Pacific Highway Upgrade: Oxley Highway to Kundabung

Urban Design and Landscape Plan: Final Detailed Design

OH2Ku-UL01-RP-0001-C2

Prepared for:
Lend Lease

Prepared by:
HBO+EMTB Urban and Landscape Design

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Project:
Pacific Highway Upgrade: Oxley Highway to Kundabung

Urban Design and Landscape Plan: Final Detailed Design

Project number:
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A Introduction

A.1 Background

The Pacific Highway between Newcastle and Brisbane forms part of the Australian Government's AusLink National Network. The AusLink National Network comprises national, regional and urban transport corridors, links to ports and airports, and intermodal connections between road and rail. The Australian and NSW governments have been jointly upgrading the Pacific Highway since 1996.

The Oxley Highway to Kundabung project (the subject of this report) is part of the Oxley Highway to Kempsey upgrade of the Pacific Highway which is approximately 37 kilometres in length. The upgrade project commences approximately 700 metres north of the Oxley Highway interchange and ties into the Kempsey Bypass project just north of Stumpy Creek. The Oxley Highway to Kempsey upgrade project is jointly funded by the Australian and NSW governments.



Figure A.1.1 Regional Context

Roads and Maritime Services will procure and deliver the 37 kilometre long highway upgrade in three stages:

- An early works construct only contract for the new Sancrox interchange
- The Oxley Highway to Kundabung Project, which includes the design and construction of 23 kilometres of highway upgrade from 700 metres north of the Oxley Highway to Barrys Creek, Kundabung
- A construct only contract for 14 kilometres of highway upgrade from near Barrys Creek Kundabung to Stumpy Creek, south of Kempsey.

The Oxley Highway to Kundabung upgrade project is approximately 23 kilometres in length and comprises:

- Approximately 17 kilometres of upgrade to full motorway standard (Class M) between the Oxley Highway and Haydons Wharf Road
- Approximately six kilometres of upgrade to arterial highway standard (Class A) between Haydons Wharf Road and Barrys Creek, Kundabung with capability of being upgraded to full motorway standard at later date.

Approximately half of The Project is a duplication of the existing Pacific Highway. The remaining half of The Project deviates significantly from the alignment of the existing highway in the vicinity of the Hastings River and Wilson River flood plains. Where possible the existing highway will be retained for use as a service road or local road connection.

A.2 Purpose and Preparation

This Urban Design and Landscape Plan (UDLP) - Final Detailed Design has been prepared to present an integrated urban design for the Oxley Highway to Kundabung upgrade project as required, by the Minister of Planning and Infrastructure Conditions of Approval B20 discussed further under Section A.5. HBO+EMTB Urban and Landscape Design have prepared this report for Lend Lease Engineering in conjunction with the Design Joint Venture - Aurecon/ Parsons Brinckerhoff (APBJV) as the Consulting Engineers, as part of the Design and Construct Contract with Roads and Maritime Services.

A.3 Oxley Highway to Kempsey Overall Project Objectives

The objectives of the overall Oxley Highway to Kempsey Project, of which the Oxley Highway to Kundabung Upgrade forms part of, are described in Section 3.2 of the Environmental Assessment. These objectives take into account the broader Pacific Highway upgrade program objectives. The Project specific objectives, as stated in the Environmental Assessment, include:

- Develop a dual carriageway road with potential to reduce crash rates to 15 crashes per 100 million vehicle kilometres over The Project length
- Develop a refined design that meets or exceeds B-double requirements, including at intersections, where required
- Maximise the use of the existing road reserve, where possible
- Integrate input from local communities into the development of The Project through the implementation of a comprehensive program of community consultation and participation, consistent with Roads and Maritime increased customer focus
- Satisfy the technical and procedural requirements of Roads and Maritime with respect to the design of The Project
- Provide for transport developments that are complementary with land use
- Allow for all connections, modifications and improvements necessary to upgrade the existing highway where it is retained as part of The Project
- Consider delay management strategies to minimise disruption to local and through traffic and maintain access to affected properties and land during construction
- Provide flood immunity for a one in 100 year flood event
- Provide intersections designed to achieve at least a level of service C 20 years post-completion to accommodate the 100th highest hourly volume
- Develop solutions that address community expectations for access to the new highway
- Develop a refined design generally meeting the criteria for a 110 km/h design speed for the vertical alignment and horizontal alignment
- Ensure The Project outcomes achieve value for money
- Provide a strategy for future upgrades to be easily integrated into The Project from both engineering and environmental perspectives
- Minimise the need to modify the preferred route option and refined design during subsequent Project phases
- Provision of a safe worksite for both construction workforce and road users.

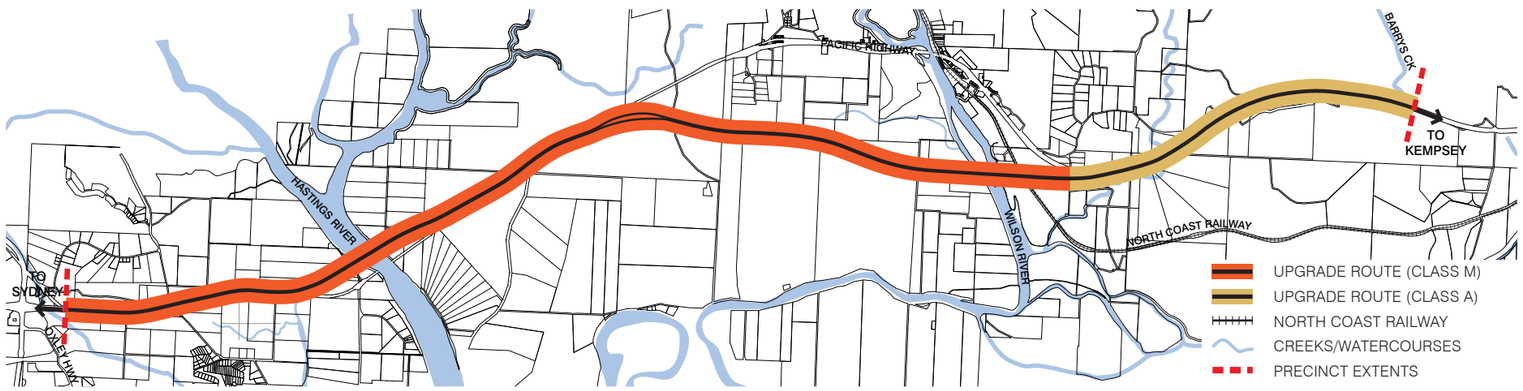


Figure A.1.2 Oxley Highway to Kundabung Project

A.4 Pacific Highway Urban Design Objectives

Urban design objectives particular to this project, and referred to under the Minister Conditions of Approval adjacent, have been discussed under Section C - Urban Design Strategy.

A.5 Minister's Conditions of Approval

On the 8 December 2006 The Project was declared by the then Minister for Planning and Infrastructure to be a project to which Part 3A of the Environmental Planning and Assessment Act 1979 applies. An Environmental Assessment was prepared and placed on public exhibition between September and October 2010. Following consideration of submissions made during the exhibition period, the submissions report, including changes to the proposal following consideration of submissions, was submitted to the then Minister for Planning and Infrastructure seeking approval. Approval of The Project was granted on 8 February 2012, subject to a number of Conditions of Approval (CoA) and Modifications post approval.

Following are the Minister's Conditions of Approval for The Project relating to urban and landscape design. The location where each specific condition is addressed in this Report is noted adjacent to the Minister's Requirement. Refer to Table A.5.1.

A.6 Community Consultation

The Urban Design and Landscaping Management Plan is relevant to all highway users and residents along the project alignment between Oxley Highway and Kundabung.

From August 2014, the Oxley Highway to Kundabung project team started consultation to seek community feedback on the proposed urban design and landscape measures outlined in the Plan.

A notification leaflet was letterbox dropped to 350 residents advising that theproposed urban design and landscape plans were on display for community comment. A static display was held from Monday 11 August to Friday 22 August 2014, allowing stakeholders to provide their comments and feedback. The Project website also had electronic versions of the plans. The static displays were held at:

- Port Macquarie Hastings Council office
- Kundabung Post Office
- Kempsey Shire Council
- RMS Motor Registry, Port Macquarie
- RMS Motor Registry, Kempsey

The displays housed a physical copy of urban design and landscape plans, summary fact sheet, feedback forms and sealed feedback form boxes. The displays enabled stakeholders to view the Plan, provide feedback and also contact the team to answer any questions.

In total, only one formal response was received, providing feedback on the UDLP. The feedback received was via the static displays.

A summary of submissions received and response to submissions is outlined in Table A.6.1.

Table A.5.1 Minister's Conditions of Approval

Minister for Planning and Infrastructure Requirement	Location in Report
Prior to Construction Requirements	
B20. The Proponent shall prepare and implement an Urban Design and Landscape Plan for the project. The plan shall be prepared in consultation with the relevant Council and shall present an integrated urban design for the project. The plan shall include, but not necessarily be limited to:	This report presents an integrated urban design for the project and was distributed for consultation with Port Macquarie - Hastings Council.
a. a principle goal of achieving the urban design objectives outlined in Table 17-4 of Volume 1 of the EA;	The urban design objectives have been achieved in the urban and landscape design outcomes. A description of the design strategy is provided in Section C Urban Design Strategy related to these objectives under C.2 in particular. Refer also Sections D - Bridges, E - Earthworks, Landform and Stabilisation, F-Landscape Design, G - Headlight Screens, and H - Road Furniture.
b. location of existing vegetation and proposed landscaping (including use of indigenous and endemic species where possible)and design features;	Existing vegetation communities are described under Section B.4 and retained landscaping with proposed landscaping illustrated in F6.2 Landscape Plans.
c. graphics such as sections, perspective views and sketches for key elements of the project (including but not limited to built elements such as retaining walls, cuttings and embankments, bridges and noise barriers);	There are no retaining walls in this project. For all other graphics describing the key elements of the project refer to Sections: D - Bridges, E - Earthworks, Landform and Slope, F - Landscape Design, G - Headlight Screens and H-Road Furniture.
d. a description of locations along the project corridor directly or indirectly impacted by the construction of the project (e.g. temporary ancillary facilities, access tracks, watercourse crossings, etc.) and details of the strategies to progressively rehabilitate regenerate and/or revegetate the locations with the objective of promoting biodiversity outcomes and visual integration. Details of species to be replanted/revegetated shall be provided, including their appropriateness to the area and considering existing vegetation and habitat for threatened species;	Refer to Section F - Landscape Design generally, but in particular to F.3 and F.4 for Planting and Seeding details; F4.5 Water Quality Basins; F4.6 Frog Ponds; F4.7 Creek Rehabilitation, Fish and Fauna Crossings, F4.8 Widened Medians and F4.9 Glider Crossings.
e. an assessment of the visual screening affects of existing vegetation and the proposed landscaping. Where residences and businesses have been identified as likely to experience high visual impact as a result of the project and high residual impacts are likely to remain, the Proponent shall in consultation with affected receptors, identify opportunities for providing at-receptor landscaping to further screen views of the project. Where agreed to with the landowner, these measures shall be implemented during the construction of the project;	An assessment has been provided in F4.12 identifying particular residences and businesses. Particular design treatments negotiated and consulted with affected residences and businesses are also described in this section and on the Landscape Plans.
f. strategies for progressive landscaping of other environmental controls such as erosion and sedimentation controls, drainage and noise mitigation;	Refer Section .4.4 Riverbank Stabilisation, F4.5 Water Quality Basins and F.5 Topsoil Management and Treatment. There is no noise wall mitigation required.
g. location and design treatments for any associated footpaths and cyclist elements, and other features such as seating, lighting (in accordance with AS 4282-1997 Control of the Obtrusive Effect of Outdoor Lighting), fencing, and signs;	There are no footpaths provided in this project. Cyclists are catered for in the road shoulder. There are no rest areas in this section of the Upgrade therefore no special seating and lighting is required. Section H describes the Road Lighting and Bus Shelter requirements.
h. evidence of consultation with the relevant council and community on the proposed urban design and landscape measures prior to its finalisation; and	Council and Community consultation have occurred and a summary is provided in Section A.6 adjacent to this table.
i. monitoring and maintenance procedures for the built elements and landscaping (including weed control) including responsibilities, timing and duration and contingencies where landscaping measures fail	Refer Section F.10 Landscape Management Report.
The Plan shall be submitted for the approval of the Director General prior to commencement of permanent built works and/or landscaping, unless otherwise directed by the Director General. The Plan may be submitted in stages to suit the staged construction program of the project.	Noted.

Table A.6.1 Issues and Responses

Community Submissions			
Stakeholder	**Date Received**	**Issue/ Comment**	**Response**
Cynthia McDonald, 528 The Hatch Rd Hacks Ferry	14/08/14	Request a row of trees along the highway adjacent to the property.	The landscape plan has been amended to include a row of 25 litre tree planting from Ch13400-Ch13900. Tubestock planting is also provided from Ch13950-Ch15500.

A.7 Study Methodology & Report Structure

The Study methodology is reflected in the report structure. The document is sequentially categorised as follows:

A Introduction

Roads and Maritime Project Objectives

- Statement of Roads and Maritime Project Objectives from the Environmental Assessment (EA) process.

Reference Sources/Document Review

- Examination of the Minister's Conditions of Approval
- A systematic review of Roads and Maritime documents, in particular the Environmental Assessments (EA), and those from other relevant sources to identify the urban and landscape design implications that these documents have upon the overall corridor.

B Contextual Analysis

- Brief local and regional contextual analysis of the road corridor in terms of built, natural and community constraints and opportunities. Includes site visits, view analysis - from site and detailed desktop review, aerial route alignment overlay to ensure:
  a. Familiarity with the route and its environmental and landscape context
  b. Ability to adequately develop a cohesive and integrated urban and landscape design vision and strategy for the road corridor
  c. Establishment of key site parameters impacting on the design development.
- Urban Design Opportunities and Issues - identification of urban and landscape opportunities and constraints, which informed further refinement of the Roads and Maritime Concept Design during the design development process.

C Urban Design Strategy

- Statement of an overall vision for The Project
- Statement of urban and landscape design project objectives for The Project
- Development of a cohesive set of urban and landscape design principles for the road corridor that reflect all previous route investigations, other base data gathered and reviewed, the above route appreciation and analysis and consistency with Roads and Maritime overall goals and objectives
- Description of the proposed urban and landscape design treatments by landscape character zone
- Presentation of a colour strategy diagram of The Project works at 1:20,000 scale.

D Bridges

- Presentation of a series of elevations at either 1:200, 1:250, 1:300, 1:400 or 1:500 scale to show appropriate level of detail
- Cross sectional elevations at 1:200 scale, with supporting text, which fully describe the urban design and landscape aspects of all proposed bridges including illustrating the overhang of the superstructure and the shape of the piers
- 3D Visualisations of Hastings River Bridge and Wilson River Bridge are provided as part of the River Bridges descriptions
- The bridges are ordered by visibility and type beginning with River Bridges, Transverse Bridges over the Main Carriageway (Overbridges), followed by Main Carriageway Bridges and lastly Culverts
  - River Bridges:
    - » SB04: Bridge over Hastings River at 15.6km North of Port Macquarie
    - » SB09: Bridge over Wilson River at 26.6km North of Port Macquarie.
  - Transverse Bridges over Main Carriageway (Overbridges):
    - » SB14: Blackmans Point Road Interchange Overbridge South at 18.1km North of Port Macquarie
    - » SB14: Blackmans Point Road Interchange Overbridge North at 18.1km North of Port Macquarie
    - » SB15: Bridge over Highway No.10 at Bill Hill Road Overpass at 21.6km North of Port Macquarie
    - » SB16: Haydons Wharf Road Interchange Overbridge at 28.1km North of Port Macquarie.
  - Main Carriageway Bridges (Underbridges):
    - » SB02: Twin Bridges over Fernbank Creek at 14.7km North of Port Macquarie
    - » SB03: Bridge over Hastings River Floodplain at 15.4km North of Port Macquarie
    - » SB05: Bridge over Hastings River Floodplain at 16.4km North of Port Macquarie
    - » SB06: Twin Bridges over Wilson River Floodplain at 23.3km North of Port Macquarie
    - » SB07: Twin Bridges over Wilson River Floodplain at 24.8km North of Port Macquarie
    - » SB08: Twin Bridges over Wilson River Floodplain at 25.7km North of Port Macquarie
    - » SB10: Bridge over North Coast Railway Line at 27.3km North of Port Macquarie
    - » SB11: Twin Bridges over Cooperabung Creek at 29.8km North of Port Macquarie
    - » SB12: Twin Bridges over Yarrabee Road at 32.2 km North of Port Macquarie
    - » SB13: Twin Bridges over Barrys Creek at 34.1km North of Port Macquarie.
  - Culverts:
    - » There are 28 box culvert locations throughout The Upgrade, many of which are fauna underpasses or combined drainage and fauna underpasses. Details are provided in Section D.4.

E Earthworks, Landform and Slope Stabilisation

- Presentation of dimensioned and annotated cross sections of all significant cuttings and embankments
- Schedule of finishes and selected illustrations for slope stabilisation
- Shotcrete Minimisation Methodology covering use and design appearance
- Drawings showing the application of shotcrete for rock seam stabilisation.

F Landscape Design

- A description of the landscape design methodology
- A description of the existing vegetation communities in The Project area
- A description of the proposed seed mixes, collection, treatment and storage
- A description of the proposed planting species proposed in The Project, described by type or location:
  - Interchanges and Underpasses
  - Floodplain
  - Riverbank
  - Water Quality Basins
  - Frog Ponds
  - Creek Rehabilitation, Fish and Fauna Crossings
  - Widened Medians
  - Glider Crossings
  - Long Stem Planting
  - Headlight Screening.
- A description of the proposed visual screening in The Project
- A description of the proposed Topsoil Management and Treatment
- A description and presentation of a series of colour concept plans at 1:4000 scale overlaid on an aerial photographic base, incorporating the existing vegetation, planting and seeding only areas, highlighting any overlap in planting and specifying plant species
- Presentation of Planting and Seeding Summary schedules with a planting palette showing plant images
- A description of the strategy and principles to maximise existing vegetation and methodology to protect existing vegetation including endangered species and sites of biodiversity
- Landscape Management Report – detailing all landscape maintenance actions for The Upgrade.

G Headlight Screens

Plans and information on urban design aspects of headlight screens for The Project including:

- Plan at 1:4000 scale showing the location and extent of the headlight screen
- Dimensioned and annotated cross sections through headlight screen demonstrating commitment to urban design requirements

H Road Furniture

- Road lighting - description and images
- Pedestrian and cyclist facilities description
- Bus Interchange and Bus Shelter.

A.8 Reference Sources/Document Review

The following documents and their principles in particular, have been utilised during the design process:

- RTA (April 2005) *Pacific Highway Urban Design Framework - Urban design guidelines for the SH10 from Hexham to Tweed Heads* RTA, Sydney, NSW
- RTA (July 2009) *Beyond the Pavement - RTA urban design policy, procedures and design principles* RTA, Sydney, NSW
- RTA (July 2003) *Bridge Aesthetics - Design Guidelines to Improve the Appearance of Bridges in NSW* RTA, Sydney, NSW
- RTA (July 2006) *Noise wall design guideline - Design guidelines to improve the appearance of noise walls in NSW* RTA, Sydney, NSW
- RTA (April 2008) *Landscape guideline - Landscape design and maintenance guidelines to improve the quality, safety and cost effectiveness of road corridor planting and seeding* RTA, Sydney, NSW
- RTA (June 2005) *Shotcrete Design Guidelines - Design guidelines to avoid, minimise and improve the appearance of shotcrete* RTA, Sydney, NSW
- RTA (November 2008) *Designing to Minimise Vandalism* (Final Draft) RTA, Sydney, NSW
- RTA (June 2003) *Procedure for Selecting Treatment Strategies to Control Road Runoff,* Version 1.1, RTA, Sydney, NSW
- Austroads (2003) *Guidelines for Treatment of Stormwater runoff from the Road Infrastructure* Austroads, Sydney, NSW
- NSW Department of Land and Water Conservation (1999) *Soil Landscape Series: 9435-9535, Soil Landscapes of the Kempsey - Korogoro Point 1:100,000*
- Department of Planning and Infrastructure (February 2012) *Major Project Assessment: Pacific Highway Upgrade - Oxley Highway to Kempsey (MP07_0090), Director General's Environmental Assessment Report* DOPI, Sydney, NSW
- GHD (September 2010) *Oxley Highway to Kempsey Upgrading the Pacific Highway Environmental Assessment* Main Volume - Chapter 17: Visual Amenity and Urban Design GHD, Sydney, NSW
- EDAW (April 2007) *Oxley Highway to Kempsey: Urban and Regional Design/ Landscaping Plan - Working Paper* EDAW, Sydney, NSW
- GHD (May 2010) *Pacific Highway Upgrade - Oxley Highway to Kempsey: Supplementary Urban Design and Landscaping Report* GHD, Sydney, NSW
- HBO+EMTB (December 2012) *Highway No.10 - Pacific Highway Upgrade Oxley Highway to Kempsey: Kundabung to Kempsey Concept Design Review Report 100%* Appendix J1, HBO+EMTB, Sydney, NSW
- HBO+EMTB (December 2012) *Pacific Highway Upgrade: Oxley Highway to Kempsey, 100% Urban and Landscape Concept Design Review Report* Report No.FCON-0001-OH2K-R-01, Issue B , HBO+EMTB, Sydney, NSW
- HBO+EMTB (April 2013) *Highway No.10 - Pacific Highway Upgrade Oxley Highway to Kempsey Kundabung to Kempsey Landscape Management Plan* Report No. FDDNUDL-0003-OH2K-R-01, HBO+EMTB, Sydney, NSW
- Roads and Maritime, (November 2012) *Weed and Pathogen Management Strategy Oxley Highway to Kempsey* Roads and Maritime, North Sydney, NSW
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- Roads and Maritime (2014) *Editorial Style Guide* Roads and Maritime, North Sydney, NSW.

B. Contextual Analysis

The purpose of this section of the report is to:

- Confirm the overall urban and landscape design approach established in The Project Environmental Assessment (EA) and subsequent concept design work by way of confirmation mapping and identification of design issues
- Present additional relevant information gained through our investigation of the route
- Synthesise key elements and issues for the urban and rural landscape that need to be addressed in the development of the overall design principles and concept design for the road corridor.

B.1 Regional Route Context

The Pacific Highway is the major eastern coastal route linking Sydney to Brisbane and functions as a major tourist, transport and freight route. The Oxley Highway to Kempsey project is located in the Mid North Coast Region of NSW, which extends from Port Stephens to the Clarence River. The project lies within the Port Macquarie - Hastings Council local government area. The costal township of Port Macquarie lies approximately five kilometres to the east of the southern extent of The Project.

Directly north of the Oxley Highway to Kundabung project is the Kundabung to Kempsey Construct Only project, which will link to the recently completed Kempsey Bypass and Macleay River Bridge. South of Port Macquarie, Herons Creek to Stills Road was also recently completed.

The Roads and Maritime Pacific Highway Urban Design Framework (2005) describes the road user experience of the Pacific Highway and in particular the area of the Oxley Highway to Kundabung Upgrade as:

"While providing access to the Pacific Coast the highway has very few views of the Pacific Ocean and is probably more accurately characterised by the mountains and foot hills of the Great Dividing Range to the west of the highway as well as the broad rivers that cross the floodplains between the mountains and the ocean ... it is the connection to the hills, mountains and rivers that provides a strong identity to the Pacific Highway (p.17)…South of Coffs Harbour, the mountains, although visible, again recede into the distance giving way to the flatter rural landscape around Kempsey. Near Port Macquarie the highway crosses the Hastings River and the Wilson River, the mountains again begin to dominate…." (p.20)

Hastings River is nominated as a key natural landmark alongside Macleay River under the *Roads and Maritime Pacific Highway Urban Design Framework* (p.23).

The Oxley Highway to Kundabung Upgrade is set within a predominantly rural landscape, which varies in character from river/creek floodplain to enclosed forest. The proposed alignment generally closely follows the existing Pacific Highway alignment for most of its route deviating at Hastings River Floodplain and from Cairncross Forest/Bill Hill Road to Haydons Wharf Road across the Wilson River Floodplain.

Travelling from south to north, The Upgrade starts approximately 700 metres north of the Oxley Highway Interchange. The area is characterised by enclosed forest with views to Cassegrain Winery and some industrial businesses based around Sancrox Road Interchange. The bridge at Sancrox and the associated interchange and local access roads are not part of this contract but the main highway alignment is.

Around Fernbank Creek the character changes to open floodplain landscape with views opening out towards the Hastings River. Riparian plantings associated with the river landscape are located along the edges of Hastings River. The River crossing is a key landmark in the Pacific Highway road journey. The large embankments for the river bridge crossing will be highly visible as will the Hastings River Bridge. Significant views south to the distant escarpment will be possible from the southbound carriageway north of Hastings River.

Heading north, the landscape becomes enclosed again in character with Cairncross State Forest and Rawdon Creek Nature Reserve either side of the alignment. Views are confined to the road corridor. Blackmans Point Interchange provides the first entry to Port Macquarie for travellers heading south and as such is an important gateway to Port Macquarie. For northbound traffic it also provides access to Telegraph Point. Approximately 1250 metres south of Bill Hill Road, the carriageways diverge for a distance of 1000 metres. The carriageways are separated a considerable distance retaining forest in the median.

From approximately 2000 metres east of Bill Hill Road, the landscape character comprises scattered trees to open floodplain at Wilson River. The Tea Tree Plantation in this area is a key landscape landmark. Riparian plantings associated with the river landscape are located along the edges of Wilson River. The large embankments for the river bridge crossing will be highly visible as will the Wilson River Bridge. The river crossing is another landmark in the Pacific Highway road journey. Haydons Wharf Interchange is located north of the Wilson River and provides access for southbound traffic to the largest area of settlement in this Project at Telegraph Point. The landscape comprises scattered forest with intermittent views.

From Cooperabung Creek to Barrys Creek, the northern most project extent, the landscape is defined by the Cooperabung Creek Nature Reserve and Ballengarra State Forest comprising dense forest with views confined to the road corridor. Cooperabung Hill/cutting is a significant topographical feature of the route at this location. Barrys Creek forms The Project's northern boundary.

Issues/Opportunities

- Recognise and strengthen the legibility of the mid coast region urban and rural structure through particular urban and landscape design treatments of the approaches and exits to Port Macquarie and Telegraph Point
- Provide a consistent urban and landscape quality with the recently completed Kempsey Bypass, proposed design for Sancrox Traffic Arrangement and the Kundabung to Kempsey upgrade
- Enable views, where practicable, from/to the foothills of the Great Dividing Range, the open floodplains and the Hastings and Wilson Rivers
- Ensure that the Landscape Design Strategy responds to the changes in character along the alignment.



View east across the Hastings River Floodplain towards Fernbank Creek



View southeast along Pacific Highway towards Hastings River Bridge

B.2 Land Use Character & Heritage Items

B.2.1 Land Use

Land uses adjoining The Project corridor generally comprise residential, rural, commercial, industrial, state forests and nature reserves. Rural land use, state forests and nature reserves are the dominant land uses. Residential areas are restricted to the village of Telegraph Point with scattered rural residential development elsewhere. A future development area known as Area 13, on the eastern side of the highway in the vicinity of the Oxley Highway, has been identified for future development including residential, commercial, and industrial uses.

Commercial and industrial uses are located mainly to the south of Telegraph Point near Sancrox Road and include Expressway Spares and Cassegrain Winery. A quarry site is also located off Sancrox Road to the north-west and at Yarrabee Road in the northern sector of The Project. Rural uses include grazing, aquaculture, orchards, tea tree plantations, vineyards, poultry farms and other agricultural activities. Oyster farming is carried out on the Hastings River.

Nature reserves are located at Rawdon Creek and Cooperabung Creek.

Refer Figure B.5.1.



Cassegrain Winery near Sancrox Road

B.2.2 Heritage

Aboriginal

Four sites of cultural sensitivity were identified at: Sancrox Road ceremonial area; Hastings River, Dalhunty Island and an ochre site near Sancrox Road. Two Aboriginal heritage sites were identified adjacent to the Hastings and Wilson Rivers. The Sancrox Road ceremonial area was assessed as having high cultural significance and the Hastings River and Dalhunty Island a low cultural significance. The ochre site had contemporary significance only as it was only recently discovered. DoPI determined that whilst The Project would impact on the Hastings River and Dalhunty Island areas, The Project would not significantly detract from the broader landscape as the impact is confined to a narrow linear corridor. The proposal does not impact the Sancrox Road ceremonial area.

Non-Aboriginal

Port Macquarie was established as a penal colony in 1823 when convicts were transported by ship from Newcastle. The convicts cut cedar from the forests surrounding the Hastings and Maria Rivers for transport to the southern colonies. Free settlement in the Port Macquarie area was permitted after 1830. This settlement was initially concentrated around the port and in areas with ready access to the rivers, as the rivers were the main corridor for transporting the materials and supplies. Other areas further away from the rivers and port were slower to develop. The first industry in the locality involved timber harvesting and later settlers cleared much of the suitable land for agricultural and pastoral use. Eleven potential heritage items were identified in the Environmental Assessment (EA). Most were determined to have nil heritage significance except for eight hand-cut sandstone kerbstones (local heritage significance), Hacks Ferry Road dairy complex (local heritage significance), Farm complex Hut platform (local heritage significance) and Stockyards and timber mill (local heritage significance). An additional item was identified post EA at Barrys Creek Bridge.

Issues/Opportunities

- Recognise and strengthen the legibility of the mid-north coast region urban and rural structure through particular urban and landscape design treatments, which differentiate urban areas from rural and forested areas
- Manage views to and from the highway to rural residential and residential areas through provision of landscape screening to minimise visual impacts on these more visually sensitive areas
- Ensure the landscape design integrates and responds to the adjacent land use patterns
- No major Aboriginal Heritage constraints. The Proposal does not directly impact any non-Aboriginal heritage items listed on any Commonwealth or State heritage register
- Sandstone kerb stones of local significance were recorded and would not be impacted, but could be removed as long as a record of the location of the heritage site is made to preserve the value of the item
- OHK9 (Hacks Ferry Road dairy complex) and OHK12 (stockyards and timber mill): Further opportunities to minimise impacts on these items will be explored during detailed design
- Barrys Creek Bridge requires archival recording prior to construction of the adjacent new bridge.



Tea Tree Plantation south of the Wilsons River. The alignment will have views across the plantation.

B.3 Topography, Geology & Soil Landscapes

Refer to Figure B.3.1 - Topography, Geology and Soil Landscapes.

The Oxley Highway to Kempsey Environmental Assessment (EA) identifies two distinct landforms - low lying alluvial floodplain comprising 5-10% slopes to the south around Hastings and Wilson Rivers; and to the north ridgelines and hills with steeper gradients and higher elevations of 15-25% slope associated with Cooperabung Hill. Correspondingly, two major geological terrain types associated with these landforms are found. The floodplains are characterised by isolated and mixed deposits of sand, silt and clay underlain by siltstone, and fine to medium grained sandstone and mudstone. The alluvial deposits in these areas extend up to 15 metres or more below ground level. Palaeochannels appear to be located below the southern floodplains of both the Hastings and Wilson Rivers and consist of sands and gravels up to 10 or more metres thick. The ridgelines and hills are typically characterised by hard residual clay and silty clay underlain by siltstone, and fine to coarse-grained sandstone and mudstone. The thickness of the soil in these areas ranges from approximately 0.5 to five metres deep.

The following soil landscape types (with a description of their landscape and soils characteristics) directly underlie the new road.

Maria River

Extensive level plains, floodplains and backswamps in the lower reaches of the major streams. Relief <1m; elevation 1-3m. Swamp species often cleared for grazing. Soils are moderately deep (100-150cm) and generally acidic with low permeability. Regular flooding causes waterlogging and foundation hazards. Features localised areas of organic soils, salinity and acid sulphate soils.

Blackmans Point

Tidal flats and creeks in coastal inlets and estuaries regularly inundated by tidal salt waters. Elevation and relief are <1m slopes <1%. Features uncleared Littoral complex vegetation. Soils are deep (>300cm) and very poorly drained. Flooding causes waterlogged soils with low wet bearing strength. Features areas of organic soils, acid sulphate soils, very strongly saline soils and areas high erodibility.

Pipers Creek

Level alluvial terraces to coastal streams. Slopes <1%; relief <1m; elevation 5-9m. Features partially cleared tall, open dry sclerophyll forest. Soils are deep (>300m). Flooding causes seasonal waterlogging. Features areas of strong acidity, moderate erodibility, low fertility and high aluminium toxicity potential.

Cooperabung

Rolling hills and rolling low hills. Slopes typically 20-30% but ranging from 10-33%. Relief 30-300m; elevation <200m. Features tall, open dry sclerophyll forest on upper slopes and partly cleared tall, open wet sclerophyll forest on lower slopes. Soils range from shallow to moderately deep with well structured subsoils. Features areas of shallow, stony soils with moderate to high erodibilityand low available waterholding capacity.

Connection Creek

Level, swampy, linear open-depressions and supratidal flats with narrow, central channel and minor tidal influence. Relief and elevation are <1m. Vegetation is thick strands of swamp oak, substantially uncleared. Soils are deep (>300cm) and very poorly drained. Flooding causes waterlogging and foundation hazards in soils of low wet bearing strength. Features areas of organic soils, acidity, salinity, aluminium toxicity and acid sulphate soils.

Cairncross

Gently inclined (1-3%) broad, open drainage depressions and footslopes of low relief (<2m) and elevation (1-5m) linking residual areas with depositional areas. Features substantially cleared swamp complex vegetation. Soils are moderate to deep (200 to >300cm) and offer very low permeability with moderate available water holding capacity. Features areas of localised flooding hazard, waterlogging, run-on, foundation hazards, low wet bearing strength and high erodibility.

Kundabung

Undulating rises with broad crests, extensive footslopes and drainage plains. Slopes range from 3-10% with elevation and relief 5-30m. Features partially cleared tall, open dry sclerophyll forest. Soils are shallow to deep (<100->300cm) and poorly drained. Features seasonal waterlogging, water erosion hazards, foundation hazards and localised run-on (localised) Also featuers hardsetting, erodible, sodic, acidic soils with low wet bearing strength, low permeability and high aluminium toxicity potential.

Austral Eden

Broad undulating levee ridges and swales on modern alluvium in the mid to lower reaches of the major rivers. Generally level with local short slopes to 20%; relief <3m; elevation 2-10m. Previous rainforest completely cleared for cropping and grazing. Soils are deep (>300cm), well-drained and uniform. Features flooding hazards, localised wind erosion hazards and localised streambank erosion. Soils are non-cohesive with low wet bearing strength, high erodibility and high permeability.

Combatine

Upper slopes of steep hills with 33-50% slopes and 90-300 metres elevation and relief. Features tall, open wet and dry sclerophyll forests and logged native forest. Soils depth varies with depth over rock and are shallow (<70cm) on ridge sand mid-slopes and moderately deep (<120cm) where heavier subsoil material is insitu. Features steep slopes with water erosion and localised mass movement hazards. Features areas of shallow stony soils with moderate erodibility and low available waterholding.

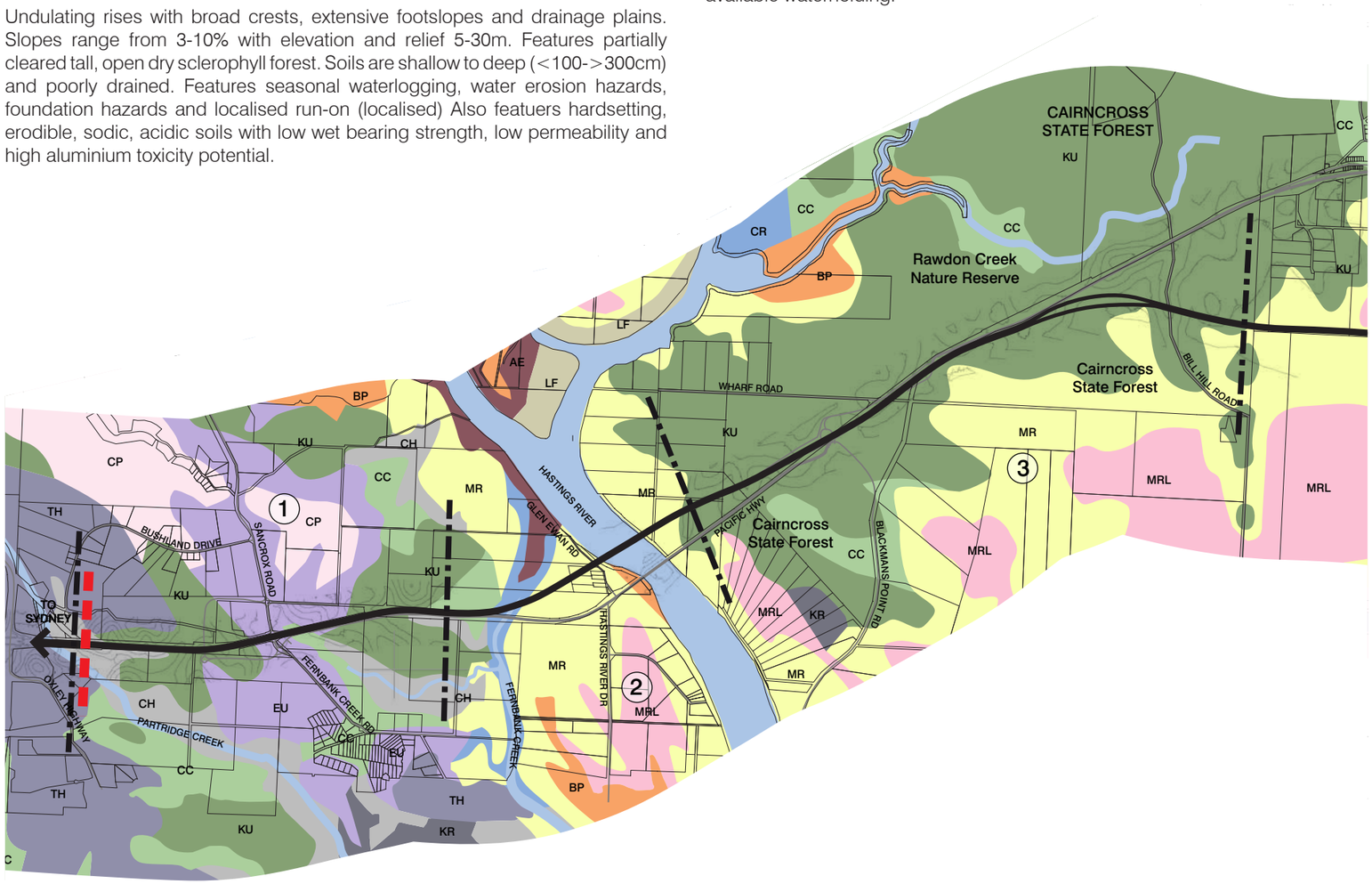


Figure B.3.1 Topography, Geology and Soil Landscapes

Euroka

Rolling low hills. Slopes 10-15% rising to 33% at times; elevation 20-90m; relief 20-60m. Features partially cleared tall, open dry sclerophyll forest. Soils are generally shallow(<100cm) but moderately deep (<120cm) where topsoils are heavier texture. Features localised seasonal waterlogging and gully erosion hazards. Also localised shallow soils with low wet bearing strength, strong acidity and high aluminium toxicity potential.

Christmas Creek

Backswamps and floodbasins forming extensive swamps of extremely low relief and low elevation (1-2m). Located on the floodplain with swamp complex vegetation. Soils are deep (>300cm) and poorly drained with low wet bearing strength and low permeability. Regular flooding causes waterlogging and foundation hazards. Features areas of localised organic soils, extreme acidity, high aluminium toxicity potential and acid sulphate soils.

Long Flat

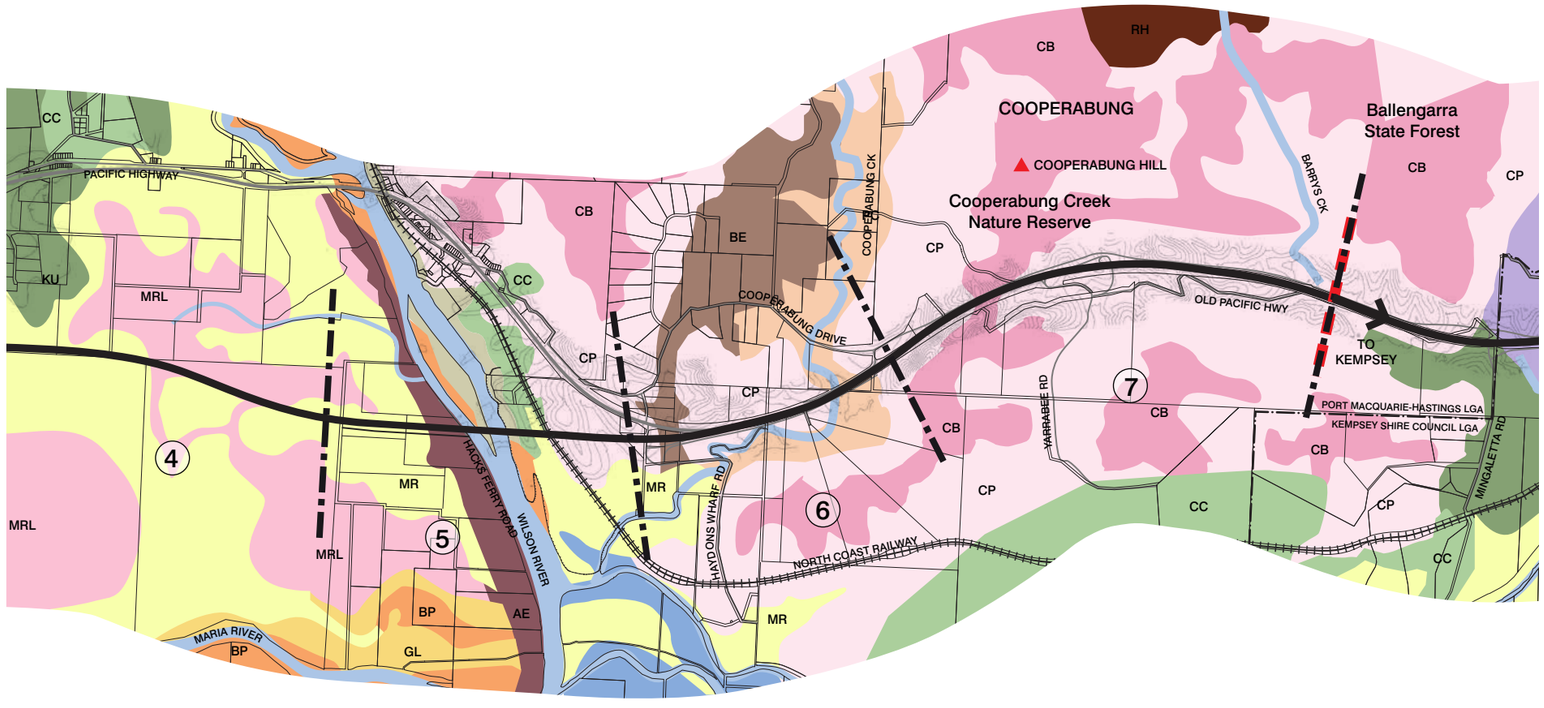
Open depressions and undulating to rolling narrow plains forming the current inset floodplain along most streams. Local relief usually <3m; elevation range from 3m downstream to 20m upstream. Mainly cleared with remnants of riverine associations. Soils are deep (>300m) and well drained. Features flooding hazard, streambank erosion and soils of low wet strength.

Beechwood

Undulating and rolling low hills in the lower valley sides. Slopes are typically 10-20%; relief 30-90m; elevation 20-60m and up to 90m. Tall open-forest cleared for grazing.

Maria River (Landscape Variant)

Swampy depressions and infilled channels on the Maria River Soil Landscape.



Issues/Opportunities

- Traversing the slopes and foothills means changes in heights, which have implications in the design of the vertical road alignment and in minimising cuts
- Traversing the floodplains above the specified flood level means the vertical road alignment must be located on fill embankments. Relief structures (bridges and culverts) are required in the embankments to avoid localised flooding
- Variations in topography provide a diverse travelling experience and views and vistas, travelling from the low river floodplains and over the higher elevation of Cooperabung Hill
- Maintaining and enabling views are an important landscape design consideration
- The undulating hills require some significant cuttings. The largest of these is at Station 21km000 and is 35m in depth and also at Station 22km660 - 29.5m in depth. Other significant cuttings include: Station 17km900 - 10m in depth, Station 22km000 - 9.0m in depth and Station 10km400 - 7.4m in depth
- The floodplains require embankments. Considering both length and height, the largest embankment is at Station 20km500 - 14.85m in height, occurring north of Cooperabung Creek. Other significant embankment include: Station 17km100 which is 12.45m in height, Station 22km200 - 9.0m in height, Station 1km650– 7.0m in height, Station 4km450 - 6.0m in height, Station 1km550 - 6.0m in height and Station 7km975 - 4.4m in height
- Topography influences the vegetation communities that the alignment passes through.
  - The soils around Hastings and Wilson River floodplains are characterised as being soft soils and will influence construction techniques
  - The water in the floodplain soils will impact on the selection of suitable landscape species
  - As soils are tied to particular plant communities, it is imperative that soil types remain in locations that they are stripped from
  - High soil acidity will require soil amelioration. There is likely to be a high percentage of seed stock in the soil, therefore, soil needs to be managed appropriately - i.e. stockpiled, mixed through, covered and so on.
- There is a potential risk of acid sulfate soils in the floodplain areas.
  - The disturbance and exposure of soils, in particular within or immediately adjacent to drainage lines and waterways, is recognised as one of the potential main environmental risks to the integrity of local water quality
  - Acid sulphate soils can corrode infrastructure. Special measures may be required to prevent erosion
  - Bridging layers are proposed to be used in soft soil/floodplain areas.

B.4 Watercourses, Wetlands, Vegetation Communities & Fauna

Refer to Figure B.4.1 – Watercourses, Wetlands, Vegetation Communities and Fauna.

B.4.1 Watercourses

The highway upgrade is located in the catchment of the Hastings River and incorporates the tributaries of the Wilson River. The proposal traverses Hastings River floodplain for approximately two kilometres and the Wilson River floodplain for approximately three kilometres. A number of smaller creeks and drainage lines are crossed by The Upgrade, including Cooperabung Creek, Fernbank Creek and Barrys Creek. The Hastings and Wilson Rivers experience extensive flooding across their respective floodplains. Sections of SEPP14 wetlands are located on Dalhunty Island and on the northern bank of the Wilson River.

Issues/Opportunities

- Retain and enhance riparian plantings at creek crossings where possible
- There is a diversity of plant species available for use in re-vegetating creek edges and detailing water quality basins
- Managing impacts on wetland systems will be important to ensure no decline in water quality. Water quality issues at creeks will need to be taken into account in the design of water quality basins as well as managed during construction
- The sections of the alignment in the vicinity of Hastings and Wilson Rivers are on embankment due to flooding issues and bridge height clearances
- There are impacts on SEPP14 Wetlands north of the Wilson River. Bridge pier locations have been designed to minimise impact on the State listed wetland on Dalhunty Island and overshadowing impacts.

B.4.2 Vegetation Communities & Fauna

The upgrade is located in the North Coast Bioregion which stretches from Raymond Terrace to the Queensland border. The area through which The Upgrade passes contains Cairncross and Ballengarra State Forests, Rawdon Creek and Cooperabung Creek Nature Reserves and wetlands including SEPP14 Coastal Wetlands. A large area of The Project is cleared and predominantly comprises paddocks as well as the existing highway and smaller roads. A further smaller area comprises partially cleared paddocks with scattered trees. Rural land uses include grazing, aquaculture, orchards, tea tree plantations, vineyards, poultry farms, and other agricultural activities. The remainder of The Upgrade area supports natural vegetation of varying quality. Most of this vegetation has been disturbed at some time, and much of it is regrowth from past major disturbances such as logging or clearing for farming and grazing. This includes the vegetation within Rawdon Creek Nature Reserve, which was logged prior to the establishment of the nature reserve. Consequently, little intact mature forest occurs within the study area.

- A total of ten vegetation communities have been identified within The Upgrade footprint. Six are endangered ecological communities (EEC) as follows: Moist Floodplain Closed Forest with Rainforest Elements (EEC)
- Riparian Forest (EEC)
- Paperbark Swamp Forest (EEC)
- Swamp Mahogany/ Forest Red Gum Swamp Forest (EEC)
- Swamp Oak Forest (EEC)
- Freshwater Wetland (EEC)
- Moist Floodplain Forest
- Moist Gully Forest
- Moist Slopes Forest
- Dry Ridgetop Forest.

Artificial or highly modified land uses include:

- Cleared, Open Grassland/ Derived Pasture with scattered trees
- Plantation/ Cropland/ Market Garden, etc
- Totally cleared Open Pasture/ Weedy Fallow.

Mangroves occur in interrupted bands of varying width along the northern and southern banks of the Hastings and Wilson Rivers and on Dalhunty Island. Seagrass beds are present on both the northern and southern banks of the Hastings River.

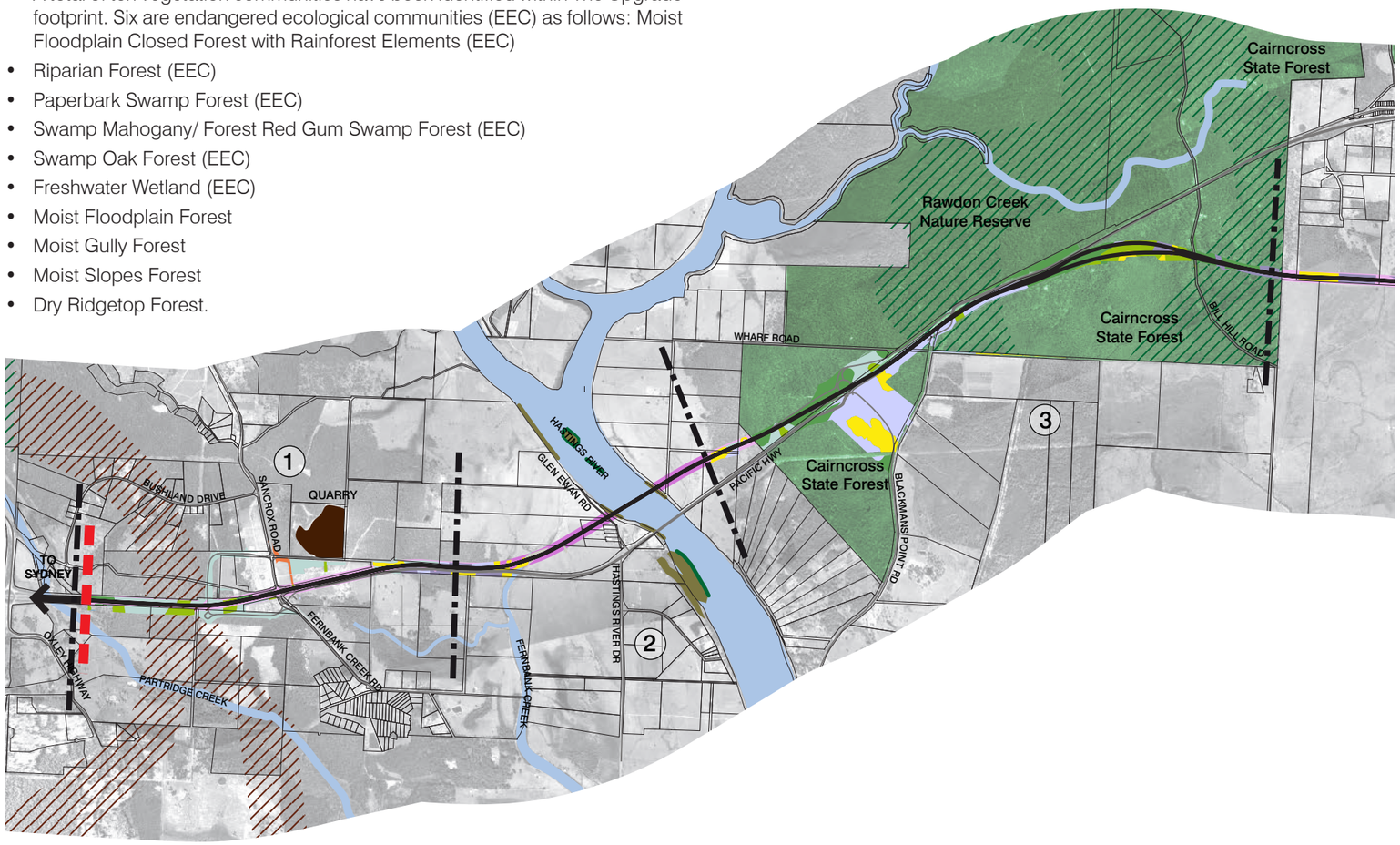
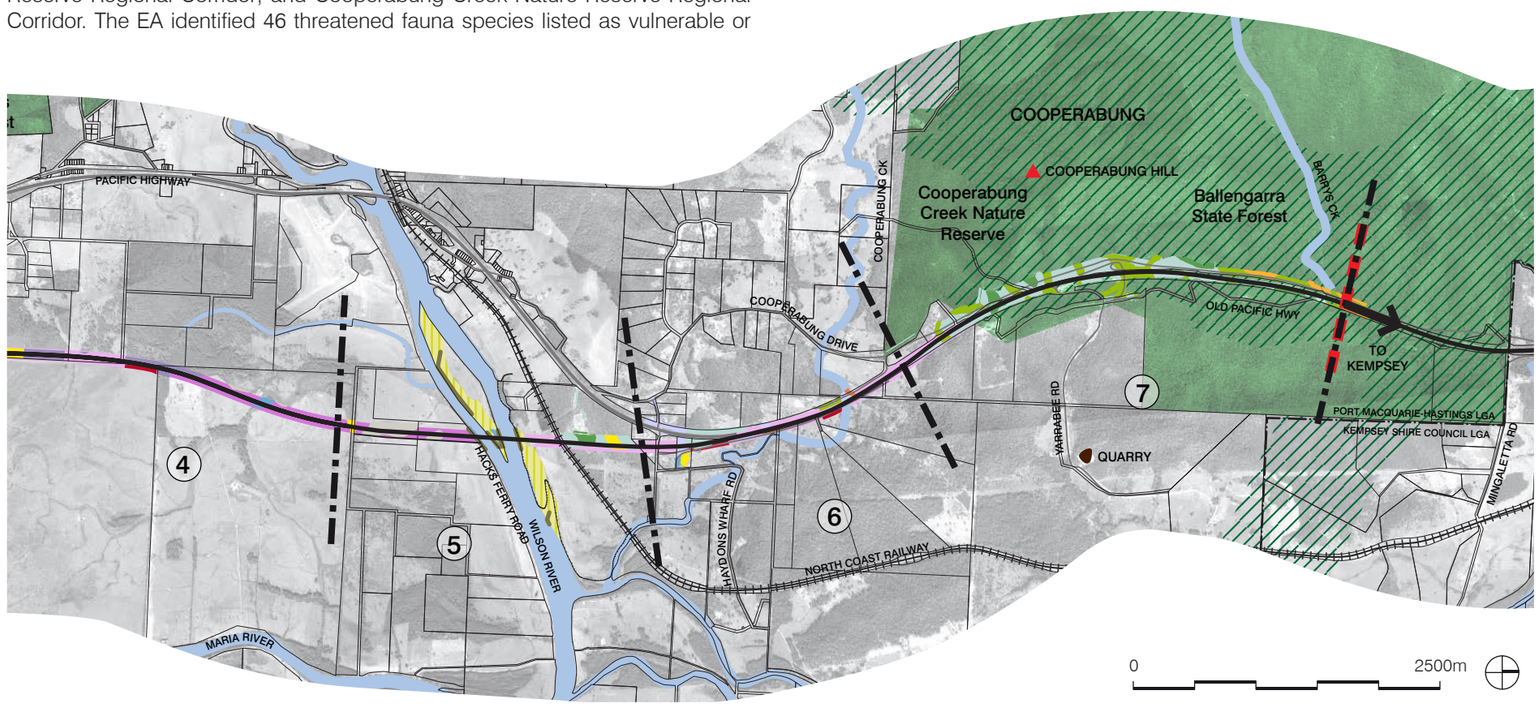


Figure B.4.1 Watercourses, Wetlands, Vegetation Communities and Fauna

The EA recorded no threatened flora within the Proposal footprint. Subsequent to the EA, three distinct sub-populations of *M.triglochinoides* were recorded in The Project area at Fernbank Creek and associated drainage lines on the Wilson River Floodplain - in both disturbed wetlands in grazed paddocks and in a straight excavated drainage channel. An additional population of 10m² is known to occur in Barrys Creek, east of The Project Corridor, in a constructed dam. The Project will directly impact two populations of *M.triglochinoides* totalling approximately 0.87 hectares in area, this is subject to further survey and design optimisation.

Areas of land within the study area are identified as 'key habitats' as defined by the former National Parks and Wildlife Service *Key Habitats and Corridors Project* (2005). The key habitats comprise areas of predicted high conservation value for forest fauna and include large areas of vegetated lands and important vegetation remnants. The Proposal passes through three of the regional and sub-regional corridors: Lake Innes - Cowarra Sub-Regional Corridor; Rawdon Creek Nature Reserve Regional Corridor; and Cooperabung Creek Nature Reserve Regional Corridor. The EA identified 46 threatened fauna species listed as vulnerable or endangered in The Project area based on previous records. Of these only 18 were recorded during field investigations with five more considered highly likely to occur. Fifty (50) migratory species were predicted to occur but only 15 were recorded during field investigations. Koala corridors have been identified near Sancrox Road, between the Hastings and Wilson Rivers and Barrys Creek. The following fauna species have been identified as examples of species requiring particular design treatments:

- Micro-bats
- Giant Barred Frog (*Mixophyes iteratus)*
- Green-thighed Frog (*Litoris brevipalmata)*
- Little Eagle (*Hieraaetus morphnoides)*
- Koala (*Phascolarctos cinereus).*



In general, as the EA has noted, The Project would result in the loss of areas of native vegetation including wetlands and mangroves. Habitat compensation and rehabilitation measures would be developed in consultation with the EPA during the detailed design phase of The Project in order to mitigate anticipated habitat fragmentation and wildlife corridor impacts.

Issues/Opportunities

- Artificial habitat for the Green-thighed Frog in the form of frog ponds will be provided in the road reserve at four locations:
  - Station 9km050 - 9km350 (both sides)
  - Station 11km550 (both sides).
- Frog fencing for the Green-thighed Frog proposed at:
  - Station 8km900 - Station 9km400 (both sides)
  - Station 11km450 - Station 11km800 (both sides).
- Frog fencing for the Giant Barred Frog proposed at:
  - Station 18km500 - Station 19km100 (eastern side)
  - Station 19km550 - Station 19km800 (both sides).
- Impacts on native vegetation communities occur throughout The Upgrade. The highway upgrade and clearing will result in permanent loss of foraging habitat and roosting and nesting habitat
- The proposed project incorporates a number of fauna mitigation measures to cater for fauna corridor areas - fauna underpasses (bridges and culverts), glider crossing zones with rope ladders, nest boxes, widened median, and fauna exclusion fencing. Fauna injury and mortality for the new highway will therefore be reduced. Integration of fauna fencing and landscaping will be an important design detail
- The Landscape plan will need to ensure that areas disturbed by Project Works are replanted with species which reflect endemic communities
- The habitat for Maundia will be optimised in the appropriate locations. No tree planting will be proposed where Maundia is expected to occur because Maundia prefers full sun for optimum conditions
- Plant communities will be designed to reinforce the adjacent landscape character and link bushland remnants where possible
- The Planting palette will reinforce, re-establish and supplement existing vegetation communities where appropriate
- Utilise dominant species from vegetation communities through which the alignment passes
- Avoid use of the Acacia spp. in planting mixes
- Utilise sedges in ground covers
- Species mixes need to reflect the local natural species
- Minimise weed introduction and spread within existing vegetation areas.

B.5 Views Analysis & Landscape Character Zones

Refer to Figure B.5.1 Views, Site Photo Analysis and Urban and Landscape Character Zones.

Seven landscape character zones have been identified in total along the highway upgrade. Figure B.5.1 summarises the key landmarks, existing and potential views and vistas, visually sensitive areas and visibility of key structures which have influenced the design approach. The visibility of bridge structures, was assessed to provide input into the urban design of structures and generally notes the river and main carriageway overbridges as having high visibility with the floodplain bridges and highway underbridges as having low to negligible visibility.

The text below describes the seven character zones in detail.

Zone 1: Port Macquarie Southern Gateway

This precinct is located at the southern end of The Upgrade and comprises scattered forest with intermittent views. The area is generally flat with a new interchange at Sancrox Road (not part of this project) providing access to an industrial area comprising Cassegrain Winery, a quarry, Expressway Spares and other industries. Retaining open views to the Commercial area is important for business visibility. In general the visual sensitivity is low and the visual impact minor. Refer Photos No.s 1-3.

Zone 2: Hastings River & Hastings River Floodplain

Hastings River and Fernbank Creek lie within this zone which is characterised by open pasture and low lying terrain with riparian plantings adjacent Hastings River and Fernbank Creek. The existing highway diverges from the proposed upgrade to the east. Views are open across the floodplain extending far east and west of the highway (Photos 4 and 5). A marine slipway and a sand extraction facility are located off Glen Ewan Road and a sand extraction facility. Distant views to the escarpment will be evident from the new southbound carriageway north of the Hastings River particularly due to the higher elevation of the road on embankment leading to the new river bridge. The Hastings River is one of sixteen important visual landmarks on the overall Pacific Highway journey, as noted in the Pacific Highway Urban Design Framework, and therefore highly visually sensitive. The design of the bridge is important as it will be visible from the Old Pacific Highway (Photos 7 and 9), to residents on Glen Ewan Road (Photo 6) and also river users (Photo 8). The existing Pacific Highway Bridge - Dennis Bridge - is a steel truss structure. The new modern Hastings River Bridge design should contrast this structure and provide a new refined and elegant counterpoint to the Dennis Bridge.

Zone 3: Port Macquarie Northern Gateway/Cairncross State Forest

This zone encompasses Cooperabung Creek Nature Reserve and Ballengarra State Forest and is characterised by a relatively flat terrain which is densely forested with tall Eucalypts (Photos 10, 11 and 12). Cairncross State Forest is to the east of the alignment with Rawdon Creek Reserve to the west. Views will be confined to the highway through this section. Blackmans Point Interchange is an important northern gateway to Port Macquarie and therefore needs to be highly visible. Gateway landscaping treatments and bridge design will be important design elements.

Continued on page 14.



Approach to Oxley Interchange - southbound



Approach to Sancrox Intersection - southbound



View along alignment - southbound



View from a private access road to new alignment



Long distance views to the west from proposed alignment

Long distance views to the east from proposed alignment

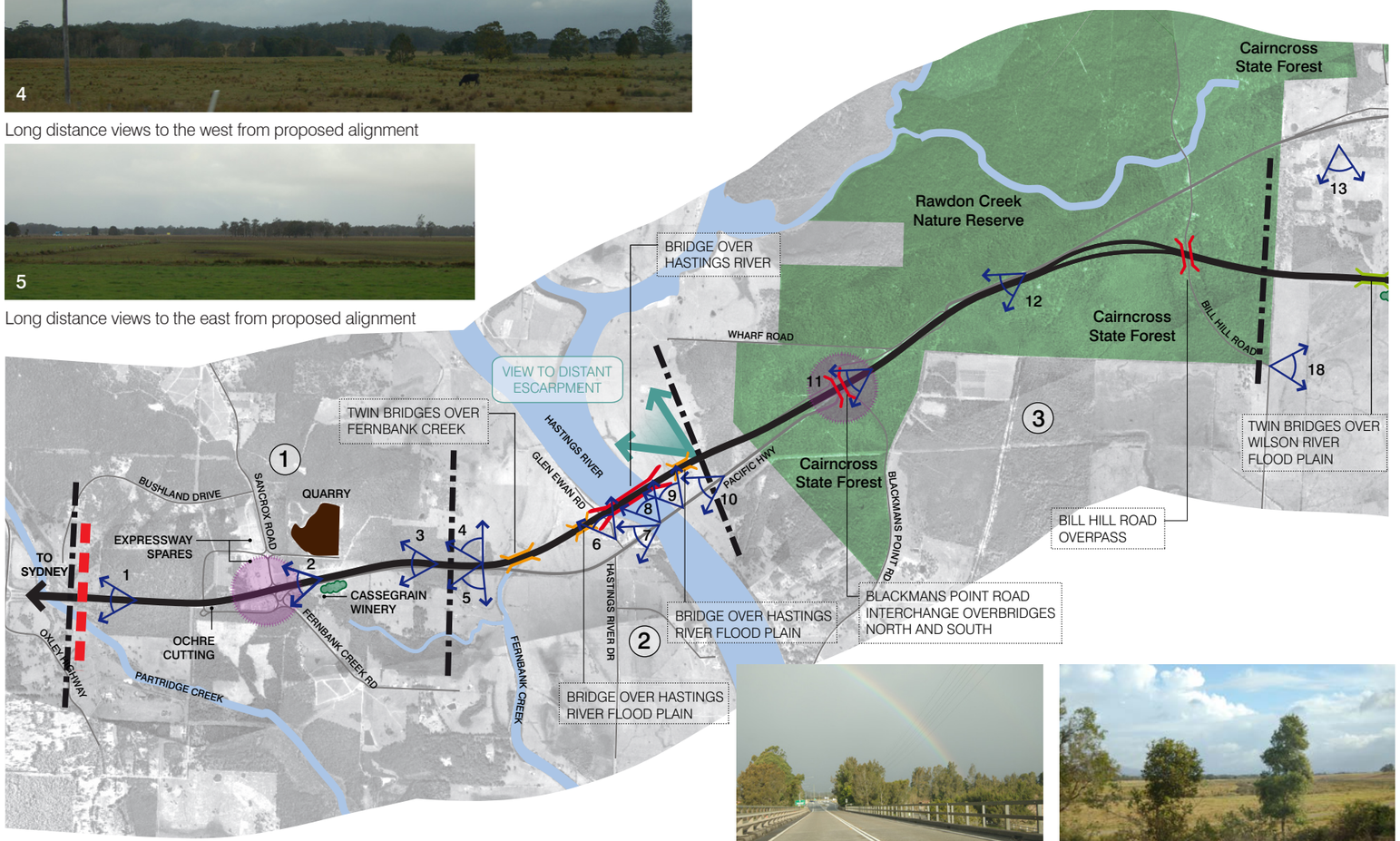
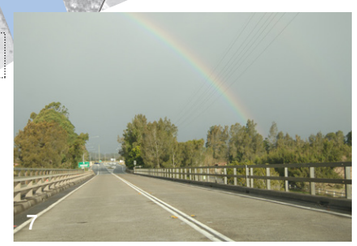


Figure B.5.1 Views, Site Photo Analysis and Urban and Landscape Character Zones



View of existing bridge carriageway



View to proposed alignment from existing highway



View along alignment



View west across river to new bridge location



Close enclosed view along side road



Narrow view along road corridor framed by forest



Views across flat pasture to trees



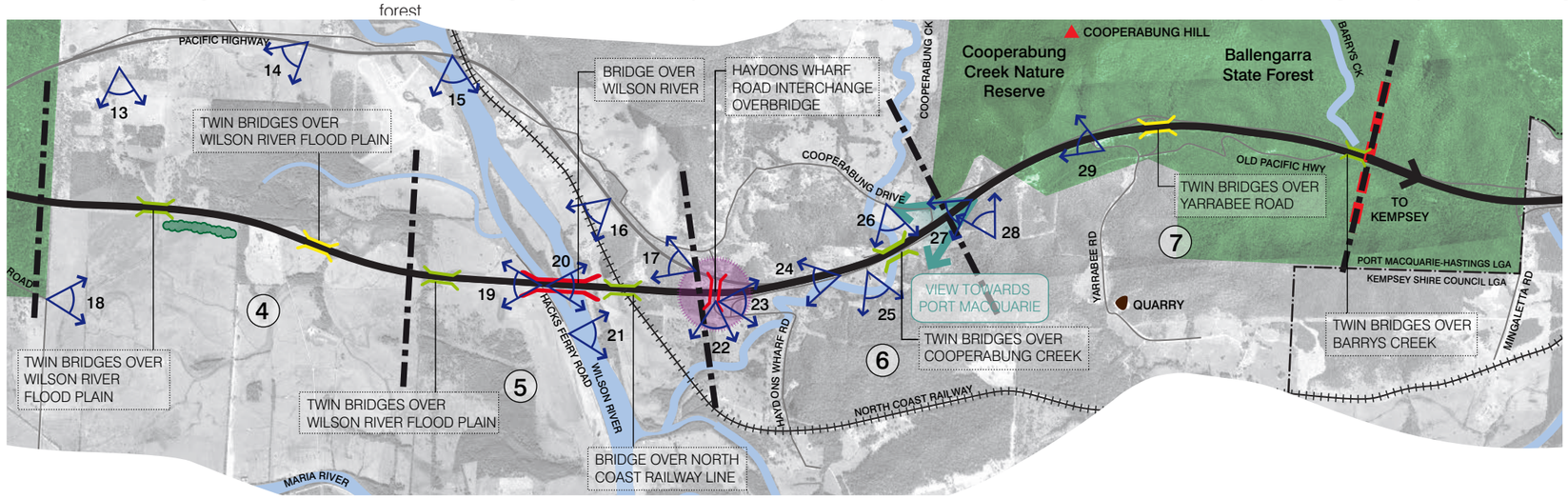
Views across floodplain to alignment beyond



View along river towards new alignment



View from existing highway to new alignment



- UPGRADE ROUTE
- EXISTING PACIFIC HIGHWAY
- LOCAL ROADS
- NORTH COAST RAILWAY
- HIGH POINT
- CREEKS
- PRECINCT BOUNDARIES
- LGA BOUNDARY
- 5 PHOTO VIEWPOINT
- SIGNIFICANT VIEW
- VEGETATION/PROPERTY SCREENING
- INTERCHANGES
- BRIDGE VISIBILITY - HIGH
- BRIDGE VISIBILITY - MEDIUM
- BRIDGE VISIBILITY - LOW
- BRIDGE VISIBILITY - NEGLIGIBLE
- STATE FOREST
- NATURE RESERVE

LANDSCAPE CHARACTER ZONES

1. PORT MACQUARIE SOUTHERN GATEWAY
2. HASTINGS RIVER AND HASTINGS RIVER FLOODPLAIN
3. PORT MACQUARIE NORTHERN GATEWAY/ CAIRNCROSS STATE FOREST
4. CAIRNCROSS STATE FOREST AND WILSON RIVER FLOODPLAIN
5. WILSON RIVER AND WILSON RIVER FLOODPLAIN
6. COOPERABUNG CREEK
7. COOPERABUNG CREEK NATURE RESERVE

0 2500m



Temporary broad open views over Teatree plantation towards new alignment



View across pasture along proposed alignment from new bridge abutment location



View along existing highway



View across Wilson River at crossing location



View across Wilson River from Hacks Ferry Rd



View along proposed new alignment



View along proposed new alignment



Road corridor framed by forest



View to residential from existing highway



View from residential to proposed alignment



Long distance view towards Port Macquarie



Elevated view over proposed alignment which is hidden by existing vegetation



Yarrabee Road exit

Zone 4: Cairncross State Forest & Wilson River Floodplain

This zone is characterised by a relatively flat terrain with some forested areas at the Tea Tree Plantation to the east and a scattered forest to the west providing a transition from Cairncross State Forest (Photos 13, 14 and 18). Wilson River floodplain is located to the east. Several floodplain bridges will located through this section but will have low to negligible visibility as they are not publicly accessible. Views are confined to the west by the forested vegetation but more open to the east over the Wilson River floodplain.

A vegetation screen is required to the Tea Tree Plantation.

Zone 5: Wilson River & Wilson River Floodplain

The proposed upgrade diverges from the existing highway to the west (Photo 7). Wilson River and Dalhunty Island lie within this zone which is characterised by open pasture and low lying terrain with riparian plantings adjacent Hastings River (Photos 15, 20 and 21). Views are open across the floodplain extending east and west of the highway. Telegraph Point village is located to the west of the highway. The North Coast Railway alignment runs alongside the Wilson River on the northern embankment. The Wilson River is an important visual landmark and as such the bridge design needs to take account of views to the bridge from Hacks Ferry Road and for river users and be a refined, elegant structure somewhat distinguished in design from the Hastings River Bridge.

