tub ground mulch	161
Figure 103	Lepironia wetlands off Wooli Road. Species from the wetland community will be used in re-vegetating water quality treatment ponds	162
Figure 104	Typical water quality basin on the Pacific Highway at Devils Pulpit with floppy top fauna fencing	163
Figure 105	Typical landscape treatment for combined box culvert fauna crossing - sketch	164
Figure 106	Typical landscape treatment for combined box culvert fauna passage - section	165
Figure 107	Chaffin Creek	166
Figure 108	Typical twin bridges over combined fauna crossing and creek	171
Figure 109	Indicative landscape treatment surrounding green-thighed frog breeding ponds	172
Figure 110	Existing view: oblique aerial looking north of proposed Tyndale interchange north with Green Hill in foreground and Maclean interchange in background	173
Figure A1	Finishes and materials	A-1
Figure F1	Ballina Bypass February 2011	F-1
Figure F2	Ballina Bypass January 2015	F-1
Figure F3	Bonville Koala Bridge September 2008	F-1
Figure F4	Bonville Koala Bridge February 2009	F-1
Figure F5	Bonville Koala Bridge September 2011	F-1
Figure F6	Devils Pulpit rest area seeding August 2014	F-1
Figure F7	Devils Pulpit rest area seeding January 2015	F-1
Figure F8	Glenugie upgrade April 2011	F-1
Figure F9	Glenugie upgrade July 2012	F-1
Figure F10	Glenugie upgrade August 2013	F-1
Figure F11	Glenugie upgrade August 2014	F-1

List of drawings

Drawing number	Drawing name	Page number
W2B-GHD-A-LX-DRG-00001	Sections 3 and 4 strategy diagram	20
W2B-GHD-A-LX-DRG-00002	Sections 3 and 4 strategy diagram	21
W2B-GHD-A-LX-DRG-00003	Strategic vision	47
W2B-GHD-A-LX-DRG-00004	Existing national parks & state forests	31
W2B-GHD-A-LX-DRG-00005	Bridges location plan	116
W2B-GHD-A-LX-DRG-00006	Visual assessment viewpoints plan	88
W2B-GHD-A-LX-DRG-00007	Geology	36
W2B-GHD-A-LX-DRG-00008	Geology	37
W2B-GHD-A-LX-DRG-00009	Land use	24
W2B-GHD-A-LX-DRG-00010	Land use	25
W2B-GHD-A-LX-DRG-00012	Existing vegetation communities	32
W2B-GHD-A-LX-DRG-00013	Existing vegetation communities	33
W2B-GHD-A-LX-DRG-00014	Heritage	34
W2B-GHD-A-LX-DRG-00015	Heritage	35
W2B-GHD-A-LX-DRG-00016	Topography and views	28
W2B-GHD-A-LX-DRG-00017	Topography and views	29
W2B-GHD-A-LX-DRG-00019	Project familiarisation diagram	38
W2B-GHD-A-LX-DRG-00100	Urban design and landscape concept plan-key plan	53
W2B-GHD-A-LX-DRG-00101	Urban design and landscape concept plan	54
W2B-GHD-A-LX-DRG-00102	Urban design and landscape concept plan	55
W2B-GHD-A-LX-DRG-00103	Urban design and landscape concept plan	56
W2B-GHD-A-LX-DRG-00104	Urban design and landscape concept plan	57
W2B-GHD-A-LX-DRG-00105	Urban design and landscape concept plan	58
W2B-GHD-A-LX-DRG-00106	Urban design and landscape concept plan	59
W2B-GHD-A-LX-DRG-00107	Urban design and landscape concept plan	60
W2B-GHD-A-LX-DRG-00108	Urban design and landscape concept plan	61
W2B-GHD-A-LX-DRG-00109	Urban design and landscape concept plan	62
W2B-GHD-A-LX-DRG-00110	Urban design and landscape concept plan	63
W2B-GHD-A-LX-DRG-00111	Urban design and landscape concept plan	64
W2B-GHD-A-LX-DRG-00112	Urban design and landscape concept plan	65
W2B-GHD-A-LX-DRG-00113	Urban design and landscape concept plan	66
W2B-GHD-A-LX-DRG-00114	Urban design and landscape concept plan	67
W2B-GHD-A-LX-DRG-00115	Urban design and landscape concept plan	68
W2B-GHD-A-LX-DRG-00116	Urban design and landscape concept plan	69
W2B-GHD-A-LX-DRG-00117	Urban design and landscape concept plan	70
W2B-GHD-A-LX-DRG-00118	Urban design and landscape concept plan	71
W2B-GHD-A-LX-DRG-00119	Urban design and landscape concept plan	72
W2B-GHD-A-LX-DRG-00120	Urban design and landscape concept plan	73
W2B-GHD-A-LX-DRG-00121	Urban design and landscape concept plan	74
W2B-GHD-A-LX-DRG-00122	Urban design and landscape concept plan	75
W2B-GHD-A-LX-DRG-00123	Pine Brush rest area	76
W2B-GHD-A-LX-DRG-00124	Pine Brush rest area	77
W2B-GHD-A-LX-DRG-00125	Tyndale interchange south	78
W2B-GHD-A-LX-DRG-00126	Tyndale interchange north	79
W2B-GHD-A-LX-DRG-00127	Maclean interchange	80
W2B-GHD-A-LX-DRG-00128	Maclean interchange	81
W2B-GHD-A-LX-DRG-00150	Cross section at Bondi Hill	83
W2B-GHD-A-LX-DRG-00151	Cross section at Tyndale interchange north	84
W2B-GHD-A-LX-DRG-00152	Cross section at Green Hill	85
W2B-GHD-A-LX-DRG-00156	Fauna crossing at Black Snake Creek illustrating typical underbridge fauna crossing arrangement	168
W2B-GHD-A-LX-DRG-00157	Rest area	134
W2B-GHD-A-LX-DRG-00158	Rest area	135
W2B-GHD-A-LX-DRG-00159	Maclean interchange	111
W2B-GHD-A-LX-DRG-00160	Fauna crossing section - bridge over Black Snake Creek	169
W2B-GHD-A-LX-DRG-00161	Cross section at Maclean interchange	86
W2B-GHD-A-LX-DRG-00162	Planting matrices	170
W2B-GHD-A-LX-DRG-00163	Waterway diversion and creek realignment concepts	166

Glossary

Terminology	Definition
Advanced plant	A containerised plant grown in a container size 200 mm x 200 mm x 200 mm deep usually for shrubs and trees in priority areas.
Bioregion	Classification of Australia's landscape into 89 distinct bioregions based on climate, geology, landform and native vegetation and species information. The project site is within the NNC - New South Wales North Coast Bioregion as defined by ABRA mapping.
Bushland soil	Topsoil stripped within mapped intact vegetation communities that have been cleared.
Compost blanket	Consists of high quality compost incorporating organic tackifiers, biological stimulants, wetting agents, soil ameliorants and seed mix that is applied to the batter surface with pneumatic blowers at a thickness of between 25-100 millimetres depending on type of vegetation to be established.
Cover crop	Fast growing, but short lived non-native pasture grasses with low reproduction levels (low fecundity) 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 100 millimetres at about 500 millimetres above ground are considered frangible.

Terminology	Definition
Hydromulching	Various types of organic fibrous materials mixed with water and sprayed onto the soil surface in slurry form that sets to form a layer that provides temporary protection from wind and water erosion. The mix may include seed of a cover crop, legume, native ground cover.
Hydroseeding	Hydraulic application of seed, seed carrier and soil ameliorants added to a tank fitted with an agitator and pump. It is commonly followed by hydromulching or straw mulching to provide surface protection.
Indigenous species	Plant species native to the bioregion in which the project is located.
Landscape Management Plan	A defined combination of techniques and frequency of activities for the successful establishment, maintenance and ongoing management of all landscape areas developed by seeding, planting or bushland regeneration.
Landscape soil	Soil profile that is either modified from a natural soil or manufactured and installed using artificial components for the purpose of sustaining vegetation that is chosen to achieve a particular landscape design outcome or revegetation.
Local provenance seed	Seed collected from plants growing in the locality of the project site which may include the road corridor and adjoining areas within the NSW North Coast Bioregion.
Native Grasses	Grass species that are native to Australia.
Natural soils	Soils remaining in-situ which have formed distinct horizons and typically sustaining specific plant communities.
Non-native	Plants that are not native to the bioregion in which the project site is located.
Noxious	Plants declared noxious weeds which are classified into one of five control classes with specified action for each class by the Noxious Weed Act, 1993 and Weed Control Order 2014.
Pasture Grass Mix	Mix of grasses and legumes; predominantly grasses with a portion of legumes to provide nitrogen; typically used on areas that are not to be managed.
Plant container	Containers for plant stock in various sizes and volumes.
Reconstruction	The practice of revegetating areas where the soil profile is disturbed by construction activity; the process involves soil treatment, which may include return of bushland soil, followed by drill seeding, hydromulching or mass planting.

Terminology	Definition
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.
Super-advanced plant	A containerised plant grown in a container size 25 - 45 litres (pots or bags) usually for trees with a plant height of 2 - 2.5 metres.
Tubestock	Rigid plant containers with a top edge length or diameter of 40-50 millimetres or 75 millimetres. Includes individual containers as well as trays, and may have proprietary names.

Abbreviations

Alignments/Pacific Highway upgrade/highway
Refers to upgraded Pacific Highway Woolgoolga to Ballina

CCTV
Closed circuit television

CPTED
Crime Prevention Through Environmental Design

CEMP
Construction Environment Management Plan

CMS
Changeable message signs

DoP&E
Department of Planning and Environment

EEC
Endangered Ecological Communities

EIS
Environmental Impact Statement

EPA
Environmental Protection Agency

FDD
Final Detailed Design

FDSC
Fixed digital speed cameras

HVIWS
High visual impact warning signs

IDD
Initial Detailed Design

IFC
Issue For Construction

ISCA
Infrastructure sustainablity Council of Australia

MCoA
Minister's Conditions of Approval

LGA
Local government area

LMP
Landscape Management Plan

OEH
Office Environment and Heritage

PH/Ex.PH
Refers to existing Pacific Highway

PSC
Professional Services Contract

Project
Refers to Glenugie to Tyndale – sections 3 and Tyndale to Maclean – Section 4

Roads and Maritime
Roads and Maritime Services

RNP
Road Noise Policy

SAP
Sustainability Action Plan

SDD
Substantial Detailed Design

SPIR
Submissions/Preferred Infrastructure Report

UDLP
Urban design and landscape plan

VMS
Variable message signs

VSLS
Variable speed limit signs

WQCP
Water quality control pond

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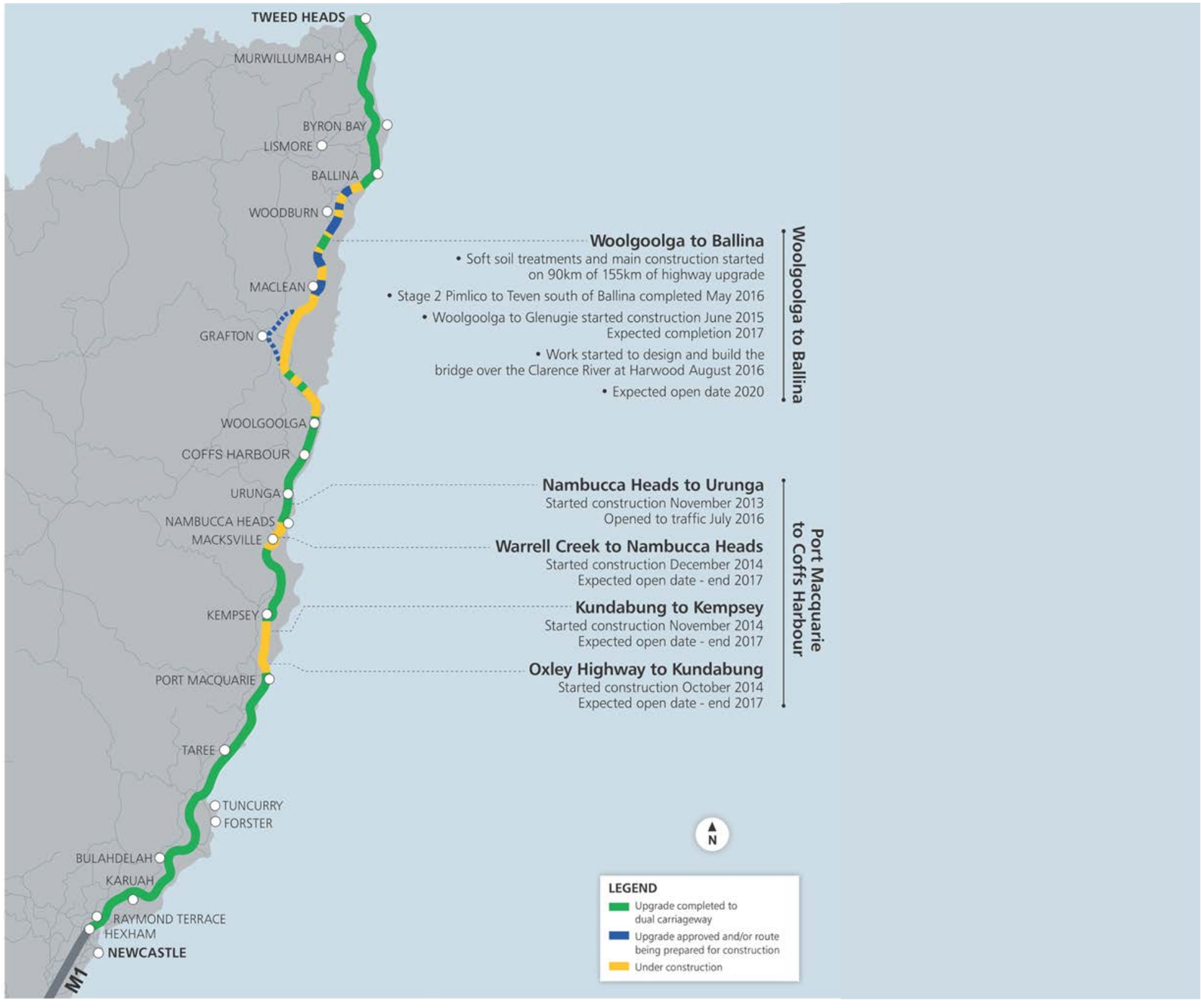
1.0 Introduction

1.1 Background

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

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

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



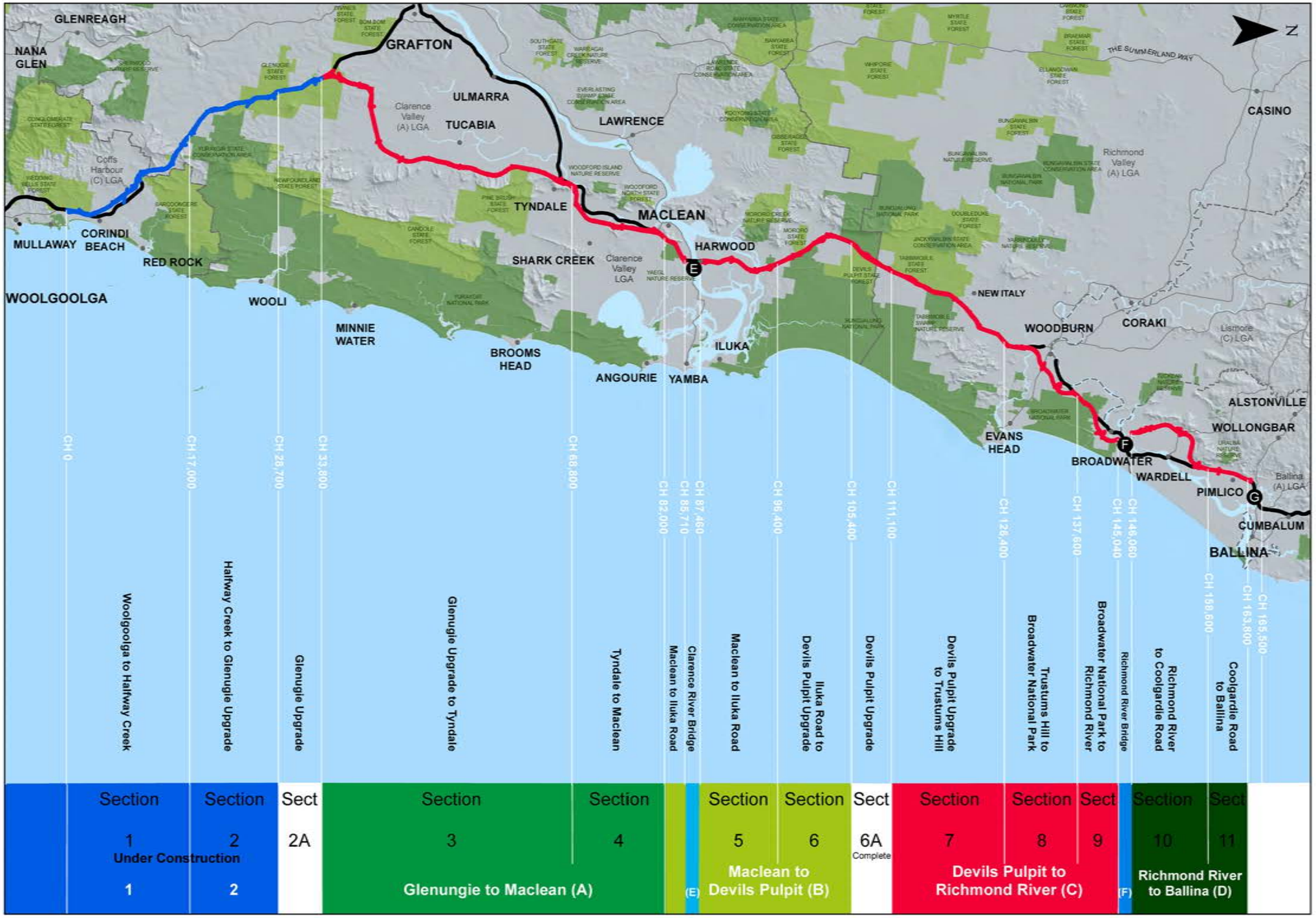


Figure 13: Staging diagram. Source: Roads and Maritime Services.

1.2 Overview of the Woolgoolga to Ballina upgrade

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

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

Key features of the upgrade include:

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

1.3 Project type and staging

The Pacific Highway Program 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 Brinckerhoff is working closely with the Pacific Highway Program 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 13).

- 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 Ballina (sections 10 and 11).

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

1.4 Purpose of this plan

This plan has been developed to address the requirements of the 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 14).

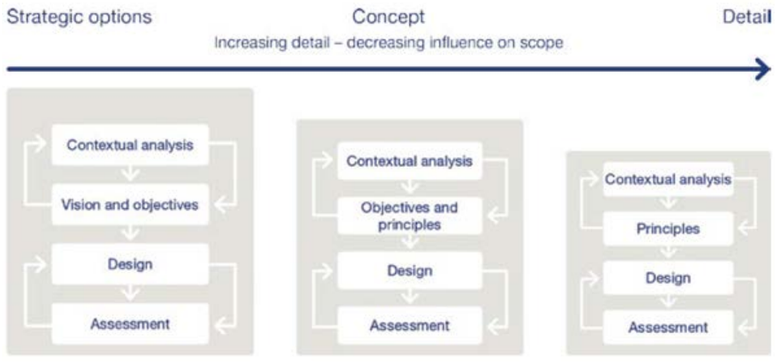


Figure 14: Methodology process diagram.
Source: Beyond the Pavement – Urban Design Policy Procedures and Design Principles, Roads and Maritime Services January 2014.

1.6 Urban design guidance

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

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

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

Approval documents (Figures 15 and 16):

- *Project Approval Notice*, dated 14 August 2014, and Modifications to the Project Approval, dated 15 January 2015, and 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 (Figures 15 and 16):

- *Guideline for Batter Surface Stabilisation using vegetation,* Roads and Maritime, 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.

Australian Government
Department of the Environment

Approval

Pacific Highway Upgrade – Woolgoolga to Ballina, NSW (EPBC 2012/6394)

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999*.

Proposed action

person to whom the approval is granted	Roads and Maritime Services
proponent's ABN	ABN 76 236 371 088
proposed action	To upgrade approximately 155 km of the Pacific Highway from Woolgoolga to Ballina, NSW [See EPBC Act referral 2012/6394].

Approval decision

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

conditions of approval

This approval is subject to the conditions specified below.

expiry date of approval

This approval has effect until 31 December 2064.

Decision-maker

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

signature

date of decision 14 August 2014

Figure 15: Approval document.

Figure 16: Covers of reference documents.

1.7 Document structure

The structure and content of the Urban Design and Landscape Plan is presented in Table 1-1 below.

Table 1-1: Structure and context of the Urban Design and Landscape Plan – Glenugie to Maclean (sections 3 and 4).

Title	Description
Executive Summary	Provides a summary of the UDLP.
Chapter 1 - Introduction	Provides a broad overview of the project and identifies the purpose and structure of the Urban Design and Landscape Plan.
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 Urban Design and Landscape Plan. 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 Glenugie to Maclean (sections 3 and 4).
Chapter 6 – Landscape and urban design principles for Glenugie to Maclean (sections 3 and 4)	Provides an overview of the Glenugie to Maclean (sections 3 and 4) highway design and describes the landscape and urban design principles and strategies specific to Glenugie to Maclean (sections 3 and 4).
Chapter 7– Landscape and urban design for Glenugie to Maclean (sections 3 and 4)	Describes the landscape and urban design concept specific to Glenugie to Maclean (sections 3 and 4). 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 Glenugie to Maclean (sections 3 and 4) at Detailed Design stage on the landscape character precincts and key views identified in the EIS. The assessment at Detailed Design is compared to the EIS assessment. This chapter also identifies additional properties potentially affected by the project between Glenugie to Maclean (sections 3 and 4). It provides a visual assessment and mitigation measures for those properties.
Chapter 8 – Landscape and urban design concept detail for Glenugie to Maclean (sections 3 and 4)	Detailed descriptions of all urban and landscape design elements for Glenugie to Maclean (sections 3 and 4).
Chapter 9 – Planting	Describes planting at the interchanges, intersections and underpasses.
Chapter 10 – Topsoil	Describes topsoil treatments and management.
Chapter 11 – Drainage and water quality	Describes water quality treatment systems.
Chapter 12 – Fauna crossing	Describes planting at the fauna crossings.
Chapter 13 – Conclusion	Summary of design outcomes.
Chapter 14 – Bibliography	Catalogue of referenced and cited documents.
Chapter 15 – Appendices	Catalogue of supporting documents.

1.8 Design development and representations

The visualisations, artists' impressions, design drawings, figures and images shown in this report accurately represent the detailed design at the time of publication. Design developments that occur during construction will be addressed in supplementary reports. Future design development may therefore occur that is not represented in this report. Artists' impressions are intended to be indicative ideas of a possible future landscape at maturity.

2.0 Compliance with environmental approval documents

2.1 Minister's conditions of approval

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

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 Conditions of Approval (D20).

Ministerial Conditions of Approval (D20)	Document Reference
D20 The Applicant shall prepare and implement an Urban Design and Landscape Plan prior to the commencement of permanent built works and/or landscaping, unless otherwise agreed by the Secretary, to present an integrated landscape and design for the SSI. The Plan shall be prepared in accordance with the Roads and Maritime Services urban design and visual guidelines, the design principles outline in the EIS, and the revegetation principles outline in the EIS Working Paper – Biodiversity. The Plan shall be prepared by an appropriately qualified expert in consultation with the relevant council and community, to the satisfaction of the Secretary. The Plan shall include, but not necessarily be limited to:	W2B-GHD-A-LX-RPT-00001 (this document)
D20 (a) Identification of design principles and standards based on:	Please refer to:
(i) Local environmental values	Chapter 6.3
(ii) Heritage values	Chapter 6.4
(iii) Urban design context	Chapter 6.2
(iv) Sustainable design and maintenance	Chapter 6.5
(v) Community amenity and privacy	Chapter 6.6
(vi) Relevant design standards and guidelines	Chapters 1.6 and 14
(vii) The urban design objectives outlined in Section 4.2 of the EIS Working Paper Urban Design Landscape Character and Visual Impact.	Chapter 5
D20 (b) the location of existing vegetation and proposed landscaping (including use of indigenous and endemic species where possible). Details of species to be replanted/revegetated shall be provided, including their appropriateness to the area and habitat for threatened species.	Chapter 9.1 and Appendix B
D20(c) a description of locations along the corridor directly or indirectly impacted by the construction of the SSI (eg temporary ancillary facilities, access tracks, watercourse crossings, etc.) and details of the strategies to progressively rehabilitate regenerate and/or revegetate the locations with the objective of promoting biodiversity outcomes and visual integration.	Chapters 6.8, 9.3 and 12
D20(d) take into account appropriate roadside planting and landscaping in the vicinity of heritage items and ensure no additional heritage impact.	Chapter 9.5
D20(e) a description of disturbed areas (including borrow sites) and details of the strategies to progressively rehabilitate, regenerate and/or revegetate these areas, including clear objectives and time frames for rehabilitation works, procedures for monitoring success of regeneration or revegetation, and corrective actions should regeneration or revegetation not conform to the objectives adopted.	Chapters 9 and 10
D20(f) location and design treatments for any associated footpaths and cyclist element, and other features such as seating, lighting (in accordance with AS 4282-1997 Control of the Obtrusive Effect of Outdoor Lighting), fencing, materials and signs.	Chapters 6.7, 8.2 and 8.3

Ministerial Conditions of Approval (D20)	Document Reference
D20 (g) an assessment of the visual screening effects of existing vegetation and the proposed landscaping and built elements. Where properties have been identified as likely to experience high visual impact as a result of the SSI and high residual impacts are likely to remain, the Applicant shall, in consultation with affected landowners, identify opportunities for providing at-property landscaping to further screen views of the SSI. Where agreed with the landowner, these measures shall be implemented during the construction of the SSI.	Chapter 9.4
D20(h) graphics such as sections, perspective views and sketches for key elements of the SSI, including but not limited to built elements of the SSI.	Chapters 7 and 8
D20(i) Strategies for progressive landscaping and other environmental controls such as erosion and sedimentation controls, drainage and noise mitigation.	Chapters 6.10,9,10 and 11
D20 (j) monitoring and maintenance procedures for the built elements, rehabilitated vegetation and landscaping (including weed control). Including performance indicators, responsibilities, timing, and duration and contingencies where rehabilitation of vegetation and landscaping measures fail.	Chapter 8, 9, 10
D20 (k) evidence of consultation with the relevant council and community on the proposed urban design and landscape measures prior to its finalisation.	Appendix G

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. These measures were further refined during the SPIR. Additional commitments were identified and conditions that had already been fulfilled were removed. Table D-1 in Appendix D and Table E-1 in Appendix E of this document outlines compliance with relevant environmental mitigation measures related to landscape and urban design specific to Glenugie to Maclean (sections 3 and 4).

The EIS identified a range of strategies and management measures to minimise the visual impact and adverse changes to the landscape character by the project. This Urban Design and Landscape Plan 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 (refer to Table 2-2).

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 Glenugie to Maclean (sections 3 and 4). For locations of the viewpoints please refer to Chapter 7. For locations of the viewpoints please refer to Table 2-3 and Chapter 7.4.2.

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

EIS Compliance	Applicable to sections 3 and 4	Document reference
11.4.1 Urban design and landscape strategy (i) Retain the strong contrasting experience of driving through forest and open agricultural land as a feature of the Pacific Highway experience (ii) Acknowledging and celebrate the small and medium sized coastal towns that mark progress along the coastal Pacific Highway journey (iii) Highlight and celebrate the numerous minor and major creek and river crossings that punctuate the Pacific Highway journey over the coastal floodplains (v) Acknowledge and preserve the natural and cultural landscapes and landmarks identified along the full length of the Pacific Highway journey.	Yes	Chapters 5 to 12
Viewpoint mitigation measures for EIS viewpoints located in sections 3 and 4	Yes	Chapter 7.4.2

Table 2-3: Viewpoint mitigation measures related to urban design and landscape compliance with EIS applicable to sections 3 and 4.

EIS Compliance	Applicable to sections 3 and 4	Document reference
Project Section 3		
9_ Old Six Mile Road, near Wants Lane • Minimise loss of existing trees • Plant dense low grasses/ground covers on low fill batters • Reinstate woodland trees between Six Mile Lane and the project.	Yes	Chapters 7 to 12
10_Avenue Road – crossing at Wants Lane • Plant dense low grasses/ground covers on low fill batter • Highlight new interchange with landscape treatment including local woodland trees in accordance with detailed landscape design.	Yes	Chapters 7 to 12
17_Pine Brush Forest • Minimise loss of existing trees • Plant local forest trees on cut/fill batters • Reinstate local forest vegetation where applicable.	Yes	Chapters 7 to 12
18_Pacific Highway, Tyndale • Minimise loss of existing forest trees • Lay back and feather top cut batters (1:3) to blend with natural landform • Plant local forest trees on cut/fill batters • Provide new landscape treatment in accordance with the concept design • Use steep batters (0.25H:1V) wherever there is competent rock to minimise the loss of forest vegetation.	Yes	Chapters 7 to 12

EIS Compliance	Applicable to sections 3 and 4	Document reference
Project Section 4		
20B_Cane fields, Tyndale (north) • Minimise loss of existing vegetation • Provide screen tree and shrub planting on embankments and between access and service roads in accordance with the landscape concept strategy and to provide a screen to nearby homes. • Prepare detail landscape designs in accordance with the landscape concept strategy.	Yes	Chapters 7 to 12
20C_Byrons Lane, Tyndale (north) • Minimise loss of existing vegetation • Provide screen tree and shrub planting on embankments and between access and service roads in accordance with the landscape concept strategy and to provide a screen to nearby homes. • Prepare detail landscape designs in accordance with the landscape concept strategy.	Yes	Chapters 7 to 12
24A_Ferry Park, Maclean • Provide landmark tree planting to highlight to entry to Maclean from the exiting highway. In accordance with the concept design • Consider additional fill between highway service roads to minimise the excessive height of embankments.	Yes	Chapters 7 to 12
24B_Schwonberg Street, Townsend • Replace existing roadside screen vegetation to provide a screen between the highway and local homes along Schwonberg and Jubilee Streets.	Yes	Chapters 7 to 12

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

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

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

To ensure a consistent approach to the mitigation, management and offsetting of biodiversity for the project, an overarching management strategy was developed as part of the EIS, comprised of: a Mitigation Strategy, a Monitoring Strategy and an Offset Strategy. Table 2-4 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 2-4: Vegetation and landscape design principles for connectivity measures identified in the Biodiversity Connectivity Strategy.

Design Principle	Applicable to sections 3 and 4	Document reference
Riparian corridors to be protected during construction works and any areas of riparian vegetation impacted by construction are to be rehabilitated to a pre-determined benchmark condition to be specified in the CEMP.	Yes	Chapter 9 and 12
Revegetation actions around crossing structures should consider the height and density of vegetation so as not to screen the structure from view, but also aim to provide some cover for fauna approaching and exiting the structure.	Yes	Chapter 9 and 13
Roadside plantings in emu crossings should not be within the first 40 metres of the road unless there is fauna exclusion fencing in place or as part of the exclusion barrier discussed above. In particular common landscape species such as Gahni, Lomandra and Dianella spp. represent food plants for emus and may attract them to the road edge and should avoid being planted.	Yes	Chapter 9 and 14
Plantings under bridges in emu crossing zones including the approaches to the crossing are to use grasses or low ground covers and avoid dense plantings of trees including low trees such as Acacia or Causarina. This is to leave the opening clear. Ground cover crops such as soybean and oats or rye grass could be used on disturbed ground around the approaches to the bridge to attract the emus to the crossing zone.	Yes	Chapter 9 and 15
Plantings around dedicated and combined underpasses is to ensure that entrances to the structure do not obscure the structure and provide a line of sight.	Yes	Chapter 9 and 16
It is important for landscaping at entrances not to intrude/shadow the window of the entrances.	Yes	Chapter 9 and 17
Landscaping should use locally indigenous species and should target key fauna food resources to encourage usage either side of the structure and thus provide the habitat linkage to the structure.	Yes	Chapter 9 and 18

2.5 Urban design and landscape compliance with Threatened Species Management Plan

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 2-5.

Table 2-5: Threatened Species Management Plans applicable to sections 3 and 4.

Threatened Species Management Plan Compliance	Applicable to sections 3 and 4	Document reference
Koala management plan.	Yes, however Koalas are not the targeted species in sections 3 and 4.	Not applicable
Coastal emu management plan.	Yes	Chapters 7 and 12
Rainforest communities and threatened rainforest plants management plan.	No	Not applicable
Threatened flora management plan.	Yes	Chapter 9.2
Threatened glider management plan.	Yes	Chapters 7 and 12
Threatened mammal management plan.	Yes	Chapters 7 and 12
Threatened frog management plan.	Yes	Chapter 12
Threatened fish management plan.	No	Not applicable
Threatened invertebrate management plan.	No	Not applicable
Flora Translocation Strategy.	Yes	Chapter 9

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

3.0 Consultation

3.1 Overview

A community and stakeholder engagement strategy was developed and implemented to support the progress of the Woolgoolga to Ballina Pacific Highway upgrade with relation to the draft Urban Design and Landscape Plan. The strategy ensured appropriate levels of consultation with key stakeholders to manage expectations and minimise risk.

The strategy outlined the:

- Level of engagement to be carried out
- Key stakeholders
- Potential issues and mitigation activities
- Consultation and communication activities to ensure effective, relevant and timely input from stakeholders and the community
- Communication protocols and responsibilities within the project team
- Evaluation activities.

The strategy recommended a co-hosted consultation approach incorporating the Urban Design and Landscape Plan alongside the proposed design refinements for consideration as part of the detailed design development process.

The desired outcomes of the stakeholder engagement and consultation included:

- Stakeholder understanding of the detailed design and urban design and landscape development processes
- Stakeholders making submissions which are captured and fed into the development of the final urban design and landscape management plan
- Development of comprehensive final urban design and landscape plans, which will guide and support major planning and investment decisions
- Early stakeholder participation in the planning of the urban design and landscape planning, which will encourage ongoing interest and commitment to its development and implementation
- Risk minimisation, and minimisation of negative media publication.

3.2 Community consultation

Community feedback was sought on the draft Urban Design and Landscape Plan. The community was able to provide feedback from 1 August to 29 August 2016. Consultation activities during this time involved:

- Sending more than 500 letters to stakeholders with property within 750 meters of the project alignment
- Distributing a community update to more than 20,000 residents
- Staffed displays at 11 locations
- Static displays at 27 locations
- Updating the project website with the draft urban design and landscape management plans, community updates as well as an online survey and collaborative mapping tool to capture feedback
- Emailing more than 1000 stakeholders registered in the project database
- Advertising in four local newspapers.

Community members and key stakeholders were encouraged to provide their feedback at staffed displays, by completing feedback surveys or providing a response by mail, email or phone. Feedback on the plans was accepted until 5:00pm, Monday 29 August 2016.

The community also provided feedback on proposed design refinements. These issues have been addressed in the proposed design refinement community consultation report, which will be made publicly available on the project website.

3.3 Specific responses for each section of the project

3.3.1 Glenugie to Maclean sections 3 and 4

Two written responses were received, key issues raised include:

- Vegetation type
- Noise and acoustic assessment.

Please refer to Appendix G – Woolgoolga to Ballina, Pacific Highway upgrade Community Consultation Report for the Urban Design and Landscape Plans, February 2017 for further information and the location of the responses in this report.

3.4 Stakeholder consultation

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

Stakeholders who will be provided the UDLP to review include:

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

Key issues raised during this review were:

- Early installation of riparian rehabilitation and landscape treatments
- Support for soft scour treatments in creek areas
- Support for reuse of woody debris
- Support for locating fauna fencing as close to highway pavement as possible.

Further details of the issues raised and responses are included in Appendix G of this report.

Following community consultation and finalisation of the report an additional submission was received from Grafton Chamber of Commerce. Issues raised relate to landscape treatments at Glenugie interchange. Issues and responses are included in Appendix H.

4.0 Pacific Highway urban design, landscape objectives and principles

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 principles 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).

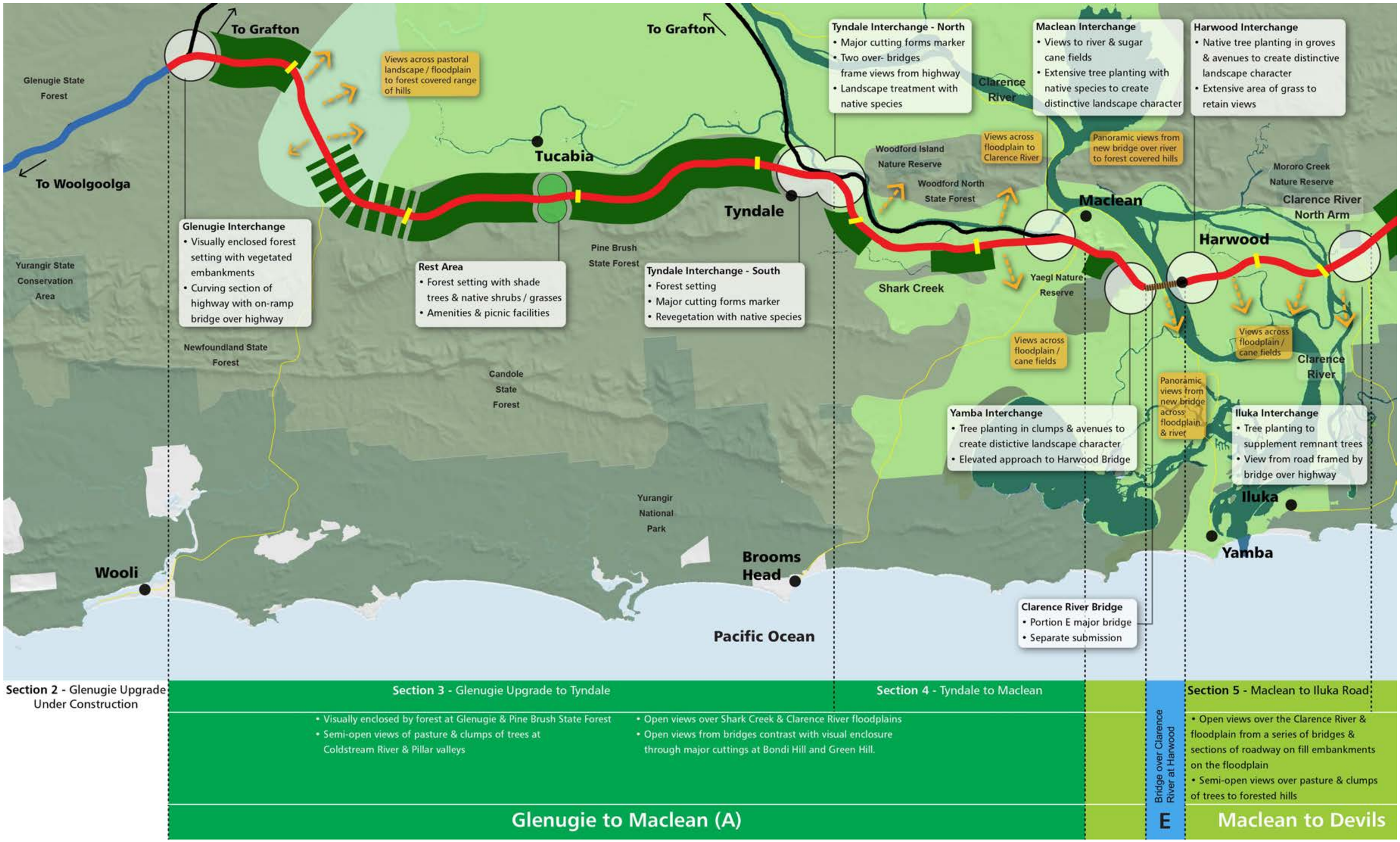
4.4 Urban design and landscape strategy

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.

Woolgoolga to Ballina Pacific Highway upgrade

Urban design and landscape plan



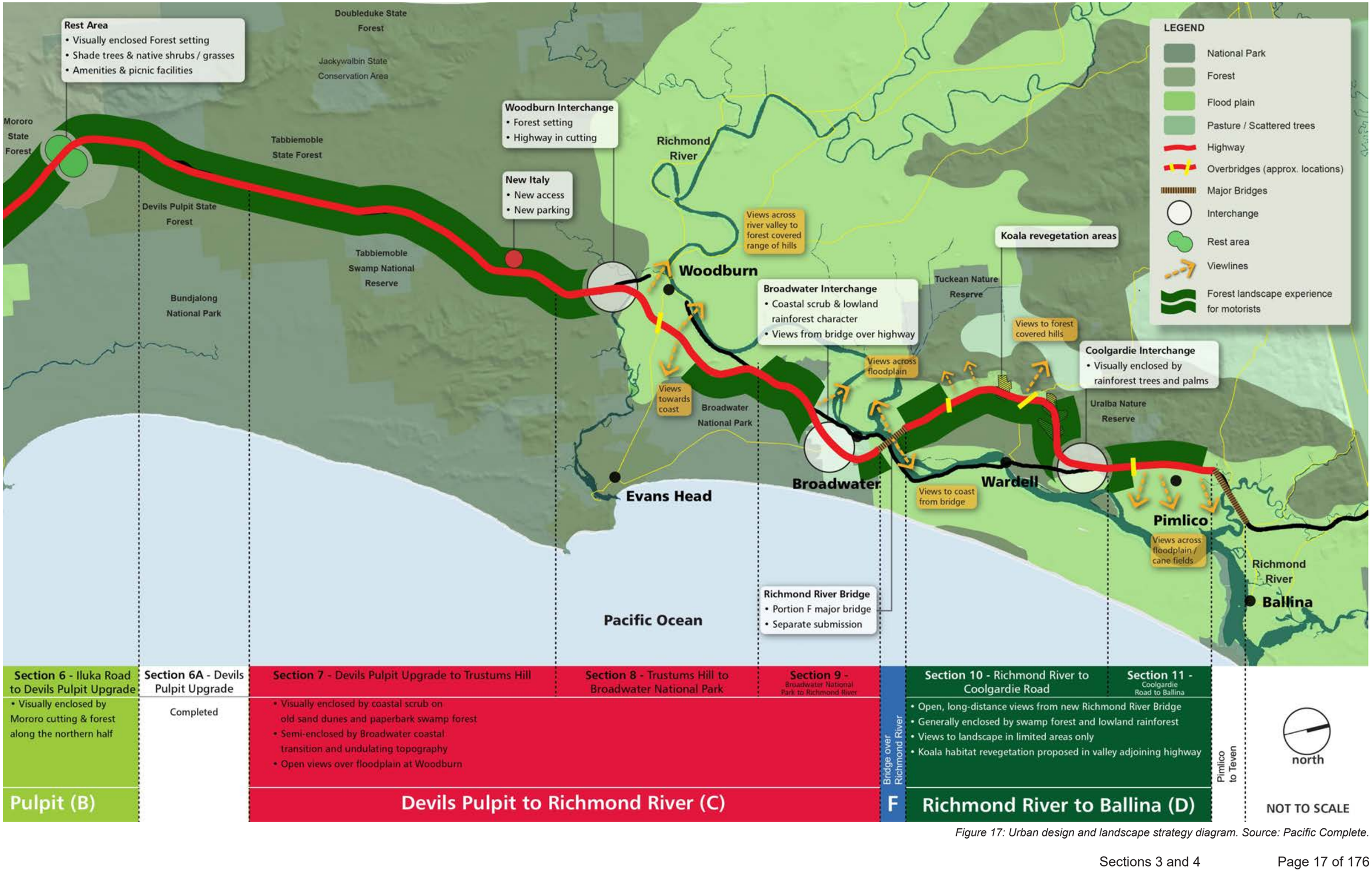


Figure 17: Urban design and landscape strategy diagram. Source: Pacific Complete.

Figure 18: Existing view: oblique aerial of proposed Tyndale interchange north. Source: Pacific Complete.

5.0 Contextual analysis

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

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

Principle 1
Acknowledge the small and medium sized coastal towns that mark progress along the coastal Pacific Highway journey.

Principle 2
Highlight and celebrate the numerous minor and major creek and river crossings that punctuate the Pacific Highway journey over the coastal floodplains.

Principle 3
Retain the strong contrasting experience of driving through forest and open land as a feature of the Pacific Highway experience.

Principle 4
Acknowledge and preserve the natural and cultural landscapes and landmarks identified along the full length of the Pacific Highway journey.

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

5.1 Character zones

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

Character zone 1 – Glenugie State Forest
- Heavy forest and woodland setting
- Closed views of forest
- Scattered rural residential, generally not visible from highway.

Character zone 2 – Coldstream and Pastureland
- Scattered pasture and woodland setting
- Intermittent open views of pastureland and forest
- Scattered rural residential, some visible from highway.

Character zone 3 – Pillar Valley
- Intermittent forest setting
- Occasional open valley views
- Scattered rural residential, generally not visible from highway.

Character zone 4 – Pine Brush State Forest
- Heavy forest and woodland setting
- Intermittent open views to the west
- Scattered rural residential, generally not visible from highway.

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

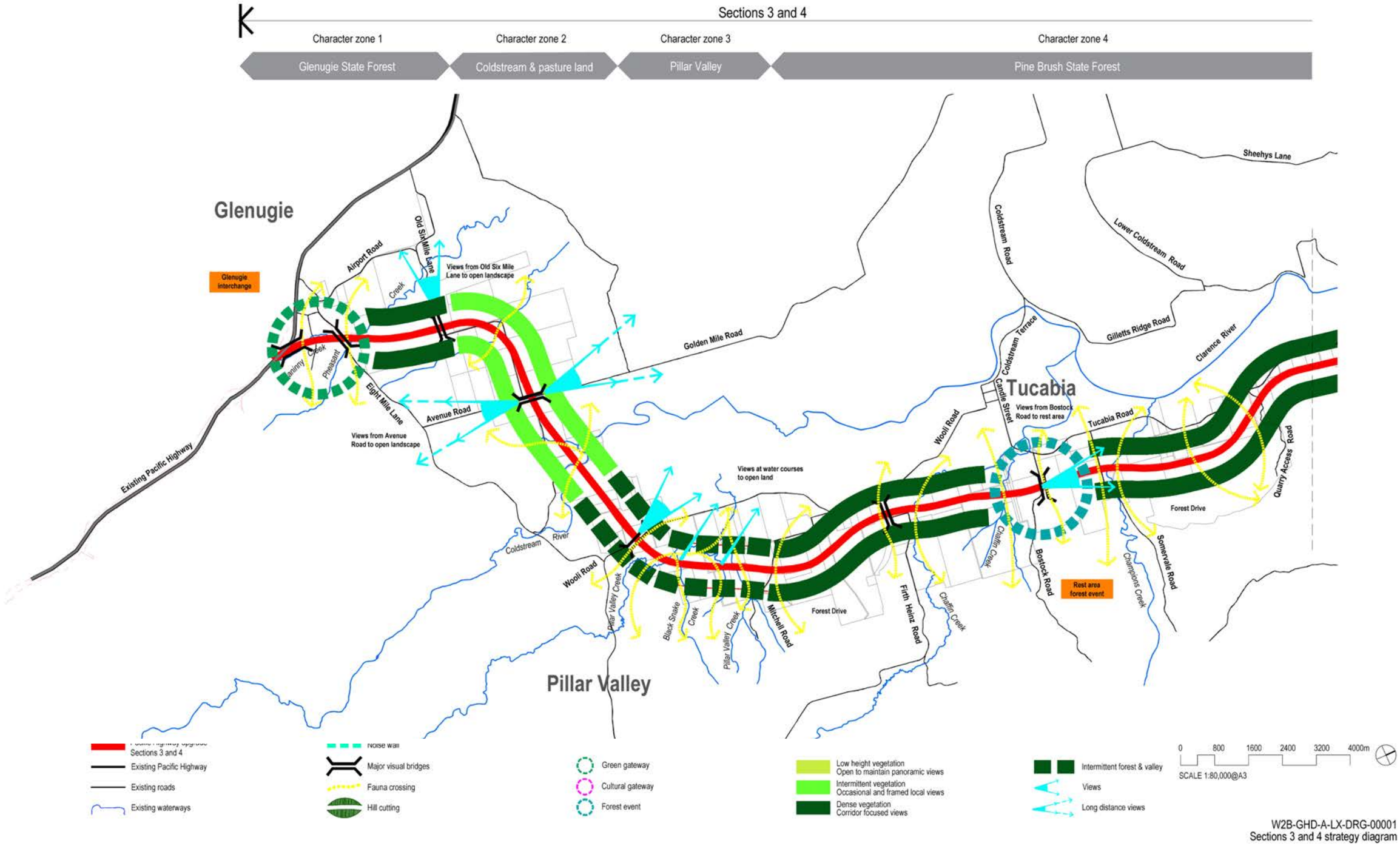
Character zone 6 –Shark Creek Floodplain
- Open floodplain and agricultural setting
- Open views to cane fields
- Scattered rural residential, some visible from highway.

Character zone 7 – Green Hill Cutting
- Heavy forest and woodland setting
- Closed views of forest
- Scattered rural residential, mostly not visible from road
- Major cutting through Green Hill
- Views to scattered rural residential from highway.

Character zone 8 – Clarence River Floodplain
- Open floodplain and agricultural setting
- Open views to cane fields
- Scattered rural residential, some visible from highway.

Character zone 9 - Maclean Township
- Open floodplain and agricultural setting
- Open views to cane fields and Clarence River south arm
- Close proximity to settlement of Maclean township.

Refer to DRG-00001 and DRG-00002.



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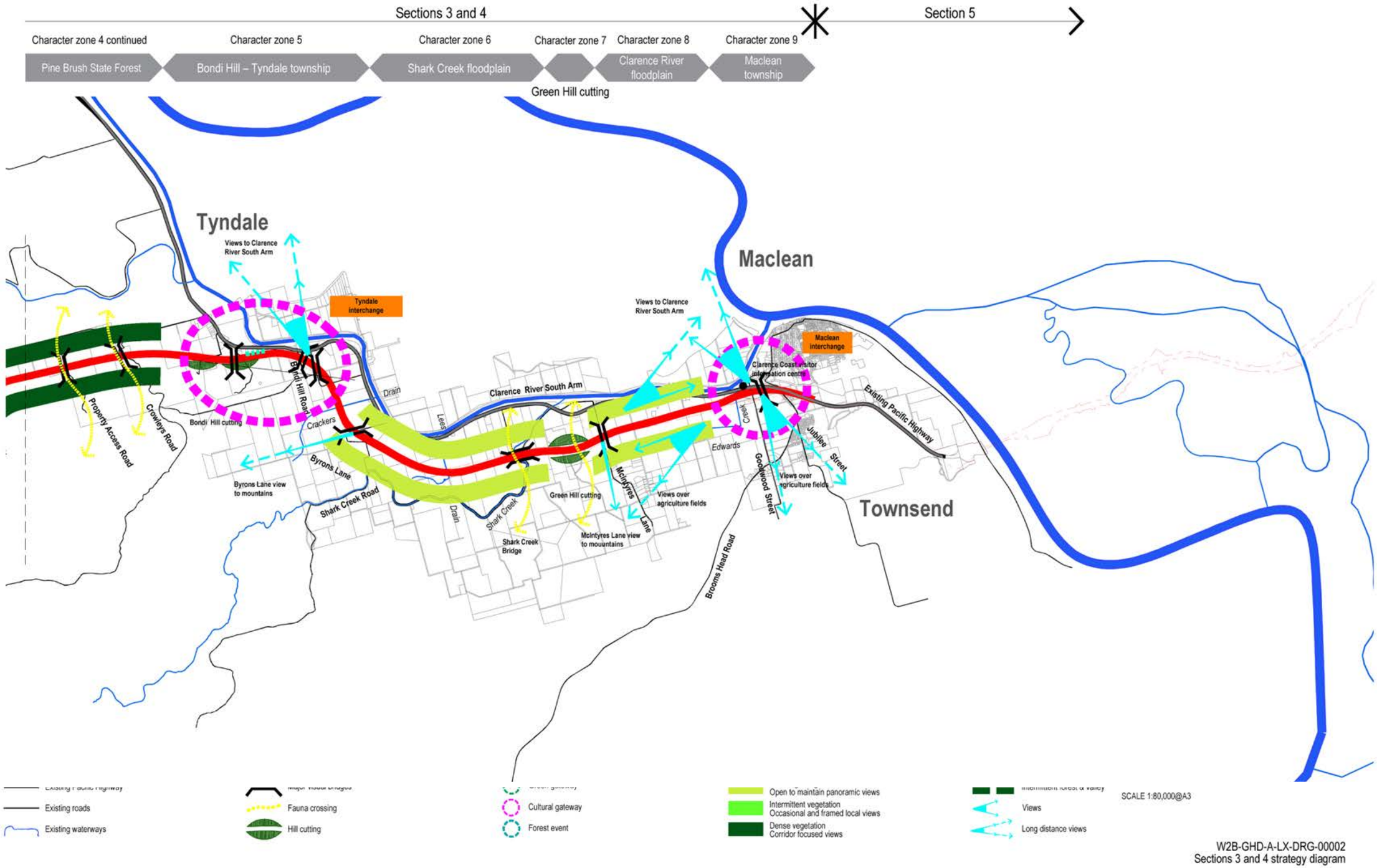
Sections 3 and 4 strategy diagram



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Sections 3 and 4 strategy diagram

5.2 Land use and communities

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

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

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

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

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

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

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

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

Ulmarra lies along the existing Pacific Highway along the Clarence River. It currently provides a pleasant rest stop for drivers and offers a number of attractions such as its riverfront open spaces, heritage buildings and streetscapes. The village was the site of a butter factory that processed milk from surrounding dairies. The village contains a number of small businesses that cater to tourists such as bed and breakfast stays, small hotels, cafes and craft shops. It will be important to provide information to drivers to alert them of the location of this village, so that business activity can be maintained (Figure 19).

Tucabia is a small village located near the rest area. It currently serves as a local village centre servicing the surrounding agricultural lands. Tucabia will not be connected to the highway and it is expected that the function of the village will remain largely unchanged. The highway can provide an opportunity through signage or interpretation at the rest area, to highlight Tucabia's location and potentially suggest an alternate scenic route along the highway that could be part of the driver's experience through the Clarence Valley (Figure 20).

Figure 19: Ulmarra view from Coldstream Street looking east.

Figure 20: Tucabia view from Cordini Street looking east.

Tyndale is the site of a major interchange with the existing Pacific Highway. It currently functions as a service point for travellers with accommodation, food and fuel. With the provision of the Tyndale interchange, these functions could be expected to become more important, as Tyndale becomes the link between the highway and other villages along the existing Pacific Highway (Figure 21).

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

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

Townsend, located to the east of Maclean, currently accesses the existing Pacific Highway at Maclean. It provides a base for some light industry and support for surrounding agricultural areas. The settlement is largely residential and contains a heritage item near the highway. Traffic in Townsend is not expected to be significantly altered by the upgrade, as Townsend is currently on the route to the highway from points east and south (Figure 22).

Community amenity and privacy

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

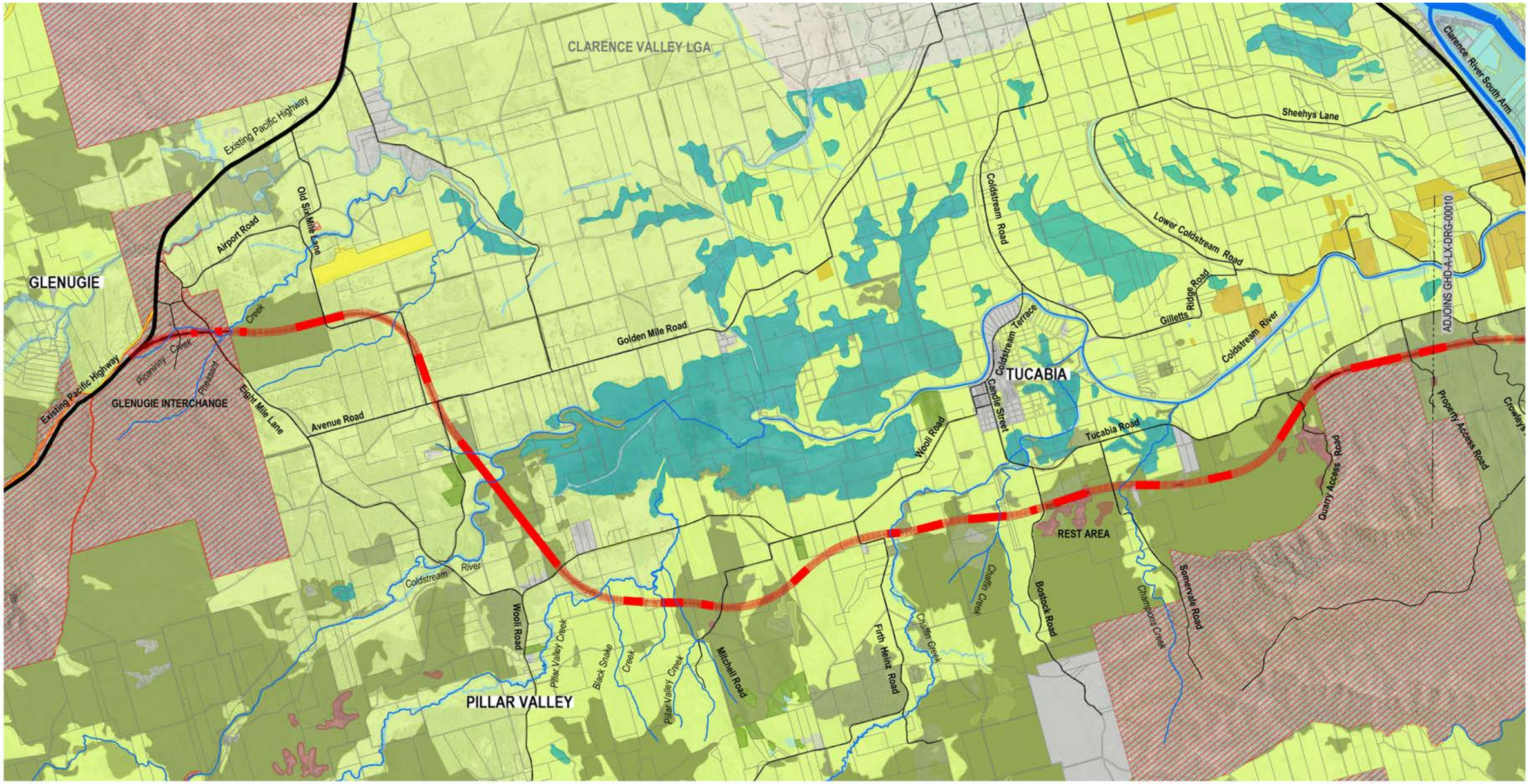
Community sensitivity to the local context is acknowledged as an important aspect of the project. The upgrade is specifically designed to respond appropriately.