Zone 6: Cooperabung Creek

Intermittent scattered forest (Photo 22) and pastureland (Photo 23) is located east and west of the proposed highway upgrade alignment. Views will be substantially confined to the upgraded highway through this section due to the highway being located in a valley (Photo 24). Some views to and from rural residences to the highway are apparent (Photos 25 and 26) and will be managed through landscape screening. The highway upgrade traverses Cooperabung Creek. Haydons Wharf Road Interchange is located in this zone and provides access to Telegraph Point. This interchange requires landscape treatment to distinguish the interchange in the road journey for users.

Zone 7: Cooperabung Creek Nature Reserve

This zone encompasses Cooperabung Creek Nature Reserve and Ballengarra State Forest and is characterised by a steeper landscape associated with Cooperabung Hill and ridgelines which are densely forested (Photos 28 and 29). Barrys Creek marks the northern extent of the highway upgrade. Due to the steeper topography through this area there are several significant cuttings. A significant view southbound over Port Macquarie will be available due to the higher elevation at the crest of Cooperabung Hill (Photo 27).

Issues/Opportunities

- Retain and enhance open views where appropriate, especially distant views to natural and cultural landmarks such as Cooperabung Hill, Hastings River and Wilson River
- Utilise landscape to enhance the forest experience, particularly where the route traverses State Forests
- Utilise landscape to ameliorate adverse visual impacts particularly for the embankments over the Hastings and Wilson River Floodplains
- Utilise landscape where appropriate to screen views to the highway from adjacent residences
- Maintain views along Fernbank and Cooperabung Creek corridors and the Hastings River and Wilson Rivers
- Design Blackmans Point Interchange and Haydons Wharf Road Interchanges to each have a distinct identity to aid in legibility for both the Pacific Highway traveller and local road users. In particular, distinguish Blackmans Point Interchange as the northern entry to Port Macquarie
- Provide architectural bridge designs at Hastings and Wilson Rivers that are elegant and neat sitting in a well designed landscape
- Design treatments to integrate, respond and be sensitive to the existing adjacent landscape character zone context in terms of topography, landscape, settlements and views
- Provide variety and legibility in the journey experience.

B.6 Proposed Highway Elements, Existing Road Networks & Flora & Fauna Requirements

Refer to Figure B.6.1 Proposed Highway Elements, Existing Road Networks and Flora and Fauna Requirements.

The Project comprises:

- Three full Interchanges located at:
  - Blackmans Point Road
  - Sancrox Road
  - Yarrabee Road.
- One half Interchange located at:
  - Haydons Wharf Road.
- Transverse Bridges over the Main Carriageways (Overbridges) at:
  - Blackmans Point Road Interchange: Overbridge South
  - Blackmans Point Road Interchange: Overbridge North
  - Bill Hill Road Overpass
  - Haydons Wharf Road Interchange Overbridge.

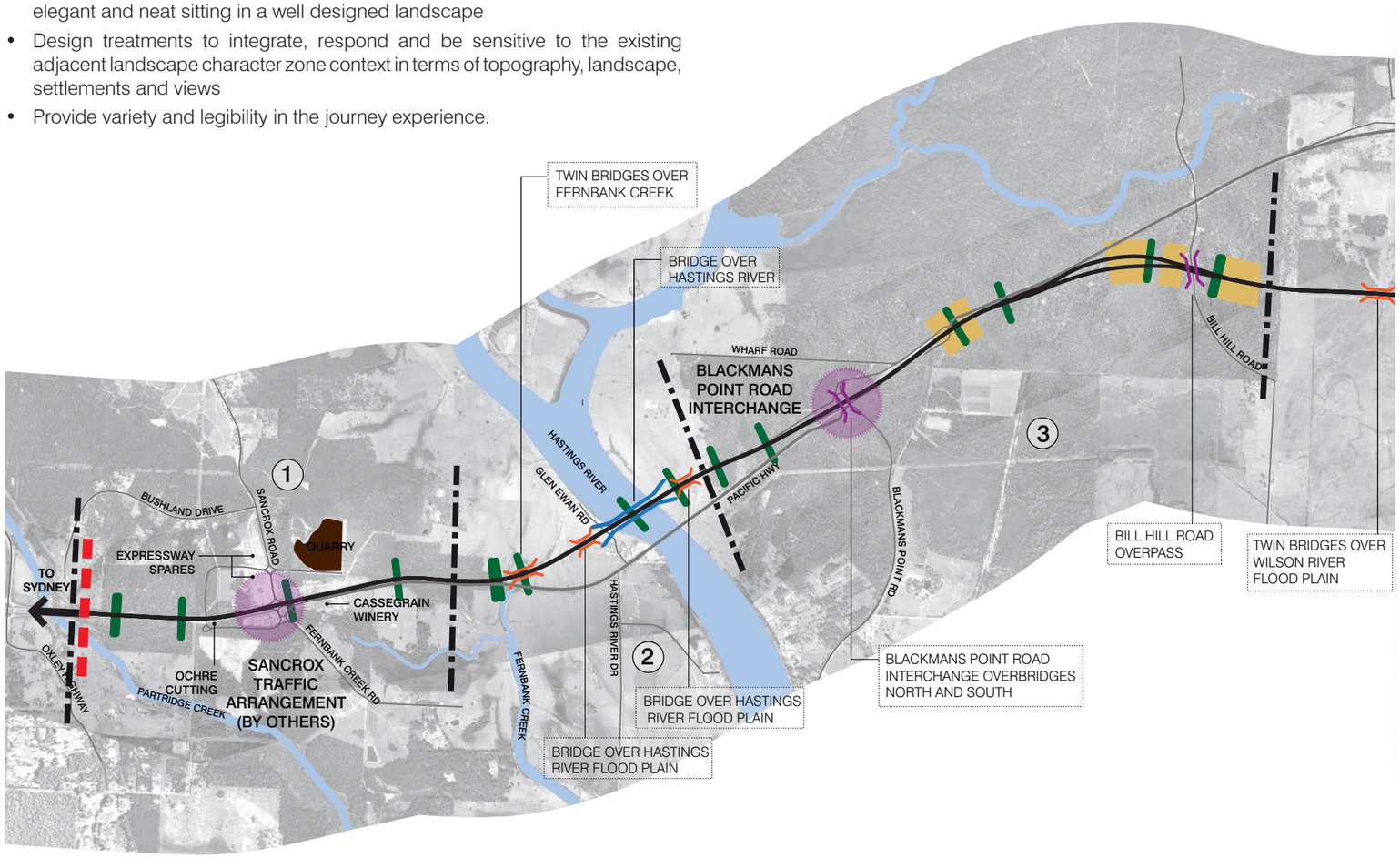
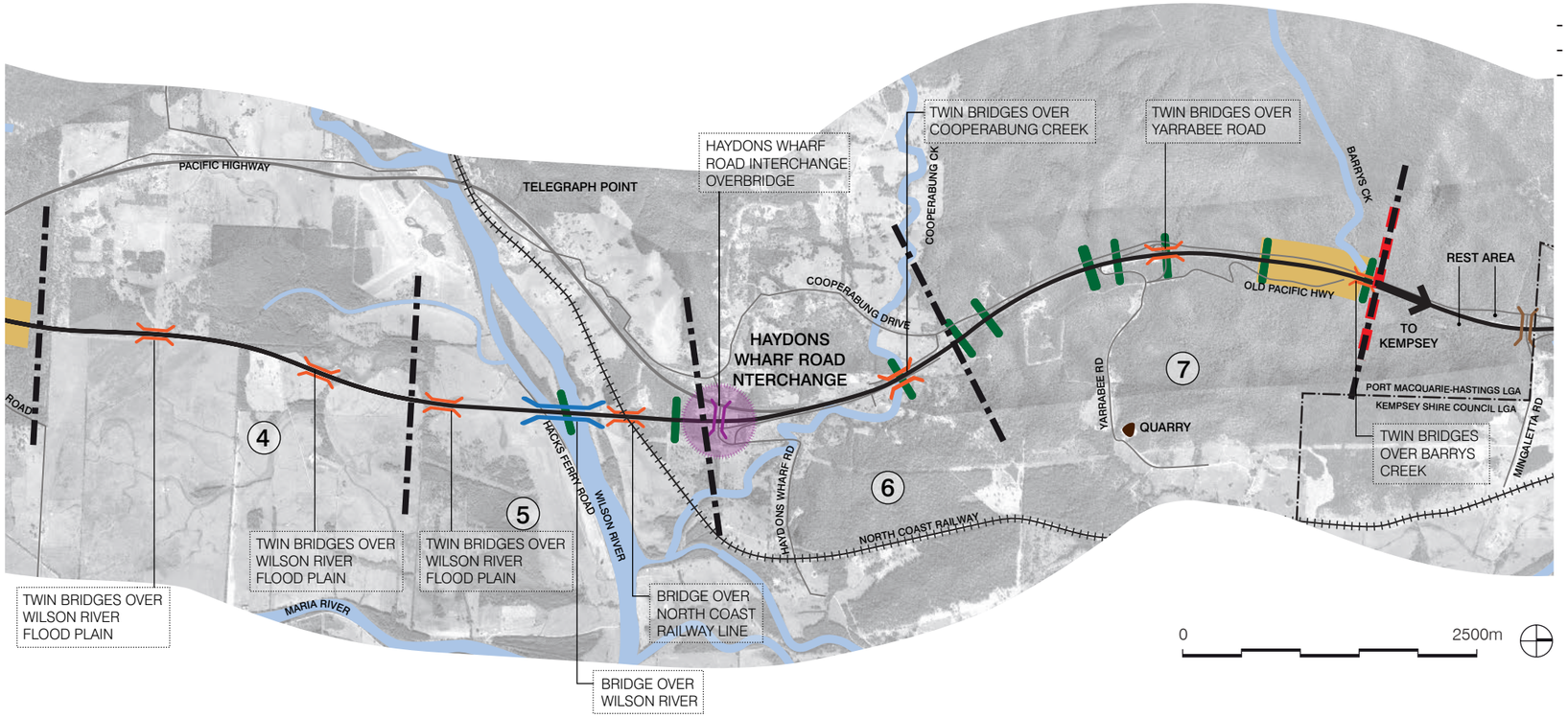


Figure B.6.1 Proposed Highway Elements, Existing Road Networks and Flora and Fauna Requirements

- Main Carriageway Bridges over the North Coast Railway, creeks, local roads, fauna, farm and drainage access at:
  - Twin Bridges over Hastings River Floodplain at 14.3km North of Port Macquarie
  - Service Road Bridge over Hastings River Floodplain at 14.3km North of Port Macquarie
  - Twin Bridges over Fernbank Creek at 14.7km North of Port Macquarie
  - Bridge over Hastings River Flood Plain at 15.2km North of Port Macquarie
  - Bridge over Hastings River
  - Bridge over Hastings River Flood Plain at 16.4km North of Port Macquarie
  - Twin Bridges over Wilson River Flood Plain at 23.3km North of Port Macquarie
  - Twin Bridges over Wilson River Flood Plain at 24.8km North of Port Macquarie
  - Twin Bridges over Wilson River Flood Plain at 25.7km North of Port Macquarie
  - Bridge over Wilson River
  - Bridge over North Coast Railway Line
  - Twin bridges over Cooperabung Creek
  - Twin Bridges over Yarrabee Road
  - Twin bridges over Barrys Creek.
- Culverts
  - There are 32 box culvert locations throughout The Upgrade, most of which serve as fauna underpasses or combined drainage and fauna underpasses. Details are provided in Section D.4.
- Retaining Walls
  - Reinforced soil wall abutments are provided for the bridge over the North Coast Railway.
- Artificial habitat for the Green-thighed Frog in the form of frog ponds will be provided in the road reserve at four locations:
  - Station 9km050 - 9km350 (both sides)
  - Station 11km550 (both sides).
- Frog fencing for the Green-thighed Frog proposed at:
  - Station 8km900 - Station 9km400 (both sides).
- Frog fencing for the Giant Barred Frog proposed at:
  - Station 18km500 - Station 19km100 (eastern side)
  - Station 19km550 - Station 19km800 (both sides).
- Nest Boxes (locations to be determined by The Project Ecologist).
- Bat Roosts (locations to be determined by The Project Ecologist).

There are Glider Crossing Zones including rope bridges and glider poles at:

- Station 9km000 - Station 9km400
- Station 10km700 - Station 11km110 (Southbound Main Carriageway)
- Station 11km200 - Station 11km400 (including rope ladder canopy bridge)
- Station 11km700 - Station 12km100
- Station 22km900 - Station 23km200
- Station 23km600 - Station 23km900 (including rope ladder canopy bridge).



- UPGRADE ROUTE
- EXISTING PACIFIC HIGHWAY
- LOCAL ROADS
- NORTH COAST RAILWAY
- HIGH POINT
- CREEKS
- PRECINCT BOUNDARY
- LGA BOUNDARY
- INTERCHANGE
- MAIN CARRIAGEWAY OVERBRIDGE
- MAIN CARRIAGEWAY BRIDGE
- RIVER BRIDGES
- FAUNA UNDERPASS/CULVERT
- GLIDER CROSSING ZONE

LANDSCAPE CHARACTER ZONES

1. PORT MACQUARIE SOUTHERN GATEWAY
2. HASTINGS RIVER AND HASTINGS RIVER FLOODPLAIN
3. PORT MACQUARIE NORTHERN GATEWAY/ CAIRNCROSS STATE FOREST
4. CAIRNCROSS STATE FOREST AND WILSON RIVER FLOODPLAIN
5. WILSON RIVER AND WILSON RIVER FLOODPLAIN
6. COOPERABUNG CREEK
7. COOPERABUNG CREEK NATURE RESERVE

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C Urban Design Strategy

C.1 Vision & Objectives

The *Pacific Highway Urban Design Framework* (RTA 2005) sets a vision for the Pacific Highway as follows:

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

The Framework document also identifies the following key objectives to support the Vision:

- 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
- The Environmental Assessment (EA) developed the following objectives specifically for the Proposal:
  - Design the upgraded highway to integrate with the immediate context
  - Design for safe, yet convenient, connections to local roads and access to adjacent properties
  - Ensure and enhance visual connections to significant landscape features
  - Integrate the new highway landforms and landscape with adjoining lands where appropriate
  - Provide a positive contribution to the landscape
  - Ensure a safe driving environment
  - Create a quality driving experience that reflects the significance of this motoring route
  - Provide cost effective solutions.
- Additional to the above and in summary, the design of The Project Works will:
  - Deliver a positive, functional and aesthetic experience to road users and to adjoining rural residents and visitors
  - Integrate with, and be sensitive and responsive to, the landform and landscape character of the surrounding rural and natural areas
  - Provide a well vegetated corridor which is related to and supportive of the landscape and ecological assets of its context including Cairncross and Ballengarra State Forests and the sedge land and riparian edges at the creek systems
  - Retain and enhance quality views from the highway west to the Great Dividing Range and over rolling hills and pastures.

C.2 Key Urban & Landscape Design Strategies/Principles

The existing character of this section of the Pacific Highway comprises part floodplain, where agricultural pursuits and rural residential development have resulted in widespread clearing, part river and part hills and spurs, which are mostly forested. The design context is typical of Pacific Highway upgrades where the route traverses mainly rural lands with relatively few visible structures in the landscape framework of The Project. The Project itself also includes relatively small numbers and extents of structures visible from the new highway: four overbridges, no noise walls, one headlight screen and one retaining wall which is only visible from the railway. The urban and landscape design strategy therefore is predominantly a landscape approach as it is the context which creates the specific identity of this section of the highway. Linear identity is provided by structures such as overbridges which in design continue similar treatments for the piers, parapets and screens from nearby upgrade projects. Lateral integration is provided by the design of the corridor landscaping so that it responds to the existing vegetation and agricultural patterns through which the highway passes - seven character zones are identified in this report along The Upgrade. Planting has been selected from and is designed to conform to the identified vegetation communities and various land uses encountered throughout the alignment.

The key urban and landscape design strategies for The Project Works include:

- Establishing a linear theme and identity through unified urban design treatments of highway structures visible from the carriageways. Linear urban design identity elements which establish a theme for this section of the highway include:
  - River Bridges - the bridge design is an evolution of the Macleay River. Bridge design with refinements to the combined headstock/pier shape and pile cap design to distinguish these bridges
  - Overbridges - the bridge design for the overbridges is consistent with the Kempsey Bypass and Kundabung to Kempsey bridge design aesthetic with refinements to throw screen designs, whilst maintaining the “family” of bridges concept. All overbridges have abutment slopes which are finished with a stone pitched finish as used on the Kempsey Bypass
  - Highway bridge barriers - identical low concrete and twin metal rail barriers are used on all highway bridges
  - Headlight Screen Design - the headlight screen design is elegant, visually recessive in form and appearance comprising a powdercoated lightweight steel structure with louvred mesh similar in appearance to the safety screen
  - Retaining wall - the reinforced earth wall finish provides a horizontal banding pattern.
- Providing lateral integration with The Project context through strategies such as:
  - Strengthening the forested edge experience with additional tall open forest planting to link isolated stands of trees
  - Responding to the existing cultural and rural residential landscape by incorporating scattered feature tree planting within the road edge planting
  - Enhancing the visual experience from the road by enabling views of the broader skyline and horizon line over foreground screen planting
  - Utilising tall forest planting (a combination of tall open forest species and low shrub species) to maintain visual “depth” into the forest. This strategy avoids mid-storey vegetation blocking views into the woods
  - Utilising only indigenous species. A great deal of effort has been made to extract the best species from each plant community with which to revegetate the alignment
  - Specifying wire rope barrier at appropriate locations in the sections of The Upgrade with widened medians to increase the effectiveness of the median as a glider crossing, by enabling tree planting closer to the inner carriageway edges
  - Due to the diversity of macrophytes available, large detention basins in view of highway users can be designed to have a distinctive character
  - Feature trees have been selected from the plant communities occurring within precincts in which they occur
  - Frangible shrub planting at bridge pylons to reduce their visual impact
  - Batter re-vegetation strategies that improve erosion resistance
  - A topsoil management strategy that optimises natural regeneration from soil, stored seed and seeding from adjacent forested areas.

A landscape maintenance strategy, provided in Section F Landscape Design, addresses the specific maintenance issues that will assist natural regeneration.

C.3 Proposed Urban & Landscape Design Treatments

The following diagrams C.3.1 to C.3.5 text and images describe the lateral integration design elements proposed for each Landscape Character Zone (LCZ).

LCZ 1: Port Macquarie Southern Gateway

LCZ 1 is located between the Southern Gateway to Port Macquarie at Oxley Highway and the Northern Gateway at the proposed Blackmans Point Interchange. Landscape treatment for this precinct will reflect its generally forested nature. Seeding will be used adjacent to retained forest and will be supplemented with tree planting at the numerous fauna crossings located in this precinct. Views to businesses signage at the Sancrox Interchange are retained. Where additional planting is proposed at the interchange it will be sympathetic to the cultural plantings already proposed as part of the early works for Sancrox. The Cassegrain Winery office complexes will be visually screened from the highway with rainforest plantings, reducing the fire risk to the winery assets. A structural headlight screen is provided between the southbound off ramp to Sancrox Interchange and the Service Road. Sancrox Overbridge design and construction is by others. Towards the northern section of LCZ 1, where the alignment diverges with the Old Pacific Highway, extensive headlight screen planting is required. This will add significantly to the character of this precinct.

LCZ 2: Hastings River & Hastings River Floodplain

In order to capitalise on the expansive views to the floodplain, distant escarpments and the Hastings River, planting in this precinct will be limited to individual tree plantings used to frame views and to plantings associated with the creek crossings and bridge abutments. Planting at the southern abutments of the Hastings River Bridge will soften the visual impact of the abutment and also screen the highway from nearby residents. The Northern abutment is close to the heavily eroded northern bank of the Hastings River and may require remediation plantings with mangroves. Pasture grasses are used as a groundcover to match the grasses in adjacent paddocks throughout this precinct.

Fernbank Creek provides habitat for Maundia so no additional tree planting is proposed in this location in order to maximise sunlight. Wetland sedge species only will be planted on Fernbank Creek bridge abutments. Fernbank Creek Bridge is visible from the Old Pacific Highway only and the pier and headstocks are simple and will be screened by planting in the long term.

LCZ 3: Port Macquarie Northern Gateway/Cairncross State Forest

The new alignment transitions sharply from floodplain to forest in this zone. Pasture grasses transition to native grasses on verges, and frangible shrubs on embankments. Blackmans Point Interchange, whilst located within the Rawdon Creek Nature Reserve and Cairncross State Forest must also present a character that indicates to motorists that this is the northern Gateway to Port Macquarie. This is achieved with Feature tree plantings - selected from the Moist Floodplain Forest vegetation community - of Foambarks and Lilly Pillies. The Foambarks will be planted in an ‘accelerating” avenue arrangement, with the Lilly Pillies in more informal groupings. Eucalypt plantings in the “doughnut” and tussock plantings on all the verges are proposed to reduce the requirement for landscape maintenance. Blackmans Point Road Interchange Overbridges and Bill Hill Road Overpass have the same bridge pier design which is elegant and references the pier designs to the north and south of The Project.

A widened median occurs near the Cairncross State Forest. Existing vegetation is retained as close as possible to the edge of the alignment and native seeds are applied to disturbed areas. Planting from Blackmans Point Interchange to the end of this zone is restricted to the numerous glider and fauna culvert crossings located in the Reserve and State Forest.

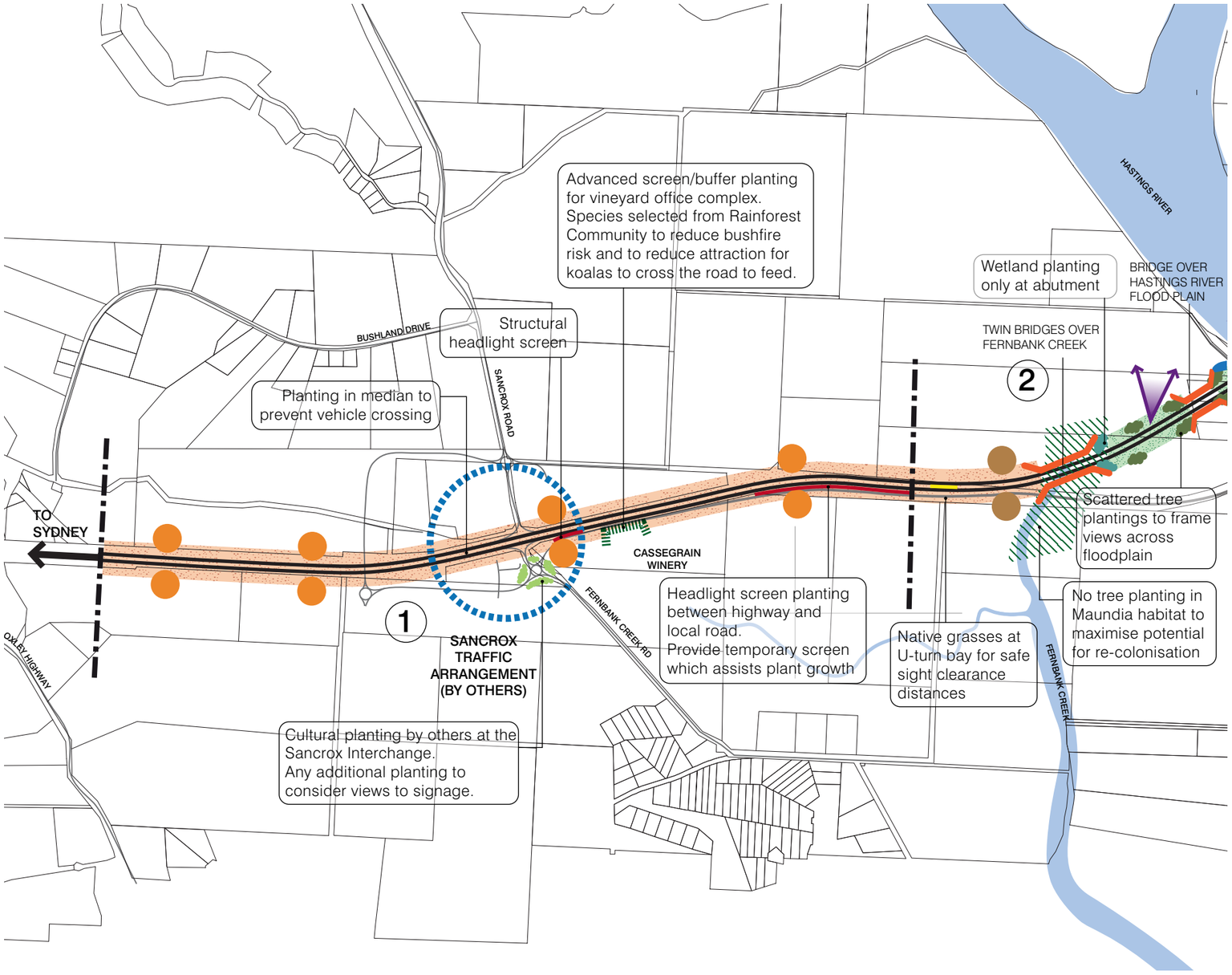


Figure C.3.1 Strategy Plan - Sheet 1

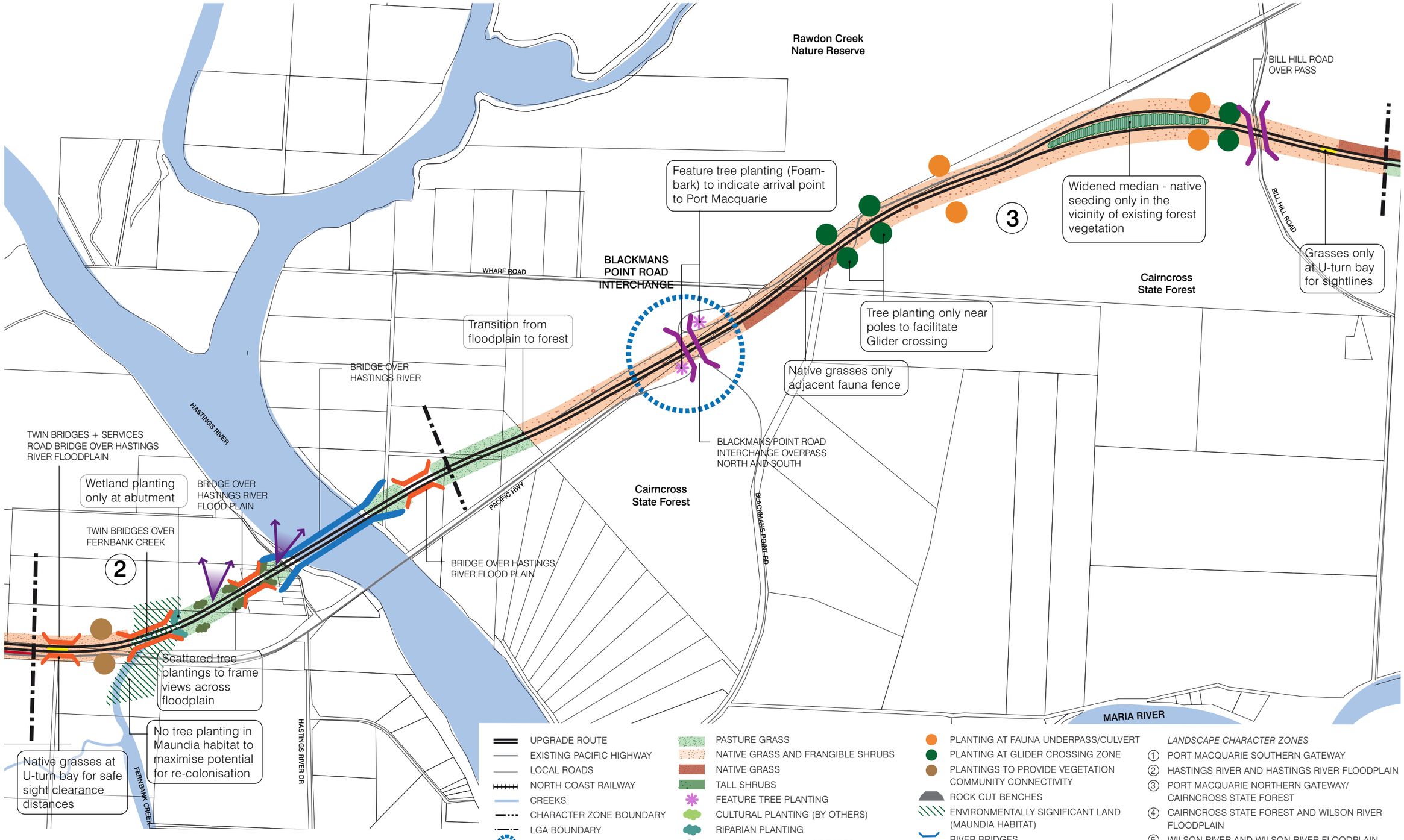


Figure C.3.2 Strategy Plan - Sheet 2

LCZ 4: Cairncross State Forest & Wilson River Floodplain

In LCZ 4 the alignment diverges from the existing highway and skirts the edge of the Wilson River Floodplain. Once again the landscape transitions from native grasses and shrubs to pasture grasses, matching that in the surrounding paddocks. Views to the floodplain to the east are maximised. Floodplain Bridges in this area are of low visibility and their design is simple and straightforward.

The dominant vegetation communities in this zone are the Paperbark Swamp Forest and the Swamp Mahogany Forest. Species from these communities are used to mitigate the visual impact of abutments at flood relief structures. Where the alignment is adjacent to Freshwater Wetland or potential Maundia habitat, native grasses are used in place of pasture grasses (the native grass seed mix contains sedges). Tree planting is avoided to minimise shading of the area. At the Tea Tree plantation, which is regarded as a desirable view for motorists, the access road to the plantation and part of a utility easement are screened with advanced plantings of densely foliaged rainforest species.

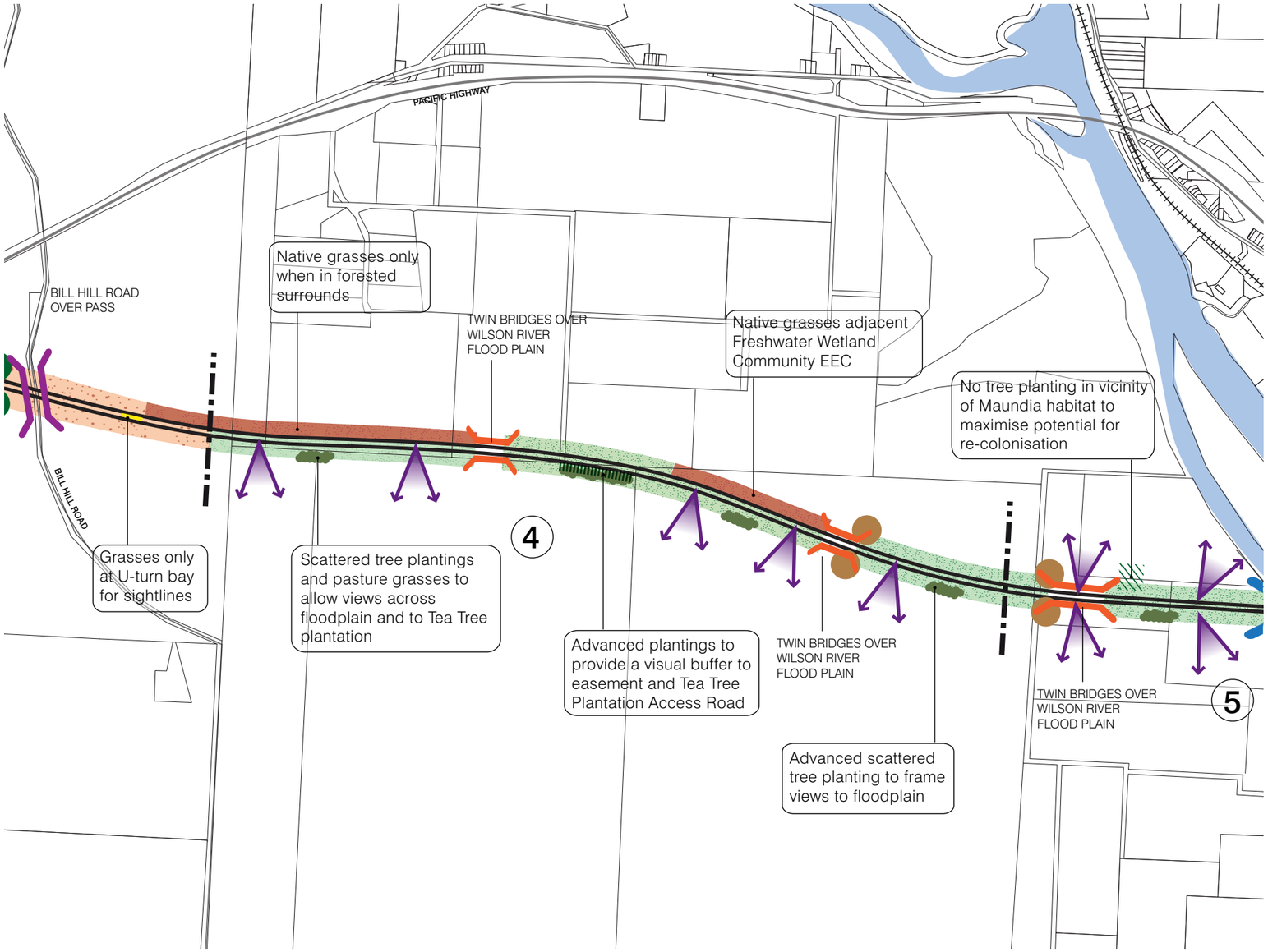


Figure C.3.3 Strategy Plan - Sheet 3

LCZ 5: Wilson River & Wilson River Floodplain

The open agricultural landscape of the floodplain in this zone is reflected with the use of pasture grasses on verges and embankments which allows unimpeded views to the floodplain. At the Wilson River Bridge abutments the riparian vegetation of the riverbank is repeated, framing Hacks Ferry Road. This also preserves the rural character by screening the new highway passing overhead. Where the bridge piers touch down on Dalhunty Island and the northern bank, planting from the Wetland and Swamp Oak Communities will be used to rehabilitate disturbance. The Wilson River Bridge design is a refined elegant single bridge structure, visible from Hacks Ferry Road at the abutment only. Vegetating the river banks prevents views generally to the bridge.

Seeding in the vicinity of the North Coast Rail corridor is of native grasses only, but elsewhere in the northern part of this zone, tall shrubs are used on the numerous high cuttings.

The Twin Bridges over Wilson River Flood Plain have low visibility and a simple, straightforward design. Views from the bridge over the flood plain will be possible at this point. The North Coast Railway Bridge will not be visible from the highway, only to the railway. The design of the retaining walls comprise a horizontal banding pattern.

LCZ 6: Cooperabung Creek

At the Haydons Wharf Road Interchange, planting is selected from the extant Moist Floodplain Forest vegetation community and includes feature tree plantings of Cabbage Gum and She Oak in informal arrangements to reinforce the rural character of the road. The overbridge pier design is identical to Blackmans Point Interchange. Throughout this zone the alignment passes through scattered forest and small farm areas The proposed landscape reflects this with intermittent shrubs and native grass areas to allow occasional views to paddocks. This is supplemented with extensive visual screen planting to screen nearby residents from the highway. At Cooperabung Creek Bridge, extensive riparian plantings are proposed both to integrate the abutments into the surroundings and to provide erosion protection to the creek bank. The Bridge is of low visibility and the design is simple and straightforward.

LCZ 7: Cooperabung Creek Nature Reserve

Large cuttings are a feature of this zone as it passes through the Cooperabung Range. The precinct is largely forested and this is reflected in the landscape design. The lower slopes of cuttings are anticipated to be rock and will not require vegetation. However the upper slopes will be seeded with tall shrubs. At the approach to cuttings, planting will be used to reduce the visual impact of the cutting.

Apart from the Yarrabee Road Interchange, which is to be planted with informal avenues of Paperbarks, planting is once again restricted to the numerous fauna culverts and glider crossings. The Yarrabee Road Underpass Bridge is of low visibility as the highway passes over. Where a creek diversion is required to tie in with the Kundabung to Kempsey works at Barrys Creek, extensive riparian planting is proposed to rehabilitate the banks. The bridge is of low visibility and is a simple straightforward design.

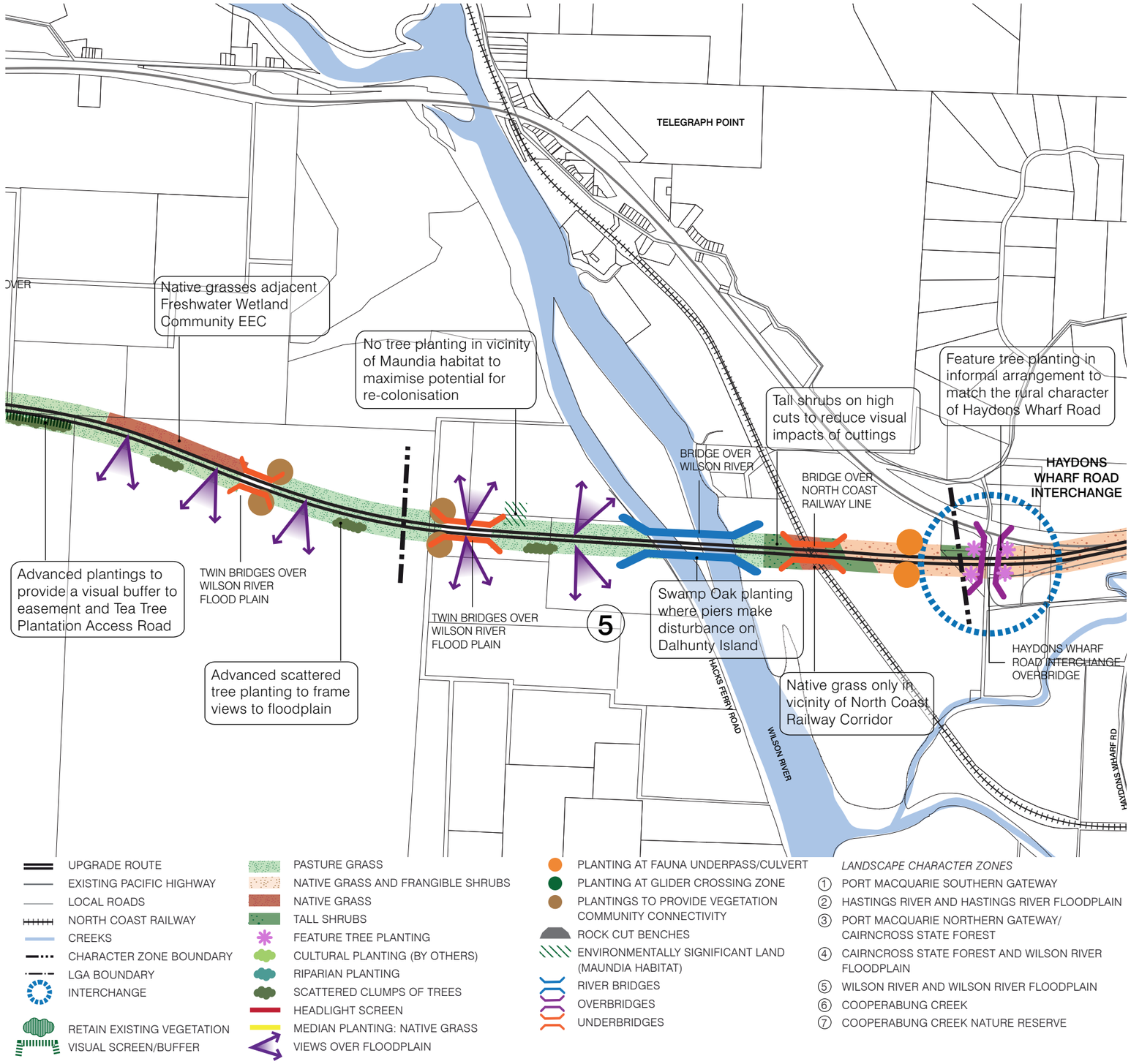
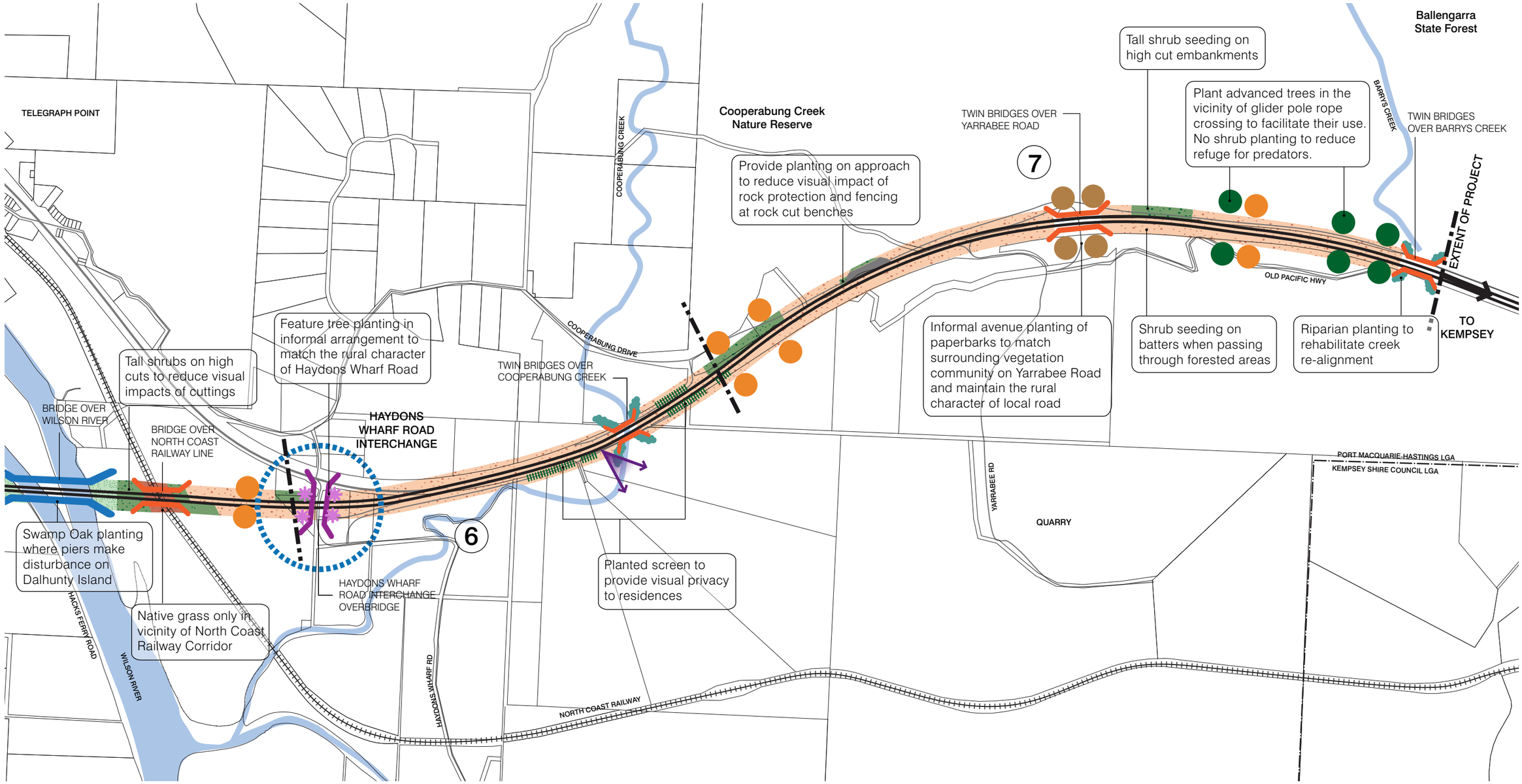


Figure C.3.4 Strategy Plan - Sheet 4



- UPGRADE ROUTE
- EXISTING PACIFIC HIGHWAY
- LOCAL ROADS
- NORTH COAST RAILWAY
- CREEKS
- CHARACTER ZONE BOUNDARY
- LGA BOUNDARY
- INTERCHANGE
- RETAIN EXISTING VEGETATION
- VISUAL SCREEN/BUFFER
- PASTURE GRASS
- NATIVE GRASS AND FRANGIBLE SHRUBS
- NATIVE GRASS
- TALL SHRUBS
- FEATURE TREE PLANTING
- CULTURAL PLANTING (BY OTHERS)
- RIPARIAN PLANTING
- SCATTERED CLUMPS OF TREES
- HEADLIGHT SCREEN
- MEDIAN PLANTING: NATIVE GRASS
- VIEWS OVER FLOODPLAIN
- PLANTING AT FAUNA UNDERPASS/CULVERT
- PLANTING AT GLIDER CROSSING ZONE
- PLANTINGS TO PROVIDE VEGETATION COMMUNITY CONNECTIVITY
- ROCK CUT BENCHES
- ENVIRONMENTALLY SIGNIFICANT LAND (MAUNDIA HABITAT)
- RIVER BRIDGES
- OVERBRIDGES
- UNDERBRIDGES

LANDSCAPE CHARACTER ZONES

1. PORT MACQUARIE SOUTHERN GATEWAY
2. HASTINGS RIVER AND HASTINGS RIVER FLOODPLAIN
3. PORT MACQUARIE NORTHERN GATEWAY/ CAIRNCROSS STATE FOREST
4. CAIRNCROSS STATE FOREST AND WILSON RIVER FLOODPLAIN
5. WILSON RIVER AND WILSON RIVER FLOODPLAIN
6. COOPERABUNG CREEK
7. COOPERABUNG CREEK NATURE RESERVE

0 1000m

Figure C.3.5 Strategy Plan - Sheet 5

D Bridges

Introduction

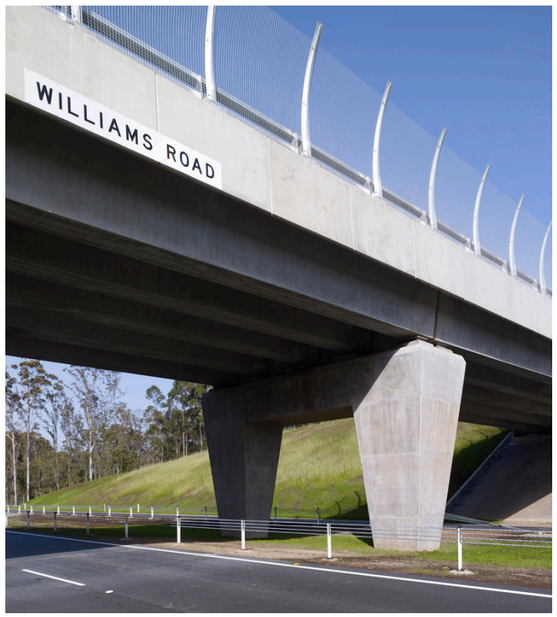
The project includes a total of 23 vehicular bridges at 15 locations, comprising single bridges over the Hastings and Wilson Rivers, four local road overbridges, a twin local road underbridge at one location, a single bridge over the North Coast Rail Corridor, twin bridges over Fernbank, Cooperabung and Barrys Creeks, twin bridges over Wilsons River floodplain at three locations and two single bridges over the Hastings River floodplain at two locations. Many of the bridges also function as fauna underpasses. Box culvert underpasses occur at 28 locations, providing either fauna crossings, drainage or both. The Report presents and describes the bridges in text, elevation and cross sectional elevation and orders the Bridges according to their visual importance and type beginning with River Bridges, Transverse Bridges over the Main Carriageway (Overbridges), followed by Main Carriageway Bridges and lastly Underpass Box Culverts. The order of presentation is as follows:



Macleay River and Floodplain Bridge Pier Design

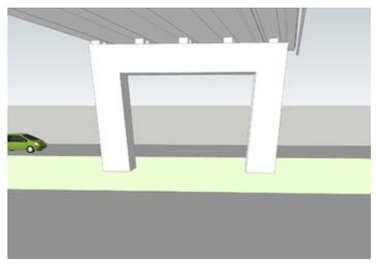


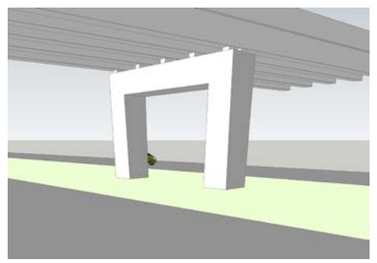
Kempsey Bypass Overbridge Safety Screen and Pier Design



Bonville Overbridge Safety Screen and Pier Design







Proposed Safety Screen and Pier Design

D.1 River Bridges

D.1.1 SB04: Bridge over Hastings River at 15.6km North of Port Macquarie

D.1.2 SB09: Bridge over Wilson River at 26.6km North of Port Macquarie.

D.2 Transverse Bridges over Main Carriageway (Overbridges)

D.2.1 SB14: Blackmans Point Road Interchange Overbridge South at 18.1km North of Port Macquarie

D.2.2 SB14: Blackmans Point Road Interchange Overbridge North at 18.2km North of Port Macquarie

D.2.3 SB15: Bridge over Highway No.10 at Bill Hill Road Overpass at 21.6km North of Port Macquarie

D.2.4 SB16: Bridge over Highway No.10 at Haydons Wharf Road Interchange Overbridge at 28.1km North of Port Macquarie.

D.3 Main Carriageway Bridges (Underbridges)

D.3.1 SB02: Twin Bridges over Fernbank Creek at 14.7km North of Port Macquarie

D.3.2 SB03: Bridge over Hastings River Floodplain at 15.2km North of Port Macquarie

D.3.3 SB05: Bridge over Hastings River Floodplain at 16.4km North of Port Macquarie

D.3.4 SB06: Twin Bridges over Wilson River Floodplain at 23.3km North of Port Macquarie

D.3.5 SB07: Twin Bridges over Wilson River Floodplain at 24.8km North of Port Macquarie

D.3.6 SB08: Twin Bridges over Wilson River Floodplain at 25.7km North of Port Macquarie

D.3.7 SB10: Bridge over North Coast Railway Line at 27.3km North of Port Macquarie

D.3.8 SB11: Twin Bridges over Cooperabung Creek at 29.8km North of Port Macquarie

D.3.9 SB12: Twin Bridges over Yarrabee Road at 32.2 km North of Port Macquarie

D.3.10 SB13: Twin Bridges over Barrys Creek at 34.1km North of Port Macquarie.

D.4 Underpass Box Culverts

D.4.1 Typical Box Culvert Elevation and Cross Section.

The proposed Bridge designs comply with the requirements of The Project Scope of Works and Technical Criteria. In addition, the designs also reflect careful consideration of: the applicable sections of The Project Environmental Assessment (EA) and the Roads and Maritime publication *Bridge Aesthetics* (July 2012). They are also consistent with the overall urban and landscape design strategy established for The Project.

The following design characteristics apply generally to The Project's bridges:

- The bridge designs are related to bridges either already constructed, or to be constructed, in upgrades to the north of the Oxley Highway to Kundabung project. Immediately to the north is the Kundabung to Kempsey upgrade which is a Construct Only contract and further north of that is the recently completed Kempsey Bypass and Macleay River and Floodplain Bridge projects. Sancrox Traffic Arrangement which includes Sancrox Road Overbridge is also located in this section. The pier shapes, safety screen and Overbridge designs for this project are a refinement of these upgrades. The designs provide visual consistency without directly replicating the adjacent upgrade designs and distinguish this section of the road journey
- The two River Bridges at Hastings River and Wilson River are highly visible structures and important landmarks in the Pacific Highway journey. The proposed single bridge carriageways have been designed to provide a continuation in the series which includes the Macleay River and Floodplain Bridge. The design delivers a structurally efficient bridge which is also aesthetically attractive with piers that are visually compatible with the differing heights required. The structure comprises slender twin concrete blade shaped piers with rounded ends. The headstock tapers to meet the width of the piers. The locations of the bridges are distinguished by patterning of the flat surface of the piers
- Bridges carrying local roads over the highway are generally consistent and recognisable as part of a 'family' of bridges, with individual variations to particular bridges which reflect the character and requirements of their specific settings. The typical piers for Main Carriageway Overbridges (referred to as Transverse Bridges) are tapered in elevation and are an inverted trapezoid "pants pier" style in cross sectional elevation. All overbridges are fitted with safety screens to avoid objects being thrown onto the highway below. The safety screen design references the Kempsey Bypass and the Kundabung to Kempsey Upgrade with a slight modification in the former case to meet the SWTC requirement for parapets to not be obscured by safety screen posts. (Refer Figure D.1). The design proposes curved screens in cross section, visible from the local roads, to provide a refinement to the design so that kinked mesh is not required for stiffening
- Bridges carrying the highway over the North Coast Railway, creeks, Yarrabee Road and fauna routes are simple, economical structures, with careful attention paid to their detailing, particularly the parapets and twin rail barriers which are highly visible from the main highway carriageways
- Spill-through abutments are generally used for the sense of openness they provide. They are also less subject to graffiti attack than retaining wall abutments and are utilised on all main carriageway overbridges. The spill through abutments for most highway bridges are treated with a stone pitch finish, sourced from within The Project, to provide scour protection and a long term low maintenance finish. This finish is also used on the Kempsey Bypass upgrade. Rip Rap armour stone boulders are used under the creek and floodplain bridges for scour protection
- Parapets on bridges consist of a metal two rail and post system mounted on top of a 650mm high concrete barrier, in order to maximise views from the bridges towards the landscape.

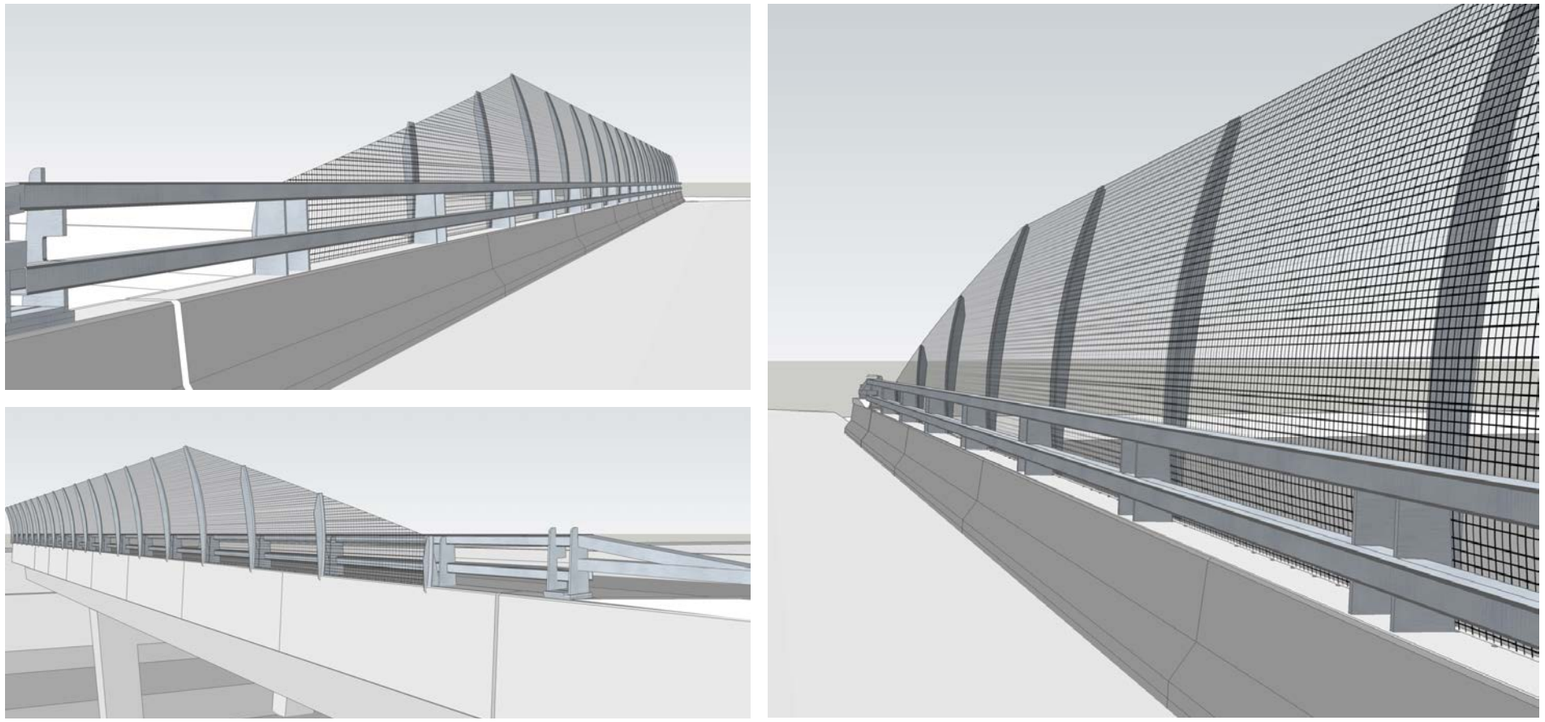


Figure D.1 Proposed Safety Screen profile

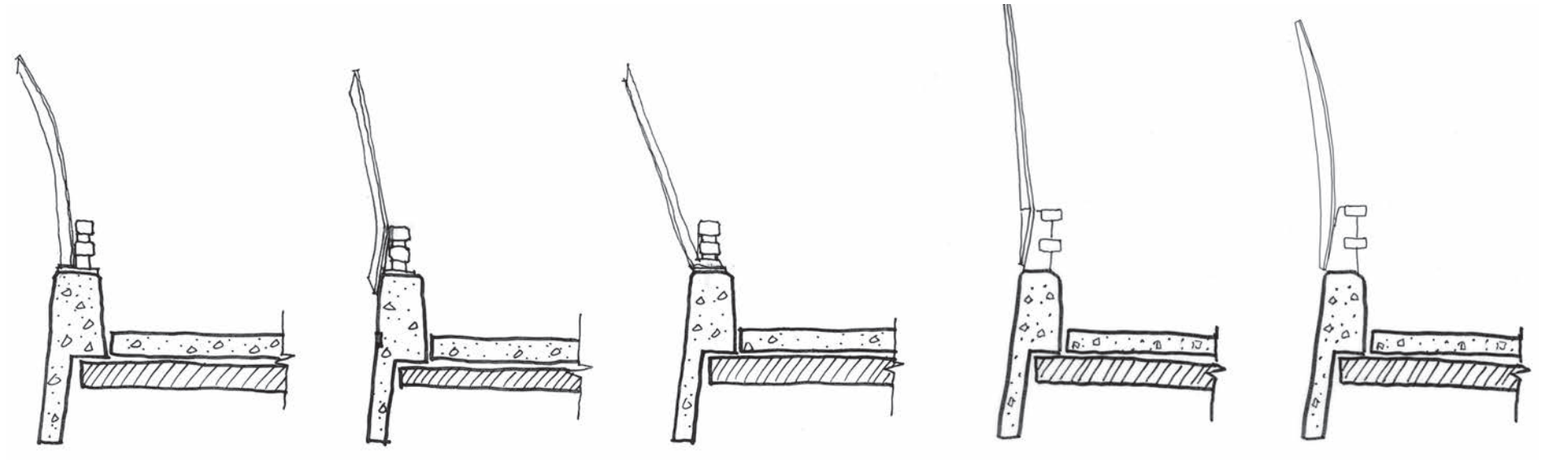


Figure D.2 Safety Screen profiles in nearby projects

D.1 River Bridges

The two bridges over the Hastings River and Wilson River are highly visible structures and important landmarks in the Pacific Highway journey. The proposed single bridge carriageways have been designed to provide a continuation in a series of River Bridges in this North Coast region, starting with the Macleay River and Floodplain Bridge at Kempsey. The design delivers a structurally efficient bridge which is also aesthetically attractive with piers that cope visually with the differing heights required.

Key design elements are consistent for all the River Bridges on the Oxley Highway to Kundabung Upgrade as follows (Refer to Figures D.1.1.1 to D.1.1.4).

Bridge Approaches & Abutments

The bridge approaches across the river floodplain for the Hastings River Bridge comprise embankments which are approximately four and eight metres in height. For the Wilson River Bridge they are approximately 4.5 and eight metres in height. Spill through abutments are adopted to provide more open views from the River and adjoining floodplains. They are less prone to graffiti attack than retaining wall abutments. A 1.5H:1V batter slope is adopted at the bridge abutments and batter protection is provided with stone boulders in accordance with scour protection requirements.

Piers & Pile Caps

The pier leg shape comprises slender twin rectangular blades with semicircular ends. The piers for both bridges are skewed approximately 10 degrees to the main carriageway alignment to align with river flow requirements. The bridge is seen in true elevation (perpendicular to its long axis) the piers are therefore viewed at an oblique angle and therefore not viewed face on. When the piers are viewed in true elevation, the pier design for both the Hastings and Wilson River bridges is rounded to approximately one metre diameter. Viewed in cross sectional elevation the headstock tapers to the semi-circle pier end. A central panel in each pier face is finished in a ribbed patterned surface which contrasts the smooth off form finish of the remainder of the piers. This pattern also provides additional modulation to the surface of the piers enhancing the appearance and reducing the perceived scale/width. Pile caps are rounded to reflect the pier design and are not visible above the ground line on land.

Superstructure

The Hastings and Wilson River Bridges accommodate two carriageways on a single structure. The Hastings River Bridge comprises 15 equal spans of 38 metres each and each span consists of ten 1800 millimetre deep Super-T girders. The Wilson River Bridge comprises 13 equal spans of 38 metres each and one end span of 28 metres. Each span consists of ten 1800 millimetre deep Super-T girders. This arrangement results in a slender superstructure and a minimum structural depth that is consistent with the bridge spans and method of construction.

Parapets

Parapets comprise a 650 millimetre concrete barrier with twin metal rails on top, providing an overall height of 1300 millimetre above the road surface level. The twin metal rails maximise views from the highway to the Hastings and Wilson Rivers and surrounding countryside and minimise the parapet depth as seen from the river and floodplains. The outer parapet faces extend downwards below the soffit of the bridge deck, enhancing the perceived slenderness of the superstructure and concealing a drainage pipe under the bridge deck. The parapets slope outwards towards the bottom at an angle of 5.5 degrees and the top of the parapet has an inward cross fall for drainage to minimise staining on the outer face of the parapet. The twin rail termination detail adopts a standard Roads and Maritime detail. A single conduit is located in each barrier.

The following pages show the bridges in elevation, cross sectional elevation and 3D visualisations.



Macleay River and Floodplain Bridge over floodplain viewed from South West Rocks Road



Macleay River and Floodplain Bridge viewed from the township of Frederickton



View from Macleay River and Floodplain Bridge to the Macleay River



Macleay River and Floodplain Bridge in elevation over floodplain from South West Rocks Road

D.1.1 SB04: Bridge over Hastings River at 15.6km north of Port Macquarie

A bridge is required at this location to span both the Hastings River and Glen Ewan Road. The bridge comprises a single bridge superstructure to carry both the northbound and southbound carriageways of the Pacific Highway, with the carriageways separated by a central median barrier.

The bridge comprises 15 simply supported spans with an overall length of 570 metres. The superstructure comprises ten 1800mm deep Super-T PSC girders with a 200 millimetre (minimum) thick composite cast-in-place deck slab. The girders are supported on laminated elastomeric bearings. The piers are of portal frame style with a headstock supported by blade columns. The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with stone pitching scour protection. A 750 millimetre wide inspection platform is provided in front of the abutments with stair access to the highway level at the northern abutment and down to Glen Ewan Road at the southern abutment.

The soffit of the pile caps is located lower than the mean low water spring level (MLWS) and the top of the pile cap is located one metre above the mean high water level (MHW). The river piers are oriented as closely as possible parallel to the river. A pile cap is provided under each blade column at the water level. Thus each pier leg has an individual pile cap supported by twin steel driven tube piles in-filled with concrete.

Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. On each side of the bridge the parapet extends down to cover the deck drainage which is a concealed pipe running along the length of the bridge under the deck slab. A twin rail metal traffic barrier is provided on top of the parapet providing a total parapet height of 1300 millimetres.

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

FROM OXLEY HIGHWAY

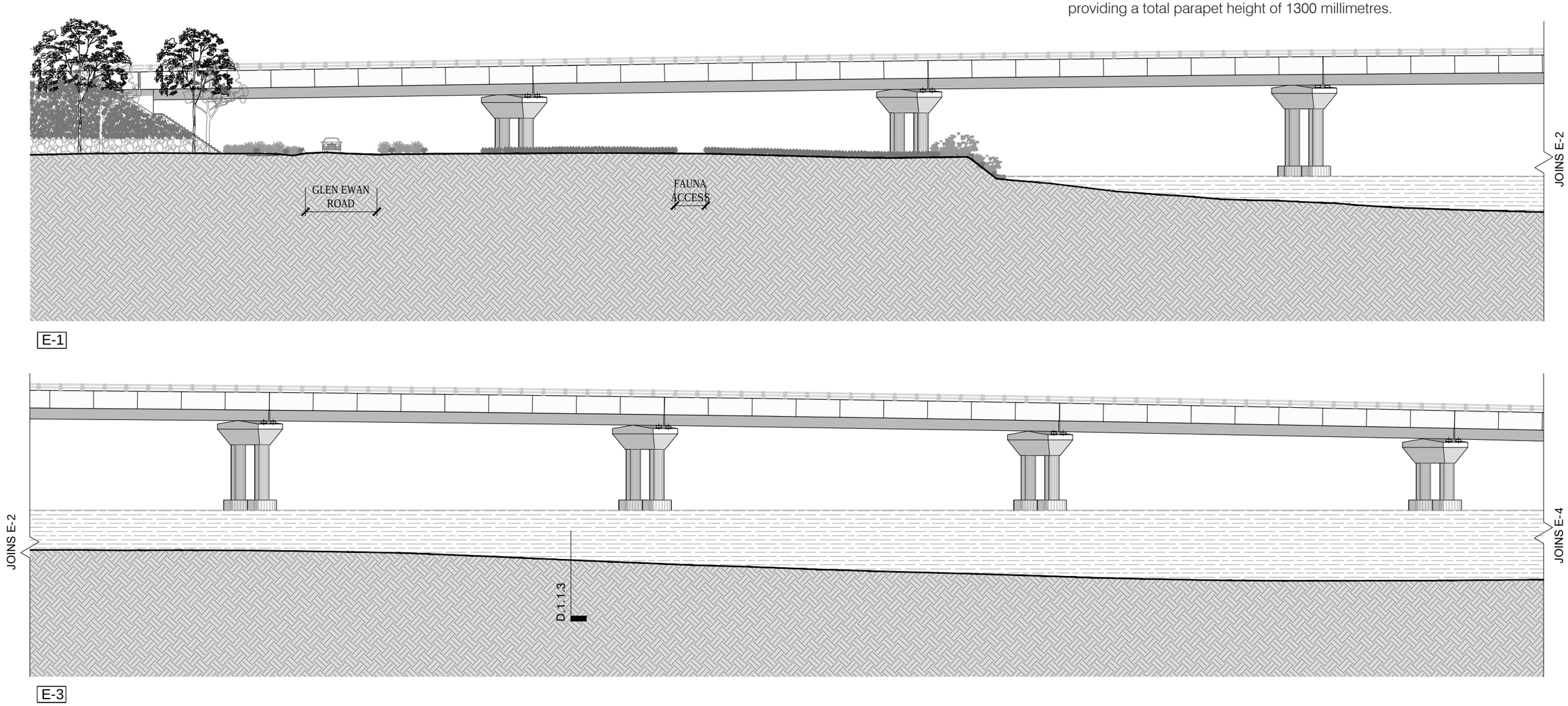


Figure D.1.1.1 SB04: Bridge over Hastings River: Elevation

0 20m

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For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

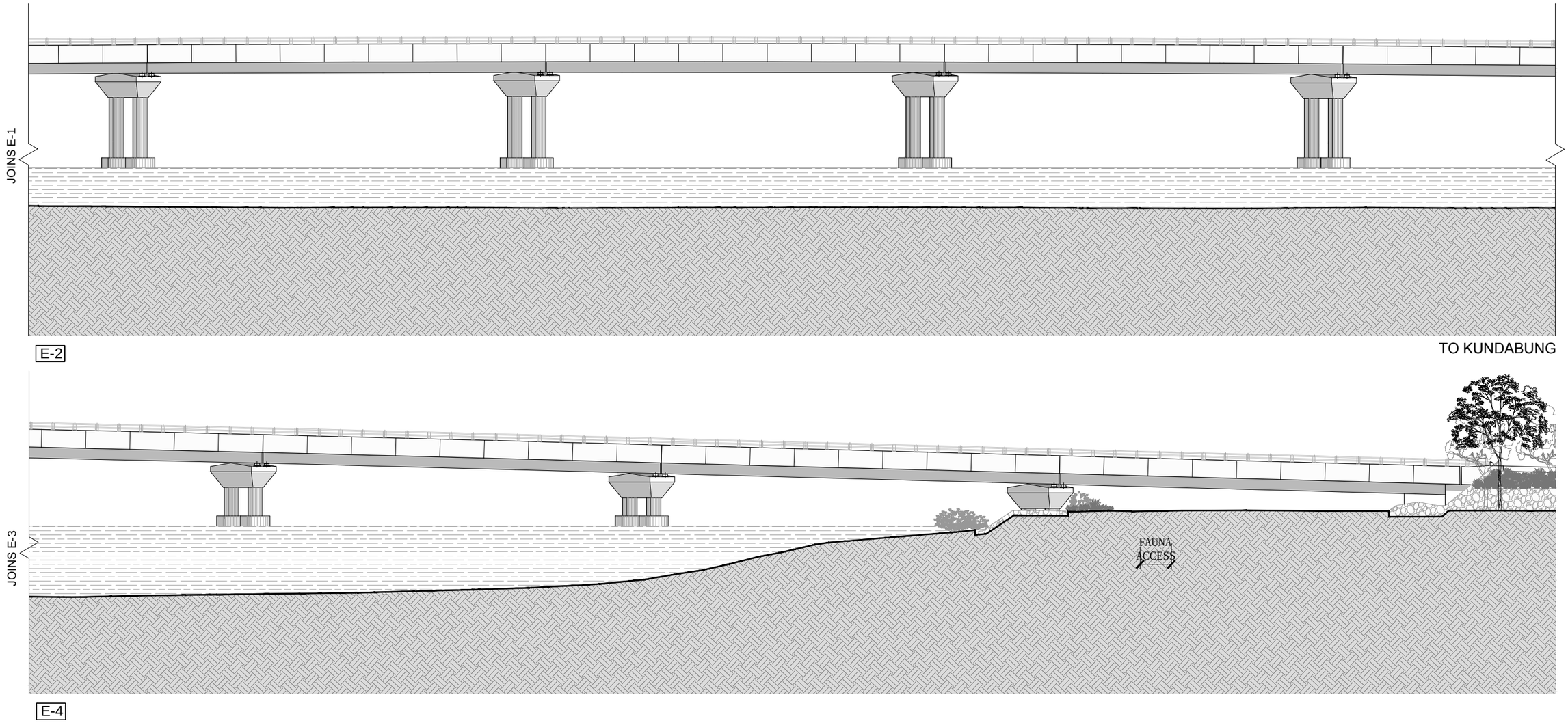
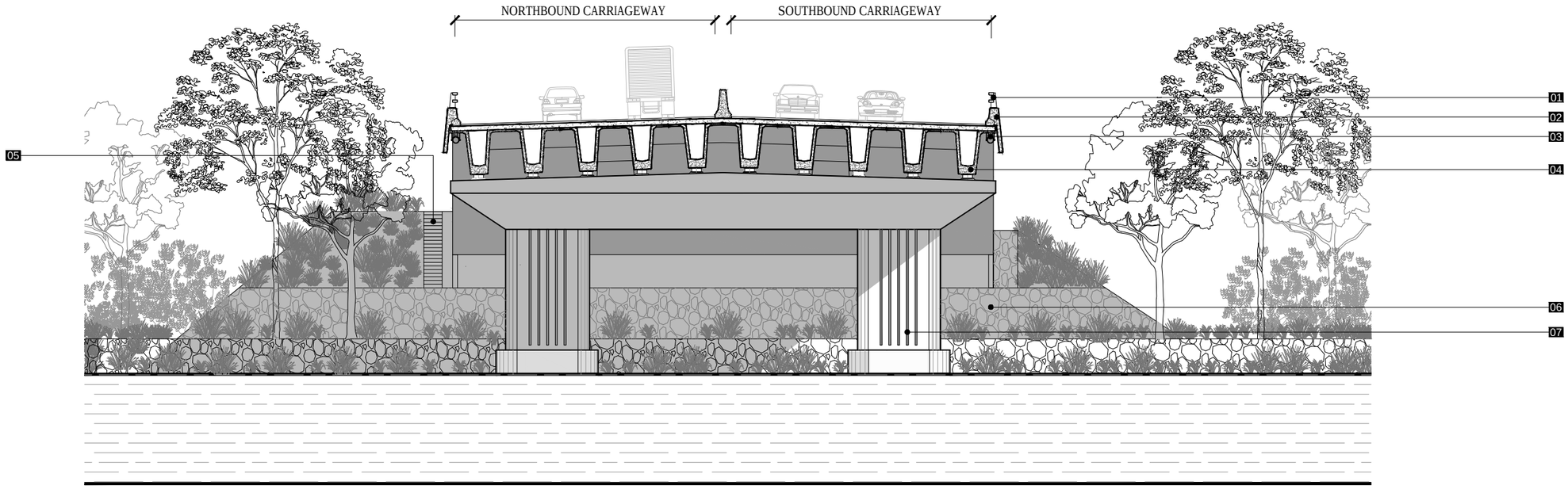


Figure D.1.1.2 SB04: Bridge over Hastings River: Elevation (North)

0 20m



01 TWIN METAL RAIL BARRIER
02 CONCRETE PARAPET
03 DRAINAGE PIPE
04 SUPER-T GIRDERS
05 MAINTENANCE ACCESS STAIRS
06 RIP-RAP ARMOUR STONE SCOUR PROTECTION
07 CONCRETE PIER WITH RIBBED PATTERN TO FLAT FACE

NOTE: SECTION DOES NOT SHOW GIRDERS BEHIND

0 10m

Figure D.1.1.3 SB04: Bridge over Hastings River: Cross Sectional Elevation



Viewpoint 1 - View from Old Pacific Highway looking south-east to Hastings River Bridge



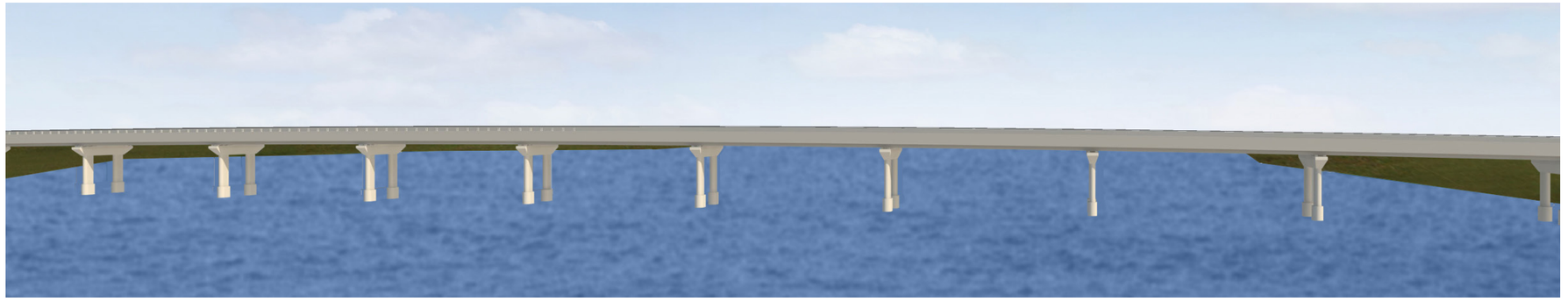
Viewpoint 2 - View along northern abutment to Hastings River Bridge



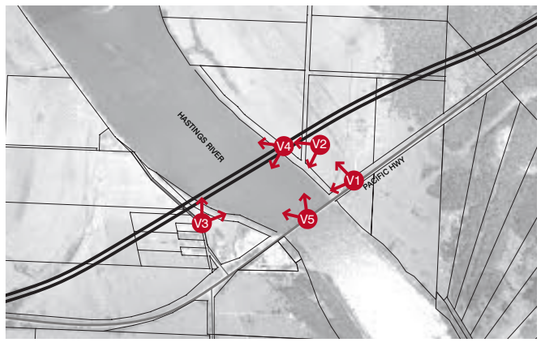
Viewpoint 3 - View from Glen Ewan Road looking north-west to Hastings River Bridge



Viewpoint 4 - Typical Piers of Hastings River Bridge



Viewpoint 5 - View from Old Pacific Highway looking west to Hastings River Bridge



Viewpoint Location Plan

Figure D.1.1.4 SB04: Bridge over Hastings River: 3D Visualisations

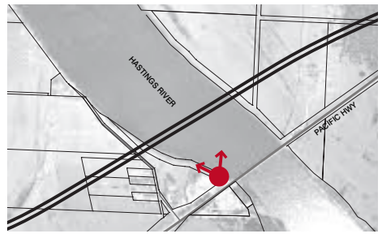




Viewpoint Location Plan

Figure D.1.1.5 Bridge over Hastings River: 3D Visualisation





Viewpoint Location Plan

D.1.2 SB09: Bridge over Wilson River at 26.6km north of Port Macquarie.

A bridge is required at this location to span the Wilson River and Hacks Ferry Road. The bridge comprises a single bridge structure to carry both the northbound and southbound carriageways of the Pacific Highway, with the carriageways separated by a central median barrier.

The bridge comprises 14 simply supported spans with an overall length of 524 metres. The superstructure comprises ten 1800 millimetre deep Super-T PSC girders with a 200 millimetre (minimum) thick composite cast-in-place deck slab. The piers are portal frame style with a headstock supported by blade columns. The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with stone pitching scour protection. A 750 millimetre wide inspection platform is provided in front of the abutments with stair access to the local road level.

The soffit of the pile caps is located lower than the mean low water spring level (MLWSL) and the top of the pile cap is located one metre above the mean high water level (MHWL). The river piers are oriented as closely as possible parallel to the river. Each pier leg has an individual pile cap supported by twin steel driven tube piles in-filled with concrete. Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. On each side of the bridge the parapet extends down to cover the deck drainage which is a concealed pipe running along the length of the bridge under the deck slab. A twin rail metal traffic barrier is provided on top of the parapet providing a total parapet height of 1300 millimetres.

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

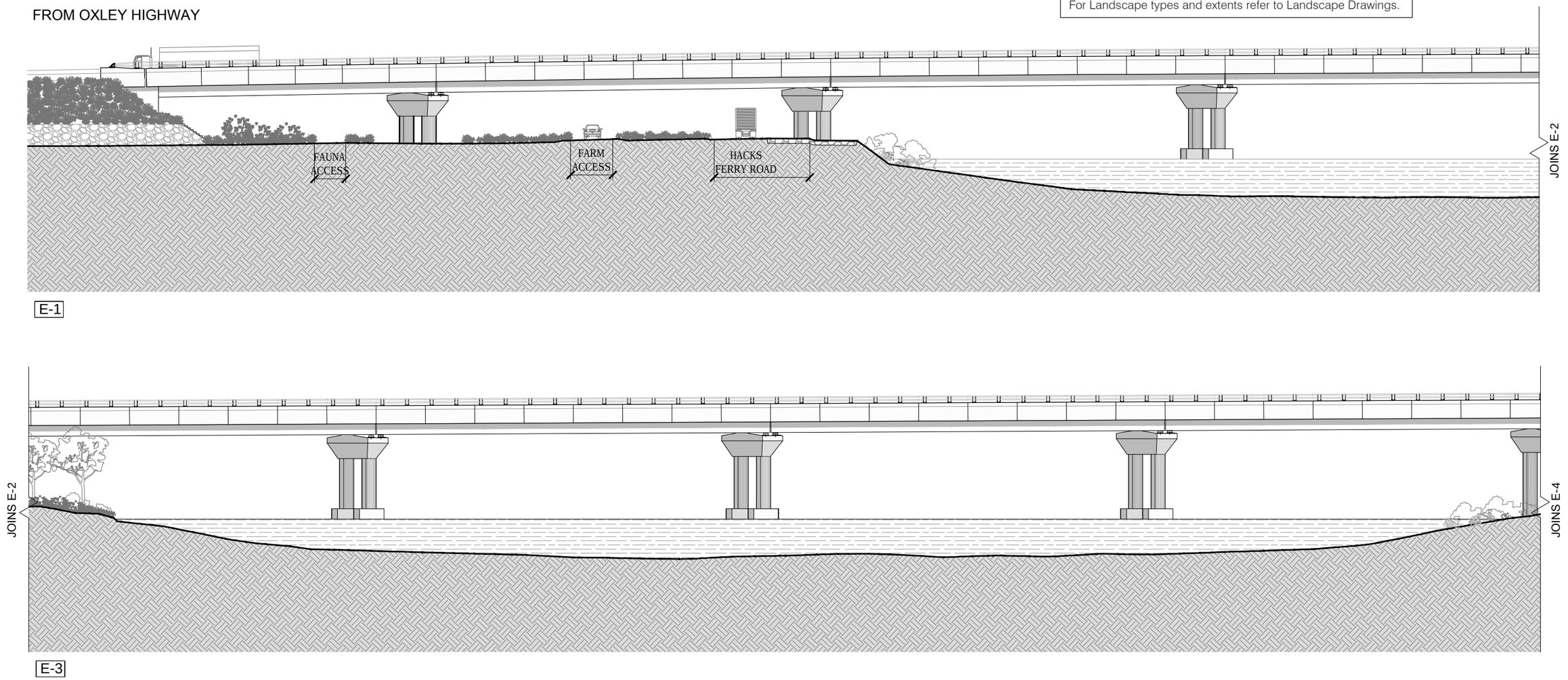
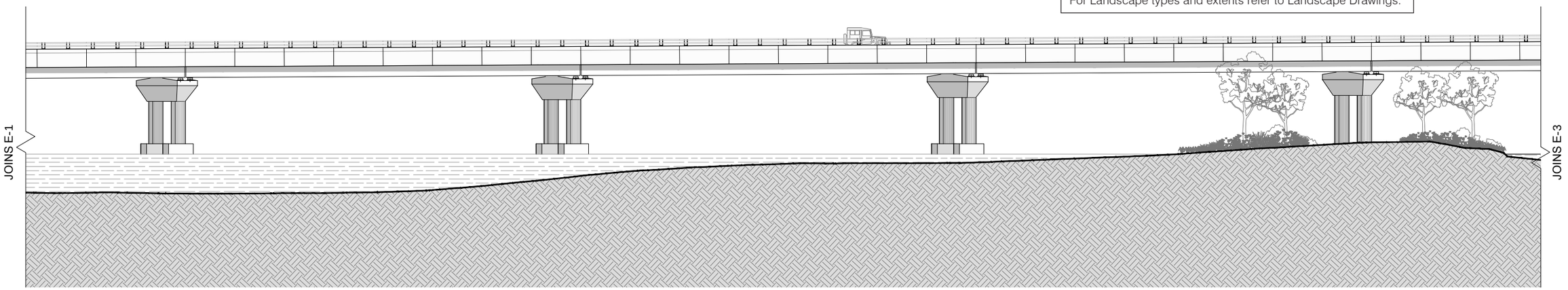


Figure D.1.2.1 SB09: Bridge over Wilson River: Elevation

0 25m

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.



TO KUNDABUNG

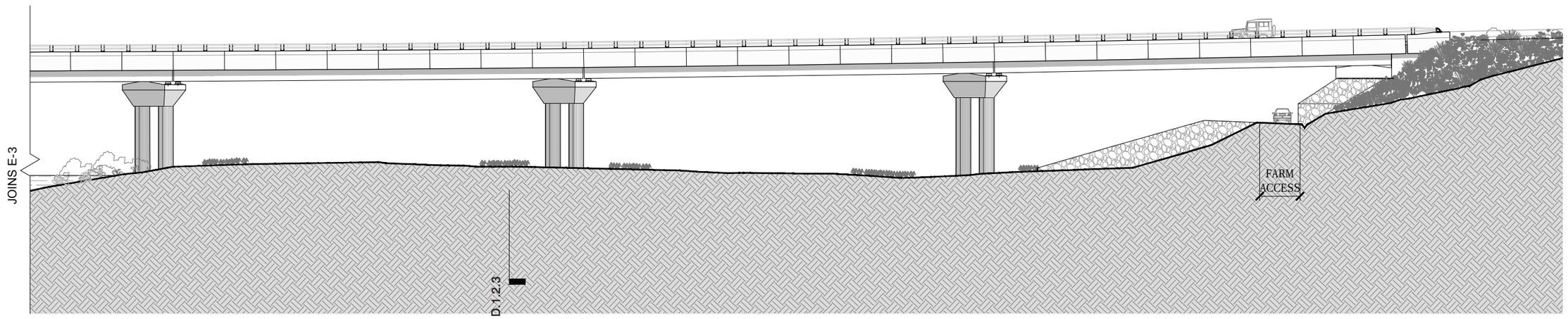
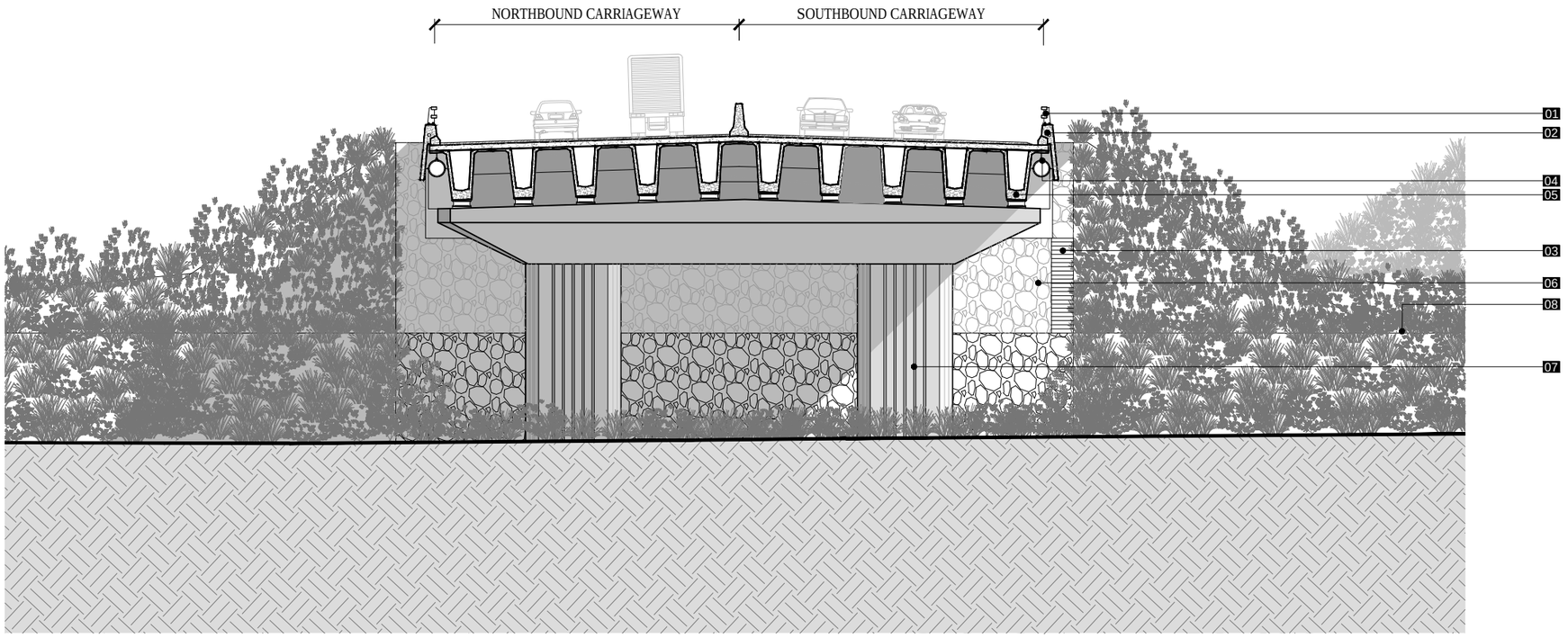


Figure D.1.2.2 SB09: Bridge over Wilson River: Elevation

0 10m



01 TWIN METAL RAIL BARRIER
02 CONCRETE PARAPET
03 MAINTENANCE ACCESS STAIRS
04 DRAINAGE PIPE
05 SUPER-T GIRDERS
06 RIP-RAP ARMOUR STONE SCOUR PROTECTION
07 CONCRETE PIER WITH RIBBED PATTERN TO FLAT FACE
08 FARMER ACCESS ROAD

NOTE: SECTION DOES NOT SHOW GIRDERS BEHIND

0 10m

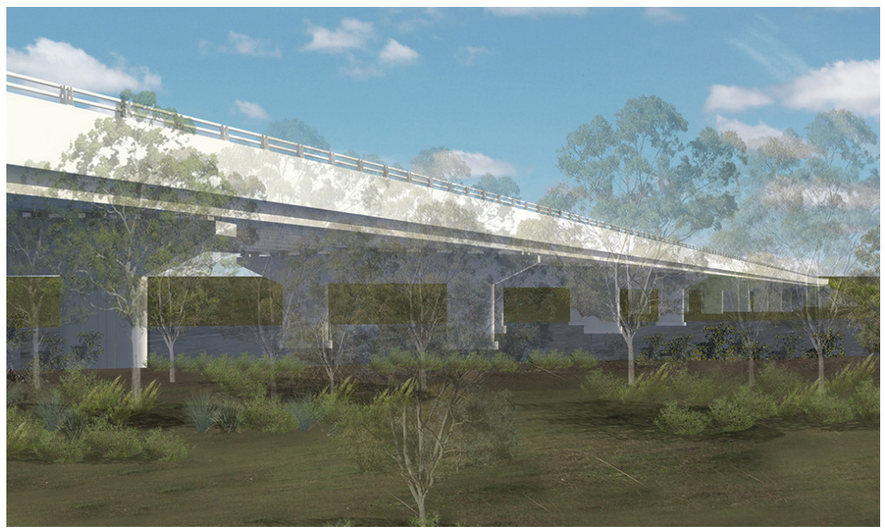
Figure D.1.2.3 SB09: Bridge over Wilson River: Cross Sectional Elevation



Viewpoint 1 - Looking west to Wilson River Bridge



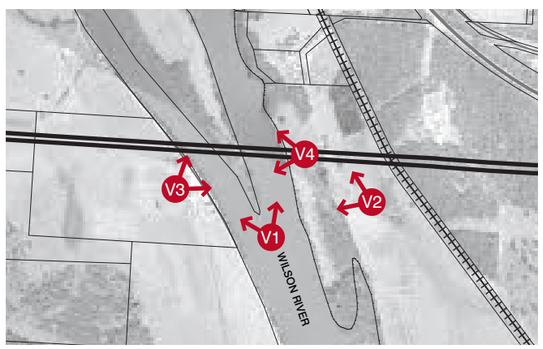
Viewpoint 2 - View looking south to Wilson River Bridge



Viewpoint 3 - View from Hacks Ferry Road



Viewpoint 4 - Typical Piers of Wilson River Bridge



Viewpoint Location Plan

Figure D.1.2.4 SB09: Bridge over Wilson River.: 3D Visualisations

D.2 Transverse Bridges over Main Carriageway (Overbridges)

These bridges are highly visible as they are located over the Pacific Highway and provide a repetitive design element up and down the highway. As such they require a high quality architectural design consistent with overbridge designs to the north and south. Key design elements are consistent for all the overbridges on the Oxley Highway to Kundabung Upgrade as follows (Refer to Figures D.2.1 to D.2.3):

Piers

The piers for the overbridges are tapered in elevation and are an inverted trapezoid “pants pier” style in cross sectional elevation, in line with the look of the Kundabung to Kempsey and Sancrox Traffic Arrangement upgrades as well as the completed Kempsey Bypass Upgrade.

Abutments

Spill through abutments have been adopted on all overbridges to allow open views along the highway. They are less prone to graffiti attack than retaining wall abutments. A 1.5H:1V batter slope has been adopted locally at all bridge abutments. Abutment batters are finished with stone pitching (stones set in concrete) as used in the Kempsey Bypass upgrade, which assists with weed control. The paved surface extends one metre beyond the edge of the parapet to prevent scouring from the drip line.

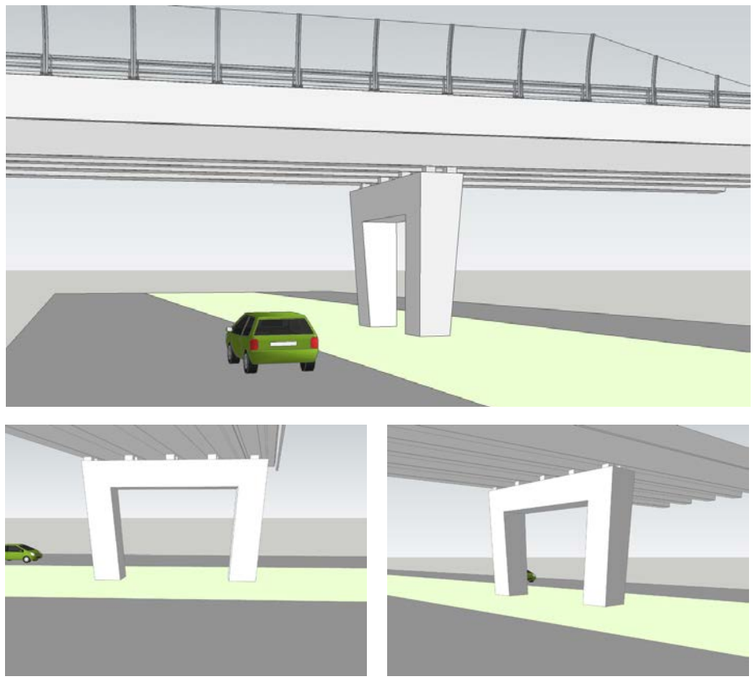


Figure D.2.1 Overbridge Pier Design: 3D Images

Parapets

Parapets comprise a 650 millimetre concrete barrier with twin metal rails on top, providing an overall height of 1300 millimetre above the road surface level. The twin metal rails maximise views from the local roads on the bridges and minimise the parapet depth as seen from the highway. The outer parapet faces extend downwards below the bridge deck soffit, enhancing the perceived slenderness of the superstructure. The parapets slope outwards towards the bottom at an angle of 5.5 degrees and the top of the parapet has an inward cross fall for drainage to minimise staining on the outer face of the parapet. The twin rail termination detail adopts a standard Roads and Maritime detail. A single conduit is located in each barrier.



Stone pitching abutment finish on Kempsey Bypass



Kempsey Bypass Overbridge Pier Design

Safety Screens

The Safety Screen design references the design of screens on the adjacent Kundabung to Kempsey and Sancrox Traffic Arrangement upgrades, with refinements to the steel T-section shape to enable a better visual outcome for the steel mesh which they support. Each safety screen upright is mounted on the top of the concrete parapet/barrier. The Safety Screen is located between the two uprights of each twin rail barrier post, ensuring a neat and symmetrical integration of the safety screen upright and barrier post.

The design, in cross section, proposes tapered curved T-section steel posts supporting curved steel mesh screens, reducing the visual impact of the screens. The curved supports begin by following the line of the parapet face and curve outwards creating a more open feel on the bridge, compared to a vertical or inwardly sloping screen. The curved mesh is sufficiently stiff such that unsightly “kinks” are not required in the mesh. This provides a refinement to the current Kundabung to Kempsey and Sancrox Traffic Arrangement screens, where kinked mesh is required to stiffen the flat section screens. The proposed curved screens provide a smooth appearance on the local road side, from which they are primarily visible. The curved screen has been used previously on several Pacific Highway Upgrades, including the Bonville upgrade project.

The throw screens taper at each end in elevation to terminate in three evenly spaced sloping panels which end at the last twin metal rail post before the expansion joint of the parapet twin rail for all Overbridges. The only exception is on the North Coast Railway Line Underbridge where there is only one sloped panel. This is due to the fact that the abutments are not sloping and therefore there is no space to taper gradually to the abutment as happens on spill through abutments over the highway. The full height of the safety screen is required for a longer stretch due to its proximity to the rail track.

The following pages show the bridges in elevation and cross sectional elevation.

D.2.1 SB14: Blackmans Point Road Interchange Overbridge South at 18.1km North of Port Macquarie.

D.2.2 SB14: Blackmans Point Road Interchange Overbridge North at 18.1km North of Port Macquarie.

D.2.3 SB15: Bridge over Highway No.10 at Bill Hill Road Overpass at 21.6km North of Port Macquarie.

D.2.4 SB16: Bridge over Highway No.10 at Haydons Wharf Road Interchange Overbridge at 28.1km North of Port Macquarie.



Kinked mesh on Kempsey Bypass Safety Screen

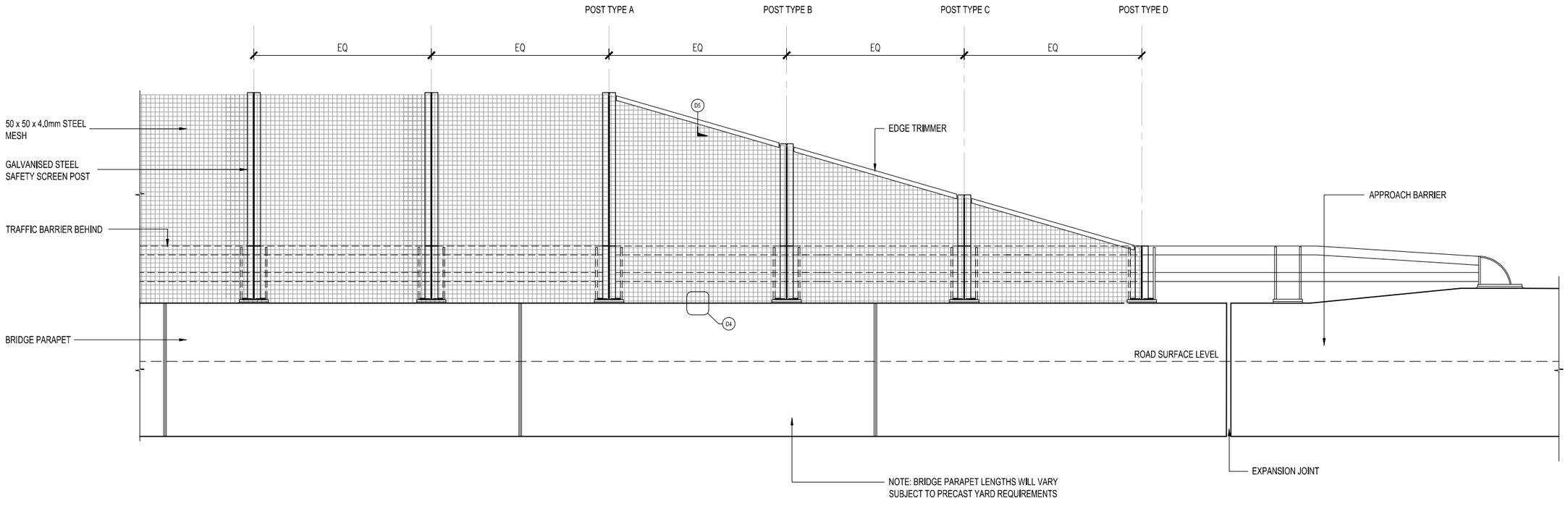
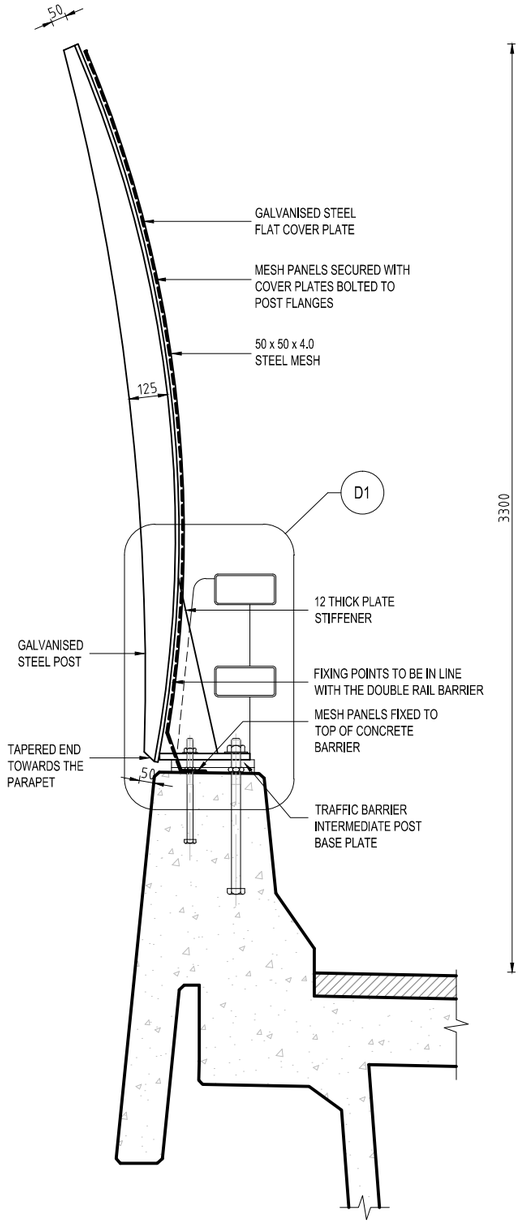
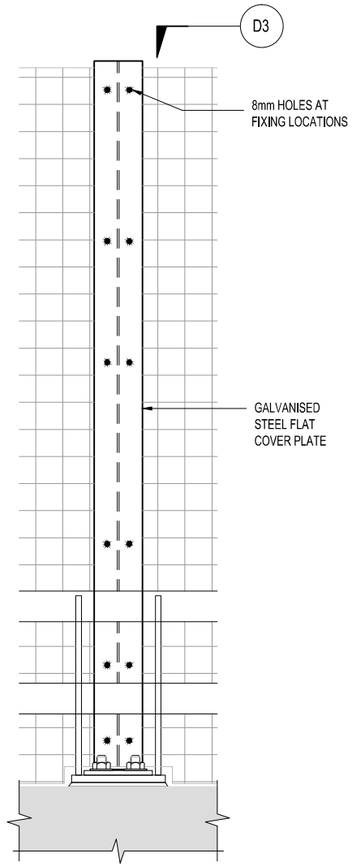


Figure D.2.2 Typical Elevation at end of Safety Screen for the Oxley Highway to Kundabung Design

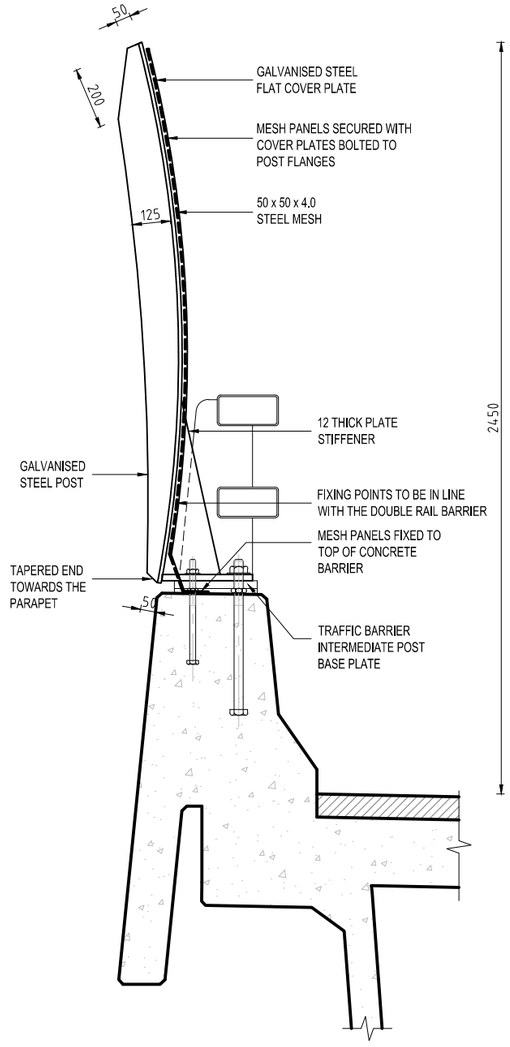
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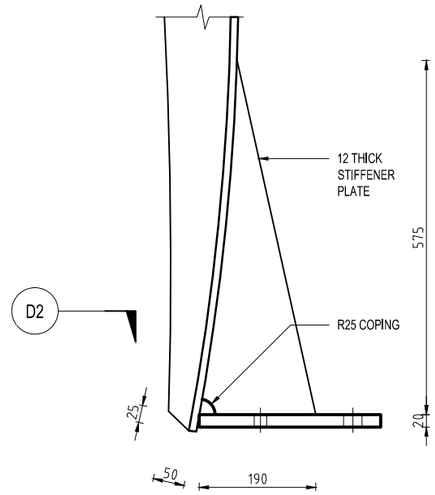
TYPICAL FULL HEIGHT POST, SECTION - TYPE A
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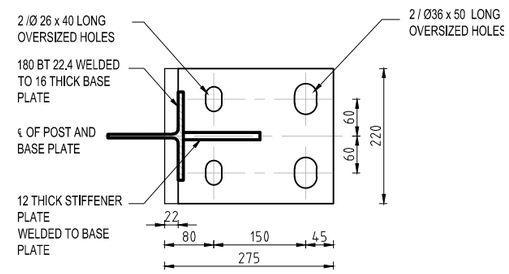
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TAPERED POST, SECTION - TYPE B
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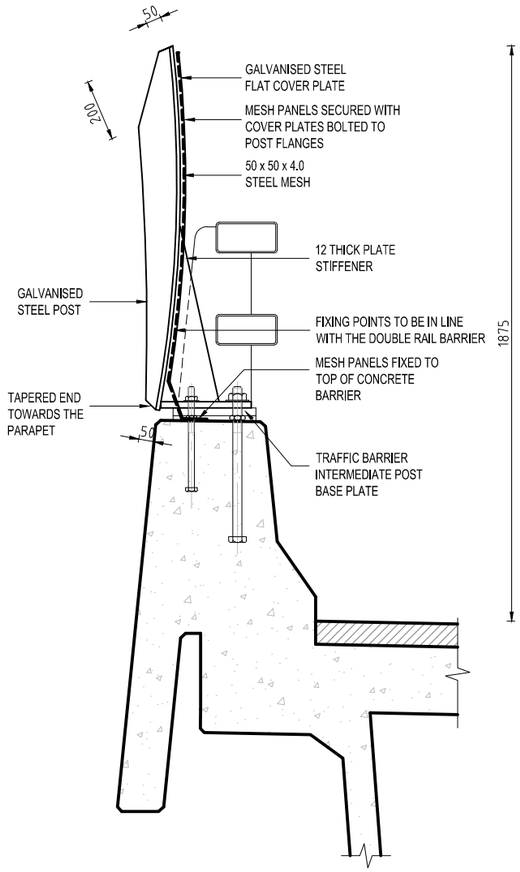


DETAIL D1 (D1)
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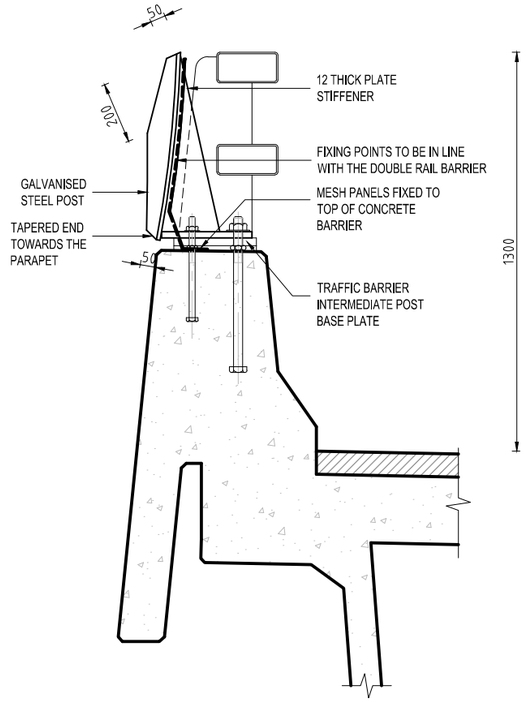


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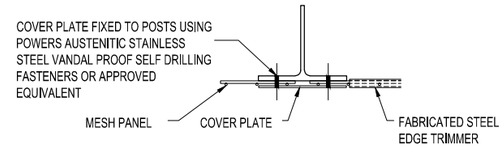
Figure D.2.3 Typical Safety Screen Details - Sheet 1



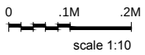
TAPERED POST, SECTION - TYPE C
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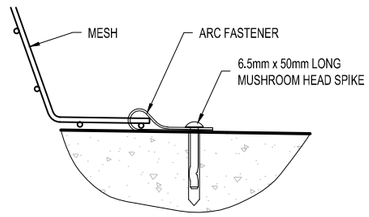


TAPERED POST, SECTION - TYPE D
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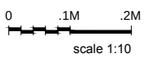


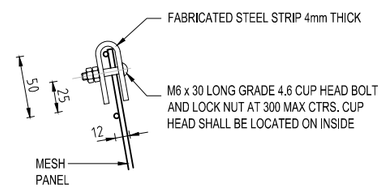
DETAIL D3 (D3)
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DETAIL D4 (D4)
1:5 @ A3





EDGE TRIMMER DETAIL D5 (D5)
1:5 @ A3

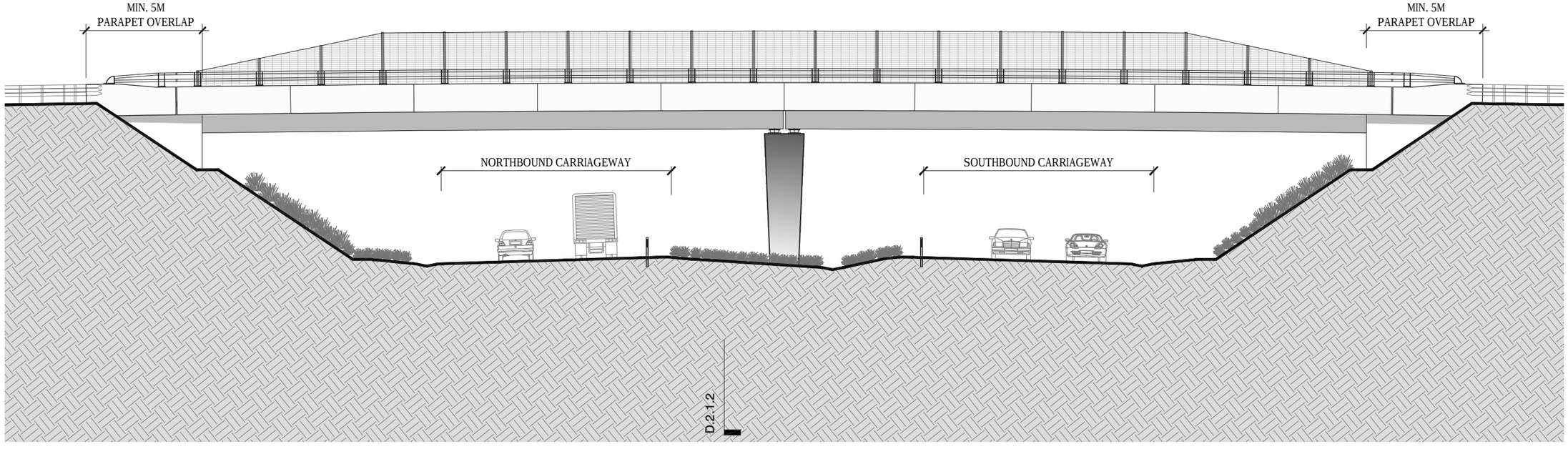
Figure D.2.4 Typical Safety Screen Details - Sheet 2

D.2.1 SB14: Blackmans Point Road Interchange Overbridge South at 18.1km north of Port Macquarie

The road geometry of the interchange includes a roundabout with an oval shape, allowing two straight bridge spans.

The superstructure comprises two spans supported by a single central portal frame pier which has a tapered appearance in elevation. A 1200 millimetre deep Super T girder superstructure with a 180 millimetre thick in-situ topping has been adopted. The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with stone pitching. A 750 millimetre wide inspection platform is provided in front of the abutments with stair access from the highway level.

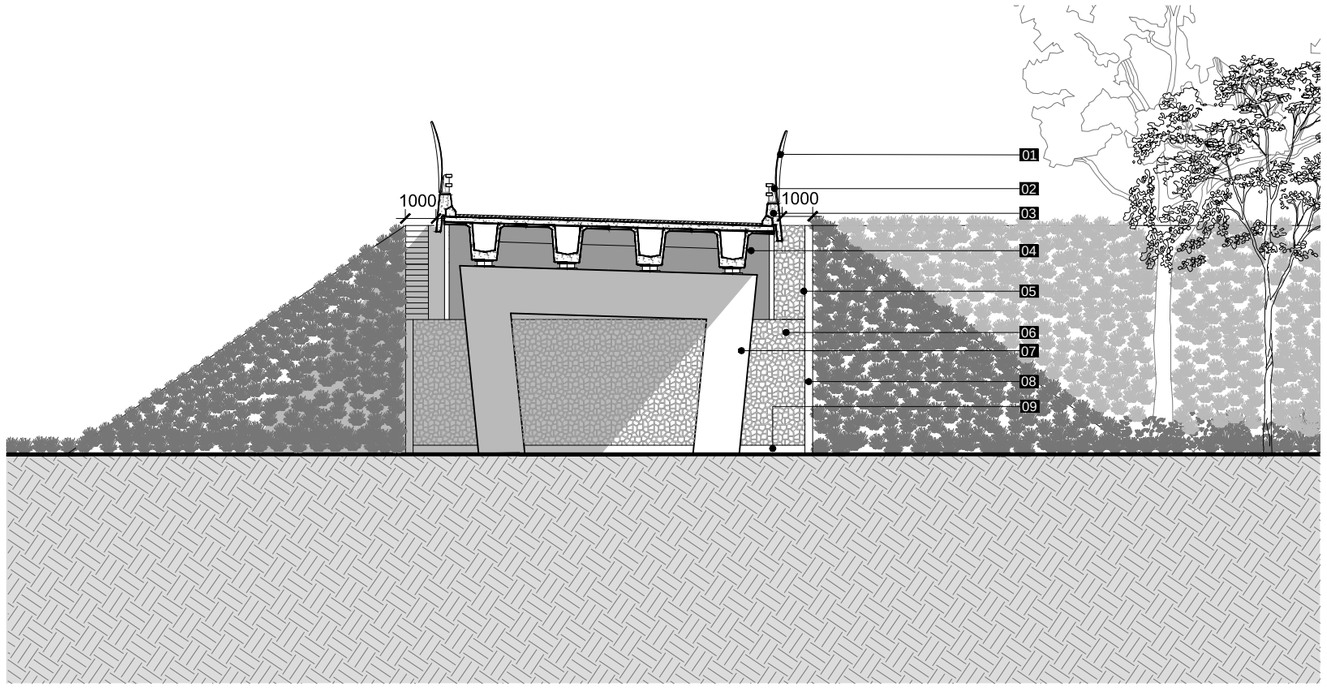
Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. Deck drainage is via surface runoff to the abutments and then channelled through the road drainage system. A twin rail metal traffic barrier is provided on top of the parapets providing a total parapet height of 1300 millimetres. Curved safety screens are integrated with traffic barriers and parapets so as to reduce the visibility of the screens in elevation.



Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

Figure D.2.1.1 SB14: Blackmans Point Road Interchange Overbridge North: Elevation

0 10m



01 CURVED SAFETY SCREEN
02 TWIN METAL RAIL BARRIER
03 CONCRETE PARAPET
04 SUPER-T GIRDERS
05 MAINTENANCE ACCESS STAIRS
06 STONE PITCHING
07 CONCRETE PIERS
08 REINFORCE CONCRETE EDGING STRIP
09 CONCRETE TOE BEAM

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

0 10m

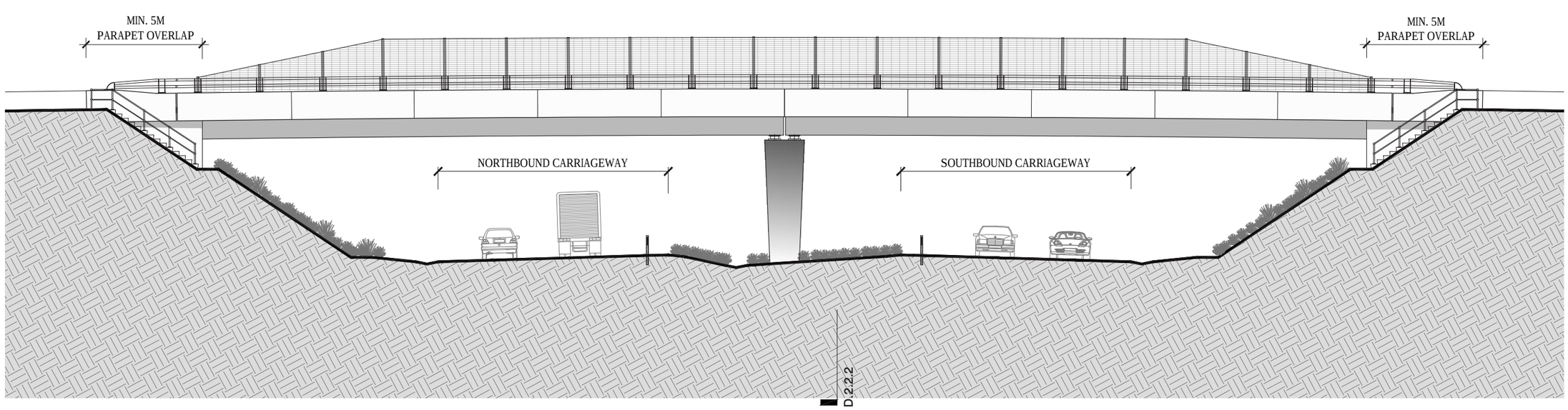
Figure D.2.1.2 SB14: Blackmans Point Road Interchange Overbridge North: Cross Sectional Elevation

D.2.2 SB14: Blackmans Point Road Interchange Overbridge North at 18.1km north of Port Macquarie

This bridge is identical in design to the Overbridge to the south providing a pair of bridges seen in quick succession. The road geometry of the interchange includes a roundabout with an oval shape, allowing two straight bridge spans.

The superstructure comprises two spans supported by a single central portal frame pier which has a tapered appearance in elevation. A 1200 millimetre deep Super T girder superstructure with a 180 millimetre thick in-situ topping has been adopted. The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with stone pitching. A 750 millimetre wide inspection platform is provided in front of the abutments with stair access from the highway level.

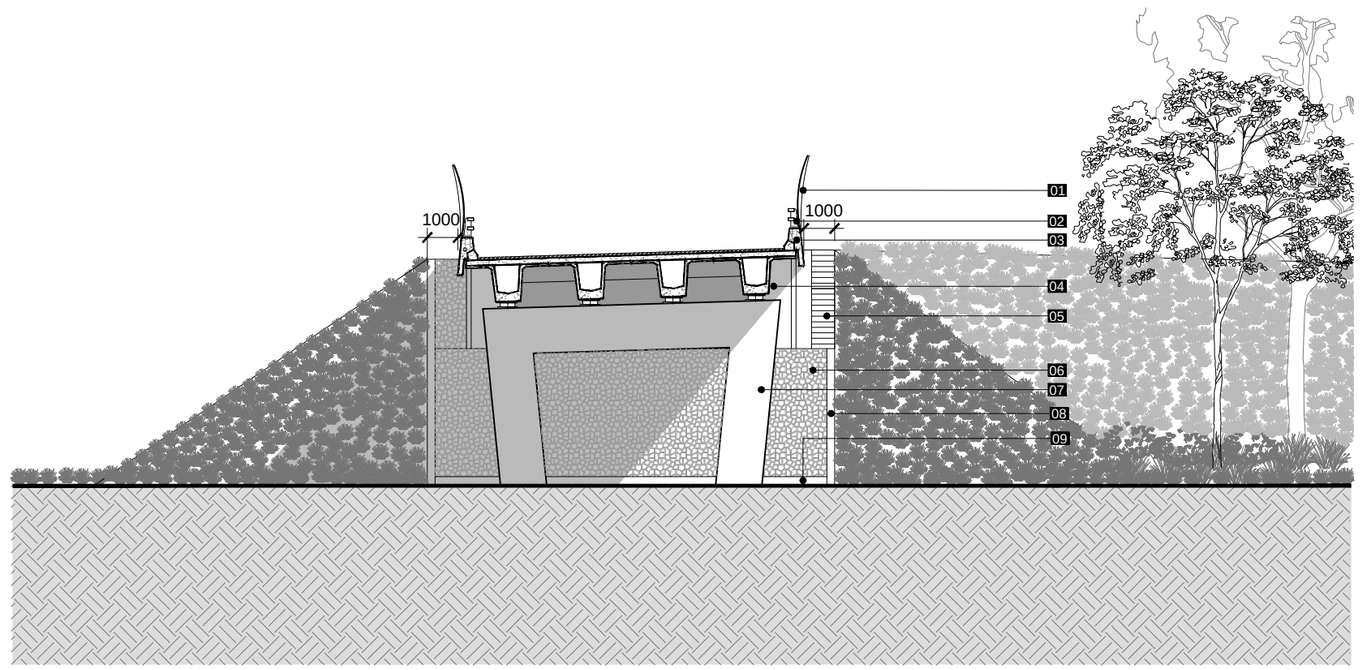
Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. Deck drainage is via surface runoff to the abutments and then channelled through the road drainage system. A twin rail metal traffic barrier is provided on the parapet providing a total parapet height of 1300 millimetres. Curved safety screens are integrated with traffic barriers and parapets so as to reduce the visibility of the screens in elevation.



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For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

Figure D.2.2.1 SB14: Blackmans Point Road Interchange Overbridge South: Elevation

0 10m



01 CURVED SAFETY SCREEN
02 TWIN METAL RAIL BARRIER
03 CONCRETE PARAPET
04 SUPER-T GIRDERS
05 MAINTENANCE ACCESS STAIRS
06 STONE PITCHING
07 CONCRETE PIERS
08 REINFORCE CONCRETE EDGING STRIP
09 CONCRETE TOE BEAM

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

0 10m

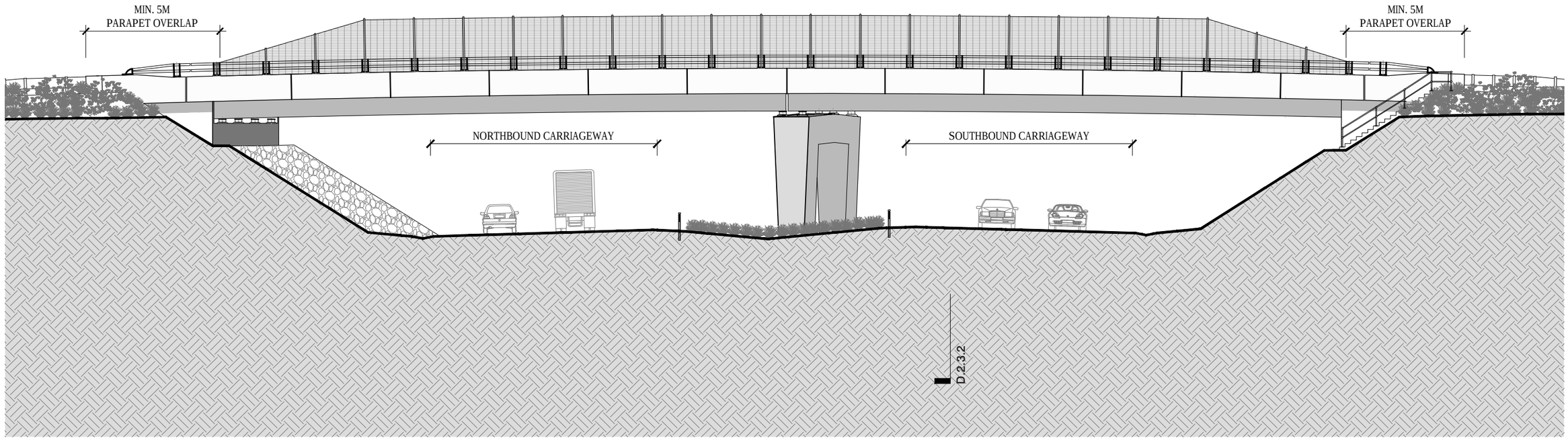
Figure D.2.2.2 SB14: Blackmans Point Road Interchange Overbridge South: Cross Sectional Elevation

D.2.3 SB15: Bridge over Highway No.10 at Bill Hill Road Overpass at 21.6km north of Port Macquarie

To create a family of bridges and consistency and unity along the highway the design of the bridge appearance is identical to all other Overbridges.

A 1200 millimetre deep Super T girder superstructure has been adopted. Bill Hill Road overpass is at a 20 degree skew to the highway and the superstructure comprises two spans supported by a single central portal frame pier. The pier form is tapered in elevation. The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with stone pitching. A 750 millimetre wide inspection platform is provided in front of the abutments with stair access down from the local road level.

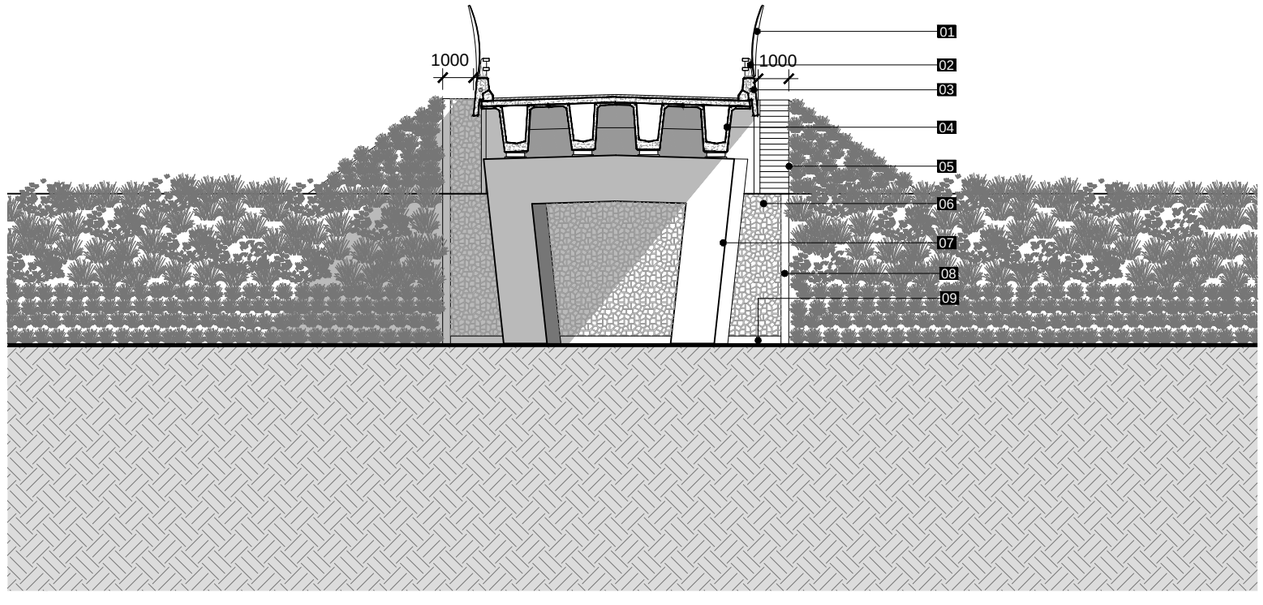
Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. Deck drainage is via surface runoff to the abutments and then channelled through the road drainage system. A twin rail metal traffic barrier is provided on the parapet providing an overall parapet height of 1300 millimetres. Curved safety screens are integrated with traffic barriers and parapets so as to reduce the visibility of the screens in elevation.



Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

0 10m

Figure D.2.3.1 SB15: Bridge over Highway No.10 at Bill Hill Road Overpass: Elevation



01 CURVED SAFETY SCREEN
02 TWIN RAIL METAL BARRIER
03 CONCRETE PARAPET
04 SUPER-T GIRDERS
05 MAINTENANCE ACCESS STAIRS
06 STONE PITCHING
07 CONCRETE PIERS
08 REINFORCE CONCRETE EDGING STRIP
09 CONCRETE TOE BEAM

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

0 10m

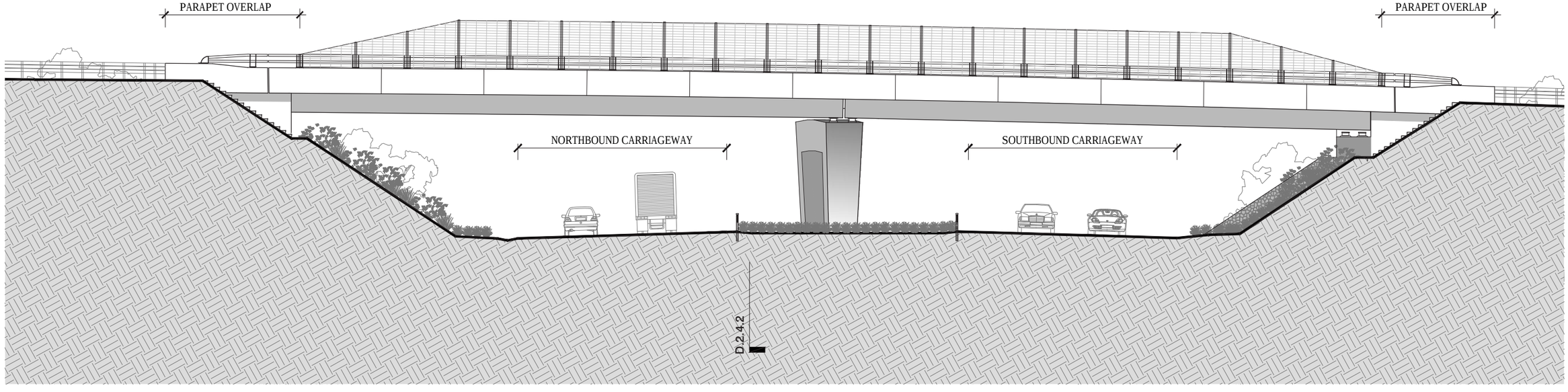
Figure D.2.3.2 SB15: Bridge over Highway No.10 at Bill Hill Road Overpass: Cross Sectional Elevation

D.2.4 SB16: Bridge over Highway No.10 at Haydons Wharf Road Interchange Overbridge at 28.1km north of Port Macquarie.

To create a family of bridges and consistency and unity along the highway the design of the bridge appearance is identical to all other Overbridges on the Tender.

A 1200 millimetre deep Super-T girder with a 180 millimetre thick in-situ topping superstructure has been adopted. The two span structure is supported by a single central portal frame pier which has a tapered appearance in elevation. The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with stone pitching. A 750 millimetre wide inspection platform is provided in front of the abutments with stair access down from the local road level.

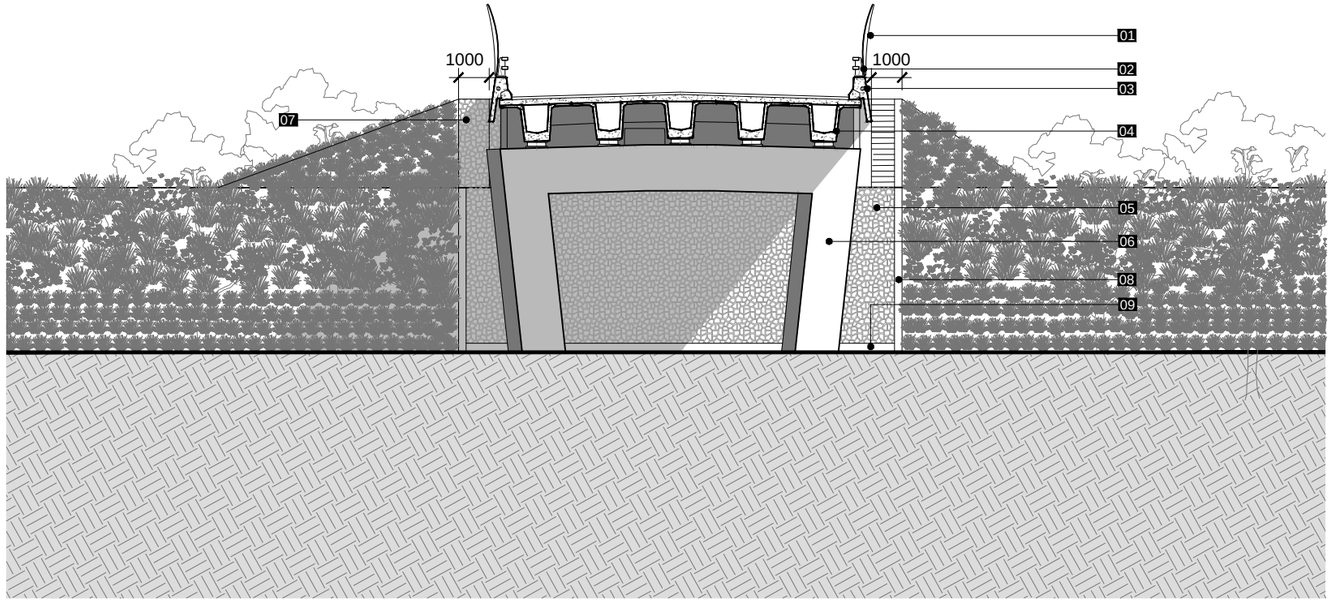
Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. Deck drainage is via surface runoff to the abutments and then channelled through the road drainage system. A twin rail metal traffic barrier is provided on the parapets providing an overall parapet height of 1300 millimetres. Curved safety screens are integrated with traffic barriers and parapets so as to reduce the visibility of the screens in elevation.



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For Landscape types and extents refer to Landscape Drawings.

Figure D.2.4.1 SB16: Bridge over Highway No.10 at Haydons Wharf Road Interchange Overbridge: Elevation

0 10m



01 CURVED SAFETY SCREEN
02 TWIN RAIL METAL BARRIER
03 CONCRETE PARAPET
04 SUPER-T GIRDERS
05 STONE PITCHING
06 CONCRETE PIERS
07 MAINTENANCE ACCESS STAIRS
08 REINFORCE CONCRETE EDGING STRIP
09 CONCRETE TOE BEAM

Drawings are for illustrative purposes only.
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For Landscape types and extents refer to Landscape Drawings.

Figure D.2.4.2 SB16: Bridge over Highway No.10 at Haydons Wharf Road Interchange Overbridge: Cross Sectional Elevation

0 10m

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D.3 Main Carriageway Bridges (Underbridges)

Generally these bridges are not highly visible. Where there are twin bridges, the near parapet of the bridge on the opposite carriageway will be seen from the new highway. The design of the bridge parapets is therefore important. Key design elements are consistent for all the underbridges on the Oxley Highway to Kundabung Upgrade as follows (Refer to Figures D.3.1.1 to D.3.10.2):

Headstock & Piers

Due to the low visibility of these bridges, simple and straightforward designs are adopted. Headstocks are rectangular in elevation and section and piers are either circular, rectangular or octagonal piles or column extensions.

Parapets

The parapets generally comprise a 650mm concrete barrier with twin metal rails on top. The twin metal rails maximise views from the highway to the surrounding countryside and for twin bridges minimise the parapet depth when seen from the other bridge. The outer parapet face extends downwards below the soffit of the bridge deck to partially obscure the substructure and any drainage pipes, provide consistent proportions and cast a strong shadow line to minimise the visual impact of the bridge structure. The parapets taper outwards toward the bottom at an angle of 5.5 degrees to match those of the overbridges. The top of the parapet has an inwards cross fall draining to the bridge deck to minimise staining on the outer face of the parapet. The twin rail termination detail adopts a standard Roads and Maritime detail.

Abutments & Scour Protection

The surfaces of spill through abutments beneath bridges are typically finished with stone boulders in accordance with scour protection and fauna passage requirements.

The twin bridges over the North Coast Railway Line have reinforced soil wall abutments as detailed under D.3.8 Bridge over North Coast Railway Line.

The following pages describe the bridges in text, elevation and cross sectional elevation.

D.3.1 SB02: Twin Bridges over Fernbank Creek at 14.7km north of Port Macquarie

D.3.2 SB03: Bridge over Hastings River Floodplain at 15.2km North of Port Macquarie

D.3.3 SB05: Bridge over Hastings River Floodplain at 16.4km North of Port Macquarie

D.3.4 SB06: Twin Bridges over Wilson River Floodplain at 23.3km North of Port Macquarie

D.3.5 SB07: Twin Bridges over Wilson River Floodplain at 24.8km North of Port Macquarie

D.3.6 SB08: Twin Bridges over Wilson River Floodplain at 275.7km North of Port Macquarie

D.3.7 SB10: Bridge over North Coast Railway Line at 27.3km North of Port Macquarie

D.3.8 SB11: Twin Bridges over Cooperabung Creek at 29.8km North of Port Macquarie

D.3.9 SB12: Twin Bridges over Yarrabee Road at 32.2 km North of Port Macquarie

D.3.10 SB13: Twin Bridges over Barrys Creek at 34.1km North of Port Macquarie..





Underbridge Pier Design on Kempsey Bypass over a local road and railway. The pier design comprises a rectangular headstock.

D.3.1 SB02 Twin Bridges over Fernbank Creek at 14.7km North of Port Macquarie

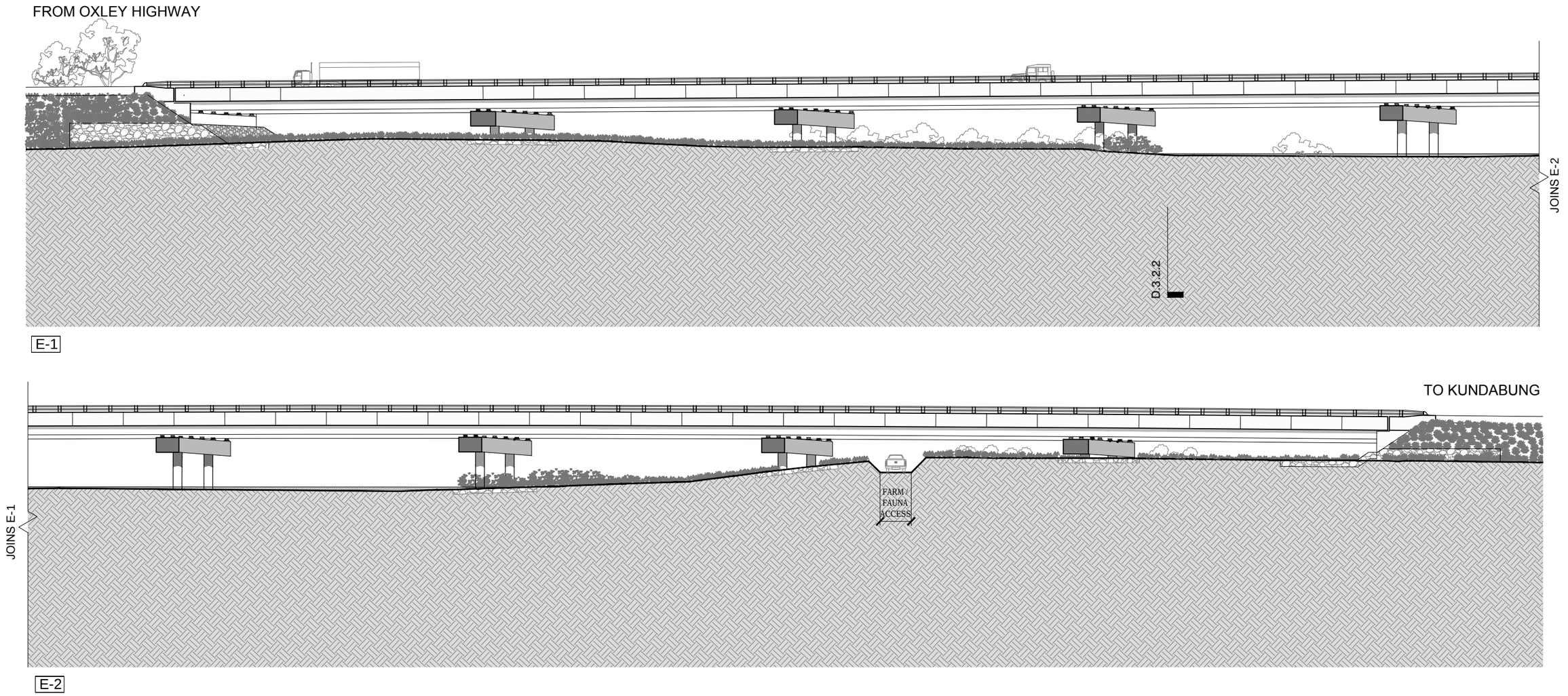
These twin bridges cross the Fernbank Creek waterway and adjacent flood plains and also provide farm and fauna access. The twin bridges comprise a superstructure approximately 260 metres in length with the northbound bridge having a carriageway width of 10.5 metres and the southbound carriageway 11.1 metres width.

The northbound bridge comprises nine 28.8 metre simply supported 1200 millimetre Super-T girder spans with a 180 millimetre cast in-situ reinforced concrete deck slab. The southbound bridge comprises seven 29.0 metre spans with two end spans of 28.8 metres. The superstructure consists of simply supported 1200 millimetre Super-T girders with a 180 millimetre cast in-situ reinforced concrete deck slab. The bridges have a skew angle of 24.5 degrees.

At the piers, the bridge superstructure is supported on a two metre wide x one metre deep reinforced concrete headstock founded on driven piles. The piles comprise a 1050 millimetre driven steel tube with concrete infill.

The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with Rip Rap stone boulder scour protection. A 750 millimetre wide inspection platform is provided in front of the abutments with stair access down from the highway level.

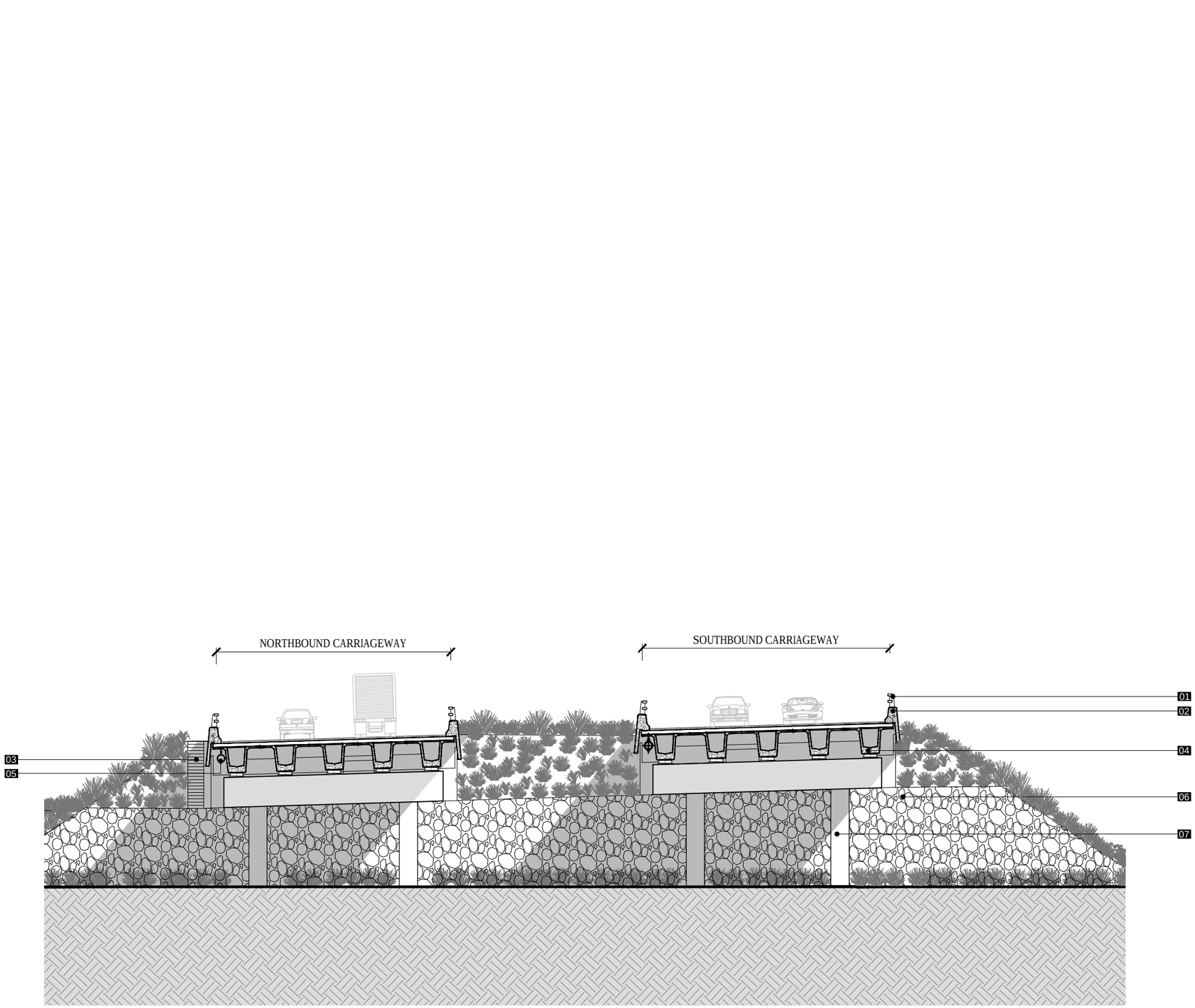
Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. The parapet extends to cover the deck drainage which is a concealed pipe running along the length of the bridge under the deck slab. A twin rail metal traffic barrier is provided on the parapet providing an overall parapet height of 1300 millimetres.



Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

Figure D.3.1.1 SB02: Twin Bridges over Fernbank Creek: Elevation showing Southbound Carriageway Bridge

0 20m



01 TWIN METAL RAIL BARRIER
02 CONCRETE PARAPET
03 MAINTENANCE ACCESS STAIRS
04 SUPER-T GIRDERS
05 DRAINAGE PIPE
06 RIP RAP ARMOUR STONE SCOUR PROTECTION
07 CONCRETE PIERS

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

0 10m

Figure D.3.1.2 SB02: Twin Bridges over Fernbank Creek: Cross Sectional Elevation

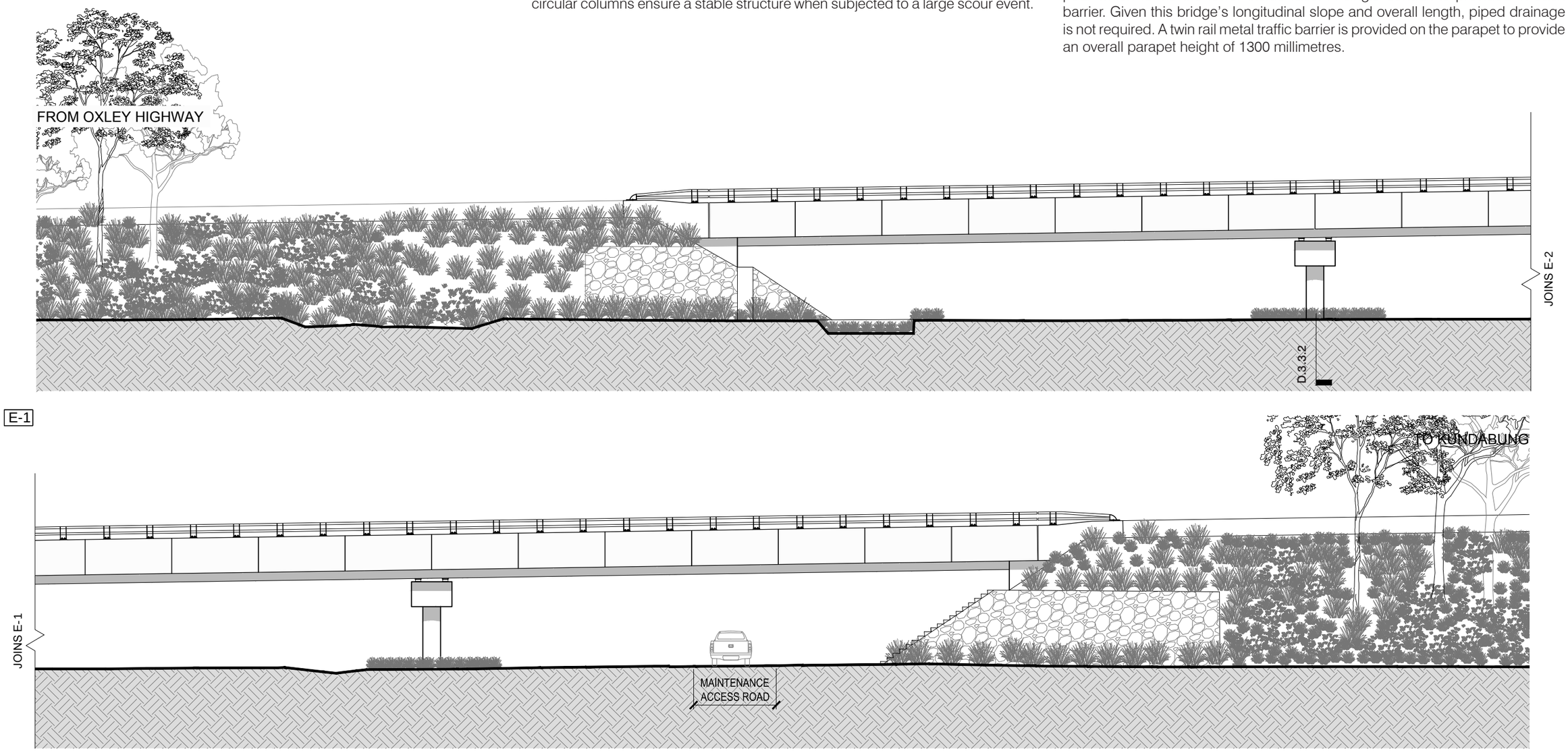
D.3.2 SB03: Bridge over Hastings River Floodplain at 15.4km North of Port Macquarie

A bridge is required at this location to span the Hastings River Floodplain approximately 100 metres south of the main Hastings River bridge crossing. The bridge comprises a single structure to carry both the northbound and southbound carriageways of the Pacific Highway, with the carriageways separated by a central median barrier.

The bridge comprises three simply supported spans, the outer spans 28.7 metres long and the central span 29.3 metres, for an overall length of 88 metres. The superstructure comprises 10 x 1200 millimetre deep Super-T girders with a 180 millimetre (minimum) thick composite cast-in-place deck slab. The piers comprise four 850 millimetre diameter circular concrete columns supporting each headstock. Each column is an extension of a driven tubular steel pile with concrete infill. Given the scour depths, flow velocities and vertical loads, the circular columns ensure a stable structure when subjected to a large scour event.

The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V finished with Rip Rap stone boulder scour protection. A 750 millimetre wide inspection platform is provided in front of the abutments with stair or ramp access up from existing ground level below the bridge.

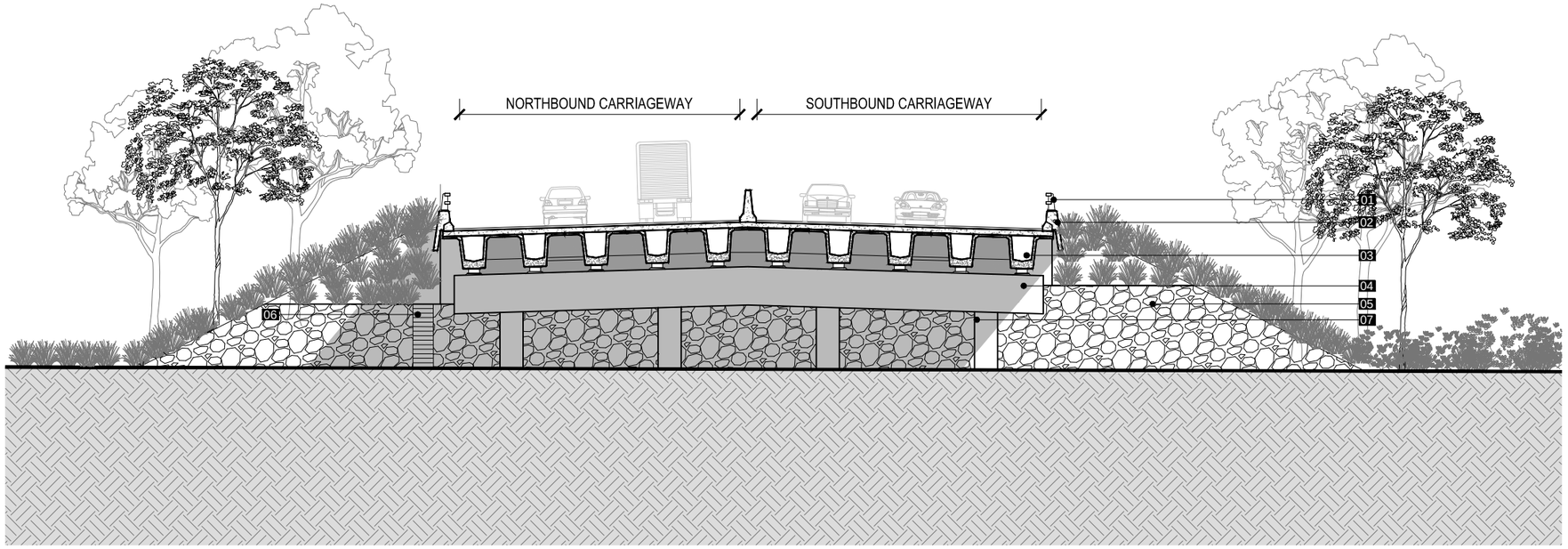
Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. Given this bridge's longitudinal slope and overall length, piped drainage is not required. A twin rail metal traffic barrier is provided on the parapet to provide an overall parapet height of 1300 millimetres.



Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

Figure D.3.2.1 SB03: Bridge over Hastings River Floodplain: Elevation

0 10m



01 TWIN METAL RAIL BARRIER
02 CONCRETE PARAPET
03 SUPER-T GIRDERS
04 CONCRETE HEADSTOCK
05 RIP RAP ARMOUR STONE SCOUR PROTECTION
06 MAINTENANCE ACCESS STAIRS
07 CONCRETE PIER

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

0 10m

Figure D.3.2.2 SB03: Bridge over Hastings River Floodplain: Cross Sectional Elevation

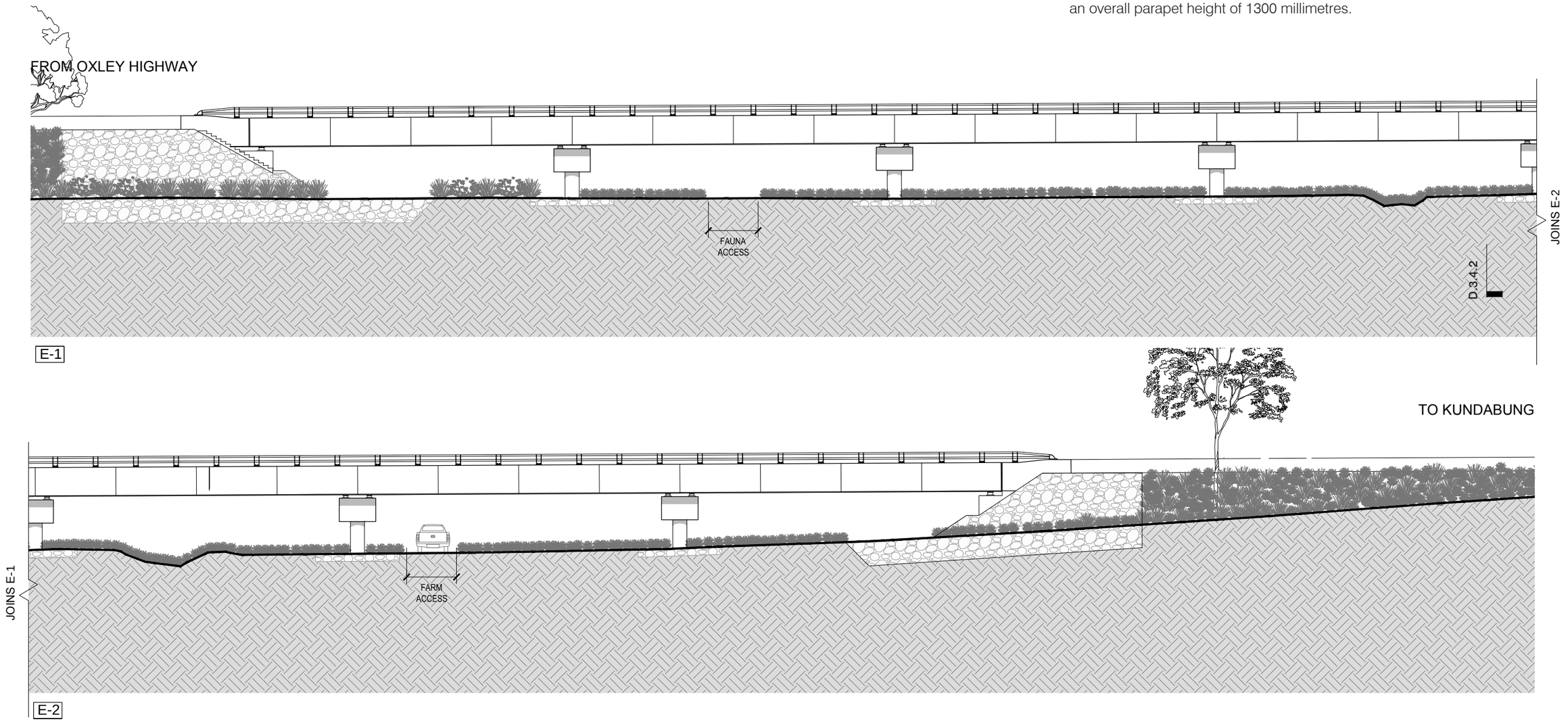
D.3.3 SB05: Bridge over Hastings River Floodplain at 16.4km North of Port Macquarie

A bridge is required at this location to span the Hastings River Floodplain approximately 200 metres north of the main Hastings River bridge crossing. The bridge comprises a single structure to carry both the northbound and southbound carriageways of the Pacific Highway, with the carriageways separated by a central median barrier.

The bridge comprises five simply supported spans, each 19.4 metres long, and two end spans of 18.7 metres, for an overall length of 136 metres. The superstructure comprises ten 750mm deep Super-T girders with a 180 millimetre (minimum) thick composite cast-in-place deck slab. The piers comprise four 850 millimetre diameter column extensions supported on 1050 millimetre diameter bored piles.

The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with Rip Rap stone boulder scour protection. A 750 millimetre wide inspection platform is provided in front of the abutments with stair access either down from the highway or up from existing ground level below the bridge.

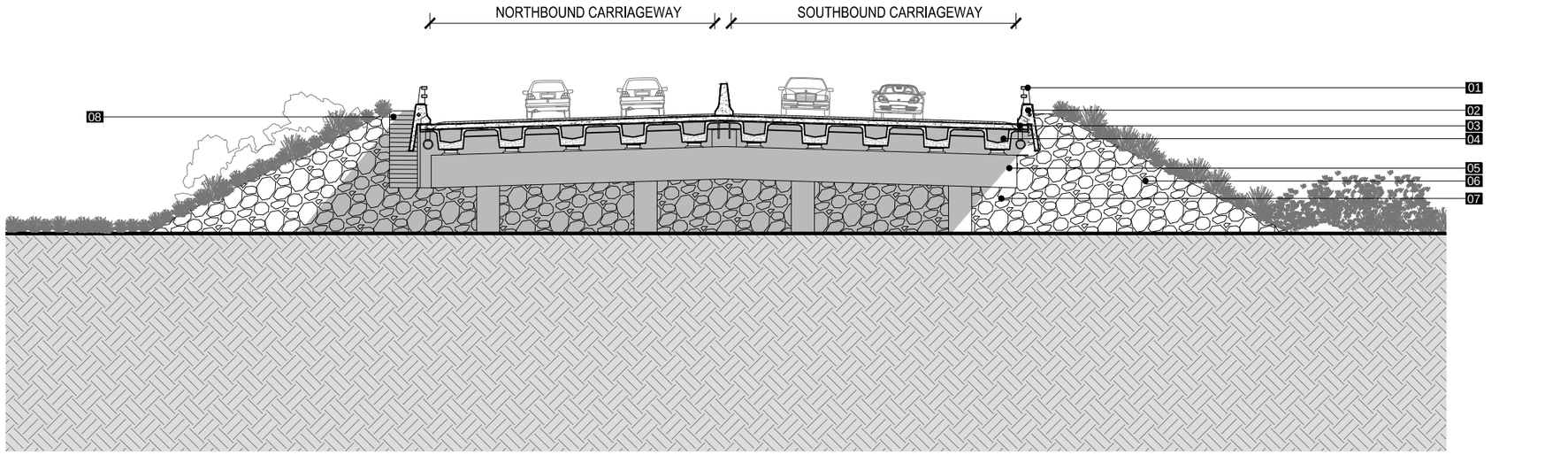
Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. On each side of the bridge, the parapet extends down to cover the deck drainage which is a concealed pipe running along the length of the bridge under the deck slab. A twin rail metal traffic barrier is provided on the parapet providing an overall parapet height of 1300 millimetres.



Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

Figure D.3.3.1 SB05: Bridge over Hastings River Floodplain: Elevation

0 10m



01 TWIN METAL RAIL BARRIER
02 CONCRETE PARAPET
03 DRAINAGE PIPE
04 SUPER-T GIRDERS
05 CONCRETE HEADSTOCK
06 RIP RAP ARMOUR STONE SCOUR PROTECTION
07 CIRCULAR CONCRETE PIERS
08 MAINTENANCE ACCESS STAIRS

Drawings are for illustrative purposes only.
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For Landscape types and extents refer to Landscape Drawings.

0 10m

Figure D.3.3.2 SB05: Bridge over Hastings River Floodplain: Cross Sectional Elevation

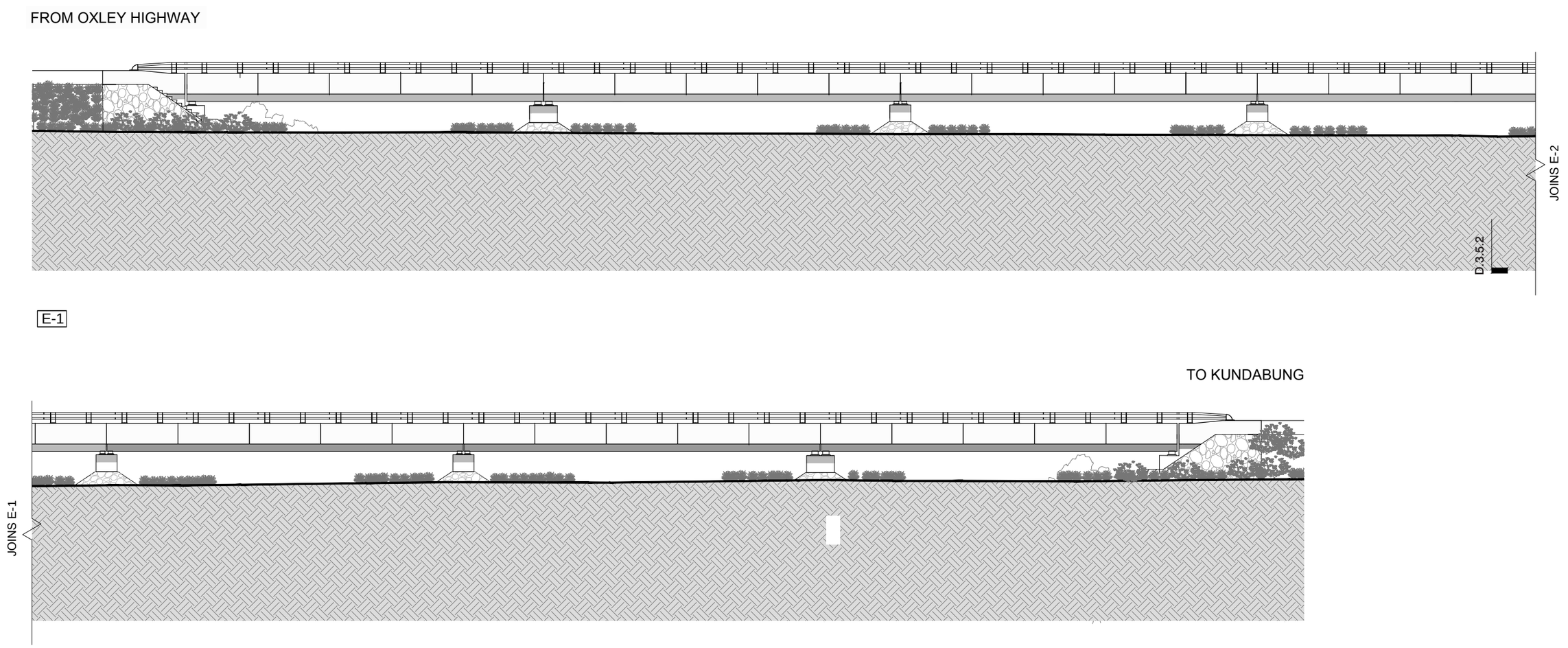
D.3.4 SB06: Twin Bridges over Wilson River Floodplain at 23.3km North of Port Macquarie

Twin bridges are required at this location to span the Wilsons River Floodplain approximately 3.2 kilometres south of the main Wilsons River bridge crossing.

Each bridge comprises seven simply supported spans, with an overall length of 149 metres. The superstructure comprises ten 740 millimetre deep by 750 millimetre wide spaced precast concrete planks. A 180 millimetre minimum thick cast-in-place deck slab creates a composite deck. The substructure comprises reinforced concrete headstock supported on two 900 millilmetre diameter bored piles.

The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with Rip Rap stone boulder scour protection. A 750 millimetre wide inspection platform is provided in front of the abutments with stair access down from highway level.

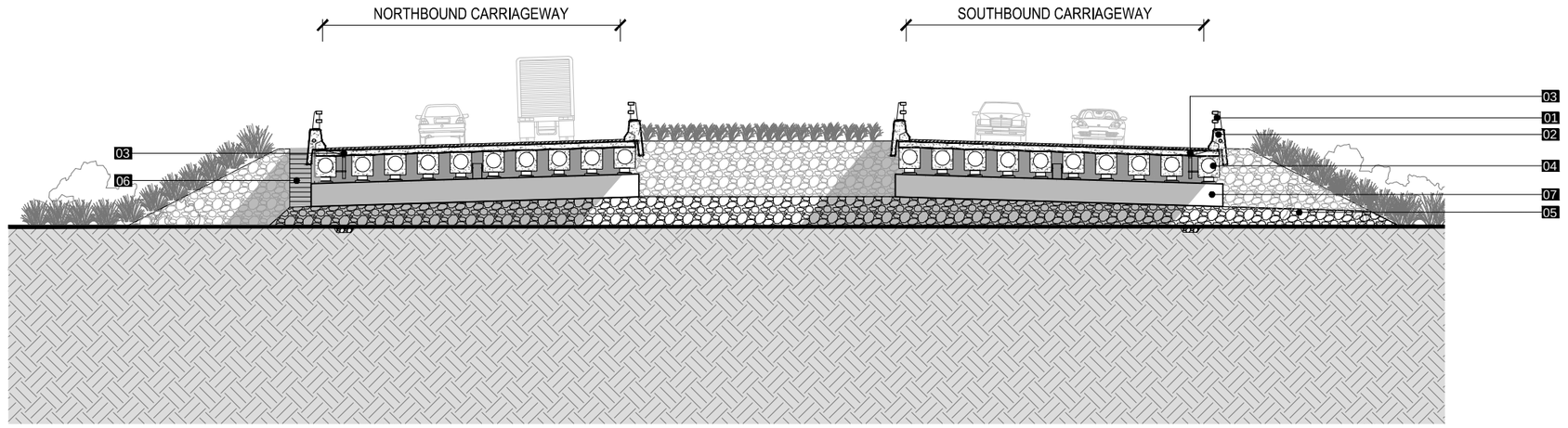
Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. Deck drainage is provided via bridge scuppers which discharge directly onto the floodplain below. A twin rail metal traffic barrier is provided on the parapet providing an overall parapet height of 1300 millimetres.



Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

0 10m

Figure D.3.4.1 SB06: Twin Bridges over Wilson River Floodplain: Elevation



01 TWIN METAL RAIL BARRIER
02 CONCRETE PARAPET
03 BRIDGE SCUPPER
04 SPACED PRECAST CONCRETE PLANKS
05 RIP RAP ARMOUR STONE SCOUR PROTECTION
06 MAINTENANCE ACCESS STAIRS
07 CONCRETE HEADSTOCK

0 10m

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

Figure D.3.4.2 SB06: Twin Bridges over Wilson River Floodplain: Cross Sectional Elevation

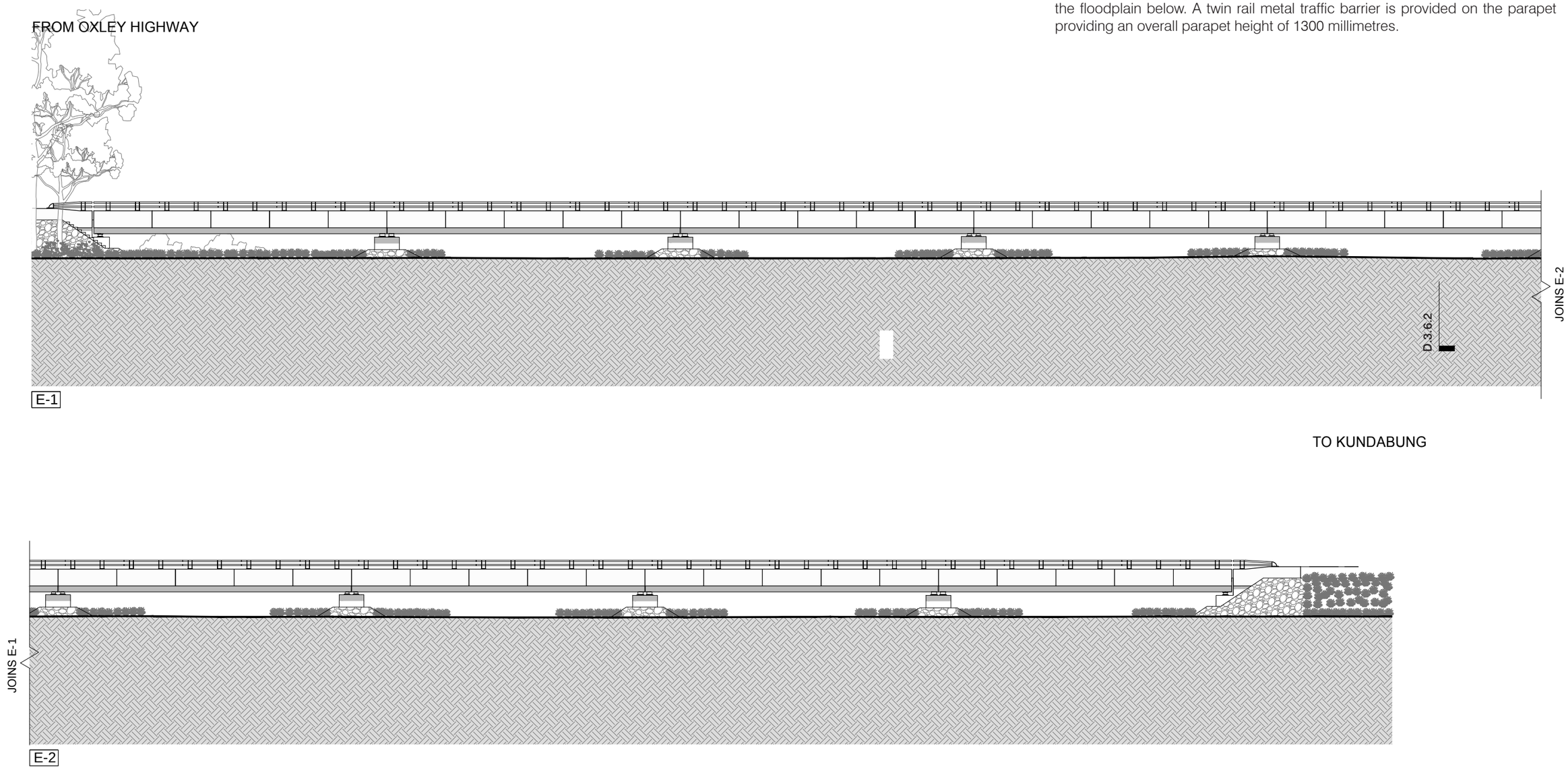
D.3.5 SB07: Twin Bridges over Wilson River Floodplain at 24.8km North of Port Macquarie

Twin bridges are required at this location to span the Wilsons River Floodplain approximately 1.7 kilometres south of the main Wilsons River bridge crossing.

Each bridge comprises seven simply supported spans of 21.3 metres and two end spans of 20.8 metres, with an overall length of 193 metres. The superstructure comprises ten 740 millimetre deep by 750 millimetre wide spaced precast concrete planks. A 180 millimetre (minimum) thick cast-in-place deck slab creates a composite deck. Two 900 millimetre diameter driven tubular steel piles with concrete infill extend up to the underside of each reinforced concrete headstock.

The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with Rip Rap stone boulder scour protection. A 750 millimetre wide inspection platform is provided in front of the abutments with stair access down from highway level.

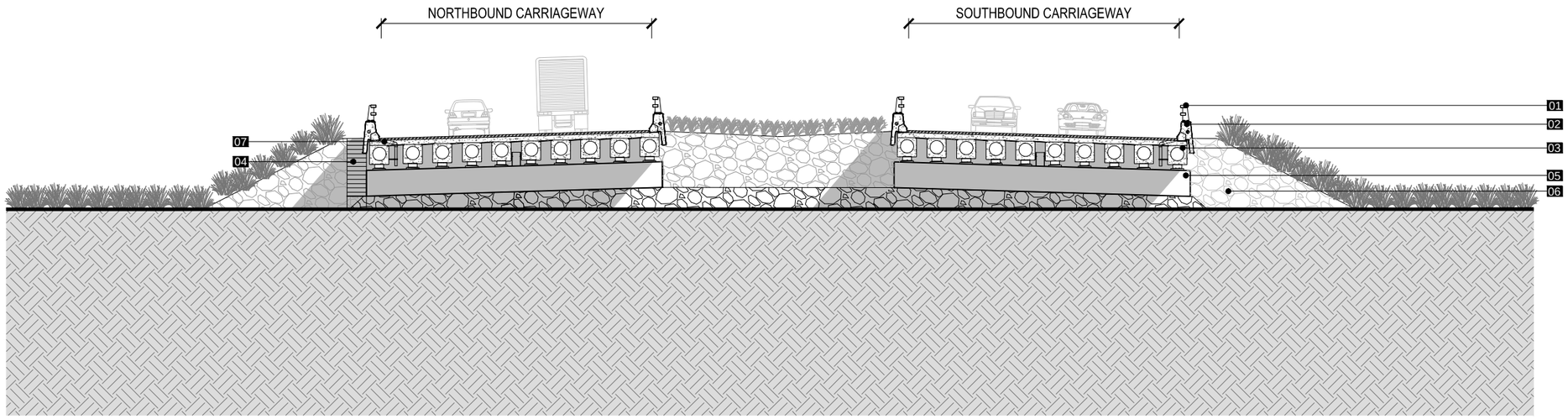
Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. Deck drainage is provided via scuppers which discharge directly onto the floodplain below. A twin rail metal traffic barrier is provided on the parapet providing an overall parapet height of 1300 millimetres.



Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

Figure D.3.5.1 SB07: Twin Bridges over Wilson River Floodplain: Elevation

0 15m



01 TWIN METAL RAIL BARRIER
02 CONCRETE PARAPET
03 SPACED PRECAST CONCRETE PLANKS
04 MAINTENANCE ACCESS STAIRS
05 CONCRETE HEADSTOCK
06 RIP RAP AMOUR STONE SCOUR PROTECTION
07 DRAINAGE PIPE

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

0 10m

Figure D.3.5.2 SB07: Twin Bridges over Wilson River Floodplain: Cross Sectional Elevation

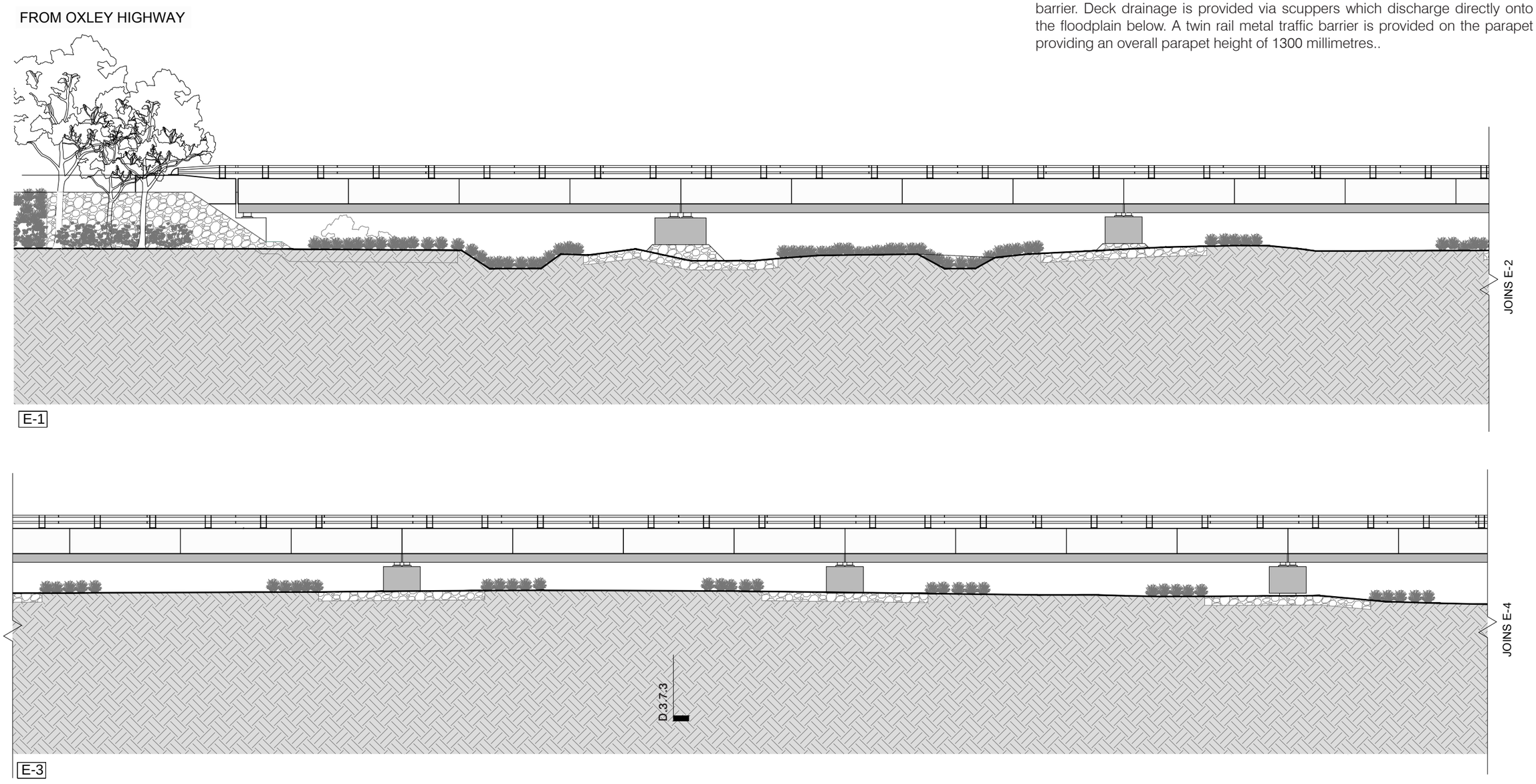
D.3.6 SB08: Twin Bridges over Wilson River Floodplain at 25.6km North of Port Macquarie

Twin bridges are required at this location to span the Wilsons River Floodplain approximately one kilometre south of the main Wilsons River bridge crossing.

Each bridge comprises nine simply supported spans at 21.6 metres and two end spans of 21.1 metres, with an overall length of 239 metres. The superstructure comprises ten 740 millimetre deep by 750 millimetre wide spaced precast concrete planks. A 180 millimetre minimum thick cast-in-place deck slab creates a composite deck. The planks bear on reinforced concrete headstocks, each of which is supported on a pair of circular driven piles.

The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with Rip Rap stone boulder scour protection. A 750 millimetre wide inspection platform is provided in front of the abutments with stair access down from highway level.

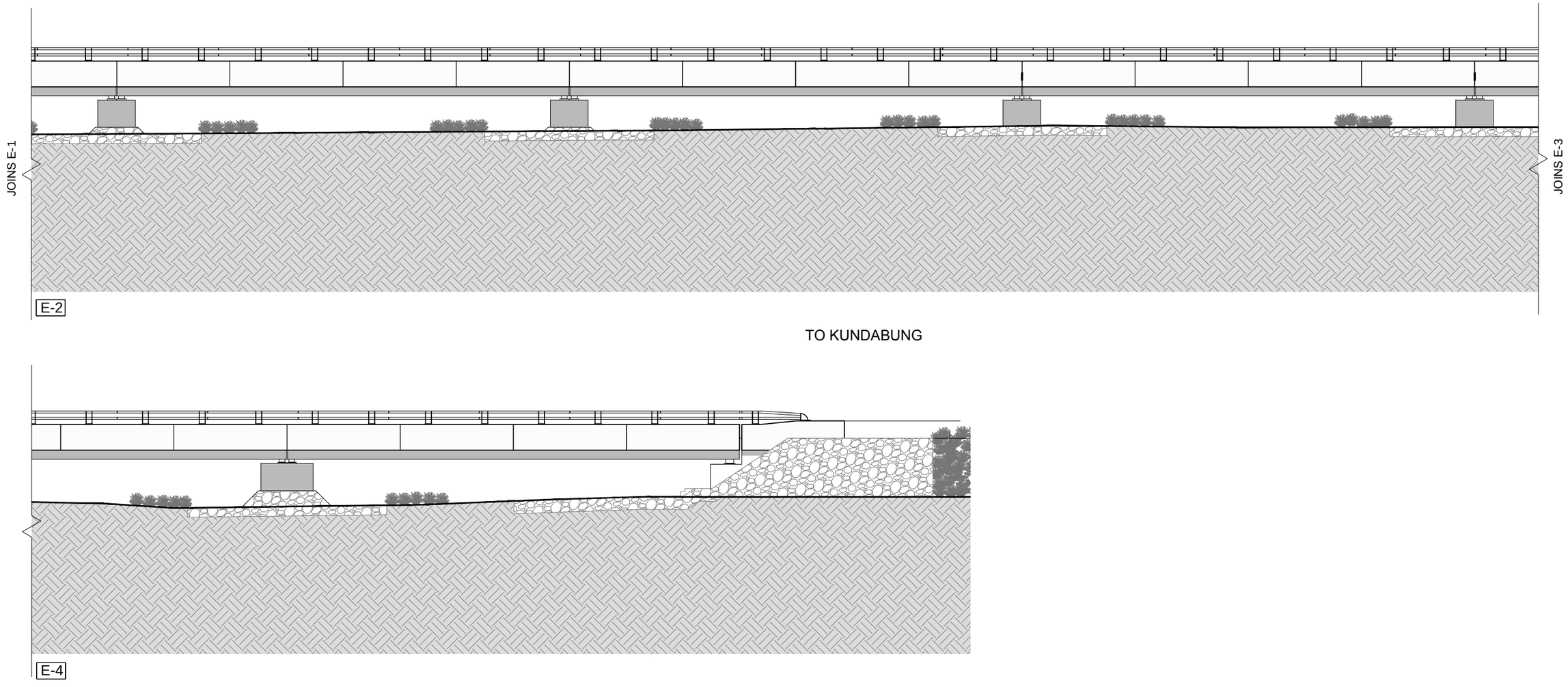
Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. Deck drainage is provided via scuppers which discharge directly onto the floodplain below. A twin rail metal traffic barrier is provided on the parapet providing an overall parapet height of 1300 millimetres..



Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

Figure D.3.6.1 SB08: Twin Bridges over Wilson River Floodplain: Elevation Sheet 1

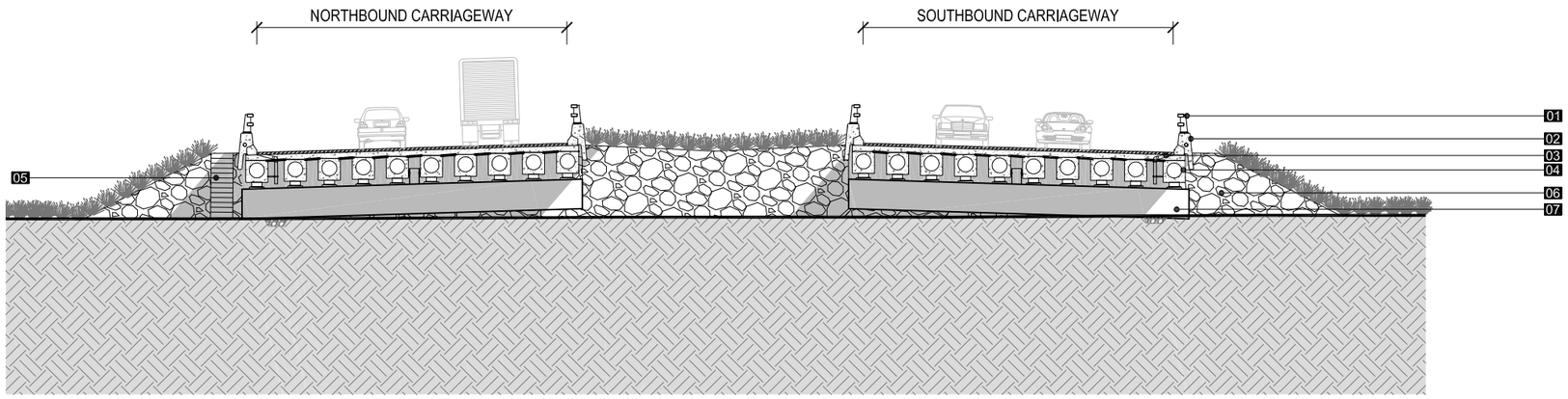
0 10m



Drawings are for illustrative purposes only.
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For Landscape types and extents refer to Landscape Drawings.

Figure D.3.6.2 SB08: Twin Bridges over Wilson River Floodplain: Elevation Sheet 2

0 20m



01 TWIN METAL RAIL BARRIER
02 CONCRETE PARAPET
03 DRAINAGE PIPE
04 SPACED PRECAST CONCRETE PLANKS
05 MAINTENANCE ACCESS STAIRS
06 RIP RAP ARMOUR STONE SCOUR PROTECTION
07 CONCRETE HEADSTOCK

Drawings are for illustrative purposes only.
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For Landscape types and extents refer to Landscape Drawings.

0 10m

Figure D.3.6.3 SB08: Twin Bridges over Wilson River Floodplain: Cross Sectional Elevation

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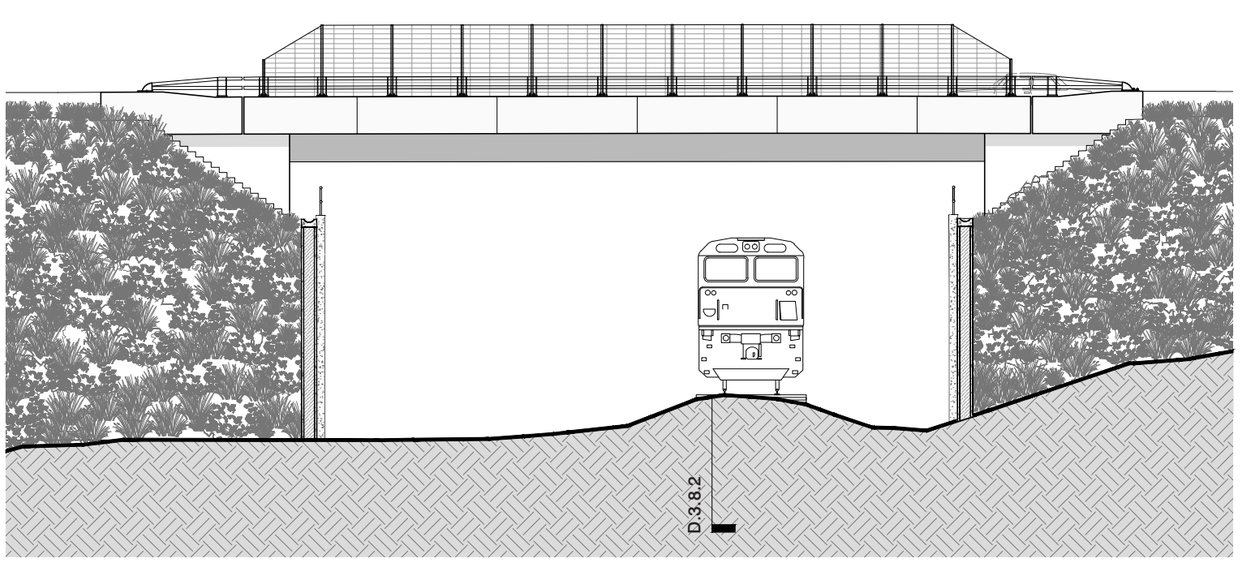
D.3.7 SB10: Bridge over North Coast Railway Line at 27.3km North of Port Macquarie

This bridge spans the North Coast Railway Line. It is a 25.7 metre long single-span structure with a minimum clear width of 11 metres between traffic barriers on each carriageway.

The superstructure comprises ten 1200 millimetre deep Super-T girders with 180 millimetre thick in-situ concrete deck. The overall width of the deck is approximately 23 metres. The skew angle normal to the centreline of the bridge and the centreline of the abutment is approximately 33 degrees. A vertical height clearance of minimum 7.1 metres is provided from the top of the rail to the soffit of the superstructure.

Vertical reinforced soil wall type abutments are used to allow a single-span bridge for the railway crossing. As the rail track is curved under the bridge, the setting out of retaining structures and abutments is based on a minimum offset of 5.2 metres from the chords of the track centre under the bridge. The reinforced soil wall abutments are aligned parallel on two edges to these and are straight except for one end of each wall, which rotates away from the railway line.

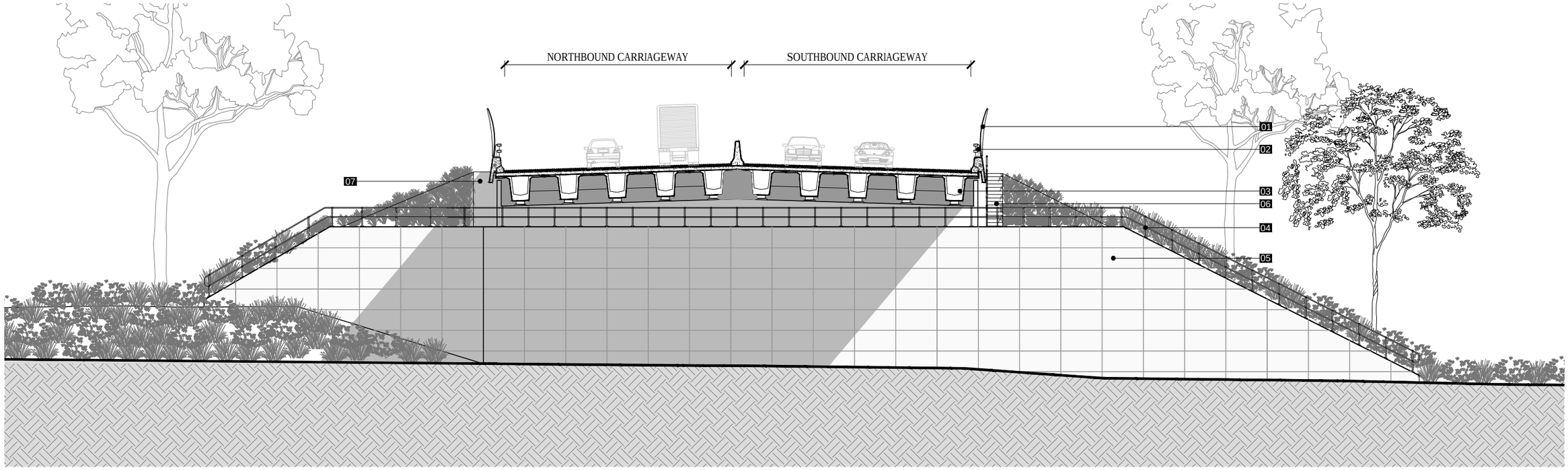
Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. A 650 millimetre high twin rail metal traffic barrier is provided on the parapet providing an overall parapet height of 1300 millimetres. A curved three metre high safety screen is provided along both edges of the bridge. The extents of the screens meet ARTC and AS5100 requirements. Each screen is fully integrated with the parapet and rail barrier.



Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

Figure D.3.7.1 SB10: Bridge over North Coast Railway Line: Elevation

0 10m



01 GALVANISED CURVED SAFETY SCREEN
02 TWIN METAL RAIL BARRIER
03 SUPER-T GIRDERS
04 MAINTENANCE SAFETY FENCE
05 CONCRETE PANEL FINISH REINFORCED SOIL WALL
06 MAINTENANCE ACCESS STAIRS
07 DARK TINTED CONCRETE FINISH TO ABUTMENT SLOPE

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

0 10m

Figure D.3.7.2 SB10: Bridge over North Coast Railway Line: Cross Sectional Elevation

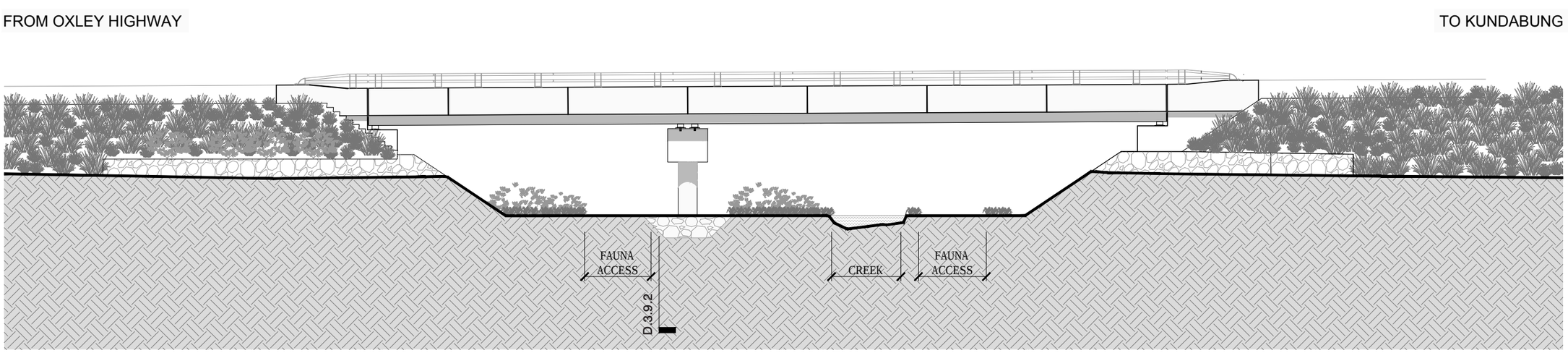
D.3.8 SB11: Twin Bridges over Cooperabung Creek at 29.8km North of Port Macquarie

Twin bridges are required at this location to span Cooperabung Creek. The bridge arrangement allows for a fauna passage (3.0 metres wide x 2.5 metres high) on each side of the creek. The overall bridge length is 36 metres to comply with hydraulic and environmental opening requirements. Cooperabung Creek is a Class 2 Waterway hence the bridge is offset so that the central pier does not encroach into the creek banks.

Each bridge comprises two simply supported spans of 14.4 and 21.3 metres. The superstructure comprises ten 740 millimetre deep by 750 millimetre wide spaced precast concrete planks with a 180 millimetre minimum thick composite cast-in-place deck slab. Two 850 millimetre diameter columns extended above 1050 millimetre diameter bored piles, support the central reinforced concrete headstock.

The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with Rip Rap stone boulder scour protection. A 750 millimetre wide inspection platform is provided in front of the abutments with stair access down from highway level.

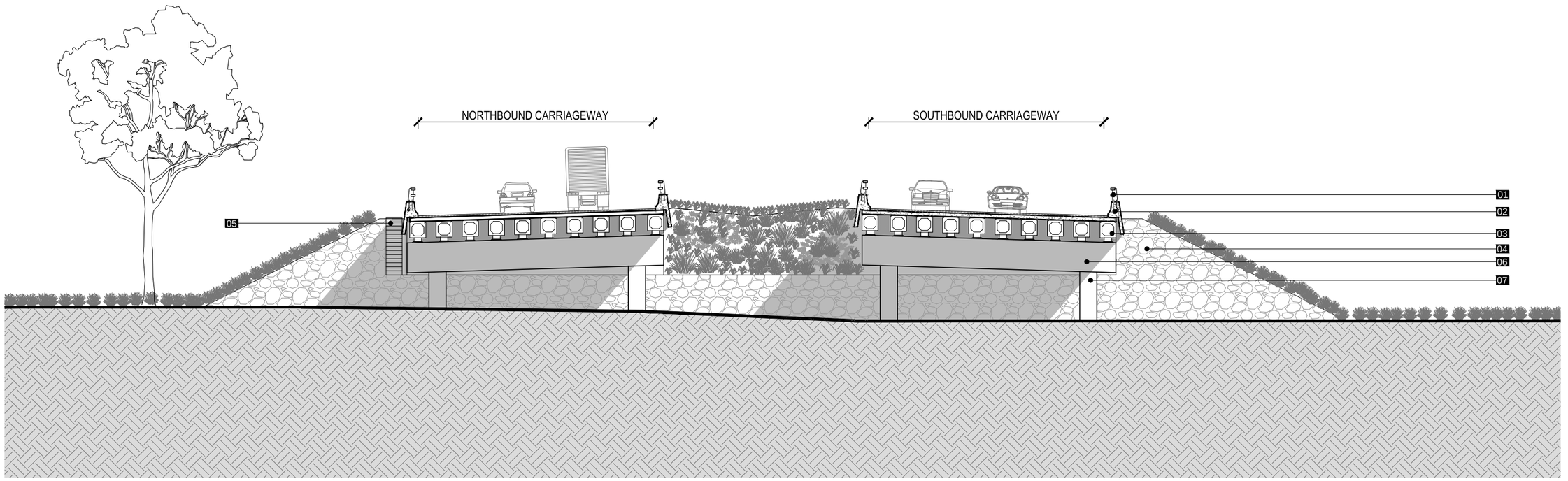
Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. A 650 millimetre high twin rail metal traffic barrier surmounts the parapet giving an overall parapet height of 1300 millimetres.



Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

Figure D.3.8.1 SB11: Twin Bridges over Cooperabung Creek: Elevation

0 10m



01 TWIN METAL RAIL BARRIER
02 CONCRETE PARAPET
03 SPACED PRECAST CONCRETE PLANKS
04 RIP RAP ARMOUR STONE SCOUR PROTECTION
05 MAINTENANCE ACCESS STAIRS
06 CONCRETE HEADSTOCK
07 CIRCULAR CONCRETE PIERS

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

0 10m

Figure D.3.8.2 SB11: Twin Bridges over Cooperabung Creek: Cross Sectional Elevation

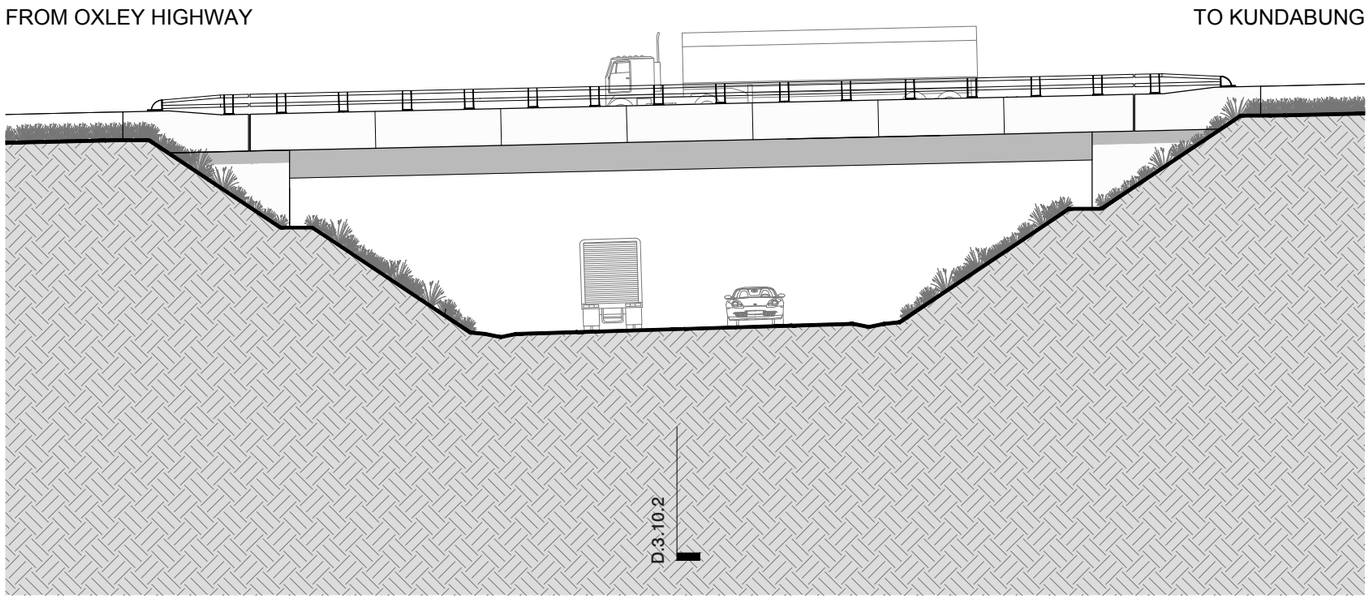
D.3.9 SB12: Twin Bridges over Yarrabee Road at 32.2 km North of Port Macquarie

Twin bridges are required at this location to span Yarrabee Road. The 28.8 metre twin bridges are single-span structures supporting the north and south bound main carriageway over Yarrabee Road with a minimum clear carriageway width of 11 metres.

The superstructure consists of five 1200 millimetre deep Super-T composite girders with a 180 millimetre thick in-situ concrete deck slab.

The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with stone pitching. A 750 millimetre wide inspection platform is provided in front of the abutments with ramp access up from the local road level.

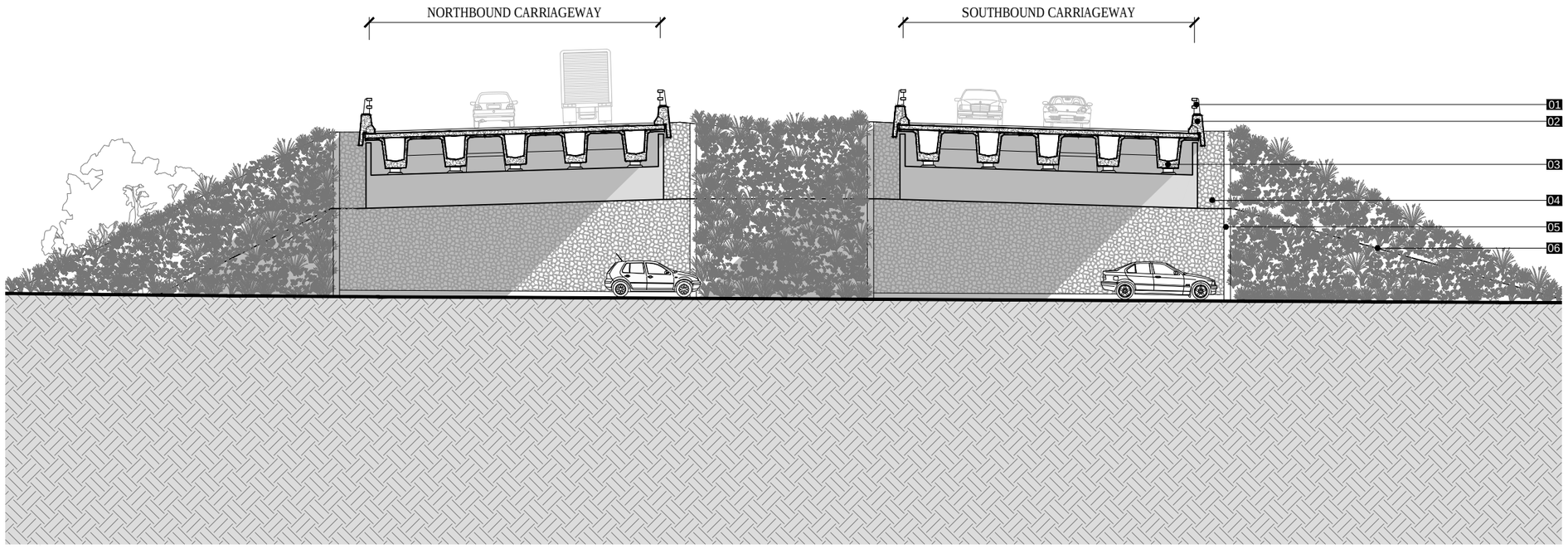
Precast concrete barrier/parapets are attached to the deck by a continuous stitch pour which forms the lower inside face. A single conduit is provided in each barrier. A 650 millimetre high twin rail metal traffic barrier is provided on the parapet giving an overall parapet height of 1300 millimetres.



Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

Figure D.3.9.1 SB12: Twin Bridges over Yarrabee Road: Elevation

0 10m



01 TWIN METAL RAIL BARRIER
02 CONCRETE PARAPET
03 SUPER-T GIRDERS
04 STONE PITCHING
05 REINFORCED CONCRETE EDGING STRIP
06 ACCESS RAMP

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

0 10m

Figure D.3.9.2 SB12: Twin Bridges over Yarrabee Road: Cross Sectional Elevation

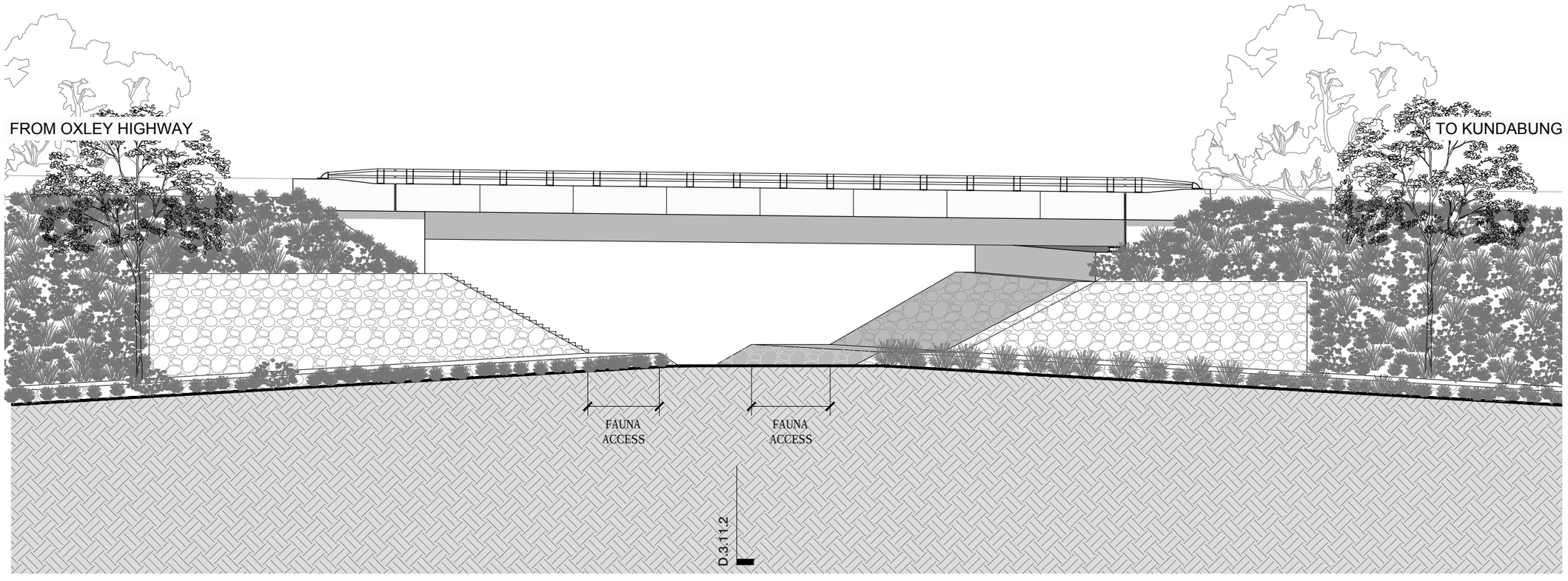
D.3.10 SB13: Twin Bridges over Barrys Creek at 34.1km North of Port Macquarie.

Twin bridges are required at this location to span Barrys Creek. Two single-span bridges 32.1 metres in length support the highway north and south bound carriageways with a minimum clear carriageway width of 11 metres between traffic barriers.

Each bridge superstructure comprises five 1500 millimetre deep Super-Ts supporting a 180 millimetre thick cast in-situ deck slab. The skew angle between the centreline of the bridge and the centreline of the abutment is approximately 30 degrees.

The abutments comprise spill-through type abutments with a reinforced concrete headstock. The abutment batter slope is 1.5H:1V and finished with Rip Rap stone boulder scour protection. A 750 millimetre wide inspection platform is provided in front of the abutments with stair access from ground level below the bridge.

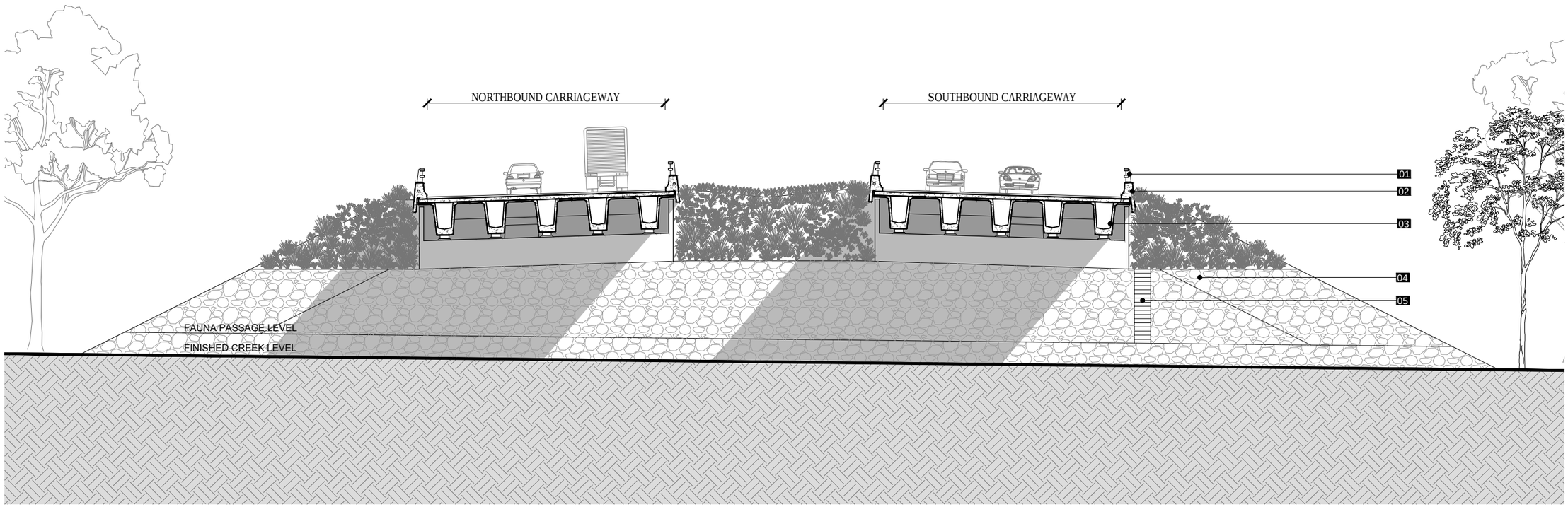
The bridge arrangement allows for a fauna passage (3.0 metres wide x 2.5 metres high) each side of the creek.



Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

Figure D.3.10.1 SB13: Twin Bridges over Barrys Creek.: Elevation

0 10m



01 TWIN METAL RAIL BARRIER
02 CONCRETE PARAPET
03 SUPER-T GIRDERS
04 RIP RAP ARMOUR STONE SCOUR PROTECTION
05 MAINTENANCE ACCESS STAIRS

Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

0 10m

Figure D.3.10.2 SB13: Twin Bridges over Barrys Creek: Cross Sectional Elevation

D.4 Underpass Box Culverts

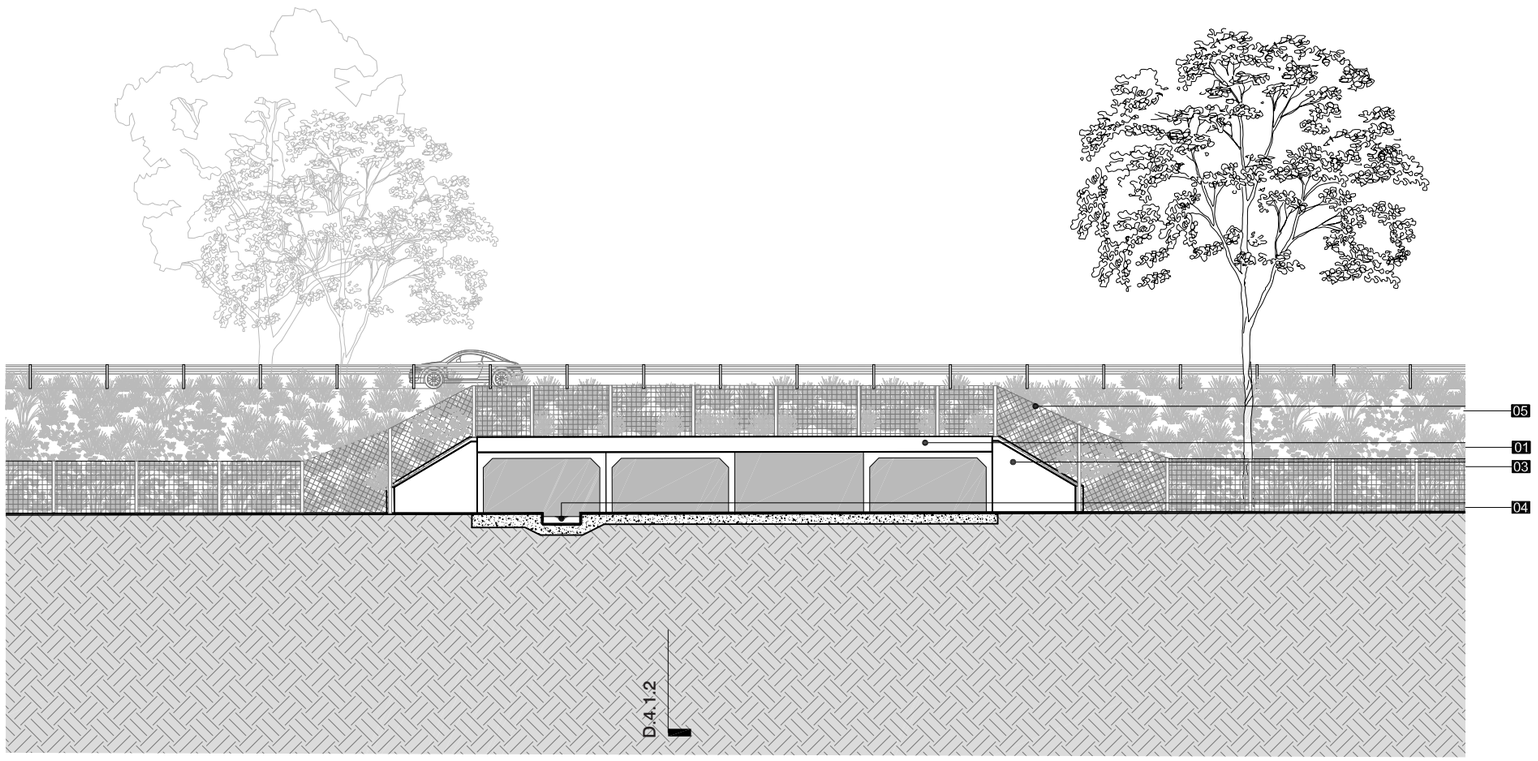
The box culvert structures are generally of low visibility. The Upgrade includes box culverts which serve as fauna and/or drainage underpasses. They are located at the following locations:

Design Lot No.	Location	Type	No. of Cells / Dimensions
DC01	C01.60 - Ch 01+600	Drainage Culvert	2x2400x1200
	C03.59A - Ch 03+580	Fauna/Drainage Culvert	1x1800x1200
	C03.59B - Ch 03+590	Fauna/Drainage Culvert	1x1800x1200
	C03.59C - Ch 03+600	Fauna/Drainage Culvert	1x3000x1800
	C03.59D - Ch 03+630	Fauna/Drainage Culvert	1x3000x1800
	C04.50 - Ch 04+500	Drainage Culvert	1x3600x1800
	C06.72 - Ch 06+720	Fauna/Drainage Culvert	1x3000x2400
	C07.26 - Ch 07+260	Fauna/Drainage Culvert	1x3000x2400
	C09.21 - Ch 09+210	Fauna/Drainage Culvert	1x3000x3000
	C11.08 - Ch 11+120	Fauna/Drainage Culvert	1x3000x2400
	C11.14 - Ch 11+140	Fauna/Drainage Culvert	1x3000x2400
DC02	C17.70 - Ch 17+700	Fauna/Drainage Culvert	1x3000x3000
	C20.26 - Ch 20+260	Fauna/Drainage Culvert	1x3000x2400
	C21.54 - Ch 21+540	Fauna/Drainage Culvert	1x3000x3000
	C21.80 - Ch 21+800	Fauna/Drainage Culvert	1x3000x3000
	C23.05 - Ch 23+050	Fauna/Drainage Culvert	1x3000x3000
SC01	F01.04 - Ch 01+040	Fauna Underpass	1x3000x3000
	F01.62 - Ch 01+620	Fauna Underpass	1x3000x3000
	F09.70 - Ch 09+700	Fauna Underpass	1x3000x3000
	F11.67 - Ch 11+670	Fauna Underpass	1x3000x2400
SC02	C02.60 - Ch 02+600	Drainage and Fauna Underpass	2x3000x2100*
	C04.22 - Ch 04+220	Flood Relief Culvert	3x3000x900
	C04.46 - Ch 04+460	Drainage and Fauna Underpass	3x3000x2100
SC03	C14.30 - Ch 14+300	Flood Relief Culvert	5x3300x900
	C16.10 - Ch 16+100	Flood Relief Culvert	3x3000x900
SC04	F20.54 - Ch 20+540	Fauna Underpass	1x3000x3000
	F21.24 - Ch 21+240	Fauna Underpass	1x3000x3000
	F22.32 - Ch 22+320	Fauna Underpass	1x3600x3600

* This dimension currently being finalised.