Strategies

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

Figure 21: Tyndale view from Sheehys Lane looking north.

Figure 22: Townsend view from Jubilee Street looking west.



LEGEND

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

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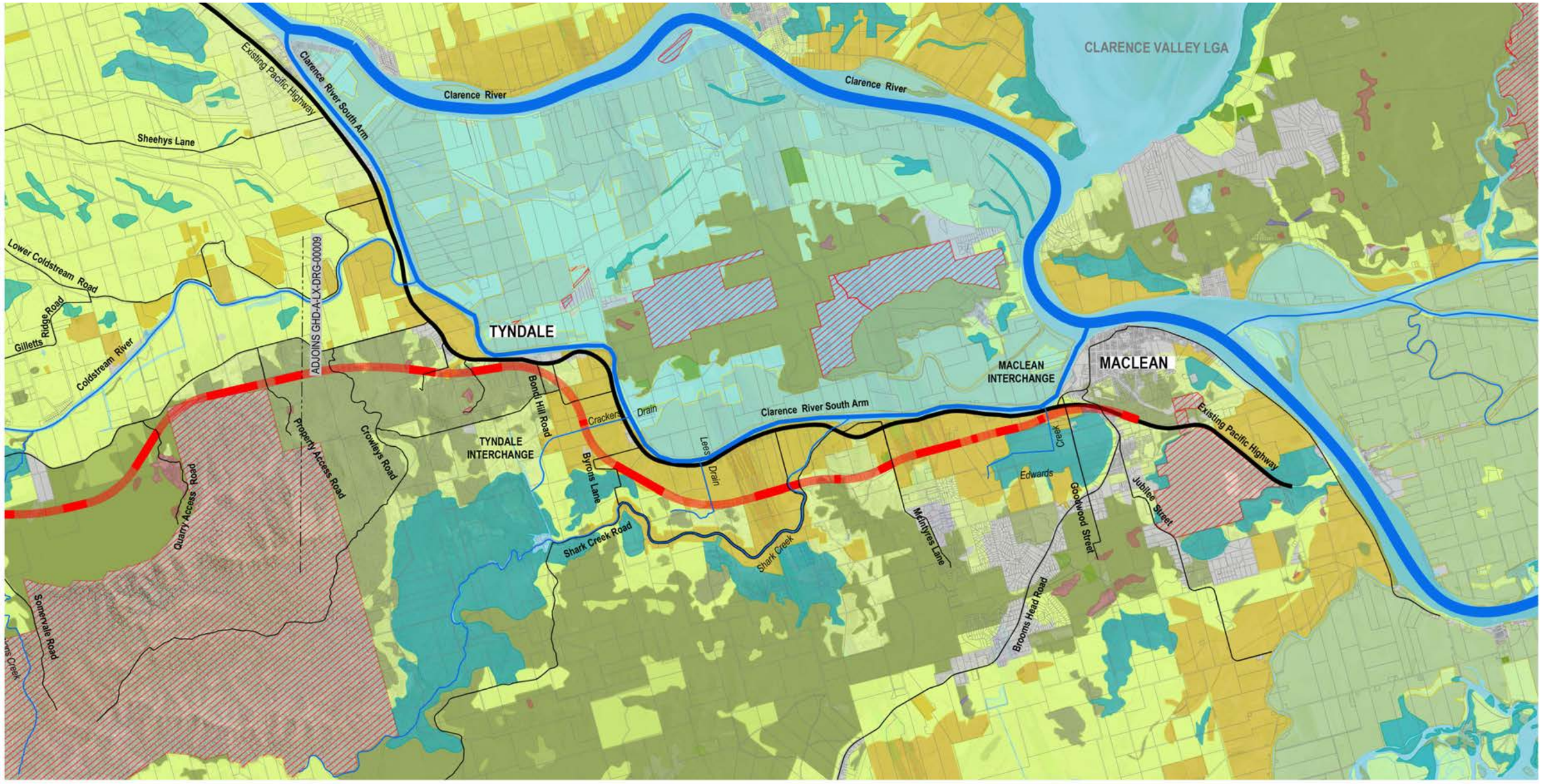
Land use



LEGEND

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

0 800 1600 2400 3200 4000m

SCALE 1:80,000@A3

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Land use

5.3 Landform and hydrology

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

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

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

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

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

Flood modelling studies are subject to detailed design development and consultation with local communities. Refer to Chapter 6.9.

Strategies

- Locate appropriate Roads and Maritime signage at each watercourse crossing
- Consider appropriate landscape treatments to signal a riparian environment to drivers
- Develop a consistent bridge language that signals watercourses to drivers
- Provide appropriate fauna landscape for all creeks.

Topography and views

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

Long distance views to some of the peaks (Glenugie Peak and Clarence Peak) are visible through open pasture areas and the flood plains. The design will ensure that the interrelationship of the route topography and significant views are maintained, or enhanced, along key locations of the route. (Figures 23 to 29, DRG-00016 and DRG-00017).

Figure 23: Shark Creek character.

Figure 24: Chaffin Creek character.

Figure 25: Existing view: oblique aerial looking east to Tucabia with Clarence Peak in background. Source: Pacific Complete..

Figure 26: Glenugie Peak looking north along existing Pacific Highway near Glenugie.

Figure 27: Coldstream/Pillar Valley character.

Figure 28: Maclean lookout, view looking east.

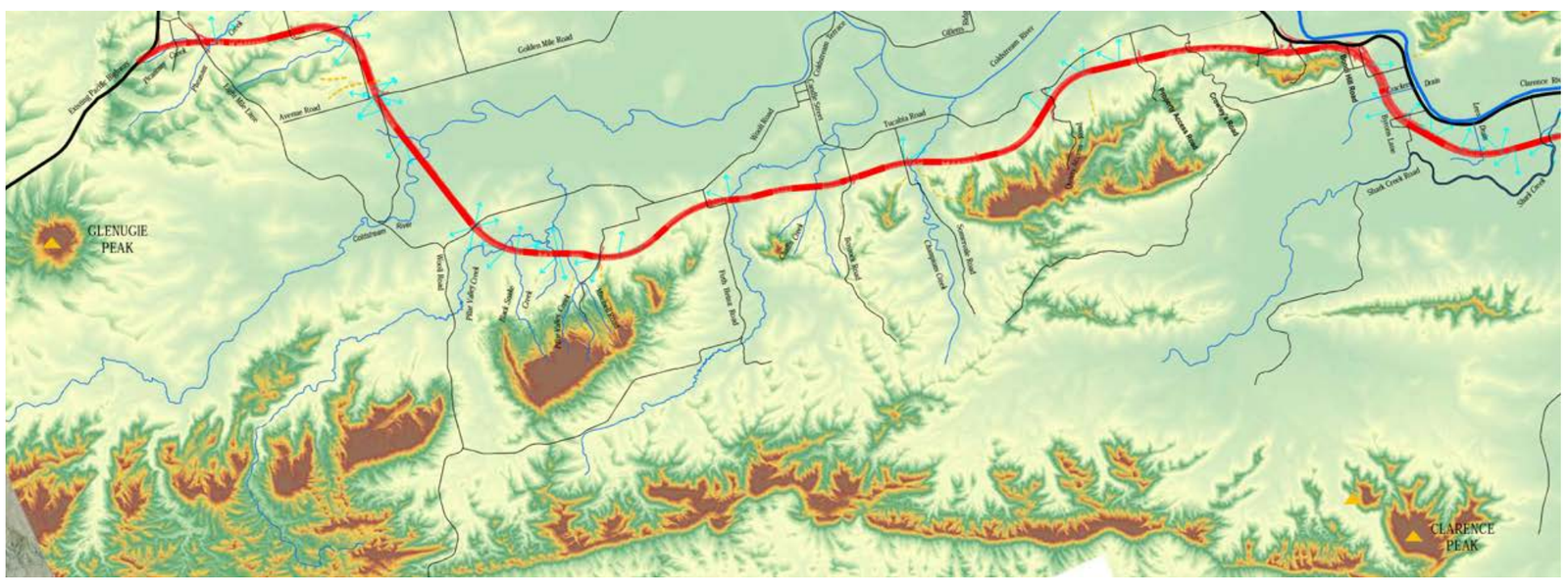
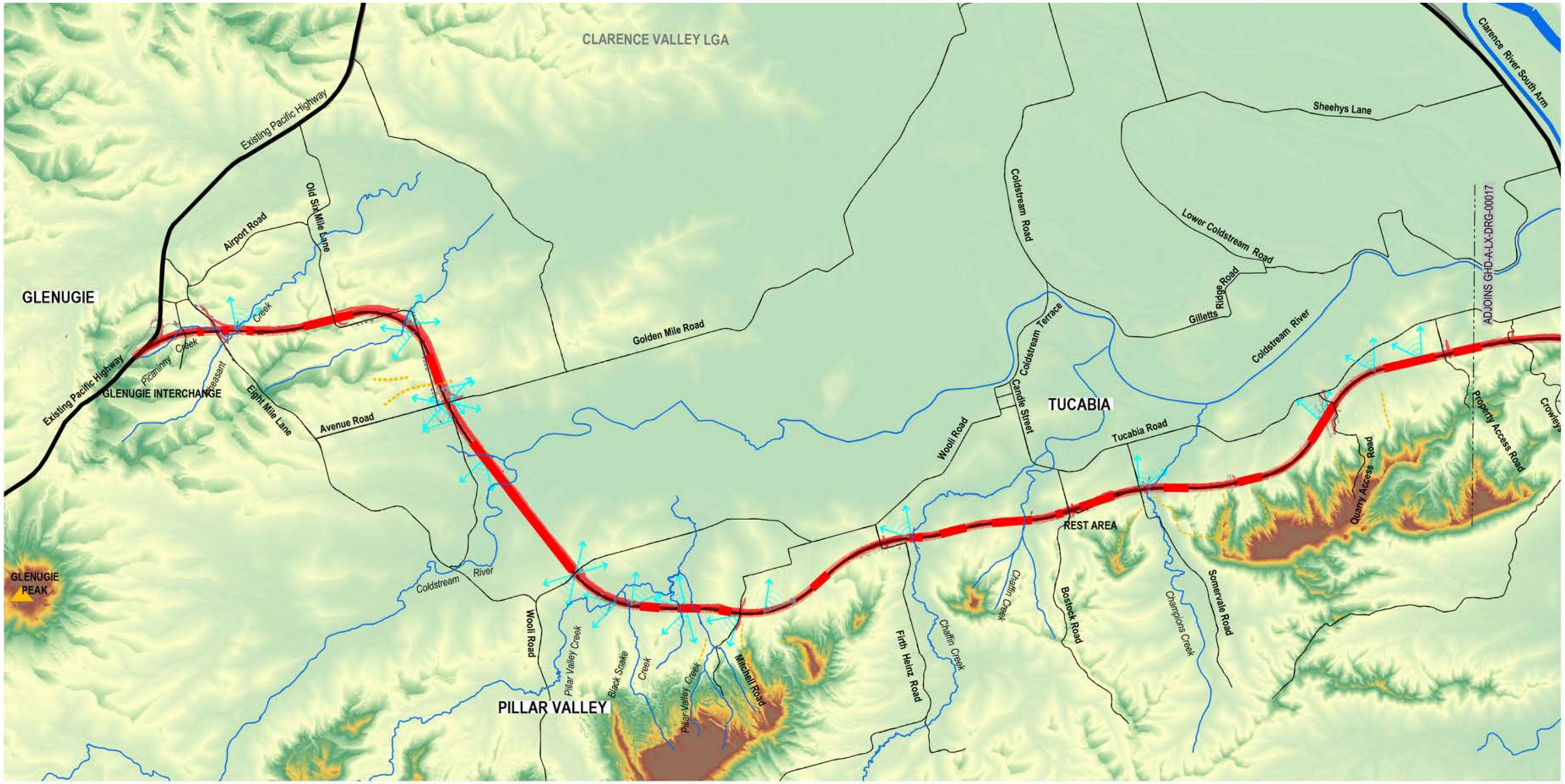


Figure 29: Major ridges and peaks.



DTM Souce: GHD

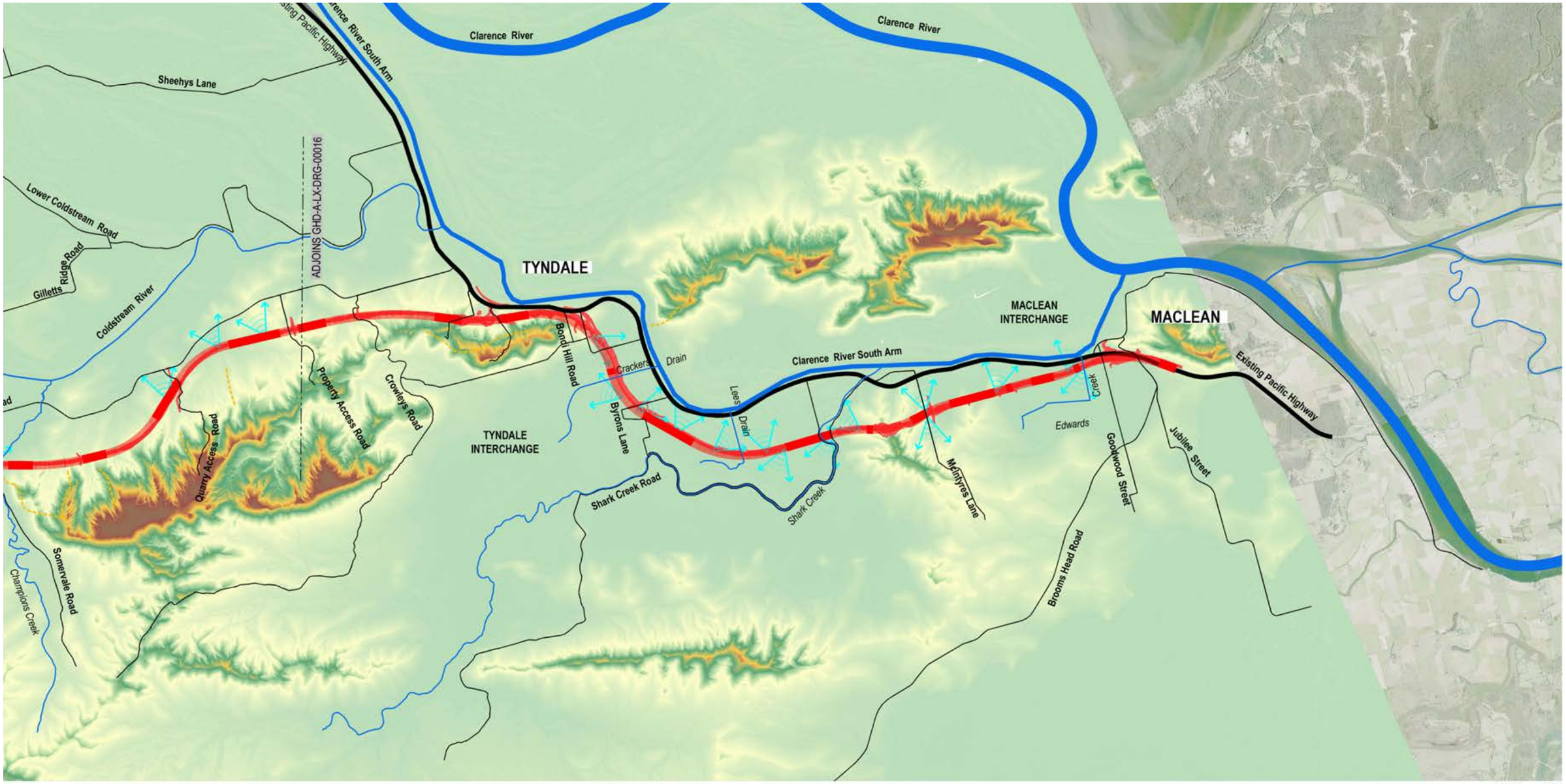
LEGEND

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

0 800 1600 2400 3200 4000m

SCALE 1:80,000@A3

W2B-GHD-A-LX-DRG-00016
Topography and views



DTM Souce: GHD

LEGEND

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

0 800 1600 2400 3200 4000m

SCALE 1:80,000@A3

W2B-GHD-A-LX-DRG-00017
Topography and views

5.4 Flora and fauna

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

Landscape will be provided to enhance the contrast between these two types of driver experiences. Sections 3 and 4 contain a number of areas where this shift is evident and can be reinforced. These include Pillar Valley, Glenugie and the transition from forest areas to cane fields in this area (Figures 30 to 31, DRG-00004, DRG-00012 and DRG-00013).

Strategies

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

5.5 Heritage

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

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

Refer to DRG-00014, DRG-00015 and Chapter 6.4 for details.

Figure 30: Enclosed forest driver experience.

Figure 31: Open valley driver experience.

5.6 Geology and soils

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

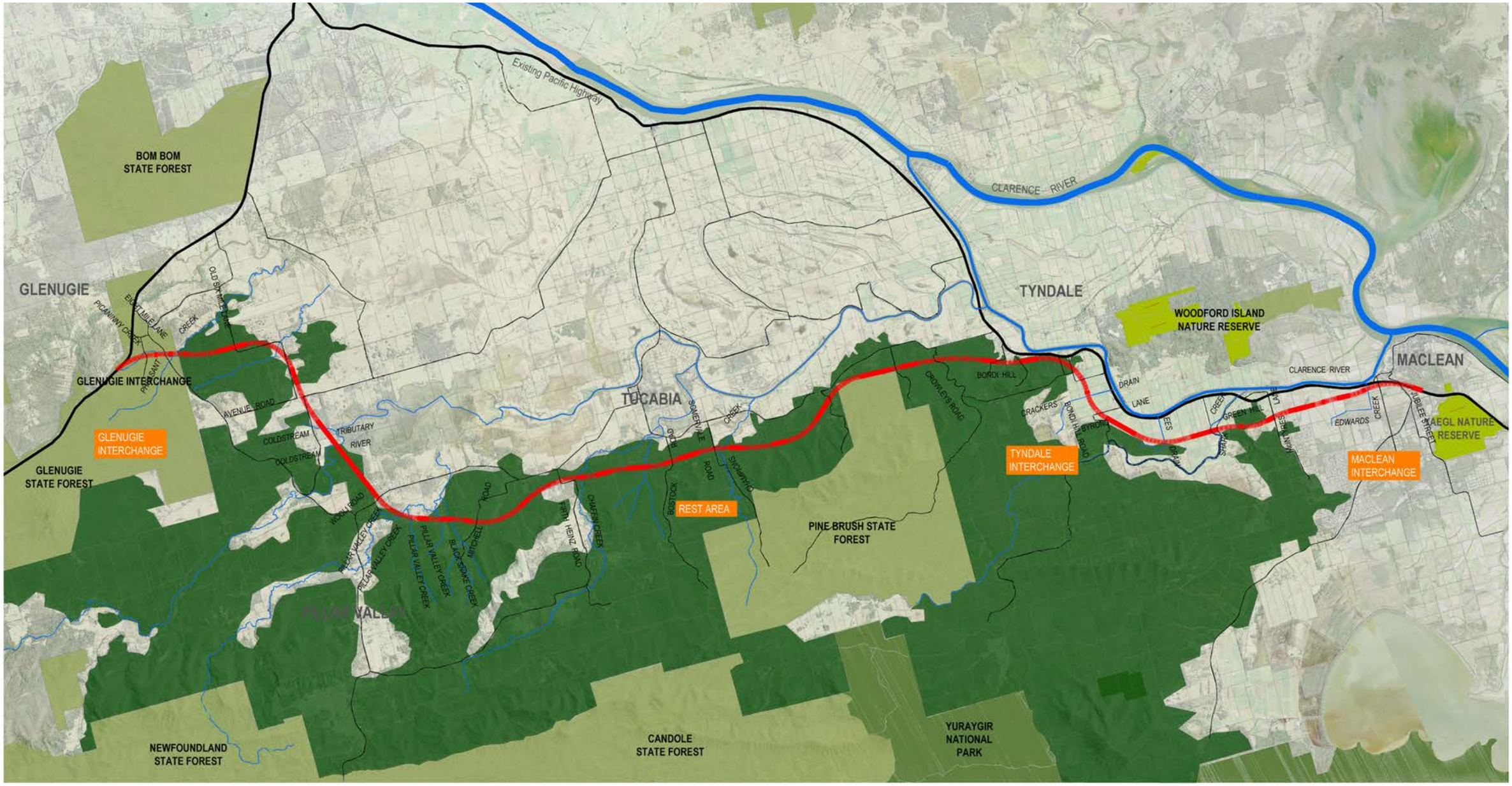
The Grafton formation overlies and grades into the Kangaroo Creek Sandstones. The soil derived from the Grafton formation are iron rich creating a very red coloured soil.

Green Hill cutting is associated with coal formations.

The design will ensure that appropriate landscape types are proposed that suit the geology, soil and climatic conditions in the vicinity of the route traversed (DRG-00007 and DRG-00008).

5.7 Key views

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



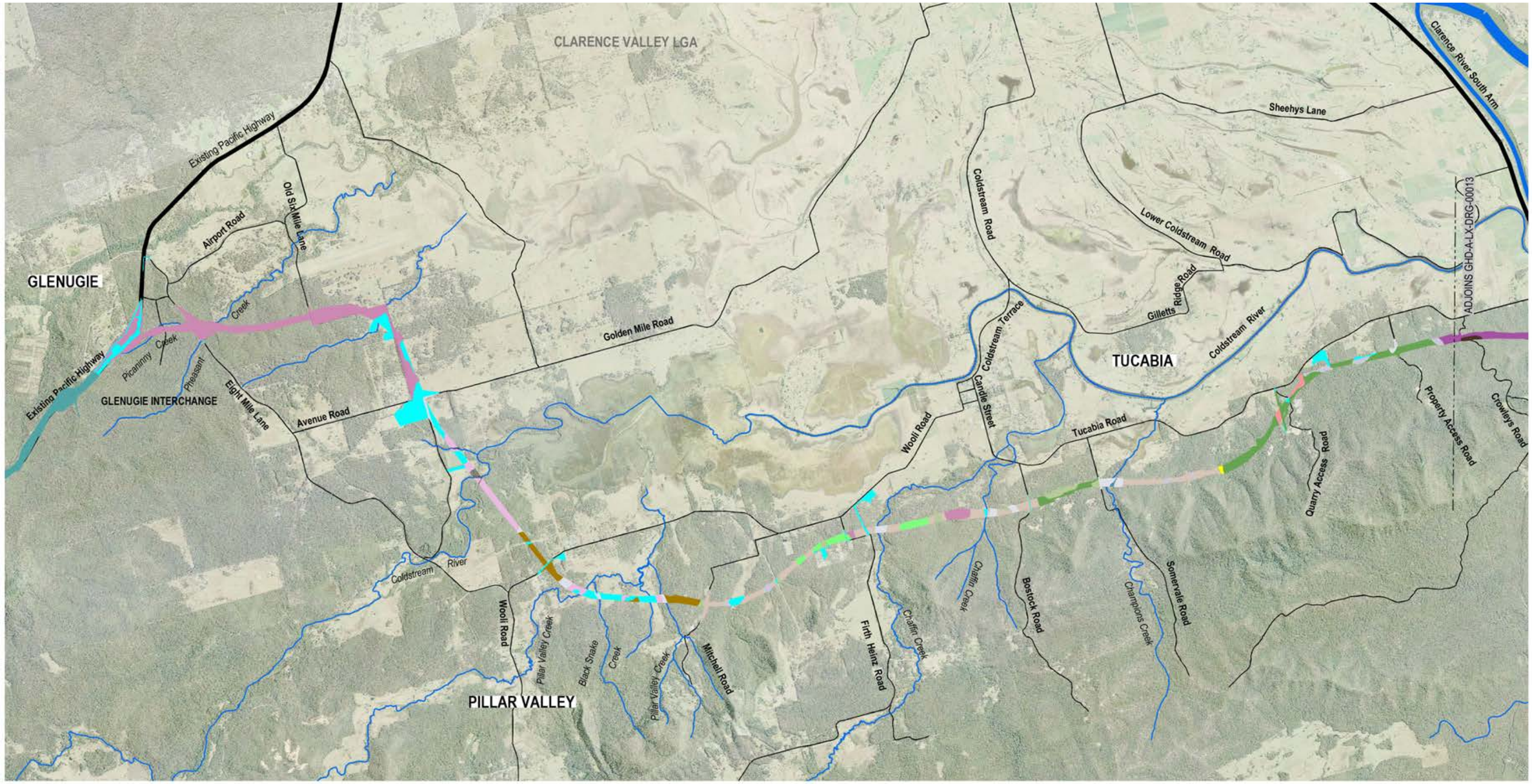
LEGEND

- Pacific Highway upgrade Sections 3 and 4
- Existing Pacific Highway
- Existing roads
- Existing major watercourses
- Other forest /dense vegetated areas
- National Parks
- State Forest

0 1250 2500 3750 5000 6250

SCALE 1:125,000@A3

W2B-GHD-A-LX-DRG-00004
Existing national parks and state forests



Based on biometric data

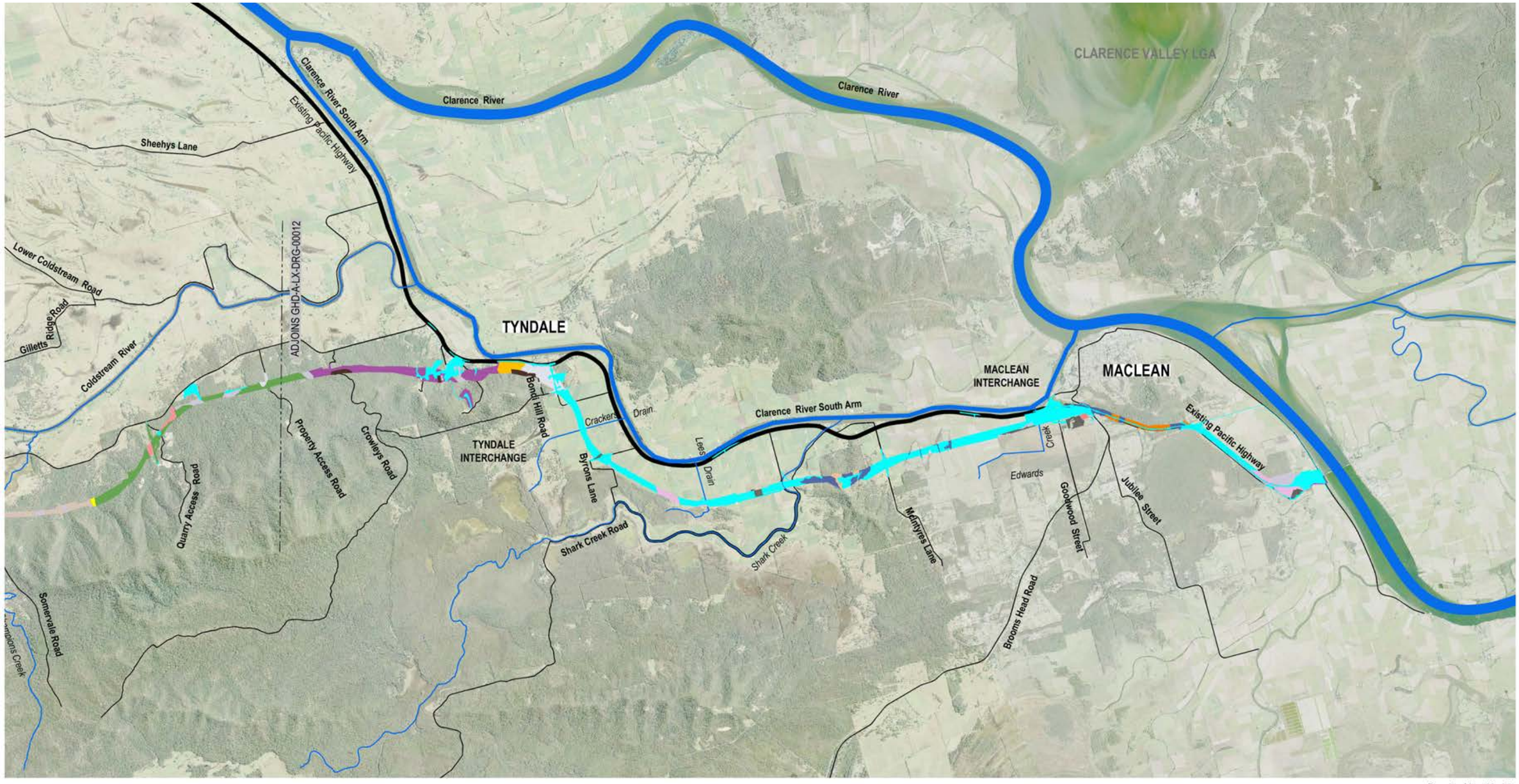
LEGEND

- Angophora robur shrubby forest and woodland on sandstones of the North Coast
- Black Bean - Weeping Lilly Pilly riparian rainforest of the North Coast
- Blackbutt - Bloodwood dry heathy open forest on sandstones of the northern North Coast
- Swamp Box swamp forest of the coastal lowlands of the North Coast
- Coastal floodplain sedgelands, rushlands and forblands
- Coastal freshwater meadows and forblands of lagoons and wetlands
- Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast
- Swamp Mahogany swamp forest of the coastal lowlands of the North Coast
- Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast
- Grey Gum - Grey Ironbark open forest of the Clarence lowlands of the North Coast
- Narrow-leaved Ironbark dry open forest of the North Coast
- Swamp Oak swamp forest of the coastal lowlands of the North Coast
- Paperbark swamp forest of the coastal lowlands of the North Coast
- Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the North Coast
- Scribbly Gum - Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast
- Turpentine moist open forest of the coastal hills and ranges of the North Coast
- Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the 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
- Cleared

0 800 1600 2400 3200 4000m

SCALE 1:80,000@A3

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



Based on biometric data

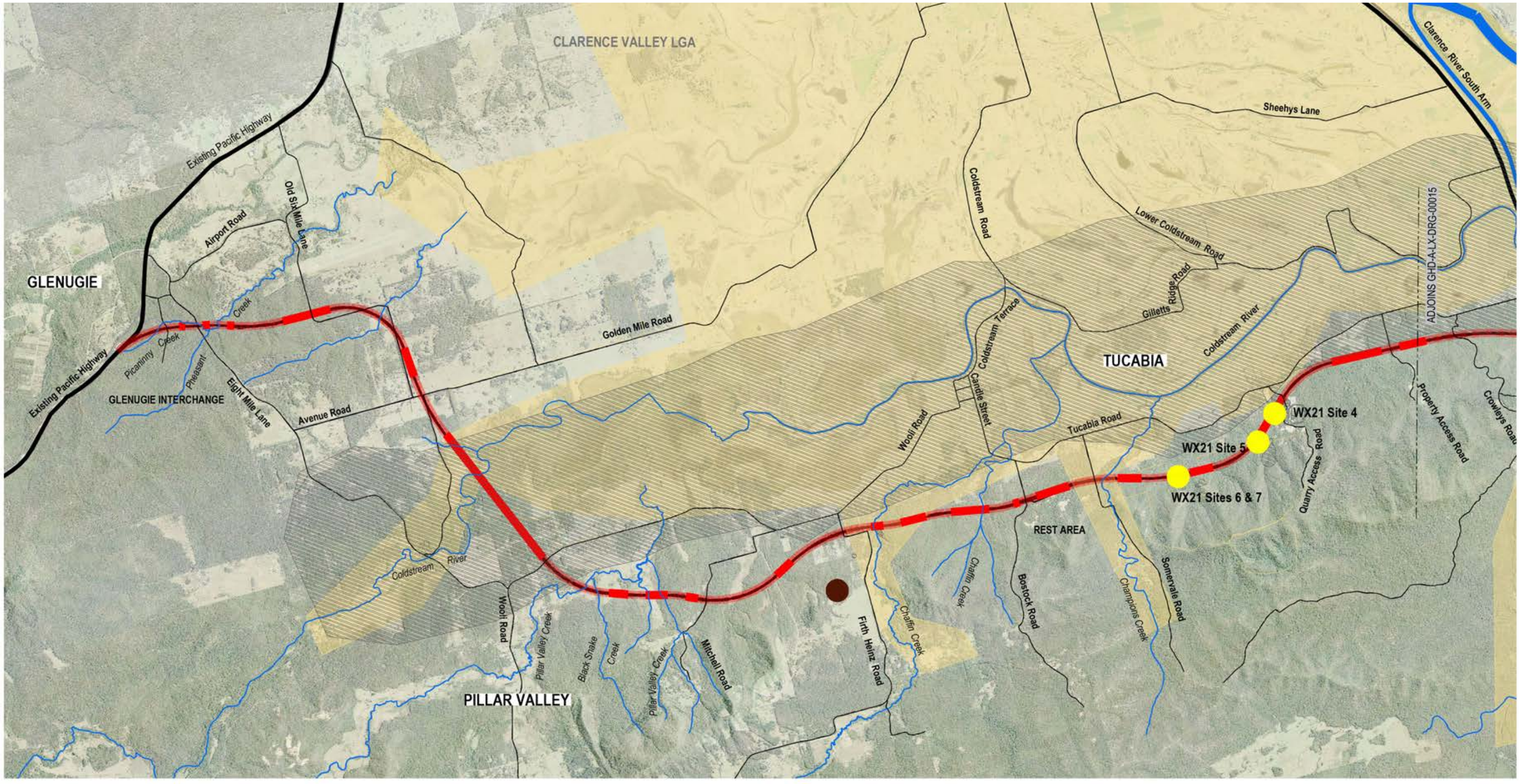
LEGEND

- Angophora robur shrubby forest and woodland on sandstones of the North Coast
- Black Bean - Weeping Lilly Pilly riparian rainforest of the North Coast
- Blackbutt - Bloodwood dry heathy open forest on sandstones of the northern North Coast
- Swamp Box swamp forest of the coastal lowlands of the North Coast
- Coastal floodplain sedgelands, rushlands and forblands
- Coastal freshwater meadows and forblands of lagoons and wetlands
- Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast
- Swamp Mahogany swamp forest of the coastal lowlands of the North Coast
- Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast
- Grey Gum - Grey Ironbark open forest of the Clarence lowlands of the North Coast
- Narrow-leaved Ironbark dry open forest of the North Coast
- Swamp Oak swamp forest of the coastal lowlands of the North Coast
- Paperbark swamp forest of the coastal lowlands of the North Coast
- Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the North Coast
- Scribbly Gum - Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast
- Turpentine moist open forest of the coastal hills and ranges of the North Coast
- Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the 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
- Cleared

0 800 1600 2400 3200 4000m

SCALE 1:80,000@A3

W2B-GHD-A-LX-DRG-00013
Existing vegetation communities



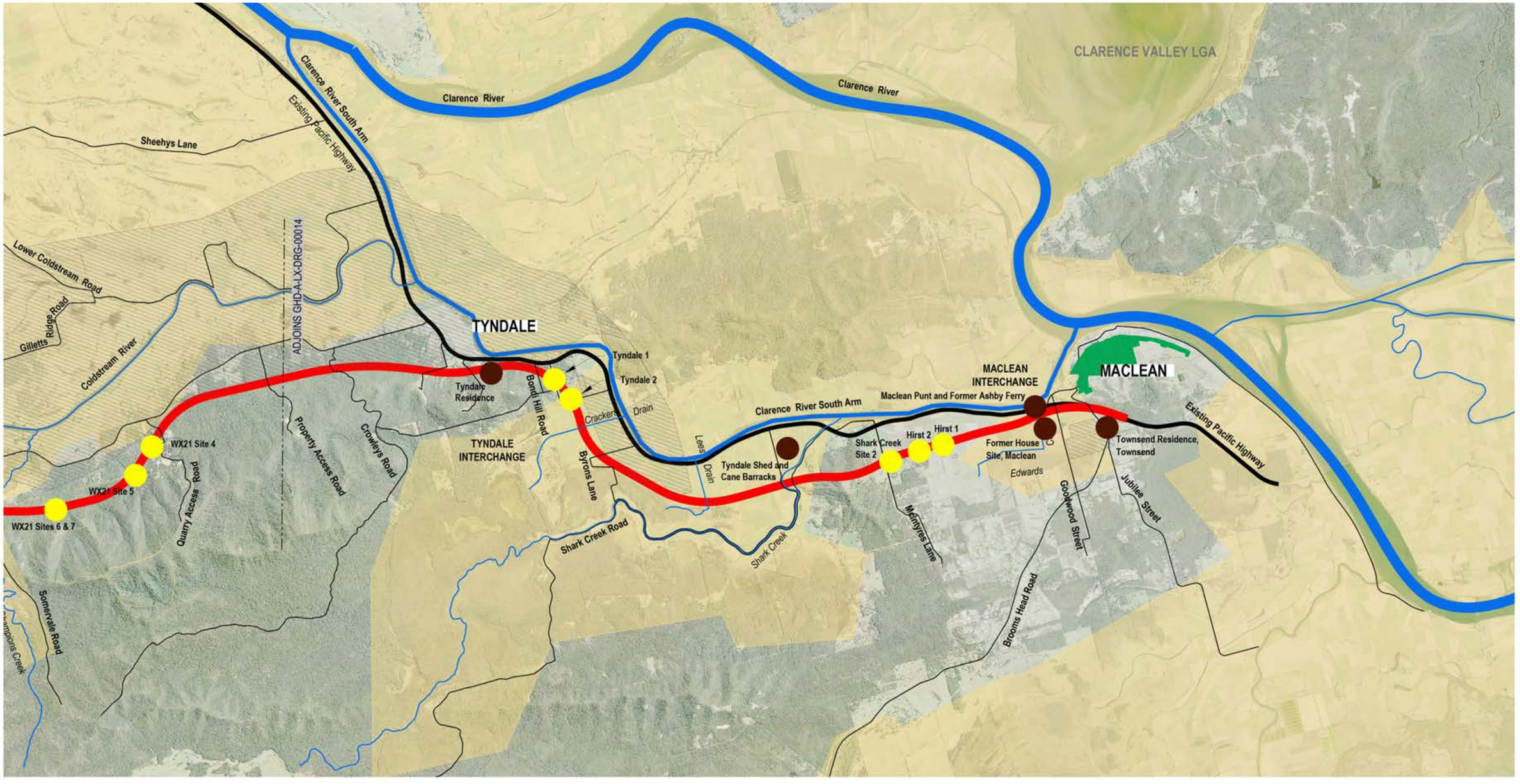
LEGEND

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

0 800 1600 2400 3200 4000m

SCALE 1:80,000@A3

W2B-GHD-A-LX-DRG-00014
Heritage



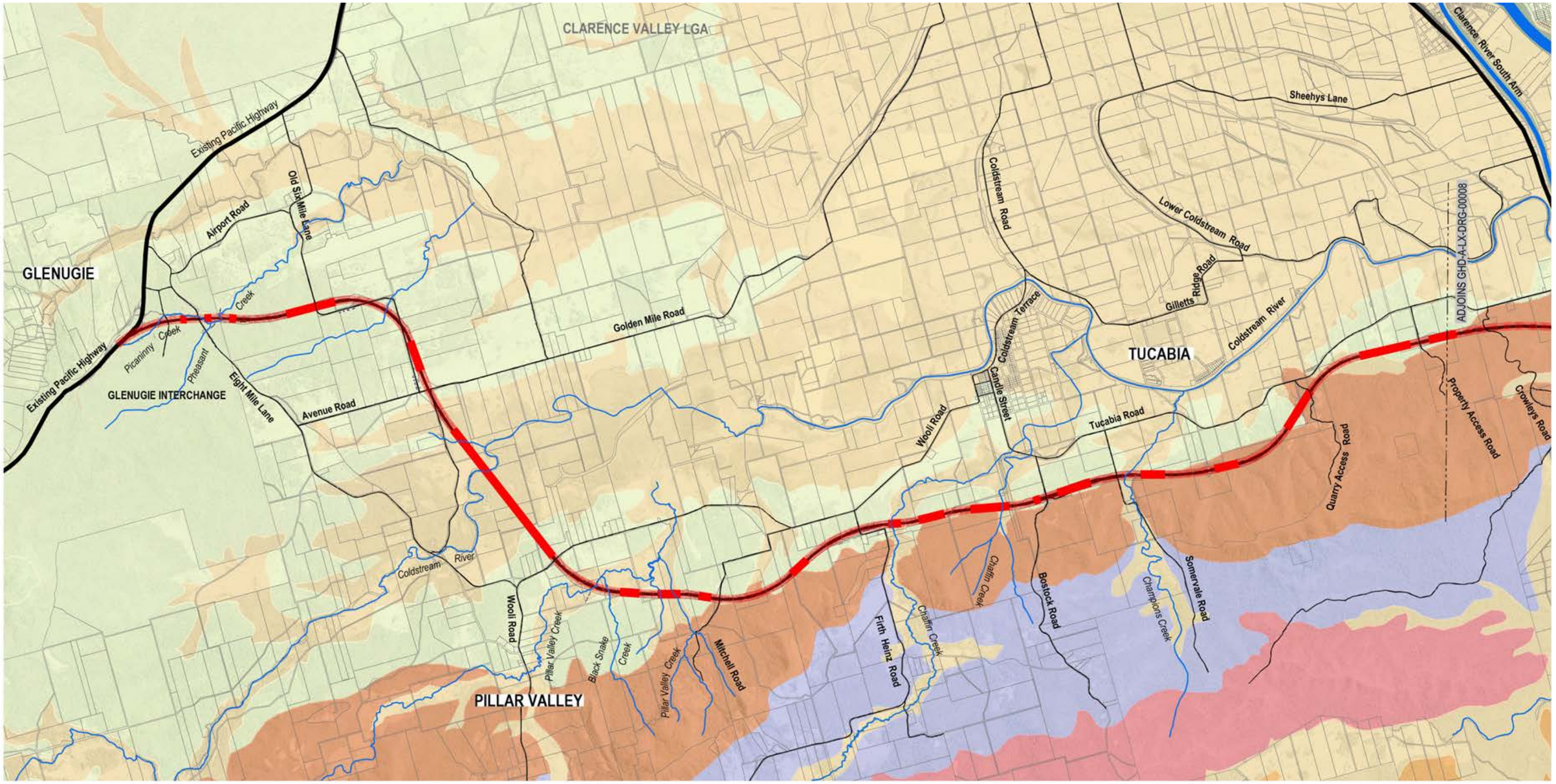
LEGEND

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

0 800 1600 2400 3200 4000m

SCALE 1:80,000@A3

W2B-GHD-A-LX-DRG-00015
Heritage



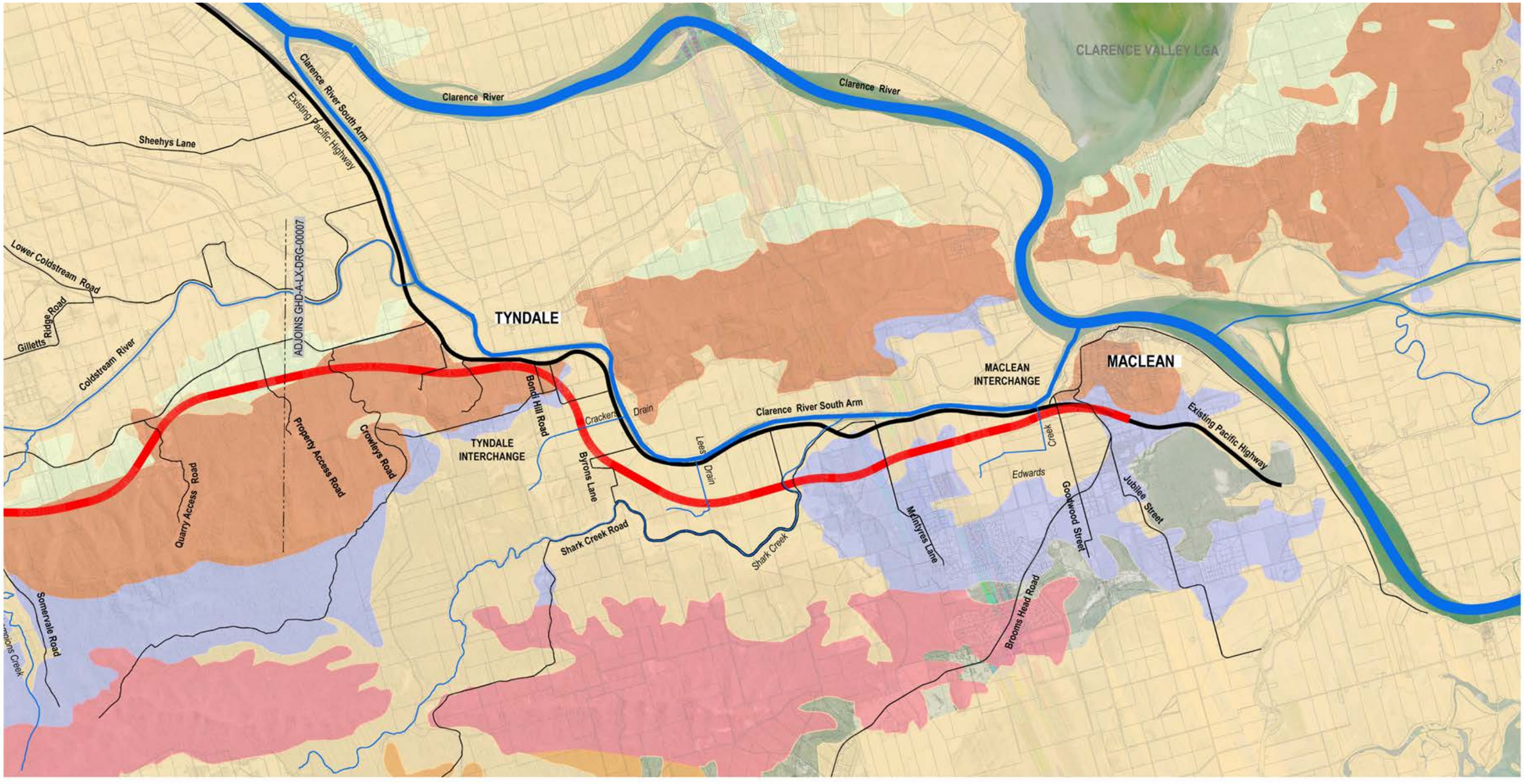
LEGEND

- Pacific Highway upgrade Sections 3 and 4
- Existing Pacific Highway
- Existing roads
- Existing major watercourses
- Chillingham Volcanics
- Coramba Beds
- Gatton Sandstone
- Grafton Formation
- Kangaroo Creek Sandstone
- Koukandowie Formation
- Laytons Range Conglomerate
- Lismore Basalt
- Marine
- Neranleigh-Fernvale Beds
- Raceview Formation
- Ripley Road Sandstone
- Tallawudjah Leucoadamellite
- Walloon Coal Measures
- Water

0 800 1600 2400 3200 4000m

SCALE 1:80,000@A3

W2B-GHD-A-LX-DRG-00007
Geology



LEGEND

- Pacific Highway upgrade Sections 3 and 4
- Existing Pacific Highway
- Existing roads
- Existing major watercourses
- Chillingham Volcanics
- Coramba Beds
- Gatton Sandstone
- Grafton Formation
- Kangaroo Creek Sandstone
- Koukandowie Formation
- Laytons Range Conglomerate
- Lismore Basalt
- Marine
- Neranleigh-Fernvale Beds
- Raceview Formation
- Ripley Road Sandstone
- Tallawudjah Leucoadamellite
- Walloon Coal Measures
- Water

0 800 1600 2400 3200 4000m

SCALE 1:80,000@A3

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

Australian Government

BUILDING OUR FUTURE

Woolgoolga to Ballina Pacific Highway upgrade

Urban design and landscape plan

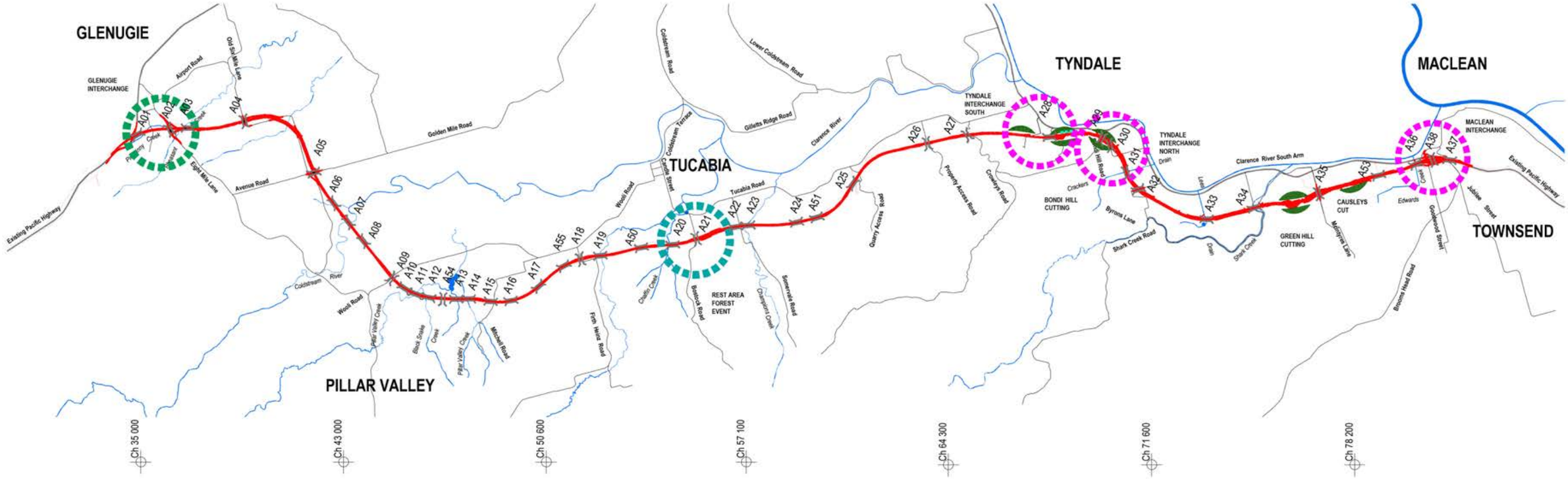
NSW MAKING IT HAPPEN

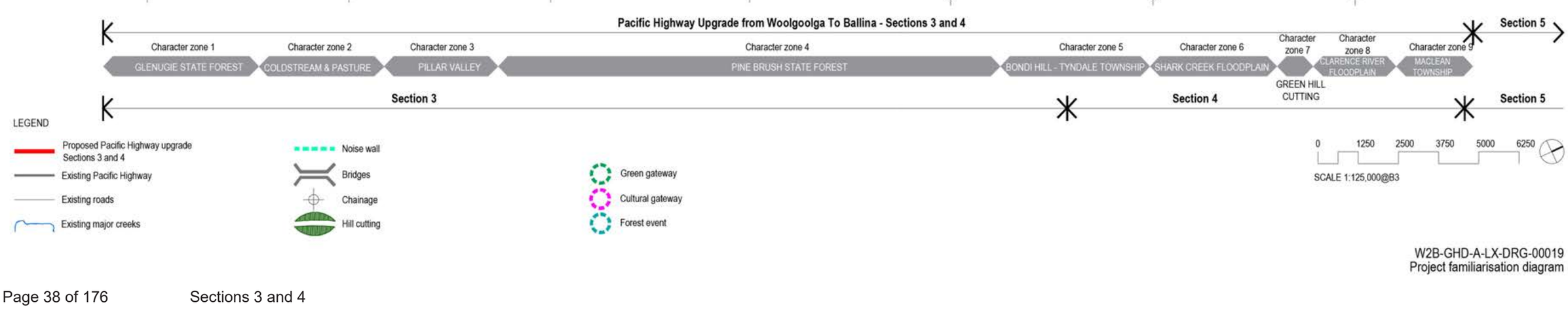
A01	Twin bridges on State Highway 10 over Glenugie Southbound on ramp
A02	Bridge over State Highway 10 on Eight Mile Lane
A03	Twin bridges over Pheasant Creek
A04	Bridge over State Highway 10 on Old Six Mile Road
A05	Bridge over State Highway 10 on Avenue Road
A06	Twin bridges over Coldstream River 1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

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

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

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





W2B-GHD-A-LX-DRG-00019
Project familiarisation diagram

6.0 Design principles

Vision Statement

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

6.1 Section 3 and 4 description

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

GHD, BG&E and CM^{+} are carrying out the detailed design between Glenugie and Maclean. This section of the project encompasses Glenugie to Tyndale (section 3) and Tyndale to Maclean (section 4). This report covers about 45 kilometres of the overall project. Refer to DRG-00019.

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

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

- Begins at Glenugie and extends from the previously upgraded section of the Pacific Highway, heading in a northerly direction through the Glenugie State Forest towards Grafton Airport, crossing under Eight Mile Lane and over Picaninny Creek
  - Gently rolling terrain and is heavily forested
  - A number of fauna crossings
  - Comprises the Glenugie interchange, which is currently subject to further design development.
- Continues north towards the environs of Grafton Airport and then turns significantly to the north-east at Old Six Mile Lane
  - Terrain is flatter countryside of the Coldstream Valley
  - A number of fauna crossings
  - Scattered pasture and woodland setting with intermittent open views
  - Local road grade separated crossings in this area include Old Six Mile Lane and Avenue Road.
- Continues north to Wooli Road as it enters Pillar Valley, mostly following along the foothills of the Clarence Valley and typically skirts the upland of the Coldstream River plain
  - Intermittent forest setting with limited, but significant, views opening up at watercourse and valley crossings with potential glimpses of the river
  - A number of fauna crossings
  - Embankments and cuttings to maintain appropriate gradients.
- Continues into western edge of Pine Brush State Forest about three kilometres east of Tucabia
  - Heavily forested with occasional pasture views towards the west
  - A number of fauna crossings
  - Overbridges at Firth Heinz Road, Bostock Road and underbridges at Mitchell Road and Somervale Road
  - Two rest areas, one each along both the northbound and southbound carriageways located between Bostock Road and Somervale Road, providing facilities and amenities for light and heavy vehicle parking. No connections from local roads to the rest areas.
- Continues north through a series of cut and fill batters until it is near the existing Pacific Highway at Tyndale interchange, located close to the Clarence River South Arm
  - Scattered pasture and woodland setting with intermittent views to surrounding
  - Potential views to Clarence River South Arm
  - Connects to the existing Pacific Highway and Tyndale township
  - Significant cut and fill batter through Bondi Hill
  - Underbridge, overbridge and local road crossings, and associated surface roadways with major cuttings between the bridges
  - Major cuttings prominently visible to drivers on the main alignment and on surface roads.
- Continues north, leaving the mostly forested mountainous topography and enters the agricultural floodplain of Shark Creek
  - Dramatic and panoramic views of river, floodplain and mountains
  - A number of fauna crossings
  - Open views to cane fields
  - A long bridge, more than 800 metres over Shark Creek
  - There is little tree cover in this area until after the alignment crosses Shark Creek and passes through Green Hill. A significant cutting is required to maintain appropriate gradients at this cutting.
- Continues north and passes through Green Hill
  - Heavy forest and woodland setting of Green Hill
  - A number of fauna crossings
  - Significant cutting through Green Hill required to maintain appropriate gradients at this point, highly visible to drivers
  - There is little tree cover in this area until after the alignment crosses Shark Creek and passes through Green Hill.
- Continues north and enters the agricultural floodplain of Clarence River
  - Dramatic and panoramic views of river, floodplain and mountains
  - Number of fauna crossings
  - Open views to cane fields.
- Continues north and enters the Maclean township
  - Dramatic and panoramic views of river, floodplain and mountains
  - Open views to cane fields
  - Comprises the Maclean interchange with two roundabouts, an overbridge and a number of connections to local roads
  - Forms a significant new gateway to Maclean and Clarence River.