The box culvert structures comprise crown units ranging from 1.8 metres to 3.6 metres in width and 0.9 metres to 3.6 metres in height with fill heights ranging from 0.9 metres to three metres. Crown units sit on base slabs. Wingwalls have varying heights. Wing walls and headwalls are precast and secured with a cast in-situ stitch pour.

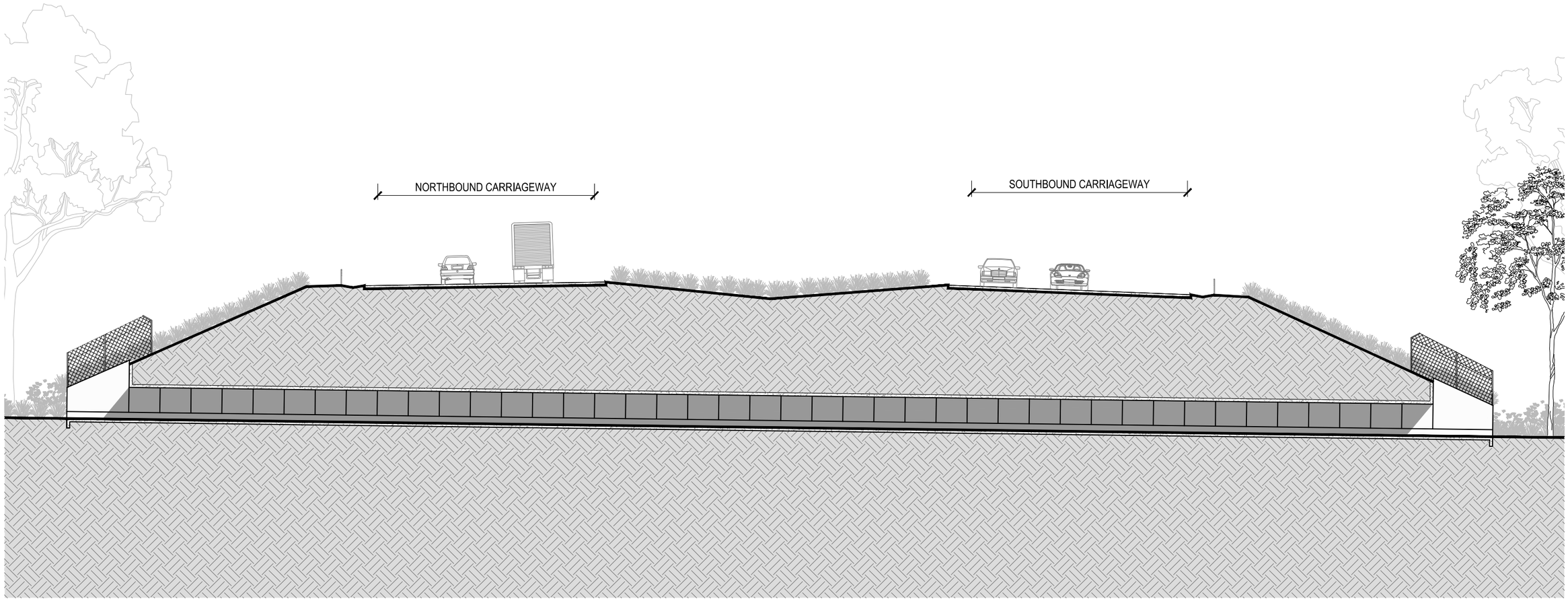
A typical culvert is illustrated in Figures D.4.1.1 to D.4.1.2.



Drawings are for illustrative purposes only.
For dimensions and extent of works refer to Engineers Drawings.
For Landscape types and extents refer to Landscape Drawings.

Figure D.4.1.1 Underpass Box Culvert Cross Elevation

0 10m



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For Landscape types and extents refer to Landscape Drawings.

Figure D.4.1.2 Underpass Box Culvert Long Section

0 10m

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E Earthworks, Landform & Slope

Introduction

Earthworks are a major determinant of the aesthetic quality of a rural highway. As noted in Chapter B Contextual Analysis, this project is characterised by generally two types of landform. Undulating to steep terrain with rounded hills and ridges occurs to the north of Wilson River around Cooperabung Hill and Cooperabung Creek Nature Reserve. The second landform type comprises the flat floodplain areas of Fernbank Creek, Hastings River, Wilson River and the Wilson River floodplain.

In general, the earthworks have been designed to integrate with the adjoining existing landforms, taking into account a range of factors including topography, corridor width 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 occur through Cooperabung Creek Nature Reserve and Ballengarra State Forest forested areas in the north at Stations 20km900 to 21km200 and Station 22km400 to 22km800.

The earthworks design is generally consistent with the requirements of Section 15.3 of Appendix 15: Urban Design Performance and Design Requirements and referenced requirements in Appendix 9: Geometric Performance and Design Requirements of the *Scope of Works and Technical Criteria* and the *RTA Shotcrete Design Guidelines* (June 2005). Particular attention has been 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.

E.1 Cross Sections Illustrating Significant Cuttings & Embankments

As illustrated in the following typical sections, the vertical alignment of The Upgrade creates a number of significant cuttings and fill embankments (Refer to Figures E.1.1 to E.1.12).

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 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 fea.thered into the adjacent landform
- Cuttings are more visible than embankments to highway users and therefore require careful design
- Ends of cuttings will be rounded off and feathered into the adjacent landform..

E.1.1 Batter Rounding

Batter rounding is required at the top and bottom of batters. Rounding is shown in all typical cross sections. Generally the rounding is a two metre radius but is increased to three metre radius at the top of low shallow fills and decreased to one metre at the top of high fills at the edge of the carriageway and high side of interchange entry/exit ramps.

The ends of batters in cuttings will be rounded and the batter progressively flattened for a minimum distance of 50 metres to blend the batters into the surrounding landform.

E.1.2 Drainage Sheet Flow over Batters due to removal of SO Gutters

It is proposed to remove SO gutters and allow stormwater to sheet directly over fill batters up to approximately five metres high. This will apply additional erosive pressure to the batters. The landscape strategies to be employed to help prevent erosion on fill batters in this situation include:

- Where sheet flow occurs in pasture/floodplain areas, Couch Grass/Carpet Grass is used in the pasture grass seed mix. Couch establishes rapidly and forms a thick sward of rhizomes which will effectively resist erosion and it is tolerant of saline and acidic soils. Couch is regarded as a native and is prevalent in the adjoining paddocks, although it also occurs outside Australia. Carpet Grass is a naturalised species in the area and found in the adjacent pasture. It establishes easily and binds well but is not aggressive
- The use of rice or sugar cane straw mulch to 25mm thickness over hydroseeding mixes. Straw mulching is a superior binder to the mulch component generally applied with hydromulching
- The use of composted site mulch berm windrows at the top and bottom of batters and along contour intervals of three metres on slopes during the establishment period
- The addition of up to 50% composted site mulch (following advice from the soil scientist) added to site topsoil either at the stockpile site or by mixing on the prepared slope using the windrowed berms. Composted tub-ground site mulch is superb at resisting erosion
- Where planting is required on such batters, use planting strategies such as long stem planting
- Direct return and preservation of the soil seedbank which will re-introduce the diversity of species and contribute to the resilience and resistance of vegetation to erosion in forested areas.

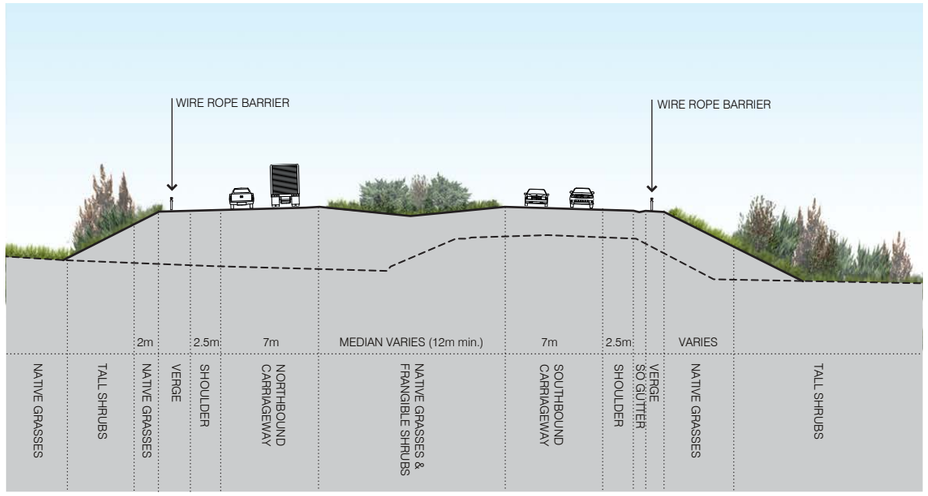


Figure E.1.1 Significant Embankment Cross Section at Station 1km550

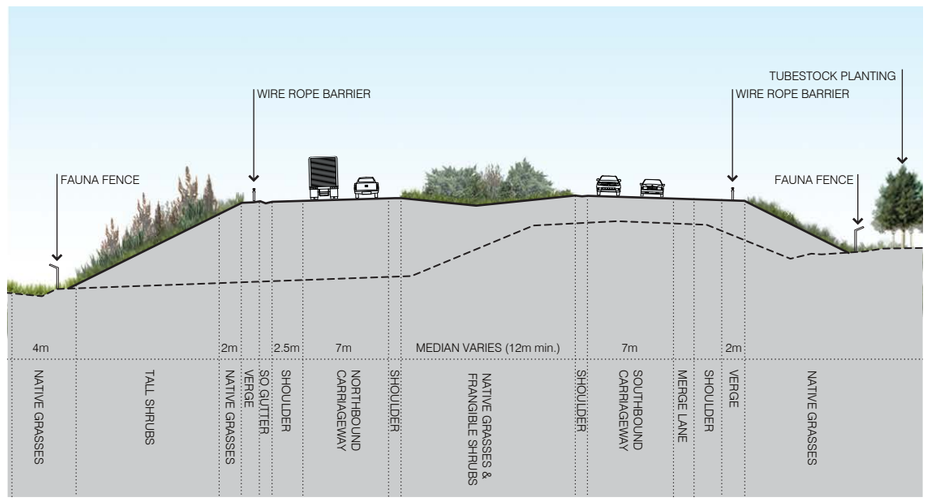


Figure E.1.2 Significant Embankment Cross Section at Station 1km650

0 25m

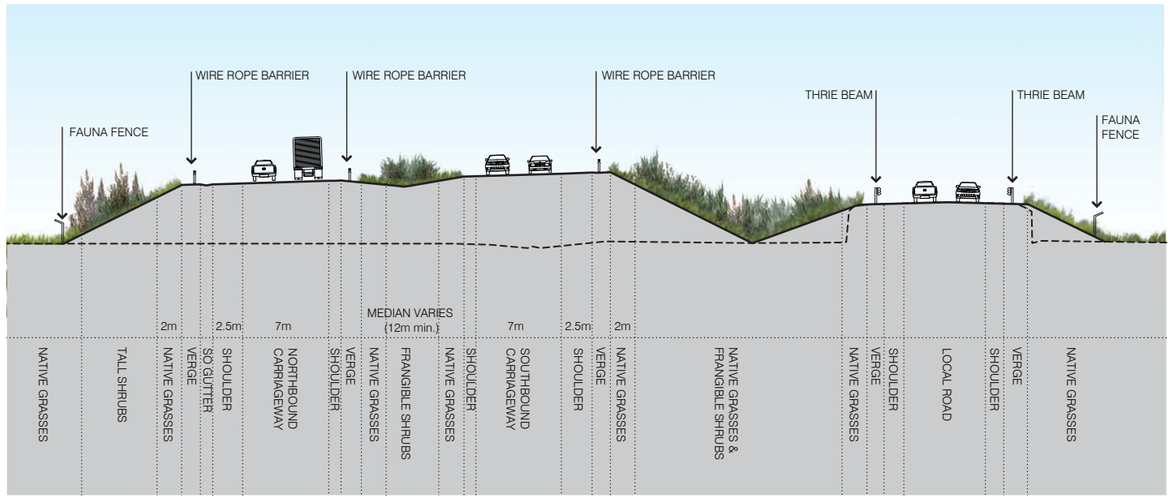


Figure E.1.3 Significant Embankment Cross Section at Station 4km450

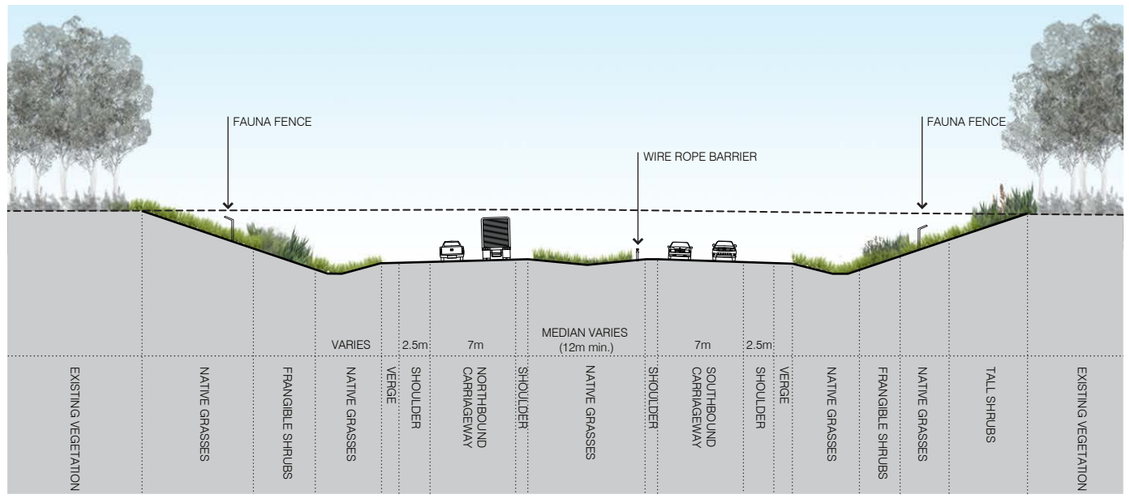


Figure E.1.4 Significant Cutting Cross Section at Station 7km125

0 25m

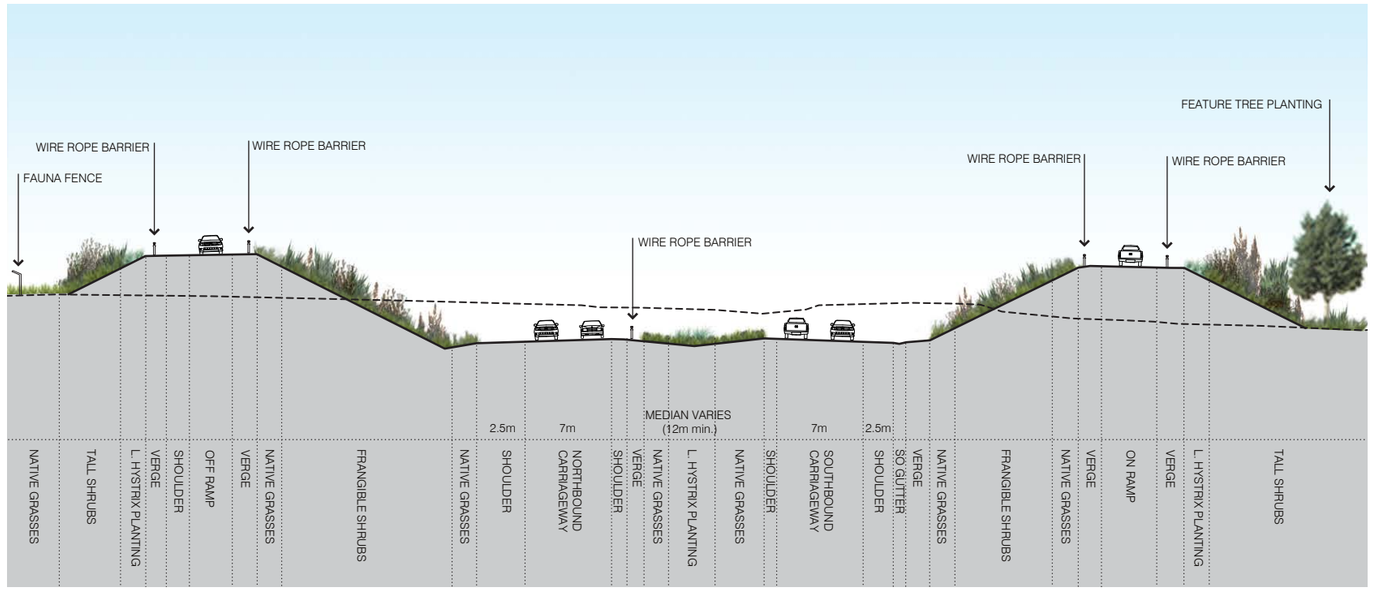


Figure E.1.5 Significant Embankment Cross Section at Station 7km975

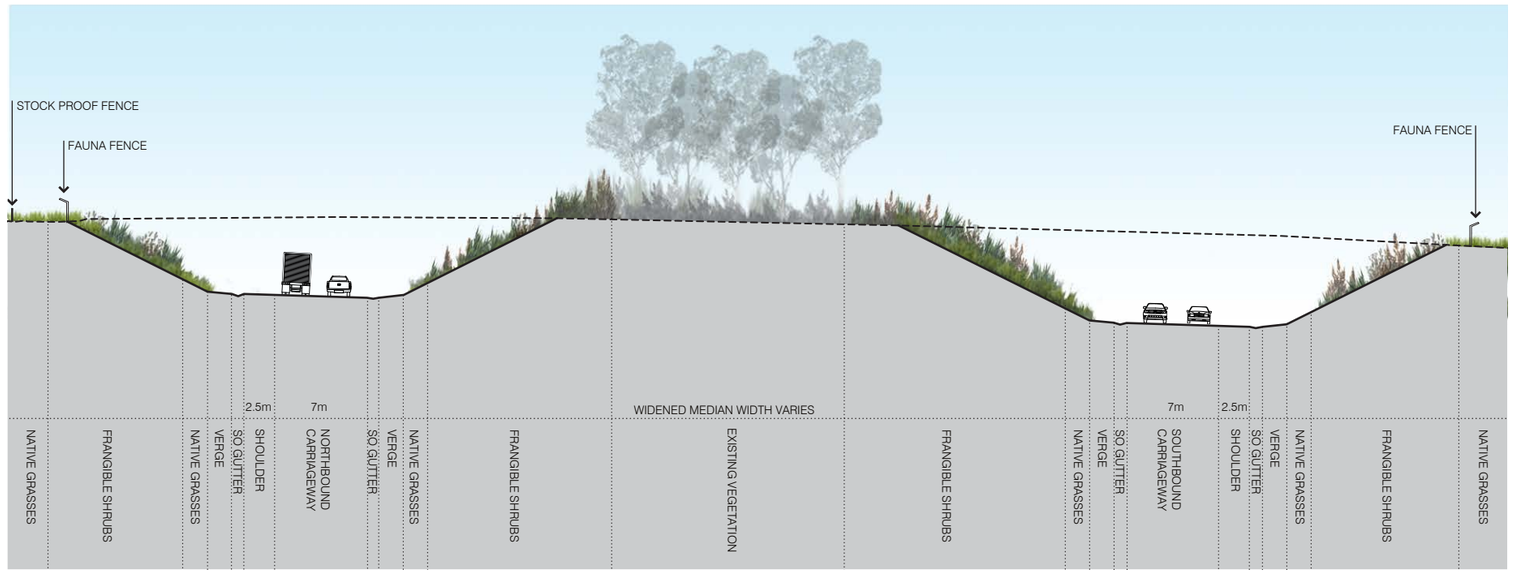


Figure E.1.6 Significant Cutting Cross Section at Station 10km400

0 25m

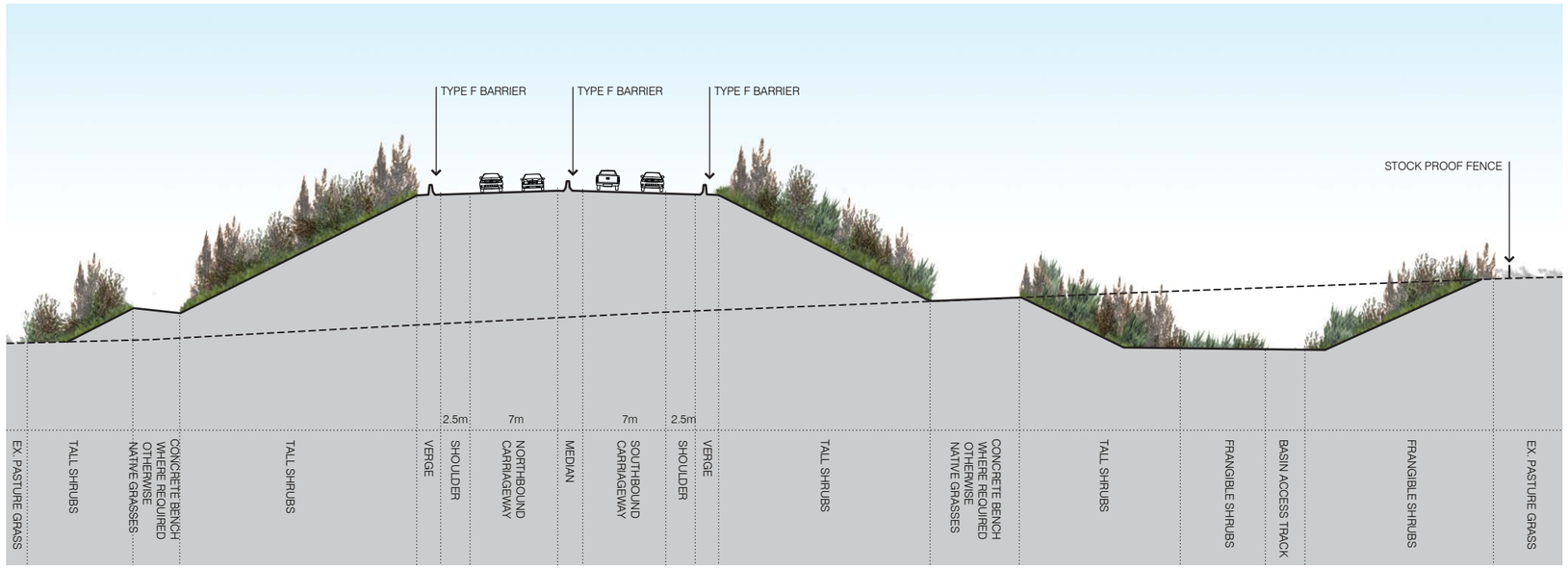


Figure E.1.7 Significant Embankment Cross Section at Station 17km100

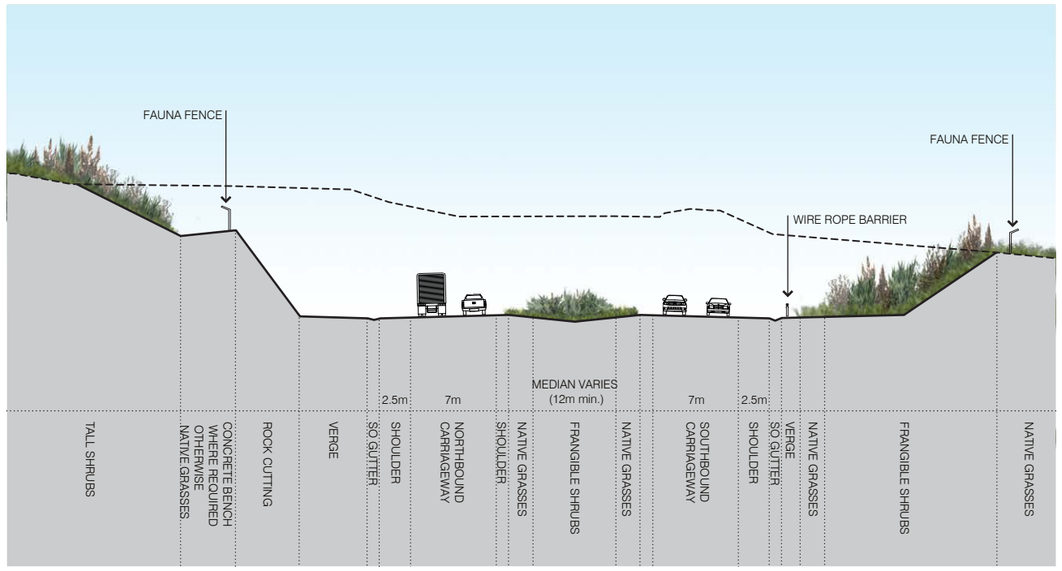


Figure E.1.8 Significant Cutting Cross Section at Station 17km900

0 25m

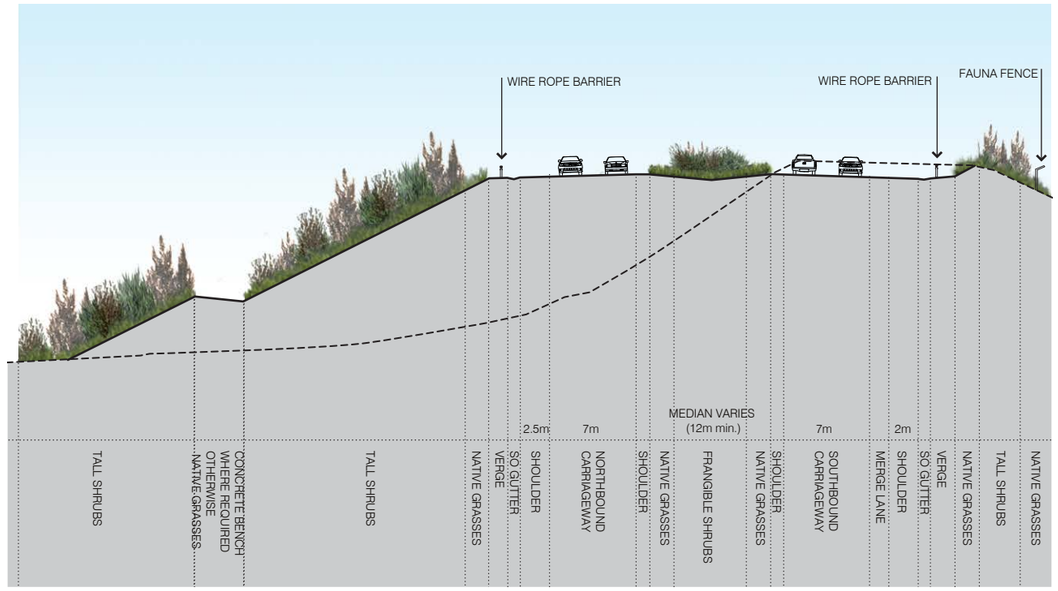


Figure E.1.9 Significant Embankment Cross Section at Station 20km500

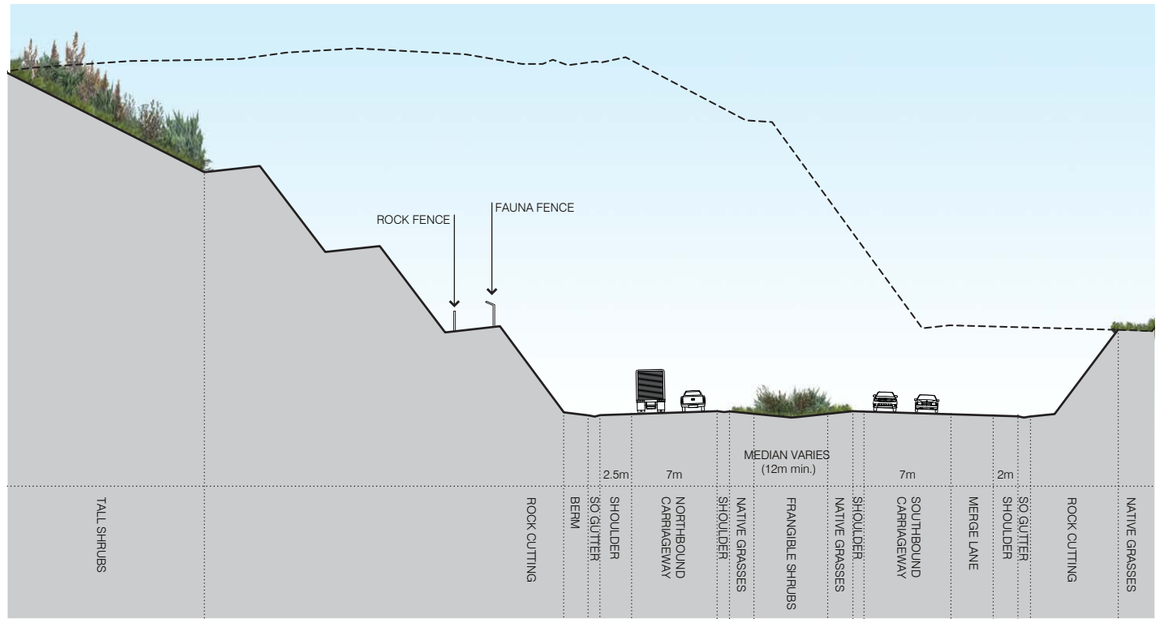


Figure E.1.10 Significant Cutting Cross Section at Station 21km000

0 25m

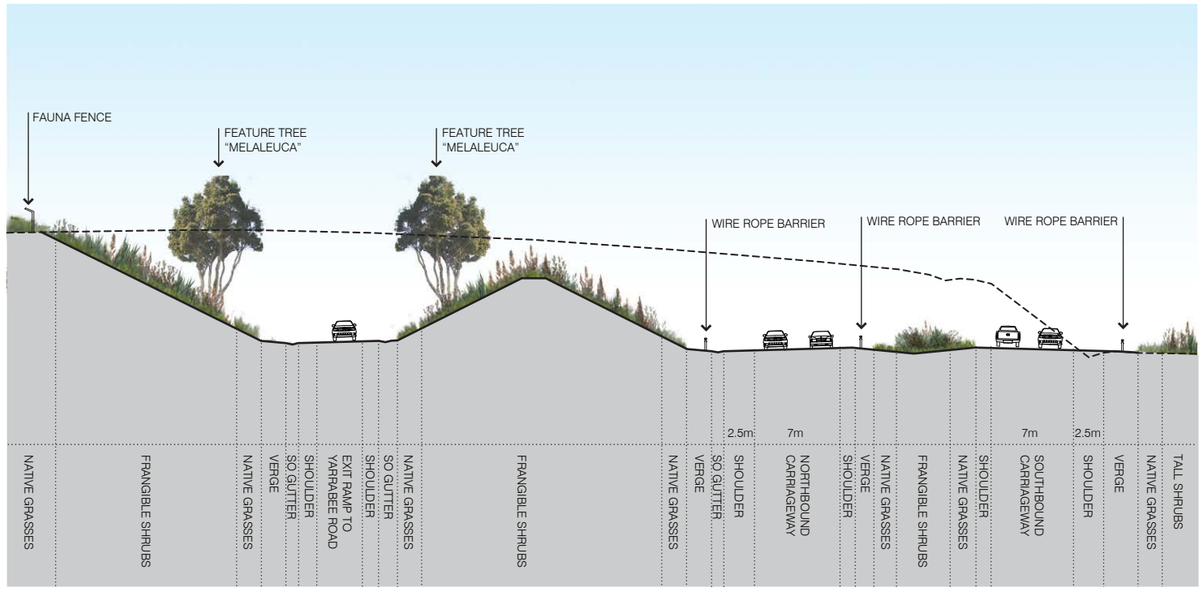


Figure E.1.11 Significant Cutting Cross Section at Station 22km000

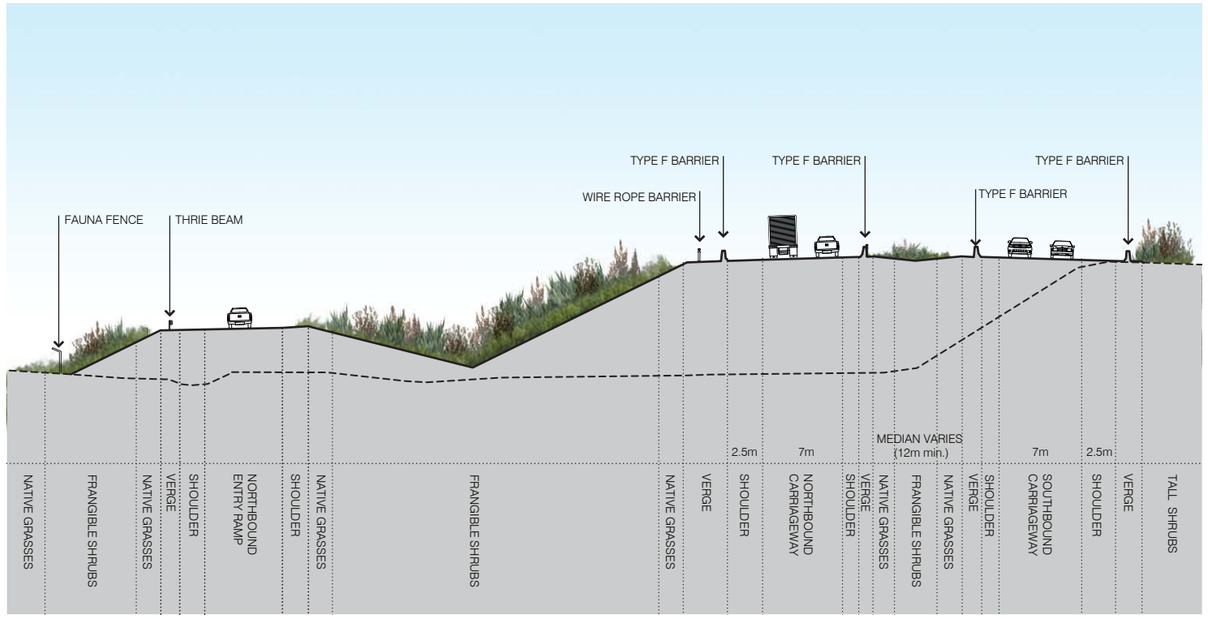


Figure E.1.12 Significant Embankment Cross Section at Station 22km150

0 25m

E.2 Schedule & Illustration of Finishes

E.2.1 Slope Stabilisation

The 2H:1V slopes generally adopted throughout The Project are hydromulched or hydroseeded and strawmulched to stabilise them. 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 Section E.3.

The only cut slopes which have been identified to be exposed rock are the lower benches in the cutting between Station 20km900 to 21km200 and Station 22km400 to 22km800. Here it is expected that either shotcrete in seams and rock bolts, or rock mesh will be required on some parts of the cut slope. The rock mesh will be considered as an alternative to shotcrete in order to match the existing rock protection netting on the existing facing slope.

In addition to either rock mesh or shotcrete, rock protection fencing is required on the lowest cut bench.



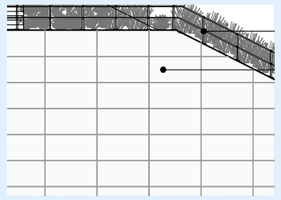
Existing rock mesh on Cooperabung Cut.

Stone pitching to finish overbridge abutments has been adopted as the preferred finish to the 1.5H:1V slopes for the highway bridge abutments, as illustrated in the photo from the Kempsey Bypass project in E.2.3 Schedule and Illustration of Finishes. See Section F Landscape Topsoil Treatments, for the slope preparation required to establish vegetation.

E.2.2 Precast Concrete Panel Walls

For the abutment walls to the bridge over the North Coast Railway Line the reinforced soil wall panel design has been designed so that horizontal joints are accentuated to provide strong horizontal banding and so that the vertical joints are minimised and less accentuated. The panels are not pigmented avoiding fabrication issues of matching panel colours, the plain grey natural concrete colour contrasts well with vegetation, and the design is relatively simple allowing it to recess into the environment. The panel design accommodates all the required panel heights, providing fabrication and construction advantages.

E.2.3 Schedule & Illustration of Finishes

Finish	Location and Notes	Illustration of Finish
Planting - vegetated embankments	Preferred finish predominantly utilised on The Project - exceptions noted below. Vegetation comprises pasture grasses or shrubs and groundcovers or sedges or a mixture according to location and context.	
Exposed Rock	Preferred finish as far as practicable. Where additional stability is required metal mesh is acceptable as it matches the existing batter finish.	
Stone Pitching	Bridge abutments for Main Carriageway Overbridges.	
Rip Rap Armour Stone (stone boulders)	Underbridge abutments for scour protection.	
Precast Panels for Reinforced Soil Walls	North Coast Railway Line Vertical Bridge Abutments vertical emphasis (Refer Chapter D.3.8 Bridge over North Coast Railway Line).	

E.3 Shotcrete Avoidance & Minimisation Strategy

E.3.1 Methodology to avoid & minimise use

In the Design for this project exposed areas of sprayed concrete (shotcrete) have been avoided as far as possible.

During construction every effort will continue to be made to achieve batter stabilisation without the use of shotcrete. Where its use cannot be avoided, shotcrete will comply with the following.

E.3.2 Design Appearance

Where the use of shotcrete cannot be avoided:

- The extent of shotcrete will be minimised
- The edges of the shotcrete will be masked off to avoid overspray
- The colour and texture of the shotcrete will match the colour and texture of the adjacent rock batter (test panels will be provided) or be a dark recessive colour
- Areas of shotcrete along rock seams will be recessed to allow the exposed rock to visually dominate
- Shotcrete will have a wood float finish and a gun finish will be avoided
- Soil nails and rock bolts will also be recessed and any supporting shotcrete finished with a wood float finish
- Should areas of weak rock be exposed during construction, stone pitching using locally won rock will be considered to infill the weak areas
- Shotcrete will be screened by plantings where possible
- No shotcrete will be visible from the areas around the abutments of bridges.

E.4 Application of Shotcrete for Rock Seam Stabilisation

Figure E.4.1 shows the use of stone pitching to stabilise slopes and Figure E.4.2 illustrates the application of shotcrete for rock seam stabilisation.

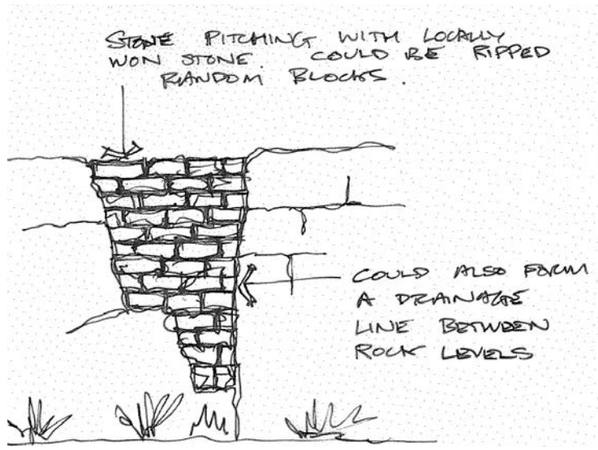


Figure E.4.1 Stone Pitching

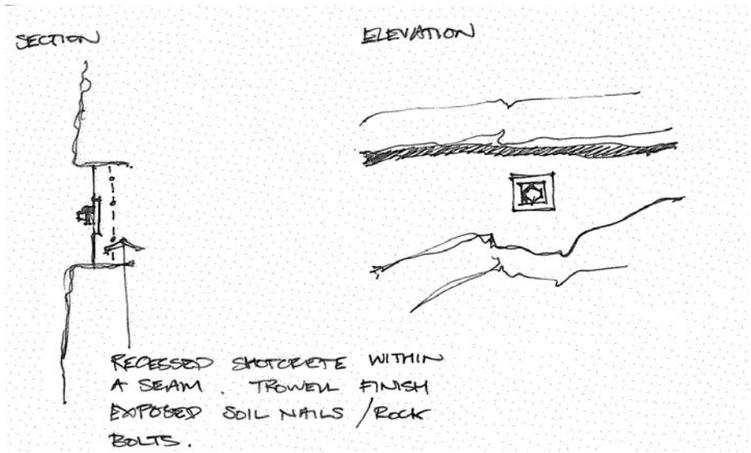


Figure E.4.2 Rock Seam Stabilisation

E.5 Treatment of Potential Landscape Mounds

Refer Figures E.5.1 to E.5.6.

In this project there will be a significant excess of excavated material which must be accommodated within the project corridor. The ultimate amount of excess spoil cannot be accurately predicted ahead of construction due to factors such as the physical properties of the actual material removed and weather conditions, which can alter the structural performance of excavated material. It is prudent to plan for the most extreme case. If a lesser quantity of material remains after construction, it can be readily accommodated within the plan. If the largest predicted amount of excess material were actually produced during construction, a total of approximately 60 Landscape Mounds would be required. These Potential Landscape Mounds (PLM), located along the road alignment, would take the form of batter widenings, integrated and standalone mounds. Their proposed locations and extents have been determined under strict vegetation clearing limits already established and approved for the project, to minimize ecological disturbances within the project boundaries. The goal is to achieve a fully integrated design solution and feasible construction methodology for the incorporation of spoil mounds that fully addresses all related issues: earthworks, utilities, drainage, urban and landscape design, flora and fauna.

The primary urban and landscape design consideration is the visual impact and appearance of the landscape mounds as seen from the highway. In some cases mounds may also provide useful screening of the road as seen from neighbouring properties.

A set of draft design principles has been developed that will directly inform the shape, extent and location of the landscape mounds:

- The design and construction methodology is to be developed in collaboration with Earthworks, Civil and Hydrologic Engineering, Environmental and Urban and Landscape Design consultants;
- Proposed landscape mound sites are to be integrated into the highway design formation and/or adjacent local landform and landscape;
- Proposed landscape mound sites are to be prioritized, with highest priority sites being those which minimize environmental impacts;
- Provide a contingency plan to dispose of excess material if volumes exceed estimations;
- Mound profiles are to be informed by a set of design guidelines in the form of drawings (Figures E.5.1 to E.5.6) that integrate the mounds with the highway formation, cuttings and the surrounding topography and landscape;
- Landscape mounds are to be located only within approved RMS clearing limits;
- Distribution of spoil material is to follow a progressive construction/placement methodology in which as far as possible Stage 1 mounding is to be completed before Stage 2 mounding commences (refer to guideline drawings). In general, spoil is to be distributed across multiple sites incrementally, rather than one site being filled to its Stage 2 maximum before nearby sites are used;
- Top soil is to be added to completed mounds with sufficient depth to support the proposed vegetation treatment at each mound;
- Vegetation selection and treatment is to provide vigorous growth to assist in slope stabilization and reduce visual impacts;
- Vegetation treatment is to utilize tree and plant species that are compatible with surrounding vegetation communities and suitable for mound slopes;
- The design guidelines and drawings are to form an integral part of the landscape design construction documentation;
- The Contractor is to ensure permanent landscape mounds adhere to the agreed design profiles and guidelines, the applicable landscape drawings and are finished in consultation with Roads and Maritime;
- The design methodology is to allow for case by case design development, especially in visually sensitive areas, to ensure that each landscape mound achieves the agreed profiling; and
- The methodology is to be adaptable to onsite conditions and variations in material volumes.

Figures E.5.1 to E.5.6 show the agreed design guidelines for typical mound situations where:

- Mounds are located in open areas with views;
- Mounds are located on level grade where no views from highway occur;
- Mounds are located on embankments;
- Mounds are located in cuttings;
- Mounds are incorporated into widened embankments on floodplains where views from the highway are to be retained; and
- Landmark mounds are located at interchanges, major intersections and/or significant carriageway convergence.

The drawings incorporate the following detailed design principles:

- Mound slopes facing the highway or seen in approach from it must be no steeper than 1V:3H; and
- Mound apexes and slope changes are to be rounded as shown on the drawings.

Because the ultimate quantity of excess spoil may vary significantly, the drawings show two stages of mounding.

An iterative design process is envisaged as the amount of excess material and preferred locations become clearer during construction. Provided that the principles and guidelines are followed, the final result will be generally satisfactory and in some locations beneficial.

Where excess topsoil remains, it will be used to increase topsoil depths generally.

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

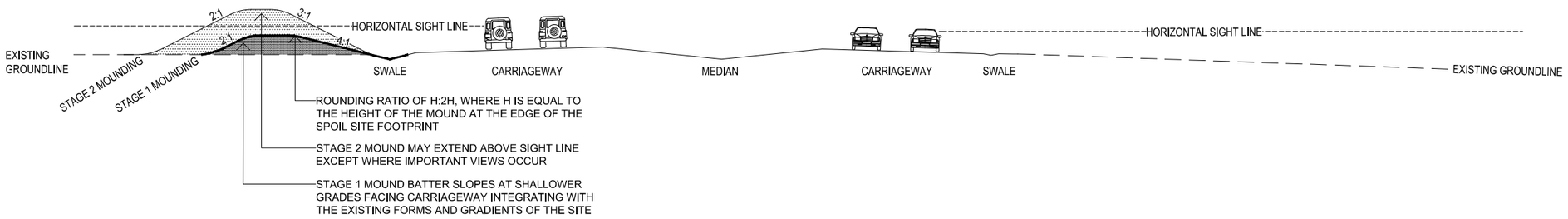


Figure E.5.1 Cross Section: Typical mound location and profile in open areas with views

0 15m

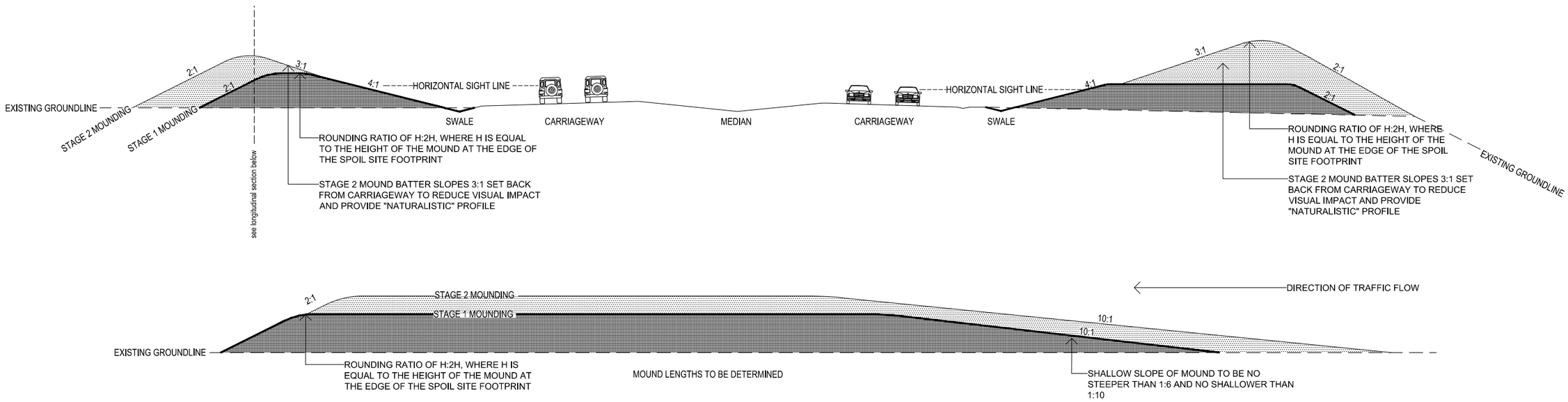


Figure E.5.2 Cross and Longitudinal Section: Landscape mound location and batter profiles on level grade where no views from highway

0 15m

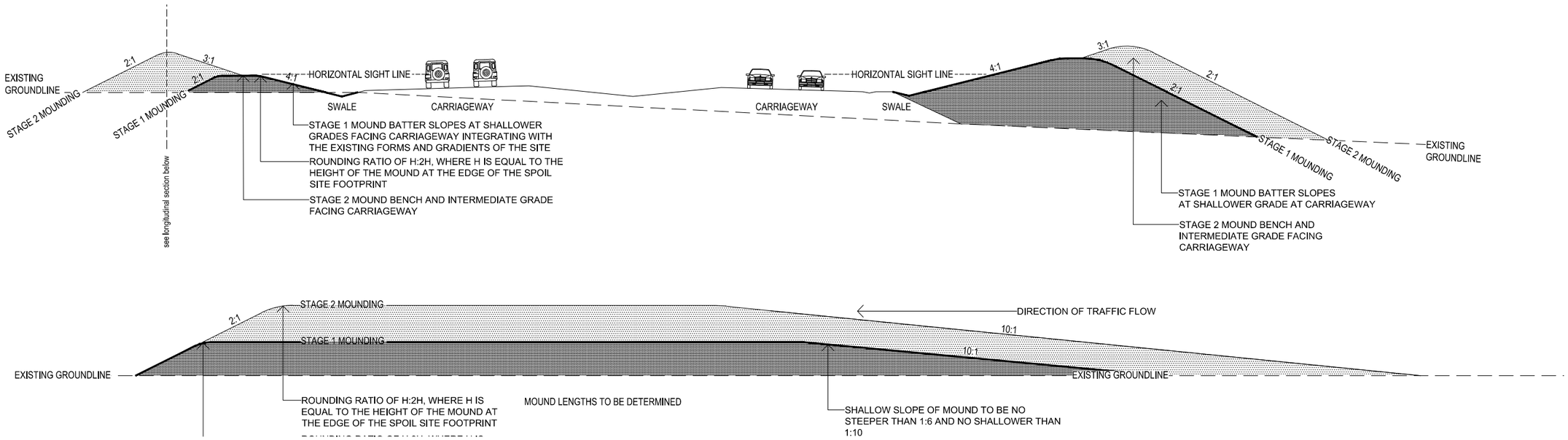


Figure E.5.3 Cross and longitudinal section: Mound location and batter profiles on embankment

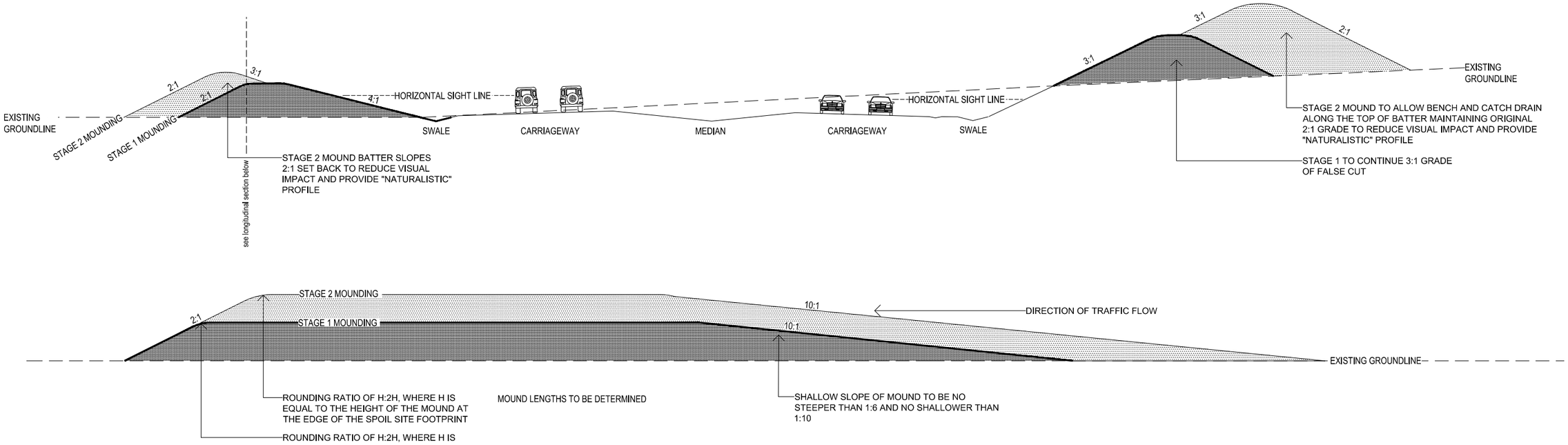


Figure E.5.4 Cross and longitudinal section: Mound location and batter profiles in cutting -

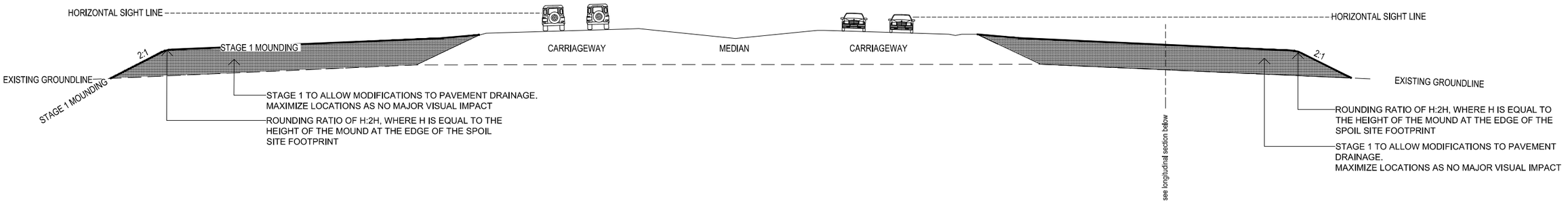


Figure E.5.5 Cross section: Widened embankment on flood plain - Typical views from highway to be retained

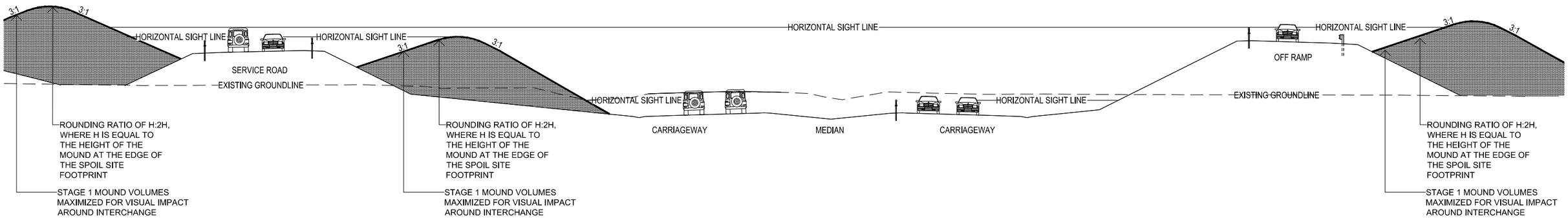


Figure E.5.6 Cross section: Landmark mound at interchange, major intersections and or significant carriageway convergence

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F Landscape

The overall Landscape Strategy and Concept is described in Section C Urban Design Strategy. This section provides further detail on landscape designs elements and implementation.

F.1 Landscape Design Methodology

Key requirements of the landscape design are to:

- Respond to the character of the adjacent landscape
- Maintain, enhance and/or ameliorate views
- Maintain safety clearances and other performance and safety requirements
- Provide a methodology for the successful establishment of vegetation. A holistic approach which extends to the initial topsoil stripping is used in order to best achieve the 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 for providing a cost-effective method of establishing such a large tract of vegetation. The landscape design augments the existing vegetation patterns by connecting patches of remnant vegetation to each side of the highway and ensuring that the newly installed landscape is not always lining the roadside and creating a linear edge.

A key element of the strategy is the management of topsoil and providing the circumstances for natural regeneration. This is particularly important in forested areas where stored soil seed banks will be present within the existing topsoil, and can be preserved in the stripped topsoil to be returned, and where fringing trees and shrubs will disperse seed into the disturbed areas of the alignment.

Natural regeneration ensures that foreign genotypes are not introduced to the existing vegetation communities and also that the species diversity of the community is not diluted. It also has other benefits. It reduces fertilizer requirements (which can run off and cause algal blooms and fish death in waterways). It also introduces endemic 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 colonizers that will persist or colonise rapidly where conditions are favourable to them without the necessity to include them in seed mixes (*Pteridium esculentum* - Common Bracken, *Calochlaena dubia* - Soft Bracken and *Imperata cylindrical* - Blady Grass). All of these types of plants can be expected to re-colonise disturbed areas with the application of correct topsoil management procedures.

Ideal circumstances would see the majority of the alignment revegetated through natural regeneration, and with seeding mixes (described overleaf) as a “stop gap” measure or “back-up plan” to be deployed where obvious failures in the topsoil strategy are observed. Planting would be confined to highlighting special areas such as interchanges and town approaches and providing specific vegetation matching at rivers, creeks and fauna crossings and where headlight screening is required. However there are only isolated circumstances where lead time can allow natural regeneration to be relied upon. These are areas within natural forest where the alignment works are commenced early to win material for the road building. Where these areas are identified within the programming (generally the significant cuts to the north of The Project eg at approximate Station 22km600) trial will be conducted to assess restoration by natural regeneration.

F.2 Vegetation Communities

Planting and seeding schedules have been devised based upon the vegetation communities identified in the Flora and Fauna assessments and also through ground-truthing investigation by the design team. In addition to cleared and disturbed lands, eleven vegetation communities have been identified that are traversed by the proposed highway alignment. This includes Mangroves (recorded as aquatic flora in the Environmental Assessment (EA) but recorded here as terrestrial flora for the purposes of the landscape design). The vegetation community species composition has been used specifically in the preparation of the planting schedules.

Due to the similarities in species composition between Moist Slopes Forest and Moist Gully Forest, these two vegetation communities have been amalgamated for the purposes of setting out the planting. The vegetation communities and locations comprise Endangered Ecological Communities (EEC) and Non-endangered Ecological Communties (Non-EEC) as follows:

1. **Moist Floodplain Closed Forest with Rainforest Elements (EEC)** - Floodplain of Barrys Creek and tributaries near the Yarrabee Road Junction
2. **Riparian Forest (EEC)** - Cooperabung Creek, Barrys Creek
3. **Paperbark Swamp Forest (EEC)** - Floodplain South of the Wilsons River; Cairncross State Forest; the vicinity of Fernbank Creek; north of the Wilsons River only at just north of Wilmaria Road
4. **Swamp Mahogany Forest/Forest Red Gum Swamp Forest (EEC)** - South of the Wilsons River on the Wilsons River Floodplain; Cairncross State Forest; and in the vicinity of Fernbank Creek. Associated with drainage depressions on poorly drained soils
5. **Swamp Oak Forest (EEC)** - Small patches on Dalhunty Island; the banks of the Wilsons River; drainage line on the floodplain south of the Wilsons River; and the very southern end of the study area. Permanently wet depressions with some saline influence
6. **Freshwater Wetland on Coastal Floodplain (EEC)** - Depressions on the Wilsons River and Hastings River Floodplains and small patches along Fernbank Creek
7. **Mangroves - Hastings River (EEC)** - Hastings and Wilson River banks and Dalhunty Island
8. **Moist Floodplain Forest (Non-EEC)** - Former community of the Hastings River Floodplain. Usually dry areas subject to occasional flooding
9. **Moist Gully Forest (Non-EEC)** - Moist, sheltered gullies in undulating terrain, typically at the base of steeper slopes. Generally associated with ephemeral drainage lines or minor creeklines
10. **Moist Slopes Forest (Non-EEC)** - Slopes or low ridges with a moist sheltered aspect and good drainage in undulating terrain
11. **Dry Ridgetop Forest (Non-EEC)** - Ridgetops and upper slopes in undulating terrain or more elevated and exposed areas above the floodplain in flatter terrain.

F.3 Seeding

The seed mixes contain seed of plants known to establish well from seed and which occur across most or all of the listed communities, and especially from those vegetation communities where the influence of groundwater is low (Moist Gully, Moist Slopes and Dry Ridgetop Forest).

The seeding mixes are therefore more generic than the planting mixes due to the fact that:

- The embankments (where the bulk of seeding is used) provide a different and more generic set of microclimatic factors than the surroundings and areas where planting is proposed
- The seed mixes must be calibrated to satisfy clearance requirements for safety (eg: frangible and non-frangible), maintenance requirements (eg: for mowing) and height requirements for safe sight clearance distances
- Many of the species from minority communities recorded along the proposal alignment (eg; Riparian Forest at 2.8% of the proposal footprint) will not be suited for revegetation purposes on embankments where the microclimate for establishment is difficult.

Tall tree seed is not included in seed mixes due to the restrictions placed on tree location for safety and maintenance requirements. Tall trees are to be introduced by planting only, by return of topsoil containing a soil seedbank, and through the opportunistic seeding from trees in the fringing forest vegetation of the alignment. Such seeding can be anticipated to occur at the top and bottom of embankments away from the road edge within the first two years following preparation of embankments.

Only seeds and plants known to be useful to the regeneration of disturbed ground has been 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 which are more difficult to establish from seed and all tree species are included in planting only.

Other species which are not included in the seed mixes can be expected to re-colonise 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.

Seed mixes have been developed for various purposes including:

- **Native Grass seed mix** containing endemic native grass and sedge species where mowing/maintenance may be required for medians, verges, fauna fence access, where sightlines must be maintained and to allow views. The mix contains sedges which are able to withstand infrequent mowing and ensure that species will persist where moist patches or standing water occur
- **Frangible shrubs seed mix** containing endemic native grasses, sedges and frangible shrubs species for embankment areas within the safety clearance zone (up to 11 metres from the edge of carriageway), and where headlight glare minimisation is required in the median
- **Tall shrubs seed mix** containing endemic native grasses, sedges and shrubs and tall (non-frangible) shrubs and small tree species for use on embankments beyond the safety clearance zone
- **Pasture grass seeding mix** is included for areas where grass cover is required which includes both Couch Grass and Carpet Grass with cover crop. Couch establishes rapidly and forms a thick sward of rhizomes which will effectively resist erosion and is tolerant of saline and acidic soils and aluminium toxicity. Couch is regarded as a native and is prevalent in the adjoining paddocks, although it also occurs outside Australia. Carpet Grass is a naturalised species in the region and found in the adjacent pasture which establishes easily but is not aggressive
- **Cover crop seed mix** of fast growing annual grasses is to be applied to all disturbed areas of the site. The purpose of the cover crop application is to stabilise the surface material, particularly batters, and to provide an effective barrier to erosion.

Depending upon programming and construction staging, the cover crop may be applied separately or in conjunction with the final native seed mix. For pasture grass only mixes, the seed of Couch, Carpet Grass and cover crop are applied simultaneously. Should the seeding fail at any time it can be reapplied until it establishes.

Cover crop seeding will also be used to minimise erosion and weed establishment on topsoil stockpiles. Cover crop is to be applied at the rate of 30kg/ha.

We propose a reduced cover crop application over batters that are proposed to be (these will be fill batters where sheet flow will increase erosion potential). These areas will have composted mulch mixed with the topsoil to improve erosion resistance, be hydroseeded with native seed and then straw-mulched. The straw-mulching will bind the surface sufficiently until germination of native seed, which will germinate more effectively in the absence of competition from cover crop. Temporary basins and access roads are also to be seeded.

F.3.1 Seed Collection

All of the species recommended for seeding and planting will not be available commercially. However it will be important to recover and reuse the existing topsoil seed bank and to collect indigenous seed and other propagative material from the site itself, and/or from other remnant bushland within a 10 kilometre radius of the site in accordance with Roads and Maritime *Oxley Highway to Kundabung Design and Construction, SWTC: Appendix 7 - Technical Specifications R176*. Where seed cannot be collected from within this range we propose to adopt the *RTA Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects 2011* which states:

"Where the seed resources from areas to be cleared are not sufficient or available, additional seed may need to be collected from the region for the revegetation works. Selection of suitable seed collection sites is critical to ensure the genetic diversity of plant seed collected and the environmental conditions at planting and collection sites are matched."

The RTA Biodiversity Guidelines cites the Florabank Guidelines as the Code of Practice for the seed collection. The Florabank Guidelines state that:

"The matching of environmental conditions at the planting site with those of the collection location was the most important consideration in establishing the collection range."

Therefore our proposed collection regime will combines geographic distance in the first instance, with a habitat matching approach. Suppliers will be asked to fulfill and provide Annexure R176/6 - Collection Records - Record of Seed Collection which describes the collection area soil type, terrain and dominant tree species.

Preferred geographic distance will be defined as:

- 10km each side of the road alignment (all species collected within this range are assumed to meet the habitat matching criteria. All species with a "Narrow"[1] collection range must be collected in this range)
- The Mid North Coast Region stretching from the Clarence River in the North, south to Port Stephens and west to Stroud and Dorrigo (All species collected within this range will need to match the environmental conditions similar to those where the seed will eventually be sown. All species with an "Intermediate"[2] collection range must be collected from within this range)
- Within NSW (All species collected within this range must be approved by the Roads and Maritime. Plant types allowable in this range will be those that have an "intermediate" or "Regional"[3] collection range)

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

1. Narrow collection range includes all herbaceous plants, wattles and peas, orchids and lilies
2. Intermediate collection range includes all heath and understory shrubs, daisies, grasses, fleshy fruit plants (not trees), proteaceous plants, Casuarinas and Myrtaceae
3. Regional collection range includes trees with fleshy fruits.

A seed collection program will be prepared in consultation with a local ecologist to ensure there is sufficient quantity of seeds of the right species available, to complement commercially available seeds. Collection will commence throughout the clearing footprint prior to clearing in the first instance.

The optimum time for collecting most useful species is late spring.

Targeted species will be those listed in the seed schedules and to a lesser extent those in the planting schedules. These are all hardy and fast growing species for use in revegetation. No seed collection will be carried out for species protected under the NPW Act Schedule 13. Seeds collected during the pre-clearing period and throughout the design program may have an influence on the final planting and seeding schedules.

The collection program will include storage and treatment of seeds to maximise germination rates. Collection sites will be identified through examination of aerial photographs and maps, local knowledge and verified by ground searches. Seed may be collected from other parts of Northern NSW with the concurrence of the client, and it is possible that other plant material may be salvaged from the proposed development area, as appropriate.

Seed collection, processing and storage should follow the NSW protocols contained in the Florabank Guidelines (Florabank Online). Roads and Maritime Services have prepared their own Specifications for Seed Collection (D&C *R176 Seed Collection*) which are in basic agreement with the Florabank Guidelines and will be used for this project.

F.3.2 Seed Treatment & Storage Method

The following procedures will be implemented during seed cleaning and storage:

- Seed will be separated from fruits (fleshy fruits or dry capsules, pods etc) and stored in sealed, labelled containers
- Where there is evidence of insect attack, seed will be immersed in water for 12 hours, then re-dried
- Seed will be stored at 6° C in a refrigerator (based on Floyd 1989 and Florence 2000) and checked for evidence of mould
- Care will be taken not to expose seed to extremes of heat or cold or moisture
- The seed of most sclerophyll species should retain viability for two years or more if stored under these conditions.

F.3.3 Seed Application and Composted Mulch

Generally seed is applied through hydromulching. However due to the increased risk of erosion on batters typically under five metres high where SO gutters are not used and where pavement runoff will spill over batters, the seed application will utilise a two-step application. The two step application will comprise hydroseeding of native seed, followed by a hydromulching application of a minimum thickness of 25 millimetres of strawmulch.

F.4 Planting

The planting schedules include only species found in the vegetation communities. Vegetation community boundaries are indicated on the landscape plans. All proposed planting matches these communities, and therefore the planting schedules are arranged by community. The exception to the rule only occurs at intersection planting.

The landscape plans notate the vegetation communities. For the purposes of arranging the planting, Moist Slopes and Moist Gully Forest vegetation communities have been amalgamated as mentioned previously.

Trees are the diagnostic species for each community and all trees are to be planted (rather than seeded) in order to control their location in areas beyond clear zones and safety clearances as well as to prevent tall Eucalypts located in positions where they will overhang the corridor. A palette of shrubs and groundcovers from each community is also included for specific purposes such as screening, at fauna crossings, for bank stabilisation, basins and as ornamental planting at feature intersections.

F.4.1 Interchanges & Underpasses

Planting of super-advanced trees at the interchanges, intersections and underpasses are selected from the vegetation communities occurring along the alignment and will be chosen 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 motorists' journey. These key locations are:

- Blackmans Point Interchange
- Yarrabee Road Underpass
- Haydons Wharf Road Interchange.

F.4.2 Blackmans Point Interchange

Blackmans Point Interchange will signal the motorist's arrival at Port Macquarie through the signature planting of Foambark (*Jagera pseudorhus*), selected for its colourful new growth and fruit, neat habit, hardiness, suitability as a roadside tree and its connection with the rainforest setting of Port Macquarie. In addition Foambark is at its southern limit at the Manning River. Informal feature plantings of *Acmena smithii* (Lilly Pilly) and *Toona ciliata* (Red Cedar) will also be used to complement the Foambarks. Feature groundcover planting will be used at the roundabout for a neat and attractive finish and to reduce landscape maintenance requirements .

As this interchange is the northern entry point to Port Macquarie, it is appropriate to reserve the special planting for the southbound off-ramp and the Old Pacific Highway.

A CCTV and Variable Message Sign (VMS) as well as lighting are located at Blackmans Point interchange. The planting in the vicinity of this infrastructure has been laid out so as not to obscure or conflict with this infrastructure.

The SWTC Appendix 18 section 18.1.2 requires:

- CCTV cameras must be mounted at a sufficient height to ensure camera views are not affected by any signs, structures or foreseeable tree or foliage growth; and
- CCTV must be installed at Blackmans Point Road Interchange that provides full CCTV camera coverage of the Blackmans Point Road Interchange and allows NSW TMC operators to monitor traffic movements on the Northbound Main Carriageway, the Southbound Main Carriageway, Blackmans Point Road Interchange Overbridges and Ramps, Blackmans Point Road, Service Road B and Service Road C.

In addition, the SWTC App 18.1.3(d) requires:

- The CCTV infrastructure must be designed with urban design sensitivity and be included in the Urban and Landscape Design. Trees have been positioned to sightlines required for CCTV as advised by engineers.

F.4.3 Floodplain

Some 5.8 kilometres of floodplain is traversed by the proposed alignment. Most of the floodplain is cleared for pasture with patches of remnant wetland vegetation and occasional remnants of regenerating vegetation. South of the Wilson River and east of the alignment is a tea tree plantation. The alignment is elevated on embankments on average three metres above the floodplain. Generally the floodplain embankments are revegetated with pasture grass seeding to match the existing and maintain the panoramic views offered by raised carriageway over the floodplain. The variety of forested landscape juxtaposed with cleared landscape will provide interest, variety and a point of difference to provide legibility in the road journey for motorists.

In order to optimise programming/constructability and so as not to disturb potential acid sulphate soils, the topsoil in floodplain areas may not be stripped. Instead a bridging layer will be placed directly over the in-situ topsoils. In this instance topsoils for batters on the floodplain will be imported from elsewhere on the alignment. Topsoils which do not contain a soil seedbank (Landscape Topsoils or A2 horizon soils) can be used where floodplain areas are to be seeded with pasture or native grasses. These areas will not benefit from soils containing a soil seedbank.

Pasture grass seeding will be composed of two species (including a cover crop):

- Couch grass (*Cynodon Dactylon*)
- Carpet Grass (*Axonopus affinis*).

Importantly though, the patches of remnant native vegetation that occur in the floodplain have been the focus of planting efforts across the floodplain to re-establish habitat connectivity where the proposed alignment crosses. Flood relief structures provide the ideal location to connect habitat and often in locations where patches were previously isolated. Tree species will match the former vegetation community type that would have occurred prior to clearing as evidenced from vegetation remnants. Depressions on the floodplain associated with or near watercourses will use sedge species from the Freshwater Wetland vegetation community.

Where Maundia habitat has been identified, no tree planting is proposed so that sunlight - critical to Maundia colonization - is maintained.

F.4.4 Riverbank Stabilisation Measures

It is likely that riverbank revegetation stabilisation measures will be required at the Hastings Riverbank (especially on the heavily eroded northern shoreline), Wilson Riverbank and Dalhunty Island interface with the alignment. These will be in the form of succession Mangrove community revegetation either through natural regeneration or assisted by mechanical means such as rock fillets.