Summary of driver experience for sections 3 and 4

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

A summary of the driver experience includes:

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

Summary of key elements of the project

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

- There are 43 bridges including:
  - The 865 metres long Shark Creek Bridge located within the Clarence River South Arm Flood Plain
  - Overbridges at Eight Mile Lane (TBC), Old Six Mile Lane, Avenue Road, Wooli Road, Bostock Road, Crowleys Road, Bondi Hill Road, Firth Heinz Road, Tyndale north, Byrons Lane, Maclean McIntyres Lane and property access overbridges
  - A number of twin bridges over creeks and existing roads to maintain local lateral connectivity including Somervale Road, Mitchell Road and Jubilee Street
- Interchanges at Glenugie, Tyndale and Maclean
- Two rest areas, one northbound and one southbound between Bostock Road and Somervale Road
- Fauna crossings where appropriate to allow movement of fauna beneath the alignment or overbridges
- Major cuttings at Bondi Hill, Tyndale and Green Hill
- An integrated suite of road safety furniture with all other road elements, such as bridges, retaining structures and the like, consistent with other Pacific Highway road furniture
- Dense planting of riparian creek corridors and at operational water quality control ponds, to improve water quality, enhancing valuable habitat and increasing biodiversity.

6.1.1 Sections 3 and 4 urban design objectives

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

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

Detailed objectives

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

Objective 1

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

Strategies

Strategies that have guided the urban and landscape design include:

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

Implementation

Implementation activities include:

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

Objective 2

Provide a well vegetated, natural road reserve.

Strategies

Strategies that have guided the urban and landscape design include:

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

Implementation

Implementation activities include:

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

Objective 3

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

Strategies

Strategies that have guided the urban and landscape design include:

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

Implementation

Implementation activities include:

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

Objective 4

Respect communities along the route.

Strategies:

Strategies that have guided the urban and landscape design include:

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

Implementation:

Implementation activities include:

- Design highway intersections to help wayfinding and provide convenient and safe access to local roads
- Ensure residents are screened from the upgrade and associated infrastructure with appropriate planting, where feasible
- Mitigate noise impacts at Tyndale and Maclean utilising appropriate noise attenuation measures
- Screen road users and adjoining houses from noise barriers, if required, with appropriate planting/landscaping
- Implementing appropriate design that minimises impact on culturally significant areas in consultation with Aboriginal communities.

Objective 5

Provide 'consistency with variety' in road elements.

Strategies:
Strategies that have guided the urban and landscape design include:

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

Implementation
Implementation activities include:

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

Objective 6

Provide a safe, simplified and unobtrusive road design.

Strategies:
Strategies that have guided the urban and landscape design include:

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

Implementation
Implementation strategies include:

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

Objective 7

Incorporate environmentally sustainable urban and landscape design solutions.

Strategies:
Strategies that have guided the urban and landscape design include:

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

Implementation:
Implementation strategies include:

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

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

6.2 Urban design context

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

Figure 32: Existing view: oblique aerial of Maclean township looking north-west and surrounding context. Source: Pacific Complete.

Glenugie | Population 2011 – 245

Located just to the north of the alignment, this hamlet straddles the Pacific Highway and consists of scattered houses. It is located to the south of Grafton Airport. Nearby to Glenugie is the North Coast Railway Branch Tramway historic site. Rock from the peak was used in the building of the North Coast rail line. Care must be taken to ensure that impacts to this site, visual or otherwise, are limited. Around 50 per cent of the land is within the Glenugie State Forest (Figures 33 to 34).

Principle Activities

- Tourism, Agricultural Show
- Farming.

Landscape Character

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

Grafton | Population 2014 – 18,698

Located along the Clarence River, Grafton currently acts as a hub for its environs and straddles the connection of the existing Pacific Highway with the Gwydir Highway. It is comprised primarily of single family houses and also has an airport just to the east of the town, near the alignment of the upgraded Pacific Highway and the outlying areas of South Grafton and Clarenza (Figures 35 to 36).

Principle Activities

- Tourism, Agricultural Show
- Farming
- Local administration.

Landscape Character

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

Ulmarra | Population 2011 – 784

Located to the west of the alignment along the existing Pacific Highway, this village provides some highway supported services and support for nearby rural areas. Traffic through Ulmarra may be expected to decrease as the upgraded Pacific Highway provides a bypass for this village. Ulmarra has a strong connection to the river as it has direct river frontage and is comprised primarily of single family houses (Figures 37 to 38).

Principle Activities

- Tourism and community functions
- Arts crafts and antiques.

Landscape Character

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

Maclean | Population 2011 – 2,600

Maclean is a major town along the Clarence River and serves as a hub for its surroundings. The Maclean interchange will permit easy access to the town and increase its prominence along the corridor. It is comprised primarily of single family houses organised within a town street grid. The town has a strong Scottish cultural heritage (Figures 39 to 40).

Principle Activities

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

Landscape Character

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

Figure 33: Existing Pacific Highway near Glenugie.

Figure 34: Glenugie. Source: Google.

Figure 35: Grafton town centre.

Figure 36: Grafton town centre.

Figure 37: Ulmarra town centre.

Figure 38: Ulmarra town centre.

Figure 39: Maclean town centre.

Figure 40: Maclean town centre.

Tucabia | Population 2011 – 287

Located to the west of the alignment, this hamlet is located in pasture and scattered woodland. No direct connection to the upgraded Pacific Highway is envisioned. The rest areas will be located about three kilometres east of Tucabia (Figures 41 to 42).

Principle Activities

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

Landscape Character

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

Tyndale | Population 2011 – 334

Located on the Clarence River South Arm, Tyndale will be connected to the upgraded Pacific Highway by the Tyndale interchange. This village consists of single family residential houses in a rural setting. Tyndale will become an entry point for this area of the mid North Coast. The existing Pacific Highway runs between the river and the town (Figures 43 to 44).

Principle Activities

- Tyndale Tourism Park Roadshow
- Accommodation.

Landscape Character

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

Townsend | Population 2011 – 817

Located just to the east of Maclean this town is essentially an outlying part of greater Maclean. This area is characterised by single family houses and some light industrial areas. Its main connection to Maclean is through Jubilee Street which crosses under the Pacific Highway and over the ridge to Maclean (Figures 45 to 46).

Principle Activities

- Tourism and local cultural attractions
- Light industry.

Landscape Character

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

Gulmarrad | Population 2011 – 1,644

Gulmarrad is located to the south of Townsend and may also be considered part of the greater Maclean area. This area is characterised by single family houses and some mixed use areas. It is nestled on relatively flat land between agricultural fields to the south and forest to the north. Its main connection to Maclean is through Brooms Head Road which also travels south to the coast at Brooms Head (Figures 47 to 48).

Principle Activities

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

Landscape Character

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

Figure 41: Cordini Street, Tucabia looking west.

Figure 42: Tucabia Village, Cordini Street looking west.

Figure 43: View of Tyndale from existing Pacific Highway.

Figure 44: View of proposed Tyndale interchange south.

Figure 45: Jubilee Street looking west to existing Pacific Highway.

Figure 46: Townsend. Source: Google.

Figure 47: Brooms Head Road, Gulmarrad looking north.

Figure 48: View of alignment from Sheehans Lane, near Gulmarrad.

6.2.1 Section 3 and 4 urban design strategies

Forest setting zone

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

Open agricultural setting zone

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

Pasture scattered woodland zone

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

Green gateway

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

Cultural landscape gateways

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

Forest event

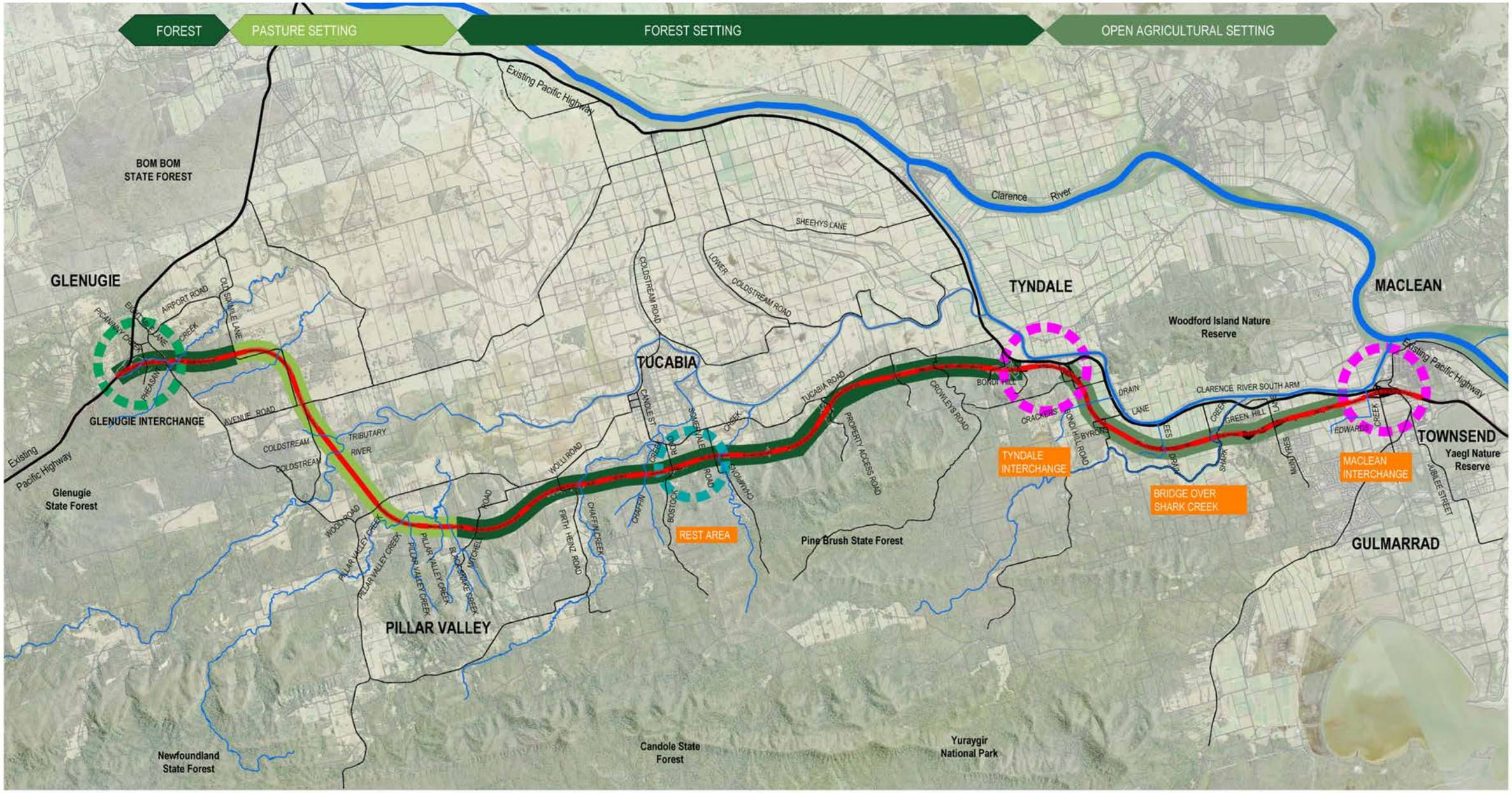
- Occurs at the rest areas on each side of the motorway near Tucabia, generally within a cutting and form part of the forest experience
- Signature planting and appropriate placement of rest area facilities can create a special place within the forest.

Refer to Figures 49 to 51 and DRG-00003.

Figure 49: Existing view: forest setting zone. Source: Pacific Complete.

Figure 50: Existing view: pasture scattered woodland setting zone. Source: Pacific Complete.

Figure 51: Existing view: open agricultural setting zone. Source: Pacific Complete.



LEGEND

- Pacific Highway upgrade W2B Sections 3 to 4
- Existing Pacific Highway
- Existing roads
- Existing major watercourses
- Green gateway (subject to further design development)
- Cultural landscape gateway
- Forest event

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6.3 Local environmental values

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

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

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

6.4 Heritage values

Heritage sites are identified in the EIS and SPIR documents. Refer to Woolgoolga To Ballina | Pacific Highway Upgrade, EIS, *Main Volume 1B, Chapter 13 – Historical (non-Aboriginal) Heritage* and Pacific Highway Upgrade: Woolgoolga to Ballina, SPIR, *Main Report*, *Chapter 2.15 – Non-Aboriginal Heritage* for details of heritage sites in the project corridor.

6.4.1 Aboriginal heritage

The majority of these sites have been salvaged or the alignment is configured so that they avoid these zones. Where this is not possible, exclusion zones have been provided, so that these sites are not impacted.

Strategies to achieve this include:

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

6.4.2 Non-Aboriginal heritage

A summary of non-Aboriginal sites are noted below:

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

The alignment does not impact on any of the above items.

Strategies to achieve this include:

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

6.5 Sustainable design and maintenance

The sustainable design and maintenance measures for sections 3 and 4 Urban Design and Landscape Plan are developed in accordance with the sections 3 and 4 Sustainability Action Plan.(SAP) to ensure the design is an Ecologically Sustainable Development (ESD), when tested using the Infrastructure Sustainability Council of Australia (ISCA) rating tool.

The key urban design related objectives in the SAP 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
- Identify design principles and standards for sustainable design and maintenance.

The urban design strategies to achieve the objectives are to:

- Use native plant species which are low maintenance, drought resistant and incorporate water sensitive urban design (WSUD) principles and other water management initiatives
- Use appropriate plant species to maximise wildlife habitat and biodiversity at fauna crossings for connectivity, coordinated with fauna fencing at appropriate locations
- Minimise impact of design on heritage items and inclusion of heritage context in cultural landscape plantings, at interchanges and other place making areas such as rest areas
- Use solar lighting, WSUD principles and smoother traffic flows to save fuel consumption, provision of amenities and improved visual aesthetic of project elements.

6.6 Community amenity and privacy

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

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

Strategies

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

6.7 Pedestrians, cyclists and shared paths

Pedestrians

1. For safety reasons, no pedestrian access would be provided to the motorway class sections of the main carriageways
2. Pedestrians are permitted to utilise the shoulders of A Class roads.
3. Pedestrian access across the project would be provided via overpasses and underpasses which are listed in the Table 6-1
4. Pedestrian footways would be provided on overpasses where warranted based on safety and future demand and agreed with council and stakeholders, in accordance with the Table 6-1.

Shared paths

1. Consultation with councils and local communities in relation to future provisions for shared paths connections across the Pacific Highway has been completed
2. The project will provide for future shared path provisions as agreed with council and stakeholders
3. Cyclist/shared paths and footpaths beyond the project corridor are not in the scope of the project and will be provided by councils.

Cyclists

1. Current NSW legislation permits cyclists to use the project's road shoulders, including across bridges.
2. Cyclists would also be able to use service roads, where there would be less traffic.
3. Cyclist access would be provided across the project in accordance with Table 6-1.

Table 6-1: Cyclist and pedestrian facilities for the Woolgoolga to Ballina upgrade.

Sections	Bridge name	Pedestrian/cyclist access
3 and 4	Glenugie Southbound entry ramp overpass	Shoulder
3 and 4	Eight Mile Lane overpass	Shoulder
3 and 4	Old Six Mile Road overpass	Shoulder
3 and 4	Avenue Road overpass	Shoulder
3 and 4	Wooli Road overpass	Shoulder
3 and 4	Firth Heinz Road overpass	Shoulder
3 and 4	Bostock Road overpass	Shoulder
3 and 4	Twin Bridges at Somervale Road	Cyclists on shoulder
3 and 4	Crowley's Road overpass	Shoulder
3 and 4	Tyndale interchange (south)	Shoulder
3 and 4	Bondi Hill Road overpass	Shoulder
3 and 4	Southbound Exit Ramp overpass	Cyclists on shoulder
3 and 4	Byron's Lane overpass	Shoulder
3 and 4	McIntyres Lane overpass	Shoulder - widened following Council consultation
3 and 4	Maclean interchange bridge	Shared use path provided under Jubilee Street and past Maclean interchange
3 and 4	Twin Bridges over Jubilee Street	Shared use path provided under Jubilee Street and past Maclean interchange
5 and 6	Koala Drive underpass	Shoulder
5 (E)	Existing Harwood Bridge	Shared use path on western side
5 (E)	Bridge over Clarence River at Harwood	Cyclists to use Harwood bridge
5 and 6	Serpentine Channel Road North overpass	Shoulder
5 and 6	Chatsworth Road overpass	Shoulder
5 and 6	Iluka Road interchange overpass	3.0m Footpath northern side
7, 8 and 9	Woodburn interchange overpass	3.0m Footpath southern side
7, 8 and 9	Woodburn-Evans Head Road overpass	3.0m Footpath southern side
7, 8 and 9	Broadwater Evans Head Road overpass	3.0m Footpath northern side
9 (F)	Bridge over Richmond River	Cyclists on shoulder
10 and 11	Old Bagotville Road underpass	Shoulder
10 and 11	Wardell Road overpass	Shoulder
10 and 11	Coolgardie Road interchange overpass	3.0m Footpath northern side
10 and 11	Whytes Lane overpass	1.8m Footpath southern side
Pimilco to Tavern (Ballina)	Smiths Drive bridge	3.0m Footpath - Construction deferred

Chapters 8.2 and 8.3 provide detailed information for this section of the project.

Shared path access will be provided across the project at an underpass at Jubilee Street. This underpass will maintain shared path connections between Maclean and Townsend and Gulmarrad. This is an important pedestrian route, particularly for school pupils.

6.8 Temporary work, ancillary facilities, access tracks, watercourse crossings

Project ancillary facilities

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

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

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

Ancillary facilities covered by the Management Plan include:

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

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

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

Borrow sites

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

General location and size

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

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

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

Ancillary and borrow site rehabilitation principles

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

Commitment to site rehabilitation

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

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

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

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

6.9 Flood focus groups

Extensive flood modelling has been undertaken for the upgrade. Roads and Maritime Services has re-formed flood focus groups for the Woolgoolga to Ballina Pacific Highway upgrade. The groups exist for sections of the upgrade not currently in major work where the design is currently being finalised. The focus group meetings address the upgrade's potential flood impacts; review updated flood models and any changes as part of the detailed design development process; review the upgrade's proposed waterway structures, and review flood impact maps.

The latest flood modelling reflects the final design of the project as shown in the UDLP. The results of the flood modelling, any impacts and associated mitigation measures and the outcomes of the community and landowner consultation process will be reported in the project's Hydrological Mitigation Report which will be submitted to the Department of Planning & Environment for review in early 2017. Once finalised, information will be made available through the project website.

Relevant documentation is available at:

rms.nsw.gov.au/W2B

Refer to Chapters 8 and 11 for information on the landscape design responses to flood modelling.

6.10 Noise mitigation

The operational noise impacts associated with the project were assessed in line with the NSW Environmental Protection Authority's *Road Noise Policy* (RNP) and Roads and Maritime's guideline for the implementation of the RNP, the *Noise Criteria Guideline* (NCG). Operational noise mitigation measures were identified for the project in line with Roads and Maritime's *Noise Mitigation Guideline* (NMG).

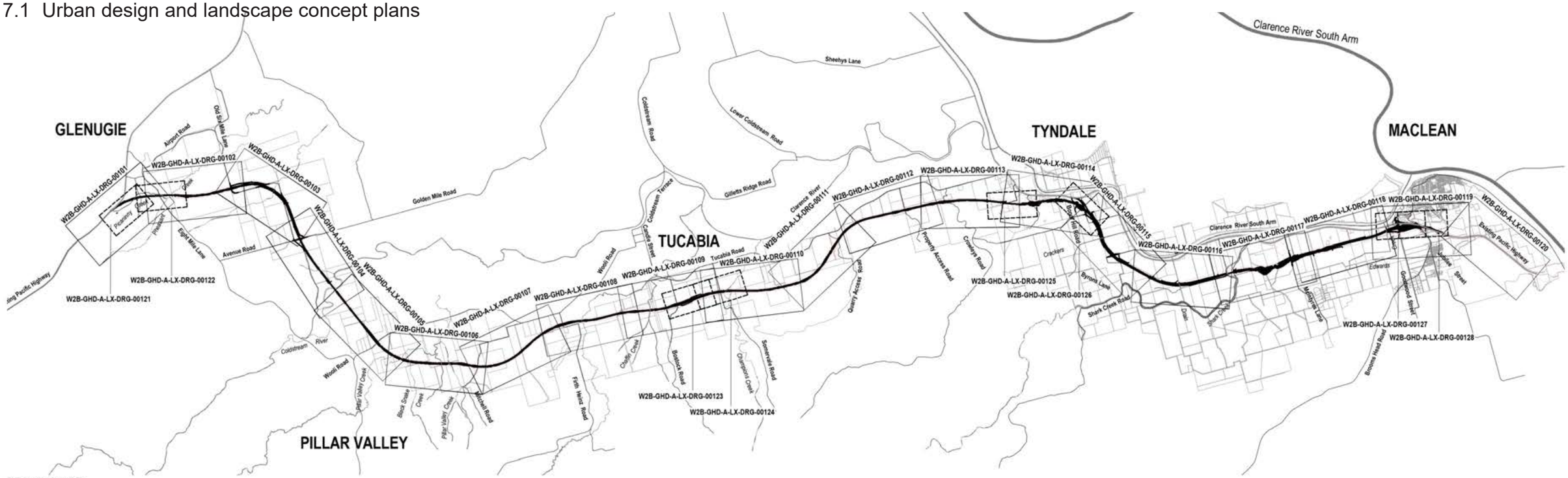
The operational noise modelling carried out, as part of the detailed design, identified the following mitigation measures:

- One noise barrier at Tyndale
- Low noise pavement
- At-house noise treatments.

- Refer to Chapter 8.1.1 for details.

7.0 Urban design and landscape plan

7.1 Urban design and landscape concept plans



DRAWING LIST

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W2B-GHD-A-LX-DRG-00127	MACLEAN INTERCHANGE
W2B-GHD-A-LX-DRG-00128	MACLEAN INTERCHANGE

NOTES:

- POTENTIAL LANDSCAPE (SPOIL) MOUNDS NOT SHOWN FOR CLARITY. REFERENCE MADE IN 1:4000 PLANS.

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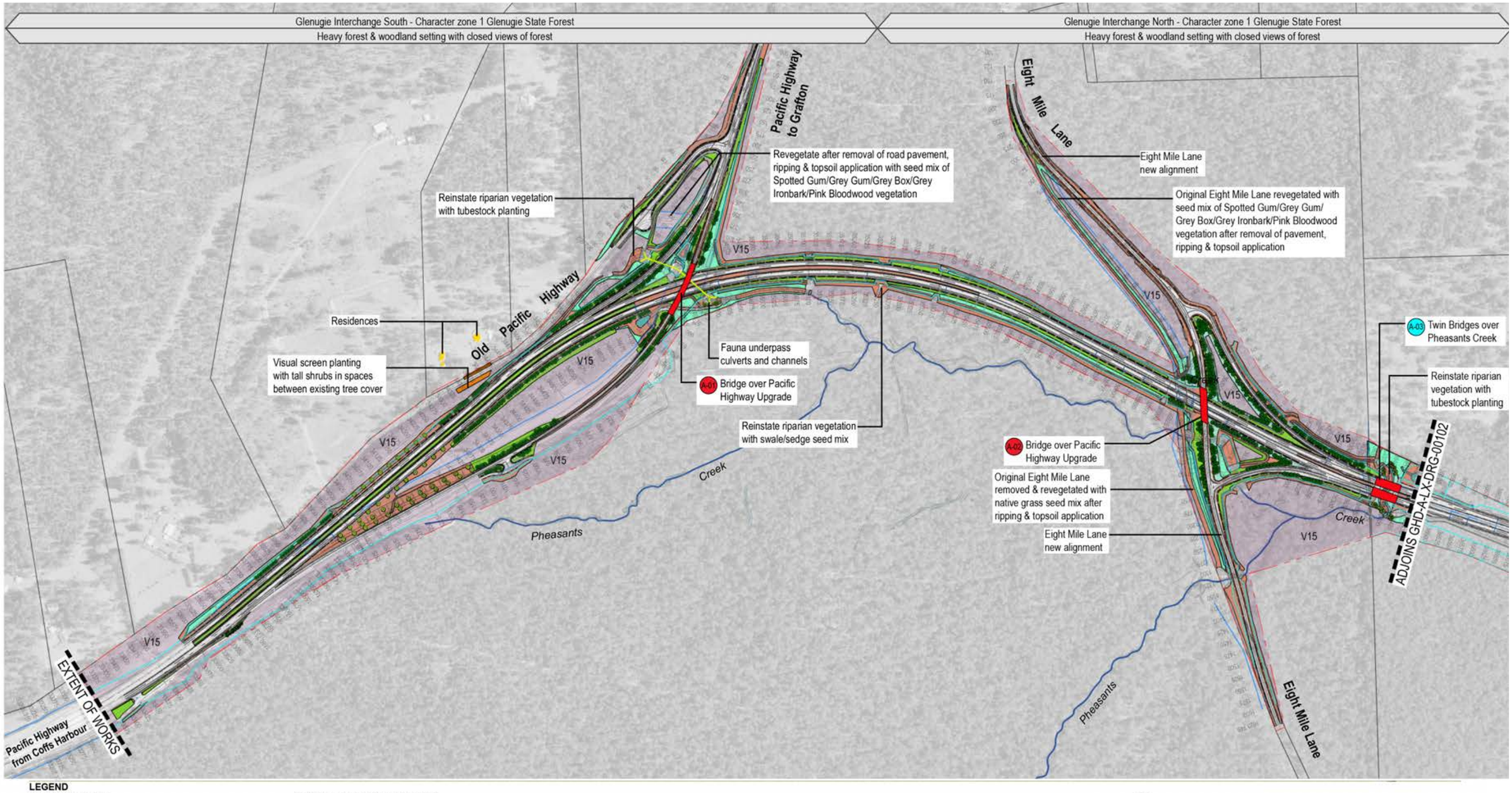
Number of trees/elements shown is indicative only. Landscape shown at maturity approximately 15 years.



LEGEND

EXISTING FEATURES

- Existing Pacific Highway
- Existing bridges
- Existing road
- Watercourse
- Property boundary
- Nearby building
- Key views to surrounding landscape

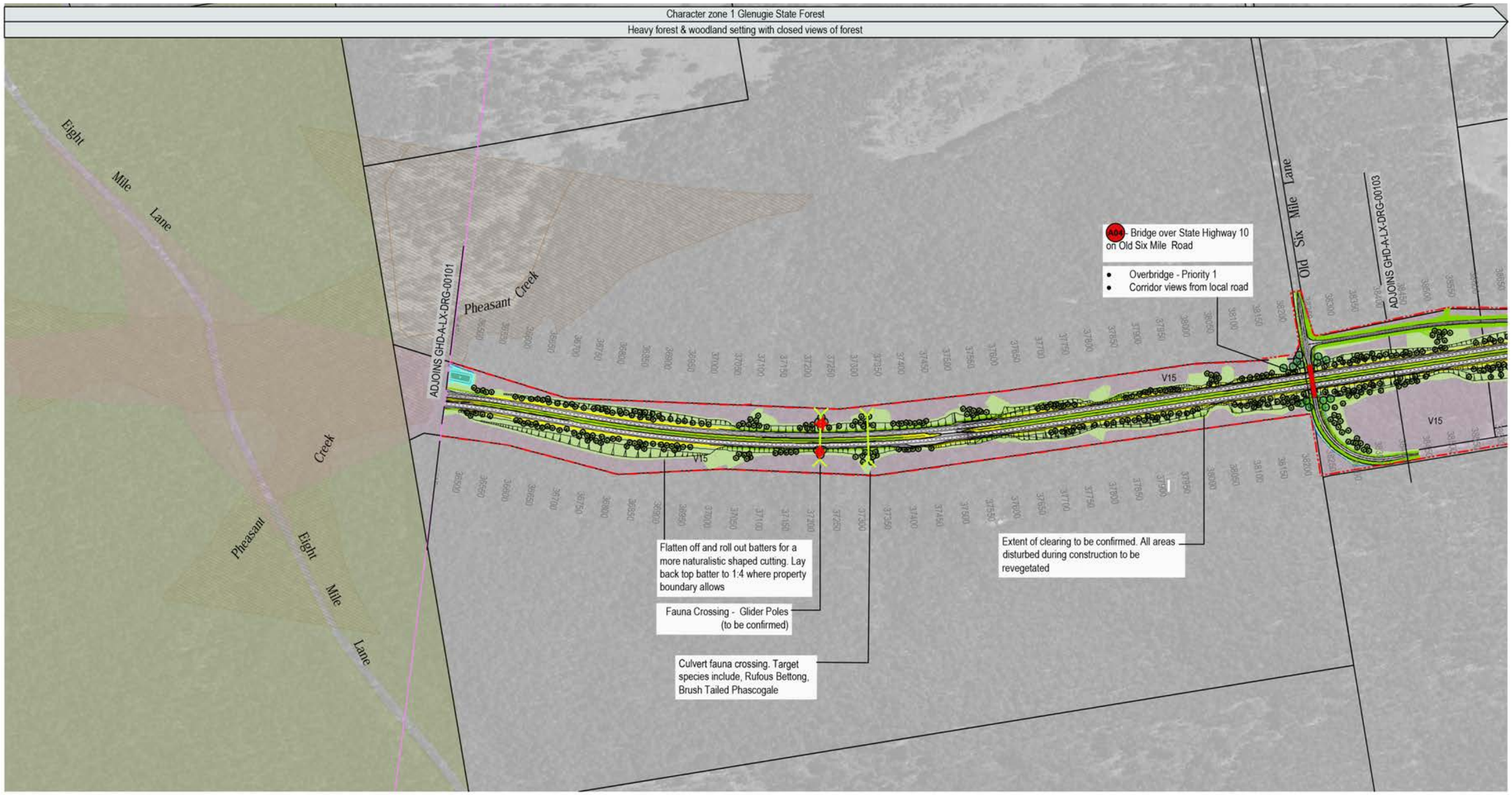
EXISTING VEGETATION COMMUNITIES

- V1 Angophora robur shrubby forest and woodland
- V2 Black Bean - Weeping Lilly Pilly riparian rainforest
- V3 Blackbutt - Bloodwood dry heathy open forest
- V4 Coastal floodplain sedgelands, rushlands and forblands
- V5 Coastal freshwater meadows and forblands of lagoons and wetlands
- V6 Flooded Gum - Brush Box moist forest
- V7 Forest Red Gum - Swamp Box
- V8 Grey Gum - Grey Ironbark open forest
- V9 Narrow-leaved Ironbark dry open forest
- V10 Paperbark swamp forest
- V11 Pink Bloodwood - Tallowwood moist open forest
- V12 Scribbly Gum - Needlebark Stringybark heathy open forest
- V13 Scribbly Gum - Red Bloodwood heathy open forest
- V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest
- V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest
- V16 Swamp Box swamp forest
- V17 Swamp Mahogany swamp forest
- V18 Swamp Oak swamp forest
- V19 Turpentine moist open forest
- Koala habitat

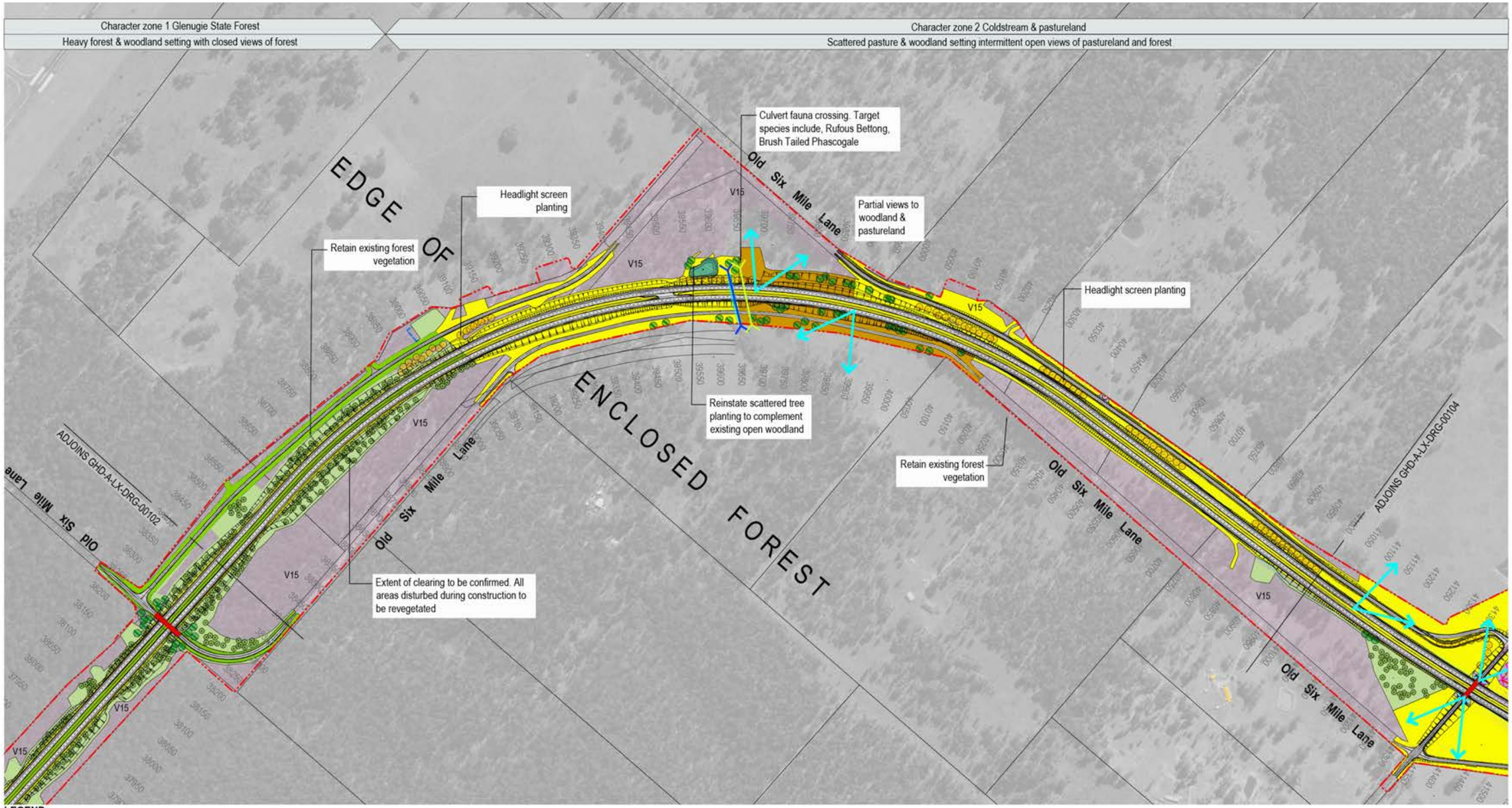
EEC

- *Freshwater wetlands on coastal floodplains (EEC)*
- *Lowland rainforest on coastal floodplains (EEC)*
- *Subtropical coastal floodplain forest on coastal floodplains (EEC)*
- *Swamp oak floodplain forest on coastal floodplains (EEC)*
- *Swamp sclerophyll forest on coastal floodplains (EEC)*

Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.



Number of trees/elements shown is indicative only. Landscape shown at maturity approximately 15 years.



LEGEND

EXISTING FEATURES

- Existing Pacific Highway
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- Existing road
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- Property boundary
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- V12 Scribbly Gum - Needlebark Stringybark heathy open forest
- V13 Scribbly Gum - Red Bloodwood heathy open forest
- V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest
- V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest
- V16 Swamp Box swamp forest
- V17 Swamp Mahogany swamp forest
- V18 Swamp Oak swamp forest
- V19 Turpentine moist open forest
- Koala habitat

EEC

- *Freshwater wetlands on coastal floodplains (EEC)*
- *Lowland rainforest on coastal floodplains (EEC)*
- *Subtropical coastal floodplain forest on coastal floodplains (EEC)*
- *Swamp oak floodplain forest on coastal floodplains (EEC)*
- *Swamp sclerophyll forest on coastal floodplains (EEC)*

Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00103

Character zone 2 Coldstream & pastureland

Scattered pasture & woodland setting intermittent open views of pastureland and forest

Headlight screen planting

ADJOINS GHD-A-LX-DRG-00103

Views to open landscape

A05 - Bridge over State Highway 10 on Avenue Road
- Overbridge - Priority 1
- Views to woodland & pastureland.
- Tapered views in median

Avenue Road

Fauna crossing. Target species are medium to large mammals (including the Rufous Bettong) and fish

Reinstate riparian vegetation. Maintain filtered views over adjacent landscape and creek from bridge

Fauna crossing. Target species are medium to large mammals (including the Rufous Bettong) and fish

Reinstate riparian vegetation. Maintain filtered views over adjacent landscape and creek from bridge

ADJOINS GHD-A-LX-DRG-00105

Tributary

Coldstream River

Old Six Mile Lane

Wants Lane

Extent of clearing to be confirmed. All areas disturbed during construction to be revegetated

Lavadia

Avenue Road

A06 - Twin bridges over Coldstream River 1
- Underbridge - Priority 3.
- Views to woodland & pastureland

A07 - Twin bridges over Coldstream River 2
- Underbridge - Priority 3.
- Views to woodland & pastureland

Coldstream River

PACIFIC HIGHWAY UPGRADE
- Pacific Highway upgrade boundary
- New bridge
- Wire rope safety barrier
- W-Beam barrier
- Boundary fence
- Fauna fence

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

FAUNA CROSSINGS
- Fauna crossing
- Fish passage
- Glider poles

LANDSCAPE TREATMENTS
- Pasture grasses
- Native grasses
- Mixed shrubs
- Forest revegetation
- Riparian revegetation
- Tubestock planting shrubs & groundcovers
- Water quality basins
- Accent shrub and groundcover verge planting

EVENTS
- Green gateway, cultural, forest event

TREES
- Advanced tree Species varies
- Interchange feature tree species varies
- Interchange feature tree cabbage-tree palm
- Screening tree

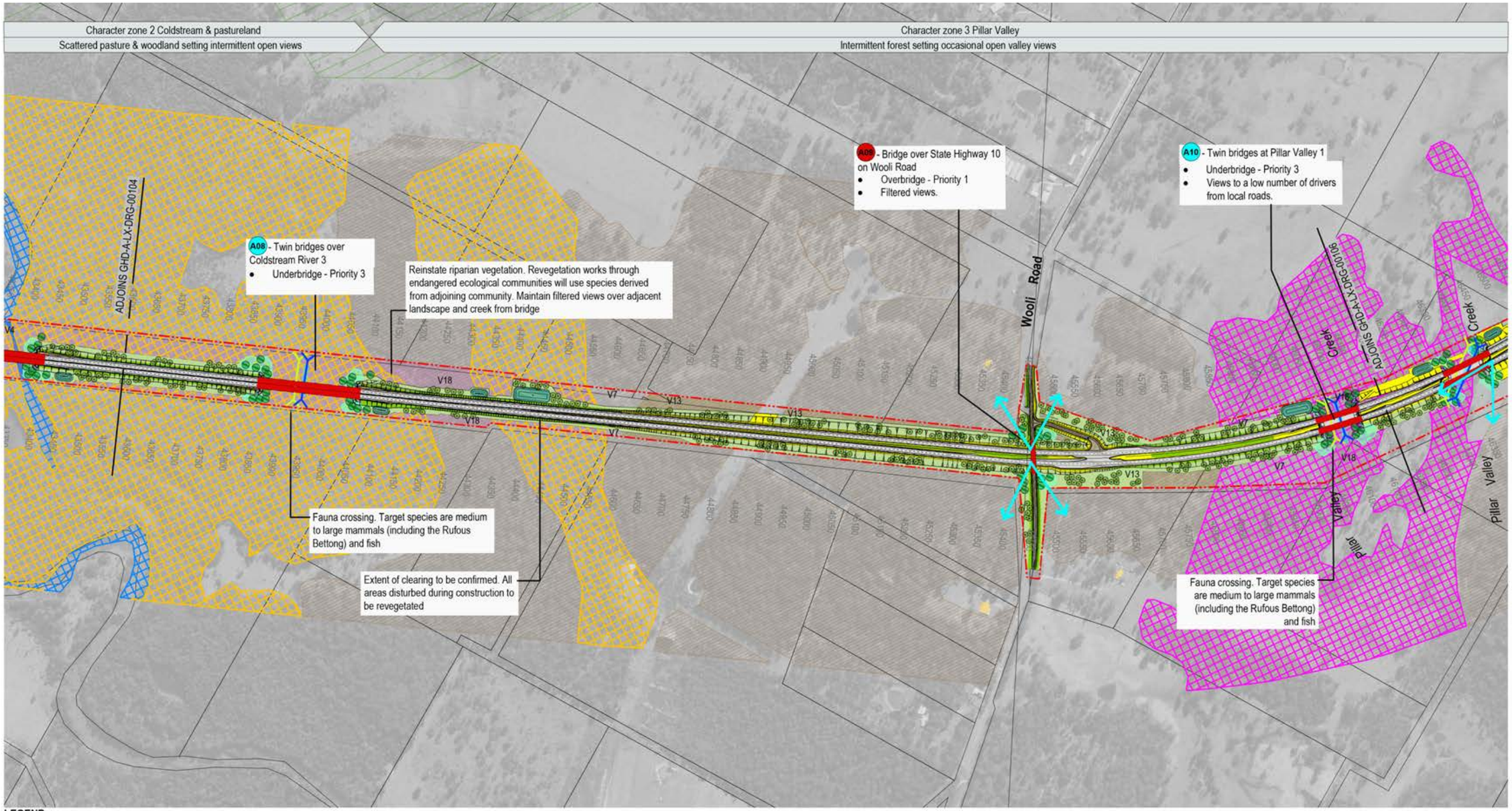
KEY PLAN

0 80 160 240 320 400m

SCALE 1:8000@A3

Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00104



LEGEND

EXISTING FEATURES

- Existing Pacific Highway
- Existing bridges
- Existing road
- Watercourse
- Property boundary
- Nearby building
- Key views to surrounding landscape

EXISTING VEGETATION COMMUNITIES

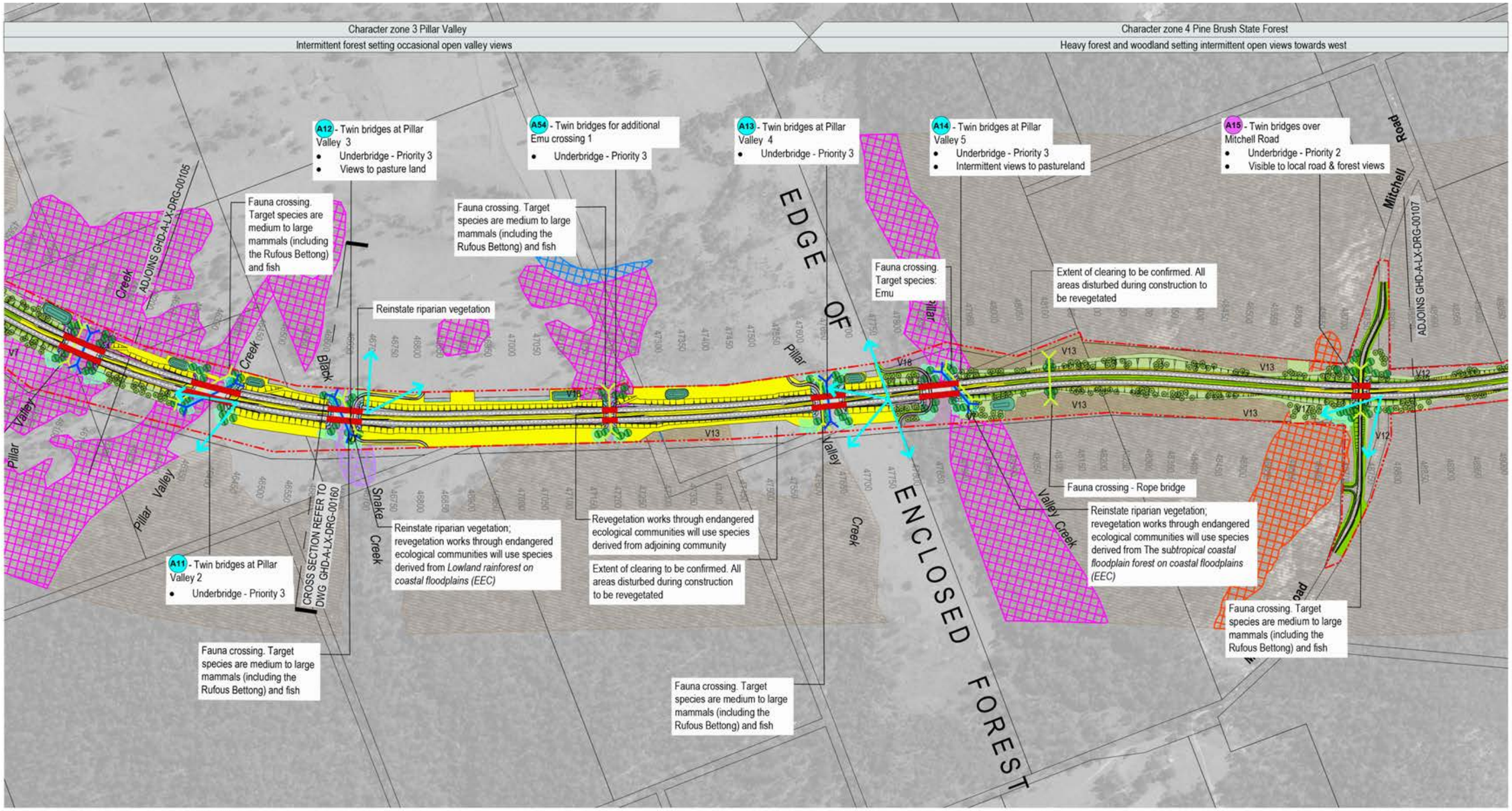
- V1 Angophora robur shrubby forest and woodland
- V2 Black Bean - Weeping Lilly Pilly riparian rainforest
- V3 Blackbutt - Bloodwood dry heathy open forest
- V4 Coastal floodplain sedgelands, rushlands and forblands
- V5 Coastal freshwater meadows and forblands of lagoons and wetlands
- V6 Flooded Gum - Brush Box moist forest
- V7 Forest Red Gum - Swamp Box
- V8 Grey Gum - Grey Ironbark open forest
- V9 Narrow-leaved Ironbark dry open forest
- V10 Paperbark swamp forest
- V11 Pink Bloodwood - Tallowwood moist open forest
- V12 Scribbly Gum - Needlebark Stringybark heathy open forest
- V13 Scribbly Gum - Red Bloodwood heathy open forest
- V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest
- V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest
- V16 Swamp Box swamp forest
- V17 Swamp Mahogany swamp forest
- V18 Swamp Oak swamp forest
- V19 Turpentine moist open forest
- Koala habitat

EEC

- *Freshwater wetlands on coastal floodplains (EEC)*
- *Lowland rainforest on coastal floodplains (EEC)*
- *Subtropical coastal floodplain forest on coastal floodplains (EEC)*
- *Swamp oak floodplain forest on coastal floodplains (EEC)*
- *Swamp sclerophyll forest on coastal floodplains (EEC)*

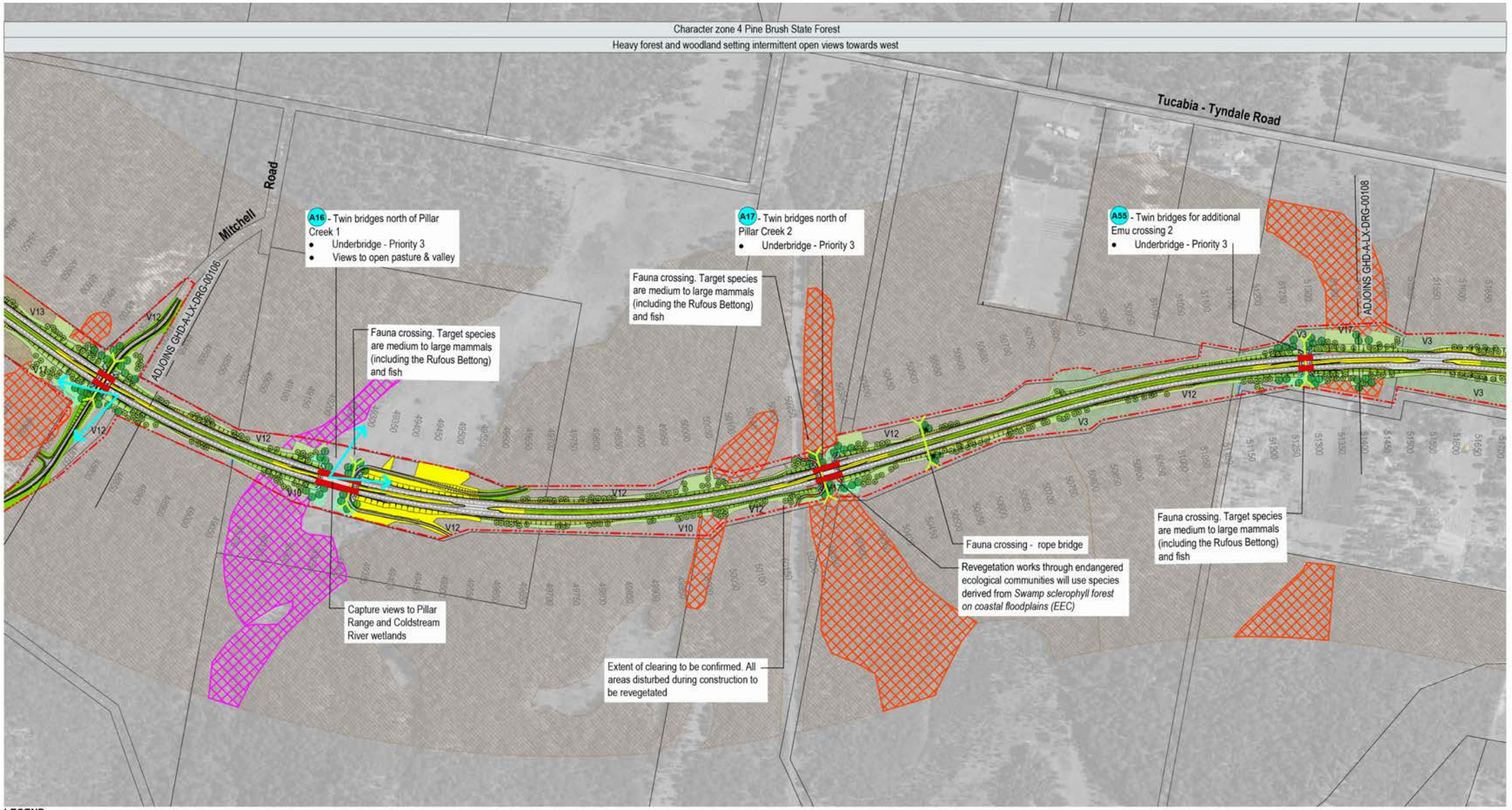
Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00105



Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00106



LEGEND

EXISTING FEATURES

- Existing Pacific Highway
- Existing bridges
- Existing road
- Watercourse
- Property boundary
- Nearby building
- Key views to surrounding landscape

EXISTING VEGETATION COMMUNITIES

- V1 Angophora robur shrubby forest and woodland
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- V18 Swamp Oak swamp forest
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- Koala habitat

EEC

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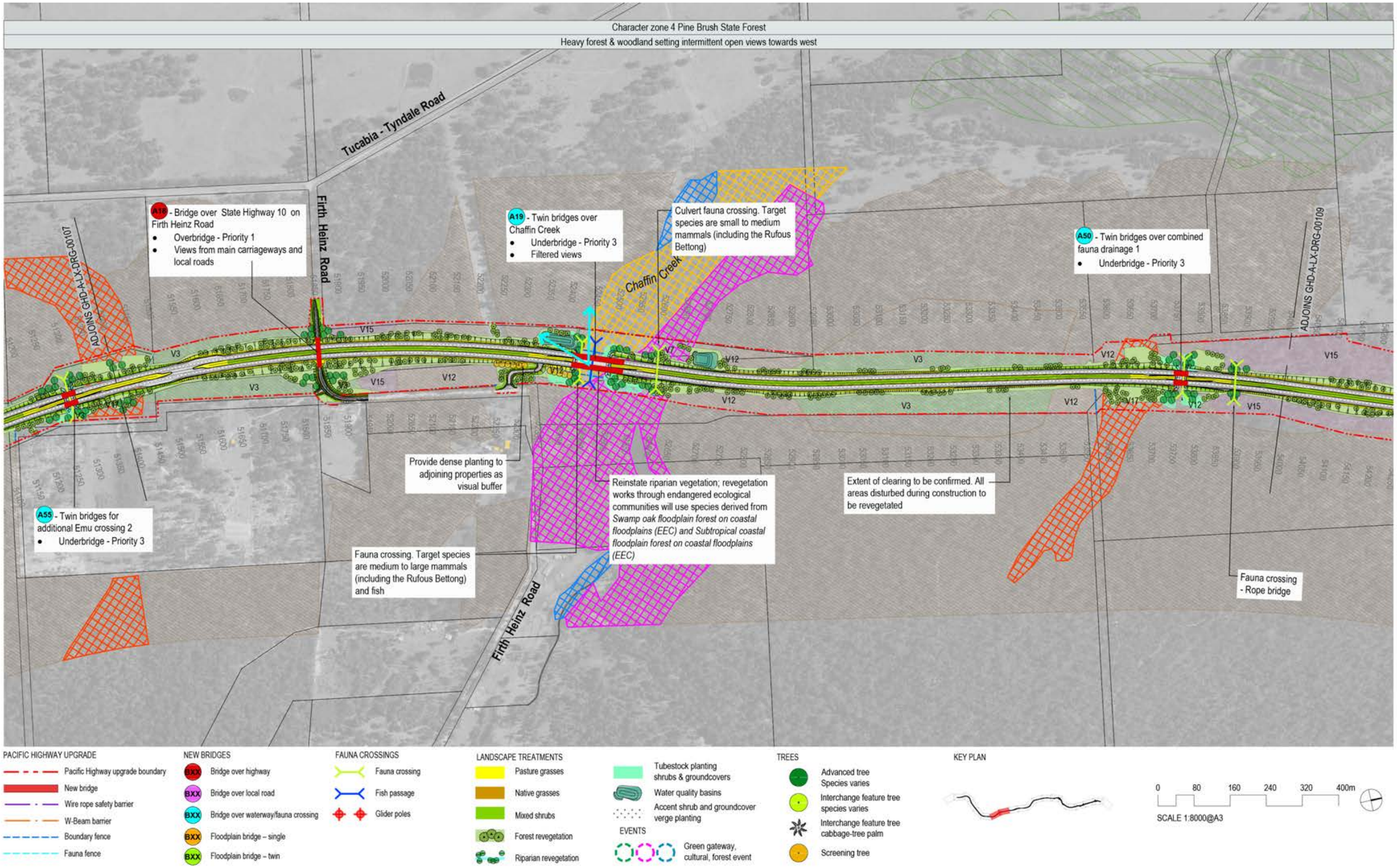
- *Lowland rainforest on coastal floodplains (EEC)*
- *Subtropical coastal floodplain forest on coastal floodplains (EEC)*
- *Swamp oak floodplain forest on coastal floodplains (EEC)*
- *Swamp sclerophyll forest on coastal floodplains (EEC)*

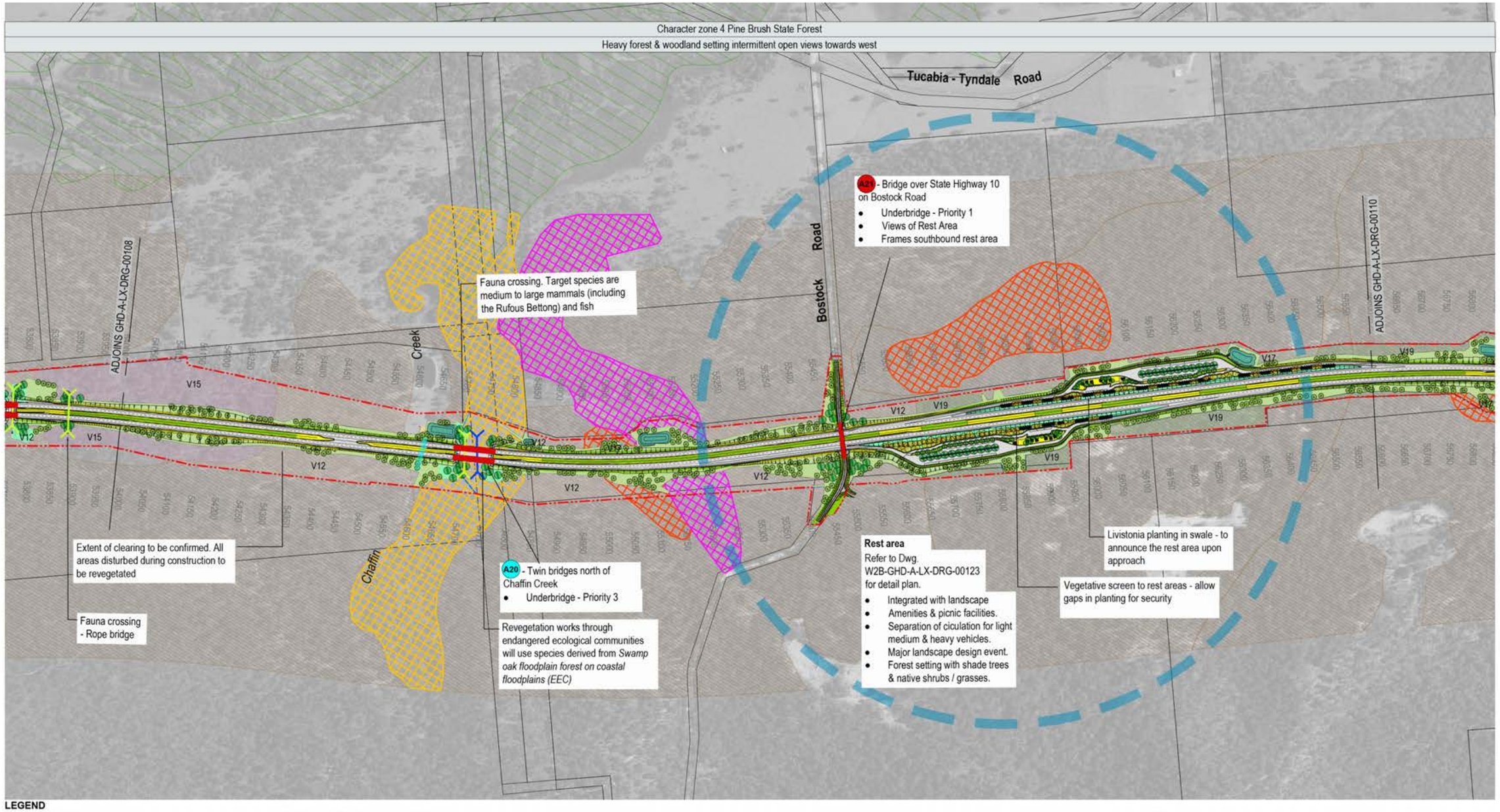
Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00107