F.4.5 Water Quality Basins

Water quality basins will be "wet" basins with a typical permanent depth of 2.75 metres. On occasions they will be dry when the water level drops following dry periods. The strategy for basins is to prepare the margin zone of periodic wetting as for Topsoil Treatment 1 (overleaf) but with the addition of organic fibre mesh to help control erosion on the 2H:1V sides. The basins are to be seeded over the crest and to the maximum water level with native grass seed mix (which contains endemic sedge species seed).

Temporary construction basins will be decommissioned and the area reinstated. Landscape treatment will include topsoiling followed by hydromulching with one of the seed mixes depending on context, as shown on the landscape plans.

The native grass seed mix contains the following species which are anticipated to germinate at the margins and colonise the basin over time as and where conditions are favourable:

Botanical name	Common name
Ficina nodosa	Knobby Club-rush
Lepidospermum laterale	Variable Saw-sedge
Juncus usitasus	Common Rush

F.4.6 Frog Ponds

Frog breeding ponds are required for Green-Thighed Frogs and will typically be constructed as shown in Figure F.4.6.1. The final location and construction of each pond will be supervised by The Project Ecologist and undertaken in consultation with the Environment Protection Authority (EPA).

Grasses and sedges from the Freshwater Wetland vegetation community (refer F.8 Planting and Seeding Schedules) will be planted to provide habitat and refuge from predators on the margins of the ponds.

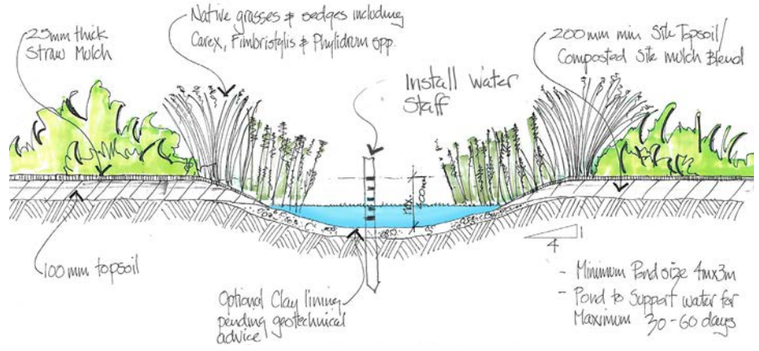


Figure F.4.6.1 Indicative landscape treatment for Green-Thighed Frog breeding ponds

F.4.7 Creek Rehabilitation, Fish & Fauna Crossings

The environmental design requirements for creek rehabilitation and fish and fauna crossings include:

- Plantings to attract fauna
- Allowing unobstructed views to, and through the underpass, and strategic tree plantings for fauna refuge.

Many of the drainage lines and creeks crossed by the highway are intermittent and respond to seasonal rains.

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 50-100mm depth of additional topsoil through which tubestock (ideally "long stem") 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 500-1000mm in natural formation to assist holding down mesh and for scour protection where the new work interfaces with the existing creek channel (This treatment is for zones beyond scour protection and only where rocks occur in the natural creek bed)
- Beyond the zone of normal high water begins the typical landscape zone of trees shrubs and groundcovers with 100-200mm additional topsoil if required and 75mm mulch if planted
- Rice straw mulch is used in place of site-won tub-ground mulch in the proximity of riparian zones to prevent tannins from leaching into the waterways
- Planting of riparian vegetation species including plants such as *Lomandra hystrix* and sedges known to bind embankments and resist erosion at creek crossings will be planted directly adjacent to the scour protection both top and bottom
- Where scour protection is utilised at the egress to fauna culverts, *Lomandra hystrix* and sedge species will be planted at a low density to provide habitat amongst the scour rocks
- Where required, fauna escape poles are located on the embankment out of the main channel and approximately four metres from the end of the headwall. A second pole is to be provided where existing trees are more than 10m from the first pole

F.4.8 Widened Medians

A widened median is required to be located in Cairncross State Forest between Bill Hill Road in the north and Station 10km000. The extent of disturbed areas at the edge of formation within the widened median will be revegetated with frangible shrubs except where catch drains or fauna fences are required, in which case native grasses will be used. Existing trees will be retained where they are beyond the embankments and clearing footprint.

F.4.9 Glider Crossings

Habitat trees for gliders are proposed within gliding distance of glider poles for glides in both directions. Specific species will be finalised in consultation with the Environmental Protection Authority (EPA). Vegetation likely to provide prospect for predators in the vicinity of the base of the glider poles is not used.

F.4.10 Long Stem Planting

Long stem planting may be deployed throughout The Project where it will advantage establishment at the base of fill batters and at creek crossings, with the exception of those species which cannot be procured as long stem stock. Long stem planting is the deeper planting of either especially grown stock (in order to develop an elongated stem) or stock which has been crowded in the nursery or has outgrown its pot. Traditionally these have been regarded as "pot-bound" stock and discarded. Long stem planting buffers the planting stock against heat and the drying out of surface soils because the roots are kept cool and moist at the deeper levels. New adventitious shoots develop from the stem in contact with the soil. Long stem planting is more resistant to the type of erosion encountered in the proximity of waterways. The procedure can also be deployed for most tussock and sedge species. Refer Figure F.4.10.1.

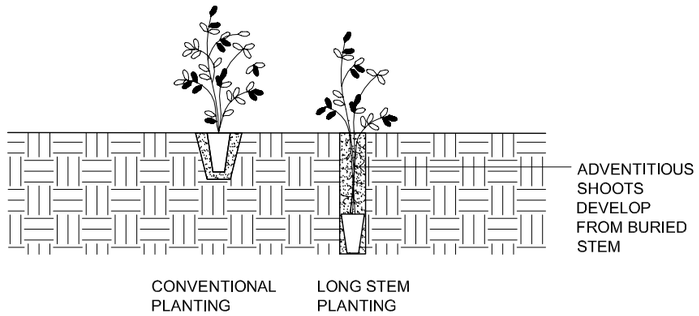


Figure F.4.10.1 Sketch comparing long stem planting with conventional planting

F.4.11 Headlight Screening

Trees and shrubs of advanced stock will be used to provide headlight screening between local roads and the highway in locations that have been identified as requiring headlight screening and where space for vegetation permits. As stipulated in the SWTC, if the separation between local road and highway is less than 13 metres, a permanent solid barrier is provided. If it is between 13 and 25 metres with less than 2.5m vertical separation between roadways, then planting will be used as long as the space for planting is not less than five metres wide. A palette of small bushy trees, shrubs and groundcovers from each community is included for the specific purpose of headlight screening. The proposal for temporary headlight screening (required where the vegetation is not expected to be effective at the time of opening) is to erect windbreak fabric on one side of the planting. This will also assist with the growth of the planting. Table 10 provides details of vegetation proposed for headlight screens.

Where width requirements for a planted headlight screen are not achieved, a single species headlight screen is to be installed. (Refer Figure F.4.11.2 for typical detail)

Planted headlight screens occur at the following locations:

- 3km 825 - 3km 875 - Southbound
- 3km 890 - 4km110 - Southbound

Single species planted headlight screens occur at the following locations:

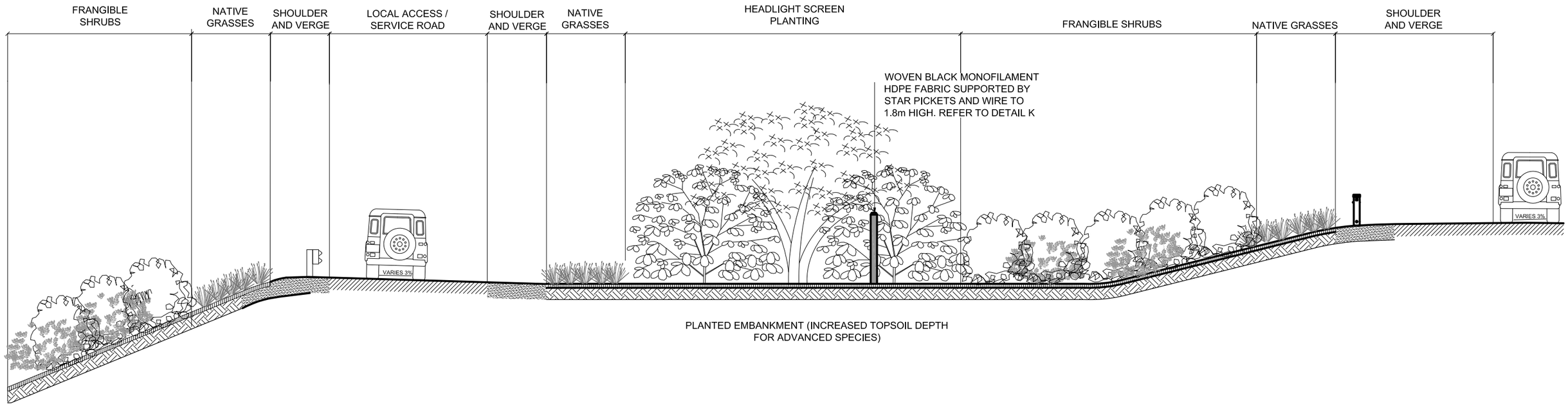
- 2km 775 - 3km 000 - Southbound
- 3km 825 - 3km 890 - Southbound
- 4km110 - 4km 350 - Southbound
- 19km325 - 19km375 - Median

The proposal for temporary headlight screening (required where the vegetation is not expected to be effective at the time of opening) is to erect windbreak fabric on one side of the planting. This will also assist with the growth of the planting. Refer Figure F.4.11.1.

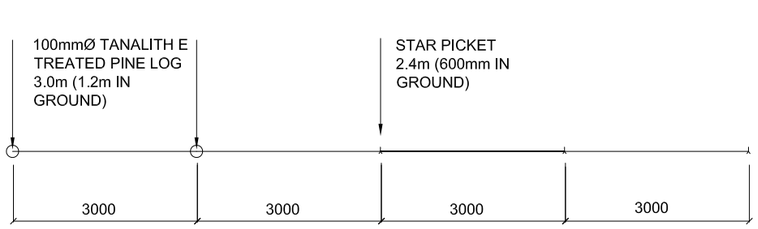


Waterhousia Floribunda. Pacific Highway North of Kempsey. Demonstrating dense screening habit suitable for headlight screening.

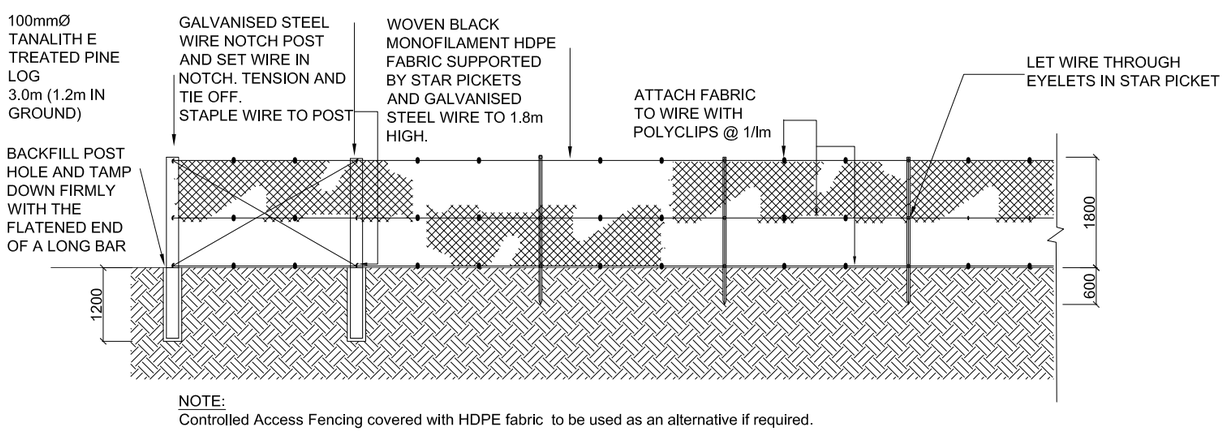
Headlight Screen Planting	
Acmena smithii	Lilly Pilly
Callistemon salignus	Willow Bottlebrush
Elaeocarpus reticulatus	Blueberry Ash
Lomandra hystrix	Mat Rush
Waterhousea floribunda	Weeping Lilly Pilly



TYPICAL CROSS SECTION THROUGH HEADLIGHT SCREEN PLANTING



TYPICAL PLAN VIEW THROUGH TEMPORARY HEADLIGHT SCREEN



NOTE:
Controlled Access Fencing covered with HDPE fabric to be used as an alternative if required.

DETAIL K: TYPICAL ELEVATION OF TEMPORARY HEADLIGHT SCREEN

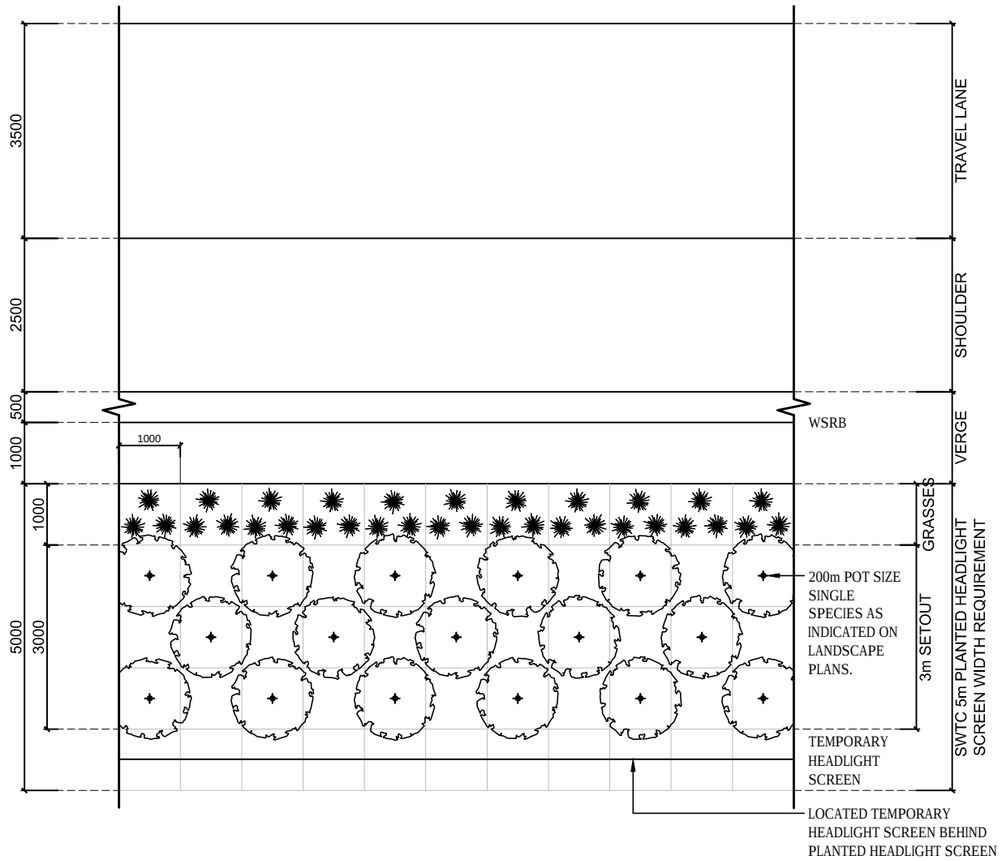


Figure F.4.11.1 Headlight Screen Planting and Temporary Headlight Screen Design

Figure F.4.11.2 Single Species Planted Headlight Screen Setout Plan

F.4.12 Visual Screening

The Environmental Assessment (EA) considered the overall visual impact of The Upgrade to be low to moderate generally as a result of relatively few viewers being located in proximity to the Oxley Highway to Kundabung Project (The Project). In addition, large sections of The Project are visually enclosed within the heavily forested areas of Cairncross State Forest, Rawdon Creek Nature Reserve, Cooperabung Nature Reserve and Ballengarra State Forest.

The Project widens the existing cleared corridor where it follows the existing highway but is primarily viewed by road users only.

Potential visual impacts to residences occur where the alignment passes north of the Wilson River, south of the Cooperabung Creek Nature Reserve, and in particular at Haydons Wharf Road Interchange.

Approximate locations of particular sites that have been addressed with visual screen planting between the highway and residences are listed in Table 11.

Visual Screen Planting Locations

Carriageway	Property Owner	Location	UL03 Sheet Reference
Service Road	Cassegrain Winery	Ch 2650 – 2700	0108
Service Road	Hastings Estate	Ch 2995 – 3140	0110
Southbound	Cassegrain Tea Tree	Ch 1360 – 13880	0153 – 0155
Southbound	McDonald Property	Ch 13950 – 15480	0153 – 0162
Southbound	Mann Property	Ch 19100 – 19350	0178/0179
Northbound	Soropos and Trincker Property	Ch 19310 – 19350	0179
Southbound	Humphrey Property	Ch 19350 – 1945	0179
Southbound	Hall Property	Ch 19800 – 19890	0181
Northbound	Ryman Property	Ch 19830 – 20000	0181
Southbound	Brown and Howe Property	Ch 20950 – 20200	0181/0182

There are also several rural residences on the floodplain north and south of the Hastings River that may be affected.

At Sancrox Intersection, visual exposure to the highway is required for business entries and signage so screening is not required. At Cassegrain Winery screen planting in addition to headlight screening between the main alignment and the service road is provided.

In almost all instances screening can be achieved by visual screen planting. Species to be used for privacy screen planting have been selected to form a dense bushy screen with a top, mid and lower layer canopy and includes the species listed below.

Botanical Name	Common Name
Acmena smithii	Lilly Pilly
Waterhousia floribunda	Weeping Lilly Pilly
Callistemon salignus	Willow Bottlebrush
Cordyline stricta	Narrow-leaved Palm-lily
Hibiscus splendens	Pink Hibiscus
Decaspermum humile	Silky Myrtle
Elaeocarpus reticulatus	Blueberry Ash
Eupomatia laurina	Bolwarra
Carex appressa	Tall Sedge
Dianella caerulea	Blue Flax Lily
Lomandra hystrix	Mat Rush

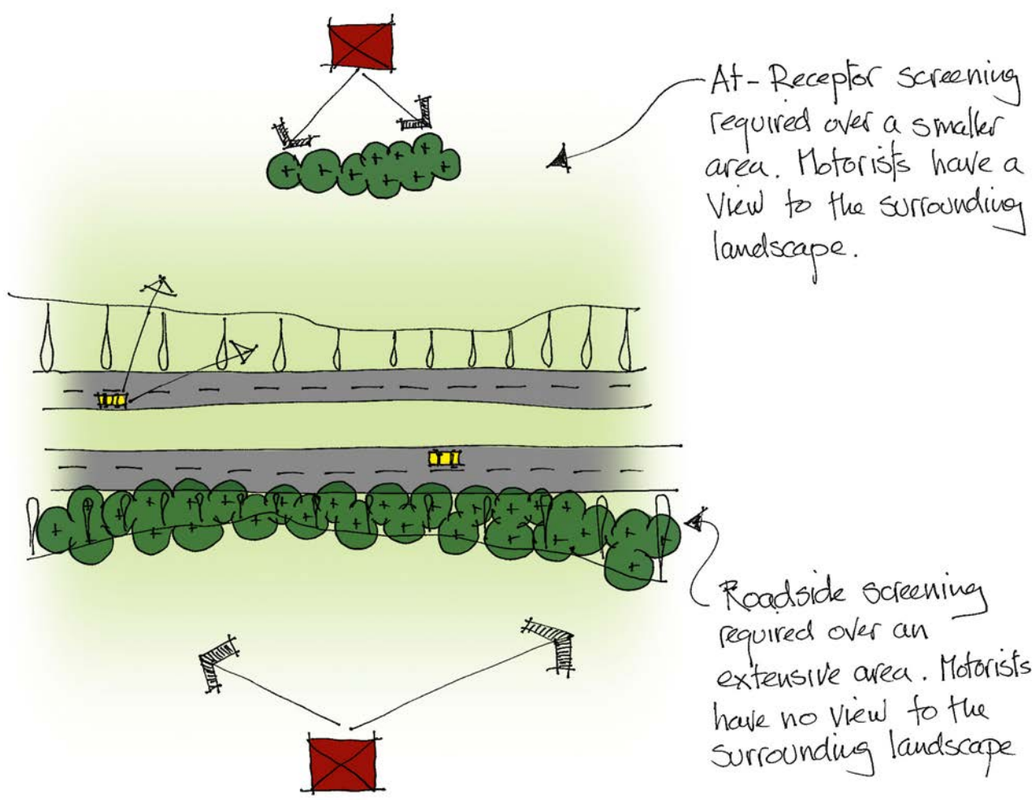


Figure F.4.12.1 At receptor screening.

Residences that are currently screened from the motorway by the retention of existing mature vegetation, distance from the motorway or by the topography of surrounding landform were deemed not to be effected and no screen planting has been provided. Where it is identified that the proposed landscaping or retained vegetation does not satisfy the visual screening requirements of adjacent residences and businesses, at-receptor landscaping will be considered in consultation with the relevant landowner and will be implemented during the construction of the Oxley Highway to Kundabung Project. At receptor landscaping can be more effective at screening as illustrated in the sketch Figure F.4.12.1.

F.5 Topsoil Management & Treatment

The management of site soil is an essential component of ensuring the long term viability of the landscaping for this project. Recent success on other Roads and Maritime projects testifies to the importance that topsoil management has to revegetation success.

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

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

Where the topsoil is to be stripped, it is to be separated by vegetation community type. EEC topsoils are to be stripped and stockpiled separately. Non-EEC topsoils can be stripped and stockpiled together (hereafter referred to as Bushland Topsoils). Topsoil stripped from pasture areas (referred to as Landscape Topsoil) is to be stripped and stockpiled separately. (Although as noted earlier, most existing pasture grass areas occur in the floodplain and will not be stripped).

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

Topsoil stockpile management and storage procedures are designed to ensure the survival of soil seedbank, microflora and micro-organisms in the stockpile for the duration of the stockpile period and until it is returned to revegetation areas. The stockpiles will be sized to maintain the viability of native seed with a maximum height of 2.5 metres and with 2H:1V batter slopes. Large, clearly legible signs will be placed and maintained on each stockpile, nominating vegetation community type, soil horizon, collection area (e.g. by station) and date of stockpiling. No soils should be stockpiled for greater than 18 months where possible.

Topsoil management zones are derived from the vegetation community boundaries marked on the landscape plans to ensure that the topsoil with stored seed from each vegetation community is returned to a location with the same vegetation community. In some instances the exact extent of a zone is rationalised in order to assist the stripping and re-application. 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 community type. As for the stripping procedure, for the purposes of stockpile management for this project, soils have been classified into three types.

The Topsoil Management Types are:

1. EEC Topsoils

Topsoil stripped within mapped vegetation communities which are Endangered Ecological Communities from which existing vegetation has been cleared. Strip and stockpile EEC topsoil from these communities and manage the stockpiles to retain the environmental integrity of the material and preserve the soil seedbank. This stripped and stockpiled material must be identified for respreading within the defined limits from which it was stripped. Stockpile separately in labelled windrows.

EEC Topsoils:

- Moist Floodplain Closed Forest with Rainforest Elements (EEC)
- Riparian Forest (EEC)
- Paperbark Swamp Forest (EEC)
- Swamp Mahogany/ Forest Red Gum Swamp Forest (EEC)
- Swamp Oak (EEC)
- Freshwater Wetland (EEC).

EEC Topsoil is for reuse where native seeding and planting is specified on the plans and within the vegetation community boundaries listed above.

2. Bushland Topsoils

Topsoil stripped within mapped vegetation communities which are non-EEC from which existing vegetation has been cleared. Strip and stockpile bushland topsoil from these communities and manage the stockpiles to retain the environmental integrity of the material and preserve the soil seedbank. Where feasible, stockpile separately but can be stockpiled together.

Bushland Topsoils:

- Moist Floodplain Forest
- Moist Gully Forest
- Moist Slopes Forest
- Dry Ridgetop Forest.

Due to the similarities in species composition between Moist Slopes Forest and Moist Gully Forest vegetation communities, they have been amalgamated for the purposes of both topsoil management and in setting out the planting.

Bushland topsoil is for reuse where native seeding and planting is specified on the plans and within vegetation community boundaries listed above.

3. Landscape Topsoils

Topsoil stripped from within existing pasture grass areas or where mapped in the Weed Management Plan as having a High Weed Density Abundance. Landscape grass soils may contain weed seeds and must be quarantined from EEC Topsoils and Bushland Topsoils.

Landscape topsoil are for re-use where pasture grasses are shown on the landscape plans.

F.5.1 Composted Mulches

Composted mulches, derived from site-won mulch which has been windrowed for a minimum of six months in a manner to accelerate composting, is to be mixed with site topsoil. At a minimum, site topsoil is to be spread on batter slopes receiving runoff and be mixed in order to increase its organic (carbon) content and to aid in erosion resistance on batters. The component of composted site mulches mixed with topsoils will be considered during the detailed design phase and will form part of the soil testing procedures with advice from The Project soil scientist conducting the testing.

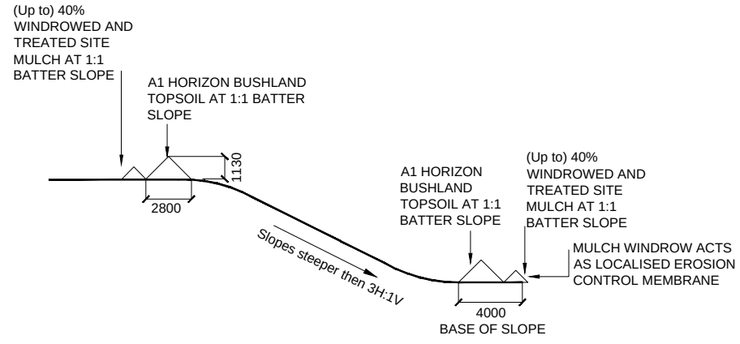
Composted mulch amelioration is required to raise the pH, to improve the composting processing thereby reducing the nitrogen drawdown effect of mulches, and to counter any major nutrient deficiencies that can inhibit germination. The project soil scientist will provide advice as to soil and compost additives to render the mix suitable for plant growth, but at a minimum it must be composted until a Nitrogen Drawdown Index (NDI) of 0.5% is achieved with a pH range of 6.5 to 8.5 and for a minimum of six weeks with the following additions:

- Urea - 600g/m^3
- Sulfate of Iron 500g/m^3
- Dolomite or Magrilime - 500g/m^3
- Sufficient water to dampen.

Once topsoil /mulch mixture has been spread it must not be compacted unless advised otherwise on the documentation drawings.

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

Composted site mulch will be mixed with site topsoil at the stockpile site or as an alternative by mixing on the prepared slope using windrowed berms (Refer Figure F.5.1.1).



NOTE:
Size of windrowed stockpiles either from the top of slope or bottom of slope indicates the precise quantity of topsoil/composted mulch mix required for the slope as shown in the diagram above to cover to a depth of 100mm.

Figure F.5.1.1 Suggested site mulch/topsoil berm windrows sketch

F.5.2 Seed Application & Mulch

Generally seed is applied through hydromulching. However due to the increased risk from erosion on batters typically under five metres high where SO gutters are not used and where pavement runoff will spill over batters, the seed application will utilise a two-step application. The two step application will comprise hydroseeding of native seed, followed by a hydromulching application of a minimum thickness of 25 millimetres of rice or sugar cane straw. Rice or sugar cane straw has a superior binding capability and lasts longer than other mulches that are able to be applied hydraulically. It does not present a risk to receiving environments from tannins.

The procedure for handling of each topsoil type is illustrated in Figures F.5.2.1 to F.5.2.3.

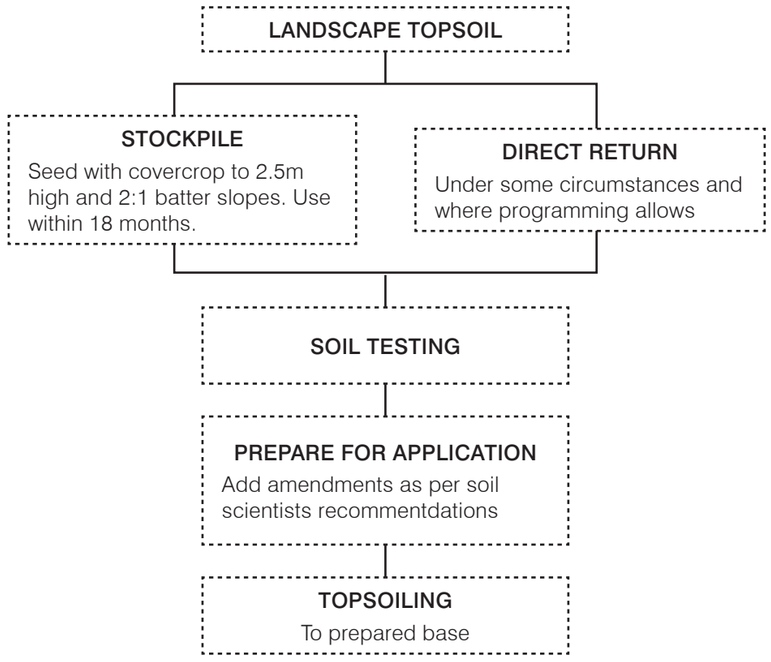


Figure F.5.2.1 Topsoil management for Landscape Topsoils

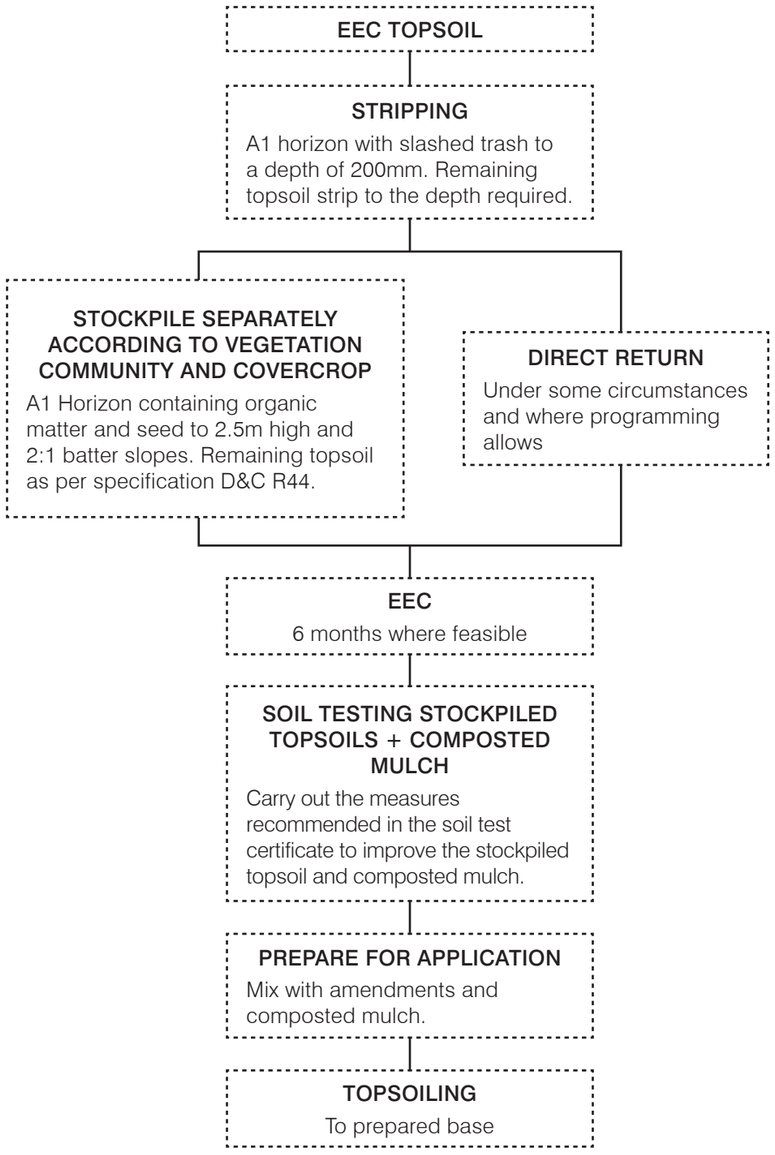


Figure F.5.2.2 Topsoil management for EEC Topsoils

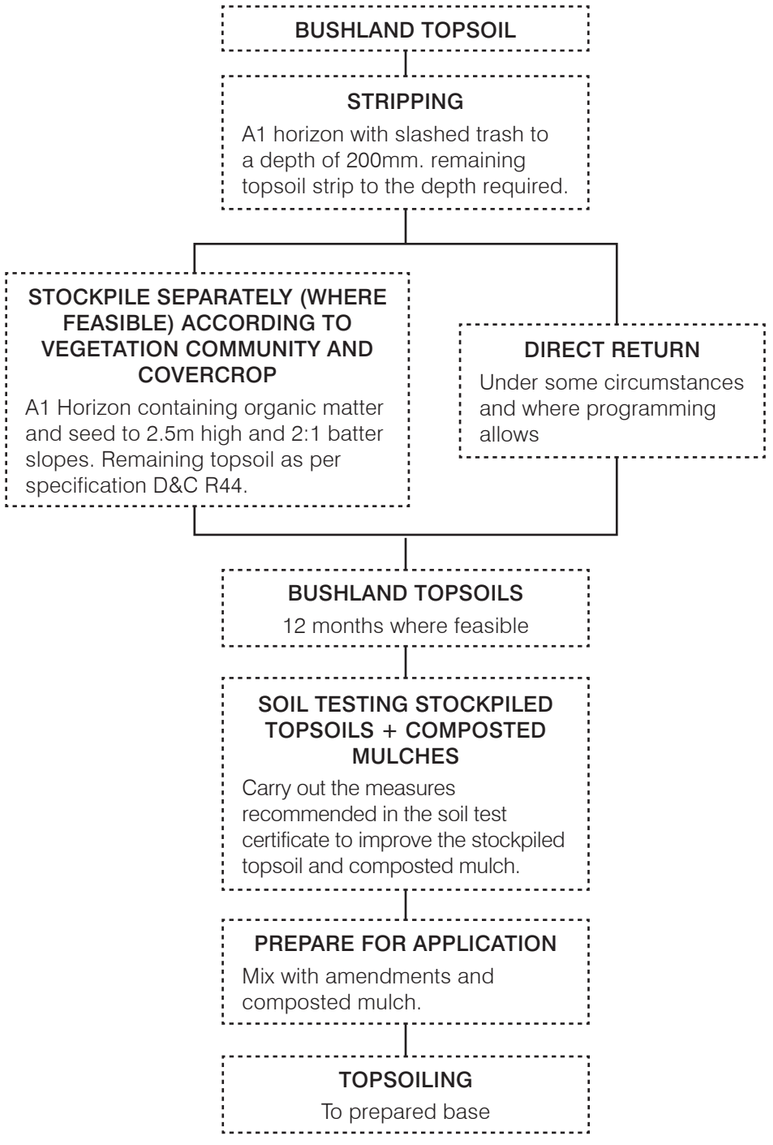


Figure F.5.2.3 Topsoil management for Bushland Topsoils

F.5.3 Topsoil Treatments

Topsoil treatments for all areas include:

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

Six topsoil treatments are used. They are:

Topsoil Treatment 1: For seeding

- Refer to D&C Specification R178 Section 3.2
- For slopes steeper than 5H:1V composted site mulch may be mixed with the topsoil to improve erosion resistance on the slopes (to a proportion as directed by the soil test results).
- For slopes steeper than 2H:1V and up to 1.5H:1V (eg; transitions from bridge abutments to 2H:1V slopes) install Organic Fibre Mesh as per the specification over final topsoil preparation and prior to hydromulching.
- For water quality basins with slopes 2H:1V install Organic Fibre Mesh as per the specification over final topsoil preparation and prior to hydromulching.
- Prepare batter slopes by ripping or roughening the surface using a chain as per R178, or by some other means to form a loosened or roughened surface suitable for the application of topsoil.
- During ripping, mix in any ameliorants required by the soil testing into the upper 100mm layer to the rates specified within the soil testing recommendations or geotechnical advisor. This may include the mixing of gypsum or any other suitable agent to prevent erosion of subsoil, if dispersivity is identified as an issue for the materials on the cut batter faces to be vegetated. Provide 'cleatmarks', 'dimples' or horizontal scores to cut and fill batters prior to topsoil application.
- For seeded areas where compost blend is required mix with windrowed composted site mulch to site-won A1 horizon Bushland or EEC Topsoil by pushing up and down the prepared slope in order to achieve a reasonable mixing of the two. Achieve a minimum depth of 100mm but not more than 200mm.
- For seeded areas where no compost blend is required apply site-won A1 horizon Bushland or EEC Topsoil to a minimum depth of 50mm, but not more than 100mm.
- Spread out the topsoil/composted mulch mix to an even surface but do not otherwise smooth or compact the surface.
- Apply appropriate hydromulch seed mix seed mix as per D&C Specification R178 Section 3.4.3.

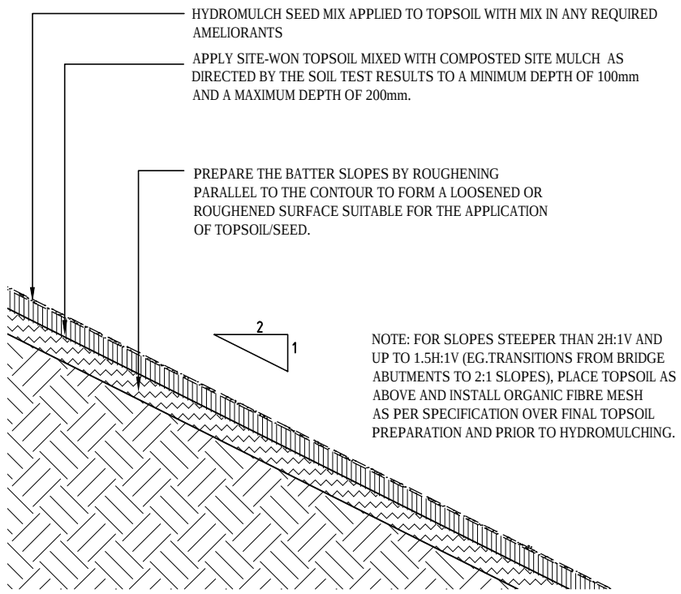


Figure F.5.3.1 Topsoil Treatment 1a - Site topsoil/composted blend detal for seeded areas

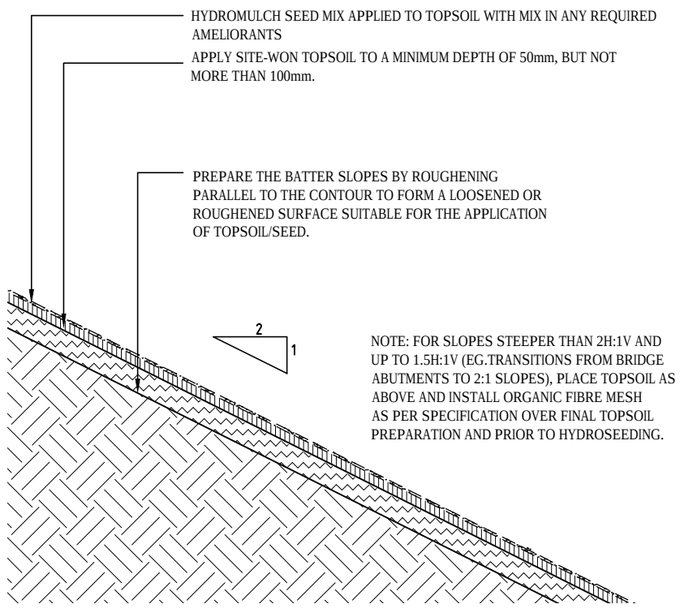


Figure F.5.3.2 Topsoil Treatment 1b - Site topsoil only detail for seeded areas

Topsoil Treatment 2: For planting

- Refer to D&C Specification R179 Section 3.5.3 Cultivation for planted areas.
- Rip the subsoil to a depth of 200mm. Avoid all cultivation within the dripline of existing trees. Do not smooth or compact the roughened subsoil surface prior to the application of topsoil.
- During ripping, mix in amendments as directed by the soil test results.
- Apply A1 horizon Bushland or EEC topsoil mixed with composted site mulch (to a proportion as directed by the soil test results), to a depth of 100mm.
- Topsoil and mulch should have been previously ameliorated and any additional materials required by soil testing mixed at the stockpile
- Spread the topsoil but do not otherwise smooth or compact the surface. Level and trim the surface flush with adjacent surfaces. Plant as follows:
  - For tubestock: prepare 200x200x200mm deep hole.
  - For 'semi advanced' (150mm pot size): Prepare 300x300x300mm deep hole
  - For 'advanced' (200mm pot size): prepare 600x600x450mm deep hole.
  - For 'super advanced trees' (25L and 35L): prepare 600x600x600mm deep hole.
  - Apply fertiliser at the recommended rates specified in the planting details.
  - Install advanced trees/tubestock and backfill with topsoil to finish flush with ground level.
- Apply mulch to a depth of 75mm.

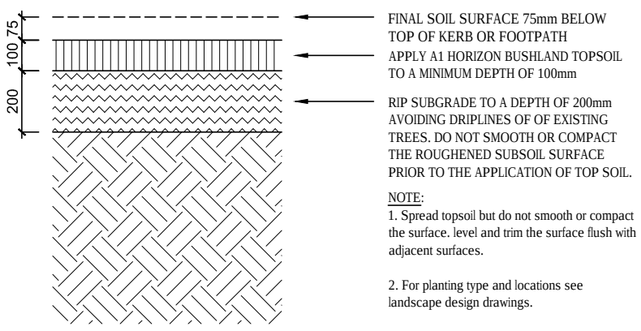


Figure F.5.3.3 Topsoil Treatment 2 - Planting

Topsoil Treatment 3: For all fill batters steeper than 3H:1V and typically under 5m vertically where SO gutter is not used above

- Prepare batter slopes by ripping or roughening the surface using the tynes on a swivelling head excavator bucket, or by some other means to form a loosened or roughened surface suitable for the application of topsoil.
- During ripping, mix in any materials required by the soil testing into the upper 100mm layer to the rates specified within the soil testing recommendations or geotechnical advisor. This may include the mixing of gypsum or any other suitable agent to prevent erosion of subsoil, if dispersivity is identified as an issue for the materials on the cut batter faces to be vegetated. Provide 'cleatmarks', 'dimples' or horizontal scores to cut and fill batters prior to topsoil application.
- For seeded areas where compost blend is required mix with windrowed composted site mulch to site-won A1 horizon Bushland or EEC Topsoil by pushing up and down the prepared slope in order to achieve a reasonable mixing of the two. Achieve a minimum depth of 100mm but not more than 200mm.
- Apply appropriate hydroseed seed mix as per D&C Specification R178 Section 3.4.3.
- Apply strawmulching with binder over hydroseeding as per D&C Specification R178 Section 3.4.4.

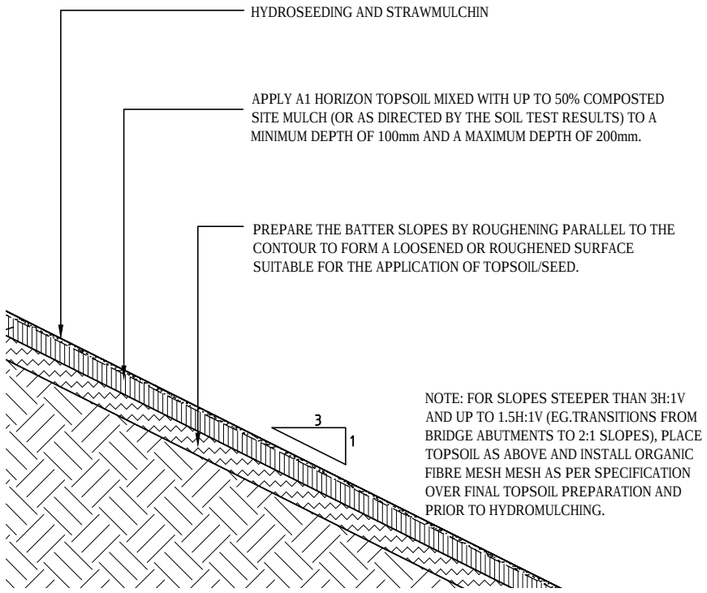


Figure F.5.3.4 Topsoil Treatment 3

Topsoil Treatment 4: For vegetated swales, channels and the batters of Water Quality Basins (to the maximum water level)

- Refer to D&C Specification R178 Section 4 Vegetation of Open Drains.
- Prepare batter slopes by ripping or roughening the surface using the tynes on a swivelling head excavator bucket, or by some other means to form a loosened or roughened surface suitable for the application of topsoil.
- During ripping, mix in any materials required by the soil testing into the upper 100mm layer to the rates specified within the soil testing recommendations or geotechnical advisor. This may include the mixing of gypsum or any other suitable agent to prevent erosion of subsoil, if dispersivity is identified as an issue for the materials on the cut batter faces to be vegetated. Provide 'cleatmarks', 'dimples' or horizontal scores to cut and fill batters prior to topsoil application.
- Apply A1 horizon site-won Bushland and EEC topsoil mixed with composted site mulch (to a proportion as directed by the soil test results), to a minimum depth of 50mm, but not more than 100mm (topsoil and mulch should have been previously ameliorated and any additional materials required by soil testing mixed at the stockpile)
- Apply organic fibre mesh laid over the slope and berms following topsoil spreading and preceding hydromulching/hydroseeding/strawmulching to the extent of the topsoiling and/or to the top and bottom of the embankments.

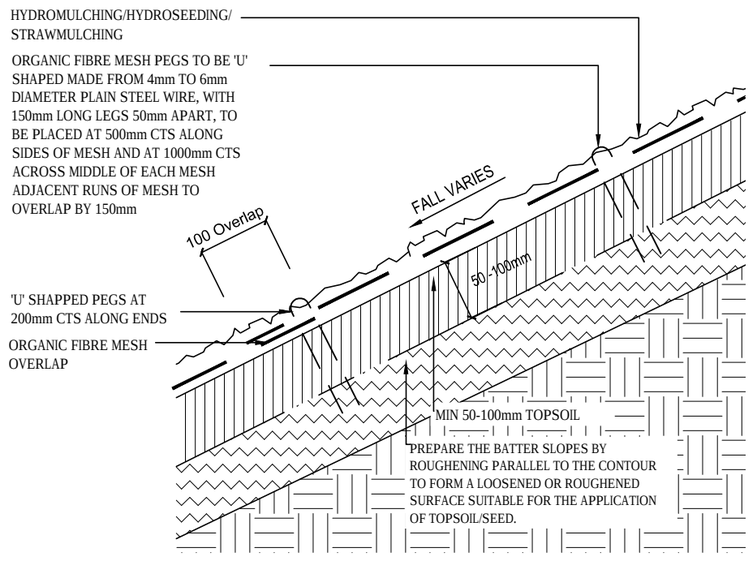


Figure F.5.3.5 Topsoil Treatment 4

Topsoil Treatment 5: For pasture grasses and native grass seeding in floodplain areas, medians and berms

- Refer to RMS D&C Specification R178 Section 3.1.2 for seeded areas.
- Refer to RMS D&C Specification R178 Section 3.2 for vegetated areas.
- Roughen existing subgrade to a depth of 150mm. Do not smooth or compact the roughened subsoil surface prior to application of topsoil.
- Apply site-won Bushland or EEC topsoil A2 horizon soil from forested areas generally from depths of between 150-350mm and applied to depths of 50mm which has been previously ameliorated to soil scientist specifications.
- Spread the topsoil, level and trim the surface flush with adjacent surfaces to provide an even finish and roll to lightly compact.
- Apply appropriate hydromulch seed mix as per D&C Specification R178 Section 3.4.3.
- Apply fertiliser to pasture grasses at the recommended rates as outlined in Table R178.1 of the RMS D&C Specification R178

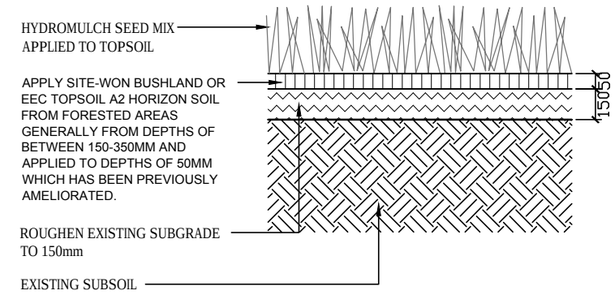


Figure F.5.3.6 Topsoil Treatment 5

Topsoil Treatment 6: For pasture grasses and native grass seeding on access tracks, verges and where there is no Wire Rope Safety Barrier or seal

- Apply site-won Bushland or EEC topsoil A2 horizon soil from forested areas and applied to depths of 50mm which has been previously ameliorated to soil scientist specifications.
- Prepare by ripping or roughening the surface using the tynes on a swiveling head excavator bucket, or by some other means to form a loosened or roughened surface suitable for the application of topsoil.
- Spread the topsoil, level and trim the surface flush with adjacent surfaces to provide an even finish.
- Apply appropriate hydromulch seed mix as per RMS D&C Specification R178 Section 3.4.3.
- Apply fertiliser to pasture grasses at the recommended rates as outlined in Table R178.1 of the RMS D&C Specification R178.

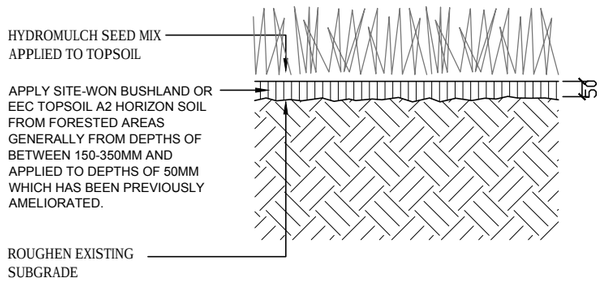


Figure F.5.3.7 Topsoil Treatment 6

Topsoil Treatment 7: Where Existing Pavement is to be removed

- Refer to D&C Specification R178 Section 3.1.3 for seeded areas.
- Remove the pavement to the depth of the road formation.
- Rip to the greater of the full depth of the hardstand or pavement.
- Where A2 horizons is absent, apply A2 Horizon to a minimum depth of 200mm.
- Apply A1 horizon bushland or EEC topsoil to a minimum depth of 200mm over the A2 horizon.
- Apply appropriate hydromulch seed mix as per D&C Specification R178 Section 3.4.3.

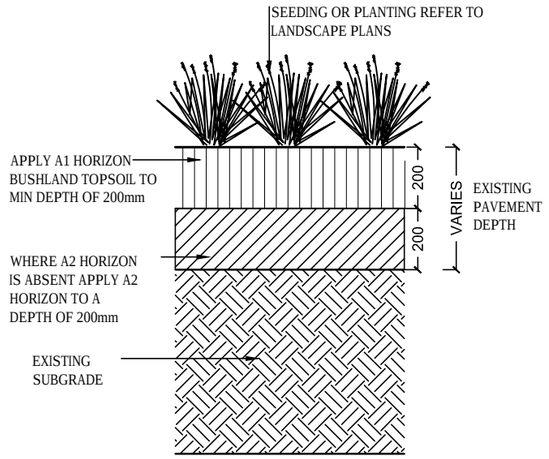


Figure F.5.3.8 Topsoil Treatment 7

Topsoil Treatment 8: Where planting occurs on slopes steeper than 2H:1V

- Apply A1 horizon site-won Bushland and EEC topsoil mixed with composted site mulch (to a proportion as directed by the soil test results), to a minimum depth of 50mm, but not more than 100mm (topsoil and mulch should have been previously ameliorated and any additional materials required by soil testing mixed at the stockpile)
- Ensure topsoil stockpiled from a particular vegetation community be applied within the vegetation community from which it was derived.
- For slopes steeper than 2H:1V and up to 1.5H:1V (eg; transitions from bridge abutments to 2H:1V slopes) install Organic Fibre Mesh as per the specification over final topsoil preparation and prior to planting.
- Prepare batter slopes by ripping or roughening the surface using the tynes on a swivelling head excavator bucket parallel to the contour or by some other means to form a loosened or roughened surface suitable for the application of topsoil.
- During ripping, mix in any ameliorants required by the soil testing into the upper 100mm layer to the rates specified within the soil testing recommendations or geotechnical advisor. This may include the mixing of gypsum or any other suitable agent to prevent erosion of subsoil, if dispersivity is identified as an issue for the materials on the cut batter faces to be vegetated. Provide 'cleatmarks', 'dimples' or horizontal scores to cut and fill batters prior to topsoil application.

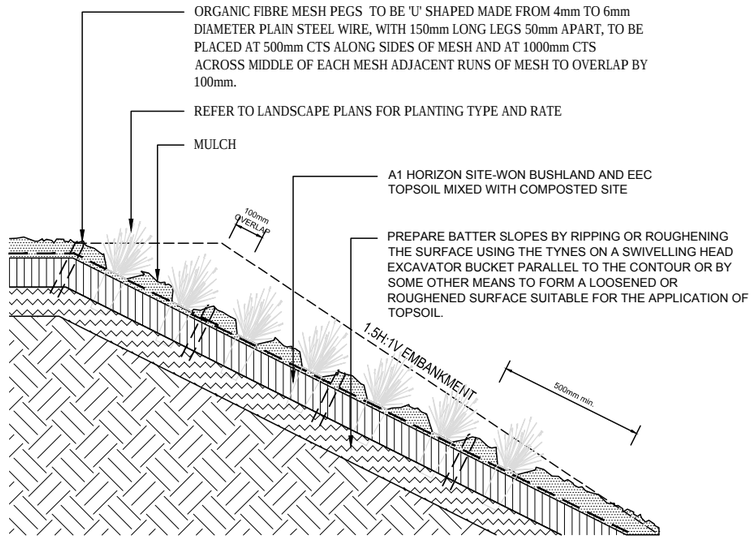


Figure F.5.3.9 Topsoil Treatment 8

F.6 Typical Cross Sections & Landscape Design Plans

F.6.1 Typical Cross Sections

Refer to Figures F.6.1.1 to F.6.1.9.

The typical landscape cross sections illustrate the adherence to safety clearance distances and where grasses, frangible shrubs and non-frangible shrubs are proposed to be used. Some of the standard clearances used are:

- Non-frangible vegetation at a minimum 11m from the edge of travel lane
- Frangible shrubs at a minimum of six metres from the edge of travel lane
- Two metre wide native or pasture grass strip at the carriageway edge of medians
- 4.3 metre wide frangible shrubs in median when in forested areas or where required to mitigate headlight glare
- No shrubs in the 1.7 metre deflection zone behind wire rope barriers
- Native grasses only within three metres of the away-from-highway side of the fauna fence and one metre to the highway side to allow for maintenance access
- No vegetation on benches in cuttings or fills.

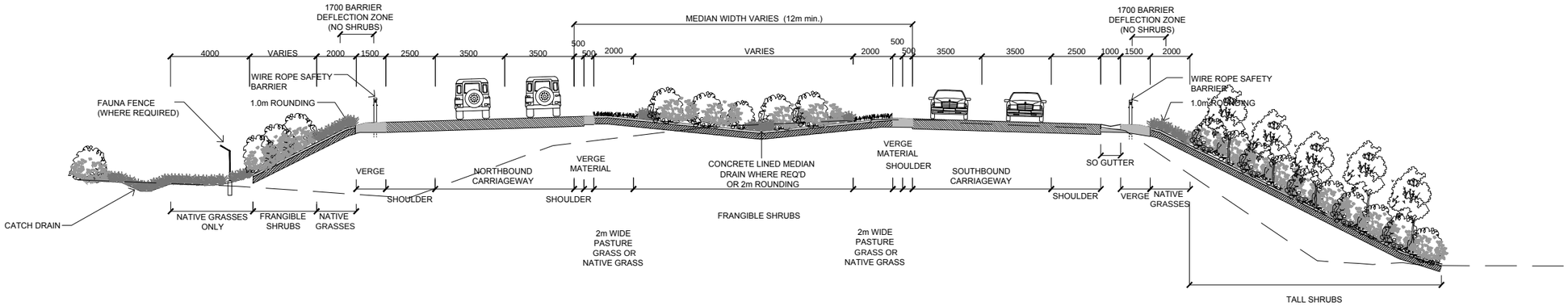


Figure F.6.1.1 Typical Section at Station 1km040

0 10m

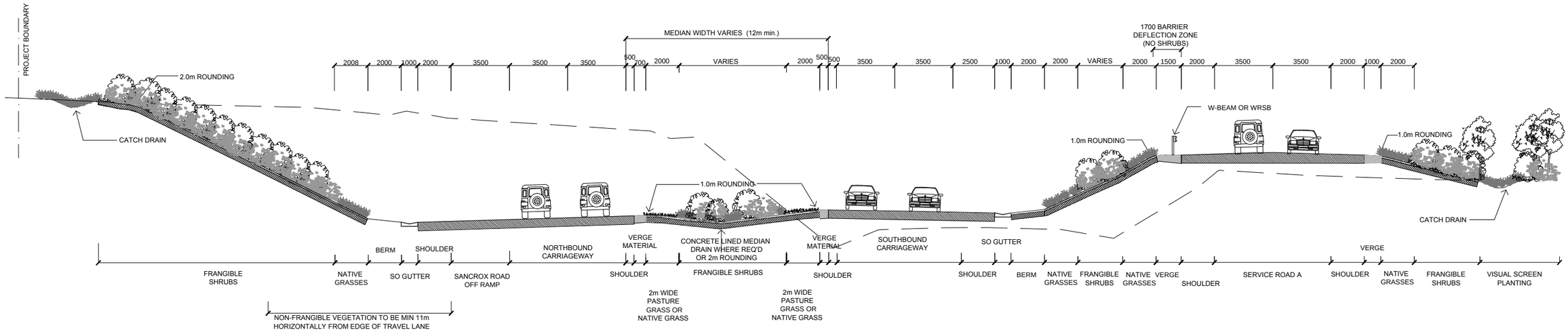


Figure F.6.1.2 Typical Section at Station 3km120

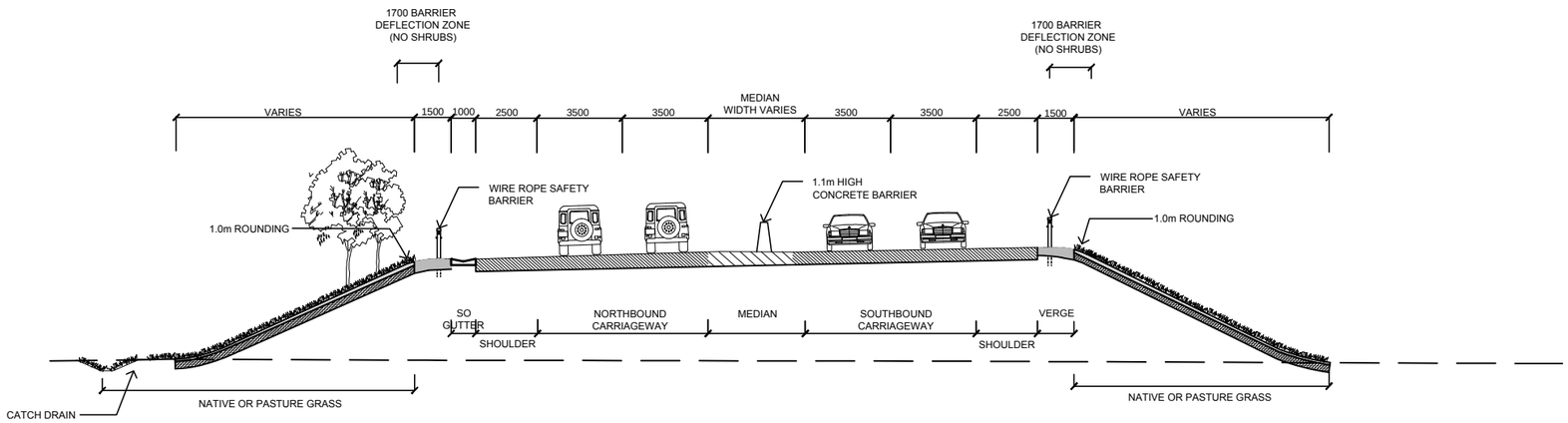


Figure F.6.1.3 Typical Section at Station 5km240

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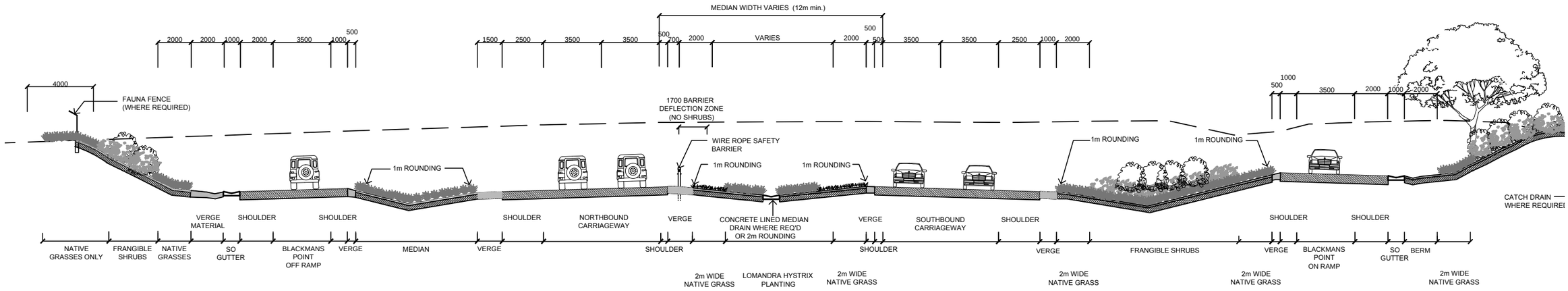


Figure F.6.1.4 Typical Section at Station 7km820

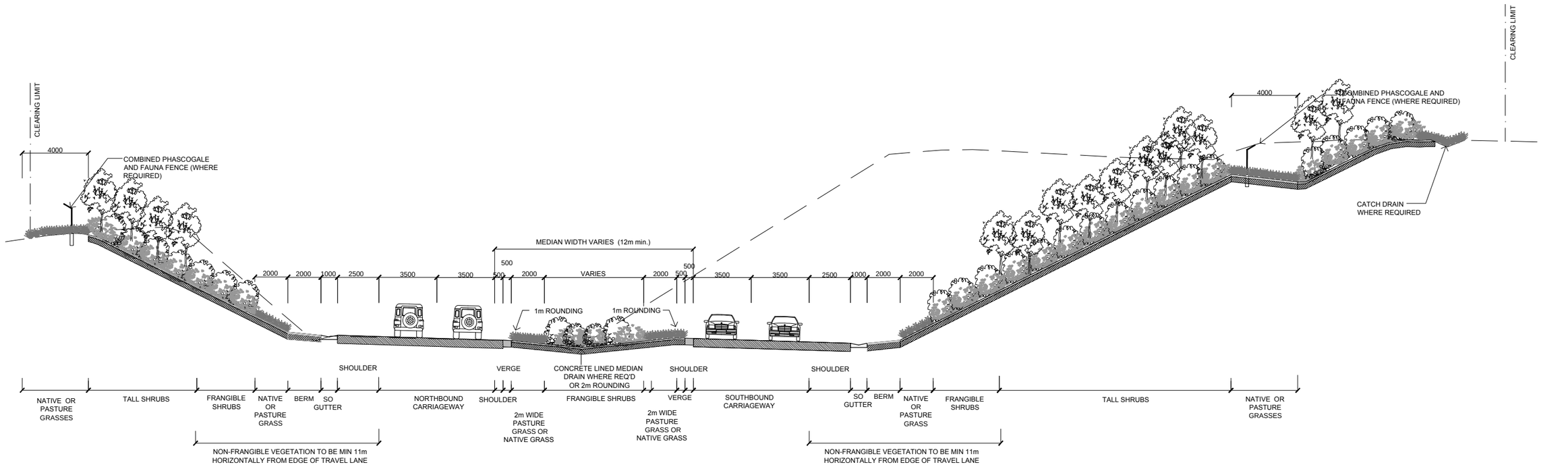


Figure F.6.1.5 Typical Section at Station 23km500

0 10m

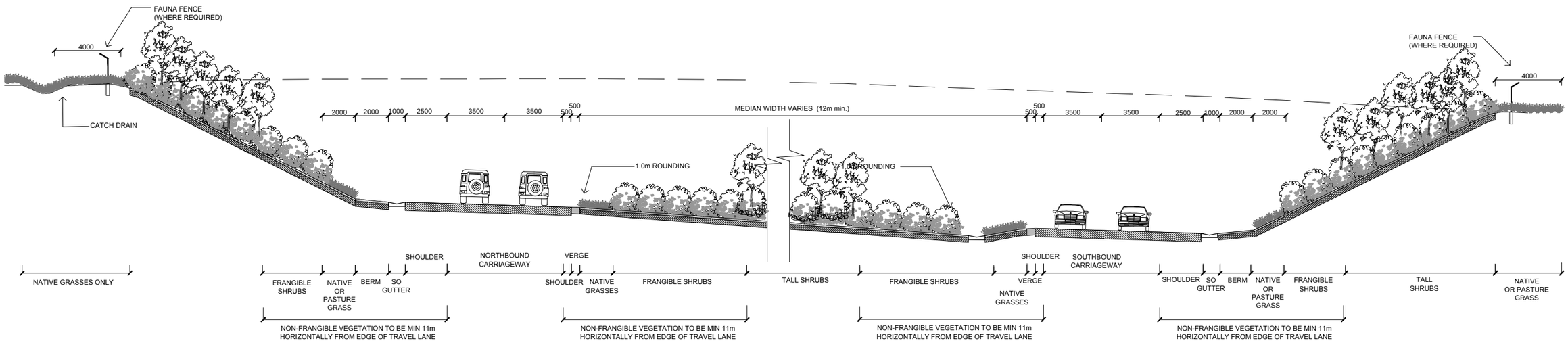


Figure F.6.1.6 Typical Section at Station 10km360

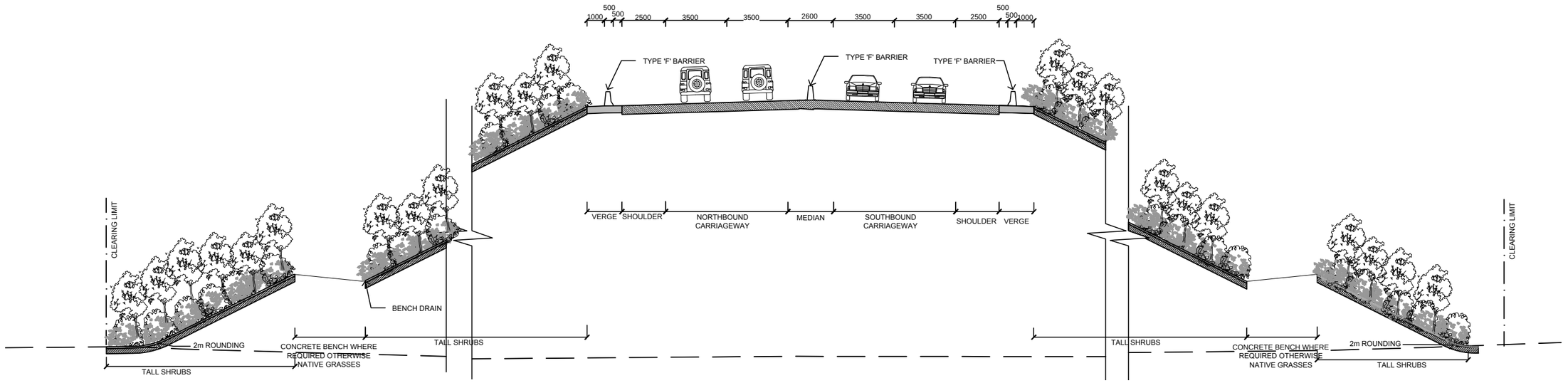


Figure F.6.1.7 Typical Section at Station 17km140

0 10m

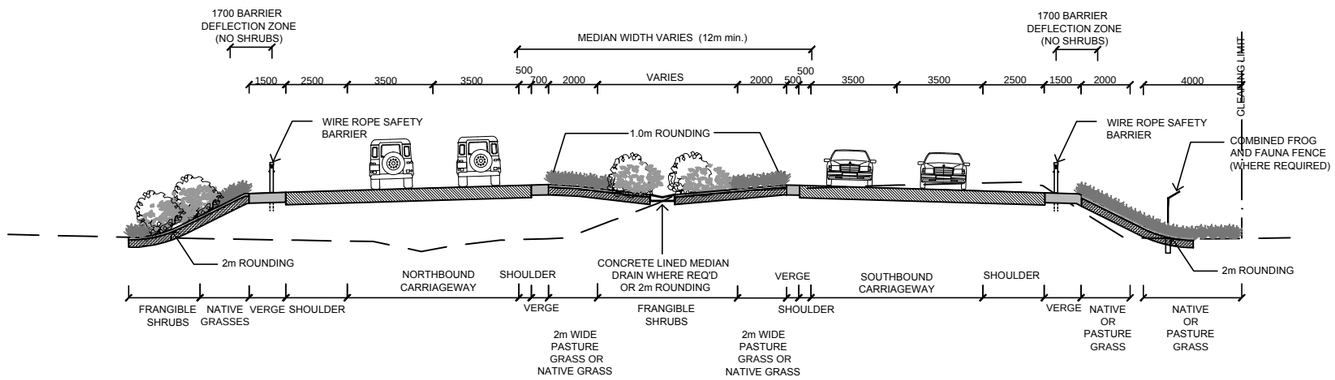


Figure F.6.1.8 Typical Section at Station 18km850

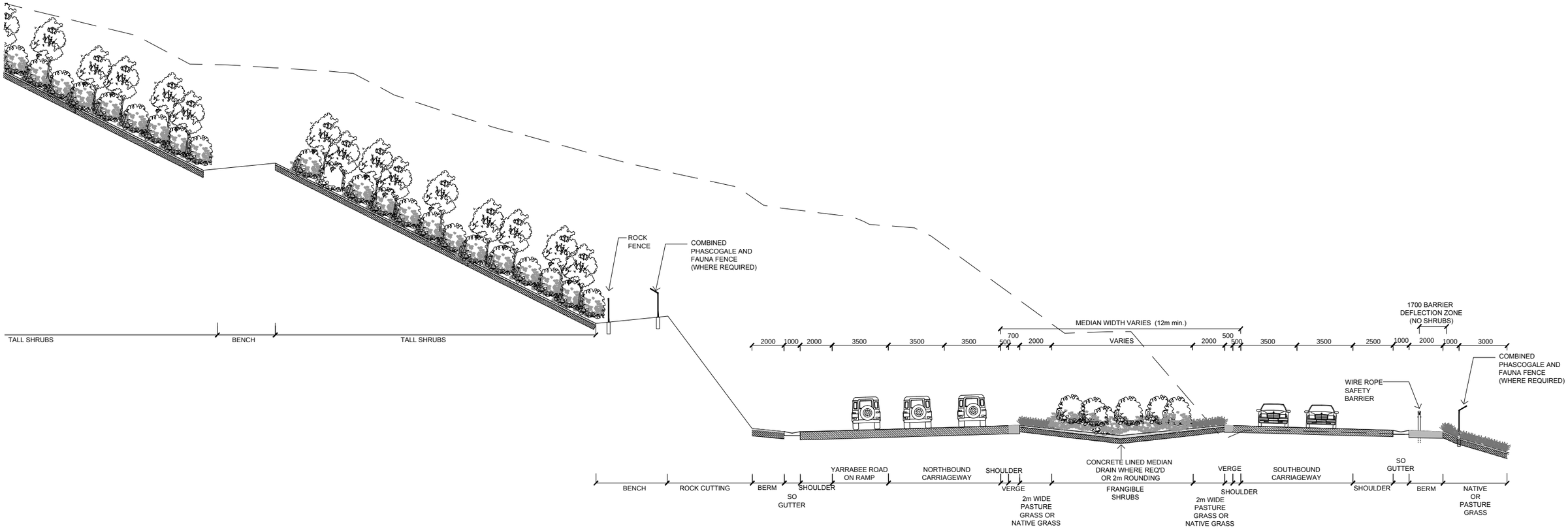
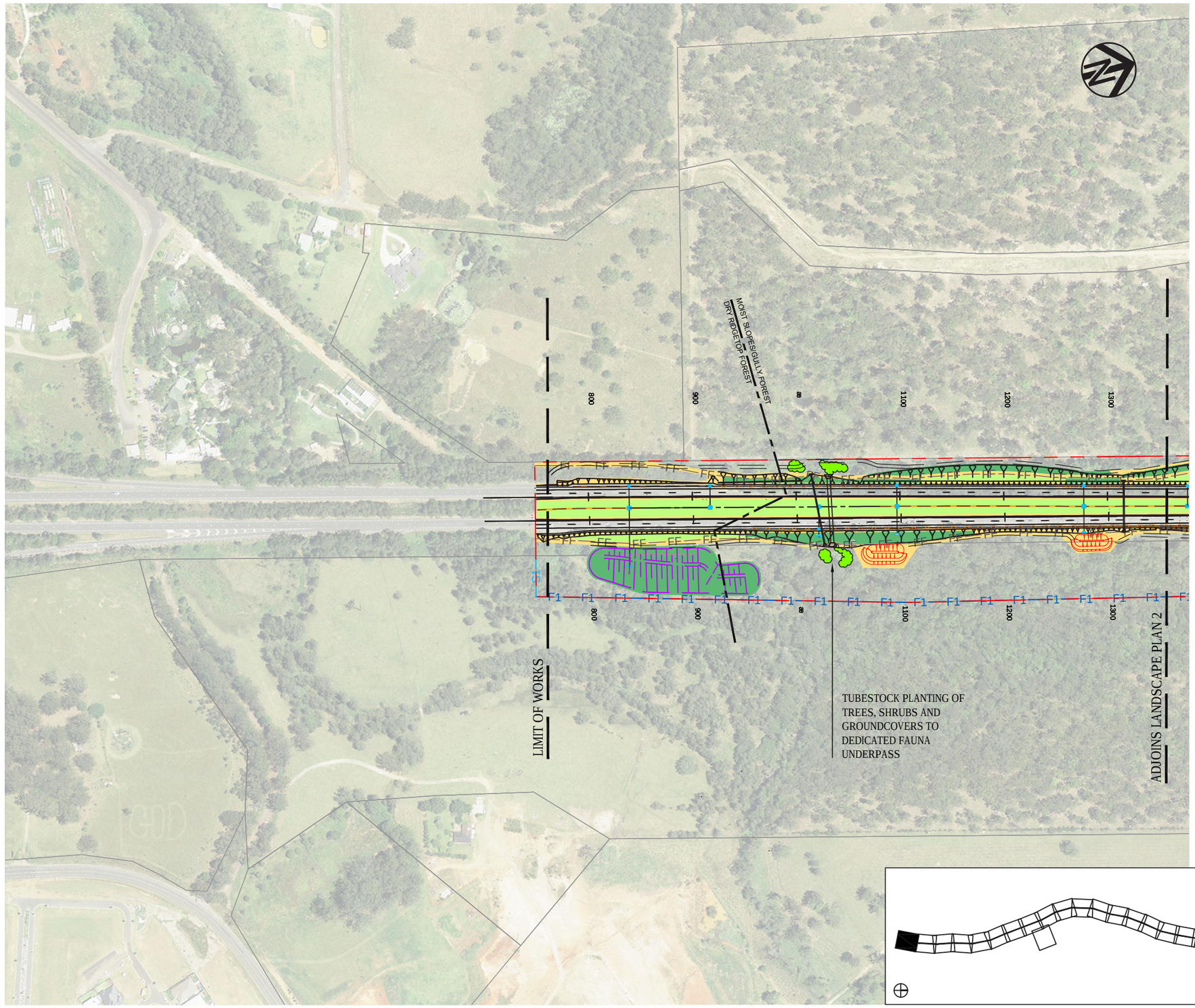


Figure F.6.1.9 Typical Section at Station 22km600

F.6.2 Landscape Plans

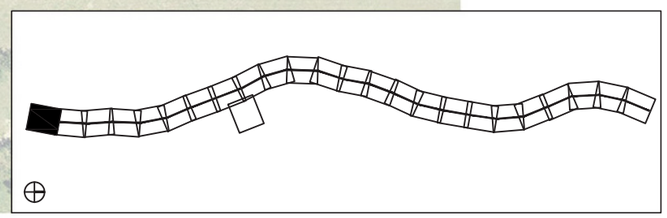
The following plans at 1:4000 scale illustrate the existing vegetation, planting and seeding areas. Plant species are specified in Planting and Seeding Schedules located in Section F.7.