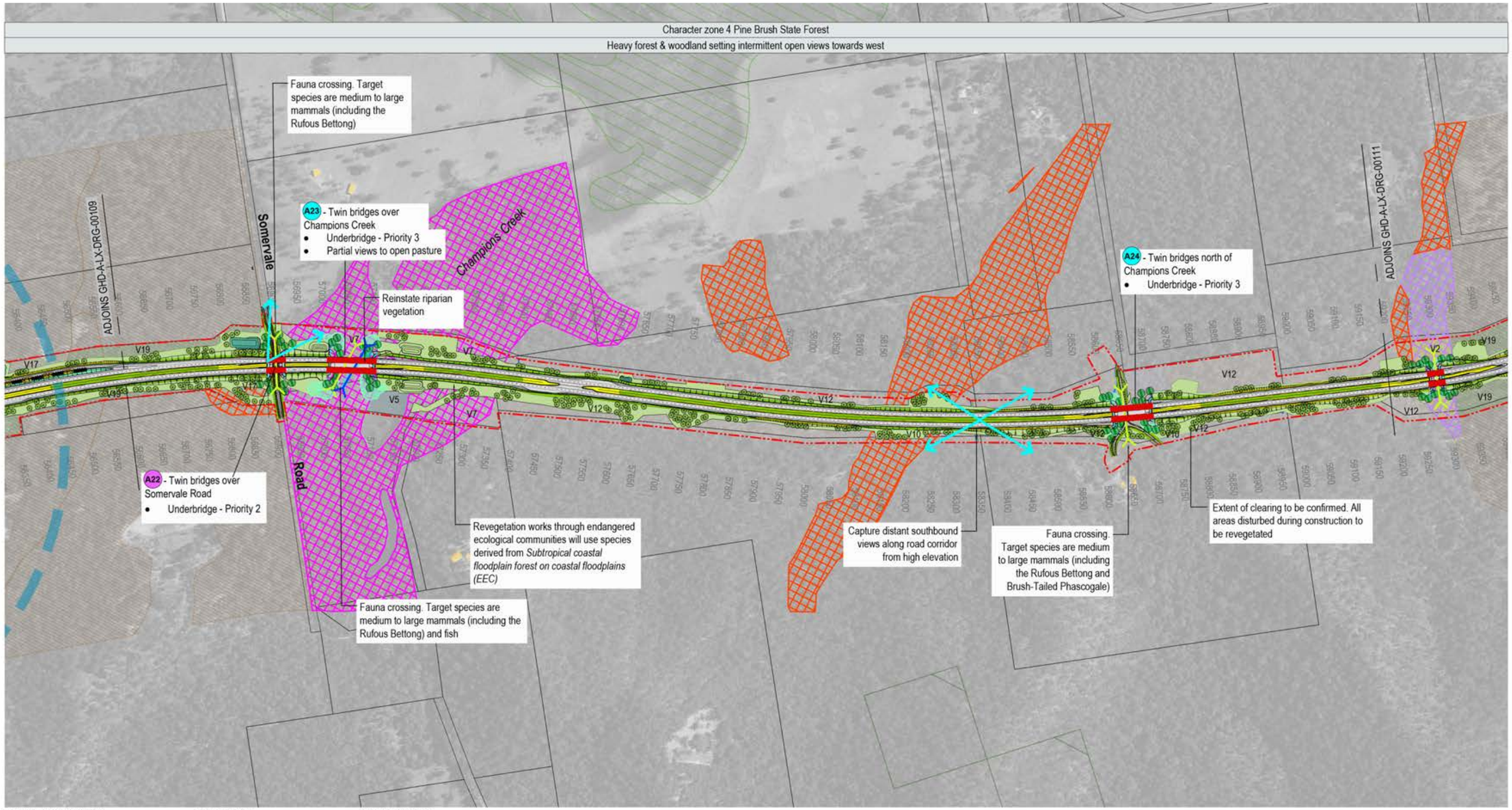
Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00108



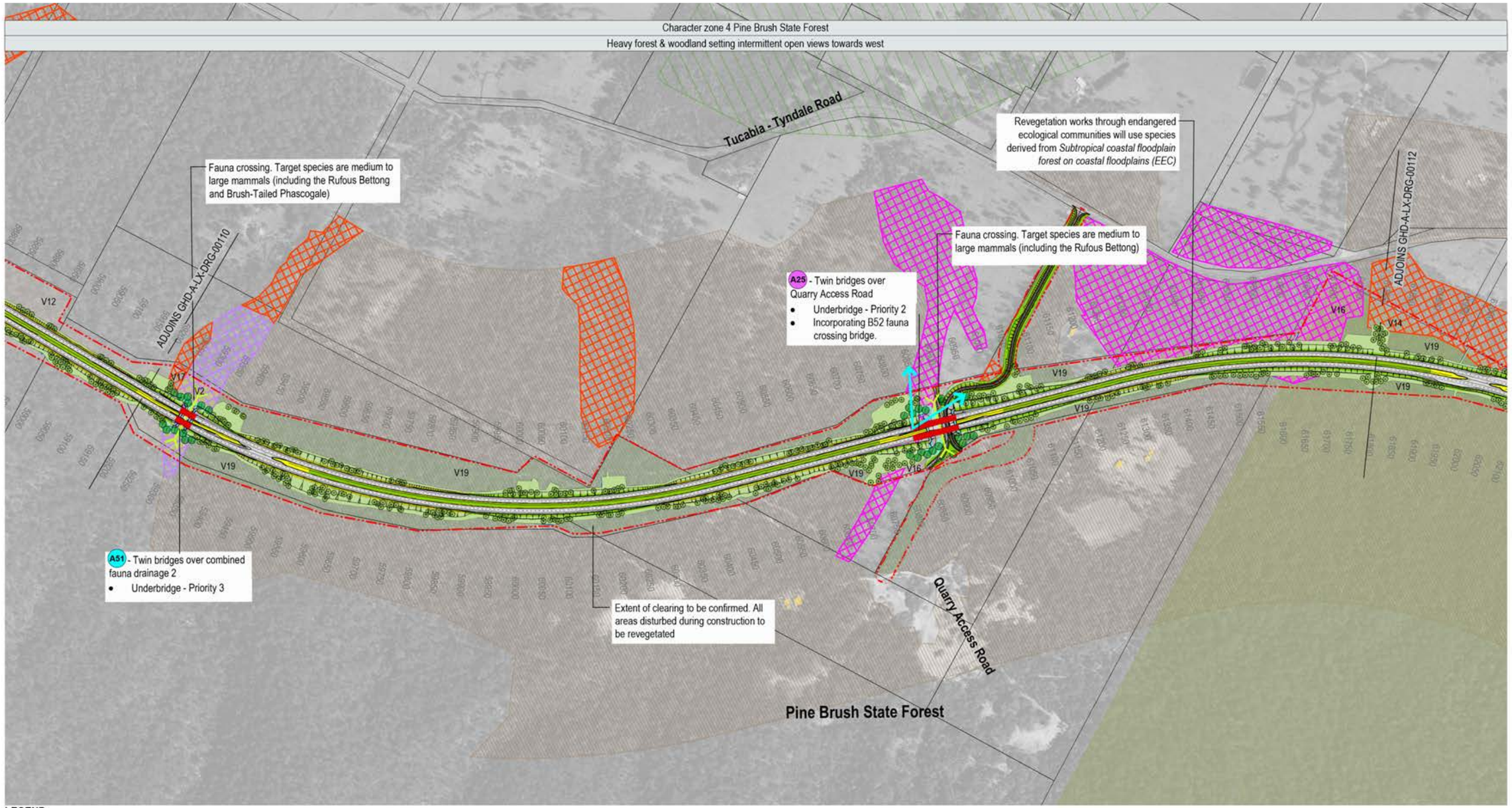
Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00109



Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00110



LEGEND

EXISTING FEATURES

- Existing Pacific Highway
- Existing bridges
- Existing road
- Watercourse
- Property boundary
- Nearby building
- Key views to surrounding landscape

EXISTING VEGETATION COMMUNITIES

- V1 Angophora robur shrubby forest and woodland
- V2 Black Bean - Weeping Lilly Pilly riparian rainforest
- V3 Blackbutt - Bloodwood dry heathy open forest
- V4 Coastal floodplain sedgelands, rushlands and forblands
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- V16 Swamp Box swamp forest
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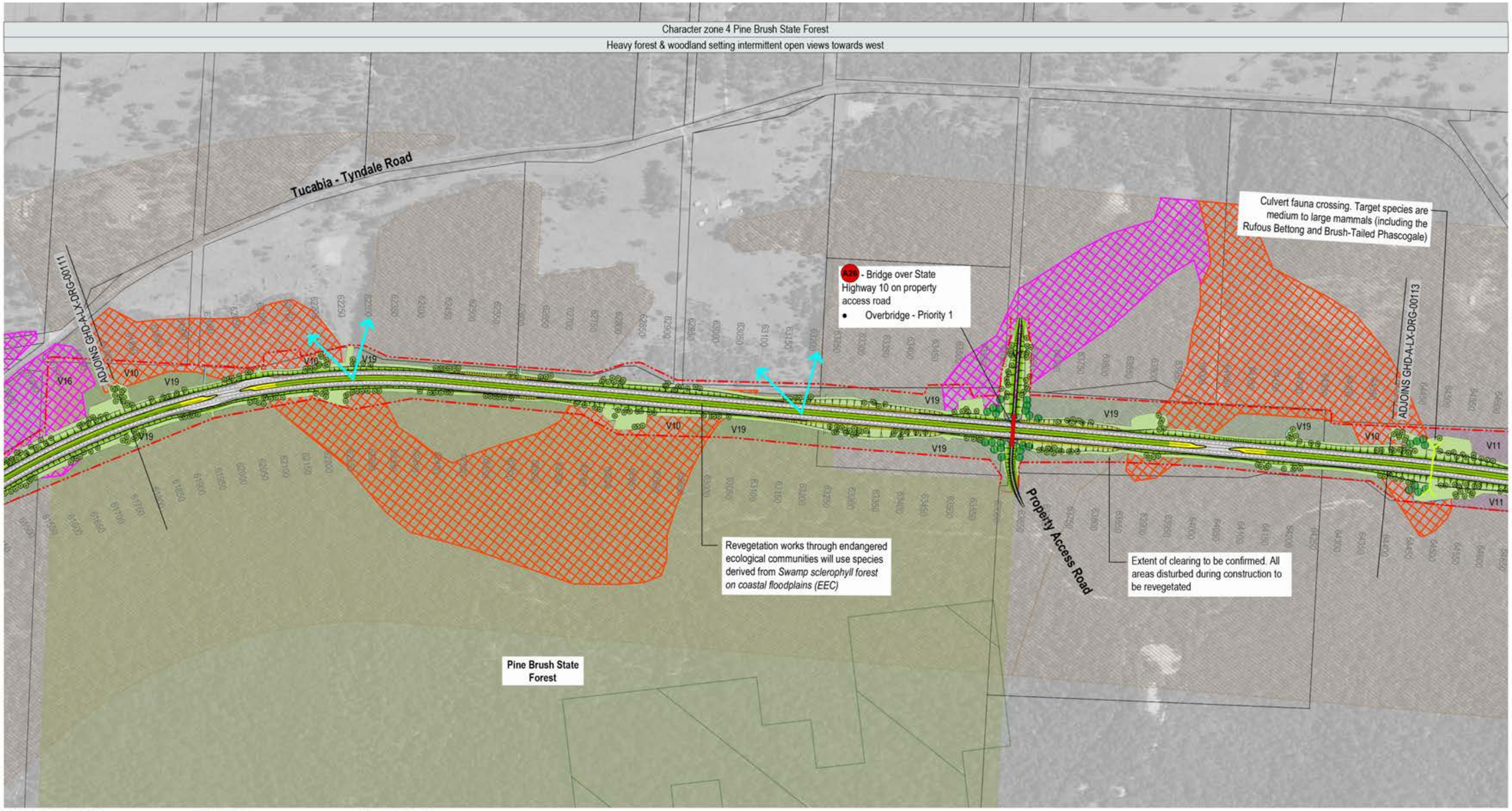
- V18 Swamp Oak swamp forest
- V19 Turpentine moist open forest
- Koala habitat

EEC

- *Freshwater wetlands on coastal floodplains (EEC)*
- *Lowland rainforest on coastal floodplains (EEC)*
- *Subtropical coastal floodplain forest on coastal floodplains (EEC)*
- *Swamp oak floodplain forest on coastal floodplains (EEC)*
- *Swamp sclerophyll forest on coastal floodplains (EEC)*

Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00111



PACIFIC HIGHWAY UPGRADE
- Pacific Highway upgrade boundary
- New bridge
- Wire rope safety barrier
- W-Beam barrier
- Boundary fence
- Fauna fence

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

FAUNA CROSSINGS
- Fauna crossing
- Fish passage
- Glider poles

LANDSCAPE TREATMENTS
- Pasture grasses
- Native grasses
- Mixed shrubs
- Forest revegetation
- Riparian revegetation
- Tubestock planting shrubs & groundcovers
- Water quality basins
- Accent shrub and groundcover verge planting

EVENTS
- Green gateway, cultural, forest event

TREES
- Advanced tree Species varies
- Interchange feature tree species varies
- Interchange feature tree cabbage-tree palm
- Screening tree

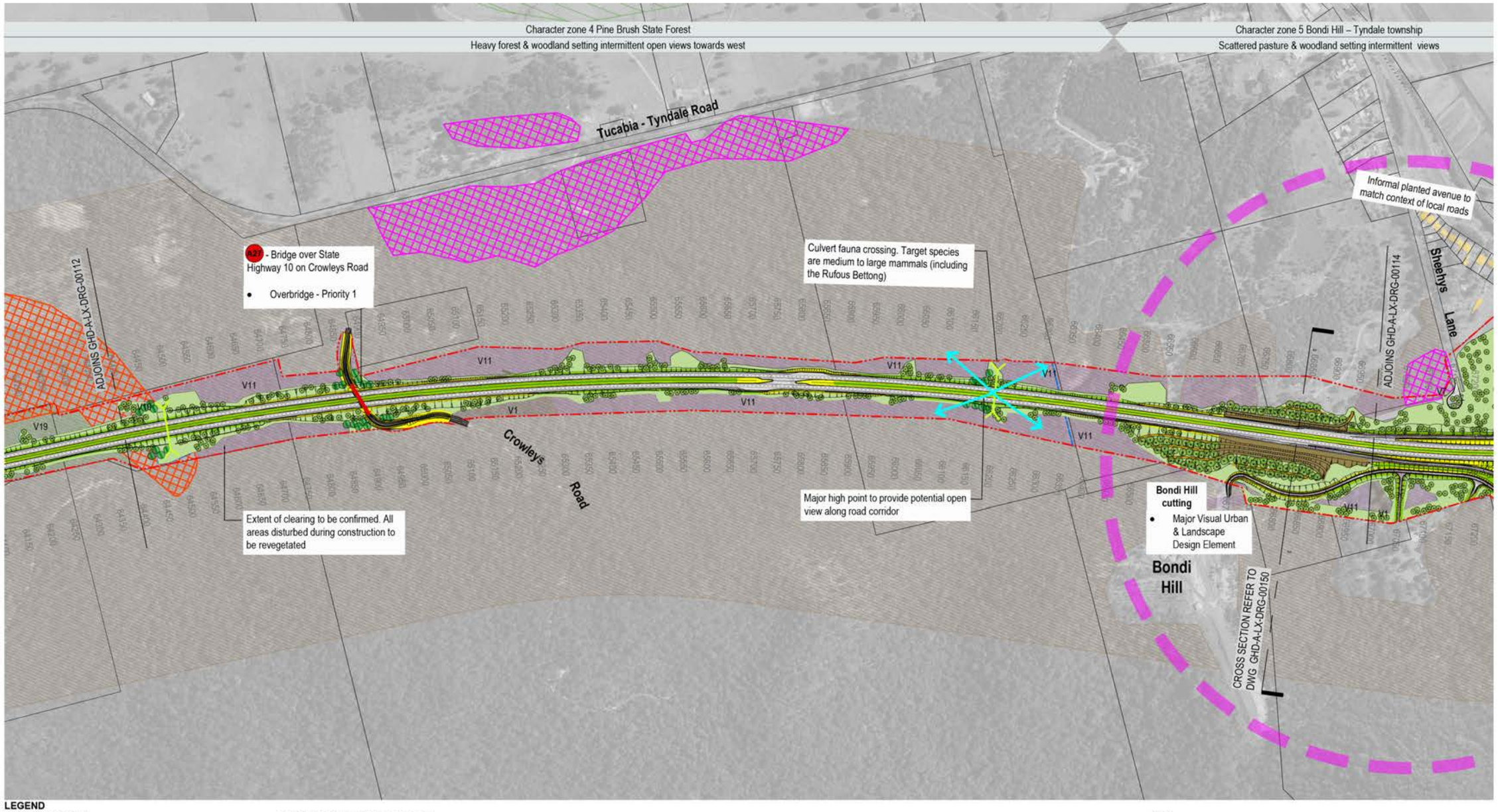
KEY PLAN

0 80 160 240 320 400m

SCALE 1:8000@A3

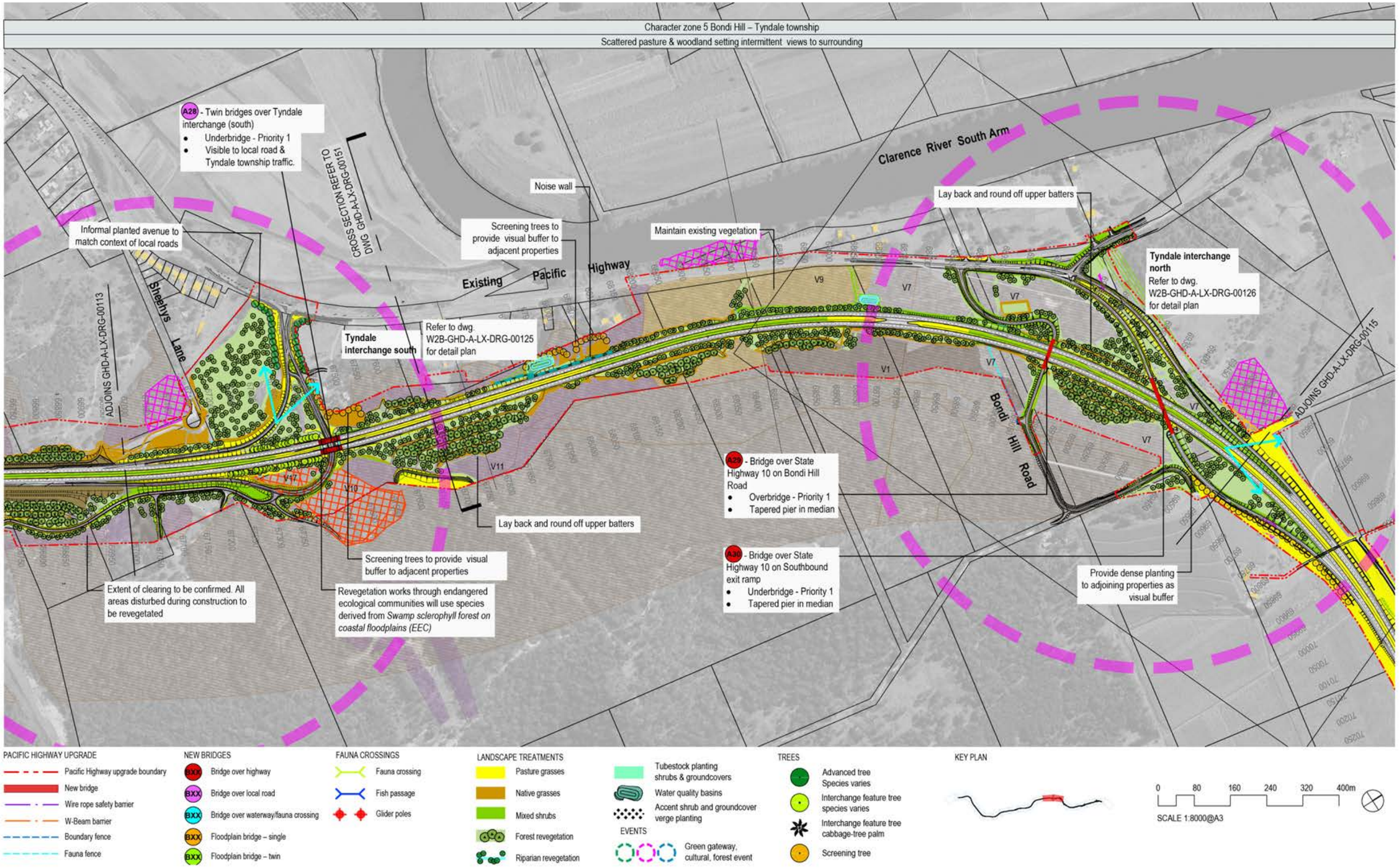
Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00112



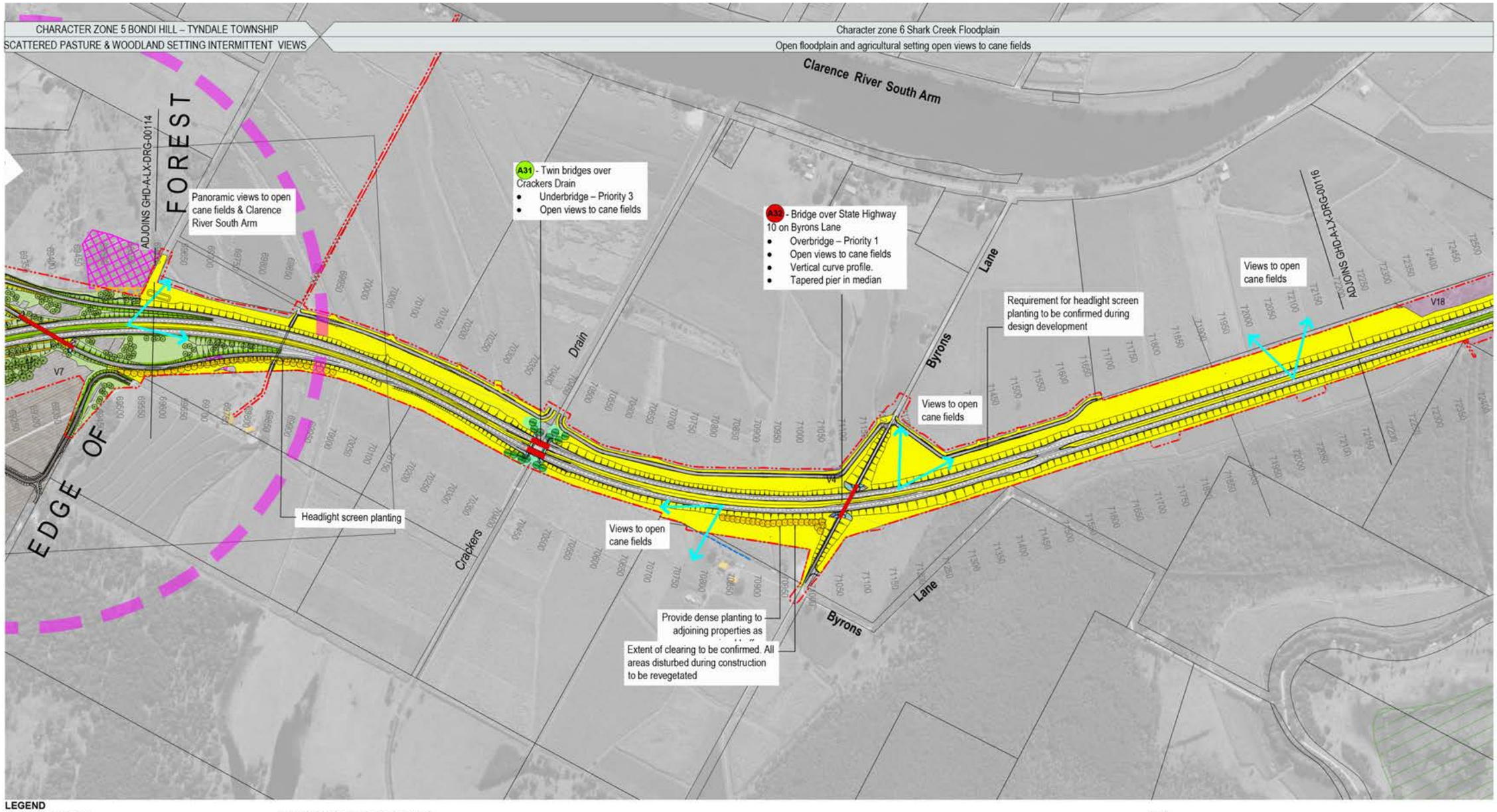
Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00113



Number of trees/elements shown is indicative only. Landscape shown at maturity approximately 15 years.

SECTION 3 & 4 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00114



LEGEND

EXISTING FEATURES

- Existing Pacific Highway
- Existing bridges
- Existing road
- Watercourse
- Property boundary
- Nearby building
- Key views to surrounding landscape

EXISTING VEGETATION COMMUNITIES

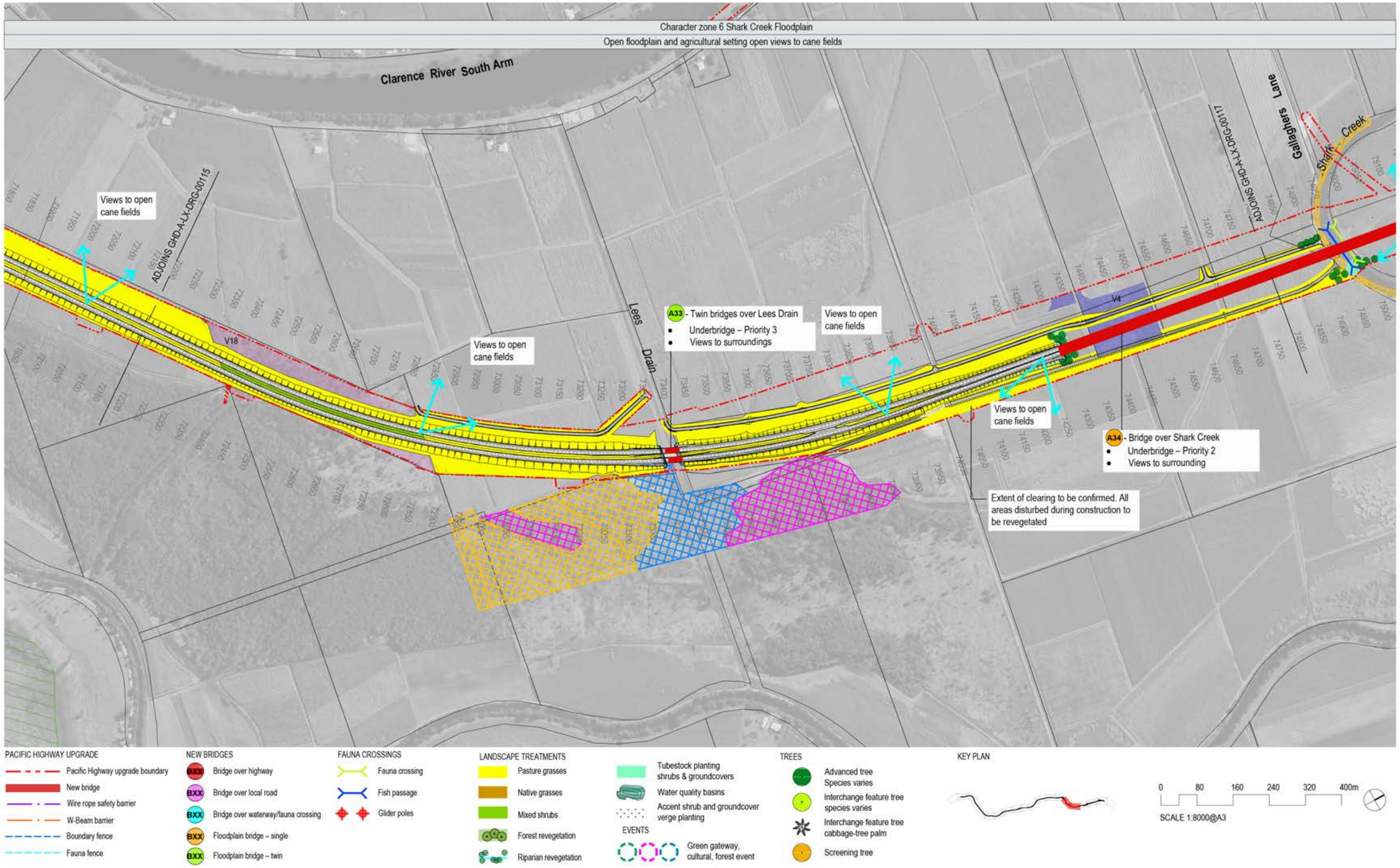
- V1 Angophora robur shrubby forest and woodland
- V2 Black Bean - Weeping Lilly Pilly riparian rainforest
- V3 Blackbutt - Bloodwood dry heathy open forest
- V4 Coastal floodplain sedgelands, rushlands and forblands
- V5 Coastal freshwater meadows and forblands of lagoons and wetlands
- V6 Flooded Gum - Brush Box moist forest
- V7 Forest Red Gum - Swamp Box
- V8 Grey Gum - Grey Ironbark open forest
- V9 Narrow-leaved Ironbark dry open forest
- V10 Paperbark swamp forest
- V11 Pink Bloodwood - Tallowwood moist open forest
- V12 Scribbly Gum - Needlebark Stringybark heathy open forest
- V13 Scribbly Gum - Red Bloodwood heathy open forest
- V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest
- V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest
- V16 Swamp Box swamp forest
- V17 Swamp Mahogany swamp forest
- V18 Swamp Oak swamp forest
- V19 Turpentine moist open forest
- Koala habitat

EEC

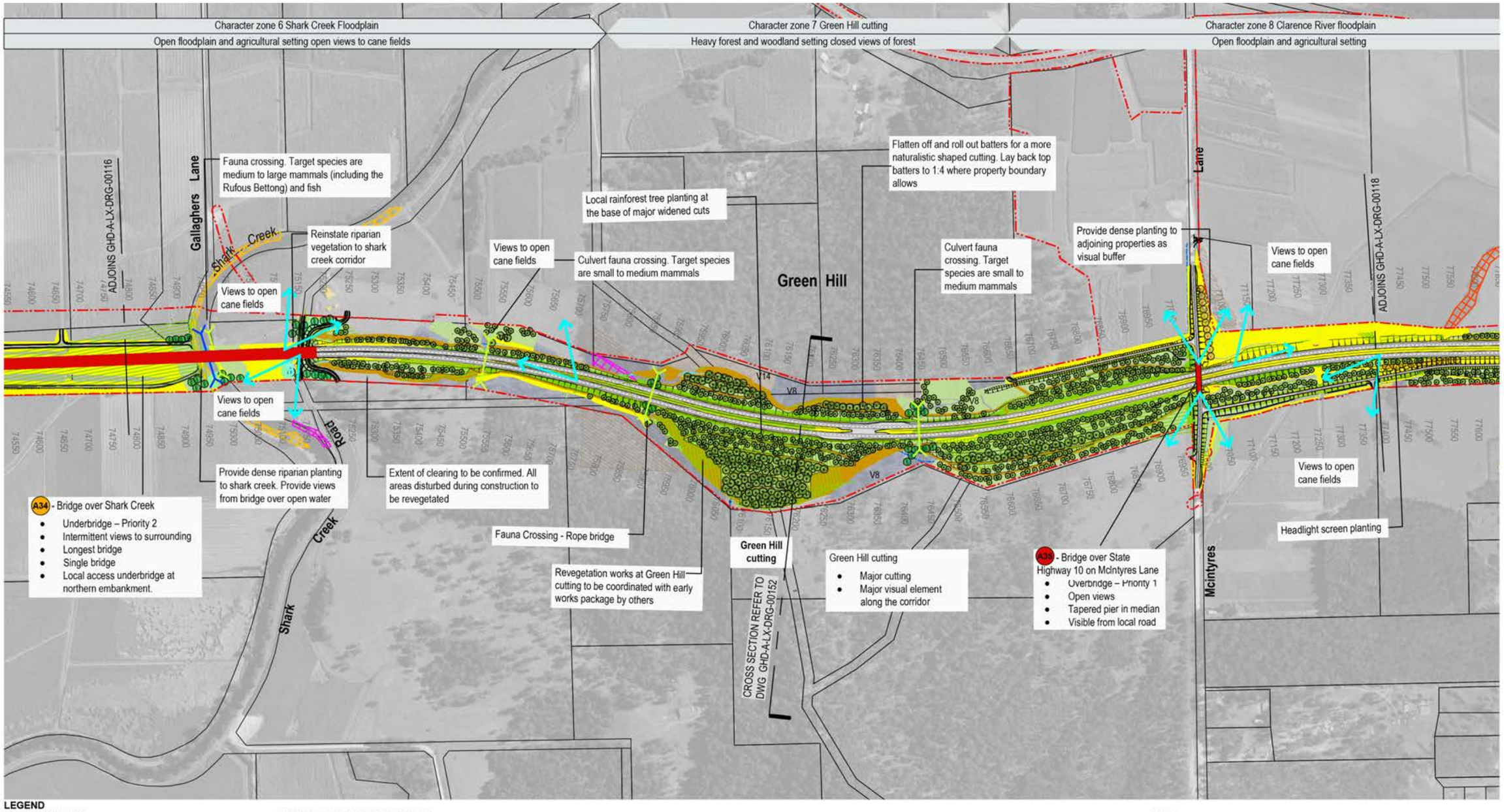
- *Freshwater wetlands on coastal floodplains (EEC)*
- *Lowland rainforest on coastal floodplains (EEC)*
- *Subtropical coastal floodplain forest on coastal floodplains (EEC)*
- *Swamp oak floodplain forest on coastal floodplains (EEC)*
- *Swamp sclerophyll forest on coastal floodplains (EEC)*

Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 4 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00115

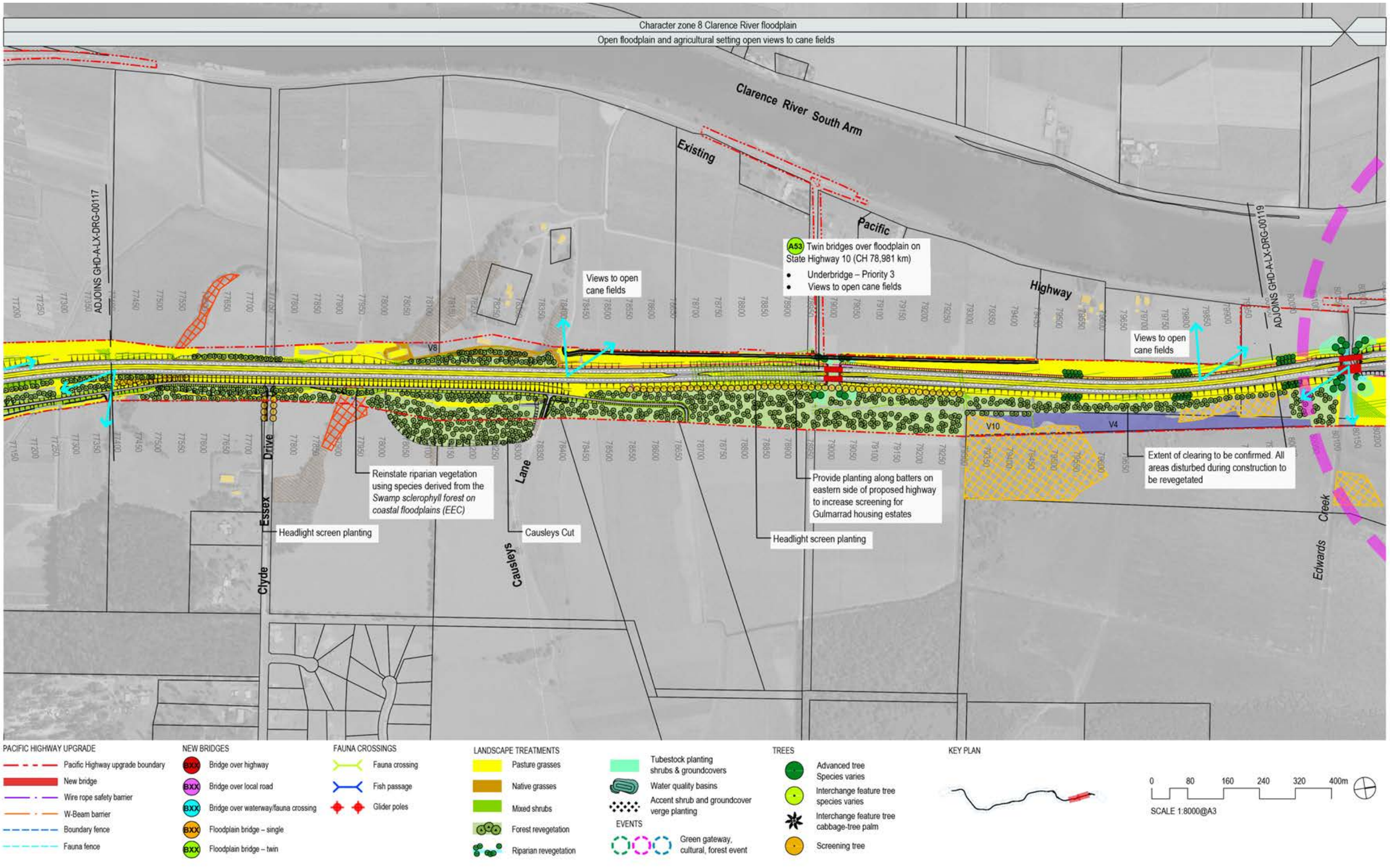


Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.



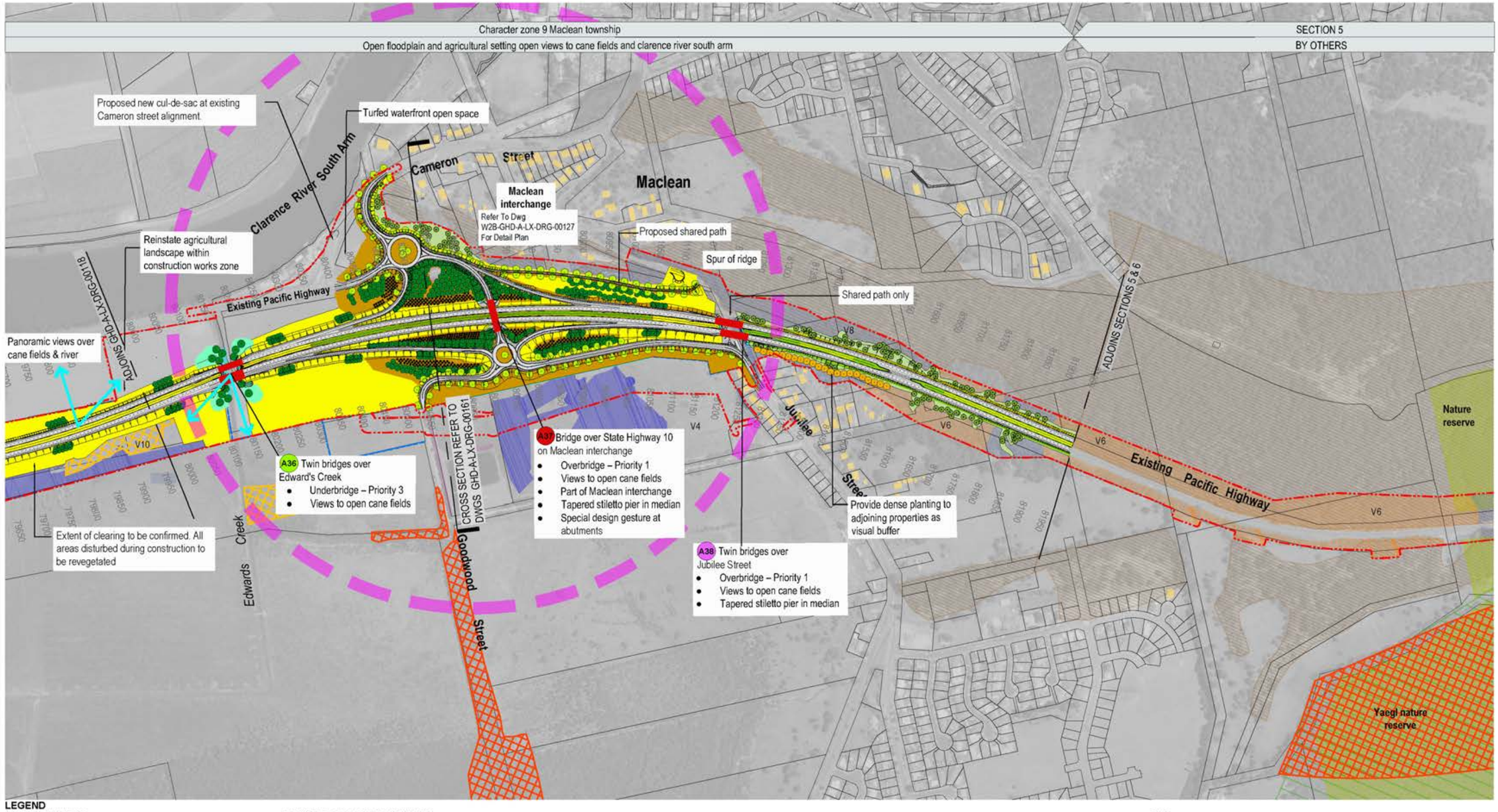
Number of trees/elements shown is indicative only. Landscape shown at maturity approximately 15 years.

SECTION 4 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00117



Number of trees/elements shown is indicative only. Landscape shown at maturity approximately 15 years.

SECTION 4 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00118



LEGEND

EXISTING FEATURES

- Existing Pacific Highway
- Existing bridges
- Existing road
- Watercourse
- Property boundary
- Nearby building
- Key views to surrounding landscape

EXISTING VEGETATION COMMUNITIES

- V1 Angophora robur shrubby forest and woodland
- V2 Black Bean - Weeping Lilly Pilly riparian rainforest
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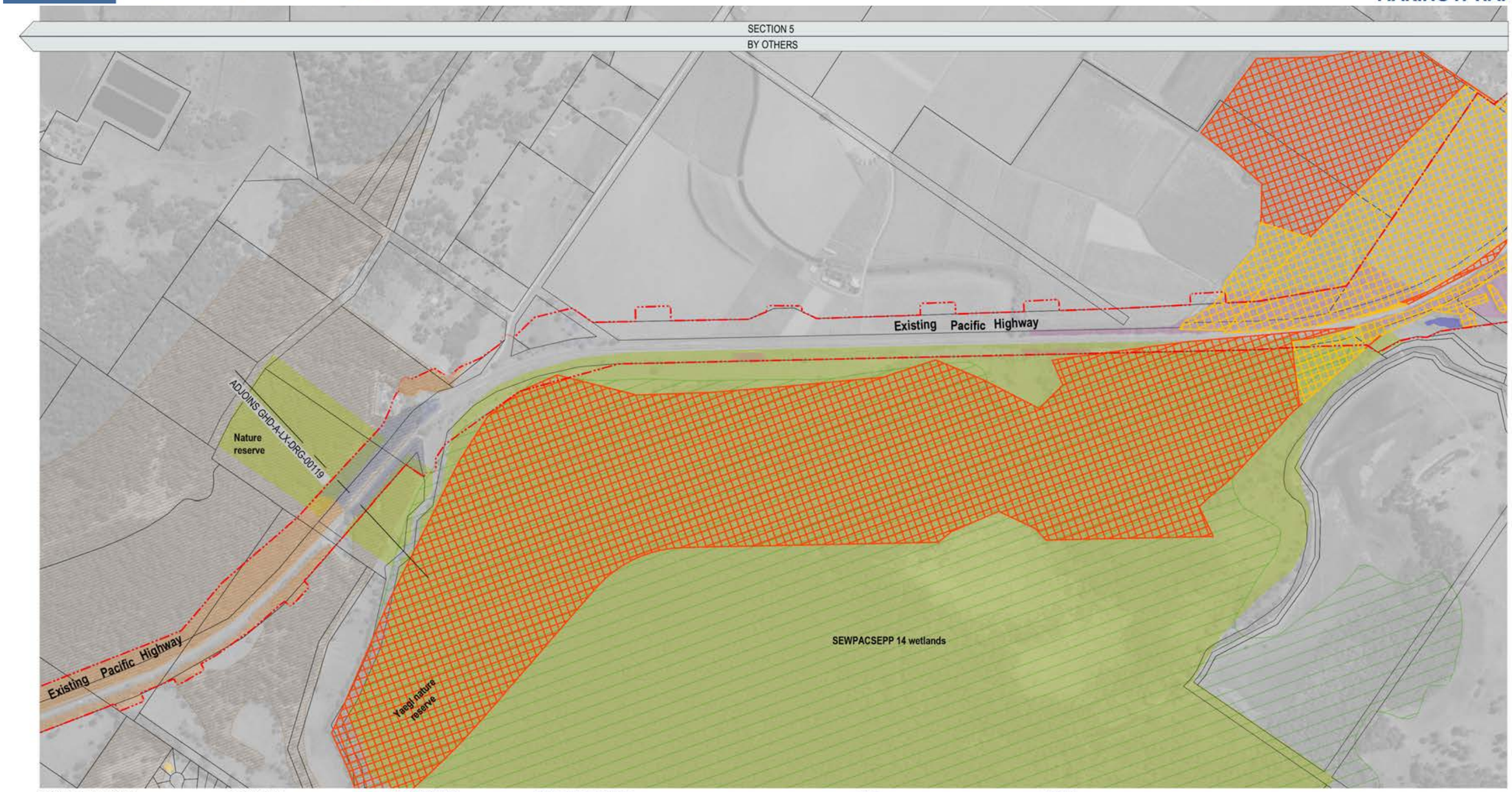
- V17 Swamp Mahogany swamp forest
- V18 Swamp Oak swamp forest
- V19 Turpentine moist open forest
- Koala habitat

EEC

- *Freshwater wetlands on coastal floodplains (EEC)*
- *Lowland rainforest on coastal floodplains (EEC)*
- *Subtropical coastal floodplain forest on coastal floodplains (EEC)*
- *Swamp oak floodplain forest on coastal floodplains (EEC)*
- *Swamp sclerophyll forest on coastal floodplains (EEC)*

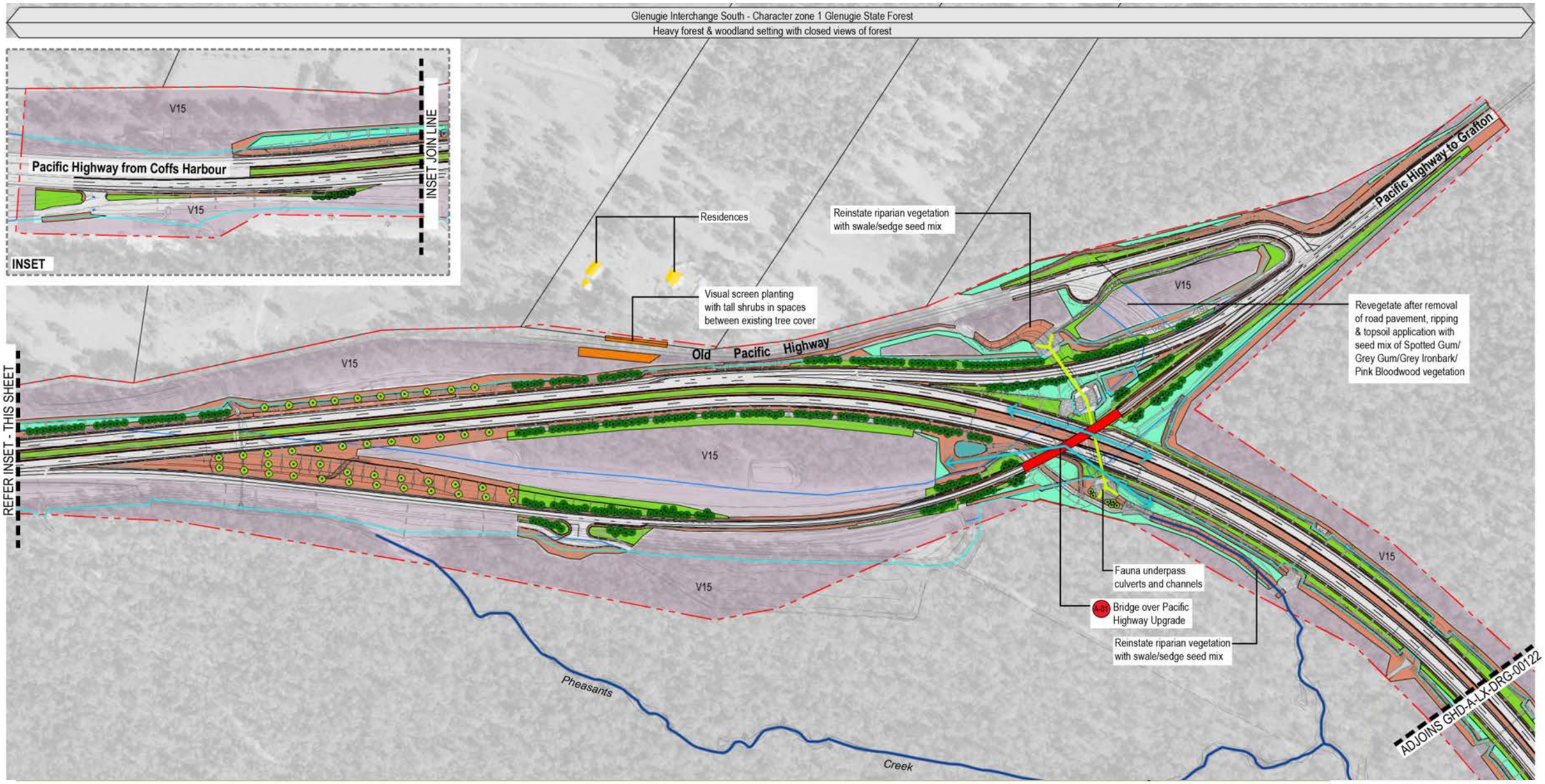
Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 4 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00119



Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 4 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00120



Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

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

Glenugie Interchange North - Character zone 1 Glenugie State Forest
Heavy forest & woodland setting with closed views of forest

Eight Mile Lane

Eight Mile Lane new alignment

Original Eight Mile Lane removed & revegetated with seed mix of Spotted Gum/Grey Gum/Grey Ironbark /Pink Bloodwood vegetation after ripping & topsoil application

V15

ADJOINS GHD-A-LX-DRG-00121

Pheasants Creek

A-02 Bridge over Pacific Highway Upgrade

Original Eight Mile Lane removed & revegetated with native grass seed mix after ripping & topsoil application

Eight Mile Lane new alignment

REFER INSET - THIS SHEET

INSET JOIN LINE

Original Eight Mile Lane removed & revegetated with native grass seed mix after ripping & topsoil application

Eight Mile Lane new alignment

INSET

A-03 Twin Bridges over Pheasants Creek

Reinstate riparian vegetation with tubestock planting

Potential landscape mound subject to approval and revegetation in accordance with detailed landscape design documentation

LEGEND

EXISTING FEATURES
- Existing Pacific Highway
- Existing bridges
- Existing road
- Watercourse
- Property boundary
- Nearby building
- Key views to surrounding landscape

EXISTING VEGETATION COMMUNITIES
- V1 Angophora robur shrubby forest and woodland
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- Koala habitat

EEC
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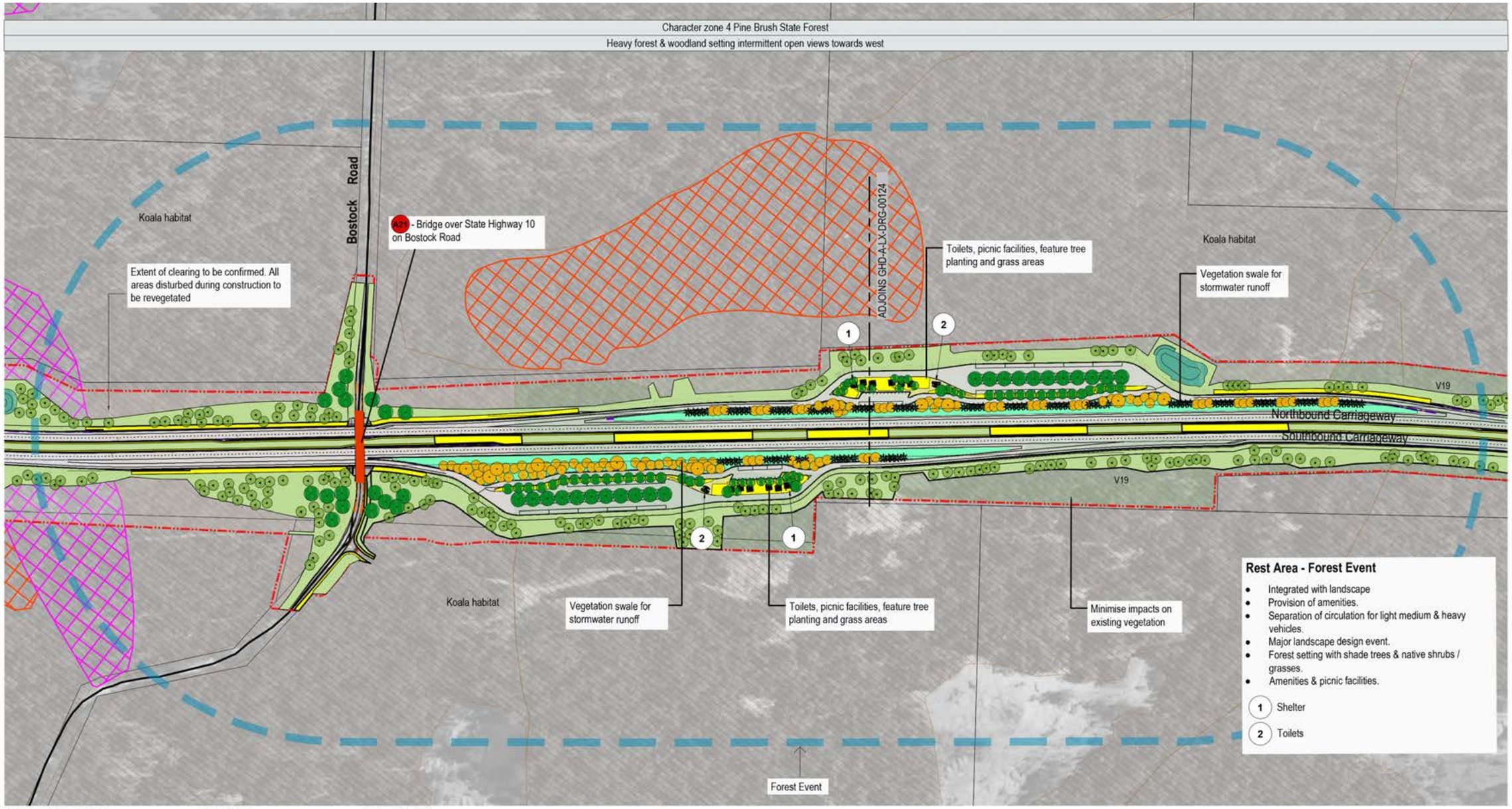
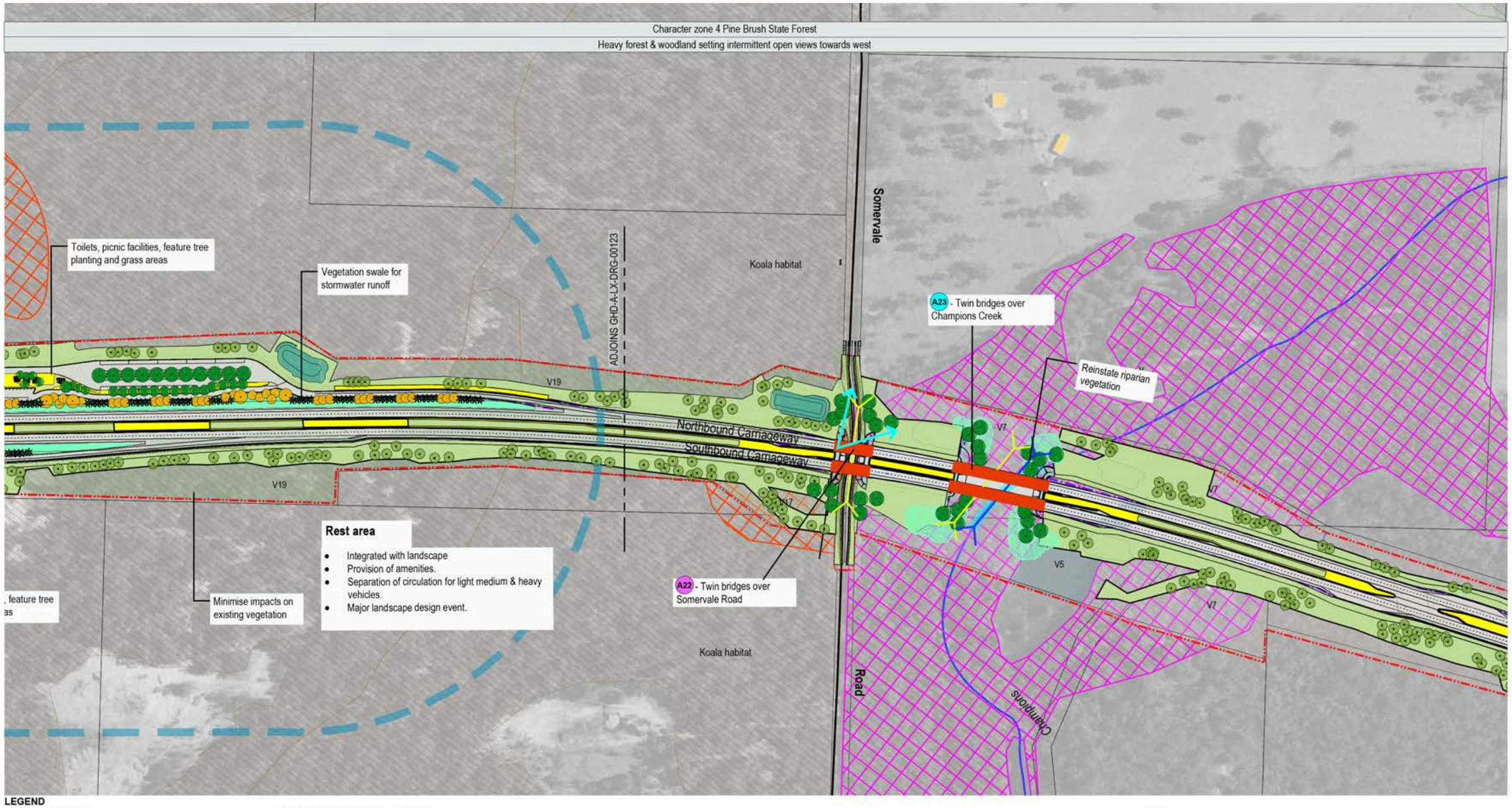
Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.



Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Pine Brush rest area W2B-GHD-A-LX-DRG-00123



LEGEND

EXISTING FEATURES

- Existing Pacific Highway
- Existing bridges
- Existing road
- Watercourse
- Property boundary
- Nearby building
- Key views to surrounding landscape

EXISTING VEGETATION COMMUNITIES

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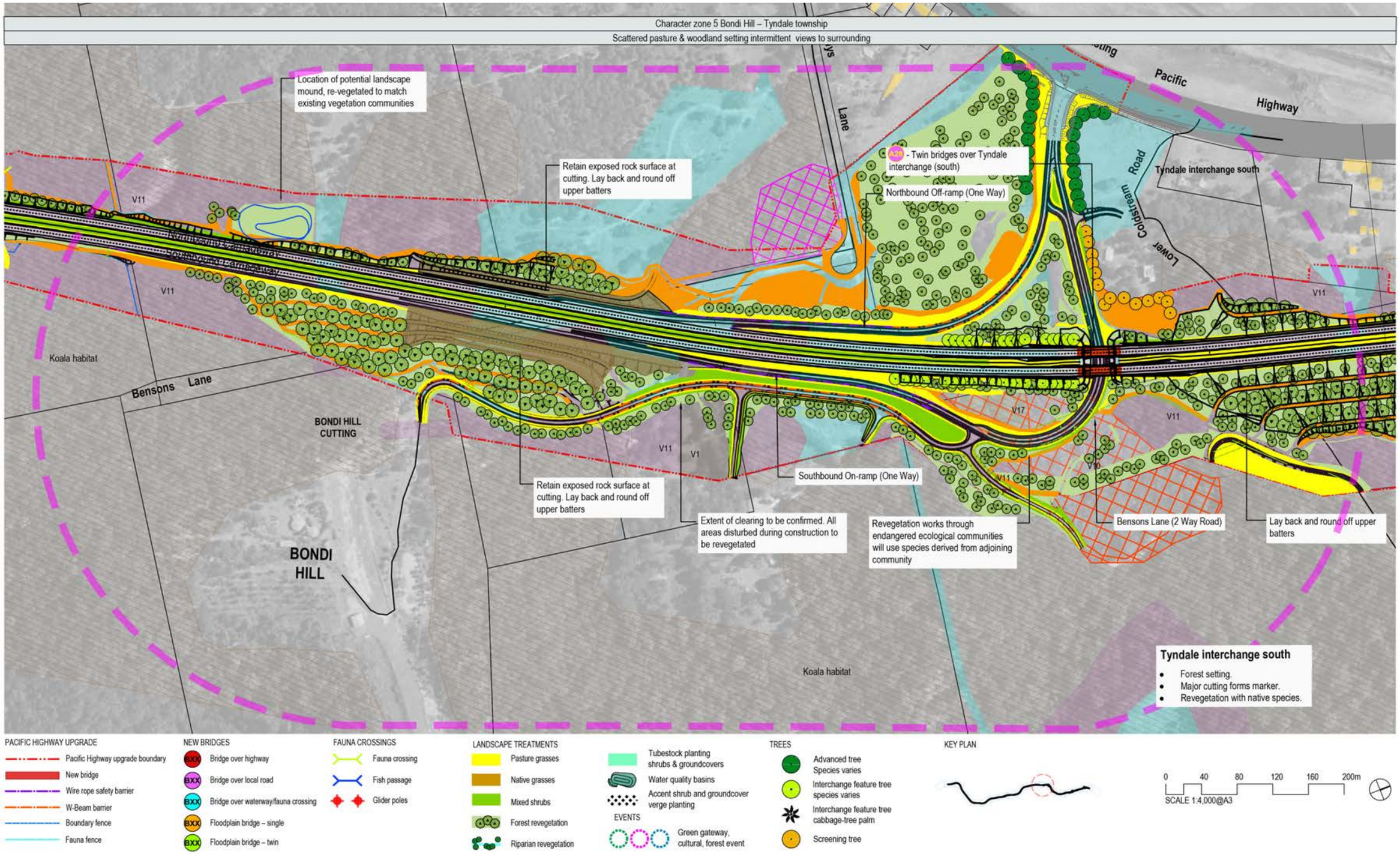
- Koala habitat

EEC

- *Freshwater wetlands on coastal floodplains (EEC)*
- *Lowland rainforest on coastal floodplains (EEC)*
- *Subtropical coastal floodplain forest on coastal floodplains (EEC)*
- *Swamp oak floodplain forest on coastal floodplains (EEC)*
- *Swamp sclerophyll forest on coastal floodplains (EEC)*

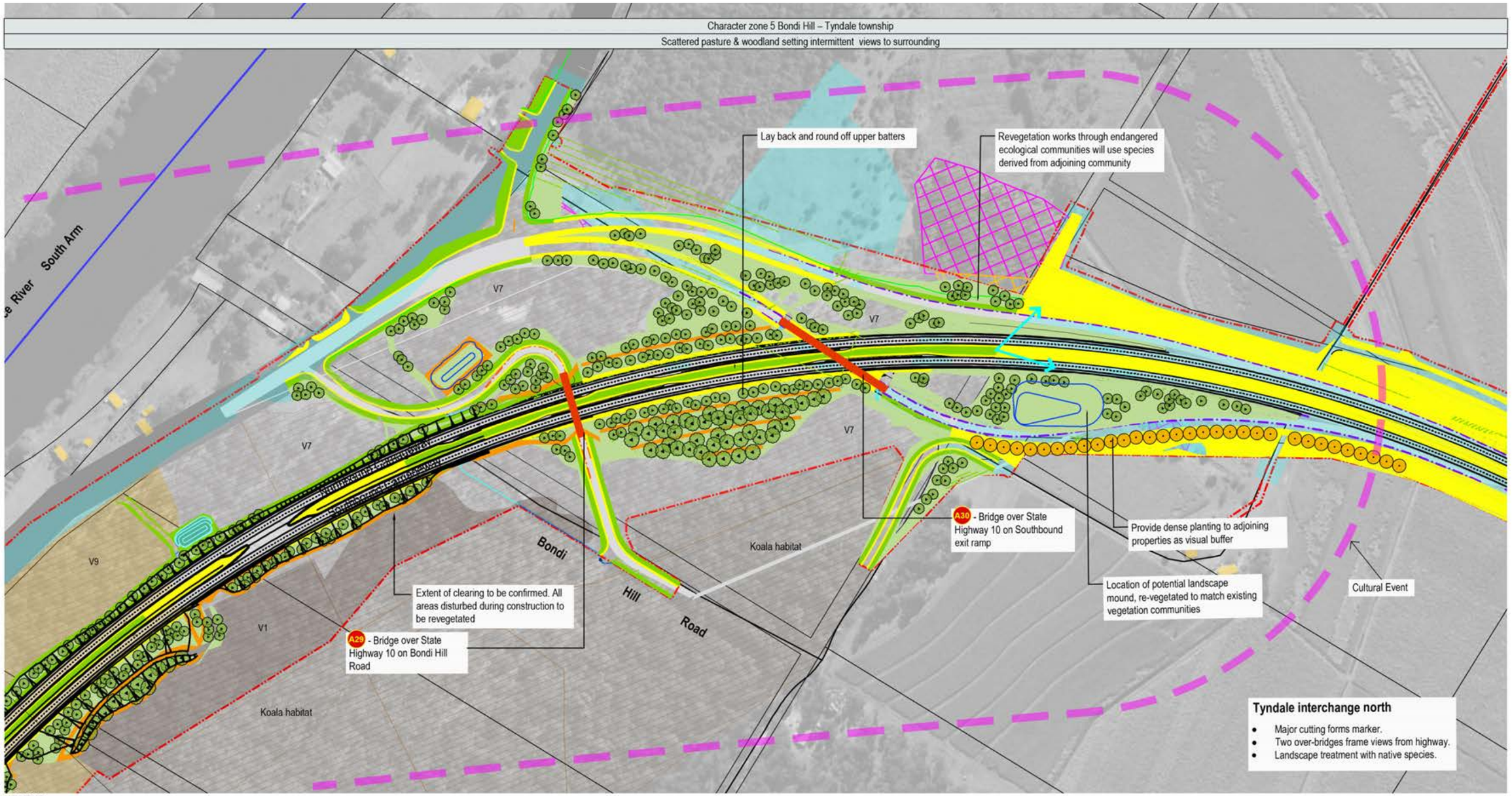
Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Pine Brush rest area W2B-GHD-A-LX-DRG-00124



Number of trees/elements shown is indicative only. Landscape shown at maturity approximately 15 years.

SECTION 4 Tyndale interchange south W2B-GHD-A-LX-DRG-00125



LEGEND

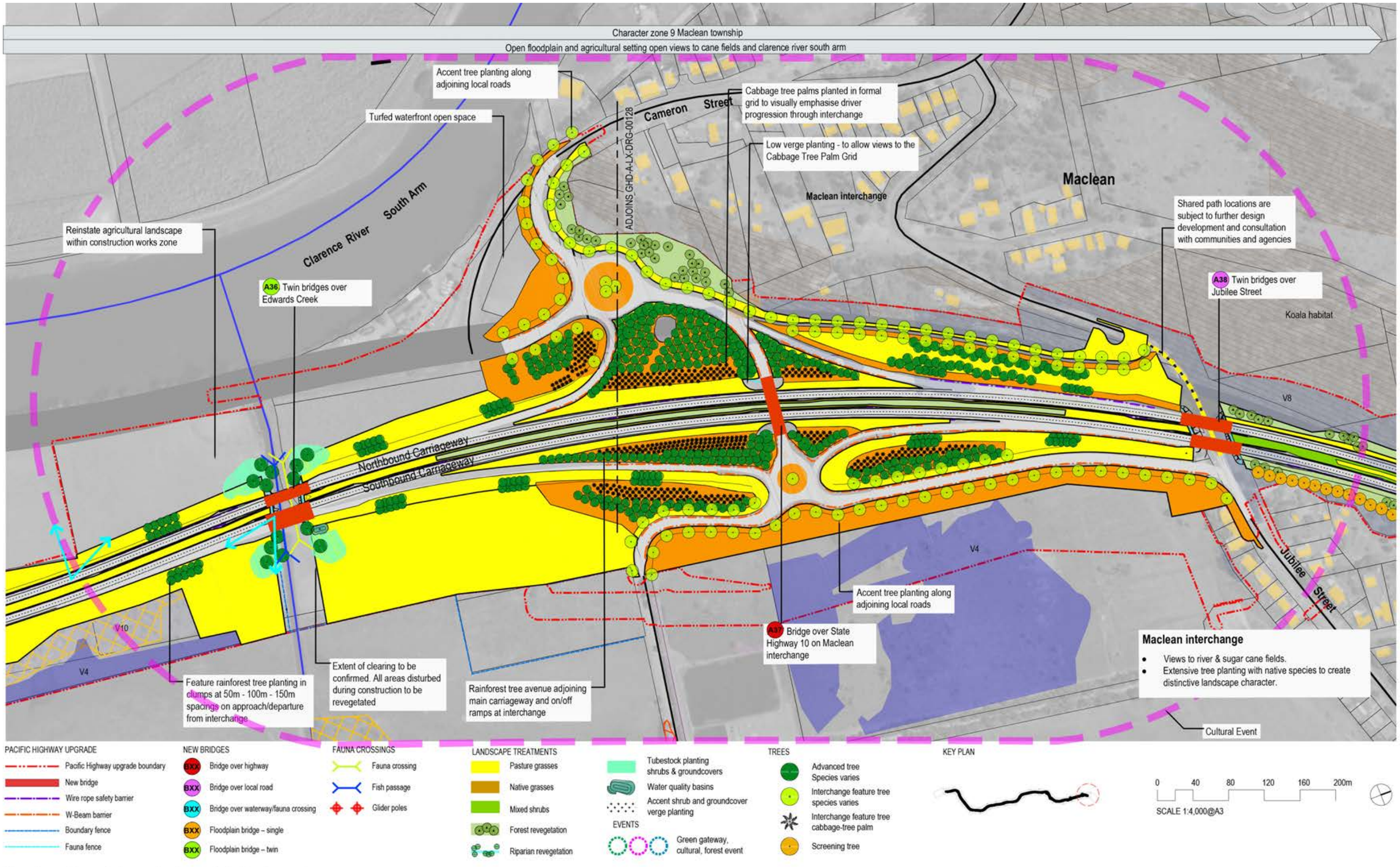
EXISTING FEATURES
- Existing Pacific Highway
- Existing bridges
- Existing road
- Watercourse
- Property boundary
- Nearby building
- Key views to surrounding landscape

EXISTING VEGETATION COMMUNITIES
- V1 Angophora robur shrubby forest and woodland
- V2 Black Bean - Weeping Lilly Pilly riparian rainforest
- V3 Blackbutt - Bloodwood dry heathy open forest
- V4 Coastal floodplain sedgelands, rushlands and forblands
- V5 Coastal freshwater meadows and forblands of lagoons and wetlands
- V6 Flooded Gum - Brush Box moist forest
- V7 Forest Red Gum - Swamp Box
- V8 Grey Gum - Grey Ironbark open forest
- V9 Narrow-leaved Ironbark dry open forest
- V10 Paperbark swamp forest
- V11 Pink Bloodwood - Tallowwood moist open forest
- V12 Scribbly Gum - Needlebark Stringybark heathy open forest
- V13 Scribbly Gum - Red Bloodwood heathy open forest
- V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest
- V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest
- V16 Swamp Box swamp forest
- V17 Swamp Mahogany swamp forest
- V18 Swamp Oak swamp forest
- V19 Turpentine moist open forest
- Koala habitat

EEC
- *Freshwater wetlands on coastal floodplains (EEC)*
- *Lowland rainforest on coastal floodplains (EEC)*
- *Subtropical coastal floodplain forest on coastal floodplains (EEC)*
- *Swamp oak floodplain forest on coastal floodplains (EEC)*
- *Swamp sclerophyll forest on coastal floodplains (EEC)*

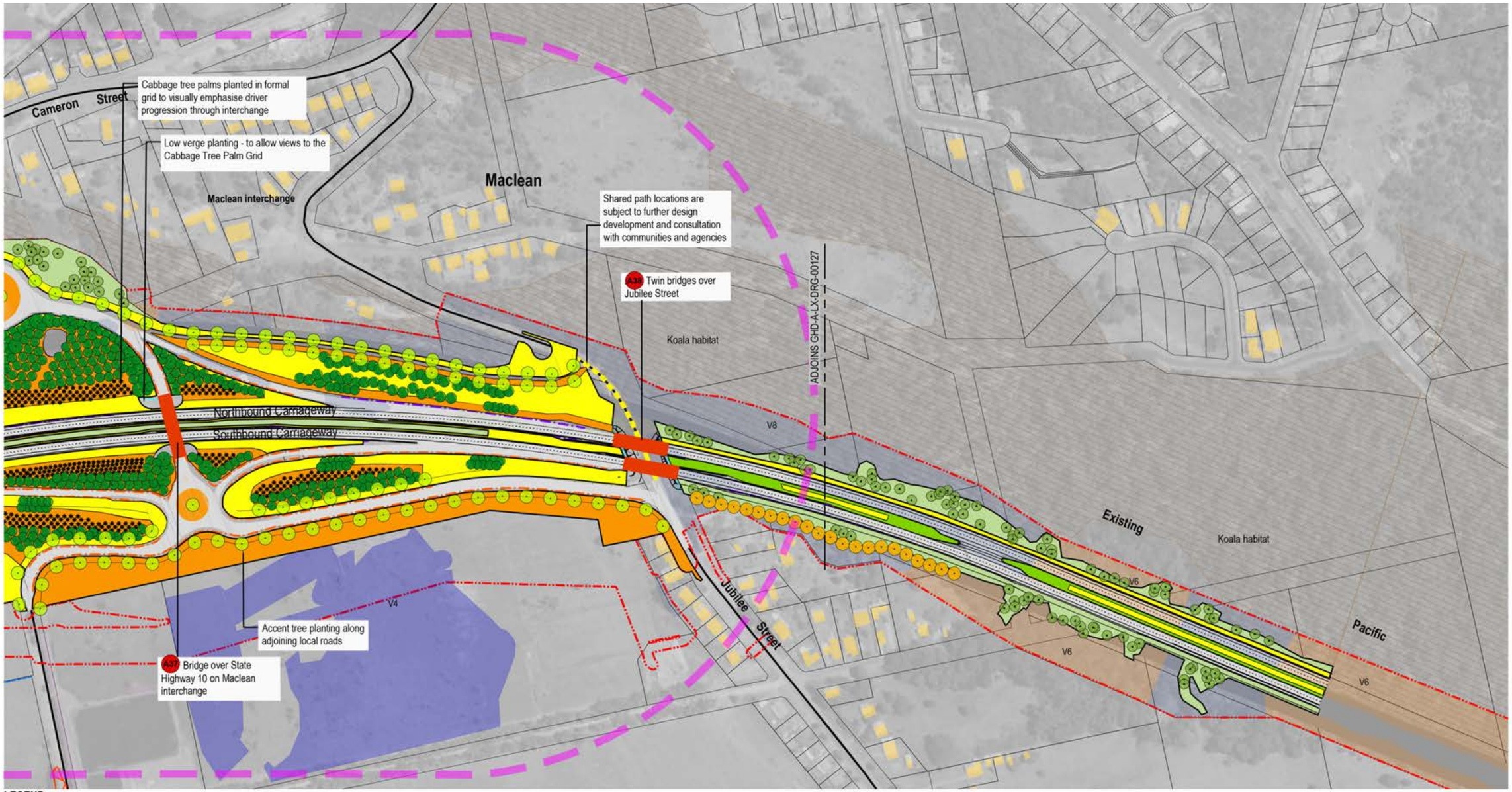
Number of trees/elements shown is indicative only. Landscape shown at maturity approximately 15 years.

SECTION 4 Tyndale interchange north W2B-GHD-A-LX-DRG-00126



Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 4 Maclean interchange W2B-GHD-A-LX-DRG-00127



LEGEND

EXISTING FEATURES

- Existing Pacific Highway
- Existing bridges
- Existing road
- Watercourse
- Property boundary
- Nearby building
- Key views to surrounding landscape

EXISTING VEGETATION COMMUNITIES

- V1 Angophora robur shrubby forest and woodland
- V2 Black Bean - Weeping Lilly Pilly riparian rainforest
- V3 Blackbutt - Bloodwood dry heathy open forest
- V4 Coastal floodplain sedgelands, rushlands and forblands
- V5 Coastal freshwater meadows and forblands of lagoons and wetlands
- V6 Flooded Gum - Brush Box moist forest
- V7 Forest Red Gum - Swamp Box
- V8 Grey Gum - Grey Ironbark open forest
- V9 Narrow-leaved Ironbark dry open forest
- V10 Paperbark swamp forest
- V11 Pink Bloodwood - Tallowwood moist open forest
- V12 Scribbly Gum - Needlebark Stringybark heathy open forest
- V13 Scribbly Gum - Red Bloodwood heathy open forest
- V14 Spotted Gum - Grey Box - Grey Ironbark dry open forest
- V15 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest
- V16 Swamp Box swamp forest
- V17 Swamp Mahogany swamp forest
- V18 Swamp Oak swamp forest
- V19 Turpentine moist open forest
- Koala habitat

EEC

- *Freshwater wetlands on coastal floodplains (EEC)*
- *Lowland rainforest on coastal floodplains (EEC)*
- *Subtropical coastal floodplain forest on coastal floodplains (EEC)*
- *Swamp oak floodplain forest on coastal floodplains (EEC)*
- *Swamp sclerophyll forest on coastal floodplains (EEC)*

Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

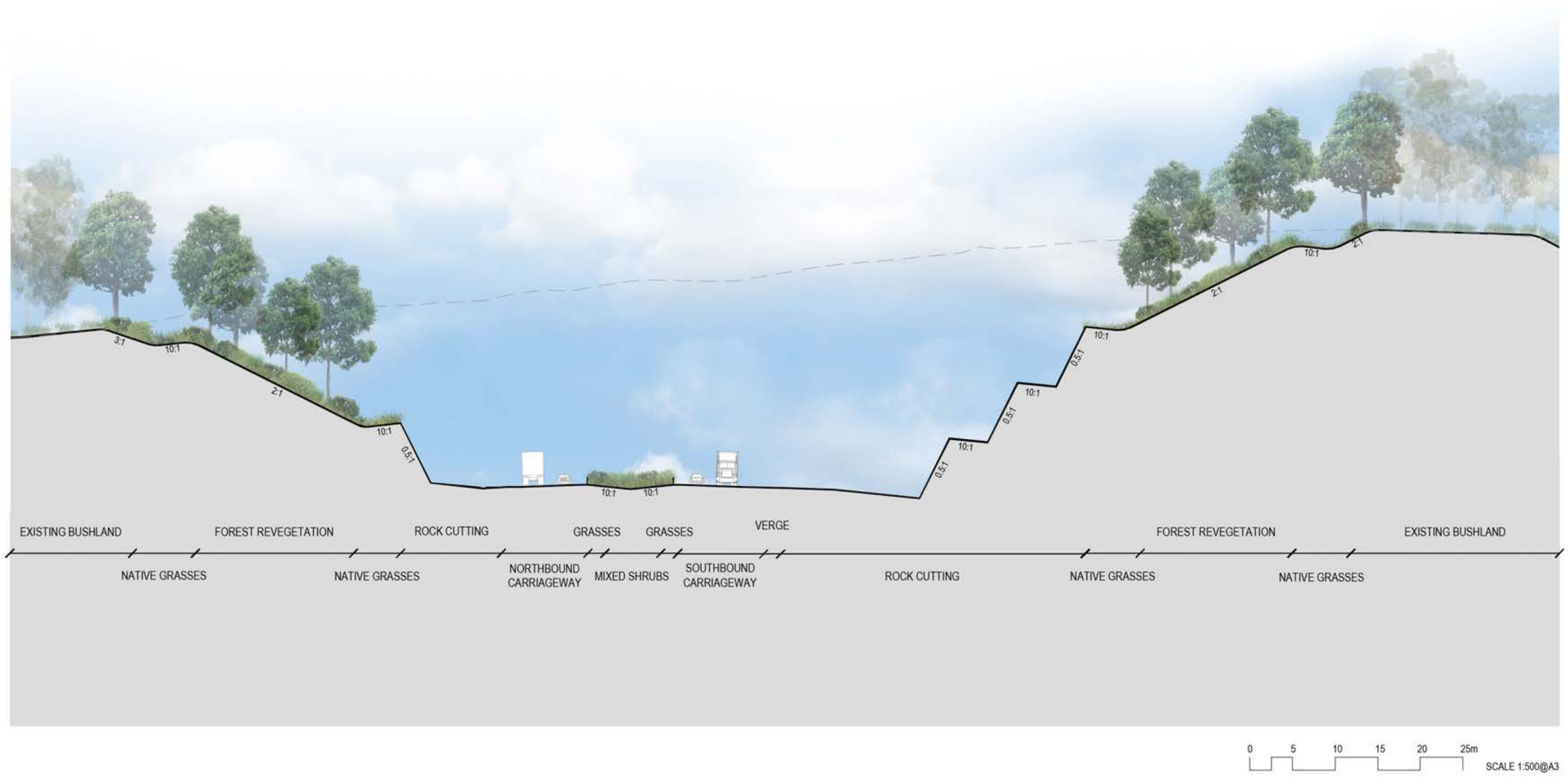
SECTION 4 Maclean interchange W2B-GHD-A-LX-DRG-00128

7.2 Cross sections

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

Cross sections are:

- Cross section at Bondi Hill
- Cross section at Tyndale interchange north
- Cross section at Green Hill
- Maclean interchange section.

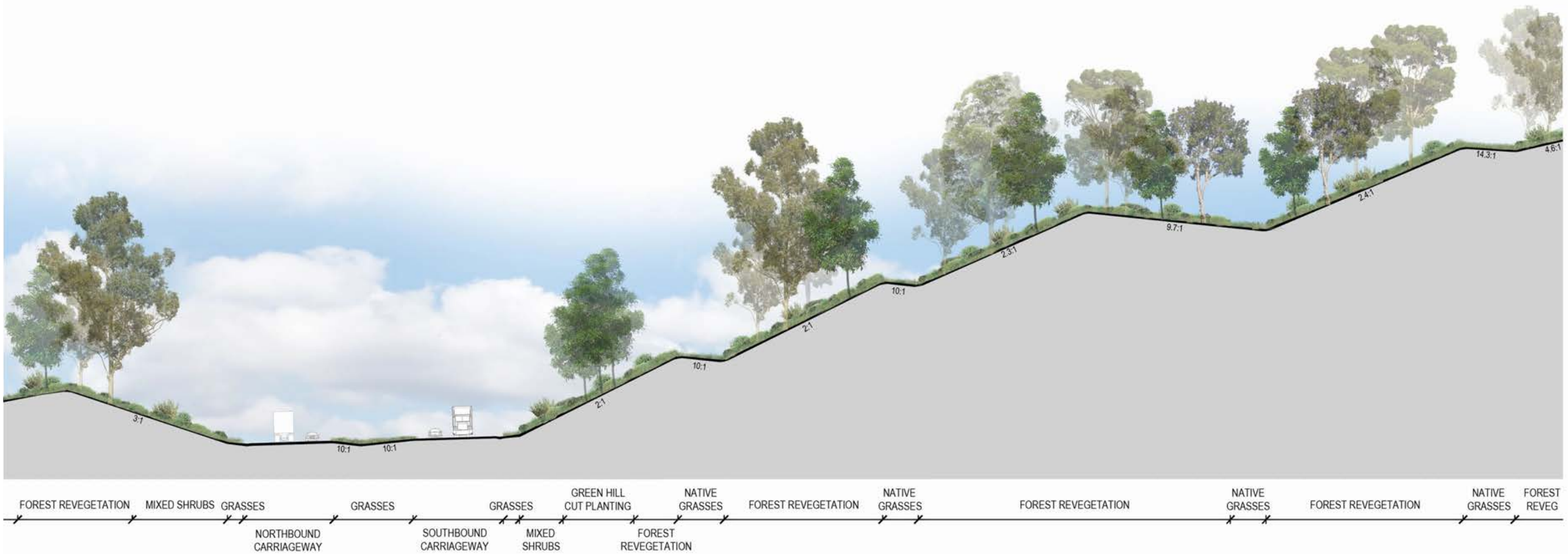


Number of trees/elements shown is indicative only. Landscape at maturity approximately 15 years.

SECTION 3 Cross section at Bondi Hill W2B-GHD-A-LX-DRG-00150

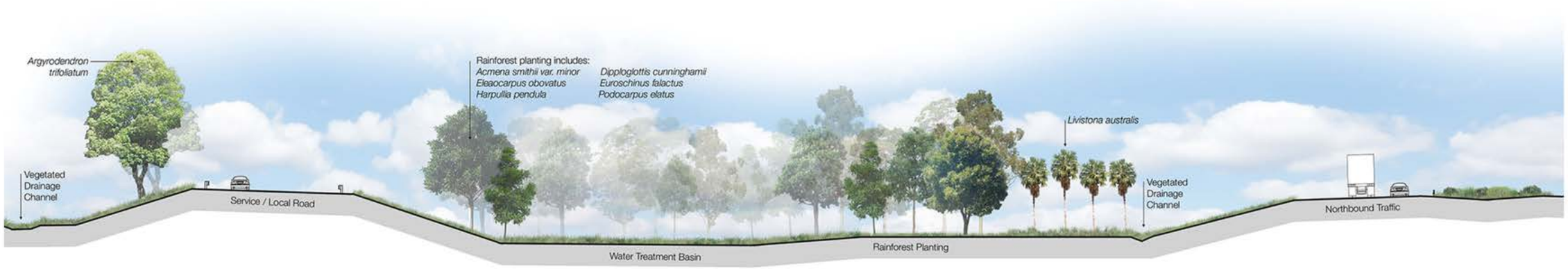
Number of trees/elements shown is indicative only. Landscape at maturity approximately 15 years.

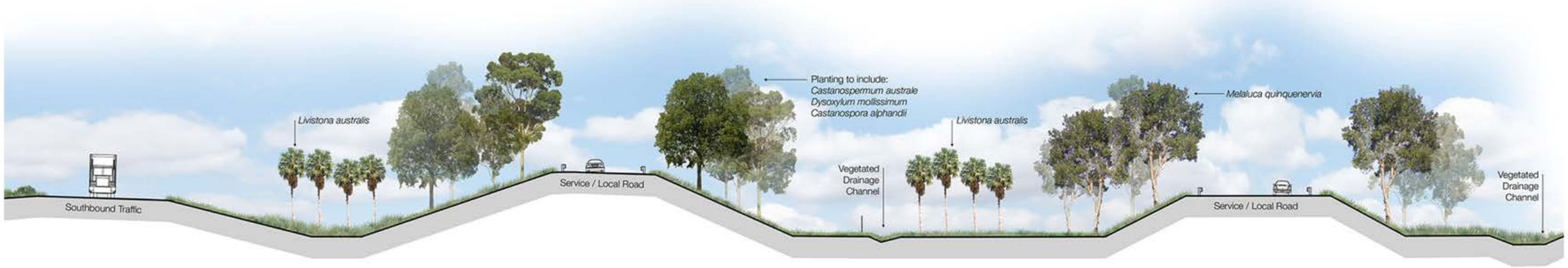
SECTION 4 Cross section at Tyndale interchange north W2B-GHD-A-LX-DRG-00151



Number of trees/elements shown is indicative only. Landscape at maturity approximately 15 years.

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





0 5 10 15 20 25m
SCALE 1:500@A3

Number of trees/elements shown is indicative only. Landscape at maturity approximately 15 years.

Cross section at Maclean interchange W2B-GHD-A-LX-DRG-00161

7.3 Summary of landscape monitoring and management

Refer to Chapter 9.10 and Appendix H Landscape Management Plan.

7.4 Visual impact assessment including mitigation

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

This chapter summarises the visual impact assessment for the project, based on the same systematic methodology utilised in the EIS Volume 1B *Chapter 11 Urban Design, Landscape Character and Visual Impact* and *Working Paper Volume 5 Urban Design, Landscape Character and Visual Impact + Historical (non-Aboriginal) Heritage* by Hassell.

The visual assessment systematically provides both a qualitative and quantitative visual assessment of the route. A review of the findings has been undertaken through a site visit and assessment of surrounding conditions.

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

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

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

The visual assessment comparison includes impacts on landscape character and key views and is based on the impact assessment grading matrix (Figure 52 and DRG-00006).

MAGNITUDE

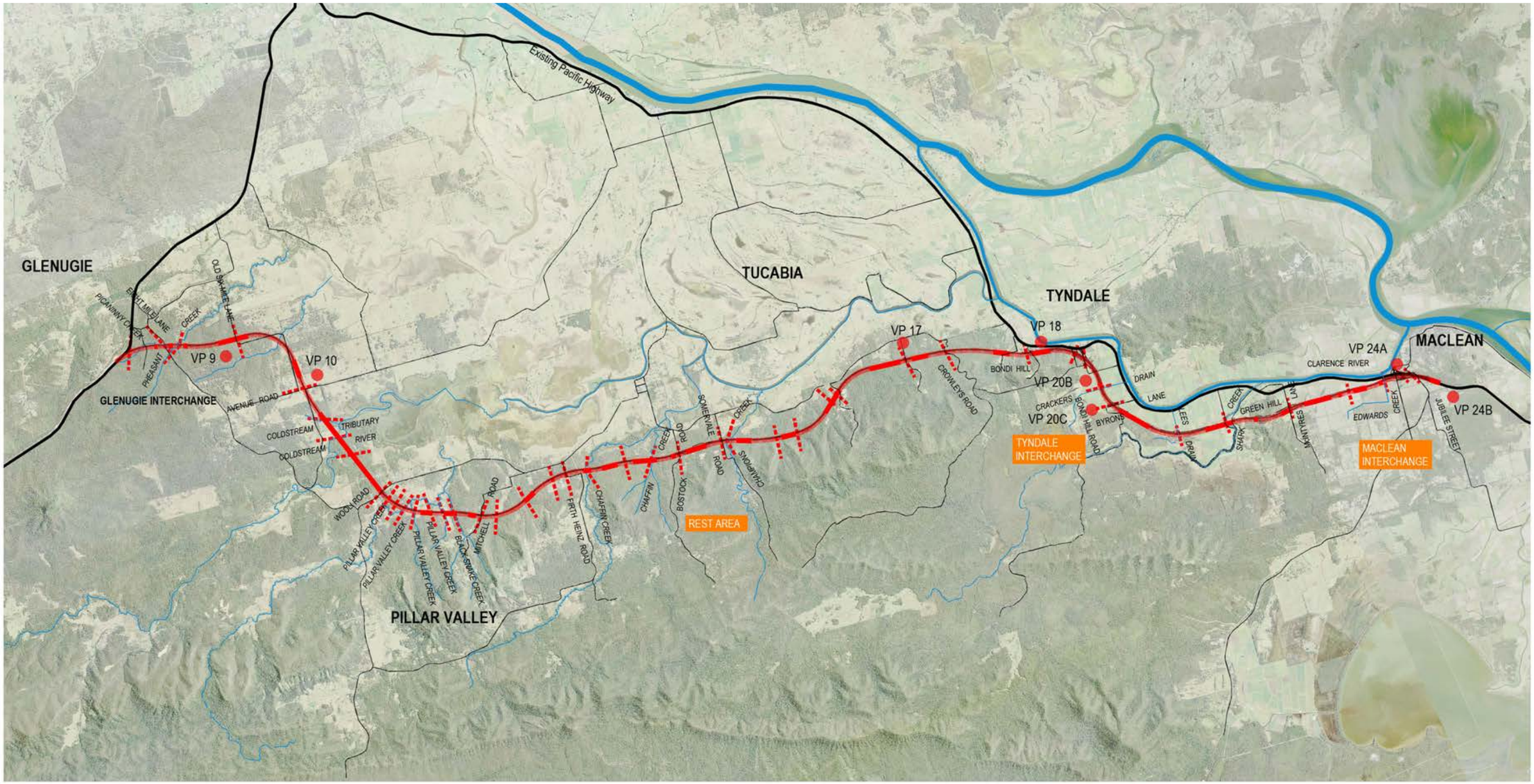
SENSITIVITY

	High	High to Moderate	Moderate	Moderate to low	Low	Negligible
High	High Impact	High Impact	Moderate - high	Moderate - high	Moderate	Negligible
High to Moderate	High Impact	Moderate - high	Moderate - high	Moderate	Moderate	Negligible
Moderate	Moderate - high	Moderate - high	Moderate	Moderate	Moderate - low	Negligible
Moderate to low	Moderate - high	Moderate	Moderate	Moderate - low	Moderate - low	Negligible
Low	Moderate	Moderate	Moderate - low	Moderate - low	Low impact	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

Figure 52: Landscape character and visual impact grading matrix.

Figure 53: Agricultural setting with open views.

Figure 54: Forest setting with intermittent view of pastureland.



LEGEND

- Pacific Highway upgrade Sections 3 and 4
- Existing Pacific Highway
- Existing roads
- Existing major watercourses
- Bridge (Indicative only)

0 1250 2500 3750 5000 6250

SCALE 1:125,000@A3

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

7.4.1 Landscape character impacts

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

Glenugie to Tyndale (section 3)

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

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

Tyndale to Maclean (section 4)

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

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

Table 7-1: Landscape character impacts in sections 3 and 4.

Precinct	Magnitude	Sensitivity	Impact	Impact
08 Glenugie State Forest	Low New corridor through foothills of State Forest Low embankments and low cuttings within existing corridor.	Low Woodland and grazing. Limited residences, good absorption capacity.	Low	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
09 Glenugie pasture	Negligible P09 is outside the road corridor.	Negligible Views limited by vegetation and landform.	Negligible	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
10 Grafton Airport/ Pheasant Creek	Moderate New road corridor generally along existing local roads. Some areas of embankment required.	Low Woodland with pastureland. Limited residences. Good absorption capacity.	Moderate – Low	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.

Precinct	Magnitude	Sensitivity	Impact	Impact
11 Coldstream River/Sandy Crossing	Moderate/High There are a number of large bridge structures crossing the Coldstream River and Pillar Valley Creek.	Moderate This is an area of high landscape quality. Extensive views towards the north and south.	Moderate – High	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
12 Pillar Valley	Moderate Moderate embankments and cuttings within a new road corridor.	Moderate The foothills of the Pillar Valley are wooded and have absorption capacity.	Moderate	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
13 Coldstream River/ swampland	Negligible P13 is outside the road corridor.	Low Scenic views toward swamplands from the corridor.	Negligible	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
14 Tucabia township	Negligible P14 (Tucabia) is outside the road corridor.	Negligible The project would not be visible from the township of Tucabia.	Negligible	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
15 Upper Coldstream	Negligible P15 is outside the road corridor.	Moderate Some views to Coldstream River Valley possible.	Negligible	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
16 Pine Brush State Forest	Moderate Cuttings and embankments hidden in the foothills.	Moderate Woodland foothills with scattered cleared areas.	Moderate	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.

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

Precinct	Magnitude	Sensitivity	Impact	Impact
22 Green Hill	Moderate Large cutting through Green Hill.	Moderate Green Hill is an elevated area within flat floodplain and is visible from a distance.	Moderate	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
23 Gulmarrad township	Low Embankments across the floodplain up to about three metres.	Low Gulmarrad township is disconnected from the road work through vegetation, distance and topography.	Low	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
24 Maclean/ Townsend township	Moderate A new interchange would be required at Maclean however this would be within close proximity to the existing road corridor.	Moderate-Low Upgrade of existing road infrastructure.	Moderate	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.
25 Maclean PInnacle	Low Limited infrastructure required. Small embankments within the existing road corridor.	Low Upgrade of existing road infrastructure.	Low	The current design will not change the magnitude and sensitivity identified in the EIS, as there is no significant change in the location of the character precincts and so the overall impact will remain the same.

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

7.4.2 Impacts on key views

Visual impact ratings were determined in the EIS based on 75 key viewpoints. Of these viewpoints, eight are located in sections 3 and 4 (refer to DRG-00006). Only the viewpoints with Moderate-high and High visual impacts are included in the comparison between EIS/SPIR and current design.

These are:

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

The results of the EIS assessment have been reviewed and re-assessed below, in accordance with Roads and Maritime impact grading matrix (refer to Figure 50), taking into consideration the design amendments between the EIS and concept design.

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

Description

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

EIS assessment

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

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

Visual impact Assessment

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

Viewpoint 10 – Avenue Road

Description

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

EIS Assessment

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

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

Visual Impact Assessment

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

Viewpoint 17 – Pine Brush Forest

Description

Foreground view of rest area looking west from local road.

EIS Assessment

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

Visual impact assessment

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

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

Viewpoint 18 – Pacific Highway, Tyndale

Description

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

EIS assessment

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

Visual impact assessment

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

Viewpoint 20B – Cane fields, Tyndale (north)

Description

Foreground ground view from cane fields, looking north.

EIS assessment

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

Visual impact assessment

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

Viewpoint 24B – Schwonberg Street, Townsend

Description

Foreground ground view from Schwonberg Street, looking northwest.

EIS assessment

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

Visual impact assessment

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

8.0 Detailed responses for urban and landscape design

8.1 Structures

8.1.1 Interchanges

Interchanges (and rest areas) provide an opportunity for placemaking and wayfinding for the project. They also enhance the driver experience and relationship of the upgraded highway to its surroundings, providing a lateral connectivity to the region. As the alignment is in a new location and will form the first major intrusion of large scale, man-made elements into that environment, a key objective of the project will be to ensure the seamless integration of the upgrade and interchanges with the landform and landscape (Figure 55).

Sections 3 and 4 have three interchanges and two rest areas (one in each direction) in the following locations:

- Glenugie
- Tyndale
- Maclean
- Rest areas between Bostock Road and Somervale Road.

Glenugie interchange

The Glenugie interchange marks an important directional change in the Pacific Highway from north-south to east west. The interchange is also a major marker approximating the entry/exit area for the southern border of the Northern Rivers Region of NSW.

The Glenugie interchange comprises two half interchanges with grade separated crossings for local roads and ramp connections. The interchange is located about sixteen kilometres south of Grafton.

The interchange while deeply enclosed in the Glenugie State Forest is designed to alert users though its signage, geometry, landscape and urban design to the following:

- A northern connection to Grafton (and Grafton airport), or
- To continue the northbound journey to Ballina, or
- To continue a southbound journey to Coffs Harbour and
- Local road users will continue to enjoy current local connections.

The interchange cannot be seen from the Pacific Highway as a whole as it is designed in a curving formation across 1.5 kilometres within the forest. Despite its length, the interchange will have an intimate forest atmosphere once the landscape is established.

Figure 55: Pacific Highway looking north at Glenugie.

The southern interchange is located on the existing Pacific Highway and northern interchange at Eight Mile Lane (refer to DRG-00101, DRG-00102, DRG-00121 and DRG-00122) and is described as follows:

Glenugie interchange south

This grade separated half interchange is located on the existing Pacific Highway at Glenugie about 1.5 kilometres south east of the Eight Mile Lane intersection and 3.5 kilometres south of Grafton Airport.

The interchange provides a northbound off ramp at surface level and a southbound on ramp that crosses over the main carriageways via a feature overbridge that is consistent with other major interchange overbridges on the Pacific Highway.

The two ramps join the existing Pacific Highway at an upgraded intersection. A small cutting is required on the south side of the north bound carriageway near the start of the intersection. However, the majority of the intersection is to be constructed on fill embankments and is located in a mild undulating terrain.

Construction of the interchange will involve clearing of vegetation that will impact the forest landscape setting. Landscape mitigation measures have been incorporated in the detailed design to manage this impact, including keeping the area of clearing to an minimum and re-establishing the forest vegetation as much as possible while meeting road safety requirements. Refer to Figure 56.

Key design outcomes include:

- The existing forest cover will be retained to the maximum extent possible by minimising the clearing footprint
- The forest landscape setting will be reinforced by revegetation to ensure that the interchange is fully integrated into the local area, through a program of seeding and planting with species that occur in the existing native vegetation community
- A landscape cultural marker will be created at the start of the interchange by planting rows of Red Ash (*Alphitonia excelsa*) together with native grasses within the triangular area between the main carriageway and the south bound on-ramp
- Grass Trees (*Xanthorrhoea australis*) salvaged during clearing operations along the road corridor further north are incorporated in the landscape design at the southern start of the intersection adjoining the signature Red Ash (*Alphitonia excelsa*) planting area
- The bridge over the main carriageway carrying the south bound on-ramp will form a ‘gateway’ marker for motorists passing below it as they travel through the interchange along the main carriageway in both directions
- The Pheasant Creek riparian corridor will be enhanced where it is within project boundaries
- Landscape treatments and wayfinding signage will signal the link to Grafton and Grafton airport.

The tall eucalyptus forest character will define the interchange space with deep shadows within the forest contrasting with the sunlight as it pours into the interchange to provide visual interest for road users, refer to Figures 56 and 58.

Figure 56: Glenugie interchange south sketch.

Glenugie interchange north - Eight Mile Lane interchange

This grade separated half interchange is located at Eight Mile Lane and about two kilometres south of Grafton Airport. A north bound on-ramp provides access from Eight Mile Lane and a south bound off-ramp connects to Eight Mile Lane, refer to Figures 57 and DRG-00101, DRG-00102.

A portion of Pheasant Creek passes through the intersection.

Key design outcomes include:

- The existing forest cover will be retained to the maximum extent possible by minimising the clearing footprint
- Landscape revegetation will be integrated with the surrounding forest setting primarily by seeding with indigenous species combined with trees planted in clumps to quickly create a vegetation structure to mark the interchange
- A landscape cultural marker will be created at the start of the interchange by planting rows of Red Ash (Alphitonia excelsa) together with native grasses framing the main carriageway
- The bridge over Pheasant Creek will mark the northern start of the interchange for motorists travelling south, with landscape treatments associated with the creek to visually reinforce the riparian corridor. Refer to Figure 75
- The Eight Mile Lane bridge over the main carriageway will form a ‘gateway marker’ for motorists passing through the interchange along the highway. The bridge with a tapered pier and curved throw screens is a complementary structure for the interchange as a whole
- Sections of residual carriageway along the Eight Mile Lane will be revegetated with the same species as adjoining areas of forest.

Located at the southern border to the Northern Rivers Region of NSW the Glenugie interchange will provide a memorable landmark for motorists passing through the sunlight-filled opening within the tall eucalyptus forest, refer to Figure 55 to 58.

Figure 57: Location of Eight Mile Lane interchange near proposed overbridge.

Figure 58: Glenugie interchange north.

Tyndale interchange

Tyndale interchange comprises two half interchanges; Tyndale interchange south (at Tyndale township) and north (north of Bondi Hill Road), located about two kilometres apart, near the Clarence River south arm and existing Pacific Highway. The interchange is described from south to north below.

Tyndale interchange south

This grade separated half-interchange occurs slightly southeast of Tyndale. The existing Pacific Highway at Tyndale township is located between the town and river, with the town located along the river.

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

Located south of the interchange is a small creek and footbridge. A pedestrian path connects to the town's main street.

Overall the half-interchange is contextually integrated with the landform.

Refer to Figures 59, 60 and 61 and DRG-00114, DRG-00125.

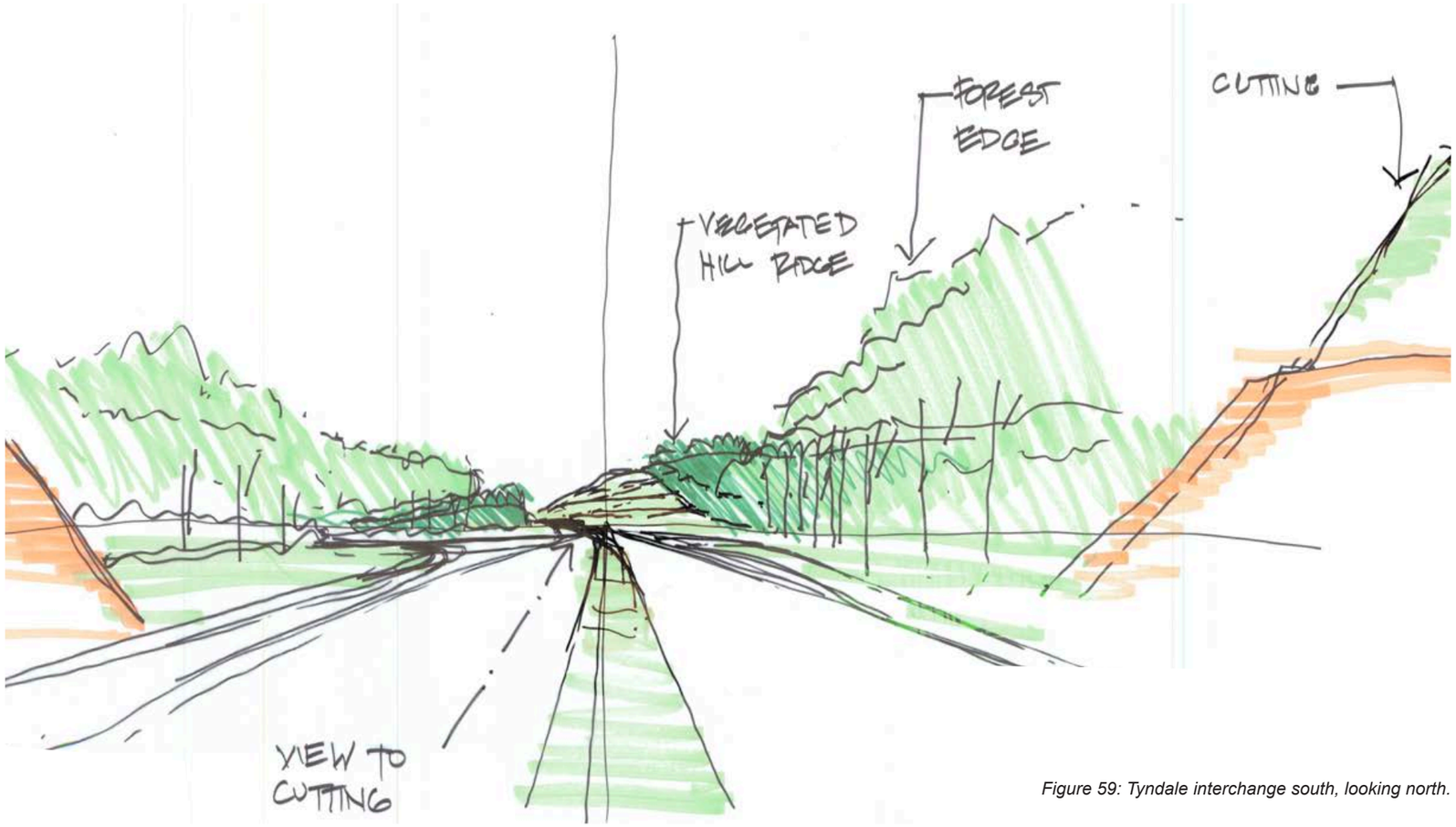
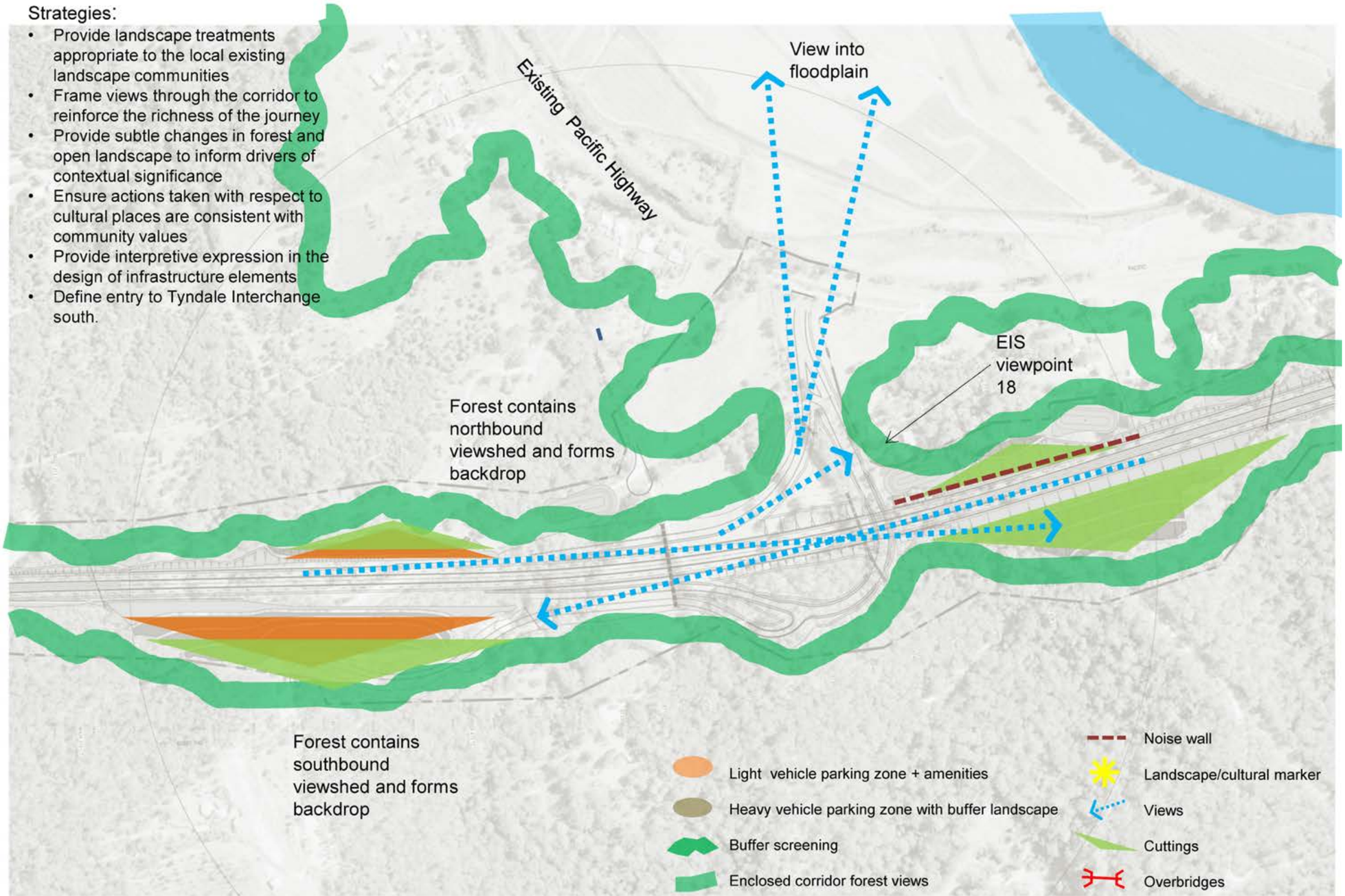


Figure 59: Tyndale interchange south, looking north.

Key design outcomes include:

- Reinforcement of the interchange's landscape setting to ensure it is fully integrated into the local area and is not overly intrusive
- Optimisation of open space to provide additional landscape
- Landscape treatments and wayfinding signage signal the link to Grafton and Grafton airport
- Improved connectivity across the Pacific Highway upgrade intersections maintains cohesiveness of the town
- Landscape treatments to be undertaken to reinforce the link between the town and the river
- Landscape treatments and batter rounding in large cuts to seamlessly integrate with the surrounding environment
- Revegetation of areas affected by EEC with species obtained from the adjoining community
- Exposed rock surfaces retained at the bottom of steep batters of cuts, where landscaping is not possible
- Architecturally treated shotcrete with a rough finish that mimics the existing stone texture to minimise the difference in appearance between the shotcrete and exposed rock face.

Figure 60: Location of proposed alignment at Tyndale interchange south from Pacific Highway.



NOTE: Alignment shown is indicative only. NTS.

Figure 61: Tyndale interchange south design principles diagram.

Noise mitigation at Tyndale

The operational noise review for the detailed design identified a noise wall at Tyndale is required. The noise wall is located within the highway corridor about half way between the northern and southern half-interchanges on the west side of the highway, the Tyndale noise wall comprises:

- Two structure types that respond to the highway landforms in a high quality minimalist appearance
- The entire wall is 280 metres long, and four metres high
- The wall will be built of concrete and steel support posts, to be durable
- The wall will be painted a mid-grey colour, to be visually recessive
- There are two different types of panel which overlap where they meet to form a continuous noise wall
- Native seeding or revegetation will be provided throughout the corridor augmented with about 200 metres of planting along the western side of the noise wall
- The noise wall will remain visible to local residents and motorists.

Refer to Figures 62 to 64.