Refer Figures F.6.2.1 to F.6.2.25.



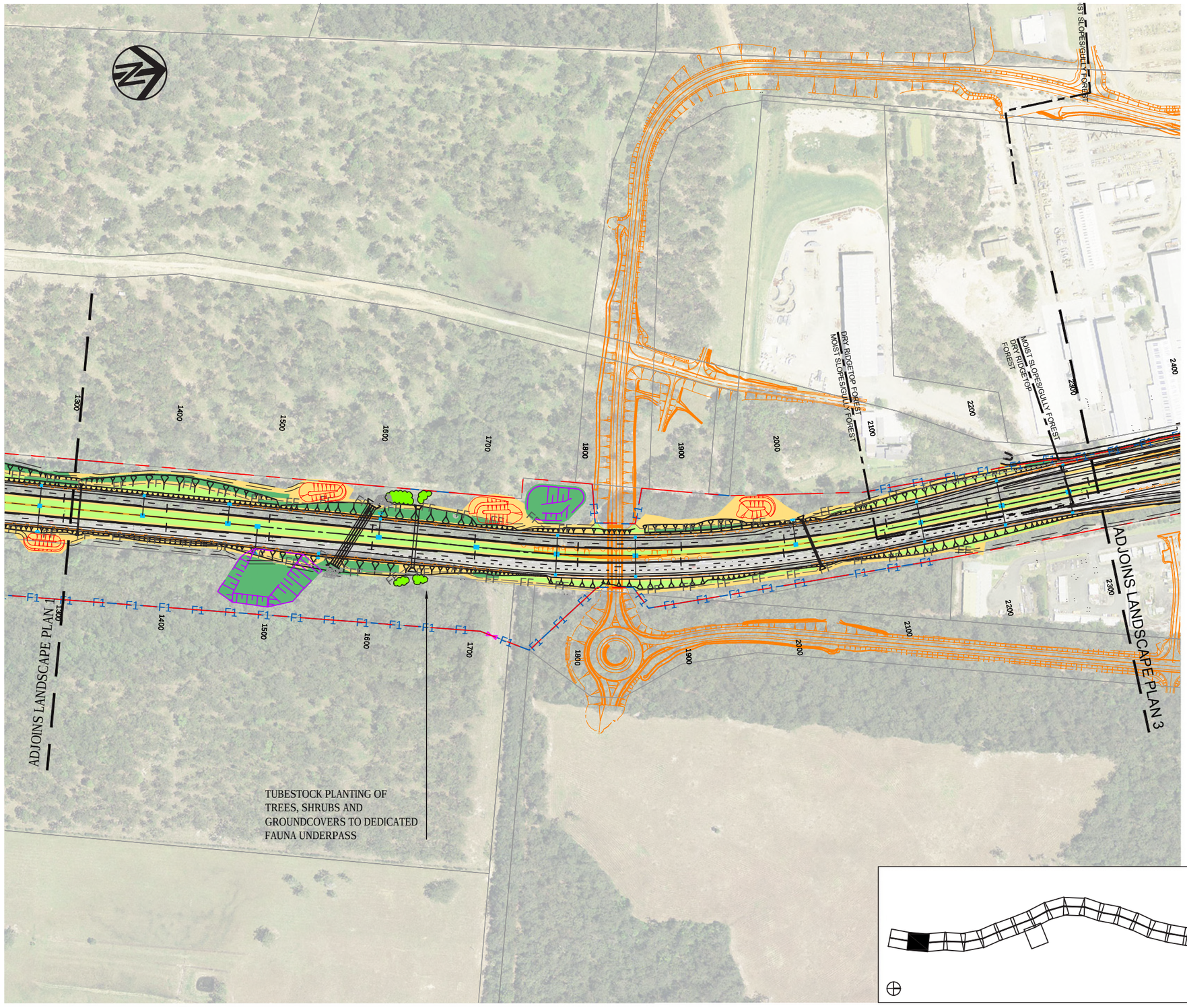
LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
- MAUNDIA POPULATION
- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
- NATIVE GRASS SEED MIX
- FRANGIBLE SHRUB SEED MIX
- TALL SHRUB SEED MIX
- PASTURE GRASS SEED MIX
- HEADLIGHT SCREEN PLANTING
- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
- PERMANENT HEADLIGHT SCREEN
- RF BDY ROCK FENCE
- FF FAUNA FENCE INFO ONLY
- F1 CONCRETE POST STOCK PROOF FENCE
- F2 1.8m CHAIN-WIRE FENCE
- F3 SPLIT HARDWOOD STOCK PROOF FENCE
- F4 TEMPORARY BOUNDARY FENCE
- S1 STOCK PROOF FENCE TYPE (TBC)
- S1 FAUNA SECURITY FENCE
- FF PHASCOGALE FENCING
- FF STD FROG FENCE
- FF COMBINED FROG FENCE
- ROPE CROSSING
- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND



0 200m

Figure F.6.2.1 Landscape Concept Plan 1

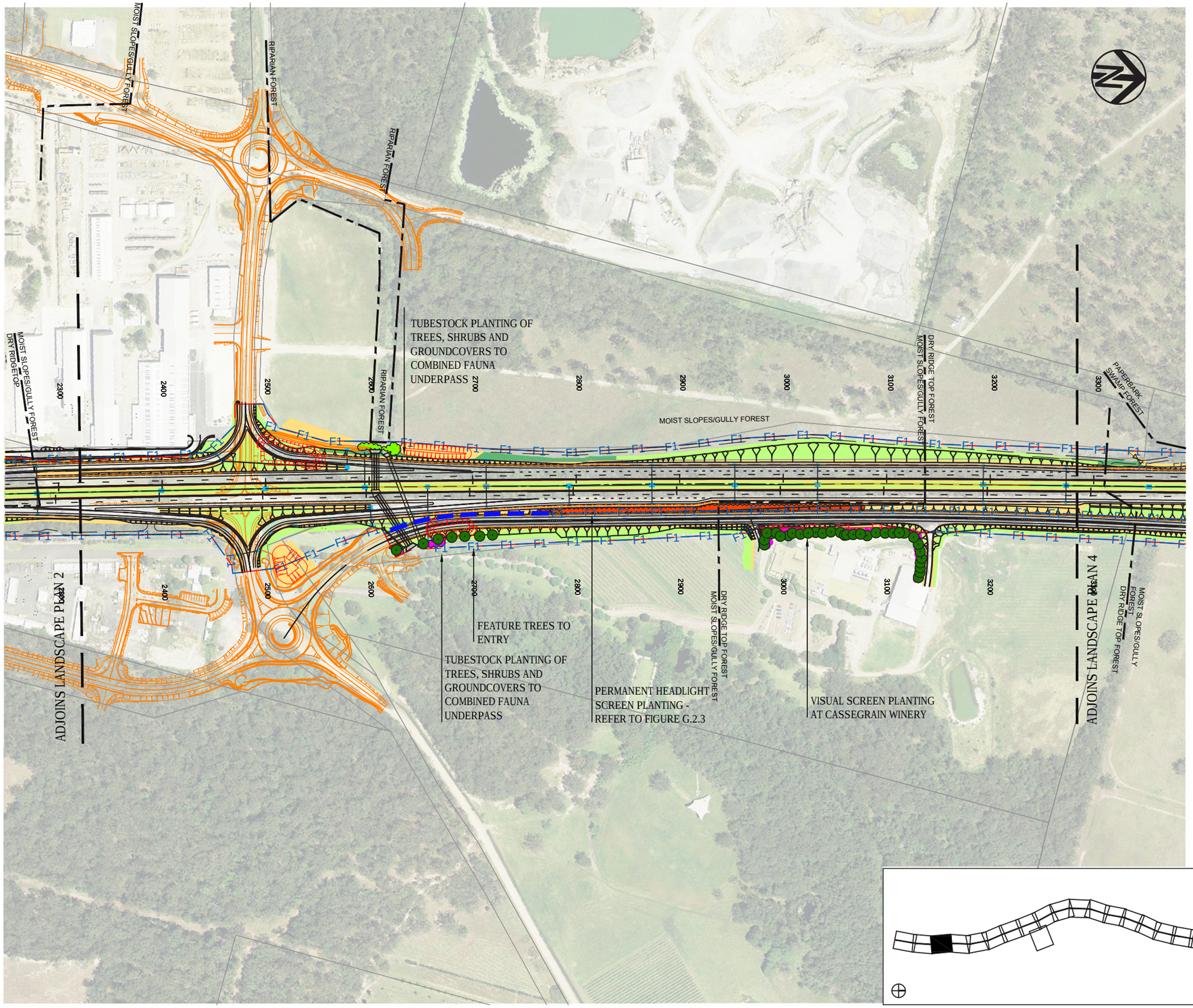


LEGEND

- PROJECT BOUNDARY
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- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
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- MAUNDIA POPULATION
- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
- NATIVE GRASS SEED MIX
- FRANGIBLE SHRUB SEED MIX
- TALL SHRUB SEED MIX
- PASTURE GRASS SEED MIX
- HEADLIGHT SCREEN PLANTING
- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
- PERMANENT HEADLIGHT SCREEN
- RF BDY ROCK FENCE
- FF FAUNA FENCE INFO ONLY
- F1 CONCRETE POST STOCK PROOF FENCE
- F2 1.8m CHAIN-WIRE FENCE
- F3 SPLIT HARDWOOD STOCK PROOF FENCE
- F4 TEMPORARY BOUNDARY FENCE
- S1 STOCK PROOF FENCE TYPE (TBC)
- FAUNA SECURITY FENCE
- FF PHASCOGALE FENCING
- FF STD FROG FENCE
- FF COMBINED FROG FENCE
- ROPE CROSSING
- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.2 Landscape Concept Plan 2

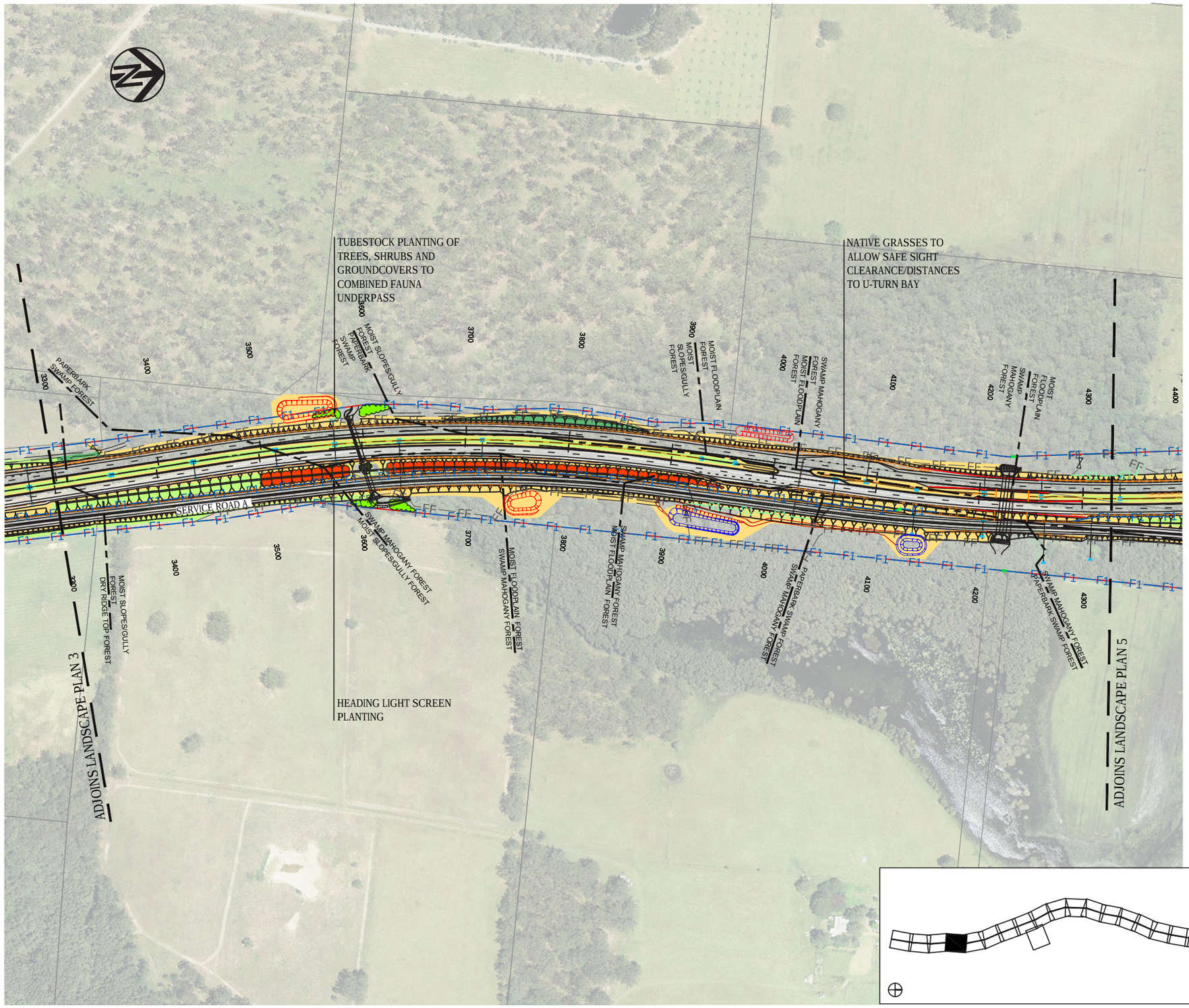


LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
- MAUNDIA POPULATION
- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
- NATIVE GRASS SEED MIX
- FRANGIBLE SHRUB SEED MIX
- TALL SHRUB SEED MIX
- PASTURE GRASS SEED MIX
- HEADLIGHT SCREEN PLANTING
- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
- PERMANENT HEADLIGHT SCREEN
- RF — BDY ROCK FENCE
- FF — FAUNA FENCE INFO ONLY
- F1 — CONCRETE POST STOCK PROOF FENCE
- F2 — 1.8m CHAIN-WIRE FENCE
- F3 — SPLIT HARDWOOD STOCK PROOF FENCE
- F4 — TEMPORARY BOUNDARY FENCE
- S1 — STOCK PROOF FENCE TYPE (TBC)
- S1 — FAUNA SECURITY FENCE
- FF — PHASCOGALE FENCING
- FF — STD FROG FENCE
- FF — COMBINED FROG FENCE
- ROPE CROSSING
- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.3 Landscape Concept Plan 3



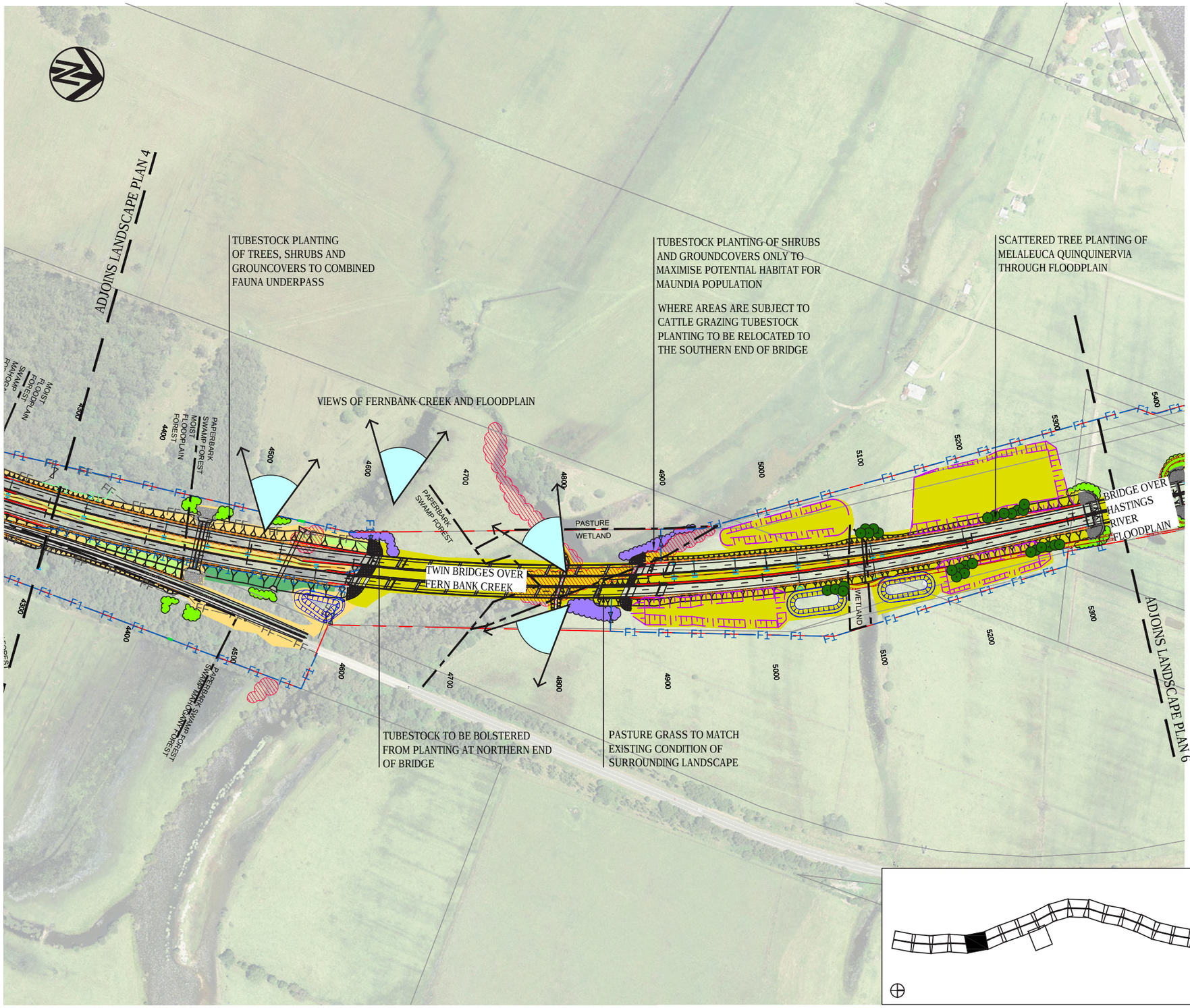
LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
- MAUNDIA POPULATION
- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
- NATIVE GRASS SEED MIX
- FRANGIBLE SHRUB SEED MIX
- TALL SHRUB SEED MIX
- PASTURE GRASS SEED MIX
- HEADLIGHT SCREEN PLANTING
- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
- PERMANENT HEADLIGHT SCREEN
- RF — BDY ROCK FENCE
- FF — FAUNA FENCE INFO ONLY
- F1 — CONCRETE POST STOCK PROOF FENCE
- F2 — 1.8m CHAIN-WIRE FENCE
- F3 — SPLIT HARDWOOD STOCK PROOF FENCE
- F4 — TEMPORARY BOUNDARY FENCE
- S1 — STOCK PROOF FENCE TYPE (TBC)
- S1 — FAUNA SECURITY FENCE
- FF — PHASCOGALE FENCING
- FF — STD FROG FENCE
- FF — COMBINED FROG FENCE
- ROPE CROSSING
- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.4 Landscape Concept Plan 4

Lend Lease

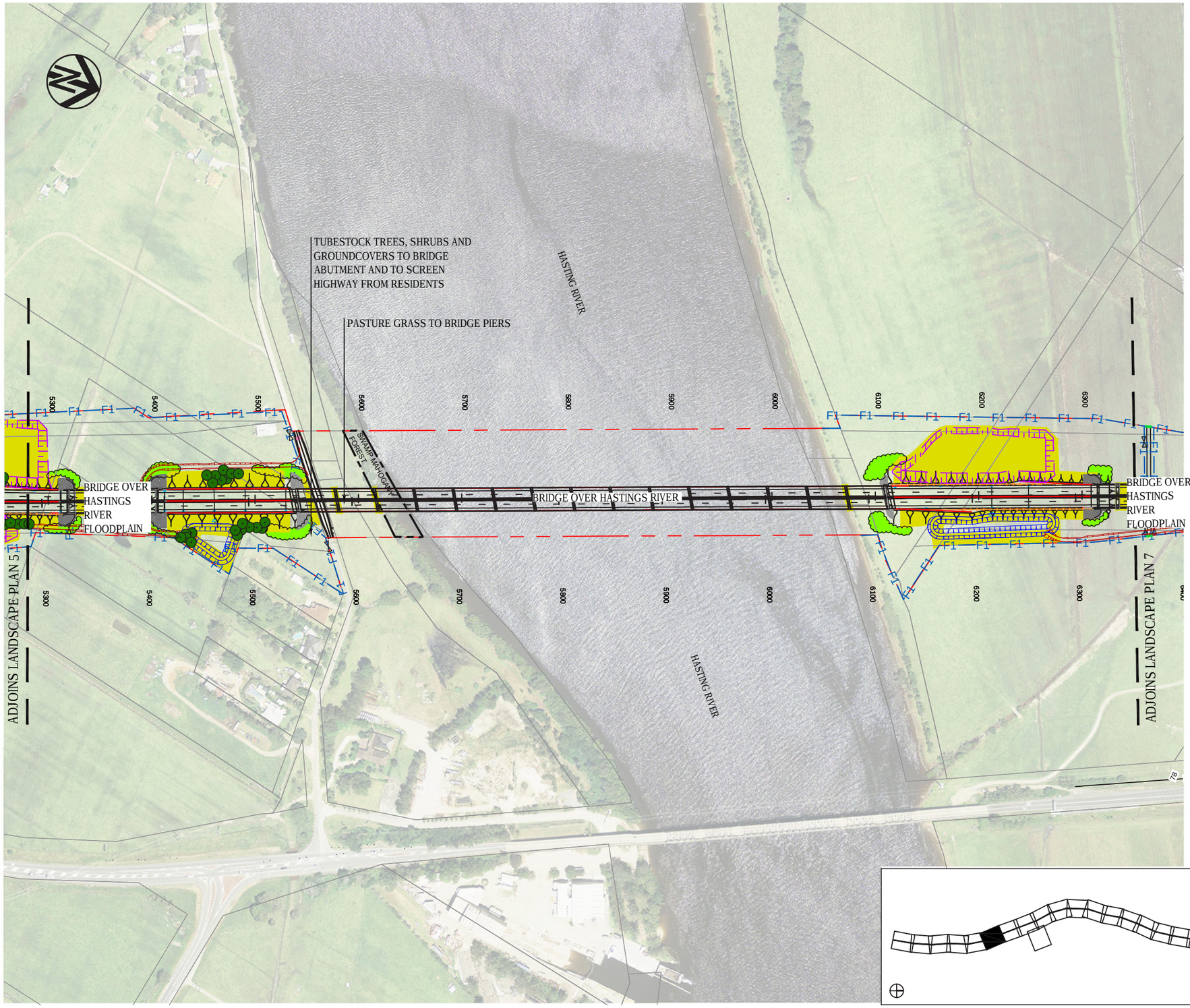


LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
- MAUNDIA POPULATION
- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
- NATIVE GRASS SEED MIX
- FRANGIBLE SHRUB SEED MIX
- TALL SHRUB SEED MIX
- PASTURE GRASS SEED MIX
- HEADLIGHT SCREEN PLANTING
- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
- PERMANENT HEADLIGHT SCREEN
- RF BDY ROCK FENCE
- FF FAUNA FENCE INFO ONLY
- F1 CONCRETE POST STOCK PROOF FENCE
- F2 1.8m CHAIN-WIRE FENCE
- F3 SPLIT HARDWOOD STOCK PROOF FENCE
- F4 TEMPORARY BOUNDARY FENCE
- S1 STOCK PROOF FENCE TYPE (TBC)
- S1 FAUNA SECURITY FENCE
- FF PHASCOGALE FENCING
- FF STD FROG FENCE
- FF COMBINED FROG FENCE
- ROPE CROSSING
- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.5 Landscape Concept Plan 5

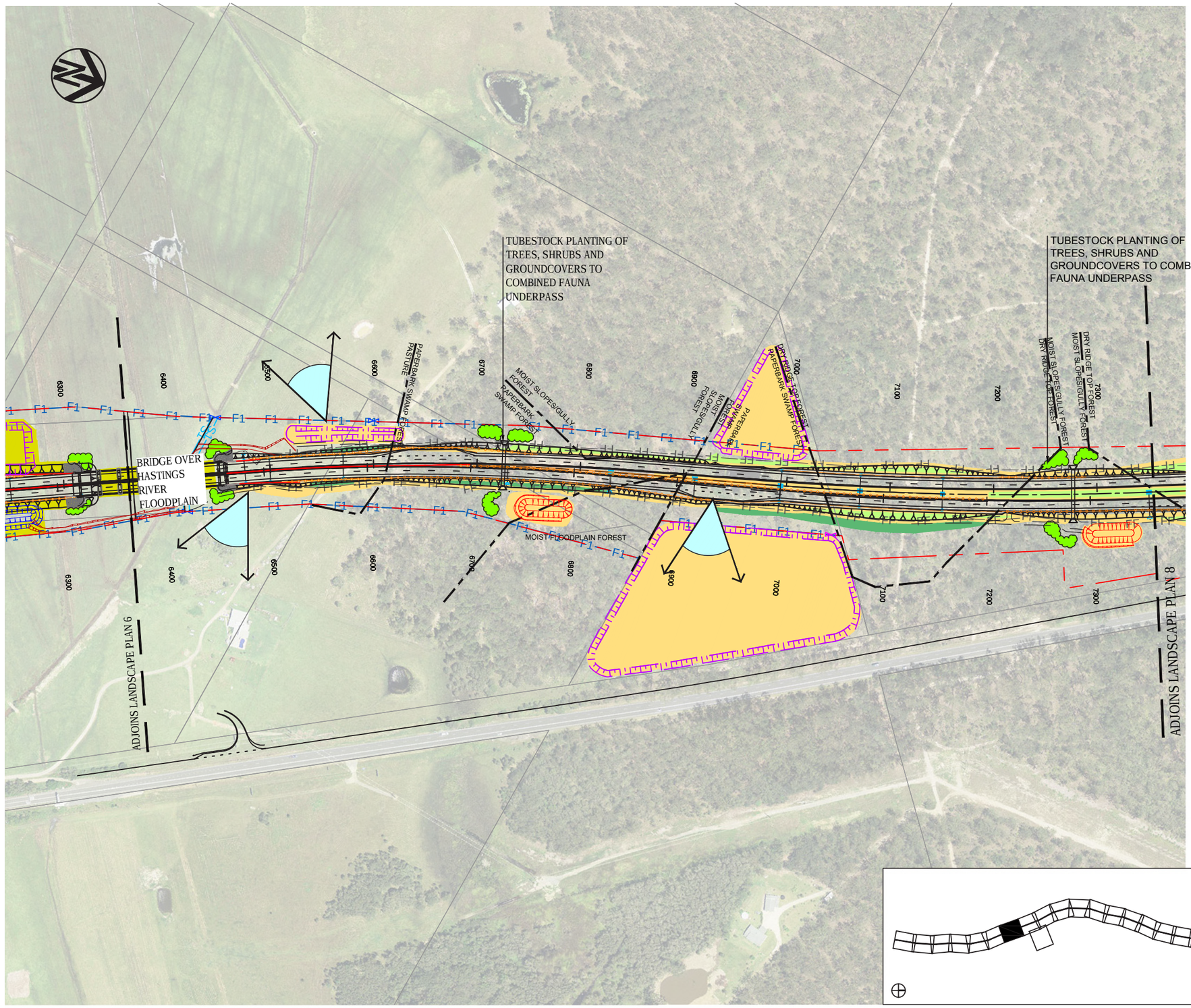


LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
- MAUNDIA POPULATION
- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
- NATIVE GRASS SEED MIX
- FRANGIBLE SHRUB SEED MIX
- TALL SHRUB SEED MIX
- PASTURE GRASS SEED MIX
- HEADLIGHT SCREEN PLANTING
- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
- PERMANENT HEADLIGHT SCREEN
- RF — BDY ROCK FENCE
- FF — FAUNA FENCE INFO ONLY
- F1 — CONCRETE POST STOCK PROOF FENCE
- F2 — 1.8m CHAIN-WIRE FENCE
- F3 — SPLIT HARDWOOD STOCK PROOF FENCE
- F4 — TEMPORARY BOUNDARY FENCE
- S1 — STOCK PROOF FENCE TYPE (TBC)
- S1 — FAUNA SECURITY FENCE
- FF — PHASCOGALE FENCING
- FF — STD FROG FENCE
- FF — COMBINED FROG FENCE
- ROPE CROSSING
- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.6 Landscape Concept Plan 6



LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
- MAUNDIA POPULATION
- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
- NATIVE GRASS SEED MIX
- FRANGIBLE SHRUB SEED MIX
- TALL SHRUB SEED MIX
- PASTURE GRASS SEED MIX
- HEADLIGHT SCREEN PLANTING
- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
- PERMANENT HEADLIGHT SCREEN
- RF BDY ROCK FENCE
- FF FAUNA FENCE INFO ONLY
- F1 CONCRETE POST STOCK PROOF FENCE
- F2 1.8m CHAIN-WIRE FENCE
- F3 SPLIT HARDWOOD STOCK PROOF FENCE
- F4 TEMPORARY BOUNDARY FENCE
- S1 STOCK PROOF FENCE TYPE (TBC)
- S1 FAUNA SECURITY FENCE
- FF PHASCOGALE FENCING
- FF STD FROG FENCE
- FF COMBINED FROG FENCE
- ROPE CROSSING
- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.7 Landscape Concept Plan 7

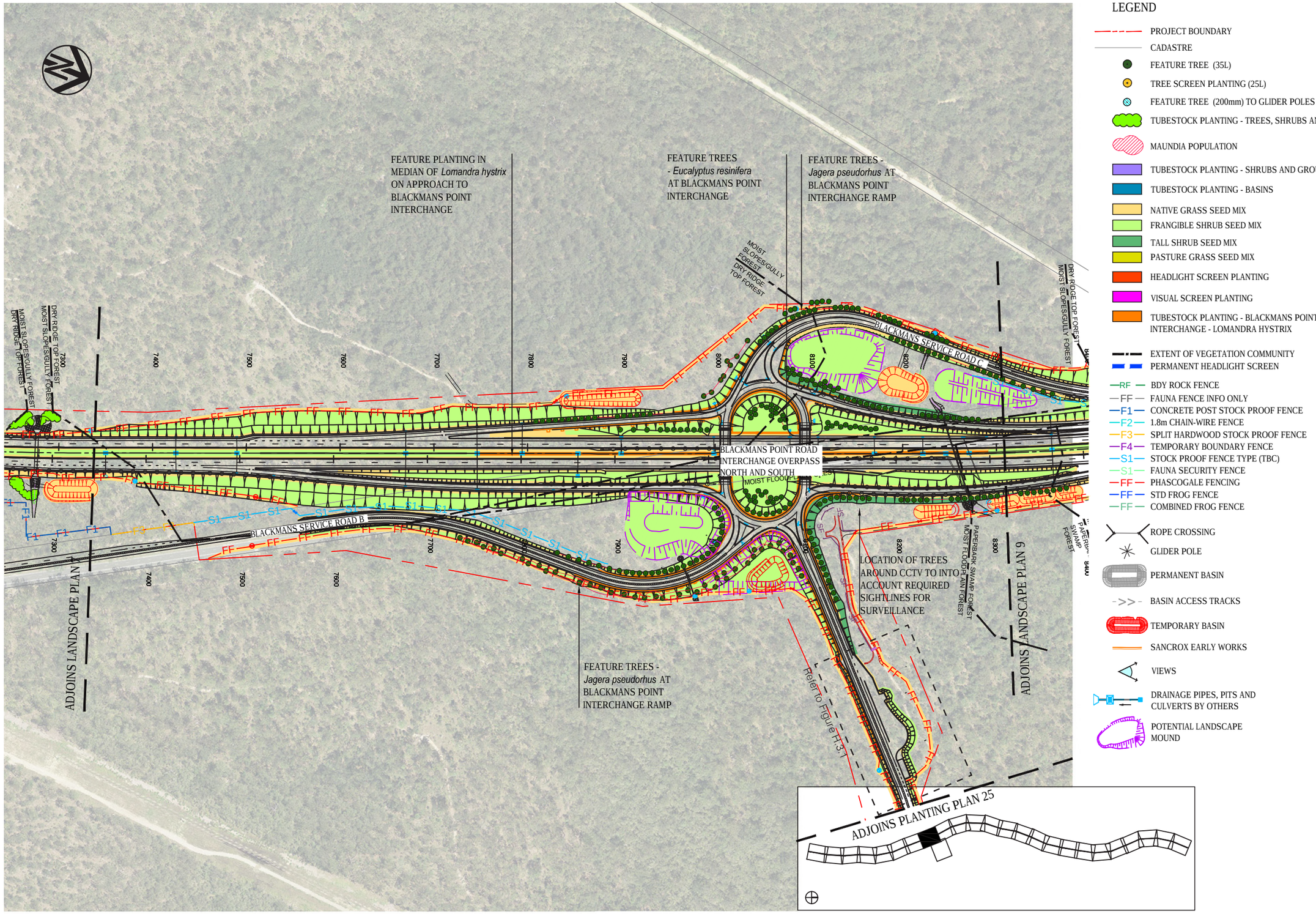
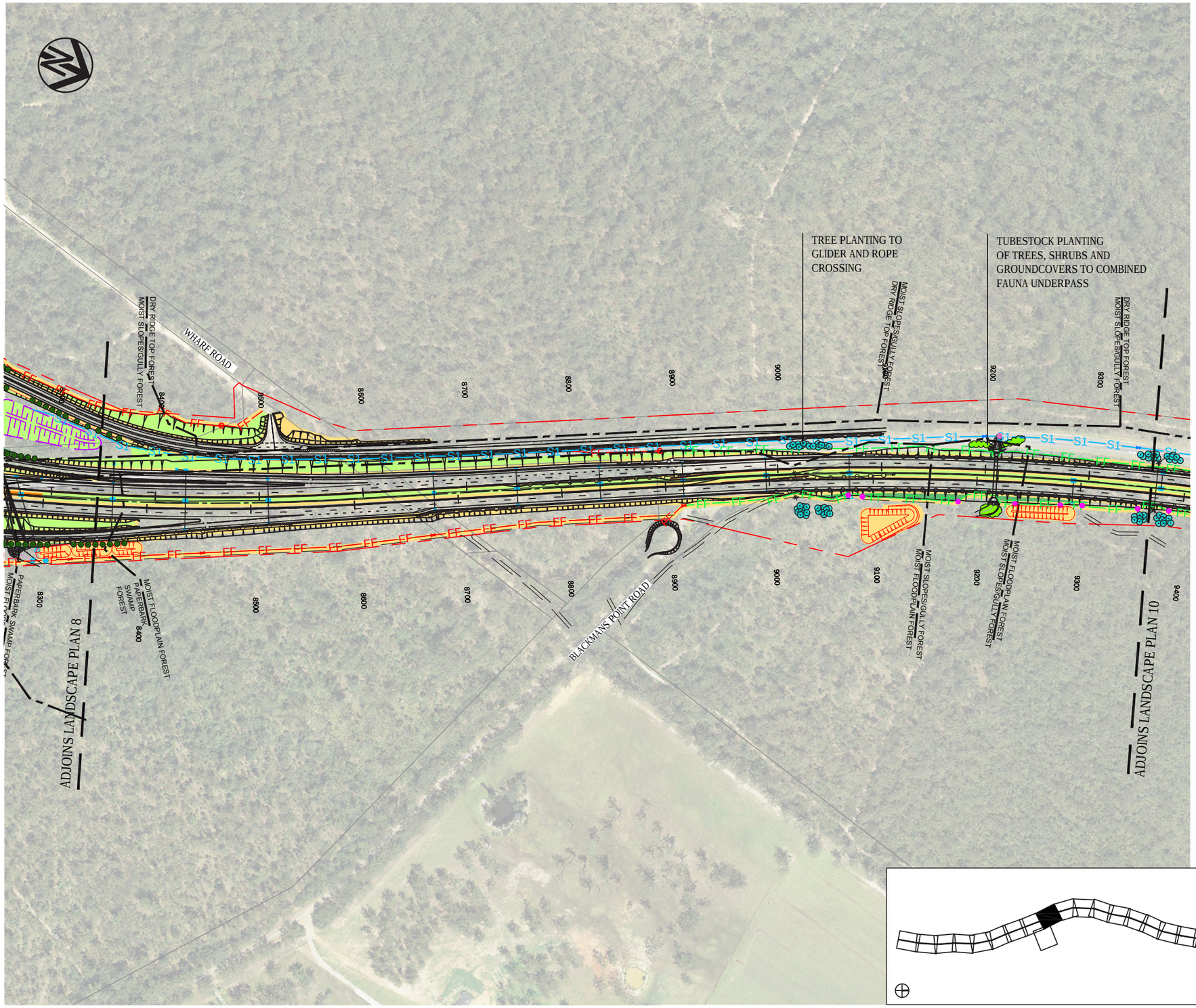


Figure F.6.2.8 Landscape Concept Plan 8

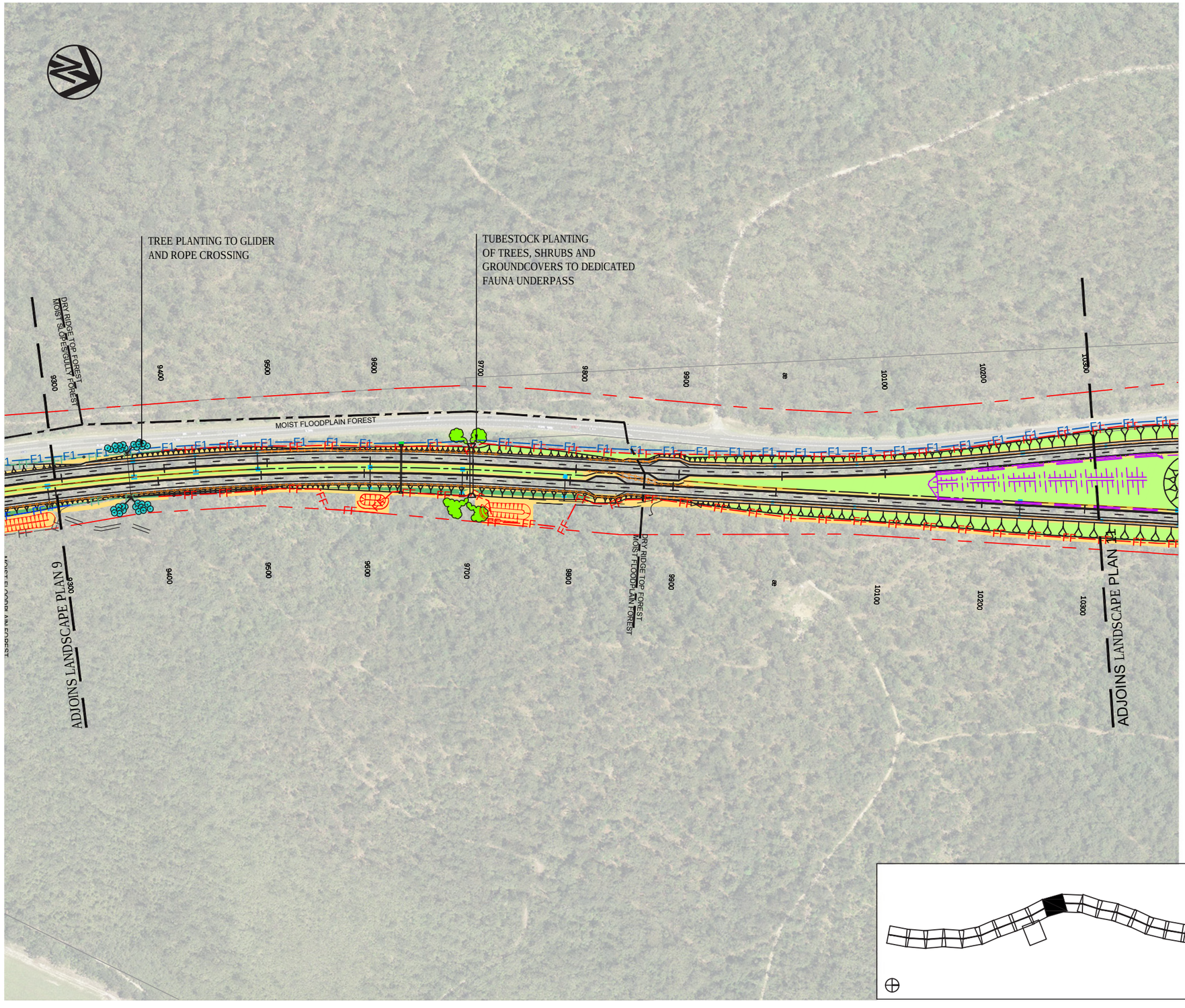


LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
- MAUNDIA POPULATION
- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
- NATIVE GRASS SEED MIX
- FRANGIBLE SHRUB SEED MIX
- TALL SHRUB SEED MIX
- PASTURE GRASS SEED MIX
- HEADLIGHT SCREEN PLANTING
- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
- PERMANENT HEADLIGHT SCREEN
- RF — BDY ROCK FENCE
- FF — FAUNA FENCE INFO ONLY
- F1 — CONCRETE POST STOCK PROOF FENCE
- F2 — 1.8m CHAIN-WIRE FENCE
- F3 — SPLIT HARDWOOD STOCK PROOF FENCE
- F4 — TEMPORARY BOUNDARY FENCE
- S1 — STOCK PROOF FENCE TYPE (TBC)
- S1 — FAUNA SECURITY FENCE
- FF — PHASCOGALE FENCING
- FF — STD FROG FENCE
- FF — COMBINED FROG FENCE
- ROPE CROSSING
- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.9 Landscape Concept Plan 9

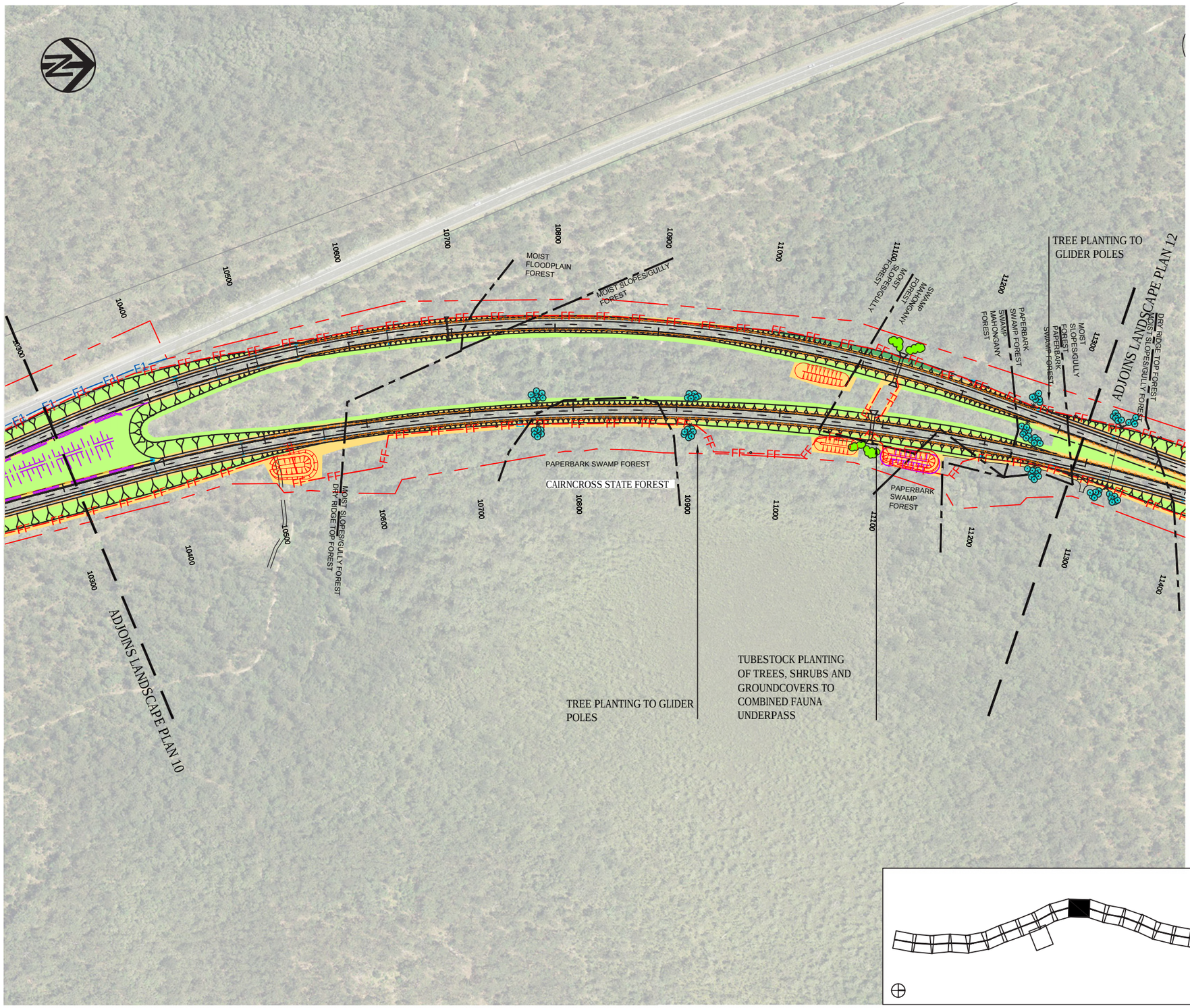


LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
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- TUBESTOCK PLANTING - BASINS
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- PASTURE GRASS SEED MIX
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- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
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- S1 — FAUNA SECURITY FENCE
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- ROPE CROSSING
- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.10 Landscape Concept Plan 10



LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
- MAUNDIA POPULATION
- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
- NATIVE GRASS SEED MIX
- FRANGIBLE SHRUB SEED MIX
- TALL SHRUB SEED MIX
- PASTURE GRASS SEED MIX
- HEADLIGHT SCREEN PLANTING
- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
- PERMANENT HEADLIGHT SCREEN
- RF — BDY ROCK FENCE
- FF — FAUNA FENCE INFO ONLY
- F1 — CONCRETE POST STOCK PROOF FENCE
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- S1 — FAUNA SECURITY FENCE
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- FF — STD FROG FENCE
- FF — COMBINED FROG FENCE
- ROPE CROSSING
- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.11 Landscape Concept Plan 11

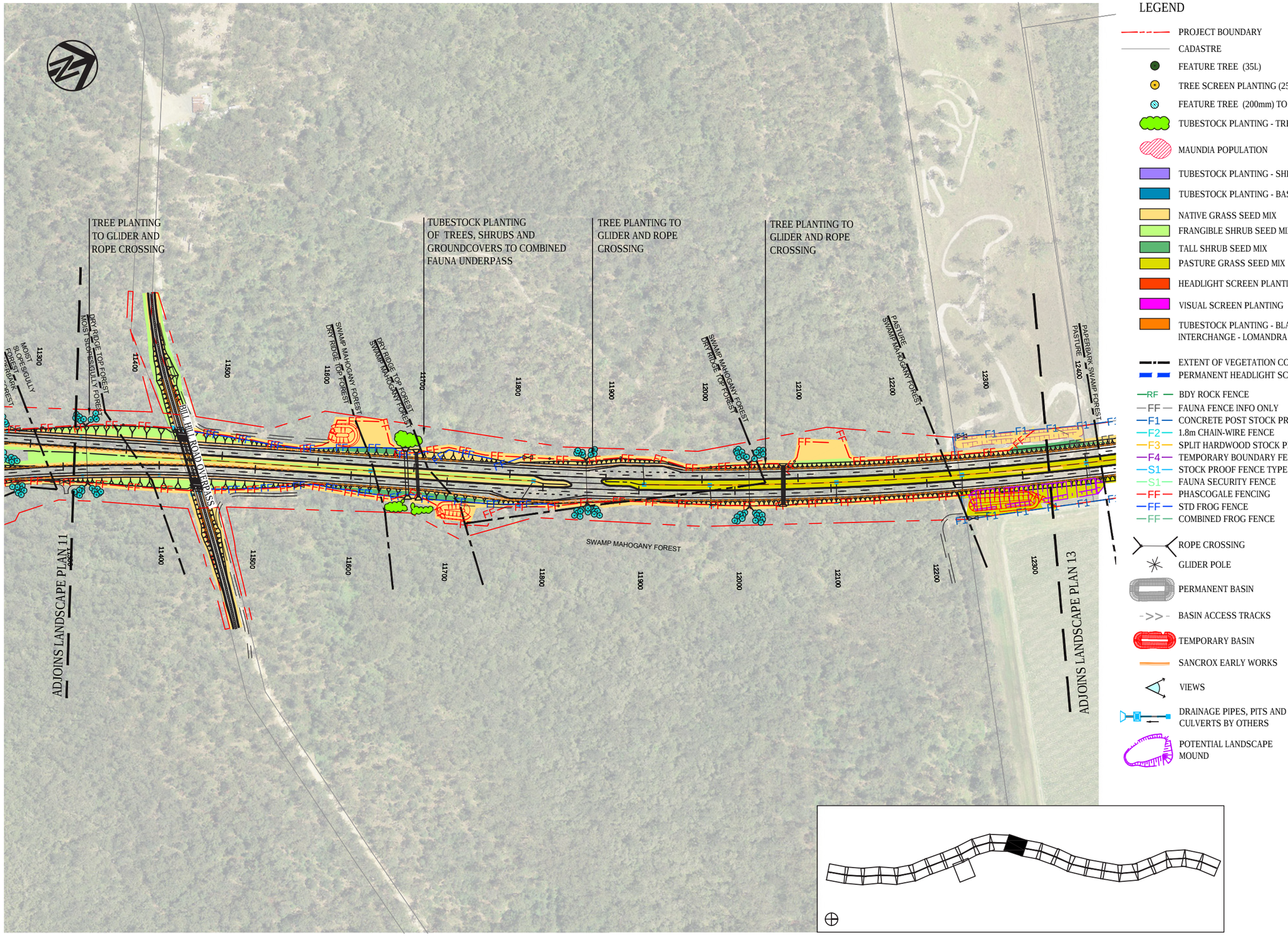
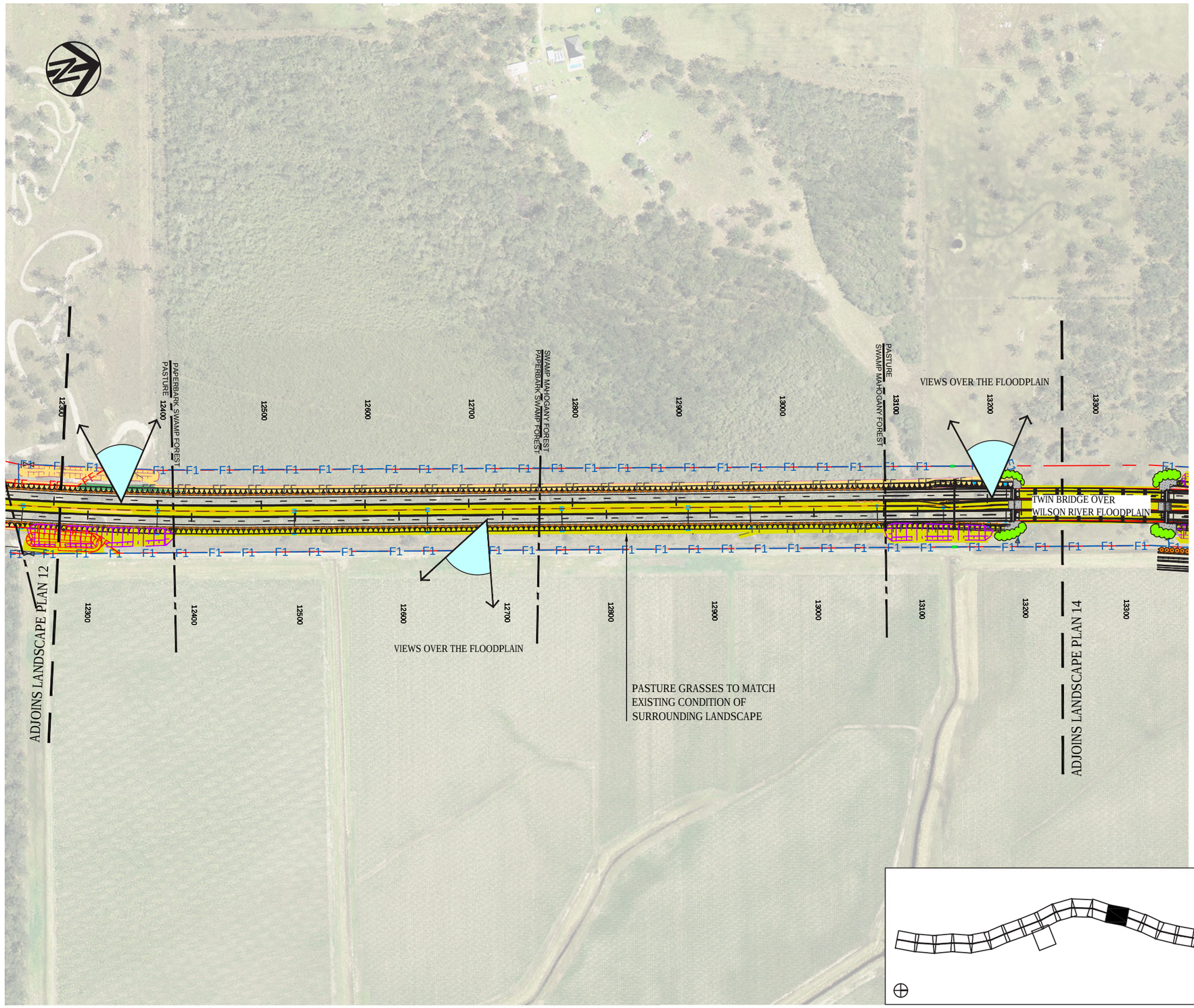


Figure F.6.2.12 Landscape Concept Plan 12

0 200m

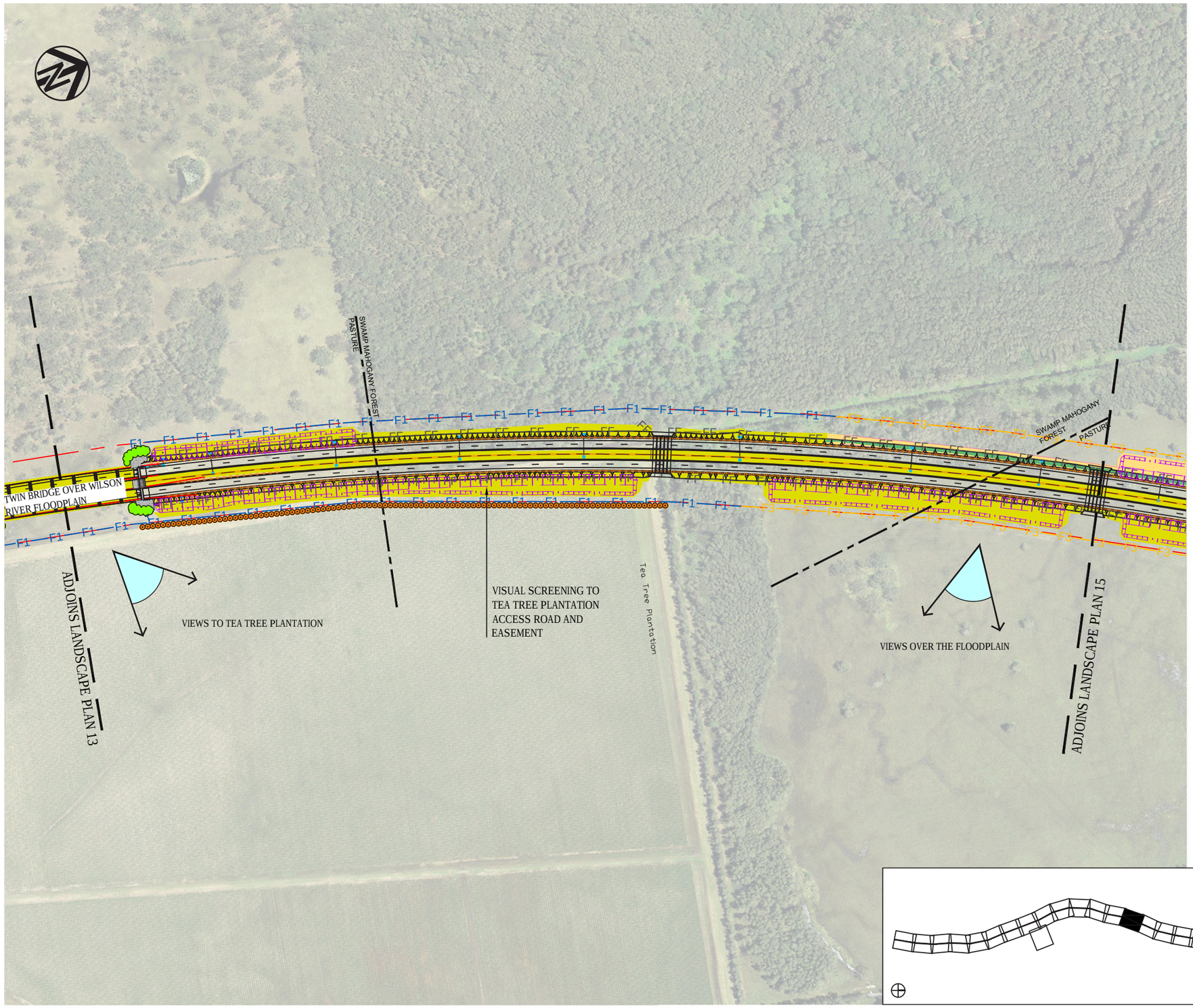


LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
- MAUNDIA POPULATION
- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
- NATIVE GRASS SEED MIX
- FRANGIBLE SHRUB SEED MIX
- TALL SHRUB SEED MIX
- PASTURE GRASS SEED MIX
- HEADLIGHT SCREEN PLANTING
- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
- PERMANENT HEADLIGHT SCREEN
- RF BDY ROCK FENCE
- FF FAUNA FENCE INFO ONLY
- F1 CONCRETE POST STOCK PROOF FENCE
- F2 1.8m CHAIN-WIRE FENCE
- F3 SPLIT HARDWOOD STOCK PROOF FENCE
- F4 TEMPORARY BOUNDARY FENCE
- S1 STOCK PROOF FENCE TYPE (TBC)
- S1 FAUNA SECURITY FENCE
- FF PHASCOGALE FENCING
- FF STD FROG FENCE
- FF COMBINED FROG FENCE
- ROPE CROSSING
- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.13 Landscape Concept Plan 13

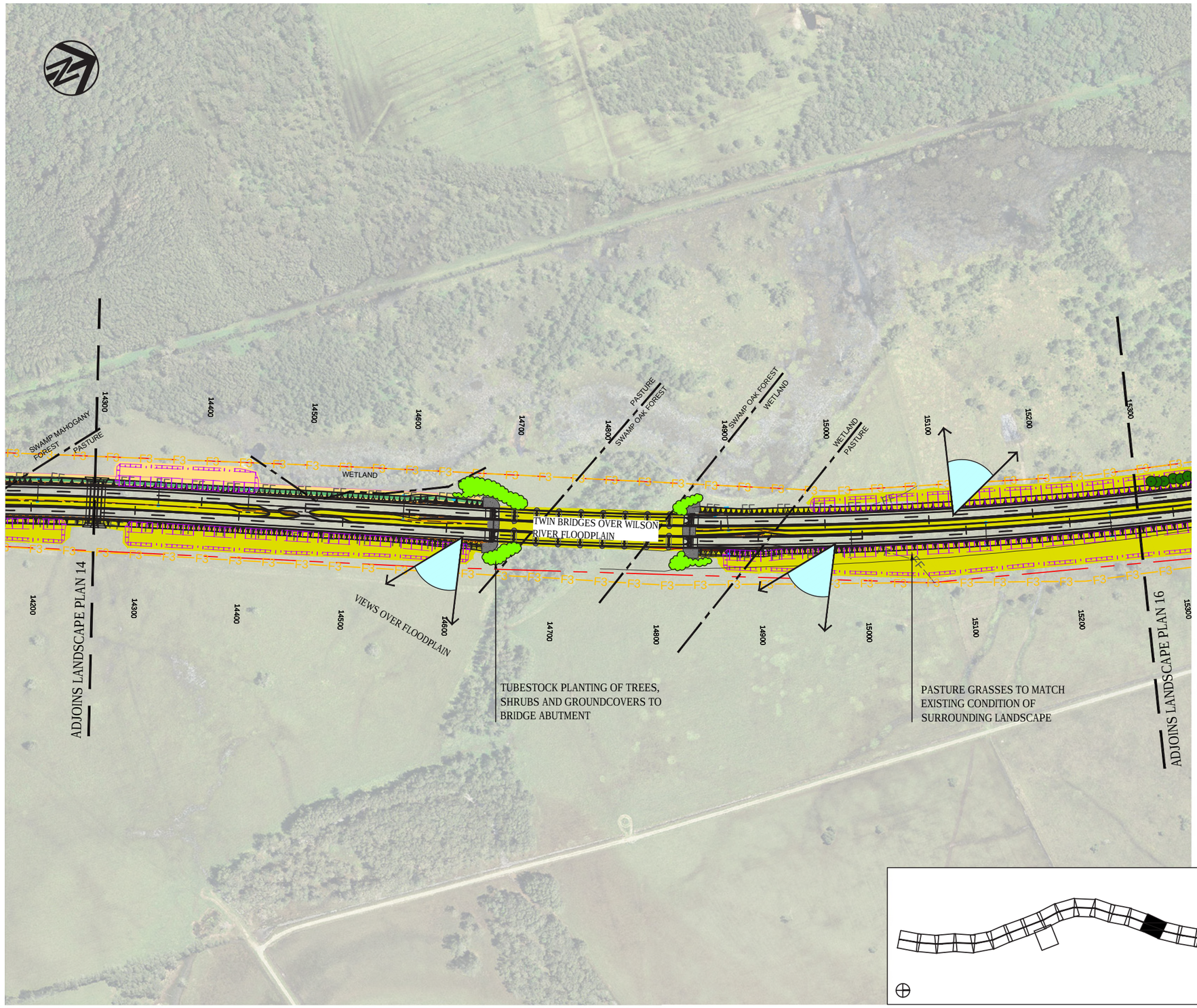


LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
- MAUNDIA POPULATION
- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
- NATIVE GRASS SEED MIX
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- TALL SHRUB SEED MIX
- PASTURE GRASS SEED MIX
- HEADLIGHT SCREEN PLANTING
- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
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- RF — BDY ROCK FENCE
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- ROPE CROSSING
- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

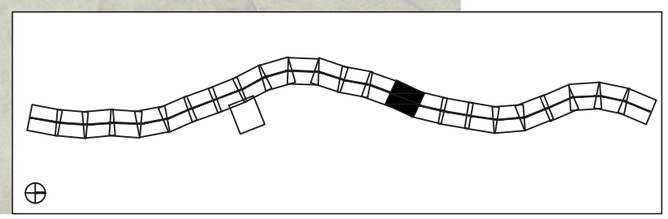
0 200m

Figure F.6.2.14 Landscape Concept Plan 14



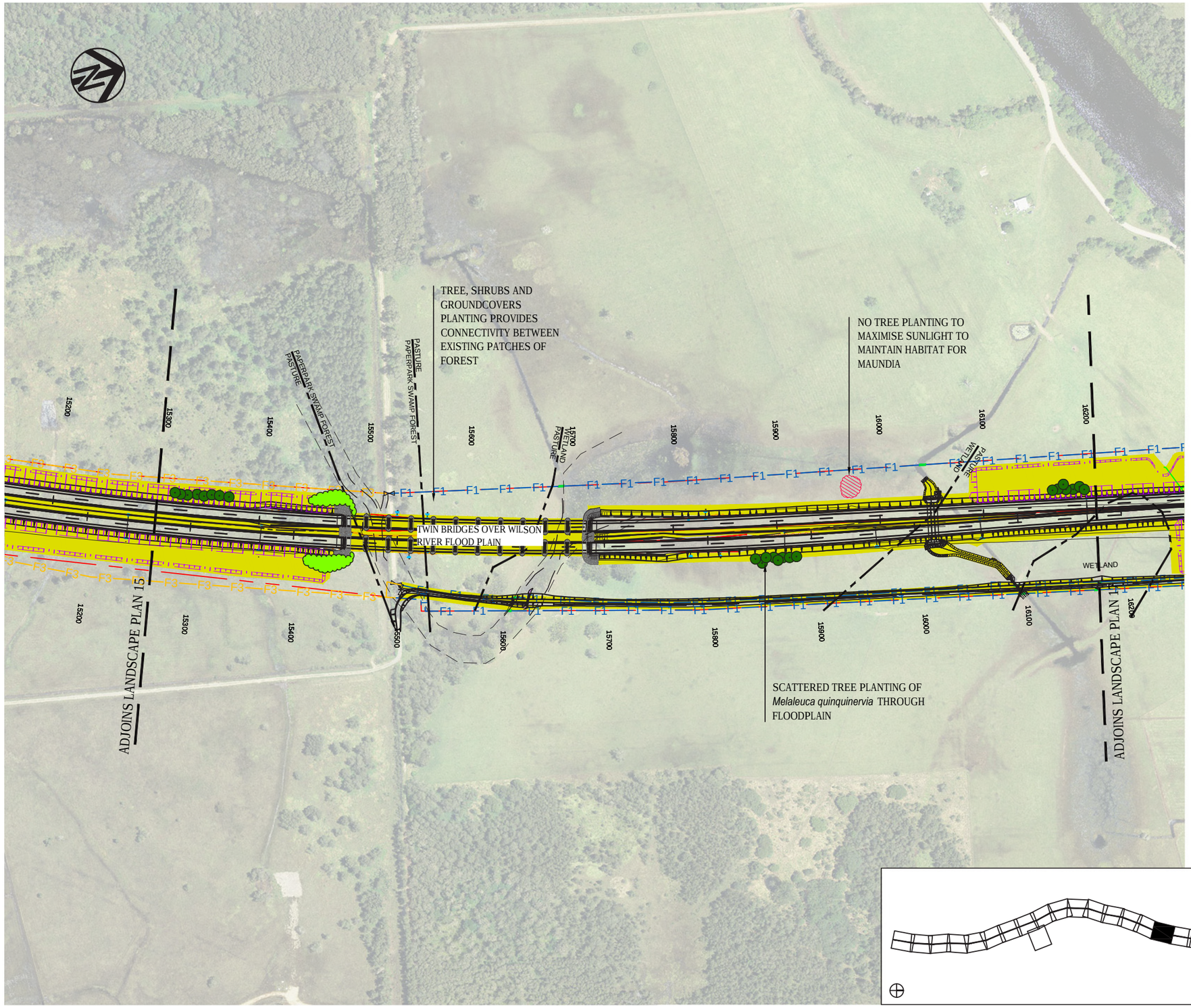
LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
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- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
- NATIVE GRASS SEED MIX
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- HEADLIGHT SCREEN PLANTING
- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
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- RF BDY ROCK FENCE
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- F1 CONCRETE POST STOCK PROOF FENCE
- F2 1.8m CHAIN-WIRE FENCE
- F3 SPLIT HARDWOOD STOCK PROOF FENCE
- F4 TEMPORARY BOUNDARY FENCE
- S1 STOCK PROOF FENCE TYPE (TBC)
- S1 FAUNA SECURITY FENCE
- FF PHASCOGALE FENCING
- FF STD FROG FENCE
- FF COMBINED FROG FENCE
- ROPE CROSSING
- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND



0 200m

Figure F.6.2.15 Landscape Concept Plan 15



LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
- MAUNDIA POPULATION
- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
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- TALL SHRUB SEED MIX
- PASTURE GRASS SEED MIX
- HEADLIGHT SCREEN PLANTING
- VISUAL SCREEN PLANTING
- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
- EXTENT OF VEGETATION COMMUNITY
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- GLIDER POLE
- PERMANENT BASIN
- BASIN ACCESS TRACKS
- TEMPORARY BASIN
- SANCROX EARLY WORKS
- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.16 Landscape Concept Plan 16