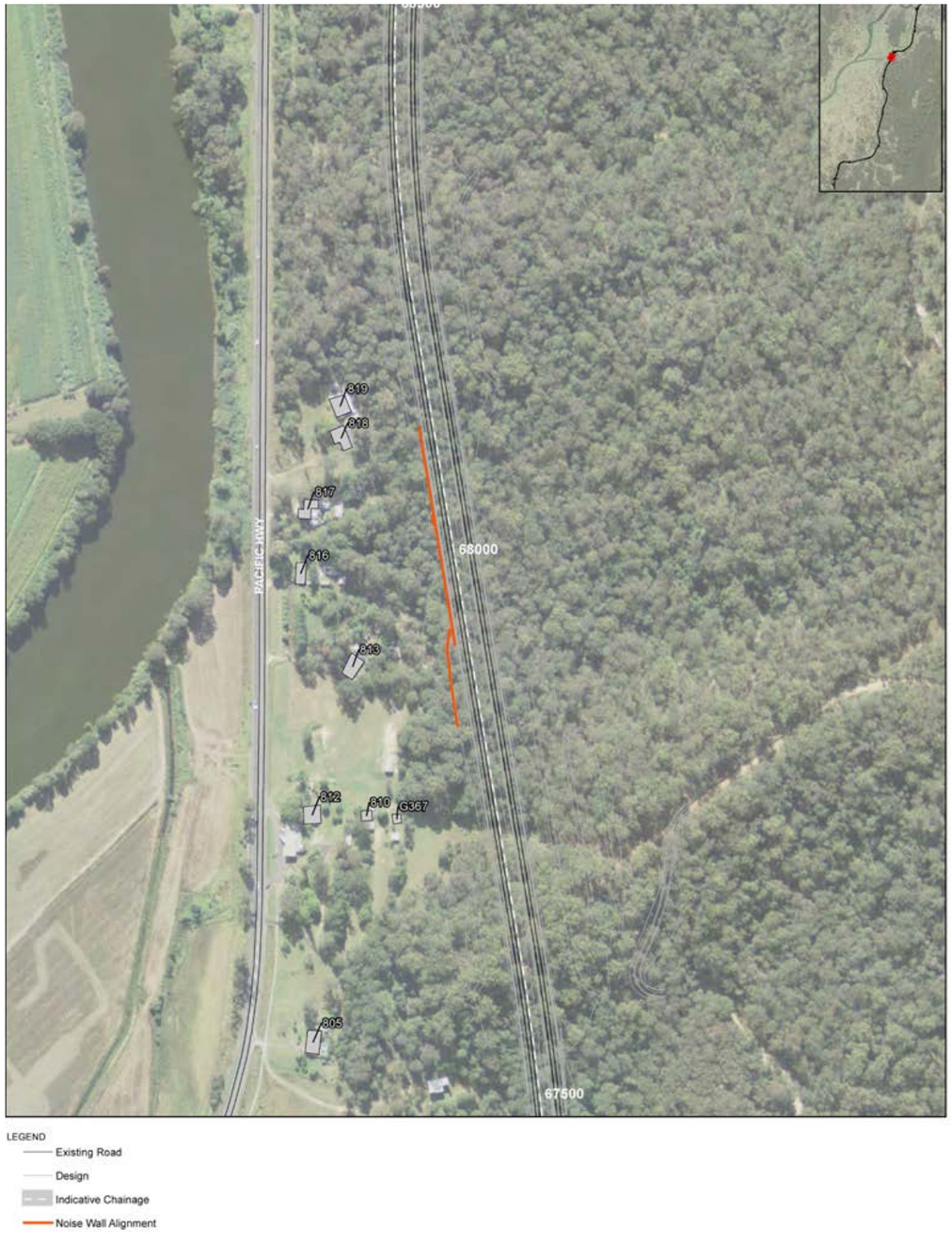


Figure 62: Tyndale noise wall plan

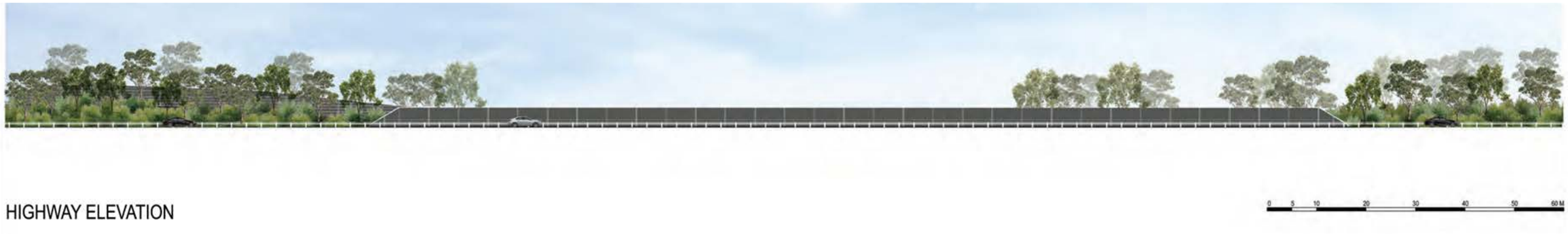


Figure 63: Tyndale noise wall highway elevation.

Figure 64: Tyndale noise wall neighbourhood elevation.

Tyndale interchange north

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

One of the most significant features of this portion of the interchange is the major cutting into Bondi Hill, located just to the south of the southbound existing ramp. Bondi Hill Road also passes over the main carriageways at this location and is realigned to cross the highway in a perpendicular relationship. This cutting will be visible to both Bondi Hill Road and the main carriageways. The cutting is likely to be visible from the existing Pacific Highway (Refer to Figure 65, 66 and 68, DRG-00114 and DRG-00126.

Key design outcomes include:

- Reinforcement of the area's landscape setting to ensure the interchange is integrated into the local area
- Optimisation of open space to provide additional landscape
- Views from overbridges will be a feature of the experience of arrival and departure from Tyndale
- The underbridge, with its landscape treatments provides a backdrop to Bondi Hill for drivers exiting the interchange along the southbound carriageway
- The noise wall is visually recessive and minimalist in appearance.
- Improved connectivity across the Pacific Highway upgrade intersections will maintain the cohesiveness of the town
- Landscape treatments provided to reinforce the link between the town and river, all plantings will be indigenous
- Where possible landscape treatments and batter rounding in selected large cuts will be provided to seamlessly integrate with the surrounding environment
- Exposed rock batters will form features of the cuttings
- Revegetated areas include species consistent with adjoining vegetation communities
- Landscape treatments are provided in verge areas.

Tyndale interchange (north and south) have the largest number of cuts in the project. Refer to EIS and SPIR documents for mitigation measures, which have been further enhanced in the current design.

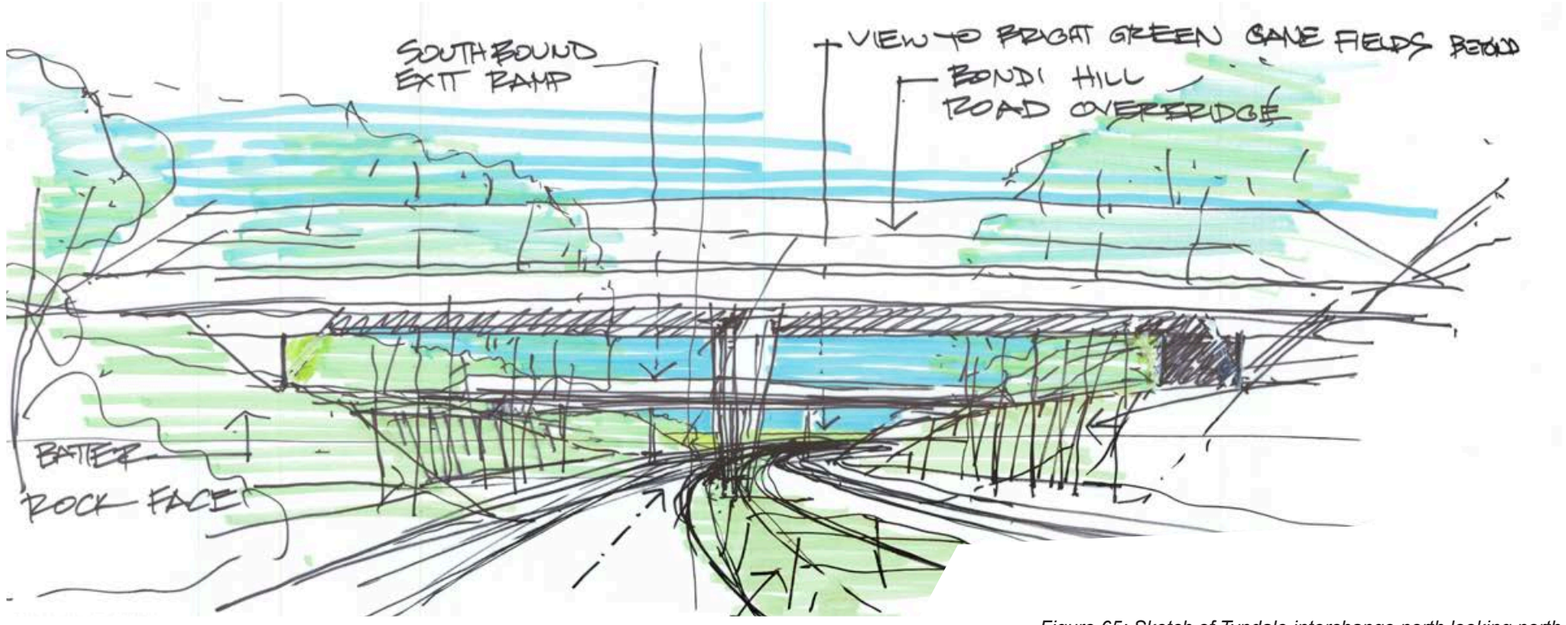
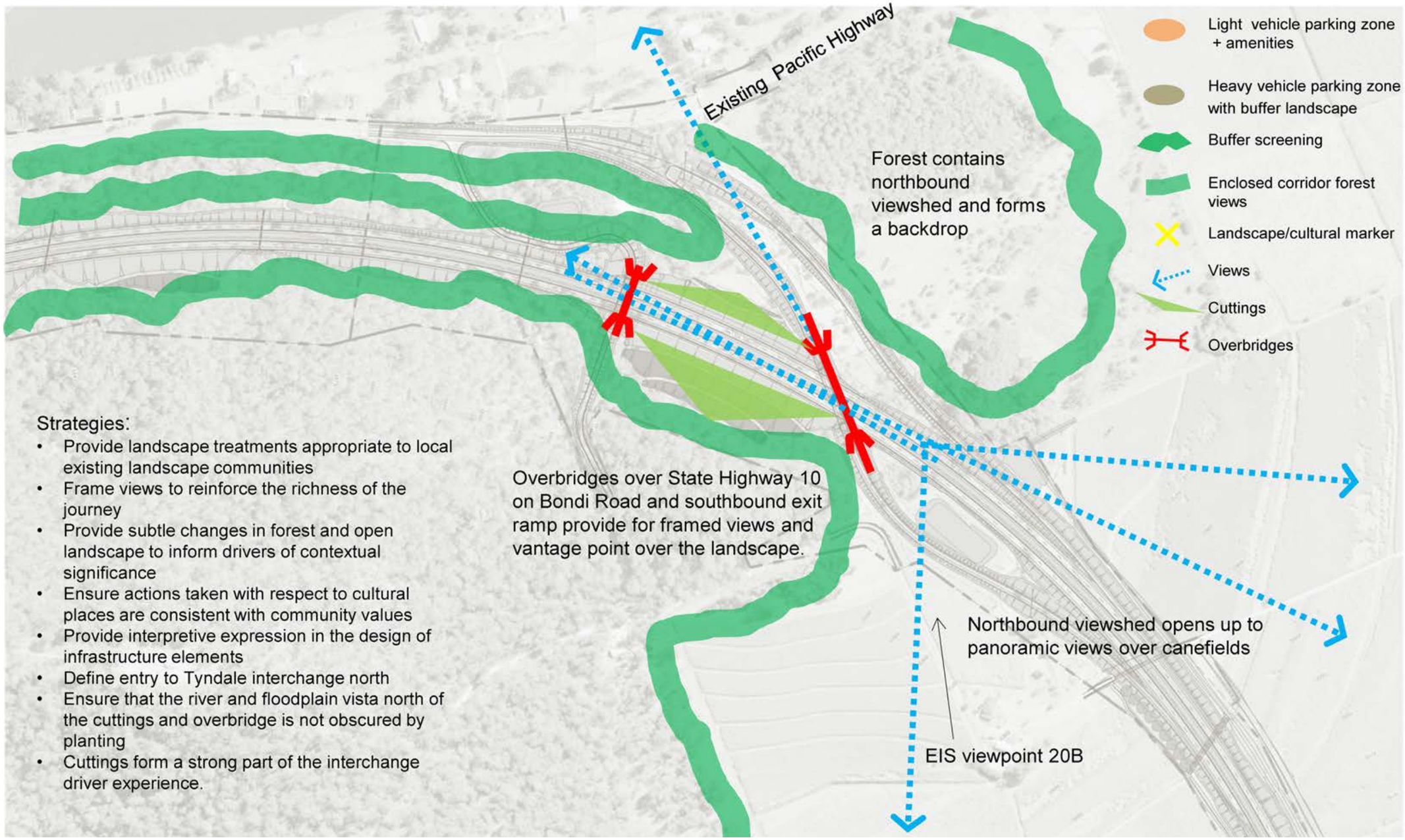


Figure 65: Sketch of Tyndale interchange north looking north.



NOTE: Alignment shown is indicative only. NTS.

Figure 66: Tyndale interchange north principles diagram.

Figure 67: Oblique aerial view of Tyndale interchange south looking north–east. Oblique aerial base from Pacific Complete.

Figure 68: Oblique aerial view of Tyndale interchange north looking north. Oblique aerial base from Pacific Complete.

Maclean interchange

Maclean has a strong relationship with the river and this is borne out by both the town's structure and cultural history. Maclean provides one of two river crossings to Woodford Island. The second crossing point is about 16 kilometres to the south at Cowper. The interchange is located just to the south of the town within an agricultural area near Ferry Park (Figures 69, 70, 71 and 72, DRG-00119 and DRG-00128).

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

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

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

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

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

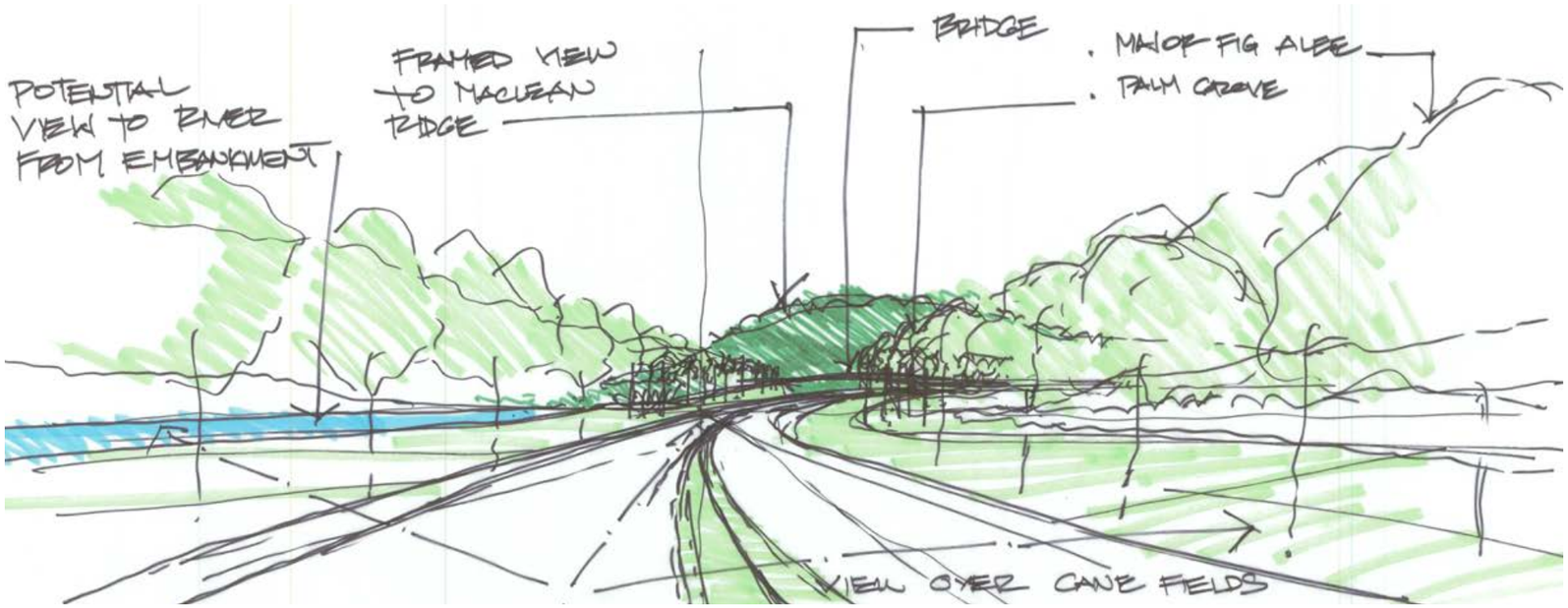
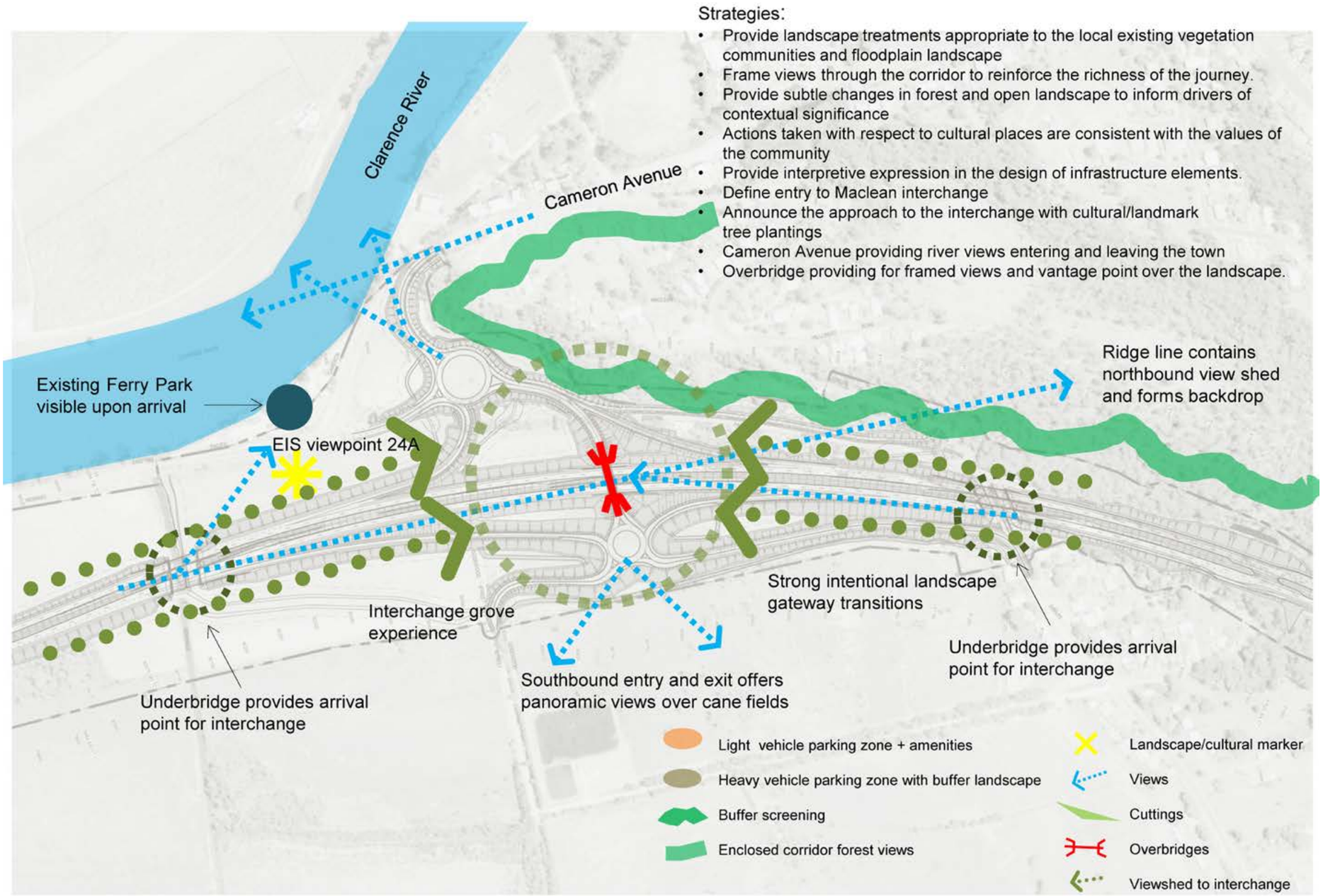


Figure 69: Sketch of Maclean interchange looking north.

Key design outcomes include:

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

Figure 70: Oblique aerial, enlargement view of Maclean interchange looking north. Oblique aerial base from Pacific Complete.



NOTE: Alignment shown is indicative only. NTS.

Figure 71: Maclean interchange design principles diagram.

LANDSCAPE LEGEND

- APPROVED PROJECT BOUNDARY (V9)
- CLEARING BOUNDARY
- F24 F24 FENCE
- RETAINED AREA OF VEGETATION
- RETAINED AREA OF EEC VEGETATION
- VEGETATED DRAINAGE CHANNEL
- NATIVE GRASS SEED MIX
- PASTURE GRASS SEED MIX
- NATIVE TREE, SHRUB AND GROUNDCOVERS
- TREE 25L
- TREE 75L
- TREE 100L
- 100L LIVISTONA AUSTRALIS

0 20 40 60 80 100m

SCALE 1:2000@A3

Number of trees/elements shown is indicative only. Landscape shown at maturity approximately 15 years.

Maclean Interchange W2B-GHD-A-LX-DRG-00159

Figure 72: Oblique aerial view of Maclean interchange looking north. Oblique aerial base from Pacific Complete.

8.1.2 Bridges including throw screens and detailed elements

Bridges are one of the most important urban design components in sections 3 and 4. These sections have the most topographically and diverse forest and floodplain environments, and require the greatest number of bridges, more than any other sections of the Woolgoolga to Ballina Pacific Highway upgrade.

The bridges adopt a consistent approach to design and detailing in relation to adjoining sections of the upgrade and other bridges along the Pacific Highway, providing a linear identity along the route. They also provide variety through lateral integration with the local context in terms of their height, bulk, scale and materiality. The development of a consistent language of typical bridge elements visually unifies all bridges on the project.

The bridge design approach ensures that the requirements of the following Roads and Maritime Guideline documents are incorporated in the structural design of the bridges to achieve an integrated urban and engineering design outcome:

- *Pacific Highway upgrade – Pacific Highway Upgrade Urban Design Framework – Urban Design Vision, Objectives and Design Principles for the Upgrade of the Pacific Highway from Hexham to Tweed Heads*, Roads and Maritime Services, 2013
- *Bridge Aesthetics – design guideline to improve the appearance of bridges in NSW,* Roads and Maritime, July 2012.

There are several types of bridges in the project, including:

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

Refer to Figures 73 to 86.

Overbridges

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

Key design features include:

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

Twin bridges

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

Key design features include:

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

Special bridges

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

Four bridges, (three overbridges and one underbridge) are categorised as special bridges:

- **Bridge A01**: Glenugie South Bound Entry Ramp
- **Bridge A02**: Overbridge at Eight Mile Lane
- **Bridge A28**: Overbridge over State Highway 10 at Tyndale southbound exit ramp
- **Bridge A34**: Bridge over Shark Creek.

Glenugie Southbound Entry Ramp overbridge

This bridge is located in the southern area of Glenugie interchange and will be highly visible to drivers as is it elevated. The bridge is located in a gently rolling, open topography in a forested area. It crosses over the main carriageways with three tapering piers, one in the median and one on each verge. It is a long four span bridge at the southern-most area (Section 3) of the upgrade project. Curved, continous throw screens with tapered ends, tapered blade piers and other bridge furniture ensure this bridge complements other similar bridges on the Pacific Highway. Refer to Figure 73.

Overbridge at Eight Mile Lane

The overbridge at Eight Mile Lane is located in the northern area of Glenugie interchange and will be highly visible to drivers as is it elevated and located in an open topography. It crosses over the main carriageways with one tapered pier which incorporates a concealed headstock. Curved throw screens with tapered ends complement other similar bridges on the Pacific Highway. Refer to Figure 74.

Bridge over State Highway 10 on southbound exit ramp

This bridge occurs at the northern area of Tyndale interchange and will be highly visible to drivers as it spans a major cutting at Bondi Hill. It crosses over the main carriageways with three circular piers in the median and along the verges. The design provides an integrated headstock that creates an appearance of a bridge deck to ‘floating’ over the structure as the bridge reaches across the main carriageways. The overall appearance is consistent with other bridges of similar configuration on the Pacific Highway. Refer to Figure 81.

Bridge over Shark Creek

The bridge at Shark Creek occurs in Tyndale to Maclean – Section 4 in the northern portion of the project. The Shark Creek bridge spans 865 metres across the creek and flood plain, forming the largest bridge on the project. It will be visible across the sugarcane fields and from local roads. The structure of this bridge has simple round columns and tapered headstock supporting the road deck. The decking is made up of 1500 millimetre deep Super – T girders. To minimise impacts on the environment, a key feature of this bridge is that the northbound and southbound carriageways are joined into a single crowned deck. This allows the headstock support to be essentially horizontal. As with other underbridges, a single rail parapet will be employed to allow for greater panoramic views from the highway. Drainage is provided through scuppers in the bridge deck. Refer to Figure 84.

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

- Glenugie South Bound Entry Ramp (Figure 73)
- Overbridge at Eight Mile Lane (Figure 74)
- Bridge over Pheasant Creek (Figure 75)
- Twin bridges at Pillar Valley 4 (Figure 76)
- Twin bridges over Mitchell Road (Figure 77)
- Bridge over State Highway 10 on Bostock Road (Figure 79)
- Twin bridges over Tyndale interchange (South) (Figure 80)
- Bridge over State Highway 10 on Bondi Hill Road (Figure 81)
- Bridge over State Highway 10 on Southbound exit ramp (Figure 82)
- Bridge over State Highway 10 on Byrons Lane (Figure 83)
- Bridge over Shark Creek (Figure 84)
- Bridge over State Highway 10 on Maclean interchange (Figure 85)
- Twin bridges over Jubilee Street (Figure 86)
- Typical fauna crossing bridge (Figure 78).

Hierarchy of bridges, ranking and visual impacts

All bridges form a 'family' of structures that have a consistent approach across all sections, detailing, shapes and finishes. These elements cross the main carriageways, span local waterways and local roads and are sometimes combined into longer contiguous structures, such as at Shark Creek and are visible within the landscape. In order to provide a cost effective and visually attractive solution to bridge design along the Woolgoolga to Ballina upgrade, a series of detailed parameters have been developed to respond to bridge visibility.

In Table 8-1, bridges are ranked as Priority 1, 2 and 3 to address their visual outcomes. Bridges with Priority 1 (High) and 2 (Medium) rankings in the table are afforded similar design consideration. Detailing will generally be similar across these bridges.

Priority 2 bridges may have simpler detailing and an attractive outcome is achieved through careful application of landscape screening.

Priority 3 bridges are for those bridges which are less visible to and from the surrounding environment. The ranking is associated with the scale and visibility of the bridge only.

Headstocks and tapered stiletto piers have consistent dimensioning across all bridges.

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

On curved bridge, the positions of precast elements and railings provide an aesthetically acceptable outcome, that features visual continuity and flowing lines.

Bridge visibility

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

Definitions for visibility

Visible bridges

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

Non-visible bridges

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

Table 8-1: Detail design parameters.

Parameter	Visible bridges	Non-visible bridges	Non-visible bridges
Priority Ranking	1 High	2 Medium	3 Low
Bridge Type	Overbridges	Underbridges at local roads	Underbridges
Bridge drainage	Mostly concealed	Mostly concealed	Visible
Near overland drainage	Landscape or natural outcome	Landscape or natural outcome	Landscape or natural outcome
Maintenance stair finish (upward from roadway to bridge)	Concrete – broom finish	Concrete – broom finish	Concrete – broom finish
Maintenance stair finish (downward from overbridge)	Concrete – broom finish	Concrete – broom finish	Concrete – broom finish
Spill through material	Rock pitching in grout	Rock pitching in grout	Rock facing
Skirt depth	Mostly short	Short	Short
Wing wall	Perpendicular	Perpendicular	Perpendicular
Column Type	Tapered stiletto Round tapered blade walls	Round	Round
Headstock	Precast concrete integrated type	Precast concrete integrated type	Precast concrete separate headstock

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

A11	Twin bridges at Pillar Valley 2
A12	Twin bridges at Pillar Valley 3
A13	Twin bridges at Pillar Valley 4
A14	Twin bridges at Pillar Valley 5
A15	Twin bridges over Mitchell Road
A16	Twin bridges north of Pillar Creek 1
A17	Twin bridges north of Pillar Creek 2
A18	Bridge over State Highway 10 on Firth Heinz Road
A19	Twin bridges over Chaffin Creek
A20	Twin bridges north of Chaffin Creek
A21	Bridge over State Highway 10 on Bostock Road

A22	Twin bridges over Somervale Road
A23	Twin bridges over Champions Creek
A24	Twin bridges north of Champions Creek
A25	Twin bridges over Quarry Access Road
A26	Bridge over State Highway 10 on property access road
A27	Bridge over State Highway 10 on Crowleys Road
A28	Twin bridges over Tyndale interchange (south)
A29	Bridge over State Highway 10 on Bondi Hill Road
A30	Bridge over State Highway 10 on Southbound off ramp
A31	Twin bridges over Crackers Drain
A32	Bridge over State Highway 10 on Byrons Lane

A33	Twin bridges over Lees Drain
A34	Bridge over Shark Creek
A35	Bridge over State Highway 10 on McIntyres Lane
A36	Twin bridges over Edwards Creek
A37	Bridge over State Highway 10 on Maclean interchange
A38	Twin bridges over Jubilee Street
A50	Twin bridges over combined fauna drainage 1
A51	Twin bridges over combined fauna drainage 2
A53	Twin bridges over floodplain on State Highway 10
A54	Twin bridges for additional Emu crossing 1
A55	Twin bridges for additional Emu crossing 2

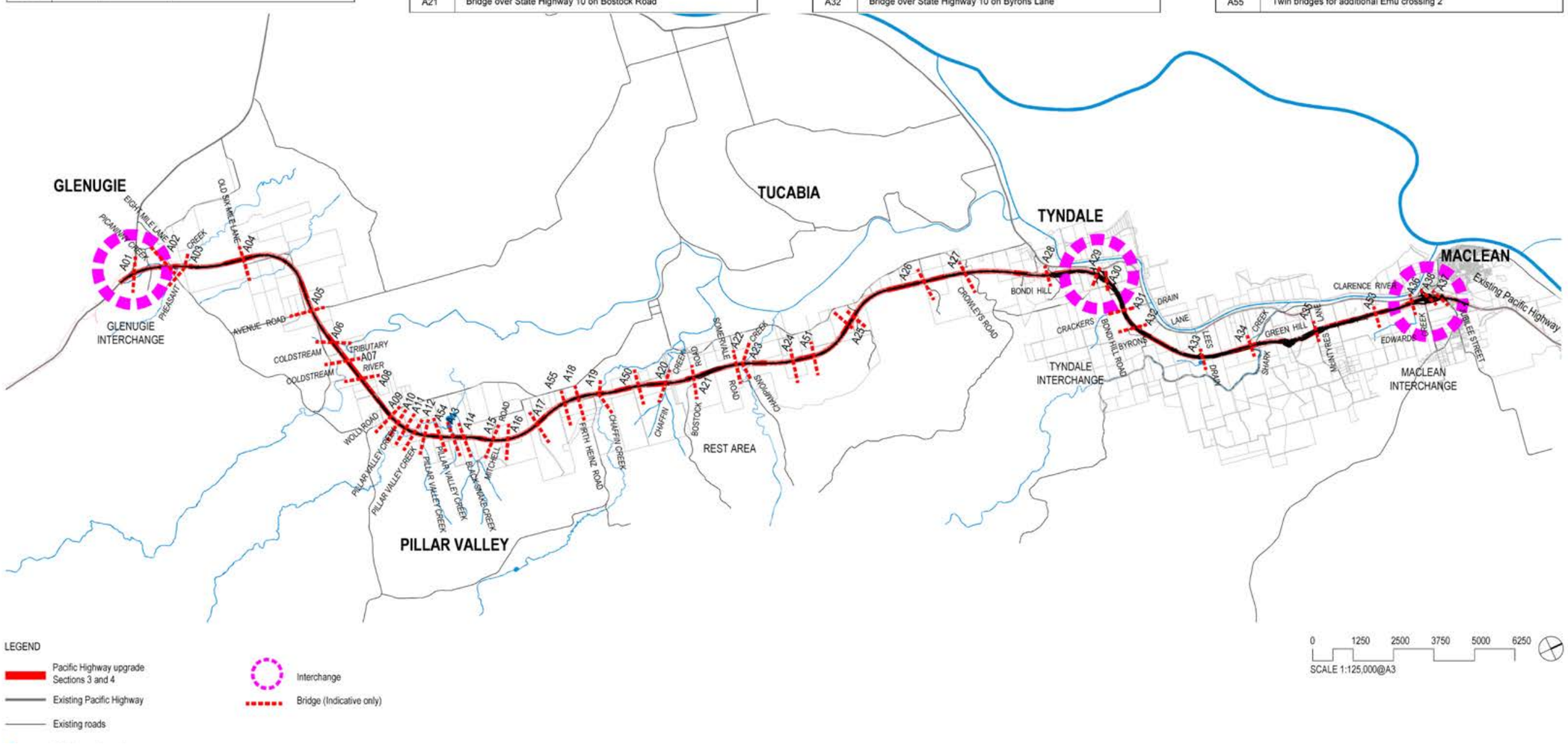


Figure 73: Glenugie Southbound Entry Ramp.

Figure 74: Eight Mile Lane Overbridge

Number of trees/elements shown is indicative only.
Landscape shown at full maturity.

Figure 75: Bridge over Pheasant Creek.

Figure 76: Twin bridges at Pillar Valley 4 – looking east.

Figure 77: Twin bridges over Mitchell Road - looking east.

Figure 78: View of typical fauna crossing bridge.

Figure 79: Bridge over State Highway 10 on Bostock Road - looking south.

Figure 80: Twin bridges over Tyndale interchange south - looking east.

Figure 81: Bridge over State Highway 10 on Bondi Hill Road - looking north.

Figure 82: Bridge over State Highway 10 on Southbound exit ramp.

Figure 83: Bridge over State Highway 10 on Byrons Lane - looking east.

Figure 84: Bridge over Shark Creek - looking south from Shark Creek Road.

Figure 85: Bridge over State Highway 10 on Maclean interchange - looking north.

Figure 86: Twin bridges over Jubilee Street - looking west from Jubilee Street.

8.2 Road corridor

8.2.1 Median and verge treatments

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

Key features include:

- Two metres of pasture grass or native shrubs at the carriageway edge of medians and verges
- Four metres minimum of mixed shrubs in the median in forested areas where there are no views
- No tree planting in medians
- Low maintenance landscape
- Maintaining sightlines in the median
- Completing the visual integration of the roadway into surrounding landscape
- Demarcation of riparian crossings in median plantings to create visual continuity and habitat connectivity
- Establishment of a bold and attractive landscape for the enjoyment of road users, where relevant
- Planting of frangible species in clear zones for road user safety
- Maintenance of sightlines on curved and ridging sections of the road
- Screening of headlights from oncoming traffic for road user safety
- Reducing rubbish collecting by incorporating a two metre wide grassed mowing strip
- Road furniture is integrated into the pavement zone and does not clash with median and verge treatment zones
- Pasture/exotic grass mix (FM 6.1) is to be used in the median to minimise maintenance.

8.2.2 Rest areas

The Pacific Highway has two rest areas that are located along the northbound and southbound alignment between Bostock Road and Somervale Road. This location is about three kilometres to the east of Tucabia in heavily forested area and no connections from these local roads are envisaged to the upgraded highway. Somervale Road will pass below the main carriageways and Bostock Road will cross the main carriageways on an overbridge (DRG-00157 and DRG-00158).

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

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

The rest areas will be framed by the overbridge at Bostock Road and the earthworks required to create the level platforms for the facilities. These will form integral parts of the driver experience for these facilities. Taken together, both rest areas, the overbridge and earthworks of this assembly will create a singular opportunity for placemaking. The overall facilities grouping will present a more open experience than the surrounding forest and be within sight of the overbridge. Refer to Figures 87 to 90.

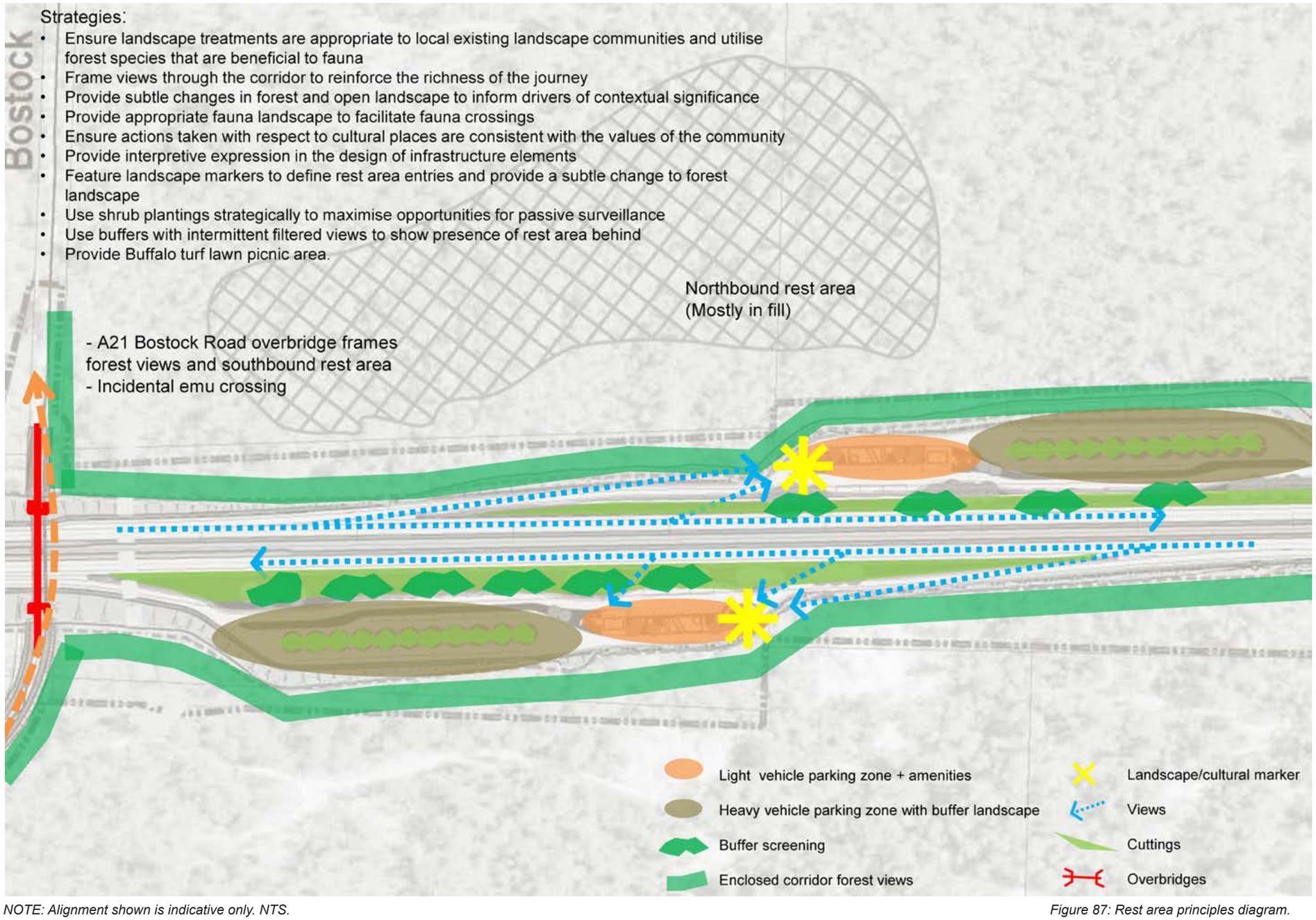
Standard Pacific Highway furnishings will be used to provide linear continuity with the rest of the Pacific Highway, while the landscape treatments will provide lateral integration with the surroundings.

The rest areas will transform the forest setting of this location and mitigation measures as identified in Chapters 2.2 and 2.3 of this report are considered to manage this impact.

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

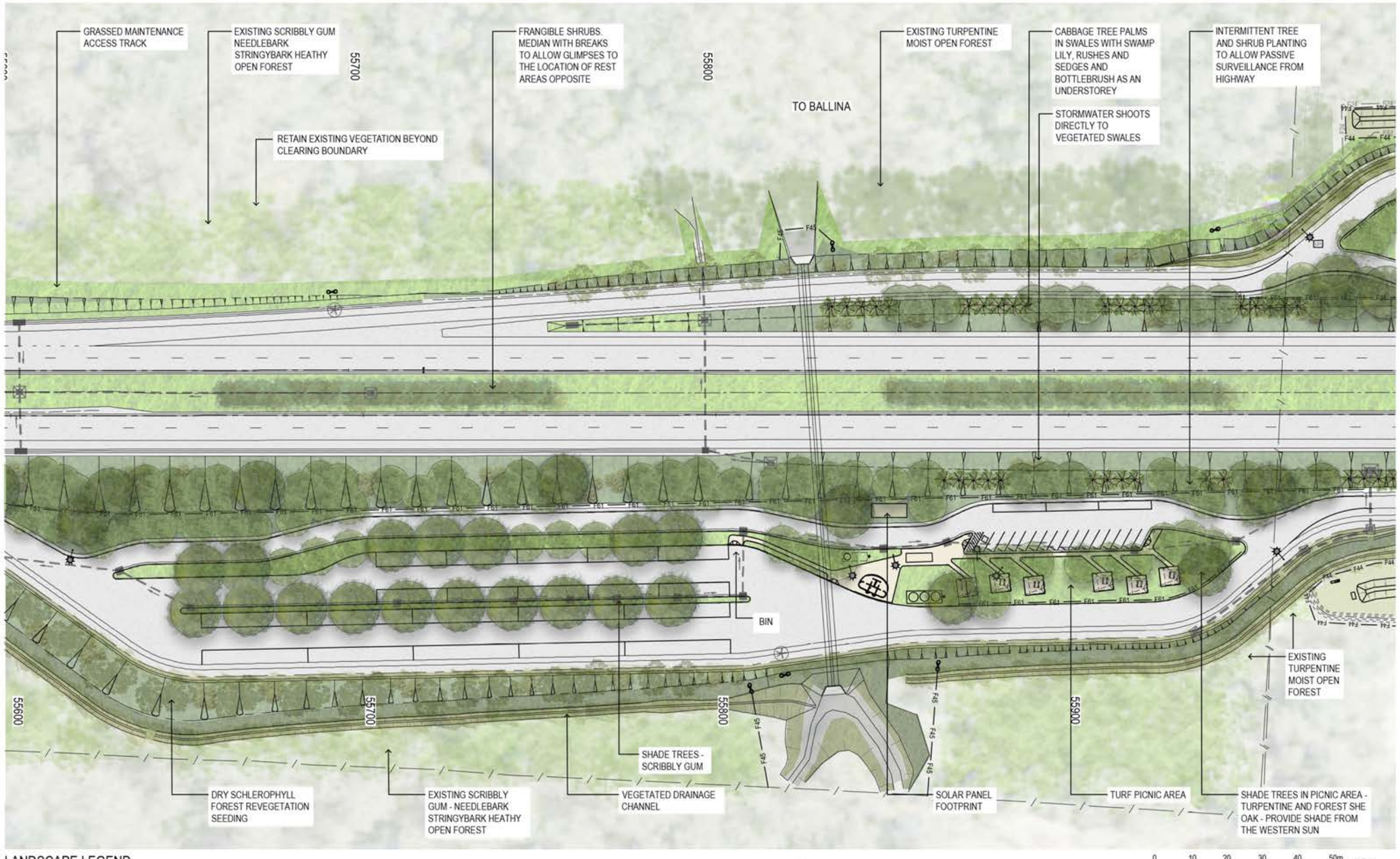
Key features include:

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



NOTE: Alignment shown is indicative only. NTS.

Figure 87: Rest area principles diagram.



LANDSCAPE LEGEND

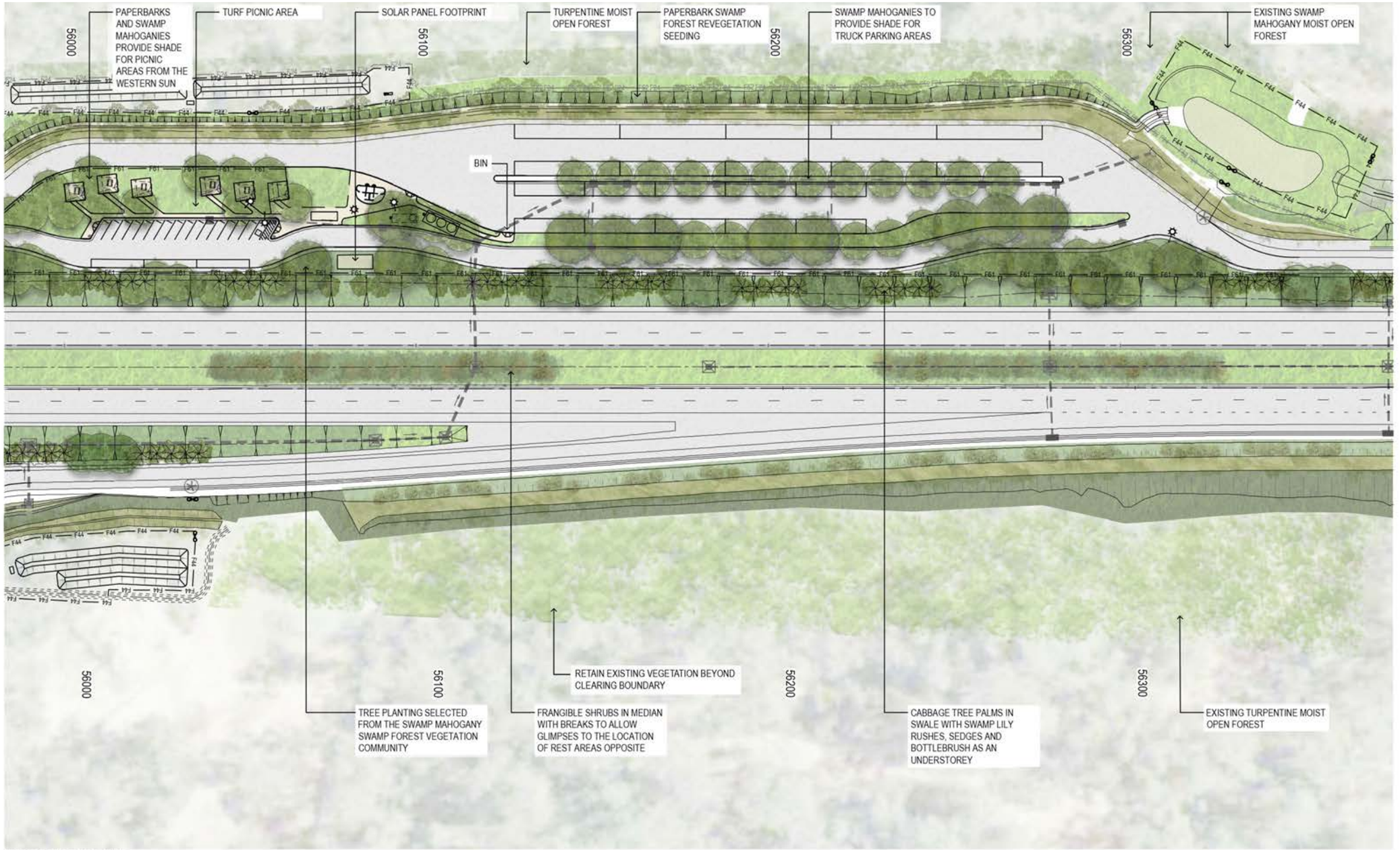
- APPROVED PROJECT BOUNDARY (V9)
- CLEARING BOUNDARY
- F24 — F24 — FENCE
- RETAINED AREA OF VEGETATION
- RETAINED AREA OF EEC VEGETATION
- BASIN PLANTING
- VEGETATED DRAINAGE CHANNEL
- NATIVE GRASS SEED MIX
- PASTURE GRASS SEED MIX
- NATIVE TREE, SHRUB AND GROUNDCOVER SEED MIX
- TREE 25L
- TREE 100L
- 100L LIVISTONA AUSTRALIS

0 10 20 30 40 50m

SCALE 1:1000@A3

Number of trees/elements shown is indicative only.
Landscape shown at maturity approximately 15 years.

Rest Area W2B-GHD-A-LX-DRG-00157



LANDSCAPE LEGEND

- APPROVED PROJECT BOUNDARY (V9)
- CLEARING BOUNDARY
- F24 F24 FENCE
- RETAINED AREA OF VEGETATION
- RETAINED AREA OF EEC VEGETATION
- BASIN PLANTING
- TURF
- NATIVE GRASS SEED MIX
- PASTURE GRASS SEED MIX
- NATIVE TREE, SHRUB AND GROUNDCOVER SEED MIX
- VEGETATED DRAINAGE CHANNEL
- TREE 25L
- TREE 100L
- 100L LIVISTONA AUSTRALIS

0 10 20 30 40 50m
SCALE 1:1000@A3

Number of trees/elements shown is indicative only.
Landscape shown at maturity approximately 15 years.

Rest Area W2B-GHD-A-LX-DRG-00158

Figure 88: Rest area northbound looking north.

Figure 89: Rest area northbound looking north along main alignment.

Figure 90: Rest area southbound looking south along main alignment.

8.2.3 Pedestrian and cyclist network

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

- Maclean interchange
  - A shared path is provided near the northbound on ramp at the Maclean interchange between Cameron Street and Jubilee Street, to ease connectivity and access to Maclean and Townsend.
- A shared path is provided at McIntyres Lane overbridge with the use of widened shoulders.

Key design outcomes include:

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

8.2.4 Bus stops

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

8.2.5 Heavy vehicle stopping bays

Heavy vehicle stopping bays are sealed areas and provide opportunities for heavy vehicles to stop near the main carriageways in both directions of travel with safe entrances and exits, while maintaining the flow of through traffic. They are provided every five kilometres along the entire upgrade in sections 3 and 4, a total number of 18 stops along both carriageways.

Key design outcomes include:

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

8.3 Furniture

8.3.1 Fences

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

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

Key design outcomes include:

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

Boundary fencing

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

Fauna fencing

Fauna fencing is provided to guide fauna to crossing points and minimise fauna interaction with traffic. Various types of fauna fencing are provided, based on specific requirements to cater for mammal, frog exclusion, phascogale, and emu exclusion.

Other fencing

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

Figure 91: Vertical colorbond fauna fence.

8.3.2 Headlight screening

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

8.3.3 Noise walls

Refer to Chapter 6.10 and Chapter 8.1.1.

8.3.4 Lighting

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

Key design outcomes include:

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

All lighting for the project complies with AS 4282-1997 Control of the Obtrusive Effects of Outdoor Lighting. Detailed lighting reports have been prepared fro the project.

8.3.5 Safety barriers

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

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

8.3.6 Signage

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

- Roads and Maritime standard signage (directional, speed and warning signs)
- Variable message signs (VMS).

Key design initiatives include:

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

Future community and stakeholder consultation is planned for signage along the alignment. There are signage standards which apply to the project, these will be communicated to the community and agencies at an appropriate time in the development of the project.

Figure 92: View of Coldstream River from Wants Lane.

9.0 Planting

Key requirements of the landscape design are to:

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

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

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

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

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

Planting at interchanges

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

- Glenugie interchange
- Tyndale interchange
- Maclean interchange.

Glenugie interchange

Glenugie interchange is located in an area of dense forest. The design intent is to retain the dense forest character with plantings of Spotted Gum, Grey Gum, Grey Ironbark and Pink Bloodwood set within a grassy understorey. Advanced tree species will be planted to frame the view.

A landscape cultural marker will be created at the start of the interchange by planting rows of Red Ash (*Alphitonia excelsa*).

Tyndale interchange

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

Figure 93: Native shrub seeded embankment with fringing Eucalypt trees. The seed from fringing trees will be released and germinate on the batter slopes as seen here on the Hunter Expressway.

Maclean interchange

Maclean interchange is located at a change in landform where the flat floodplain setting from both directions is punctuated by a forest-covered hill that separates Maclean township and the river from the existing highway. The interchange is the southern approach entry to Maclean and provides access to the eastern settlements of Townsend, Gulmarrad and Brooms Head.

The scale of the approach, off ramps, bridges and gore areas are addressed with sensitively placed planting arrangements that embed the interchange ramps within the natural setting, but also highlight the interchange and provide an appropriate landscape response that gives the interchange a character, which is different from other parts of the alignment, thereby creating a marker in the driver's journey.

The setting lends itself to the introduction of contextually significant cultural plantings that promote intuitive way finding, by announcing the approach of the interchange and alerting road users of the approaching off-ramps. This is achieved by widely spaced plantings of local native rainforest trees (Black Bean, Brown Tamarind and Red Bean) planted in clumps along the floodplain approaches, with a spacing distance that accelerates as the motorist approaches and departs the interchange. The distance between the clumps ensures that views to the river will predominate.

Secondary rainforest trees selected for local roads to the west of the highway - White Booyong and Red Cedar (both important species in the early establishment of the town as a logging port), form avenues along Cameron Street and Jubilee Street, while Broad-leaved Paperbarks forms an avenue along the local access road running parallel to the Highway in the east, in recognition of the changing landscapes and vegetation types occurring east and west of the highway.

In the large gore splitters and roundabouts, groves of Cabbage Tree Palms are located in the low-lying land and will be a distinctive marker in the driver's journey. Cabbage Tree Palm groves are a feature of low-lying ground in the locality and can be seen nearby on the Angourie Road south of Yamba. The groves are protected and back- dropped with a diversity of medium-sized local rainforest trees including Creek Lilly Pilly, Native Tamarind, Blueberry Ash, Ribbonwood, Tulipwood, Plum Pine, Bumpy Ash and Celerywood.

Tree planting at the interchange, utilises a range of container sizes including super- advanced (25 litres) and semi-mature trees (75 and 100 litres). Rainforest trees are planted in mulched beds with no understorey, as their dense canopy will sweep the ground and eventually self-mulch with leaf litter, creating a low maintenance landscape. Palm groves are planted in mulched beds with an understorey of native tussocks, sedges and lilies in recognition of their more open canopy.

Water sensitive urban design to treat water runoff and increase water quality is applied with the incorporation of vegetated swales, using bunds and cut off drains to separate clean and dirty water.

Planting at rest areas

The northbound and southbound rest areas, virtually identical in terms of their layout, occur within the Pine Brush State Forest which is characterised by an enclosed forest setting. The northbound rest area is situated wholly within a Swamp Mahogany swamp forest setting. The southbound rest area is mostly within Turpentine moist forest with elements of Scribbly Gum – Needlebark Stringybark heathy open forest to the south. The surrounding habitat for fauna at both locations is identified as high to very high value and suited to a range of threatened species, including forest dwelling species such as Rufous Bettong and hollow-dependent birds and mammals, including Brush-tailed Phascogale and Squirrel Glider. Species used for revegetating the rest area outside of the fauna fence will utilise species from these habitats.

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

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

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

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

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

Waste water irrigation areas will be required at both areas and are yet to be sited. They will be planted with sedge species from the Coastal floodplains sedgelands, rushlands and forblands vegetation community in order to absorb excess nutrients and wastewater in addition to bio-retention media.

Green Hill widened cutting

The cutting is widened on the eastern side of the highway at Green Hill. The base of the cutting is set back about 20 metres from the road edge providing the opportunity to plant local rainforest species at the base of the cut, to take advantage of the gully-like microclimatic conditions that the cut provides. The rainforest trees will grow to mitigate the visual impact of the cut and any engineered embankment stabilisation which may be required on the cutting. The planting will also prevent motorists from stopping at these locations.

The depth of the root zone in this landscape area will be to the depth of excavation of the road formation, at a minimum 700 millimetres, or alternatively the soil profile will be mounded utilising excess topsoil, providing adequate depth and space for trees to grow to their full mature size.

Species include the following:

Botanical name	Common name
Castanospermum australe	Black Bean
Castanospora alphandii	Brown Tamarind
Dysoxylum mollissimum	Red Bean
Livistona australis	Cabbage Tree Palm
Argyrodendron trifoliatum	White Booyong
Toona ciliata	Red Cedar
Dipploglottis cunninghamii	NativeTamarind
Elaeocarpus obovatus	Blueberry Ash
Euroschinus falcatus	Ribbonwood
Harpullia pendula	Tulipwood
Podocarpus elatus	Plum Pine
Polyscias elegans	Celerywood
Glochidion ferdinandii	Cheese Tree
Cupaniopsis anarcardiodes	Tuckeroo
Ficus superba var. henneana	Deciduous Fig
Waterhousia floribunda	Weeping Lilly Pilly

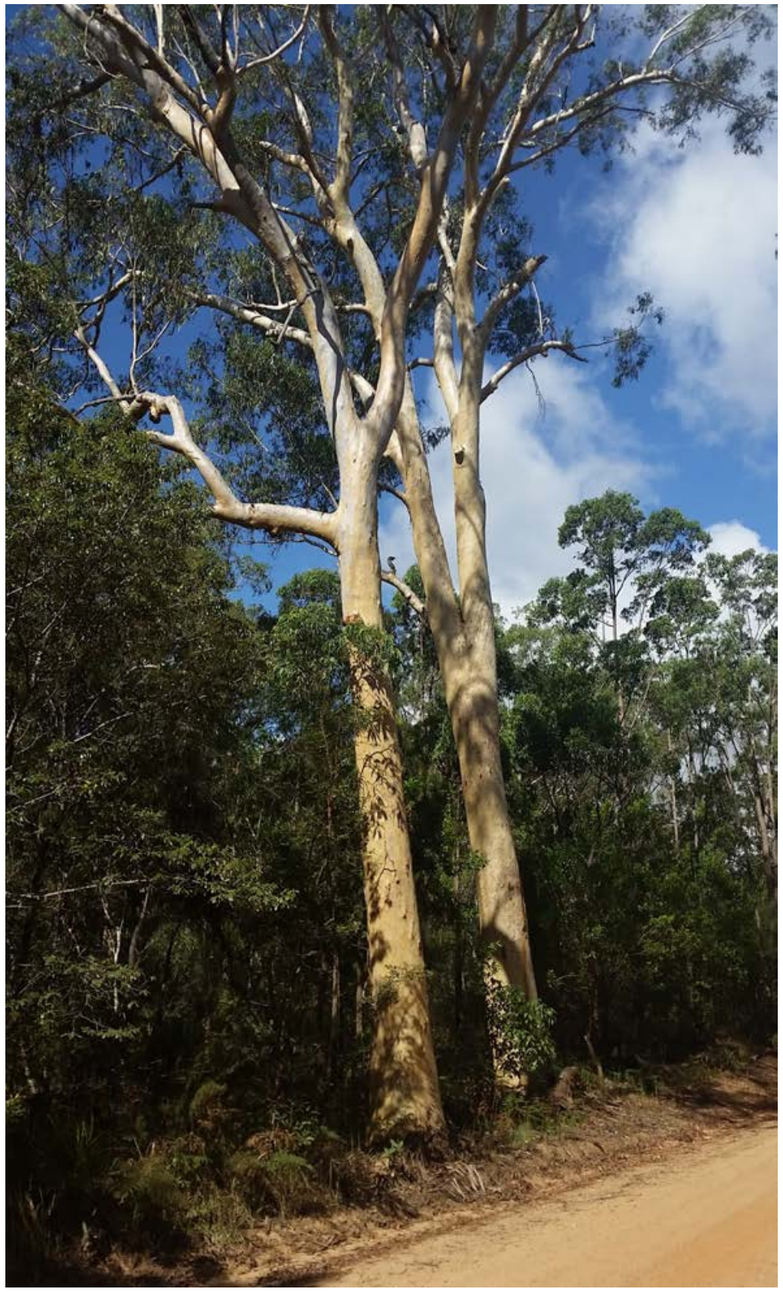


Figure 94: Scribbly Gum.

9.1 Existing vegetation and proposed landscaping

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

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

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

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

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

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

- Where design speed of road is 60km/h or less – frangible vegetation only is used within three metres from the edge of the travel lane
- Where design speed of road is 80km/h – frangible vegetation only is used within five metres from the edge of the travel lane
- Where design speed of road is 100km/h or more and the cutting slope is 3:1 – frangible vegetation only is used within eight metres from the edge of the travel lane, except where the terrain is flat, where the clearance transitions to 11 metres
- Grasses and frangible shrubs only behind wire rope safety barrier within 1.7 metres from the face of the barrier (dynamic deflection zone)
- Two metres wide native or pasture grass strip at the carriageway edge of medians and verges in cuts
- Pasture/exotic grass mix (FM 6.1) is used in the median to minimise maintenance
- Minimum four metres wide frangible shrubs in median when in forested areas (and where no views are available) or to mitigate headlight glare.

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

9.2 Vegetation communities

The majority of vegetation communities represented within the project area present as relatively undisturbed forested areas. Planting and seeding schedules are devised based upon these vegetation communities and also through ground-truthing investigation by the design team. Seventeen vegetation communities are identified as occurring within sections 3 and 4 of the project alignment. Seven of these communities are listed as EEC's. Refer to Table 9-1.

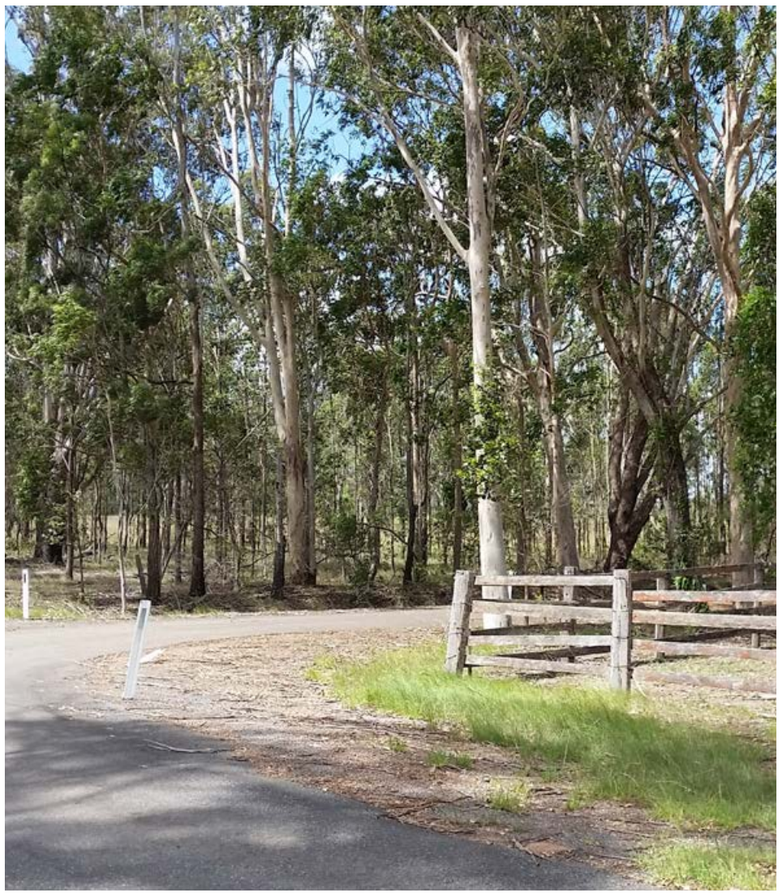


Figure 95: Forest Red Gum Swamp Box Forest where the alignment crosses Wants Lane; an endangered ecological community.

Table 9-1: Vegetation communities in the project area.

Vegetation community	Threatened ecological community type	Dominant species	Landscape features
Angophora robur shrubby forest and woodland on sandstones of the North Coast.	*Angophora robur* is listed as vulnerable. But the vegetation community is Non-EEC.	• *Angophora robur* • *A. woodsiana* • *Corymbiagummifera* • *C. intermedia, Eucalyptus baileyi* • *Banksia oblongifolia* • *B. spinulosa var. collina* • *Gompholobium pinnatum* • *Lambertia formosa* • *Leptospermum polygalifolium* • *L. trinervium.*	Open Eucalypt forests to 25 metres with prominent sclerophyll shrub stratum and open groundcover of grasses and sedges. Coastal plains, hills and plateau with sandy loams derived from high-quartz sandstones of the Moreton geological basin. In moderately high rainfall areas where they may occur at altitudes up to 400 metres.
Black Bean – Weeping Lilly Pilly riparian rainforest of the North Coast.	Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion (EEC).	• *Castanospermum australe* • *Waterhousia floribunda* • *Glochidion ferdinandi* • *Elaeocarpus obovatus* • *Dysoxylum mollissimum* • *Acmena smithii minor* • *Melaleuca linariifolia* • *Crinum pedunculatum* • *Phylidrum lanuginosum* • *Schoenoplectus mucronatus* • *Lomandra hystrix* • *Oplismenus aemulus* • *O.imbecillis.*	Margin zones of the Clarence Watercourse north of Champions Creek.
Blackbutt – bloodwood dry heathy open forest on sandstones of the northern North Coast.	Non-EEC.	• *Eucalyptus pilularis* • *Corymbia gummifera* • *Eucalyptus resinifera ssp hemilampra* • *Banksia integrifolia Banksia spinulosa Pultenaea spp* • *Persoonia stradbrokensis.*	Open forest or woodland. On deep sands of old dune systems along the coast. This ecosystem is concentrated on the Clarence-Glenreagh sandstones from Mt Belmore east to the ocean. It is protected in Yuraygir National Park and Mount Neville Nature Reserve.
Narrow-leaved Ironbark dry open forest of the North Coast.	Non-EEC.	• *Eucalyptus crebra*	North of Tyndale.

Vegetation community	Threatened ecological community type	Dominant species	Landscape features
Pink Bloodwood – Tallowwood dry moist open forest of the far northern ranges of the North Coast.	Non-EEC.	• *Eucalyptus microcorys* • *Corymbia intermedia.*	Tall to very tall forest with a very mixed canopy which usually contains Tallowwood (*Eucalyptus microcorys*). On the exposed slopes of the Koreelah, McPherson and Main Camp ranges with extensions east to the Border and Tweed ranges.
Forest Red Gum – Swamp Box of the coastal lowlands of the North Coast.	Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion (EEC).	• *Eucalyptus tereticornis* • *Lophostemon suaveolens* • *Imperata cylindrical* • *Themeda triandra.*	
Turpentine moist open forest of the coastal hills and ranges of the North Coast.	Non-EEC.	• *Syncarpia glomulifera* • *Elaeocarpus reticulatus* • *Archirhodomyrtus beckleri* • *Synoum glandulosum* • *Blechnum cartilagineum* • *Lomandra longifolia* • *Dianella caerulea.*	Mid-high to very tall open forest. Widespread on sheltered slopes and in gullies of the coastal hills and escarpment ranges.
Paperbark swamp forest of the coastal lowlands of the North Coast.	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (EEC).	• *Melaleuca quinquinervia* • *Livistona australis* • *Melaleuca linariifolia* • *Acacia longifolia* • *Glochidion ferdinandi* • *Leptospermum polygalifolium* • *subsp. Polygalifolium* • *Dianella caerulea* • *Gahnia clarkei* • *Gahnia sieberiana* • *Imperata cylindrica var. major.*	Swamp sclerophyll shrubland, woodland and forest dominated by paperbarks. On poorly drained sites that may remain waterlogged for considerable periods, and along creek banks.

Vegetation community	Threatened ecological community type	Dominant species	Landscape features
Swamp Mahogany swamp forest of the coastal lowlands of the North Coast.	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (EEC).	• *Casuarina glauca* • *Acmena Smithii* • *Juncus usitatus* • *Lomandra longifolia* • *Melaleuca alternifolia* • *Carex appressa.*	Low to very tall woodland and forest. Widespread on poorly drained sites in coastal areas.
Coastal floodplains sedgelands, rushlands and forblands.	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East bioregions (EEC).	• *Juncus usitatus* • *Carex appressa* • *Philydrum lanuginosum* • *Lepironia articulata.*	Swamps and lakes on the floodplain.
Grey Gum – Grey Ironbark open forest of the Clarence lowlands of the North Coast.	Non-EEC.	• *Eucalyptus propinqua* • *Eucalyptus siderophloia.*	Tall to very tall dry forest with a mixed canopy. On sandstone and siliceous soils in the Clarence lowlands with a western extension through the southern Richmond Range inland to Ewingar State Forest and the Mann River.
Spotted Gum – Grey Ironbark – Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast.	Non-EEC.	• *Corymbia maculata* • *Eucalyptus paniculata* • *Corymbia intermedia.*	Tall to very tall grassy woodland and open forest. Occurs on lower slopes of the foothills and lowlands of the Clarence-Moreton Basin.
Scribbly Gum – Red Bloodwood heathy open forest of the coastal lowlands of the North Coast.	Non-EEC.	• *Eucalyptus signata* • *Corymbia gummifera* • *Allocasuarina littoralis* • *Banksia oblongifolia* • *B.spinulosa* • *Pultenaea myrtoides* • *P.retusa* • *Pimelea linifolia.*	Medium forest dominated by Scribbly Gum with Red present as subdominants. There is a relatively dense heath understorey.
Scribbly Gum – Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast.	Non-EEC.	• *Eucalyptus signata* • *Eucalyptus planchoniana.*	Open forest or woodland with a dense understorey of heath shrubs. Predominantly on coastal sands and sandstone from Kempsey to the Tweed River.

Vegetation community	Threatened ecological community type	Dominant species	Landscape features
Spotted Gum – Grey Box – Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast.	Non-EEC.	• *Corymbia maculata* • *Eucalyptus microcarpa* • *Eucalyptus paniculata.*	Open forest and woodland 25-35 metres tall with scattered shrubs and diverse continuous ground cover. Mainly confined to slopes and hills on low quartz sediments in the Clarence lowlands.
Swamp Box swamp forest of the coastal lowlands of the North Coast.	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (EEC).	• *Lophostemon suaveolens* • *Imperata cylindrical* • *Themeda triandra.*	Is distributed on high and low quartz sediments in the Clarence lowlands.
Swamp Oak swamp forest of the coastal lowlands of the North Coast.	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (EEC).	• *Casuarina glauca* • *Acmena smithii* • *Cupaniopsis anacardioides* • *Glochidion sumatranum* • *Lophostemon suaveolens* • *Callistemon salignus.*	
Clearings.	The extent of topsoil in clearings necessitates an additional test location.		Generally pasture or cane fields on floodplains.

Cleared lands

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

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

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

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

9.3 Impacted landscape

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

Earth mounds

The SPIR Requirements for the project includes:

UD14 - Earth mounds

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.

Earth mounds will be required in some locations along the road alignment to allow disposal of surplus spoil in order to avoid the need to transport it long distances from the site. Generally the earth mounds will be designed to form part of the landscape works.

The technical landscape drawings indicate possible sites for earth mounds. However, the need for these mounds and their size will be depend on the volume of surplus spoil that needs to be disposed of.

Design of the earth mounds will respond to local conditions and where possible their margins will be graded to blend with existing adjoining landforms. Under most circumstances stand-alone earth mounds will have slopes no steeper than 3H: 1V to assist successful establishment of vegetation and to create a natural appearance.

Where a mound is designed as a false-cut the gradient is to be consistent with the slope from which it extends. The radius at the top of the mound and transitions will be rounded to 10 metres minimum and up to 100 metres for the large mounds, where possible.

Earth mounds will be revegetated by seeding with selected native species of trees, shrubs and grasses. Supplementary planting of trees and tall shrubs will be carried out at some locations where rapid revegetation is required to achieve a desirable outcome.

Stockpile sites

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

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

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

Progressive rehabilitation

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

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

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

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

9.4 Landscape visual screening

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

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

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

9.5 Heritage zones

As identified in section 6.4.1 and 6.4.2, there were a number of Non-Aboriginal and Aboriginal heritage sites identified during EIS investigations. These heritage items have been salvaged or removed from the project corridor to ensure there are no sites potentially impacted by Construction activities. Consultation is continuing with the Aboriginal and Non-aboriginal communities in the detail design stages of the project to ensure that there are no additional heritage impacts caused by the landscape design.

9.6 Disturbed landscape

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

9.7 Batter stabilisation planting

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

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

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

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

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

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

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

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

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

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

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

9.8 Seed application and establishment

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

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

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

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

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

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

Seed mixes are developed for various purposes as summarised in Table 9-2.

Table 9-2: Sections 3 and 4 – Seed mixes and corresponding vegetation communities.

Frangible seed mix	Non-frangible seed mix	Target vegetation community
Wet Sclerophyll Forest	Blackbutt / Flooded Gum / Tallowwood / Brush Box / Pink Bloodwood	Blackbutt grassy open forest of the lower Clarence Valley of the North Coast
		Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the North Coast
		Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast
		Brush Box - Tallowwood shrubby open forest of the northern ranges of the North Coast
	Red Mahogany / Tallowwood / Pink Bloodwood	Turpentine moist open forest of the coastal hills and ranges of the North Coast
		Pink Bloodwood - Tallowwood moist open forest of the far northern ranges of the North Coast
		Red Mahogany open forest of the coastal lowlands of the North Coast
Dry Sclerophyll Forest	Blackbutt / Bloodwood / Angophora / Needlebark Stringybark	Needlebark Stringybark - Red Bloodwood heathy woodland on sandstones of the lower Clarence of the North Coast
		Angophora robur shrubby forest and woodland on sandstones of the North Coast
		Blackbutt - bloodwood dry heathy open forest on sandstones of the northern North Coast
	Scribbly Gum / Needlebark Stringybark / Bloodwood / Angophora / Allocasuarina	Scribbly Gum - Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast
		Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the North Coast
		Angophora paludosa shrubby forest and woodland on sandstone or sands of the North Coast
	Spotted Gum / Grey Gum / Grey Box / Grey Ironbark / Pink Bloodwood	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
	Grey Gum / Grey Box / Grey Ironbark / Tallowwood / Pink Bloodwood	Grey Gum - Grey Ironbark open forest of the Clarence lowlands of the North Coast
		Narrow-leaved Ironbark dry open forest of the North Coast
		Tallowwood dry grassy forest of the far northern ranges of the North Coast
Forested Wetland	Broad-leaved Paperbark	Paperbark swamp forest of the coastal lowlands of the North Coast
		Paperbark Plantation
	Swamp Mahogany / Broad-leaved Paperbark / Swamp Box / Red Mahogany / Swamp Oak	Swamp Mahogany swamp forest of the coastal lowlands of the North Coast

Frangible seed mix	Non-frangible seed mix	Target vegetation community
	Swamp Oak	Swamp Oak swamp forest of the coastal lowlands of the North Coast
Grassy Woodland	Forest Red Gum / Narrow-leaf Red Gum / Swamp Box / Pink Bloodwood	Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast
		Forest Red Gum grassy open forest of the coastal ranges of the North Coast
		Narrow-leaved Red Gum woodlands of the lowlands of the North Coast
		Swamp Box swamp forest of the coastal lowlands of the North Coast
Heathland	N/A	Coastal heath on sands of the North Coast

Vegetation communities not covered by frangible and non-frangible tree seed mixes:

Rainforest

- Tuckeroo - Riberry - Yellow Tulipwood littoral rainforest of the North Coast
- Black Bean - Weeping Lilly Pilly riparian rainforest of the North Coast.

Dry Sclerophyll Forest

- Coast Cypress Pine shrubby open forest of the North Coast Bioregion.

Forested Wetland

- Coastal floodplain sedgelands, rushlands and forblands.

Freshwater Wetland

- Coastal freshwater meadows and forblands of lagoons and wetlands.

Saline Wetland

- Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregions Saltmarsh complex of the North Coast.

9.9 Seed procurement

Seed procurement will be the responsibility of the civil contractor who will have overall responsibility for implementation of the landscape works. The collection of native seed is to be undertaken in accordance with Roads and Maritime Specification R178.

- The native seed must be of local provenance (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) where possible
- The provenance of all seed must be provided by the seed supplier
- Where provenance seed is not available, seed must be collected from areas where the habitat of the source area mostly closely matches that of the proposed location. In all other respects, the specified activities outlined in R178 will be followed
- Seed collection, processing and storage are to generally follow the NSW protocols contained in the Florabank Guidelines (Florabank Online)
- No seed collection will be carried out for species protected under the NPW Act Schedule 13 available from the following link: *http://www.austlii.edu.au/au/legis/nsw/consol_act/npawa1974247/sch13.html*

9.10 Monitoring and ecological establishment

Refer to Appendix H – Woolgoolga to Ballina Landscape Management Plan.

10.0 Topsoil

10.1 Topsoil management

The Woolgoolga to Ballina project traverses a number of different landscape situations that include forested areas, cleared land used for grazing and flood plains that are extensively used for sugarcane and other crops. Consequently the topsoils within these landscape situations vary significantly in terms of their physical and chemical composition as well as the species of seed they contain. Topsoil is a highly valuable resource that requires management by careful planning, implementation and monitoring to ensure the best use is made of it. Good topsoil management results in cost effective landscape outcomes that require minimal on-going maintenance.

Topsoil stripped from the highway construction formation in the forested areas will contain a valuable seed bank of diverse native species that is generally not practical to replicate by seed application alone. The most effective revegetation in forest areas is therefore achieved by re-spreading site topsoil containing intact soil-borne seed bank soon after is has been stripped. The forest topsoil needs to be re-spread within a time frame that will allow most of the soil-borne seed to remain viable.

Natural regeneration from the soil-borne seed ensures that species diversity is also maximised and the risk of introducing foreign genotypes to the existing vegetation communities is minimised. Use of fertiliser is also minimised or avoided to prevent excess fertiliser in surface run-off, which can cause algal blooms in waterway resulting in death of fish and other aquatic fauna. Topsoil reuse 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 rapidly re-colonise disturbed areas of the corridor with the application of correct topsoil management procedures.

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

- Stripping of the topsoil from the existing vegetation communities to maintain the integrity of species composition and micro-organisms
- Direct return of topsoil (where feasible)
- Topsoil management zones and stockpile management procedures
- Testing Topsoil
- Amelioration of topsoil with composted mulch.

These aspects are outlined further below.

Topsoil stripping

For the purposes of stockpile management on this project two types of topsoil have been classified, which are described below.

Bushland topsoil

This includes topsoil stripped within mapped forest vegetation communities that have been cleared as part of the project. The areas of Bushland topsoil will be stockpiled and managed to provide the best opportunity to retain their environmental integrity and preserve the soil seed bank, microflora and microorganisms. Topsoils from different vegetation communities are to be stockpiled separately.

Bushland topsoil will be reused where native vegetation community is to be re-established as indicated on the landscape drawings. Where appropriate, supplementary seeding and planting will be carried out as indicated on the landscape drawings.

Landscape topsoil

This includes topsoil stripped from existing pasture grass or cultivated areas as well as areas mapped in the Weed Management Plan as having a High Weed Density Abundance. Landscape topsoil will generally contain weed seeds and therefore must be quarantined from Bushland Topsoil.

Landscape topsoil is to be used where pasture grasses are shown on the landscape drawings or where there is insufficient bushland topsoil and the area being revegetated has been former pasture lands. Areas identified as High Weed Density Abundance will be managed in accordance with the procedures outlined in the Weed Management Plan. This includes appropriate management actions to limit the potential for existing weeds to impact or spread through the landscaping and rehabilitation activities.

Direct return of topsoil

Direct return is the procedure in which site topsoil is returned to the cut/fill batters in the location from which it was stripped, either immediately or soon after formation works are completed. This effectiveness of this process is dependent on the construction staging and availability of space within constrained construction corridors. Direct return will be implemented where construction staging allows.

Topsoil management

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

The size of stockpiles will be designed to maintain the viability of native seed. They will be managed to ensure that the information on the vegetation community type, soil horizon, collection area (e.g. by station) and date of stockpiling is captured to assist the revegetation process.

Topsoil testing

Topsoils will be tested in situ prior to stripping in accordance with Roads and Maritime specification R44 to provide information for vegetation species selection. Topsoil testing in the stockpiles will also be carried out in accordance with Roads and Maritime W2B project specific Specification R178. This testing includes analysis of standard landscape and soil health parameters to guide rehabilitation activities. Where applicable, amelioration is to be carried out prior to reuse of topsoil in accordance with the recommendations of the soil test report.

Topsoil management zones are derived from the vegetation community boundaries shown on the landscape plans to ensure that the topsoil containing seed from each vegetation community is returned to a location with a similar vegetation community. In some instances the exact extent of a topsoil management zone will need to be rationalised in order to assist the stripping and direct return. 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. This adaptive management process will focus on ensuring that the landscape outcome proposed is achieved by the revegetation techniques proposed at a particular location.

Amelioration of topsoils

Amelioration of topsoils will be undertaken where the topsoil testing report identifies a potential deficiency or opportunity for improvements in the nutrient capabilities of the soils. This can include the provision of additional nutrients e.g. Gypsum, lime or dolomite and fertiliser, or the application and mixing of composted natural materials.

Figure 96: Glenugie batter slope soon after completion showing germination from the soil seedbank.

Figure 98: Spotted Gum-Grey Ironbark-Pink Bloodwood Forest where the alignment crosses Six Mile Lane, a zone from which bushland topsoil will be stripped.

Figure 97: Glenugie batter slope at the same location four years later.

Figure 99: Landscape topsoils near Green Hill.

10.2 Topsoil treatments

Topsoil treatments proposed to be implemented on the project include:

- Striping and stockpiling or immediate respreading
- Ripping the subsoil or sub base
- Placement of the site topsoil
- Application of seed mixes by direct seeding or hydro-seeding together with a hyrdo-mulch layer applied to provide surface protection on slopes
- Planting in designated locations with the application of site-won hardwood woodchip mulch (or rice or sugarcane straw mulch in riparian areas) to planted areas.

There are three main topsoil treatments that are generally used to revegetate top soil on cut and fill slopes as well as other areas disturbed by the road construction works. The three treatments used include:

Topsoil Treatment 1: Bushland topsoil containing a seed bank that is placed over cut/fill slopes

- Prepare batter slopes by ripping or roughening the surface to a depth indicated on the landscape works drawings and specifications to form a loosened or roughened surface suitable for the application of topsoil;
- During ripping, mix in any amelioration materials required by the soil testing report into the upper 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 where dispersive soils are identified as an issue 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 depths shown on the landscape drawings. Topsoil and mulch must be ameliorated at the stockpile in accordance with recommendations of the soil testing report;
- Alternatively, apply A1 horizon topsoil to depths shown on the landscape drawings and mix with windrowed composted site mulch by pushing up and down the prepared slope in order to achieve a reasonable mixing of the soil and mulch;
- Spread the topsoil/composted mulch mix to achieve an even surface but do not otherwise smooth or compact the surface;
- Apply appropriate seed mix by hydro-seeding if the topsoil has been stockpiled beyond the recommended period and soil seed is therefore not expected to germinate;
- For slopes steeper than 2H:1V and up to 1.5H:1V (e.g. transitions from bridge abutments to 2H:1V slopes) and for basins, vegetated swales and channels install organic fibre mesh over topsoil preparation prior to seeding as per the landscape drawings and specifications.

Topsoil Treatment 2: Planting and seeding areas

- Rip the subsoil to depth shown on landscape drawings and specifications. Leave the subsoil surface in a roughened and uncompacted state, prior to the application of topsoil;
- Apply A1 horizon topsoil to the depth show on landscape drawings. 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 seed mix by direct seeding or hydro-seeding or plant in accordance with landscape drawings;
- 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 surface wood chip mulch over planted areas to depths shown on landscape drawings.

Topsoil Treatment 3: Pasture grasses and native grass seeding on medians, verges and cut/fill slopes

- Cultivate all areas to depth shown on landscape drawings. Leave the subsoil surface in a roughened and uncompacted state, prior to the application of topsoil;
- Apply site-won topsoil to depth shown on landscape drawings. Do not mix composted site mulch in to the topsoil;
- 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 direct seeding or hydro-seeding with fertiliser as indicated on the landscape works drawings and specification.

Other topsoil treatments are to be applied in specific situations that include:

Topsoil Treatment 4: for vegetated swales, channels and water quality basins

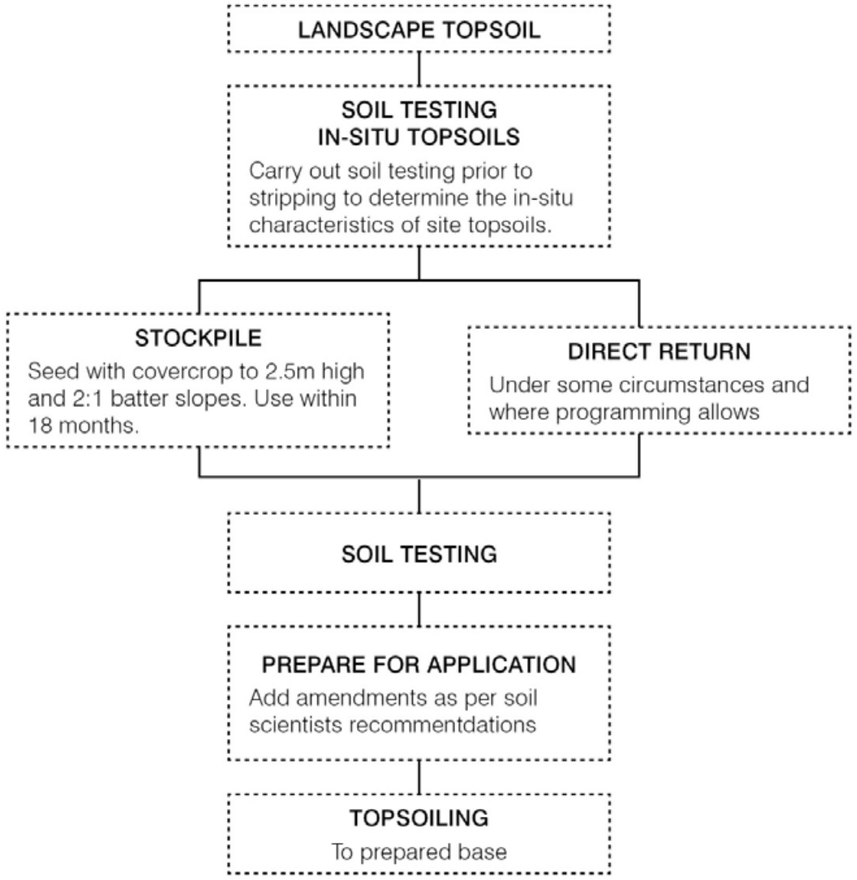
- As for Topsoil Treatment 1 but with organic fibre mesh laid over the slope and berms following topsoil spreading and preceding hydro-seeding to the extent of the topsoiling and/or to the top and bottom of the embankments; as shown in details on landscape drawings.

Topsoil Treatment 5: for wastewater treatment irrigation areas

- As for Topsoil Treatment 2 in accordance with topsoil depths shown in details on landscape drawings.

Topsoil Treatment 6: where existing pavement is to be removed

- Remove the pavement to the depth of the road formation
- Apply bushland topsoil to depths shown in details on landscape drawings
- Apply appropriate seed mix by hydro-seeding or planting in accordance with the landscape plans.



10.3 Mulches

Vegetation material generated by clearing operations is to be used as mulch in the landscape works. Wood chip mulch is to be used as a surface cover on planted areas to suppress weeds and retail soil moisture. Composted mulch is to be incorporated in top soil spread on cut and fill slopes to improve the resistance to surface erosion and assist revegetation.

Surface mulch

All planted areas are to have a layer of hardwood chip mulch sourced from site applied to the soil surface to a depth shown landscape drawings and in accordance with the R178 Specification and landscape drawings.

Figure 101: Germination from the soil seedbank. Note mulch mixed with site topsoil.

Composted mulch

Vegetation generated from site clearing is to be windrowed for a minimum of six months in a manner that will accelerate the composting process. The composted mulch may be mixed with site topsoil in accordance with landscape specifications and the landscape works drawings. The proportion of composted mulch 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 test reports.

Composted site mulch will 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 and growth of seedlings. The soil test reports will provide advice as to soil and compost additives to render the mix suitable for growth of the proposed plant species.

Within riparian zones a straw mulch (rice or sugarcane) will be used in lieu of site won mulch in order to avoid tannins from leaching into waterways.

Figure 102: Stockpile tub ground mulch.

Figure 103: Lepironia wetlands off Wooli Road. Species from the wetland community will be used in re-vegetating water quality treatment ponds.

11.0 Drainage and water quality

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

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

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

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

The permanent water quality basins adopt a naturalised shape in visually prominent areas. Where basins remain rectangular in shape, it is due to the constrained space between the road formation and the project boundary or due to clearing limits (Figure 104).

Figure 104: Typical water quality basin on the Pacific Highway at Devils Pulpit with floppy top fauna fencing.

11.2 Culverts

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

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

- Organic fibre mesh pinned to embankments 2H:1V or steeper, over 50-100 millimetres depth of additional topsoil through which tubestock macrophytes and tussocks are planted. The mesh is to cover the embankment to the top of the channel or to the extent of disturbed ground
- Site rocks of various size from 500-1000 millimetres in natural formation to assist holding down mesh and for scour protection where the new work interfaces with the existing creek channel (this treatment is for zones beyond scour protection and only where rocks occur in the natural creek bed)
- Soft scour to create a smooth crossing for mammals outside of the main channel of 50-80 millimetre flat interlocking rocks
- Beyond the zone of normal high water, the typical landscape zone of trees shrubs and groundcovers includes:
  - 100-200 millimetres additional topsoil if required
  - 75 millimetres mulch if planted
- Rice straw mulch is used in place of site-won tub-ground mulch in the proximity of riparian zones to prevent tannins from leaching into the waterways.

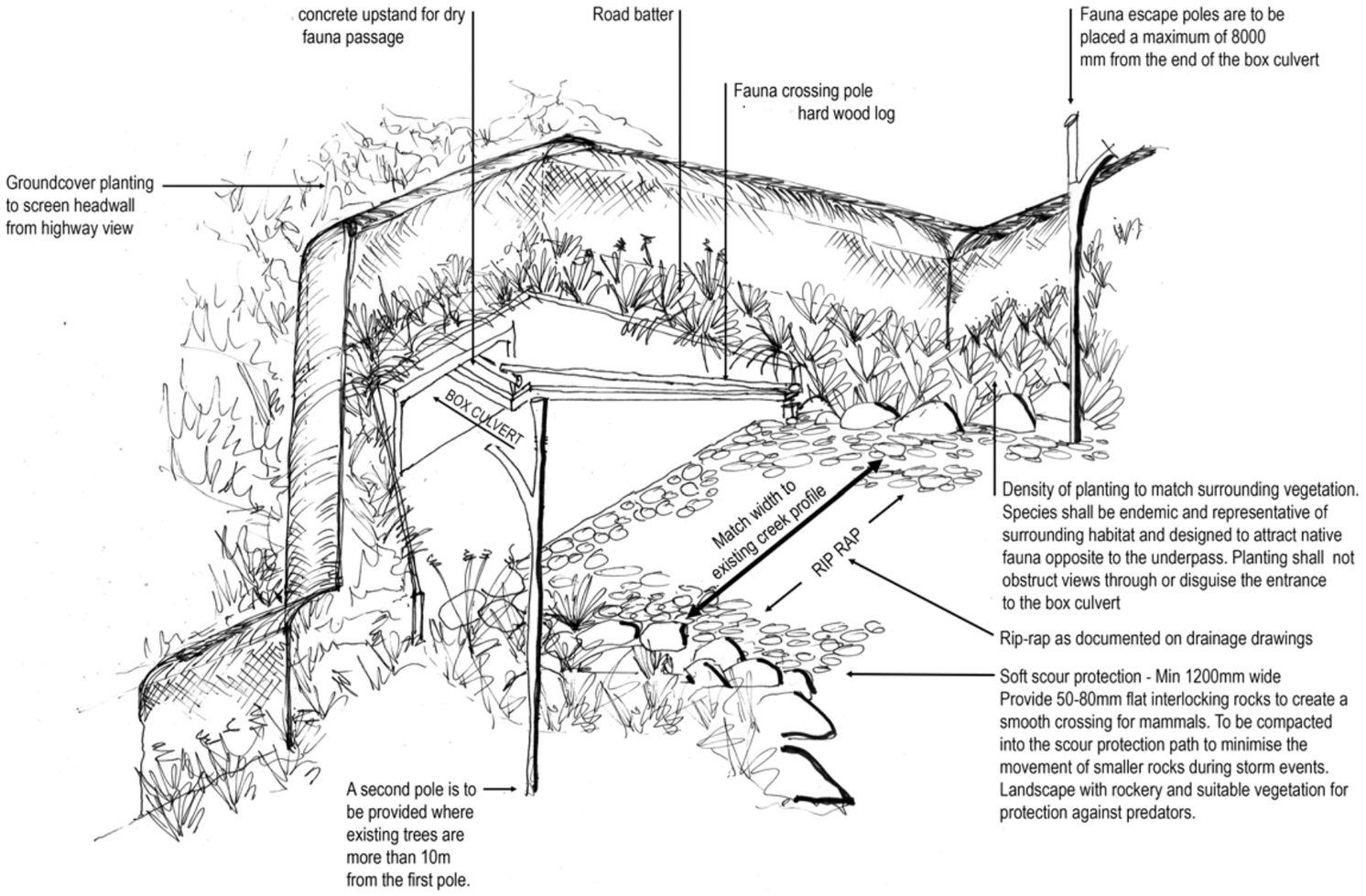


Figure 105: Typical landscape treatment for combined box culvert fauna crossing - sketch.

- Planting of riparian vegetation species including plants such as *Lomandra hystrix* and sedges known to bind embankments and resist erosion at creek crossings will be planted directly adjacent to the scour protection both top and bottom
- Where scour protection is utilised at the egress to fauna culverts, *Lomandra hystrix* and sedge species will be planted at a low density to provide habitat amongst the scour rocks
- Fauna escape poles are located on the embankment, out of the main channel and at a maximum eight metres from the end of the headwall. A second pole is to be provided where existing trees are more than 10 metres from the first pole.

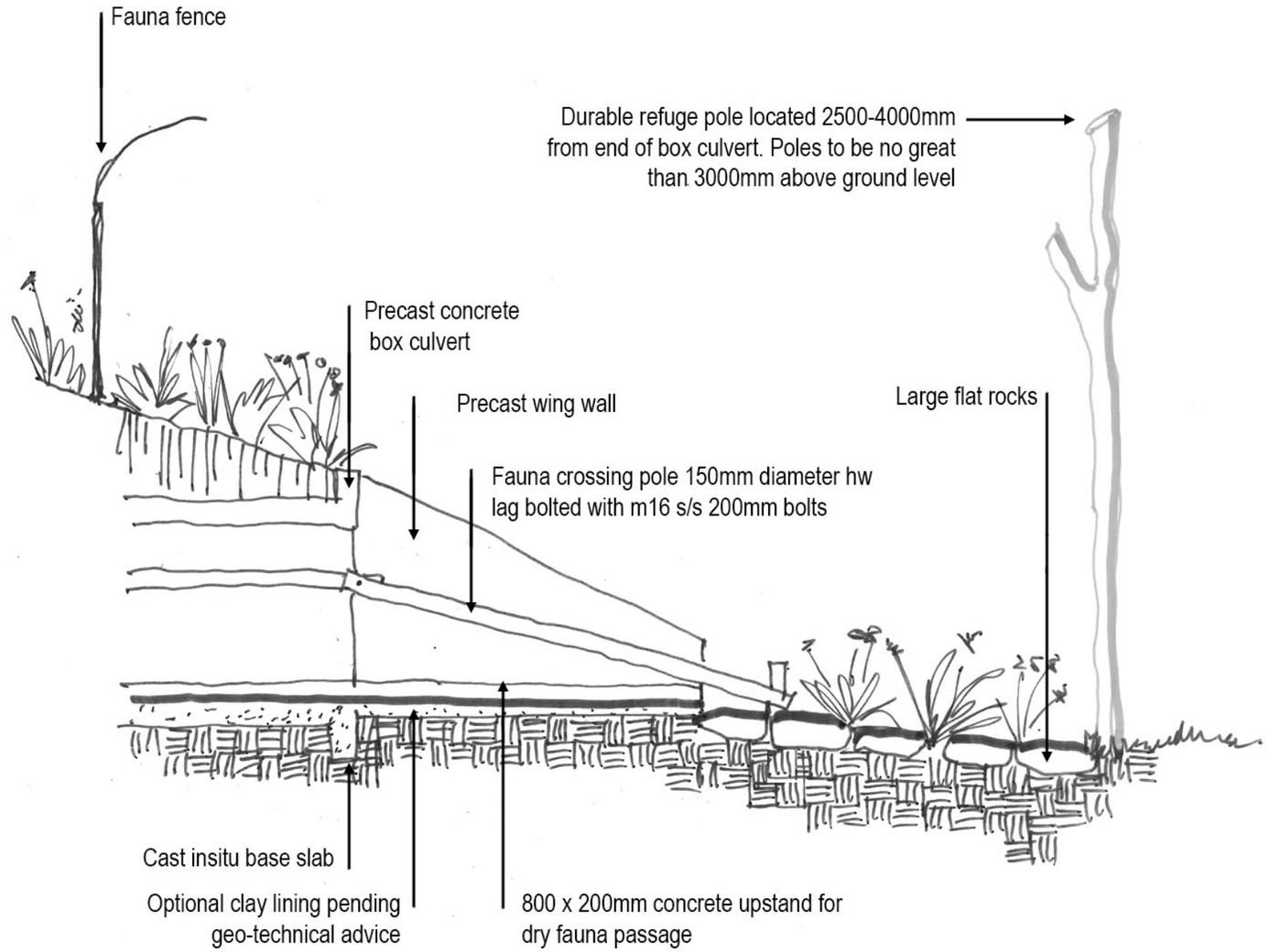


Figure 106: Typical landscape treatment for combined box culvert fauna passage - section.

11.3 Creek rehabilitation

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

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

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

Figure 107: Chaffin Creek.

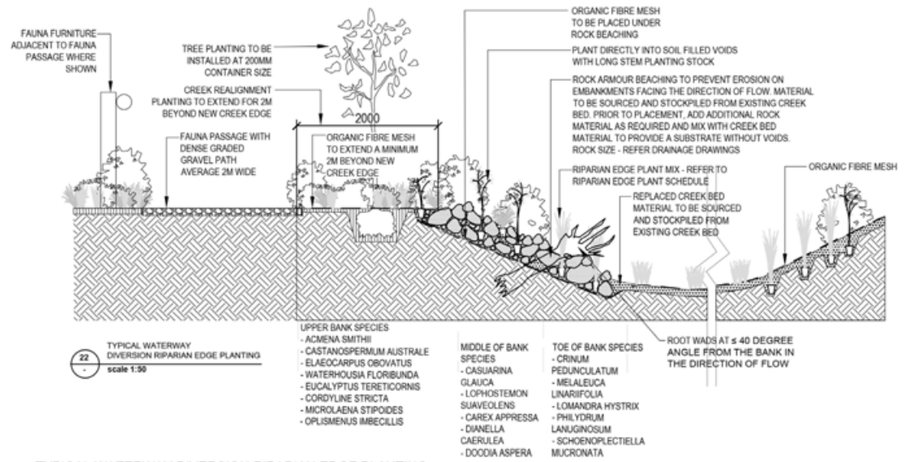
Creek re-alignments

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

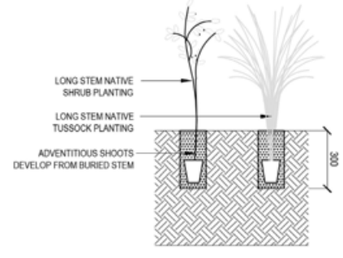
If appropriate to the situation, site-won felled timber logs with root wads will buried into the bank in combination with bracing boulders. For details of species to be used refer to the plant schedules.

The following Creeks require diversions:

- Pheasant Creek
- Pillar Valley Creek 3
- Pillar Valley Creek 5
- Waterway north of Pillar Creek 2
- Waterway north of Chaffin Creek
- Champions Creek
- Waterway north of Champions Creek
- Waterway at the Quarry access near Tucabia.



TYPICAL WATERWAY DIVERSION RIPARIAN EDGE PLANTING
SCALE 1:50



CREEK REALIGNMENT PLANTING TYPES
SCALE 1:20

12.0 Fauna crossings

12.1 Fauna connectivity

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

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

12.2 Fauna crossing structures

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

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

The design of emu crossings has incorporated the following principles:

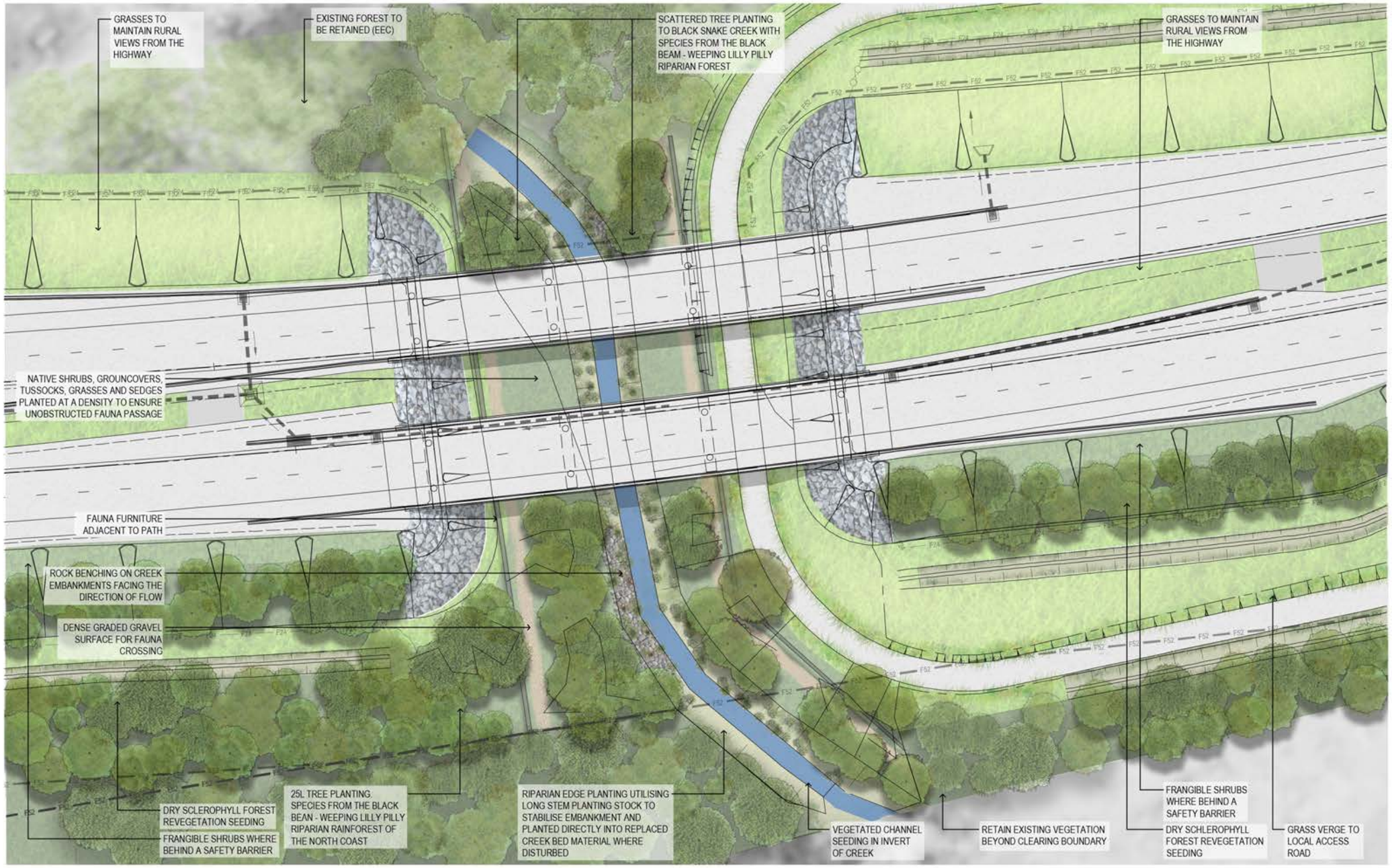
- Immediate revegetation of emu crossing zones after the completion of the construction activity, with the aim to have an established cover crop within three months of the completion of each bridge
- Ground cover crops such as soybean, oats, lablab or rye grass are to be used initially on disturbed ground around the approaches to the bridges, attracting emus to the crossing zones, as these species represent known food plants
- Sterile cover crops are to be used as these are non-native species and these areas are to be monitored and progressively replaced with native food plants
- Height and density of vegetation are not to obscure the crossing structures and provide a clear, open, line of sight
- Roadside plantings in emu habitat are not to be undertaken within the first 10 metres of the road edge, unless there is fauna exclusion fencing in place, or as part of the exclusion barrier
- Common landscape species such as *Lomandra* and *Dianella ssp*. are not to be used in roadside landscaping in emu habitat as they represent food plants for emus and attract them to the road edge
- Final landscape plantings under dedicated and combined bridges in emu zones (including the approaches) are to be planted with native grasses or low groundcovers suitable to the location
- Dense plantings of trees and shrubs including low trees such as Acacia or Casuarina are to be avoided
- Revegetation in roadside areas disturbed during construction need to be restored to the original habitat type at each location (excluding first 10 metres of the road edge unless there is fauna exclusion fencing in place or as part of the exclusion barrier).

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

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

The environmental design requirements for koalas include:

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



LANDSCAPE LEGEND

- APPROVED PROJECT BOUNDARY (V9)
- CLEARING BOUNDARY
- F24 — F24 — FENCE
- RETAINED AREA OF VEGETATION
- RETAINED AREA OF EEC VEGETATION
- VEGETATED DRAINAGE CHANNEL
- NATIVE GRASS SEED MIX
- PASTURE GRASS SEED MIX
- NATIVE TREE, SHRUB AND GROUNDCOVERS
- TREE 25L

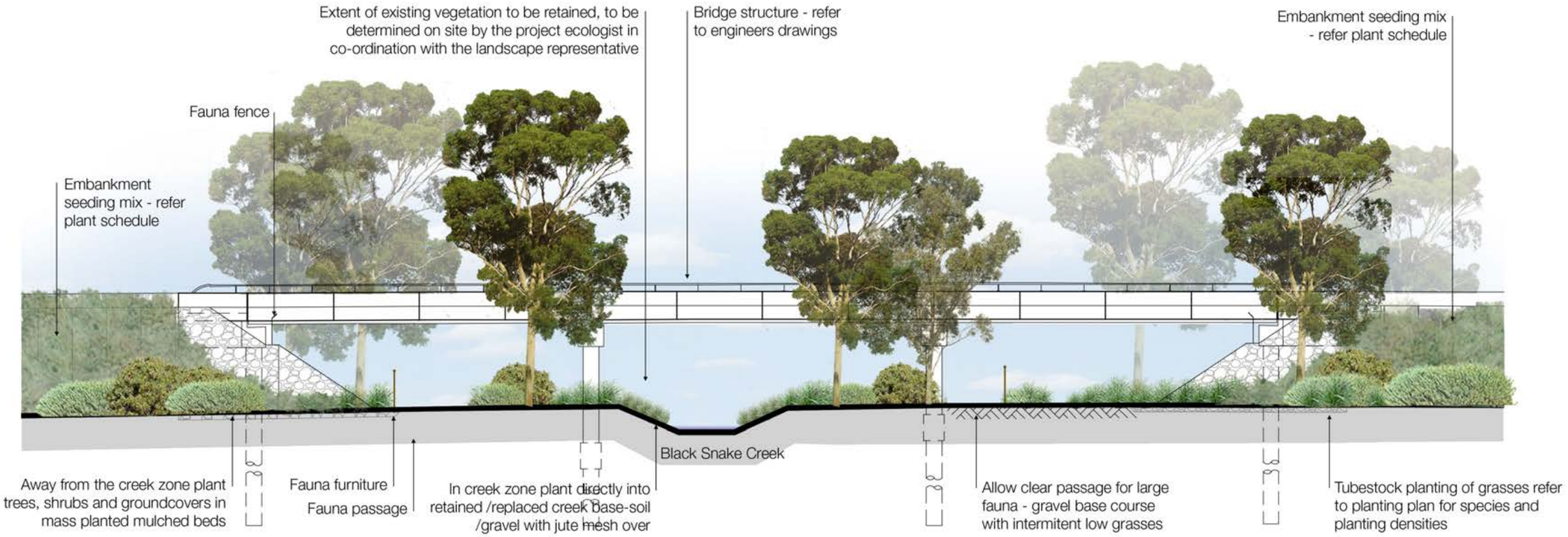
0 5 10 15 20 25m

SCALE 1:500@A3

Number of trees/elements shown is indicative only.
Landscape at maturity approximately 15 years.

SECTION 3 Urban design and landscape concept plan W2B-GHD-A-LX-DRG-00156

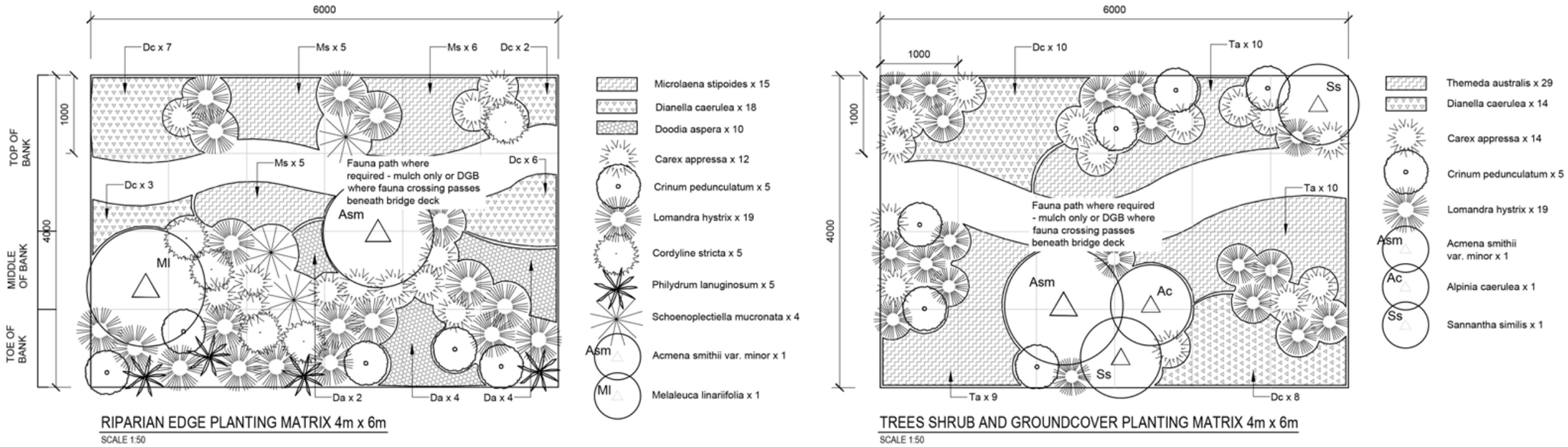
FAUNA CROSSING AT BLACK SNAKE CREEK ILLUSTRATING TYPICAL UNDERBRIDGE FAUNA CROSSING ARRANGEMENT



0 2.5 5 7.5 10 15m
SCALE 1:250@A3

Number of trees/elements shown is indicative only. Landscape shown at maturity approximately 15 years.

Fauna Crossing Section - Bridge over Black Snake Creek W2B-GHD-A-LX-DRG-00160



RIPARIAN EDGE PLANTING MATRIX 4m x 6m

SCALE 1:50

TREES SHRUB AND GROUNDCOVER PLANTING MATRIX 4m x 6m

SCALE 1:50

0 0.5 1 1.5 2 2.5m

SCALE 1:50@A3

Number of trees/elements shown is indicative only.
Landscape shown at maturity approximately 15 years.

Planting Matrices W2B-GHD-A-LX-DRG-00162

Figure 108: Typical twin bridges over combined fauna crossing and creek.

12.3 Frog ponds

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

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

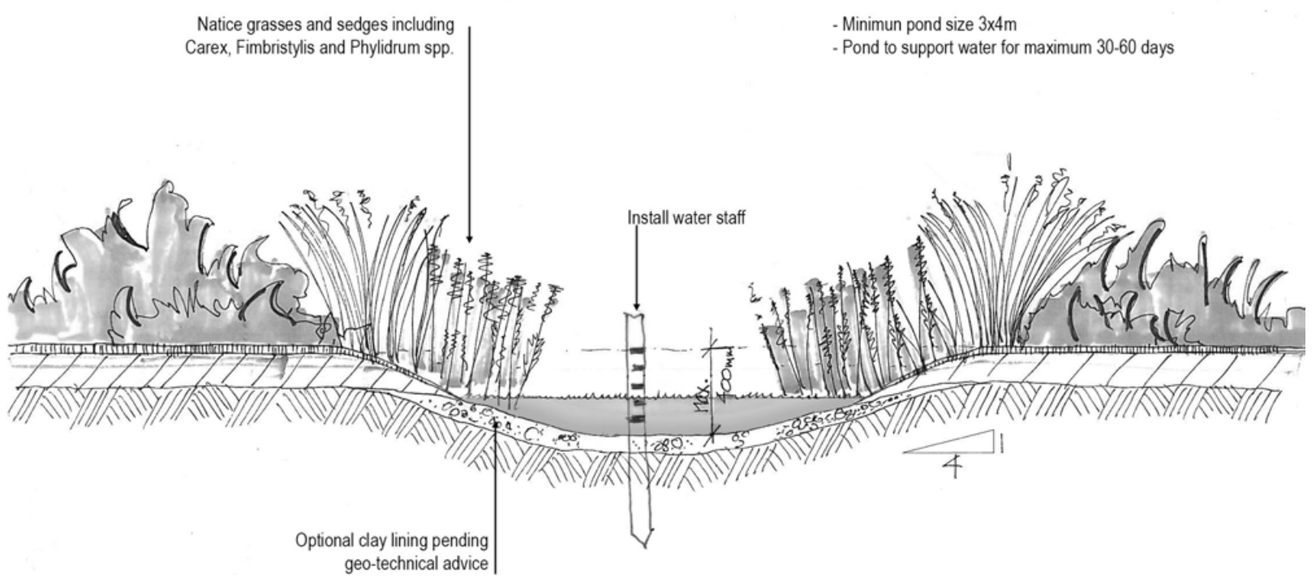


Figure 109: Indicative landscape treatment surrounding Green-thighed frog breeding ponds.

13.0 Conclusion

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

The key strengths of this UDLP are:

- Creating a seamless integration of the road infrastructure with the surrounding environment
- Transitioning across the Glenugie forest foothills with multiple bridges to improve environmental outcomes and connectivity
- Providing an important directional change in the Pacific Highway from north-south to east west at Glenugie interchange, a major marker for the southern border of the Northern Rivers Region of NSW
- Developing a consistent approach in the design of bridges
- Providing a noise wall at Tyndale interchange with native seeding and revegetation
- Developing a fauna connectivity strategy with the provision of fauna crossings providing environmental sustainability and enhanced biodiversity
- Providing a driver experience that enhances ecological and cultural values and highlights the natural features of the landscape and Clarence Valley
- Addressing impacts of the upgrade on nearby dwellings through appropriate screening and other landscape initiatives
- Providing opportunities to reinforce the identities of nearby towns, including a feature design at Maclean interchange that provides a sense of arrival and departure to and from the town
- Providing measures for Environmental Sustainable Development (ESD).

This report is submitted by the applicant, Roads and Maritime Services, for construction approval in accordance with MCoA D20.

Figure 110: Existing view: oblique aerial looking north of proposed Tyndale interchange north with Green Hill in foreground and Maclean interchange in background. Source: Pacific Complete.

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14.0 Bibliography

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Australian Standards *AS 4419 Soils for Landscape and Garden Use*

Australian Standards *AS 4454 Composts, Soil Conditioners and Mulches*

Roads and Maritime Construction Specifications including *R178 Vegetation and R179 Planting*

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Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects, September 2011

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Appendices

A Schedule of finishes and materials

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

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

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

Design principles

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

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

Figure A1: Finishes and materials.

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B Planting and seeding schedules for sections 3 and 4

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

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

Botanical Name	Common Name
Feature Trees	
Alphitonia excelsa	Red Ash
Corymbia intermedia	Pink Bloodwood
Corymbia variegata	Spotted Gum
Eucalyptus paniculata	Grey Ironbark
Eucalyptus propinqua	Grey Gum
Shrubs, groundcovers, tussocks, grasses and sedges	
Acmena smithii var. minor	Lilly Pilly
Allocasuarina torulosa	Forest She Oak
Banksia oblongifolia	Fern-leaved Banksia
Glochidion ferdinandii	Cheese Tree
Callistemon salignus	Bottlebrush
Leptospermum polygalifolium subsp. Polygalifolium	Tantoon
Melaleuca nodosa	Prickly-leaved Paperbark
Dianella caerulea	Blue Flax-Lily
Gahnia clarkei	Tall Saw-sedge
Lomandra longifolia	Spiny Head Mat Rush
Themeda triandra	Kangaroo Grass
Microlaena stipoides	Wallaby Grass

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

Botanical Name	Common Name
Feature Trees	
Acmena smithii	Lilly Pilly
Argyrodendron actinophyllum	Black Booyong
Castanospermum australe	Black Bean
Castanospora alphandii	Brown Tamarind
Dipploglottis cunninghamii	Native Tamarind
Dysoxylum mollissimum	Red Bean
Elaeocarpus obovatus	Blueberry Ash
Euroschinus falcatus	Ribbonwood
Harpullia pendula	Tulipwood
Livistona australis	Cabbage Tree Palm
Melaleuca quinquinervia	Broad-leaved Paperbark
Podocarpus elatus	Plum Pine
Polyscias elegans	Celerywood
Toona ciliata	Red Cedar
Shrubs, groundcovers, tussocks, grasses and sedges	
Alpinia caerulea	Native Ginger
Acmena smithii var. minor	Lilly Pilly
Callistemon citrinus	Crimson Bottlebrush
Crinum pedunculatum	Swamp Lily
Doodia aspera	Common Rasp Fern
Ficinia nodosa	Knobby Club Rush
Lomandra hystrix	Spiny Head Mat Rush
Melaleuca nodosa	Prickly-leaved Paperbark
Sannantha similis	Tall Baeckea
Themeda australis	Kangaroo Grass

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

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

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

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

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

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

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

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

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

Botanical Name	Common Name
Ficinia nodosa	Knobby Club-rush
Juncus usitatus	Common Rush
Philydrum lanuginosum	Woolly Waterlily
Schoenoplectus mucronatus	Bog Bulrush
lepironia articulata	Grey Sedge

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

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

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

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

Table B-10: Sections 3 and 4 fauna crossings planting schedule.

Botanical Name	Common Name
Trees as per vegetation community in which the crossing is located - indicative species shown	
Acmena smithii	Lilly Pilly
Allocasuarina littoralis	Black She Oak
Allocasuarina torulosa	Forest She Oak
Casuarina glauca	Swamp Oak
Corymbia gummifera	Red Bloodwood
Corymbia variegata	Spotted Gum
Eleaocarpus reticulatus	Blueberry Ash
Eucalyptus paniculata	Grey Ironbark
Eucalyptus planchoniana	Needlebark Stringybark
Eucalyptus resinifera ssp hemilampra	Red Mahogany
Eucalyptus signata	Scribbly Gum
Eucalyptus tereticornis	Forest Red Gum
Lophostemon suaveolens	Swamp Mahogany
Melaleuca alternifolia	Cajeput
Melaleuca sieberi	Sieber's Paperbark
Syncarpia glomulifera	Turpentine
Shrubs, groundcovers, tussocks, grasses and sedges	
Alpinia caerulea	Native Ginger
Acmena smithii var. minor	Lilly Pilly
Sannantha similis	Tall Baeckea
Crinum pedunculatum	Swamp Lily
Carex appressa	Tall Sedge
Dianella caerulea	Blue Flax Lily
Lomandra hystrix	Spiny Head Mat Rush
Themeda australis	Kangaroo Grass

Table B-11: Sections 3 and 4 frangible seed mix - Dry Sclerophyll Forest.

Botanical name	Common name
Acacia complanata	Flat-stemmed Wattle
Acacia concurrens	Curracabah Wattle
Acacia falcata	Sickle Wattle
Acacia myrtifolia	Red-stemmed Wattle
Acacia suaveolens	Sweet Wattle
Acacia terminalis subsp. Long inflorescences	Sunshine Wattle
Acacia ulicifolia	Prickly Moses
Banksia oblongifolia	Coffee Bush
Banksia spinulosa var. collina	Hairpin Banksia
Cymbopogon refractus	Barbed Wire Grass
Daviesia ulicifolia	Gorse Bitter Pea
Daviesia umbellulata	A Pea
Dichanthium sericeum	Queensland Bluegrass
Dichelachne micrantha	Shorthair Plumegrass
Dodonaea viscosa	Sticky Hop-bush
Gahnia aspera	Rough Saw-sedge
Gompholobium virgatum	Leafy Wedge Pea
Imperata cylindrica	Blady Grass
Jacksonia scoparia	Dogwood
Kennedia rubicunda	Dusky Coral Pea
Leptospermum polygalifolium subsp. cismontanum	Tantoon
Lomandra longifolia	Mat Rush
Pultenaea myrtoides	A Pea
Pultenaea spinosa	Spiny Bush-pea
Pultenaea villosa	Hairy Bush-pea
Themeda triandra	Kangaroo Grass

Table B-12: Sections 3 and 4 frangible seed mix - Forested Wetland.

Botanical name	Common name
Acacia leiocalyx subsp. leiocalyx	Curracabah
Callistemon citrinus	Crimson Bottlebrush
Callistemon pachyphyllus	Wallum Bottlebrush
Carex appressa	Tall Sedge
Cynodon dactylon	Common Couch
Cyperus polystachyos	A Sedge
Gahnia sieberiana	Red-fruited Saw-sedge
Hardenbergia violacea	False Sarsaparilla
Juncus usitatus	Common Rush
Kennedia rubicunda	Dusky Coral Pea
Leptospermum juniperinum	Prickly Tea-tree
Leptospermum polygalifolium subsp. cismontanum	Tantoon
Lomandra longifolia	Mat Rush
Melaleuca nodosa	Ball Honeymyrtle
Melaleuca sieberi	Sieber's Paperbark
Melaleuca thymifolia	Thyme Honeymyrtle
Microlaena stipoides	Weeping Grass
Oxylobium robustum	Tall Shaggy Pea
Parsonsia straminea	Common Silkpod
Pultenaea retusa	Notched Bush-pea
Pultenaea villosa	Hairy Bush-pea
Schoenoplectiella mucronata	Bog Bulrush

Table B-13: Sections 3 and 4 non-frangible native tree mix - Wet Sclerophyll Forest.

Red Mahogany / Turpentine / Tallowwood / Pink Bloodwood

Botanical name	Common name
Acacia melanoxylon	Blackwood
Acacia irrorata subsp. velutinella	Green Wattle
Allocasuarina torulosa	Forest She-oak
Alphitonia excelsa	Red Ash
Corymbia intermedia	Pink Bloodwood
Eucalyptus acmenoides	White Mahogany
Eucalyptus microcorys	Tallowwood
Eucalyptus pilularis	Blackbutt
Eucalyptus propinqua	Small-fruited Grey Gum
Eucalyptus resinifera subsp. hemilampra	Red Mahogany
Lophostemon suaveolens	Swamp Box
Syncarpia glomulifera	Turpentine

Table B-14: Sections 3 and 4 non-frangible native tree mix - Dry Sclerophyll Forest.

Blackbutt / Bloodwood / Angophora / Needlebark Stringybark

Botanical name	Common name
Acacia floribunda	Sally Wattle
Acacia implexa	Hickory Wattle
Allocasuarina littoralis	Black She-oak
Angophora woodsiana	Smudgy Apple
Corymbia gummifera	Red Bloodwood
Eucalyptus pilularis	Blackbutt
Eucalyptus planchoniana	Needle Stringybark
Syncarpia glomulifera	Turpentine

Scribbly Gum / Needlebark Stringybark / Bloodwood / Angophora / Allocasuarina

Botanical name	Common name
Acacia floribunda	Sally Wattle
Acacia implexa	Hickory Wattle
Allocasuarina littoralis	Black She-oak
Angophora woodsiana	Smudgy Apple
Corymbia gummifera	Red Bloodwood
Corymbia intermedia	Pink Bloodwood
Eucalyptus planchoniana	Needle Stringybark
Eucalyptus signata	Northern Scribbly Gum

Spotted Gum / Grey Gum / Grey Box / Grey Ironbark / Pink Bloodwood

Botanical name	Common name
Acacia implexa	Hickory Wattle
Allocasuarina littoralis	Black She-oak
Allocasuarina torulosa	Forest She-oak
Corymbia henryi	Large-leaved Spotted Gum
Corymbia intermedia	Pink Bloodwood
Corymbia variegata	A Spotted Gum
Eucalyptus carnea	Thick-leaved Mahogany
Eucalyptus moluccana	Grey Box
Eucalyptus propinqua	Small-fruited Grey Gum
Eucalyptus siderophloia	Grey Ironbark
Syncarpia glomulifera	Turpentine

Grey Gum / Grey Box / Grey Ironbark / Tallowwood / Pink Bloodwood

Botanical name	Common name
Acacia implexa	Hickory Wattle
Allocasuarina littoralis	Black She-oak
Allocasuarina torulosa	Forest She-oak
Corymbia intermedia	Pink Bloodwood
Corymbia variegata	A Spotted Gum
Eucalyptus carnea	Thick-leaved Mahogany
Eucalyptus crebra	Narrow-leaved Ironbark
Eucalyptus microcorys	Tallowood
Eucalyptus moluccana	Grey Box
Eucalyptus propinqua	Small-fruited Grey Gum
Eucalyptus siderophloia	Grey Ironbark
Syncarpia glomulifera	Turpentine

Table B-15: Sections 3 and 4 non-frangible native tree mix - Forested Wetland.

Broad-leaved Paperbark

Botanical name	Common name
Melaleuca quinquenervia	Broad-leaved Paperbark

Swamp Mahogany / Broad-leaved Paperbark / Swamp Box / Red Mahogany / Swamp Oak

Botanical name	Common name
Casuarina glauca	Swamp Oak
Eucalyptus resinifera subsp. hemilampra	Red Mahogany
Eucalyptus robusta	Swamp Mahogany
Eucalyptus tereticornis	Forest Red Gum
Lophostemon suaveolens	Swamp Box
Melaleuca quinquenervia	Broad-leaved Paperbark

Swamp Oak

Botanical name	Common name
Casuarina glauca	Swamp Oak

Table B-16: Sections 3 and 4 non-frangible native tree mix - Grassy Woodland.

Forest Red Gum / Narrow-leaf Red Gum / Swamp Box / Pink Bloodwood

Botanical name	Common name
Acacia implexa	Hickory Wattle
Allocasuarina littoralis	Black She-oak
Corymbia intermedia	Pink Bloodwood
Eucalyptus resinifera subsp. hemilampra	Red Mahogany
Eucalyptus seeana	Narrow-leaved Red Gum
Eucalyptus siderophloia	Forest Red Gum
Eucalyptus tereticornis	Grey Ironbark
Lophostemon suaveolens	Swamp Box

Table B-17: Sections 3 and 4 functional seed mixes.

Native grass seed mix

Botanical name	Common name
Austrodanthonia sp.	Wallaby Grass
Capillipedium spicigerum	Scented Top Grass
Chloris truncata	Windmill Grass
Cymbopogon refractus	Barbed Wire Grass
Cynodon dactylon	Common Couch
Dichanthium sericeum	Queensland Bluegrass
Dichelachne micrantha	Shorthair Plumegrass
Imperata cylindrica	Blady Grass
Lomandra longifolia	Mat Rush
Microlaena stipoides	Weeping Grass
Themeda triandra	Kangaroo Grass

Pasture / exotic grass mix

Botanical name	Common name
Axonopus fissifolius	Carpet Grass
Coolabah oats	Oats
Cynodon dactylon	Common Couch
Echinochloa utilis	Japanese Millet
Lolium multiflorum	Eclipse rye
Secale cereale	Rye Corn
Trifolium pratense	Red Clover

Swale / sedge mix

Botanical name	Common name
Baumea rubiginosa	Soft Twigrush
Bolboschoenus caldwellii	Club Sedge
Bolboschoenus fluviatilis	River Bulrush
Carex appressa	Tall Sedge
Ficinia nodosa	Knobby Club Rush
Gahnia sieberiana	Red-fruited Saw-sedge
Juncus usitatus	Common Rush
Philydrum lanuginosum	Frogsmouth
Schoenoplectiella mucronata	Bog Bulrush
Schoenoplectus validus	Softstem Bulrush

C Weed species list

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

Weed control orders and weed control classes referred to here can be found in the Noxious Weeds Act 1993 No 11.

Noxious Weed List 2014 - Order No30.

clarence VALLEY COUNCIL

NOXIOUS WEEDS OFFICE

The following weeds are declared noxious under Section 7 -Weed Control Orders of the *Noxious Weeds Act 1993 no.11*. This list is generated from Order No. 30 published in the NSW Government Gazette no. 23, effective 28 February 2014 as declared under authority by the Executive Director, Biosecurity NSW – Department of Primary Industries.

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

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

Class 1 – State Prohibited Weeds *notifiable*

Legal requirements for Noxious Weed Class:-
The plant must be eradicated from the land and the land kept free of the plant.
The control objective for this weed class is to prevent the introduction and establishment of those plants in NSW.

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

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

Noxious Weed List 2014 - Order No30.

Class 2 – Regionally Prohibited Weeds *notifiable*

Legal requirements for Noxious Weed Class:-
The plant must be eradicated from the land and the land kept free of the plant.

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

Characteristics (as per Section 8 (2)(b)):*Class 2 noxious weeds are plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.*

Aleman grass	*Echinochloa polystachya*
Alligator Weed	***Alternanthera philoxeroides***
Asparagus fern	*Asparagus virgatus* (syn. *Protasparagus virgatus)*
Bellyache bush	*Jatropha gossypiifolia*
Cecropia	*Cecropia* spp.
Climbing asparagus	*Asparagus africanus* (syn. *Protasparagus africanus*)
Grey sallow	*Salix cinerea*
Hygrophila	*Hygrophila costata*
Long-leaf willow primrose	***Ludwigia longifolia***
Ming (Pom pom/zig zag)	*Asparagus macowanii* var. *zuluensis* (syn. *A retrofractus*)
Paper mulberry	*Broussonetia papyrifera*
Sicklethorn	*Asparagus falcatus*

Class 3 – Regionally Controlled Weeds – Part 1

Legal requirements for Noxious Weed Class:-
The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed.

The control objective for this weed class is to reduce the area and the negative impact of those plants in parts of NSW.

Characteristics (as per Section 8(2)(c)):*Class 3 noxious weeds are plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.*

Chinese celtis	***Celtis sinensis***
Cockspur coral tree	***Erythrina crista-galli***
East Indian hygrophila	***Hygrophila polysperma***
Honey locust	***Gleditsia triacanthos***
Mahonia/ Chinese holly	*Berberis lomariifolia* (syn. *Mahonia lomariifolia*)
Montpellier broom/Cape broom	*Genista monspessulana*
Mother-of-Millions	***Bryophyllum daigremontianum, Bryophyllum delagoense, Bryophyllum x houghtonii, Bryophyllum pinnatum, Bryophyllum prolifer***
White blackberry/Mysore raspberry	*Rubus niveus*

Class 3 – Regionally Controlled Weeds – Part 2

Legal requirements for Noxious Weed Class:-
The plant must be fully and continuously suppressed and destroyed.
The control objective for this weed class is to reduce the area and the negative impact of those plants in parts of NSW.

Characteristics (as per Section 8(2)(c)): *Class 3 noxious weeds are plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.*

Broad-leaf pepper tree	***Schinus terebinthifolius***
Chinese tallow tree	***Triadica sebifera***
Giant devils fig	*Solanum chrysotrichum*
Giant rat's tail grass	***Sporobolus pyramidalis***
Green cestrum	***Cestrum parqui***
Groundsel bush	***Baccharis halimifolia***
Kudzu	***Pueraria lobata***
Mysore thorn	***Caesalpinia decapetala***
Salvinia	***Salvinia molesta***
Yellow bells	***Tecoma stans***

Class 4 – Locally Controlled Weeds

Legal requirements for Noxious Weed Class:-
The growth of the plant must be managed in a manner that continuously inhibits its reproduction.
***Note: Where indicated -* # - The plant may not be sold, propagated or knowingly distributed (whole of NSW).**
The control objective for this weed class is to minimise the negative impact of those plants on the economy, community or environment of NSW.

Characteristics (as per Section 8 (2)(d)):*Class 4 noxious weeds are plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.*

Bathurst/ Noogoora burrs	***Xanthium* spp.**
Bitou bush #	***Chrysanthemoides monilifera* subspecies *rotundata***
Black willow #	***Salix nigra***
Blackberry #	***Rubus fruticosus* aggregate spp. except cultivars**
Camphor laurel #	***Cinnamomum camphora***
Cat's claw creeper	***Dolichandra unguis-cati* (syn. *Macfadyena unguis-cati*)**
Chilean needle grass #	*Nassella neesiana*
Harrisia cactus #	*Harrisia* spp
Lantana #	***Lantana* spp.**
Madeira vine	***Anredera cordifolia***
Pampas grass	***Cortaderia* spp.**
Prickly pear	***Cylindropuntia* spp.**
Prickly pear	***Opuntia* spp. except *O. ficus-indica***
Privet (Broad leaf)	***Ligustrum lucidum***
Privet (Narrow leaf/Chinese)	***Ligustrum sinense***
Rhus tree #	*Toxicodendron succedaneum*
Serrated tussock #	*Nassella trichotoma*
St John's wort #	*Hypericum perforatum*
Water hyacinth #	***Eichhornia crassipes* (Class 2 elsewhere in state)**

Note: Class 4 Weeds where # is only legal requirement:

African boxthorn	Lycium ferocissimum
Arrowhead	***Sagittaria calycina* (syn. *S. montevidensis*)**
Asparagus	***Asparagus* spp. (except those listed above)**
Bridal creeper	*Asparagus asparagoides*
Climbing asparagus fern	*Asparagus plumosus* (syn. *Protasparagus plumosus*)
Fireweed	***Senecio madagascariensis***
Flax-leaf broom	*Genista linifolia*
Giant reed/ Elephant grass	***Arundo donax***
Ground asparagus	***Asparagus aethiopicus* (syn. *Protasparagus aethiopicus*)**
Leafy elodea/Dense waterweed	***Egaria densa***
Lippia	*Phyla canescens*
Sagittaria	*Sagittaria platyphylla* (syn. *Sagittaria graminea* variety *platyphylla*)
Scotch broom/ English broom	***Cytisus scoparius* subspecies *scoparius***
Silver-leaf nightshade	*Solanum elaeagnifolium*
Willows	*Salix* species except S. *babylonica, S.* x *reichardtii, S.* x *calodendron, S. cinerea* and *S. nigra*

Class 5 – Restricted Plants *notifiable*

Legal requirements for Noxious Weed Class:-
The requirements in the *Noxious Weeds Act 1993* for a notifiable weed must be complied with.
The control objective for this weed control class is to prevent the introduction of those plants into NSW, the spread of those plants within NSW or from NSW to another jurisdiction.

Characteristics (as per Section 8 (2)(e)):
Class 5 noxious weeds are plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.

African feather grass	*Cenchrus macrourum* (syn. *Pennisetum macrourum*)
African turnip weed	*Sisymbrium thellungii* and *S. runcinatum*
Annual ragweed	***Ambrosia artemisiifolia***
Artichoke thistle	*Cynara cardunculus*
Athel pine	*Tamarix aphylla*
Bear-skin fescue	*Festuca gautieri*
Burr ragweed	***Ambrosia confertiflora***
Cabomba	**All *Cabomba* species except *C. furcata***
Cayenne snakeweed	*Stachytarpheta cayennensis*
Clockweed	*Oenothera curtiflora* (syn. *Gaura parviflora*)
Corn sowthistle	*Sonchus arvensis*
Dodder	***Cuscuta* spp. except *C. australis, C. tasmanica* and *C. victoriana***
Espartillo	*Amelichloa brachychaeta, Amelichloa caudata*
Fine-bristled burr grass	*Cenchrus brownii*
Fountain grass	*Cenchrus setaceum* (syn. *Pennisetum setaceum*)
Gallon's curse	*Cenchrus biflorus*
Gamba grass	*Andropogon gayanus*
Glaucous star thistle	*Carthamus glaucus*
Golden thistle	*Scolymus hispanicus*
Mexican poppy	***Argemone mexicana***
Mossman River grass	***Cenchrus echinatus***
Red rice	*Oryza rufipogon*
Smooth-stemmed turnip	*Brassica barrelieri sub oxyrrhina*
Soldier thistle	*Picnomon acarna*
Texas blueweed	*Helianthus ciliaris*
Yellow nutgrass	*Cyperus esculentus*

D SPIR environmental measures

Table D-1: SPIR environmental measures.

Issue	ID number	Previous number	Environmental management measure	Timing	Relevant	Applicable to sections 3 and 4
Noise wall visual impacts	UD1	UD1	If further noise modelling identifies that noise walls are required, further visual assessment address the visual implications of the change. Their location and design will be in accordance with the Noise Wall Design Guideline (RTA, 2007) and the principles identified in Working Paper – Urban design, Landscape Character and Visual Impact (Section 4.6.3).	Pre-construction	All	The noise wall is located at Tyndale, within the highway corridor about half way between the northern and southern half-interchanges on the west side of the highway. (Chapter 8)
Landscaping and planting strategy	UD3	UD3	The project will be carried out in accordance with the urban design and landscaping strategy, as identified in Section 11.4.1 of this EIS. Detailed landscape design for all project batters, and median planting areas will be developed in accordance with the Landscape Guidelines (RTA, 2008), the requirements of the Working Paper – Biodiversity (Section 5.2.2) and the landscape strategy to provide a robust, successful and effective planting design.	Pre-construction	All	The urban design concept plans are based on the stratgies identified in the EIS and SPIR documents (Chapter 7).
Design of urban design features and road furniture	UD4	UD5	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	All	The design adopts a consistent approach to ensure all project elements are integrated in terms of their overall composition, materials and finishes (Chapter 9).
Visual impacts from viewpoints	UD6	UD7	Measures to mitigate visual impacts to viewpoints will be implemented, as identified in Table 11-42 and Working Paper – Urban Design, Landscape Character and Visual Impact. If any further viewpoints were identified during detailed design that have a moderate–high or high impact, screen planting also be considered.	Construction	All	An assessment with EIS and SPIR visual assessment is illustrated and a summary is provided (Chapter 6 and Chapter 7).

Issue	ID number	Previous number	Environmental management measure	Timing	Relevant	Applicable to sections 3 and 4
Visual impacts of ancillary facilities	UD8	UD9	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	All	A strategy for dealing visual impacts is indicated in Chapter 6 and Chapter 7.
Visual impacts of ancillary facilities	UD9	UD10	Typical landscape treatments for ancillary facilities in agricultural areas will include: • 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	All	A strategy for dealing visual impacts is indicated in Chapter 6 and Chapter 7.

E Compliance with threatened species management plans

Table E-1: Mitigation measures related to landscape and urban design applicable to sections 3 and 4.

Threatened Species Management Plan Compliance	Mitigation measures related to landscape and urban design that are applicable to sections 3 and 4
Threatened flora management plan.	Targeted weed management measures will be considered for each section fo 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. Revegetation with native species reflective of the local area and pre-disturbed vegetation communities where possible will occur post construction. Revegetation design of areas adjacent to in-situ threatened plant populations will ensure the planting will not impact on the species (eg will not compete for light or moisture) and are consistent with their habitat requirements. Seeds and other propagation material to be collected from threatened plants prior to clearing work.
Threatened glider management plan.	Provision of glide poles targeting Yellow-bellied Glider and Squirrel Glider (Chapter 7.1). Implementation of the UDLP that considers threatened glider population, habitat and revegetation of the habitat areas, including strategic revegetation around crossing structures and in disturbed areas.
Threatened mammal management plan.	Please refer to Chapter 7.1.
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.
Coastal emu management plan.	Permanent fauna exclusion fencing throughout sections 3 and 4. Fauna connectivity structures throughout sections 3 and 4.
Threatened mammal management plan.	Disturbed known and potential habitat areas within the project are to be revegetated progressively through and at the end of construction. Revegetation around fauna connectivity structures using appropriate habitat species for the targeted threatened mammals.
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.

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F Landscape outcomes

The landscape works to be carried out as part of the project upgrade will take time to develop as the new vegetation is established and grows. These changes are illustrated by Figures F1 to 113.

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

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

Figure F1: Ballina Bypass February 2011.

Figure F2: Ballina Bypass January 2015.

Figure F3: Bonville Koala Bridge September 2008.

Figure F4: Bonville Koala Bridge February 2009.

Figure F5: Bonville Koala Bridge September 2011.

Figure F6: Devils Pulpit rest area seeding August 2014.

Figure F7: Devils Pulpit rest area seeding January 2015.

Figure F8: Glenugie upgrade April 2011.

Figure F9: Glenugie upgrade July 2012.

Figure F10: Glenugie upgrade August 2013

Figure F11: Glenugie upgrade August 2014.

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G Community Consultation Report for the Urban Design and Landscape Plan, February 2017

Please note this is a project wide report.

Roads & Maritime

Woolgoolga to Ballina, Pacific Highway upgrade

Community Consultation Report for the Urban Design and Landscape Plans

February 2017

Executive summary

The Woolgoolga to Ballina Pacific Highway upgrade will duplicate about 155 kilometres to four-lane divided road from about six kilometres north of Woolgoolga (north of Coffs Harbour) to about six kilometres south of Ballina. The project does not include the completed Devils Pulpit and Glenugie upgrades.

Community feedback was sought on the draft urban design and landscape management plans for the area from Glenugie to the Ballina bypass, excluding the new bridges over the Clarence and Richmond rivers.

The community was able to provide feedback on the plans from 1 August to 29 August 2016. Consultation activities during this time involved:

- sending more than 500 letters to stakeholders with property within 750 meters of the project alignment
- distributing a community update to more than 20,000 residents
- staffed displays at 11 locations
- static displays at 27 locations
- updating the project website to with the draft urban design and landscape management plans, community update as well as an online survey and collaborative mapping tool to capture feedback
- emailing and SMS messages to more than 1000 stakeholders registered in the project database
- advertising in four local newspapers.

A total of 12 responses were received, six written and six survey. Survey responses were anonymous. Written responses included:

- five from individuals and one from a community organisation
- three responses relating to the Richmond River to Ballina area, two relating to Glenugie to Maclean and one related to Devils Pulpit to Richmond River

The six survey responses provided overall comment on the urban design and landscape plans. One respondent offered general support, two respondents did not offer general support and four respondents offered no position.

Key issues raised by the community include the visual amenity, vegetation types, noise and koala management, visual screening, landscaping design and the community consultation process. In response to community feedback the public display period was extended from 19 August to 29 August 2016.

The project team appreciates the time groups and individuals have taken to review the information and the feedback received will assist us in finalising the urban design and landscape plans.

The community also provided feedback on proposed design refinements. These issues have been addressed in the proposed design refinement community consultation report, which will be made publically available on the project website.

A separate consultation process was carried out for the draft urban design and landscape plan for the new bridge over the Clarence River at Harwood. Consultation activities and key issues raised will be made publically available on the project website in the community consultation report for the urban design and landscape plan for the new bridge over the Clarence River at Harwood.

A separate consultation process will also be carried out for the draft urban design and landscape plan for the new bridge over the Richmond River at Broadwater.

Contents

1. Introduction 6
1.1. The purpose of this report 6
2. Consultation approach 6
2.1. Consultation objectives 6
2.2. Values 6
2.3. How consultation was done 6
3. Consultation summary 8
3.1 Overview of feedback 8
2.3. Overview of issues raised 8
4. Next steps 14

1. Introduction

Draft urban design and landscape plans prepared for the Woolgoolga to Ballina, Pacific Highway upgrade include:

- Glenugie to Maclean
- Maclean to Devils Pulpit
- Devils Pulpit to Richmond River
- Richmond River to Pimlico.

These plans outline the proposed visual identity for the project, providing information about:

- the design vision visually linking the Woolgoolga to Ballina upgrade to the rest of the Pacific Highway
- urban design and landscaping objectives
- assessment of visual precincts and potential impacts
- proposed vegetation types, road furniture and lighting and along the alignment.

1.1. The purpose of this report

This report documents the consultation carried out as part of the public display of the urban design and landscape plan. It records the key issues raised and provides responses to the feedback received.

2. Consultation approach

2.1. Consultation objectives

Consultation with the community and stakeholders was carried out to obtain feedback from the about proposed urban design and landscaping to consider and where appropriate include in the final urban design.

2.2. Values

The Woolgoolga to Ballina upgrade team values collaborating with communities and key stakeholders to create better outcomes for the Woolgoolga to Ballina Pacific Highway upgrade.

2.3. How consultation was done

Consultation activities during the public display period, from 1 August to 29 August 2016 focused on:

- providing information about the urban design and landscape plans
- providing opportunities to discuss the plan with the Woolgoolga to Ballina upgrade team
- inviting feedback.

Table 1 details the consultation approach for the urban design and landscape management plans.

Table 1: Consultation approach

Consultation Approach	Consultation Outcome
Letter to affected stakeholders	Letters were distributed to more than 500 potentially affected stakeholders advising of the public display of urban design and

	landscape plans and opportunity to provide feedback.
Community update	August 2016 project update with latest project information was distributed to more than 20,000 households along the alignment.
Staffed pop-up sessions	11 staffed pop-up sessions provided the opportunity to ask the Woolgoolga to Ballina upgrade team questions about the urban design and landscape plans. Pop-up sessions were held at New Italy, Tucabia, Wardell, Yamba, Harwood, Woodburn, Evans Head, Grafton, Maclean, Ashby and Meerschaum Vale.
Static displays	Static displays were set-up in 27 locations. There were two types of display – primary and satellite. Primary display locations were Ballina Shire Council, Ballina Library, Richmond Valley Council, Evans Head Library, Clarence Valley Council, Grafton Library, Pacific Highway Office, Maclean Library, Clarence Valley Council. Consultation material provided at the nine primary displays included: one copy of each urban design and landscape plan (4), community updates, display poster advising how to provide comment, feedback survey. Consultation material provided at the 18 satellite displays included a copy of the urban design and landscape management plan specific to the display location, community updates and display poster advising how to provide comment.
Webpage	The urban design and landscape plans were available on the Roads and Maritime project website additional information available included the August 2016 community update, collaborative mapping tool and feedback survey which did not provide any response.
Newspaper advertisements	The display locations and website link were advertised in Woolgoolga Advertiser, Grafton Daily Examiner, Grafton Coastal Views and Lismore Northern Star.

Community members and key stakeholders were encouraged to provide their feedback at staffed displays, by completing feedback surveys or providing a response by mail, email or phone. Feedback on the plans was accepted until 5.00pm, Monday 29 August 2016.

The feedback surveys were anonymous and sought to confirm general support for the draft urban design and landscape plans. Feedback surveys included free text fields. The free text fields were reviewed to understand any issues that may have provided additional information, or correlated with written submissions.

Table 2 lists the written submission respondent groups and response number and where these issues are address in the urban design and landscape plans. Where similar issues have been raised in different submissions, only one response has been provided.

Table 2: Written responses, assigned identification number and issues addressed

Respondent	Identification number	Where issues are addressed in urban design and landscape plans
Individual 1	1	Glenugie to Maclean: 6.6, 7, 7.4.2
Individual 2	2	Glenugie to Maclean: 6.6, 7
Friends of the Koala Inc	3	Richmond River to Ballina: 2.3, 2.4, 2.5 , 6.3.3, 7, 8.3.1.2
Individual 4	4	Richmond River to Ballina: 2.5, 4, 7
Individual 5	5	Devils Pulpit to Richmond River: 7, 8.1.8
Individual 6	6	Richmond River to Ballina: 4, 7

3. Consultation summary

3.1 Overview of feedback

A total of 12 responses were received about the urban design and landscape plans. This included six written submissions and six anonymous feedback surveys.

Written responses included:

- five responses from individuals and one from a community organisation
- three responses relating to the Richmond River to Ballina area, two relating to Glenugie to Maclean and one related to Devils Pulpit to Richmond River

The six survey responses provided overall comment on the urban design and landscape plans. One respondent offered general support, two respondents did not offer general support and four respondents offered no position.

2.3. Overview of issues raised

Key issues identified by frequency include:

- visual screening and vegetation types (three respondents)
- noise and koala management (two respondents)
- visual amenity, landscaping and community consultation (single respondents).

A number of survey respondents highlighted the community consultation process, specifically the time available to comment on the plans. In response to this feedback the public display period was extended from 19 August to 5.00 pm, Monday 29 August 2016. This extension was communicated through three media releases and more than1000 SMS and email updates to the project's stakeholder distribution list.

Table 3 outlines the issues raised, the Woolgoolga to Ballina upgrade team response and respondents identification number.

Table 3 Response to issues raised in written submissions

Issue	Description	Response	Identification number
Visual Screening	Screening for properties through preserving vegetation and proposed revegetation. Headlight glare potentially affecting a property adjacent to Woodburn Evans Head Road overpass	Modifications to the landscape design have been made to provide additional plantings within the corridor to assist with visual screening in the Whytes Lane area. Chapter 7 of the Richmond River to Ballina plan includes the revisions to drawings which show landscape screening in the Whytes Lane area. This will provide vegetation screening on the west side of the highway within the corridor, from the properties on the Blackwall Range. It should be noted that the landscape will take five to eight years from the time of planting to provide visual screening. The project team has assessed the respondent's proximity to the location of the overpass and considered the likelihood of impacts relating to headlight glare, Upgrading the Pacific Highway Design Guidelines, March 2015. Detailed information about the overpass and visual screening is available in Chapters 7 and 8 of the Devils Pulpit to Richmond River urban design and landscape plan.	4, 5 and 6
Vegetation Type	Use of palm trees in the Glenugie section Preference for native species of vegetation, vegetation screening and mounds Vegetation near rear of properties should be limited to small trees and bushes Vegetation planning to support Koala population	The project team confirms that palm trees have not been proposed in the landscape plan in the Glenugie area. However, native species of palm trees may be considered or selected as a feature tree for limited use, such as at rest areas and interchanges in other parts the new highway alignment. The project team can also confirm that the existing trees near a respondent's property at (between the upgrade and the property) are identified to be retained. Landscaping within the upgrade at this location is proposed to be mixed shrubs. Every effort is being made in this area and across the project to reduce clearing impacts. With respect to vegetation planning to support Koala population, the Ballina Koala Plan (which includes a detailed population viability analysis) and the subsequent Koala Management Plan was approved in August 2016, as part of the project's Conditions of Approval. This approval was received during the proposal's public display period. The approved plans contain a Koala Revegetation, which outline the location and species of additional plantings, and support the finalisation of the Connectivity Strategy. These documents are being prepared by specialist consultants to ensure their applicability and relationship to the Ballina Koala Plan. It is acknowledged that some of the connectivity structures are specifically located to take advantage of plantings in the future. The Ballina Koala Plan, Koala Management Plan and associated documents are available through the project website. The project team acknowledges the interest and the need for ongoing consultation with stakeholders and landowners to foster understanding and best management of the koala during the construction process. Landscaping including vegetation screening has been included in the draft Urban Design and Landscape Plan, noting that earth mounds may be utilised as part of the construction process where it meets Environmental Protection Authority requirements.	1, 2 and 3.

Noise and acoustic assessment	Noise - assessment and monitoring	Noise assessments have been carried out as part of the EIS and impacted properties have been identified. In line with the EIS, the upgrade design has not incorporated noise walls. However, the project team can confirm that the detailed design process has included additional acoustic assessment for proposed changes identified during the design refinement process. This additional assessment aims to ensure that any changes in noise impacts are mitigated in accordance with Roads and Maritime Services guidelines.	2 and 5

Koala management	Management of species, habitat and connectivity as part of the upgrade	The project team acknowledges the relationships that have been established with Friends of the Koala Inc, adjacent landowners and other key stakeholders along the project alignment, and its commitment to continue to engage with interested stakeholder groups and project neighbours relating to koala management as part of the project's delivery. The Ballina Koala Plan (which included a detailed population viability analysis) and the subsequent Koala Management Plan was approved in August 2016, as part of the project's Conditions of Approval. This approval was received during the proposal's public display period. The approved plans contain a Koala Revegetation Strategy and Koala Habitat Planting Strategy, which outline the location and species of additional plantings, and support the finalisation of the Connectivity Strategy. These documents are being prepared by specialist consultants to ensure their applicability and relationship to the Ballina Koala Plan. It is acknowledged that some of the connectivity structures are specifically located to take advantage of plantings in the future. The Ballina Koala Plan, Koala Management Plan and associated documents are available through the project website. The details of the number and locations of connectivity structures are outlined in the approved Threatened Species Management Plans for the project. They are included in the approved Koala Management Plan and the Ballina Koala Plan. In terms of the proposed koala habitat tree planting, documents developed by Corkery Consulting outline the plan for land owned by Roads and Maritime Services and exclude a series of identified residential development lots. The Connectivity Strategy will detail the approach to connectivity structures and fauna fencing, utilising the baseline ecological survey information and investigations conducted as part of the Koala Management Plan. The issue of connectivity was addressed by Niche Environment & Heritage, who prepared the Koala Habitat Planting Strategy on behalf of Roads and Maritime Services. The location of fauna fencing is reflected in the urban design and landscape plan, and the project team will consult affected landowners before fences are installed. The project team acknowledges the interest and the need for ongoing consultation with stakeholders and landowners to foster understanding and best management of the koala	3 and 6

Visual amenity	Change to visual amenity	The project team acknowledge the upgrade will result in a change in landscape, particularly in areas where the new highway is built away from the current highway alignment. The environmental impact statement (EIS) assessed a number of visual precincts along the new highway alignment. It should be noted that the project team has clarified these assessments in specific reference to the submissions received. As detailed in the EIS, these areas have been assessed as appropriate for the project. With regards to submissions from the northern sections of the project, there significant amounts of plantings occurring both within the corridor and on adjacent Roads and Maritime Services land. These include additional Koala Food Tree plantings. The project team have assessed distances of households from the new road, the topography and the additional land to provide mitigation against direct visual impacts. Landscaping including vegetation screening has been included in the draft Urban Design and Landscape Plan for each section of the upgrade. Native plant and tree species (local to this area) have been selected for use in landscaping along the project alignment, with the project team also seeking to support landscape regeneration of the existing seedbank in topsoil in suitable locations.	6
Community and stakeholder consultation approach	Timeframe for responses to the proposals Providing ongoing opportunities for community participation	Public display of the urban design and landscape plans was 1-19 August 2016. The public display period was extended to 5.00 pm, Monday 29 August 2016 in response to community feedback. This extension was communicated through three media releases, more than1000 SMS and email updates to the project's stakeholder distribution list. The project team acknowledges the level of interest that community members and organisations have in the development and delivery of the Woolgoolga to Ballina upgrade. Community members, stakeholder groups and organisations are encouraged to contact the project team by phone or email to be included on the project stakeholder distribution list.	3

4. Next steps

In response to community feedback changes to the urban design and landscape plans include additional plantings within the corridor to assist with visual screening.

The revised urban design and landscape plans and supporting documentation will now be submitted to the NSW Department of Planning and Environment for consideration and approval.

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February 2017
RMS XX.XXX
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H Woolgoolga to Ballina Landscape Management Plan

Woolgoolga to Ballina Pacific Hwy. Upgrade - Landscape Management Plan

1. Introduction

A key component of the Pacific Highway upgrade between Woolgoolga and Ballina is the creation of a high quality, robust and sustainable landscape that is integrated with the different landscape types that the highway corridor passes through. The required landscape outcomes that described in the Project EIS include:

- 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.

The Conditions of Consent issued for the Project also include a number of conditions that relate specifically to achieving the landscape outcomes, which include:

UD3 Landscaping and planting strategy

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.

UD13 Monitoring of landscaping and rehabilitation

Landscape and rehabilitation works will be monitored and remedial measures implemented where required until vegetation has stabilised.

The Urban & Landscape Design Plan Report to which this LMP forms an appendix describes how the landscape design responds to the conditions of consent and the required landscape outcomes.

The landscape works to be carried out as part of the Woolgoolga to Ballina Upgrade will take decades to fully develop as the new vegetation is established and matures. Consequently the landscape will need to be managed throughout the establishment period as well as over the longer term in order to ensure the project objectives are achieved.

This Landscape Management Plan (LMP) sets out how the highway corridor is to be managed in order to promote the cost effective and consistent management of roadside landscape vegetation established by the Pacific Highway upgrade. The primary approach is to encourage the establishment of local native plant species and focus on the more dominant and important species within the project.

The program of landscape management set out in this LMP aims to maximise the performance and appearance of the upgrade works, particularly at interchanges, overbridges, underpasses and rest areas.

23-02-2017

The LMP covers the period from construction completion, which includes the initial landscape management by Pacific Complete, and long term landscape management after responsibility is transferred to RMS, Councils and other organisations for various components of the landscape works.

This LMP is to be read in conjunction with the *Vegetation Management Clearing and Grubbing and Weed Management Plan,* which forms part of the *Construction Environmental Management Plan (CEMP)* for the Woolgoolga to Ballina section of the Pacific Highway upgrade.

2. Landscape Maintenance

Details of landscape maintenance works are contained in an Appendix to Specifications R178 - Vegetation and R179 - Landscape Planting for the project. In general maintenance activities are to focus on the roadside, in the medians, along fences, footpaths, cycleways and at intersections, where visual and safety issues for both vehicle, cycle and pedestrian movement need to be constantly addressed.

Landscape management will take account of the different treatments used to implement the landscape works, which include:

- Revegetation by application of site specific seed mixes
- Planting
- Respreading recovered bushland topsoil

In addition, landscape management must respond to different requirements resulting from the different treatments applied to:

- Cut batters
- Fill embankments
- Basins
- Fauna crossings

Maintenance activities include:

- Management and removal of non-frangible vegetation (trees within safety zones)
- Pruning of vegetation for safety (sight lines, overhanging branches, clearance to fencing etc)
- Control of weeds
- Rubbish removal
- Pests and diseases control
- Watering during establishment
- Replacement planting and /or reseeding due to failure.

Thinning operations will be carried out where necessary to reduce the density of vegetation or restore the required balance of plant species in particular areas of revegetation.

In addition to the landscape management requirements contained in the LMP, which apply to whole of the Woolgoolga to Ballina Upgrade project, a number of landscape situations within the highway corridor have particular maintenance requirements to achieve special visual, ecological or heritage performance outcomes; these are dealt with in the appendices to the R178 and R179 Specifications for each portion of the upgrade project.

Woolgoolga to Ballina Pacific Hwy. Upgrade - Landscape Management Plan

3. Threatened Species Management Plans

A series of Threatened Species Management Plans that address specific fauna species or fauna categories have been prepared for the project as required by the Conditions of Consent. These Plans include requirements for monitoring the habitat restoration performance.

In situations where the monitoring identifies the need for remediation activities they are to be coordinated with landscape management being carried out in accordance with this LMP in order to avoid any detrimental impacts on fauna or their habitat.

4. Weed Management

Noxious weeds as required to be removed in accordance with the *Noxious Weeds Act 1993.* Weeds are declared noxious under Section 7 -Weed Control Orders of the *Noxious Weeds Act 1993 no.11.* Lists of noxious weeds for local government areas are generated from Orders published in the NSW Government Gazette.

Environmental weeds that compete with and suppress growth of vegetation established by the landscape works are to be removed without damaging other plants.

5. Vegetation Pests & Disease

Regular inspections of the landscape works are to include identification of any outbreaks of pests or disease. Where necessary samples are to be collected and sent for testing to confirm the pest species or type of disease. A program of control based on recommendations of the testing organisation is to be implemented and monitored to confirm effective control has been achieved.

6. Soil Conditions

Unsatisfactory vegetation growth and plant death may result from poor soil conditions that may include nutrient deficiencies or physical condition of the soil. Testing of soil and plant material will be required to determine the cause of the problem and identify appropriate remediation measures to be implemented.

In some situations plant die back may result from the spread of root pathogens such as Phytophthora cinnamomi. If testing confirms the presence of this pathogen then a Threat Management Plan is to be prepared to protect threatened species and ecological communities listed under the EPBC Act and other vegetation communities associated with the highway corridor landscape.

The Plan will include:

- strategies to prevent the pathogen from spreading into areas that are not infected
- strategies to reduce the impacts in infested areas
- recovery actions for the conservation of biodiversity assets currently being affected.

The management activities will be monitored to confirm that effective control has been achieved.

7. Bushfire Management

Bushfire management within the highway corridor is to be coordinated with the relevant Rural Fire Services Brigade. Access tracks used by fire fighting vehicles will be maintained to ensure they are trafficable at all times. Where necessary the level of fuel will be reduced in collaboration with the RFS.

8. Flood Damage

Landscape works may be subject to damage by flooding, particularly scouring within the riparian zone as well as on cut slopes and fill embankments. Landscape management will include a procedure for inspections following flooding to identify areas of landscape damage. Particular attention is to be given to riparian zones and fauna underpasses as well as drains and basins.

Remediation works are to be carried out immediately in order to avoid further damage and to restore the ecological function of the area. Planning and implementation of the remediation works will aim to ensure the landscape outcomes are in accordance with the relevant Conditions of Consent and as described in the UDLP Report.

9. Slope Failure

In situations where vegetated slopes fail and surface soil and vegetation are damaged, the remediation works are to include revegetation with the same species mix as applied in the initial landscape works. Details of the slope treatment, including subsoil preparation, top soil depths, surface treatment and drainage are to be reviewed and modified if necessary to avoid the risk of future slope failure.

10. Climate Change

Climatic conditions are expected to change over the establishment period and throughout the subsequent decades over which the landscape matures.

The combination of changing rainfall patters and temperature regimes together with changes in storm event frequency and severity are expected to have significant implications for the suitability of some plant species and vegetation communities within the Woolgoolga to Ballina highway corridor. The implications of climate change for the health and viability of vegetation communities and their habitat function will need to be monitored and reviewed with the involvement of a qualified ecologist who has relevant expertise in this field.

Severe drought conditions have the potential to result in a substantial number of plant deaths, particularly during the establishment period. A comprehensive assessment is to be carried out during periods of severe drought to identify dead or dying vegetation. If it is apparent that a particular species has suffered significantly higher death rates then the option of replacing the species is to be discussed with an ecologist to ensure there will be no significant impact on habitat values of site. Revegetation will generally be carried out with the same mix of species as the original landscape works.

Woolgoolga to Ballina Pacific Hwy. Upgrade - Landscape Management Plan

11. Monitoring

Monitoring procedures will be adopted to assess if the revegetation has achieved an acceptable standard as measured against defined benchmarks. Areas of landscape that have failed will be clearly identified and the nature of the failure documented.

Based on the results of the monitoring program appropriate remedial action will be determined and implemented until vegetation has stabilised and the required standard of landscape standard is achieved.

Details of the monitoring program are presented in the Landscape Maintenance Plan that forms an Appendix to the Pacific Complete Specifications R178 - Vegetation and R179 - Landscape Planting for each Portion of the Woolgoolga to Ballina section of the Pacific Highway Upgrade.

Monitoring of the landscape works will commence from the time of installation and extend until maintenance responsibilities for various portions of the project are handed over to RMS or Councils.

Monitoring will be carried out in two phases:

- Initial maintenance period – monitoring to assess the trajectory of the outcomes after approval of the work until practical completion; the purpose is to enable timely intervention or corrective actions if required to ensure vegetation growth.
- Post-completion and pre-handover period – monitoring will continues for a period of three years from practical completion; the purpose is to ensure that each landscape area has reached a condition that indicates a high probability that the intended mature outcome will be achieved in the longer term and the area is in a condition to be handed over to RMS or to a the relevant Council, even if the landscape is semi-mature.

The monitoring program will include:

- Monthly audit using Score Card Method
- Quarterly (3 monthly) assessments using a Landscape Functional Analysis process involving a series of transects
- Annual reporting on the monitoring program outcomes together with recommendations for any required actions.

Monitoring will be carried out by an Assessment Group at pre-determined locations. The timing of the assessments will take account of the period since completion of the works and the landscape type. It is expected that some areas will need longer monitoring periods due to the vegetation type and method of establishment.

12. Landscape Management Responsibilities

Pacific Complete will be responsible for the initial management period that will extend for three years after completion of the highway upgrade works. At the end of the initial management period responsibility for various components of the project will be transferred to following organisations:

RMS

- Main alignment corridor including medians
- Water quality basins

Local Council

- Local roads and roundabouts
- Rest areas and public areas

Services providers

- Corridors and easements for access to power, water and communications infrastructure that may have vegetation clearance requirements will be coordinated with landscape management along the highway corridor.

13. Landscape Management Staff

A landscape management team will be established and led by a suitably experienced manager. All members of the team will be required to have the necessary knowledge and skills to effectively carry out the various landscape management tasks for which they are responsible.

Training will be carried out where necessary to ensure all members of the landscape management team have a clear understanding of the intended outcome of the landscape revegetation program. In addition, all field staff will receive training as necessary to ensure they can recognise weed species as well as native species that form part of the revegetation program.

The landscape management team will seek advice from a revegetation specialist as necessary to address specific issues. The landscape management team will also obtain advice from suitably qualified ecologists who will provide specific advice on the coordination of landscape management activities with the various Threatened Species Management Plans applicable to the Woolgoolga to Ballina section of the Pacific Highway Upgrade.

14. Built Elements Maintenance

Policy regarding maintenance of built elements (bridges, retaining walls and such elements) is provided by the RMS Infrastructure Maintenance Program. Information about the Policy is available on-line at:

http://www.rms.nsw.gov.au/projects/key-build-program/maintenance/index.html

Maintenance of built elements that are specific to the Woolgoolga to Ballina section of the Pacific Highway Upgrade is dealt with in the Maintenance Access Strategy for each Section of the project and is monitored by RMS.

I Agency design review

PACIFIC COMPLETE

AGENCY DESIGN REVIEW			
Document title:		A-84-LX-01 Glenugie to Maclean Sections 3 and 4	**Document no.** W2B-GHD-A-LX-RPT-00001-SDD
Designer/originator:		GHD / CM+	**Lot No.**
Agency		DPI, EPA, Clarence Valley Council	
Reviewer comment summary and close-out (insert additional rows as required)			

Agency	Reference/item	Reviewer comment (refer attached sheets where applicable)	Designer/originator response	Reference in UDLP
NSW DPI Fisheries	Planting of riparian vegetation species including plants such as Lomandra hystrix and sedges known to bind embankments and resist erosion at creek crossings will be planted directly adjacent to the scour protection both top and bottom	There does not appear to be a commitment to soft scour treatment	Soft scour treatments have been included in the design near identified fauna connectivity and drainage structures. This design has been developed based on existing RMS Pacific Highway Design Guidelines and recent highway upgrade projects.	Chapters 11.0 12.0
NSW DPI Fisheries		NSW DPI supports the use of logs with rootballs attached to enhance realigned creeks	DPI support for reuse of rootballs is noted.	Chapter 11.3
NSW DPI Fisheries		NSW DPI Would like to see a commitment in the plan to creeks and rivers being planted/rehabilitated as soon as they are constructed to both prevent erosion at the site and to restore shading and habitat as quickly as possible	The support for early establishment and rehabilitation of creek zones is noted. RMS is committed to install the landscape treatments as outlined in the UDLP. Where reasonable and feasible the establishment of creeks zones treatments will be early in the construction process. This is subject to the construction program and future works at those locations potentially impacting on rehabilitated works.	Chapter 11.3
EPA		The EPA notes that the fencing specifications are under review and will be finalised for IFC. The EPA supports fauna fencing being placed as close to the pavement as possible.	EPA comments on fencing principles noted.	Chapter 7.1
EPA		The EPA Biodiversity team are paricularly concerned about details of the proposed fauna path treatments and Riparian revegetation. We would like to see these details captured in construction drawings or in an early (UDLP) attachment that can be issued with the design drawings to enable progressive riparian revegetation from as early a stage in construction as possible.	The support for early establishment and rehabilitation of creek zones is noted. RMS is committed to install the landscape treatments as outlined in the UDLP. Where reasonable and feasible the establishment of creeks zones treatments will be early in the construction process. This is subject to the construction program and future works at those locations potentially impacting on rehabilitated works.	Chapters 12.1 and 12.2
EPA		In both Riparian revegetation and fauna path treatment the EPA supports the use of soil/jute mat/plantings and the use of woody debris where possible and appropriate.	EPA support for the soft scour treatments and use of woody debris is noted.	Chapters 12.1 and 12.2
Clarence Valley Council		*RMS Note: Clarence Valley Council were invited to comment on the proposed UDLP in addition to the public display period however no formal response has been received to date.*		Chapter 3.0 and Appendix G

Record of task completion and agreement of comments			
Designer/originator – The above verification comments have been addressed and incorporated or responded to as appropriate.			
Designer/originator			
Signature:			
Date:			

PACIFIC COMPLETE

AGENCY DESIGN REVIEW

Document title:		A-84-LX-01	**Document no.** (where allocated):
Designer/originator:			**Lot No.**
Agency		Grafton Chamber of Commerce	

Reviewer comment summary and close-out (insert additional rows as required)

Agency	Reference/item	**Reviewer comment** (refer attached sheets where applicable)	**Designer/originator response**
Grafton Chamber of Commerce	General	Apologies for late submission.	Noted.
Grafton Chamber of Commerce	Southern approach	Could you please consider the Jacaranda Tree for which the Clarence Valley (and Grafton in particular) is so well known at the juncture of the new highway and the southern approach to Grafton. The Jacaranda Festival remains the primary tourist event for Grafton and the Clarence Valley.	The project team has reviewed the potential inclusion of Jacarandas near the Glenugie interchange and does not consider that they are appropriate for the interchange. Jacaranda Trees have invasive seeding properties, which were regarded as unsuitable as cultural plantings in the Glenugie Forest area. Feature plantings have been incorporated at this location, they are not Jacaranda trees. It is noted that the Grafton Bridge project includes specific feature plantings of Jacarandas to reinforce the entrance to the town at the southern end of Grafton Bridge project. This is considered the most appropriate place for these plantings rather than the W2B project.
Grafton Chamber of Commerce		A row of Jacarandas o neither side of the approach road and visible from the highway would do much to remind passing travellers of Grafton and encourage them to visit and tour the Clarence Valley. If possible, plantings on both sides of the entry to the approach road for a kilometre would be ideal.	Noted. As outlined above Jacarandas are not included in the proposed plantings schedules at this location. Directional and tourist signage is considered and outlined in the project signage strategy developed to MCoA D17 and D18, which is separate to the UDLP reports.
Grafton Chamber of Commerce		Arborists have identified Jacaranda Mimosifolia would require trenches of approximately 2 metres wide by 2 metres deep back filled with good quality soil to be self-sufficient. The Grafton Chamber of Commerce has a Jacaranda Project committee that could supply the Jacaranda Trees for planting given notice.	Noted.

Record of task completion and agreement of comments			
Designer/originator – The above verification comments have been addressed and incorporated or responded to as appropriate.			
Designer/originator			
Signature:			
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