Lend Lease

TREE PLANTINGS TO FRAME HACKS FERRY ROAD, SCREEN HIGHWAY AND MAINTAIN RURAL CHARACTER

TUBESTOCK PLANTING OF SHRUBS AND GROUNDCOVERS AROUND BRIDGE PIERS

TALL SHRUBS ON HIGH EMBANKMENTS

VIEW OVER WILSON RIVER

SWAMP OAK FOREST

PASTURE

HACKS FERRY ROAD

BRIDGE OVER WILSON RIVER

WETLAND

VIEW OVER WILSON RIVER

VETLAND SWAMP OAK FOREST

PASTURE WETLAND

MOIST SLOPES GULLY FOREST

PASTURE

DRY RIDGETOP MOIST SLOPES GU

MOIST FLOODPLAIN FOREST

TUBESTOCK PLANTING OF SHRUBS AND GROUNDCOVERS AROUND BRIDGE PIERS

NATIVE GRASSES IN THE VICINITY OF THE NORTH COAST RAIL WAY LINE TO PRESERVE SAFETY CLEARANCES

ADJOINS LANDSCAPE PLAN 16

ADJOINS LANDSCAPE PLAN 18

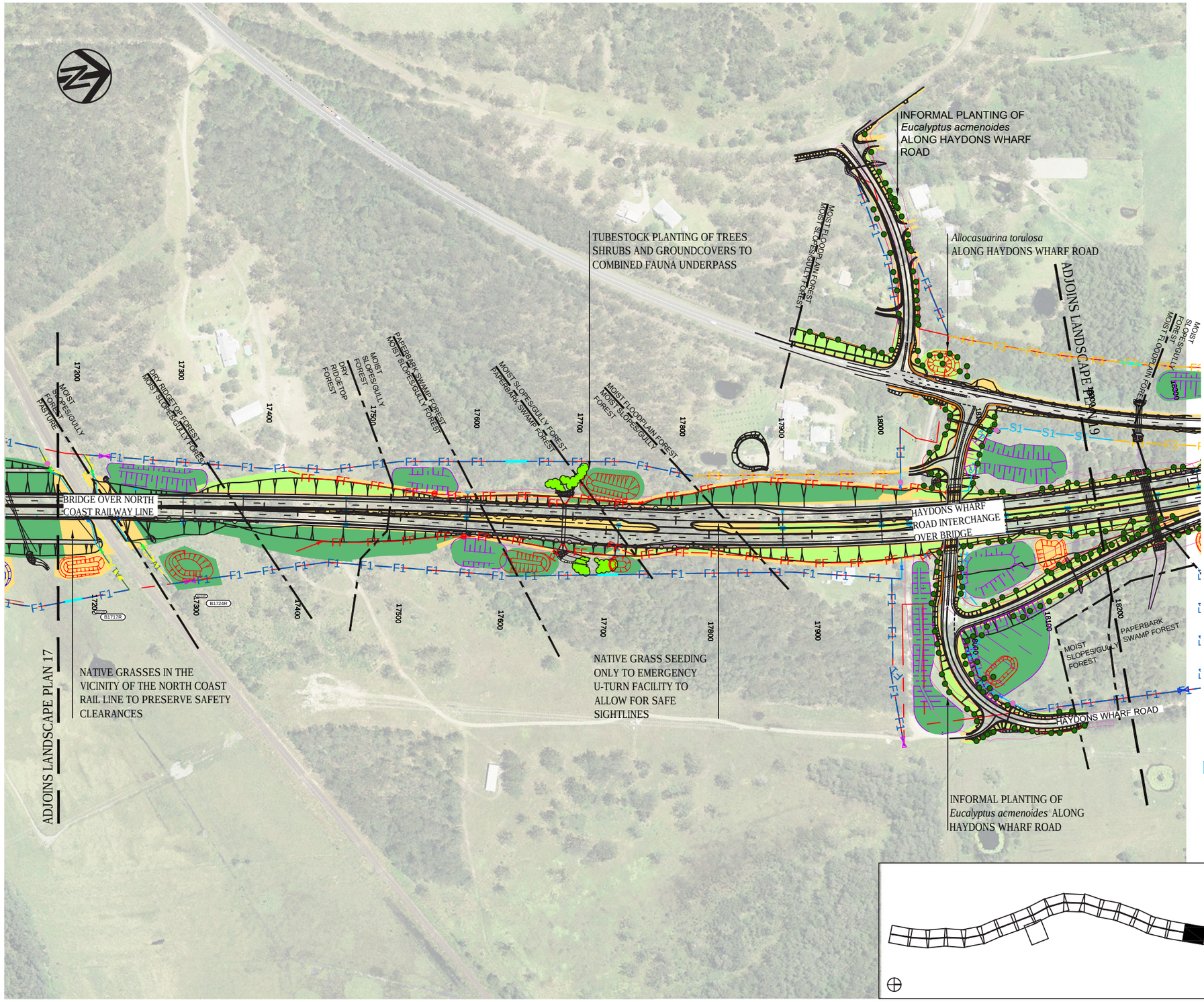
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LEGEND

- PROJECT BOUNDARY
- CADASTRE
- FEATURE TREE (35L)
- TREE SCREEN PLANTING (25L)
- FEATURE TREE (200mm) TO GLIDER POLES AND ROPE CROSSING
- TUBESTOCK PLANTING - TREES, SHRUBS AND GROUNDCOVERS
- MAUNDIA POPULATION
- TUBESTOCK PLANTING - SHRUBS AND GROUNDCOVERS
- TUBESTOCK PLANTING - BASINS
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- HEADLIGHT SCREEN PLANTING
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- TUBESTOCK PLANTING - BLACKMANS POINT INTERCHANGE - LOMANDRA HYSTRIX
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- RF BDY ROCK FENCE
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- GLIDER POLE
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- BASIN ACCESS TRACKS
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- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.17 Landscape Concept Plan 17



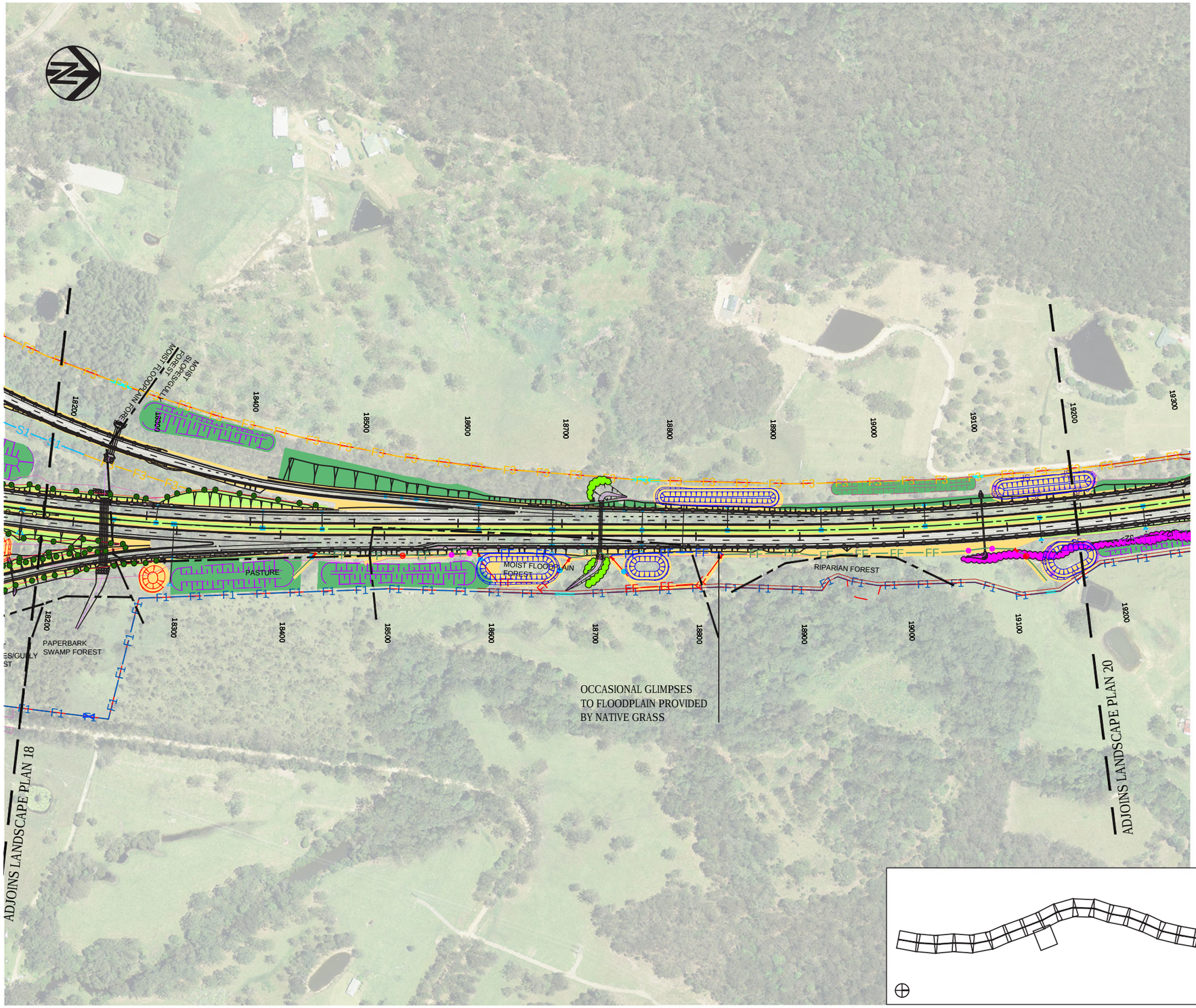
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- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.18 Landscape Concept Plan 18

Lend Lease

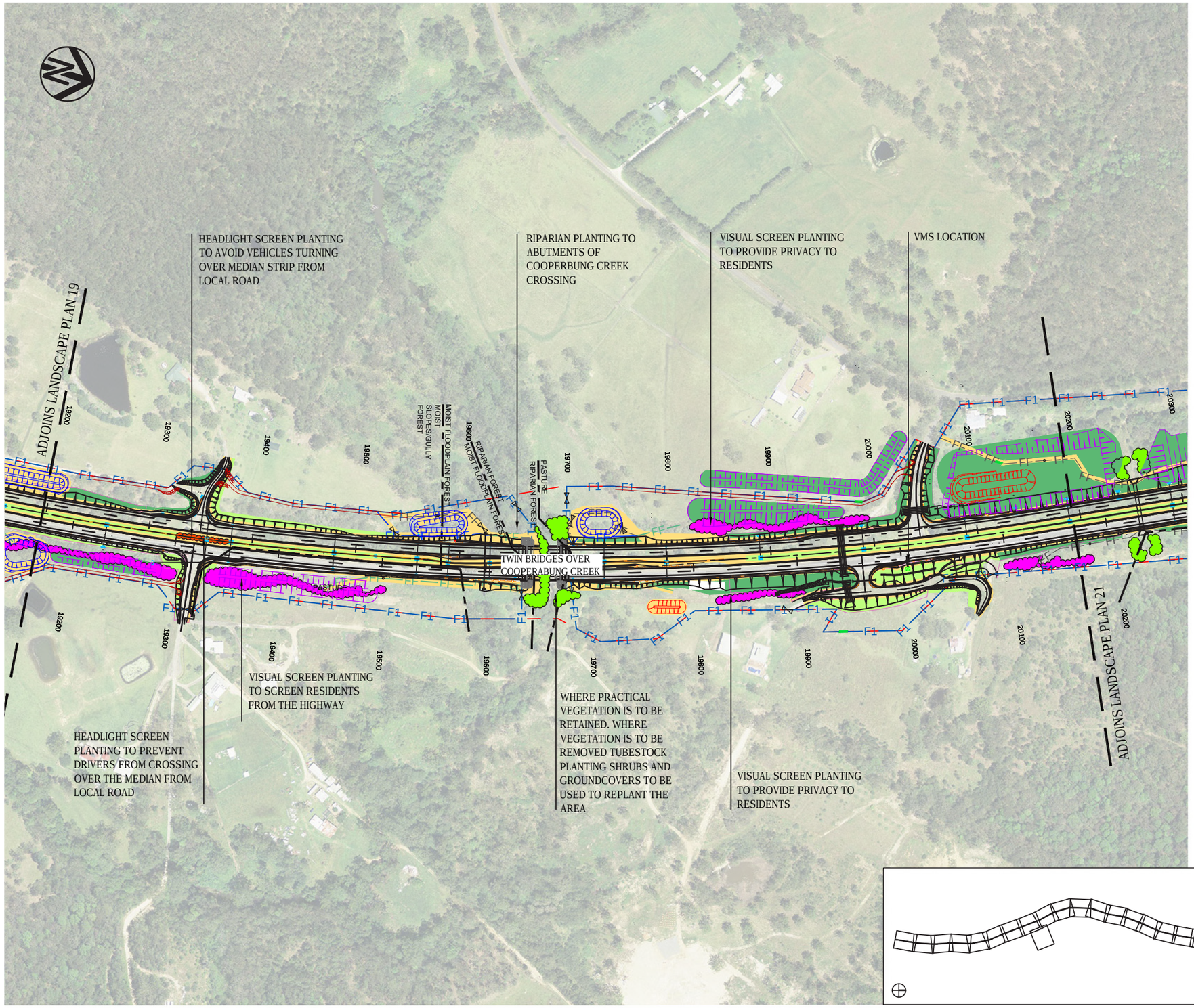


LEGEND

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- VIEWS
- DRAINAGE PIPES, PITS AND CULVERTS BY OTHERS
- POTENTIAL LANDSCAPE MOUND

0 200m

Figure F.6.2.19 Landscape Concept Plan 19

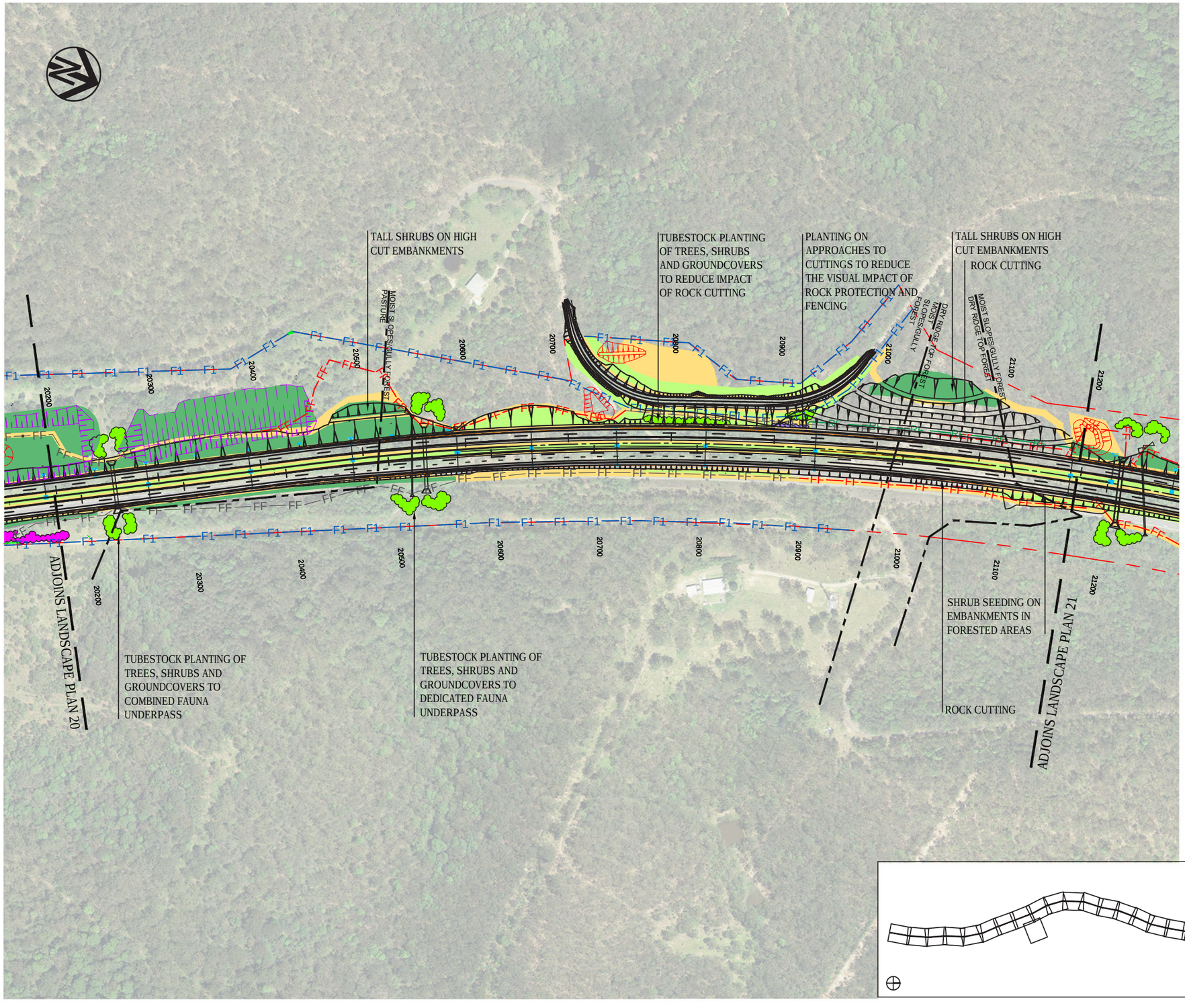


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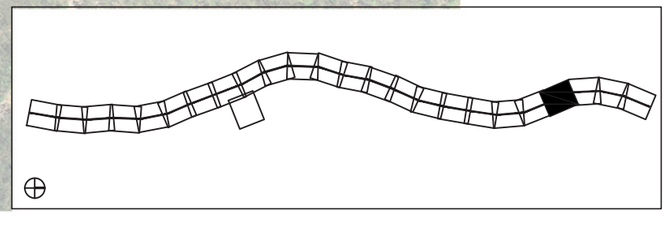
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Figure F.6.2.20 Landscape Concept Plan 20



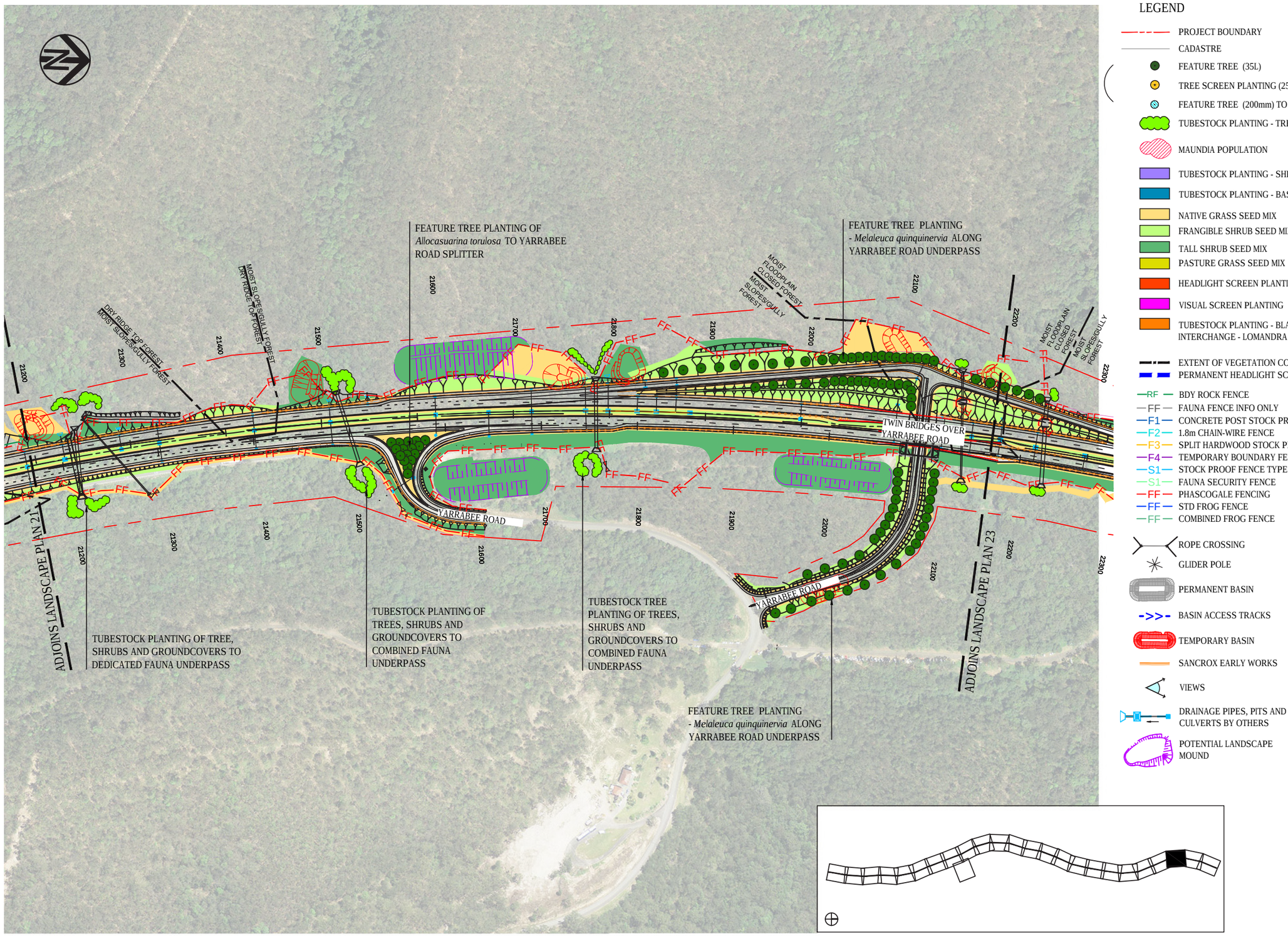
LEGEND

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0 200m

Figure F.6.2.21 Landscape Concept Plan 21

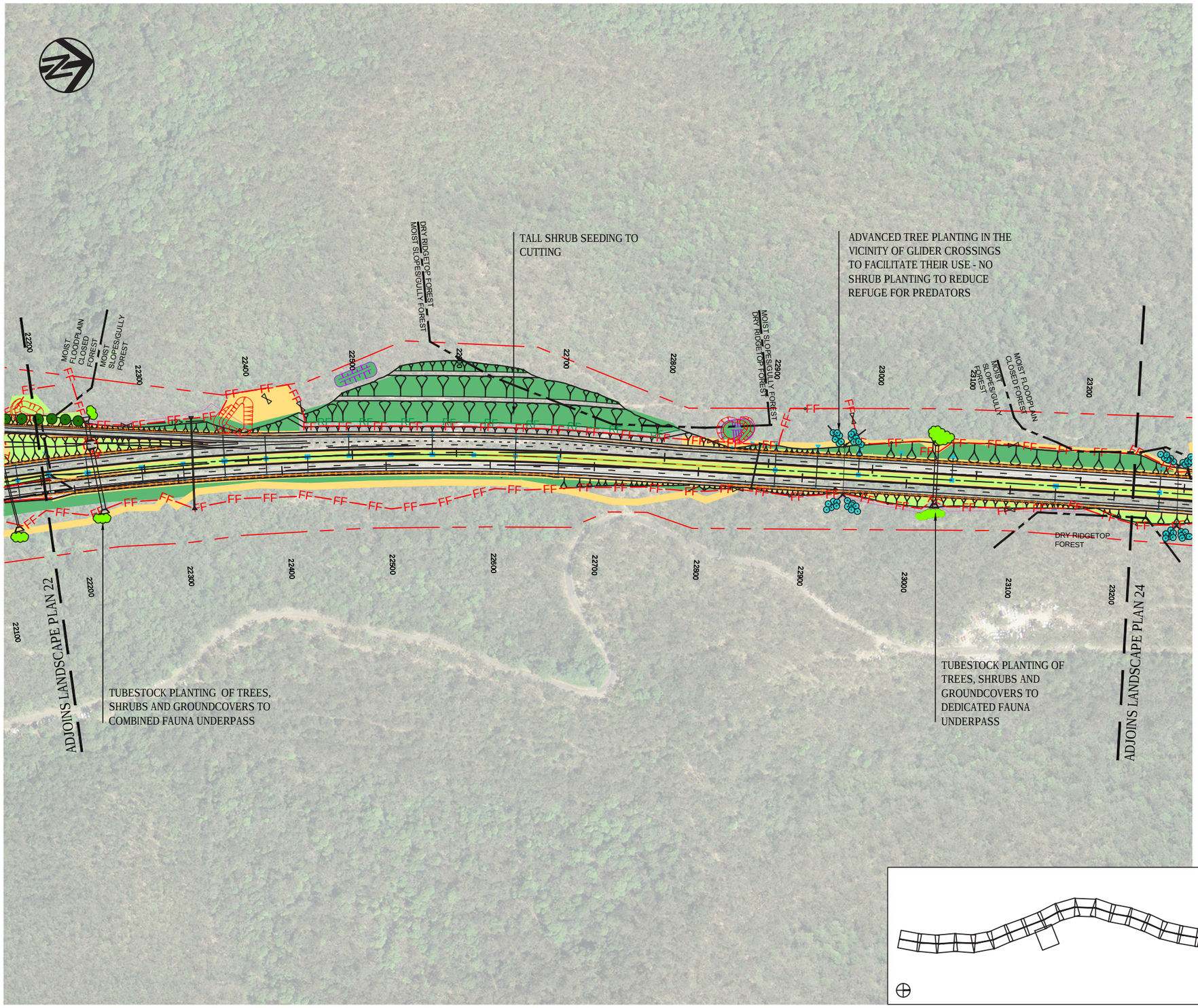


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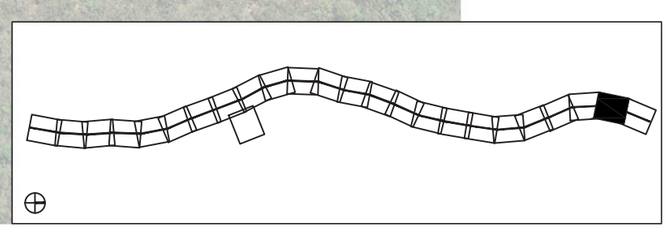
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Figure F.6.2.22 Landscape Concept Plan 22



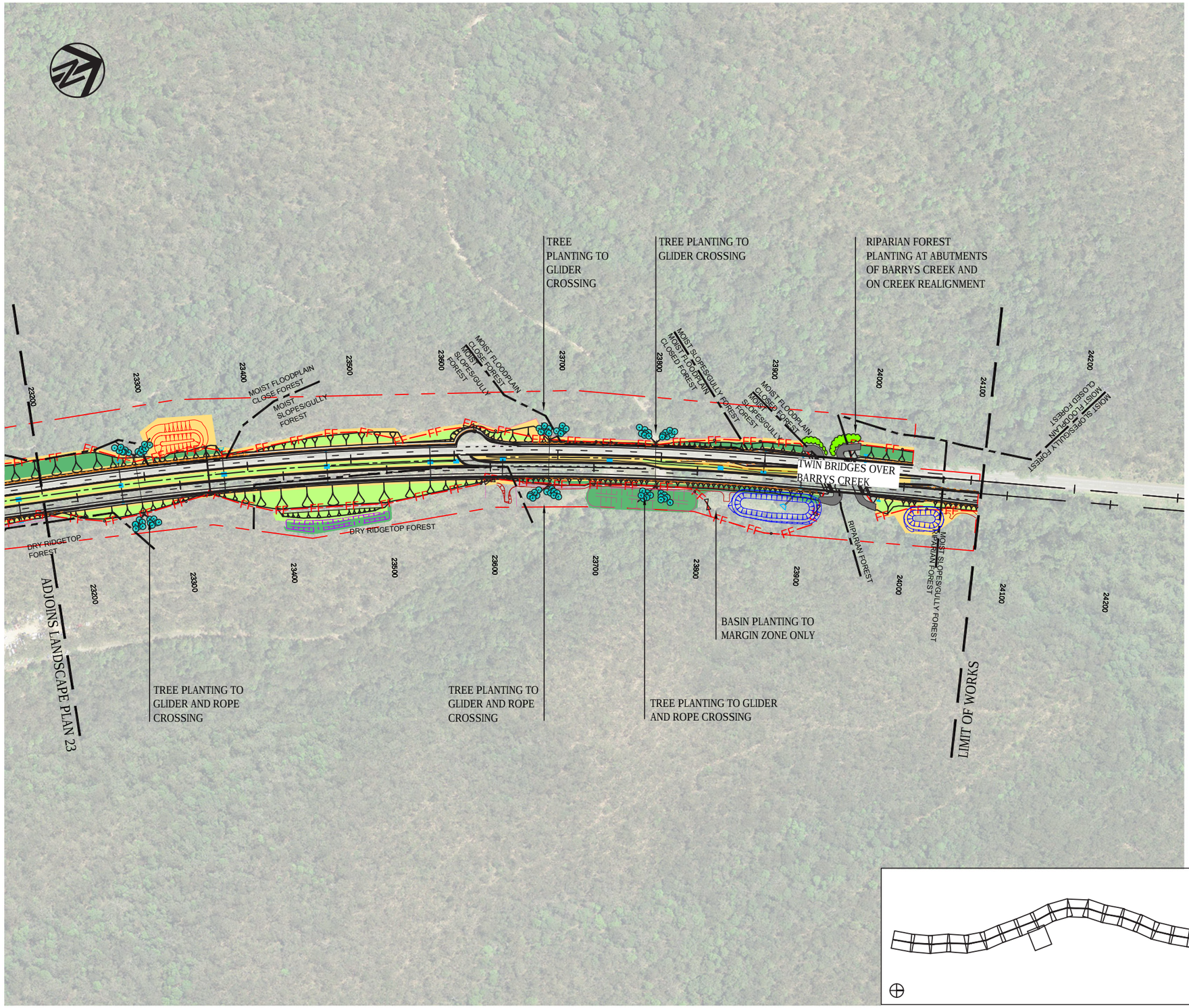
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0 200m

Figure F.6.2.23 Landscape Concept Plan 23

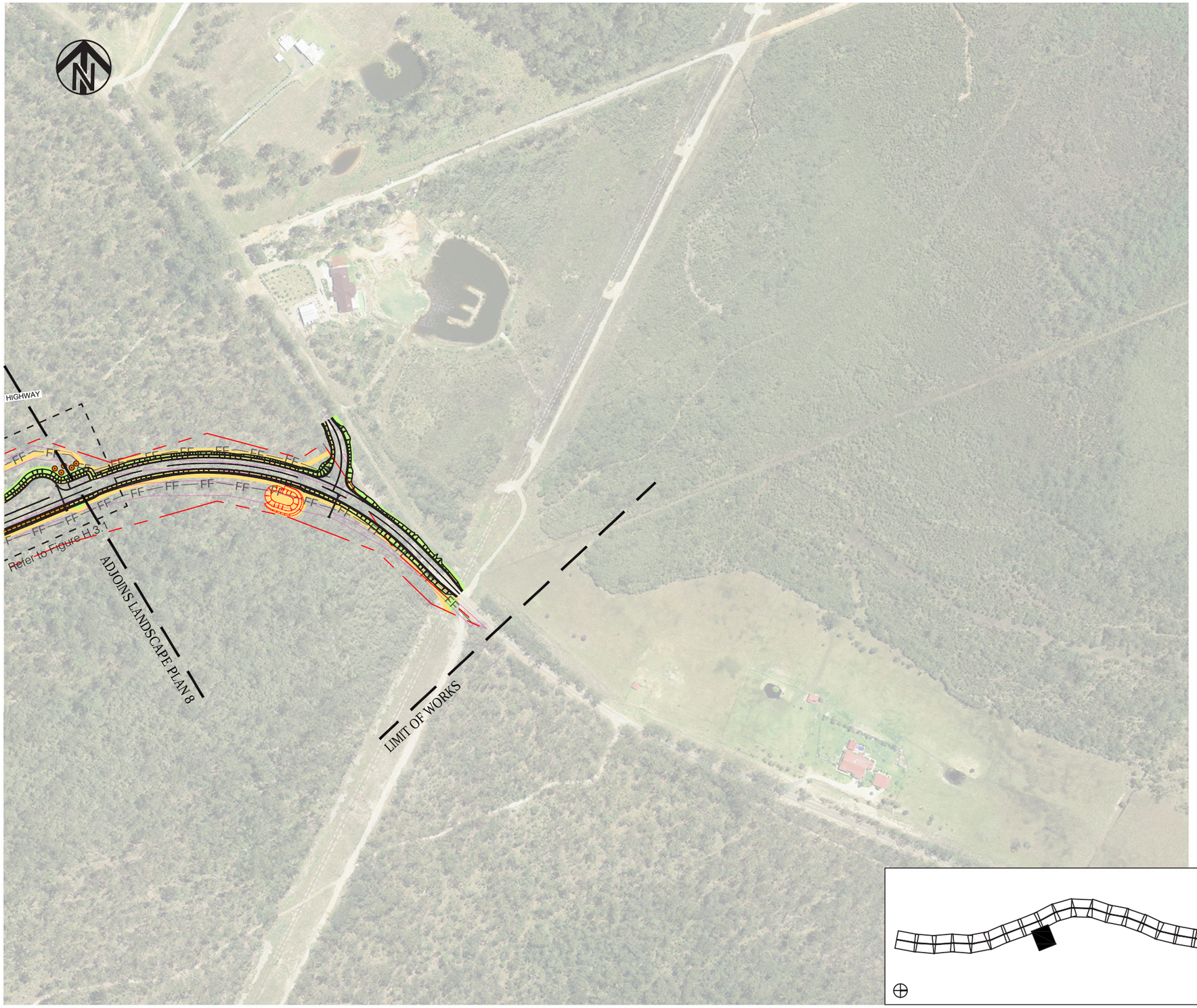


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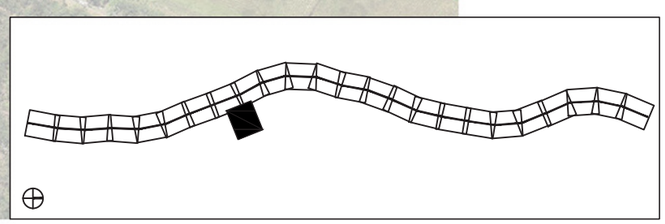
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Figure F.6.2.24 Landscape Concept Plan 24



LEGEND

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0 200m

Figure F.6.2.25 Landscape Concept Plan 25

F.7 Planting and Seeding Schedules

F.7.1 Planting Schedule

Botanical Name	Common Name	% of Species per Area	Spacing (m²)	Sizes	Qty.
Moist Slopes/Moist Gully Forest (Non-EEC)					
Trees			**Area (m²)**		**10844**
Allocasuarina torulosa	Forest She Oak	As Shown	As Shown	35Litre	16
Lophostemon confertus	Brush Box	As Shown	As Shown	35Litre	18
Allocasuarina torulosa	Forest She Oak	10%	0.1	NT	57
Corymbia gummifera	Red Bloodwood	10%	0.1	NT	108
Eucalyptus microcorys	Tallowood	10%	0.1	NT	108
Eucalyptus pilularis	Blackbutt	20%	0.1	NT	217
Eucalyptus propinqua	Small-fruited Grey Gum	10%	0.1	NT	108
Eucalyptus tereticornis	Forest Red Gum	20%	0.1	NT	217
Lophostemon confertus	Brush Box	10%	0.1	NT	108
Syncarpia glomulifera	Turpentine	10%	0.1	NT	108
Total		**100%**			**1063**
Shrubs			**Area (m²)**		**10936**
Banksia spinulosa var. collina	Hairpin Banksia	20%	0.5	NT	1094
Callistemon salignus	Willow Bottlebrush	25%	0.5	NT	1367
Cordyline stricta	Narrow-leaved Palm Lily	10%	2	NT	2187
Hibiscus splendens	Hollyhock Tree	10%	0.5	NT	547
Leptospermum polygalifolium	Tantoon	25%	0.5	NT	1367
Melaleuca nodosa	Prickly leaved Paperbark	10%	0.5	NT	547
Total		**100%**			**7108**
Groundcovers, tussocks, grasses and sedges			**Area (m²)**		**10935**
Dianella caerulea	Flax Lily	30%	4	NT	13123
Lomandra longifolia	Mat Rush	40%	3	NT	13123
Ziera smithii	Sandfly Ziera	30%	3	NT	9842
Total		**100%**			**36087**

Botanical Name	Common Name	% of Species per Area	Spacing (m²)	Sizes	Qty.
Moist Floodplain Forest (Non-EEC)					
Trees			**Area (m²)**		**845**
Acmena smithii	Lilly Pilly	As Shown	As Shown	35Litre	43
Jagera Pseudorhus	Foambark	As Shown	As Shown	35Litre	123
Eucalyptus resinifera	Red Mahogany	As Shown	As Shown	35Litre	44
Allocasuarina torulosa	Forest She Oak	As Shown	As Shown	35Litre	42
Eucalyptus acmenoides	Cabbage Gum	As Shown	As Shown	35Litre	88
Allocasuarina littoralis	Black She Oak	5%	0.1	NT	4
Allocasuarina torulosa	Forest She Oak	5%	0.1	NT	4
Corymbia gummifera	Red Bloodwood	10%	0.1	NT	8
Corymbia intermedia	Pink Bloodwood	10%	0.1	NT	8
Eucalyptus acmenoides	White Mahogany	10%	0.1	NT	8
Eucalyptus globoidea	White Stringybark	10%	0.1	NT	8
Eucalyptus microcorys	Tallowood	10%	0.1	NT	8
Eucalyptus pilularis	Blackbutt	10%	0.1	NT	8
Eucalyptus resinifera	Red Mahogany	10%	0.1	NT	8
Eucalyptus siderophloia	Grey Ironbark	5%	0.1	NT	4
Glochidion ferdinandi	Cheese tree	5%	0.1	NT	4
Livistona australis	Cabbage Tree Palm	5%	0.1	NT	4
Syncarpia glomulifera	Turpentine	5%	0.1	NT	4
Total		**100%**			**420**
Shrubs			**Area (m²)**		**845**
Leptospermum polygalifolium	Tantoon	25%	0.5	NT	106
Melaleuca sieberi	Paperbark	25%	0.5	NT	106
Banksia spinulosa var. collina	Hairpin Banksia	25%	0.5	NT	106
Melaleuca thymifolia	Thyme Honey Myrtle	25%	0.5	NT	106
Total		**100%**			**422**
Groundcovers, tussocks, grasses and sedges			**Area (m²)**		**845**
Dianella caerulea	Flax Lily	25%	4	NT	845
Gahnia sieberiana	Red-fruited Saw-sedge	25%	3	NT	634
Juncus usitatus	Common Rush	25%	4	NT	845
Lomandra hystrix	Mat Rush	25%	3	NT	634
Total		**100%**			**2959**
Blackmans Point Interchange			**Area (m²)**		**3683.5**
Lomandra hystrix	Mat Rush	100%	3	NT	11051
Total		**100%**			**11051**

Botanical Name	Common Name	% of Species per Area	Spacing (m²)	Sizes	Qty.
Moist Floodplain Closed Forest with Rainforest Elements (EEC)					
Trees			**Area (m²)**		**101**
Melaleuca quinquenervia	Broad-leaved Paperbark	As Shown	As Shown	35Litre	79
Acmena smithii	Lilly Pilly	10%	0.1	NT	1
Acronychia oblongifolia	White Lilly Pilly	10%	0.1	NT	1
Cryptocarya microneura	Murrogun	10%	0.1	NT	1
Endiandra sieberi	Pink Walnut	5%	0.1	NT	1
Eucalyptus grandis	Flooded Gum	5%	0.1	NT	1
Eucalyptus pilularis	Blackbutt	5%	0.1	NT	1
Eucalyptus propinqua	Small-fruited Grey Gum	5%	0.1	NT	1
Eucalyptus resinifera	Red Mahogany	5%	0.1	NT	1
Ficus coronata	Sandpaper Fig	10%	0.1	NT	1
Glochidion ferdinandi	Cheese Tree	10%	0.1	NT	1
Guoia semiglauca	guioa	10%	0.1	NT	1
Lophostemon confertus	Brush Box	5%	0.1	NT	1
Melaleuca styphelioides	Prickly-leaved Tea Tree	5%	0.1	NT	1
Syncarpia glomulifera	Turpentine	5%	0.1	NT	1
Total		**100%**			**93**
Shrubs			**Area (m²)**		**100.9**
Callistemon salignus	Willow Bottlebrush	50%	0.5	NT	25
Cordyline stricta	Narrow-leaved Palm Lily	13%	2	NT	26
Hibiscus splendens	Pink Hibiscus	13%	0.5	NT	7
Pittosporum spinescens	Orange Thorn	12%	0.5	NT	6
Tabernaemontana pandacaqui	Banana Bush	12%	0.5	NT	6
Total		**100%**			**69**
Groundcovers, tussocks, grasses and sedges			**Area (m²)**		**101**
Carex appressa	Tall Sedge	30%	3	NT	91
Cissus hypoglauca	Water Vine	5%	3	NT	15
Gahnia clarkei	Tall Saw-sedge	30%	3	NT	91
Geitonoplesium cymosum	Scrambling Lily	5%	4	NT	20
Lomandra hystrix	Mat Rush	30%	3	NT	91
Total		**100%**			**308**

Botanical Name	Common Name	% of Species per Area	Spacing (m²)	Sizes	Qty.
Riparian Forest (EEC)					
Trees			**Area (m²)**		**2877.3**
Acmena smithii	Lilly Pilly	10%	0.1	NT	29
Acronychia oblongifolia	White Lilly Pilly	10%	0.1	NT	29
Alphitonia excelsa	Red Ash	5%	0.1	NT	14
Clerodendrum tomentosum	Hairy Clerodenrum	5%	0.1	NT	14
Cryptocarya microneura	Murrogun	5%	0.1	NT	14
Cupaniopsis anacardioides	Tuckeroo	5%	0.1	NT	14
Elaeocarpus obovatus	Blueberry Ash	5%	0.1	NT	14
Endiandra sieberi	Pink Walnut	5%	0.1	NT	14
Eucalyptus grandis	Flooded Gum	5%	0.1	NT	14
Eucalyptus microcorys	Tallowood	5%	0.1	NT	14
Eucalyptus tereticornis	Forest Red Gum	5%	0.1	NT	14
Glochidion ferdinandi	Cheese Tree	5%	0.1	NT	14
Gmelina leichhardti	White Beech	5%	0.1	NT	14
Guoia semiglauca	guioa	5%	0.1	NT	14
Jagera pseudorhus	Foambark	5%	0.1	NT	14
Melaleuca styphelioides	Prickly-leaved Tea Tree	5%	0.1	NT	14
Melaleuca linariifolia	Flax-leaved Paperbark	5%	0.1	NT	14
Tristaniopsis laurina	Water Gum	5%	0.1	NT	14
Total		**100%**			**282**
Shrubs			**Area (m²)**		**2877**
Backhousia myrtifolia	Grey Myrtyle	25%	0.5	NT	360
Cordyline stricta	Narrow-leaved Palm Lily	25%	0.5	NT	360
Hibiscus splendens	Pink Hibiscus	25%	0.5	NT	360
Rubus hillii	Native Rasberry	25%	0.5	NT	360
Total		**100%**			**1441**
Groundcovers, tussocks, grasses and sedges			**Area (m²)**		**2877.3**
Carex appressa	Tall Sedge	35%	3	NT	3021
Geitonoplesium cymosum	Scrambling Lily	10%	4	NT	1151
Gymnostachys anceps	Settlers Flax	10%	4	NT	1151
Lomandra hystrix	Mat Rush	45%	3	NT	3884
Total		**100%**			**9210**

Botanical Name	Common Name	% of Species per Area	Spacing (m²)	Sizes	Qty.
Paperbark Swamp Forest (EEC)					
Trees			**Area (m²)**		**9092**
Melaleuca quinquinervia	Broad-leaved Paperbark	As Shown	As Shown	35L	90
Melaleuca linariifolia	Flax-leaved Paperbark	25%	0.1	NT	227
Melaleuca quinquinervia	Broad-leaved Paperbark	25%	0.1	NT	227
Melaleuca styphelioides	Prickly-leaved Tea Tree	25%	0.1	NT	227
Tristaniopsis laurina	Water Gum	25%	0.1	NT	227
Total					**1001**
Shrubs			**Area (m²)**		**10928**
Callistemon salignus	Willow Bottlebrush	50%	0.5	NT	2732
Cordyline stricta	Narrow-leaved Palm Lily	15%	2	NT	3278
Leptospermum polygalifolium	Tantoon	35%	0.5	NT	1912
Total		**100%**			**7926**
Groundcovers, tussocks, grasses and sedges			**Area (m²)**		**10928**
Carex appressa	Tall Sedge	20%	3	NT	6557
Gahnia sieberiana	Red-fruited Saw-sedge	20%	3	NT	6557
Juncus usitatus	Common Rush	20%	4	NT	8743
Lomandra hystrix	Mat Rush	20%	3	NT	6557
Total		**100%**			**34971**

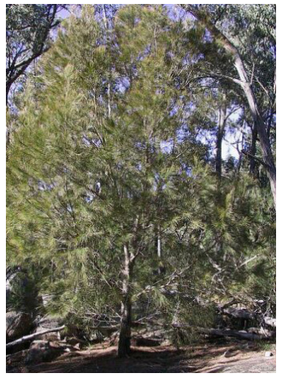
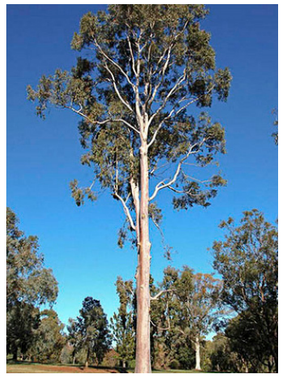
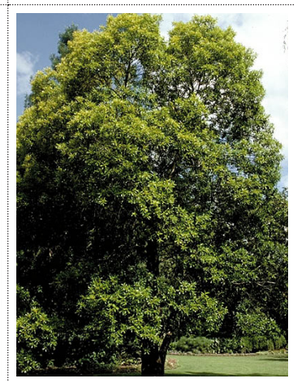
Botanical Name	Common Name	% of Species per Area	Spacing (m²)	Sizes	Qty.
Swamp Mahogany Forest/Forest Red Gum Swamp Forest (EEC)					
Trees			**Area (m²)**		**3807**
Melaleuca quinquinervia	Broad-leaved Paperbark	As Shown	As Shown	35L	0
Alphitonia excelsa	Red Ash	10%	0.1	NT	38
Eucalyptus amplifolia	Cabbage Gum	10%	0.1	NT	38
Eucalyptus resinifera	Red Mahogany	10%	0.1	NT	38
Eucalyptus robusta	Swamp Mahogany	10%	0.1	NT	38
Eucalyptus tereticornis	Forest Red Gum	10%	0.1	NT	38
Melaleuca decora	Paperbark	10%	0.1	NT	38
Melaleuca linariifolia	Flax-leaved Paperbark	20%	0.1	NT	76
Melaleuca quinquinervia	Broad-leaved Paperbark	20%	0.1	NT	76
Total		**100%**			**380**
Shrubs			**Area (m²)**		**3807**
Callistemon salignus	Willow Bottlebrush	60%	0.5	NT	1142
Melaleuca nodosa	Prickly leaved Paperbark	20%	0.5	NT	381
Leptospermum polygalifolium	Tantoon	20%	0.5	NT	381
Total		**100%**			**1901**
Groundcovers, tussocks, grasses and sedges			**Area (m²)**		**3807**
Carex appressa	Tall Sedge	10%	3	NT	1142
Crinum pedunculatum	Swamp Lily	20%	3	NT	2284
Gahnia clarkei	Tall Saw-sedge	10%	3	NT	1142
Gahnia sieberiana	Red-fruited Saw-sedge	10%	3	NT	1142
Juncus usitatus	Common Rush	10%	4	NT	1523
Lomandra hystrix	Mat Rush	30%	3	NT	3426
Schoenus melanostachys	Black Bog Rush	10%	4	NT	1523
Total		**100%**			**12179**

Botanical Name	Common Name	% of Species per Area	Spacing (m²)	Sizes	Qty.
Swamp Oak Forest (EEC)					
Trees			**Area (m²)**		**3479**
Casuarina glauca	Swamp Oak	100%	0.1	NT	348
Total		**100%**			**348**
Shrubs			**Area (m²)**		**4575**
Callistemon salignus	Willow Bottlebrush	50%	0.5	NT	1144
Guioa semiglauca	Guioa	15%	0.5	NT	343
Melaleuca nodosa	Prickly leaved Paperbark	20%	0.5	NT	457
Myoporum acuminatum	Water Bush	15%	0.5	NT	343
Total		**100%**			**2286**
Groundcovers, tussocks, grasses and sedges			**Area (m²)**		**4575**
Baumea juncea	Bare Twig-rush	50%	3	NT	6862
Carex appressa	Tall Sedge	25%	3	NT	3431
Gahnia sieberiana	Red-fruited Saw-sedge	25%	3	NT	3431
Total		**100%**			**13724**
Headlight screen planting					
			Area (m²)		5094
Acmena smithii	Lilly Pilly	20%	0.5	200mm	509
Callistemon salignus	Willow Bottlebrush	20%	1	200mm	1019
Elaeocarpus reticulatus	Blueberry Ash	20%	0.5	200mm	509
Lomandra hystrix	Mat Rush	30%	3	150mm	4585
Waterhousia floribunda	Weeping Lilly Pilly	10%	0.3	25L	153
Total		**100%**			**6776**

Botanical Name	Common Name	% of Species per Area	Spacing (m²)	Sizes	Qty.
Visual screen planting at Winery, Tea tree plantation and approx. Ch. 19200, 19400, 19900 and 20000					
					10789
Acmena smithii	Lilly Pilly	As Shown	As Shown	25L	30
Elaeocarpus reticulatus	Blueberry Ash	As Shown	As Shown	25L	30
Waterhousia floribunda	Weeping Lilly Pilly	As Shown	As Shown	25L	17
Callistemon salignus	Willow Bottlebrush	15%	1	NT	1119
Cordyline stricta	Narrow-leaved Palm Lily	10%	2	NT	1492
Hibiscus splendens	Pink Hibiscus	5%	1	NT	373
Eupomatia laurina	Bolwarra	10%	3	NT	2237
Carex appressa	Tall Sedge	20%	4	NT	5966
Dianella caerulea	Blue Flax Lily	20%	4	NT	5966
Lomandra hystrix	Mat Rush	20%	3	NT	4475
Total		**100%**			**21708**
Tree Planting to Glider Poles and Rope Bridges					
					310
Corymbia maculata	Spotted Gum	50%	As Shown	200mm	155
Eucalyptus tereticornis	Forest Red Gum	50%	As Shown	200mm	154
Total		**100%**			**309**

Totals	
Total 75 Litre	
Total 35 Litre	543
Total 25 Litre	230
Total 200mm	2348
Total 150mm	4585
Total No. Native Tubes-trees	3174
Total No. Native Tubes-shrubs	26374
Total No. Native Tubes-Groundcovers	136896
Total No. of all Native Tubes	166444
Total Area of all Planting Beds (m²)	**59637**

Plant Palette - Trees

							
Acmena smithii	*Allocasuarina torulosa*	*Allocasuarina littoralis*	*Alphitonia excelsa*	*Corymbia gummifera*	*Elaeocarpus obovatus*	*Elaeocarpus reticulatus*	*Jagera pseudorhus*
							
Eucalyptus globoidea	*Eucalyptus acmenoides*	*Eucalyptus tereticornis*	*Eucalyptus propinqua*	*Melaleuca styphelioides*	*Melaleuca linariifolia*	*Syncarpia glomulifera*	*Ficus coronata*
							
Casuarina glauca	*Eucalyptus microcorys*	*Archontophoenix cunninghamiana*	*Corymbia intermedia*	*Eucalyptus pilularis*	*Eucalyptus grandis*	*Corymbia maculata*	*Eucalyptus fibrosa*
							
Glochidion ferdinandi	*Eucalyptus resinifera*	*Eucalyptus siderophloia*	*Livistona australis*	*Melaleuca quinquinervia*	*Lophostemon confertus*	*Tristaniopsis laurina*	*Cupaniopsis anacardioides*

Lend Lease

Plant Palette - Shrubs

							
Callistemon salignus	*Leptospermum polygalifolium*	*Backhousia myrtifolia*	*Hibiscus splendens*	*Cordyline stricta*	*Tabernaemontana pandacaqui*	*Melaleuca linariifolia*	*Banksia spinulosa var. collina*
							
Melaleuca nodosa	*Daviesia ulicifolia*	*Gompholobium pinnatum*	*Pilidiostigma glabrum*	*Pultenaea villosa*	*Melaleuca sieberi*		

Plant Palette - Groundcovers, tussocks, grasses and sedges

							
Baumea articulata	*Lomandra longifolia*	*Gahnia sieberiana*	*Carex appressa*	*Crinum pedunculatum*	*Dianella caerulea*	*Schoenus*	*Phylidrum lanuginosum*
							
Isolepsis inundata	*Gahnia clarkei*	*Juncus usitatus*	*Themeda australis*		*Lomandra longifolia*	*Lepidosperma laterale*	*Schoenus melanostachys*

F.7.2 Seeding Schedule

Botanical Name	Common Name	Mature Height	Application Rate of Seed Kg/Ha	Fertilizer: Organic slow release for natives (low p)	Total (Kg)
Native Grasses			**Area (Ha)**		**39.4**
Austrodanthonia richardsonii	Wallaby Grass	30cm	0.5	250Kg/Ha	19.7
Austrostipa scrabra	Speargrass	1.8m	1	250Kg/Ha	39.4
Bothriochloa macra	Tussock Grass		0.5	250Kg/Ha	19.7
Capillipedium spicigerum	Scented Top Grass	1.5m	1	250Kg/Ha	39.4
Chloris truncata	Windmill Grass	100cm	1	250Kg/Ha	39.4
Cymbopogon refractus	Barbed Wire Grass		0.5	250Kg/Ha	19.7
Imperata cylindrica	Blady Grass		0.5	250Kg/Ha	19.7
Ficinia nodosa#	Knobby Club-rush		0.5	250Kg/Ha	19.7
Juncus usitatus#	Common Rush		0.5	250Kg/Ha	19.7
Lepidosperma laterale#	Variable Saw-sedge		0.5	250Kg/Ha	19.7
Lomandra longifolia	Mat Rush		0.5	250Kg/Ha	19.7
Themeda triandra	Kangaroo Grass		1	250Kg/Ha	39.4
	Total		**8**		**315**
# denotes sedge species					

Botanical Name	Common Name	Mature Height	Application Rate of Seed Kg/Ha	Fertilizer: Organic slow release for natives (low p)	Total (Kg)
Frangible shrubs			**Area (Ha)**		**24.8**
Austrostipa scrabra	Speargrass		0.2	250Kg/Ha	5.0
Bothriochloa macra	Tussock Grass		0.2	250Kg/Ha	5.0
Capillipedium spicigerum	Scented Top Grass		0.2	250Kg/Ha	5.0
Chlorus truncata	Windmill Grass		0.2	250Kg/Ha	5.0
Juncus usitatus	Common Rush		0.2	250Kg/Ha	5.0
Themeda triandra	Kangaroo Grass		0.2	250Kg/Ha	5.0
*Acacia falcata**	Wattle	3m	1	250Kg/Ha	24.8
*Acacia longissima**	Long leaved Wattle	4m	1	250Kg/Ha	24.8
*Acacia myrtifolia**	Myrtle Wattle		0.5	250Kg/Ha	12.4
Banksia spinulosa var. collina	Hairpin Banksia	3m	0.1	250Kg/Ha	2.5
*Daviesia ulicifolia**	Gorse Bitter Pea	2m	0.5	250Kg/Ha	12.4
Dianella caerulea	Flax Lily	0.4m	0.2	250Kg/Ha	5.0
Dodonaea triquerta	Hp Bush		0.2	250Kg/Ha	5.0
*Gompholobium pinnatum**	Pinnate Wedge Pea	0.3m	0.2	250Kg/Ha	5.0
*Hardenbergia violaceae**	Native Sarsasparilla		0.5	250Kg/Ha	12.4
Lomandra hystrix	Mat Rush		0.5	250Kg/Ha	12.4
Lomandra longifolia	Mar Rush	1.2m	1	250Kg/Ha	24.8
Melaleuca nodosa	Prickly leaved Paperbark	4m	0.1	250Kg/Ha	2.5
Ozothamnus diosmifolius	Rice Flower	4m	0.2	250Kg/Ha	5.0
*Platylobium formosum**	Handsome Flat Pea	2m	0.2	250Kg/Ha	5.0
*Pultenaea retusa**	Notched Bush-Pea	2m	0.2	250Kg/Ha	5.0
*Pultenaea villosa**	Hairy Bush-Pea	1m	0.2	250Kg/Ha	5.0
Zieria smithii	Zieria	1.5m	0.2	250Kg/Ha	5.0
	Total		**8**		**199**

* Pre treatment to assist germination by immerging seeds contained in a bag in hot water (90°C) for 60 minutes

Botanical Name	Common Name	Mature Height	Application Rate of Seed Kg/Ha	Fertilizer: Organic slow release for natives (low p)	Total (Kg)
Tall shrubs			**Area (Ha)**		**14.1**
Austrostipa scrabra	Speargrass		0.1	250Kg/Ha	1.4
Bothriochloa macra	Tussock Grass		0.1	250Kg/Ha	1.4
Capillipedium spicigerum	Scented Top Grass		0.2	250Kg/Ha	2.8
Chlorus truncata	Windmill Grass		0.2	250Kg/Ha	2.8
Juncus usitatus	Common Rush		0.1	250Kg/Ha	1.4
Themeda triandra	Kangaroo Grass		0.2	250Kg/Ha	2.8
*Acacia falcata**	Wattle	3m	0.2	250Kg/Ha	2.8
*Acacia myrtifolia**	Myrtle Wattle		0.3	250Kg/Ha	4.2
Banksia spinulosa var. collina	Hairpin Banksia	3m	0.1	250Kg/Ha	1.4
*Daviesia ulicifolia**	Gorse Bitter Pea	2m	0.2	250Kg/Ha	2.8
Dianella caerulea	Flax Lily	0.4m	0.2	250Kg/Ha	2.8
Dodonaea triquerta	Hp Bush		0.2	250Kg/Ha	2.8
*Gompholobium pinnatum**	Pinnate Wedge Pea	0.3m	0.2	250Kg/Ha	2.8
*Hardenbergia violaceae**	Native Sarsasparilla		0.5	250Kg/Ha	7.0
Lomandra hystrix	Mat Rush		0.5	250Kg/Ha	7.0
Lomandra longifolia	Mar Rush	1.2m	0.5	250Kg/Ha	7.0
Melaleuca nodosa	Prickly leaved Paperbark	4m	0.1	250Kg/Ha	1.4
Ozothamnus diosmifolius	Rice Flower	4m	0.2	250Kg/Ha	2.8
*Platylobium formosum**	Handsome Flat Pea	2m	0.2	250Kg/Ha	2.8
*Pultenaea retusa**	Notched Bush-Pea	2m	0.2	250Kg/Ha	2.8
*Pultenaea villosa**	Hairy Bush-Pea	1m	0.2	250Kg/Ha	2.8
Zieria smithii	Zieria	1.5m	0.2	250Kg/Ha	2.8
Acacia binervata	Two-veined Hickory		0.4	250Kg/Ha	5.6
*Acacia fimbriata**	Fringed Wattle	5m	0.5	250Kg/Ha	7.0
Acacia floribunda	Sally Wattle		0.4	250Kg/Ha	5.6
Acacia irrorata	Green Wattle		0.4	250Kg/Ha	5.6
*Acacia longifolia**	Sydney Golden Wattle	7m	0.5	250Kg/Ha	7.0
*Acacia longissima**	Long leaved Wattle	4m	0.2	250Kg/Ha	2.8
Allocasuarina torulosa	Forest She-oak	7m	0.1	250Kg/Ha	1.4
Callistemon salignus	Willow Bottlebrush	7m	0.1	250Kg/Ha	1.4
Hibiscus splendens	Pink Hibiscus	5m	0.2	250Kg/Ha	2.8
Leptospermum polygalifolium	Tantoon	5m	0.1	250Kg/Ha	1.4
Melaleuca linariifolia	Flax-leaved Paperbark		0.1	250Kg/Ha	1.4
Melaleuca sieberi	Paperbark	5m	0.1	250Kg/Ha	1.4
	Total		**8**		**113**

* Pre treatment to assist germination by immerging seeds contained in a bag in hot water (90°C) for 60 minutes

Botanical Name	Common Name	Mature Height	Application Rate of Seed Kg/Ha	Fertilizer: Organic slow release for natives (low p)	Total (Kg)
Pasture grasses seeding mix			**Area (Ha)**		**15.2**
Axonopus fissifolius	Carpet Grass		5	250Kg/Ha	76.0
Cynodon dactylon	Unhulled Couch		5	250Kg/Ha	76.0
Echinochloa itilis (Sep-Mar) or Secale cereale (Apr-Aug)	Japanese Millet or Rye Corn		40	250Kg/Ha	607.9
Lolium multiflorum	Eclipse Rye		20	250Kg/Ha	303.9
Trifolium pratense	Red Clover		5	250Kg/Ha	76.0
	Total		**75**		**1140**
Cover crop seeding mix (All disturbed areas identified to be hydromulched except Pasture grass areas which already contains cover crop) cover crop may be applied separately or in conjunction with all other hydromulch mixes			**Area (Ha)**		**78.3**
Echinochloa itilis (Sep-Mar) or Secale cereale (Apr-Aug)	Japanese Millet or Rye Corn		20	250Kg/Ha	1566.9
Lolium multiflorum (All Year)	Eclipse Rye		10	250Kg/Ha	783.5
	Total		**30**		**2350**

F.8 Locations Impacted by the Construction of The Project

The following areas may be impacted by the construction of the Oxley Highway to Kundabung Project (The Project): temporary ancillary facilities, access roads and watercourses that cross The Project alignment.

As a minimum, these sites will be prepared as for other vegetated areas, topsoiled and seeded with native plants, native grasses or pasture grasses in order to restore the site to its former condition. The landscape concept plan (refer Figures F.6.2.1-F.6.2.25) and schedules (Section F.7) nominate which species are to be used according to the vegetation community type occurring in any given area. Refer to Section F.8.1 and F.8.2 for the procedures required to be followed to minimize the impacts of ancillary facilities and temporary stockpile sites on the environment.

The proposed treatment of landscape mounds on The Project are discussed in Section E.1.2. Not all landscape mounds will necessarily be installed as they are dependant on the final quantity of material remaining at completion of construction of the main works.

Where temporary waterway crossings are required as part of the temporary works, the contractor must prepare and include in the Construction Environment Management Plan (CEMP) a Work Method Statement (WMS) detailing the control measures to avoid where possible, and minimise any adverse impact on water quality and riparian fauna and flora. The contractor must consult the Roads and Maritime Representative, Environmental Protection Agency (EPA), Department of Primary Industries (DPI) and NSW Office of Water and other relevant agencies in preparing the WMS and prior to undertaking any works near or in the waterways.

For restoration procedures proposed at permanent waterway crossings refer to Section F.4.7.

The landscape design addresses some of the loss of vegetation and the visual impacts for some residences where existing vegetation is removed. Where residual visual impacts remain, these are discussed in Section F.4.12.

Note that headlight screen planting is proposed (approximately 760 metres). This planting will also assist in providing visual mitigation of the highway for adjacent businesses and residences.

For a description of the management of the existing vegetation on The Project refer to Section F.9.

F.8.1 Ancillary Facilities

Ancillary facilities are all temporary site infrastructure required to construct The Upgrade and can include site compounds for offices, car parks, toilets sheds, hardstand and batch plants. There are also access tracks associated with these sites.

All proposed sites will go through an environmental approvals process in accordance with the requirements for ancillary facilities in Ministers Conditions of Approval (MCoA) C28. Such assessment(s) will be submitted to NSW Department of Planning and Environment separately or as part of the CEMP) required under condition B30. Where ancillary facilities are located within Roads and Maritime owned land, the site is to be rehabilitated as required by the Roads and Maritime specification R178 Vegetation when no longer in use.

The procedures to be followed to protect and minimise the impact of ancillary facilities on the environment are to be contained in the contractor's CEMP. Where temporary ancillary facilities are located within private lands, the contractor will make arrangements/agreements with the landholder regarding the condition of the subject lands at handover.

F.8.2 Stockpile Sites

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

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

The criteria used to determine the location of stockpiles and minimum mitigation measures are to be stated in the contractor's CEMP as required by MCoA B30.

At the de-commissioning of stockpile sites they are to be rehabilitated to a condition equal to the condition prior to disturbance as required by the Roads and Maritime specification R178 Vegetation.

F.8.3 Progressive Re-vegetation

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 followed by seeding
- In accordance with Roads and Maritime specifications all prepared areas flatter than 3H:1V requiring vegetation must be vegetated within 14 days and steeper than 3H:1V within seven days
- All topsoiled areas are to be seeded within two days of completion of soil preparation or, if delayed by the weather conditions, as soon as weather conditions permit
- Open drains are to be vegetated within seven days of excavation
- Use of cover crops for rapid stabilisation of bare soils. Cover crop may be applied separately or in conjunction with all other hydromulch mixes
- Planting is used where trees, shrubs and ground covers are required for early landscape and visual effect and for early landscape establishment in fauna movement corridors and adjacent to underpasses and below bridge structures and at creeksides
- Maintenance inspection of plantings must be carried out at least monthly and missing or dead plants must be replaced within 14 days of detection.

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

Areas which receive erosive pressures such as vegetated channels, water quality basins and slopes steeper than 2H:1V, will have organic fibre mesh installed in order to improve the establishment of the re-vegetation.

F.9 Strategy & Principles to Maximise Existing Vegetation & Methodology to Protect Existing Vegetation

Due to the presence of Endangered Ecological Communities (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. Providing a methodology for those carrying out the work is also important in order to protect existing vegetation.

Where fauna fencing alone occurs, the construction footprint beyond the top of cuts will be restricted to 3.7 metres and beyond the toe of fills 3.7 metres. When catch drains also occur the restriction will be 6.7 metres and 6.7 metres respectively.

The advantages of retaining the existing vegetation as close as possible to the carriageways are not only environmental. Retention of existing vegetation also provides better visual and economic outcomes.

The following summarises the procedures to protect and maximise retention of existing vegetation and is given as a guide only. Where any of the following recommendations are not consistent with the Construction Environment Management Plan (CEMP) requirements for this project, the CEMP takes precedence:

- A pre-clearing assessment is to be undertaken by a qualified ecologist to identify the following:
  - hollow bearing and /or habitat trees
  - Threatened species or endangered ecological communities.
- Where identified, the use of fencing around all threatened species or EEC's shall be undertaken to ensure construction activities do not encroach into threaten habitats or habitats containing threatened species where disturbance has not been approved
- Collection of seed will be implemented prior to clearing where possible
- Where significant stands of vegetation are to be retained, exclusion fencing will be erected before the commencement of construction. Similarly, parking areas, storage sites, turning circles and access points will be fenced off
- Prior to demolition or construction work commencing, all trees to be retained will be marked with non-injurious, easily visible and removable means of identification. All such identification will be removed on completion of works. Individual trees to be retained will be tagged. Groups of trees or shrubs will be bounded or encircled by exclusion fencing
- Storage of materials, mixing of materials, vehicle parking or stockpiling of materials will not be carried out within the drip line of existing trees to be retained. No bulk materials and /or harmful materials will be placed under or near trees. Spoil, chemicals or construction waste from excavations will not be placed against tree trunks, even for short periods. All measures will be undertaken to prevent windblown materials from harming trees and plants
- Topsoil will not be added to or removed from within the drip line of existing trees without approval. Should it be necessary to excavate within the drip line, hand methods such that root systems are preserved intact and undamaged will be used.

No encroachments into adjacent nominated bushland or vegetation will be permitted for access of machinery, for traffic control or for the stockpiling of material required for construction.

- Activities prohibited within existing fenced areas will include:
  - Entry of machinery or people
  - Storage of building materials
  - Parking of any kind
  - Erection or placement of site facilities
  - Removal of stockpiling of soil or site debris
  - Disposal of any liquid waste including paint and concrete wash
  - Excavation or trenching of any kind, including for irrigation or electrical connections
  - Attaching signs or any other objects to trees
  - Placement of waste disposal or skip bins
  - Pruning and removal of branches, except by a qualified Arborist.
- Where necessary a qualified Arborist will be appointed to advise on specific aspects of tree protection prior to commencement of demolition or construction.

F.9.1 Endangered Species - Maundia triglochinoides

M. triglochinoides is a perennial wetland species listed as Vulnerable under the NSW Threatened Species Conservation Act 1995. The most current surveys identify that at most 0.87 hectares of *M. triglochinoides* is to be impacted. These sites are located at Fernbank Creek and associated drainage lines, and on the Wilson River floodplain drainage lines. The report: *Surveys and Assessment of Impact: Maundia triglochinoides in the Pacific Highway Upgrade - Oxley Highway to Kempsey Project area. SMEC Hyder Joint Venture 13 June 2013* notes that a translocation strategy would not be feasible or reasonable and suggests mitigation and management measures including specific landscaping/revegetation measures to buffer the areas adjacent to *M. triglochinoides* populations with appropriate vegetation.

The habitat for Maundia will be optimised in these locations through the following strategies:

- No tree planting is proposed where Maundia occurs because Maundia prefers full sun for optimum conditions.
- Where sites are disturbed in the vicinity of potential Maundia habitat, planting of endemic sedges will be used to both rehabilitate the disturbance and to buffer the Maundia habitat.
- The implementation of weed and erosion control measures in and adjacent to retained populations will be captured in the landscape management report (LMP), to be provided with the design documentation.

Removal and relocation (called translocation) of other threatened species found present within the disturbed areas where considered feasible will be managed and protected under the supervision of The Project Ecologist.

Arthraxon hispidus has been recorded within 2km of the existing highway at Kundabung. *Melaleuca biconvexa* has been recorded just south of the Oxley Highway/Pacific Highway interchange and may be found in other locations along the route. Further investigations conducted and reported in the *Preliminary Aquatic Flora and Fauna Assessment for the project* (HWR Ecological, 2005), also identified Scented Acronychia (*Acronychia littoralis*) as being present on the Wilson River floodplain.

F.9.2 Sites of Biodiversity

In addition to the above, where clearing is undertaken adjacent to EECs, clearing will be undertaken so as to avoid trees falling into the protected vegetation. Where trees are entwined the ecologist may request the tree to be removed by an arborist. Where vegetation is to be retained, and construction buffer zones are to be enforced to restrict the movement of plant and machinery outside the allowed area, and limit project works, delineation and signage will be erected to serve this purpose, before clearing commences.

Control measures would be implemented to prevent and minimise construction impacts in riparian zones and to ensure that appropriate rehabilitation is undertaken. Such measures may include:

- Establishing a vegetated 'buffer' area along the waterway where possible
- Existing trees, grasses and other ground cover will be retained as far as possible within 15 metres of rivers, creeks and watercourses and in all drainage lines immediately before construction commences in an area
- Fencing off mature trees (especially those with hollows) and vegetation for protection
- Minimising the footprint of temporary works including crossings
- Ensuring that snags and other aquatic habitat features are not disturbed
- Clearly identifying stockpile and storage locations
- Providing erosion and sediment controls around stockpiles
- Restricting the entry of plants and persons to the banks of the waterway to prevent damage and instability
- Rehabilitating disturbed or degraded areas with appropriate native species;
- Generally the use of heavy machinery will not be permitted within 10m of the tree line or moist areas
- Trees within ten metres of the centreline of any bridges to be constructed and five metres of the bank of any stream or other waterway are to be cleanly cut off between 300 and 600mm above the adjacent ground level to ensure stable vegetation is retained on the banks.

F.10 Landscape Management Report

A Landscape Management Report (LMR) is required to be prepared as part of the design documentation and will detail all landscape maintenance actions for The Upgrade. The landscape maintenance works will be monitored and maintained by a suitably qualified landscape specialist for a period as specified in Roads and Maritime Specifications D&C R178 and R179.

Any required remediation measure(s) will be implemented to maintain landscaping works as required.

The landscaping will be cost effective and will minimise ongoing maintenance requirements and utilise native species, dense planting, bold simple planting designs and rapid planting establishment.

1.0 Introduction

1.1 Purpose of this Report

This Landscape Maintenance Plan (LMP) is required by the Roads and Maritime to promote the cost effective and consistent management of roadside landscape vegetation established for Oxley Highway to Kundabung (OH2Ku).

For contractual requirements of the Landscaping Maintenance refer to The Project Deed Section 14 Landscape Maintenance and the Scope of Works and Technical Criteria section 2.2.2 Nature and Extent of Landscape Maintenance

This LMP promotes a standard approach to the maintenance of landscape plantings, both in technique and frequency.

To avoid duplication and to highlight the specific maintenance requirements of some landscape types, the LMP details the required maintenance actions into two categories:

- All Areas; Those maintenance actions that apply to every section of the landscape.
- Specific Landscape Types; Those maintenance actions specific to the different landscape types present.

The Landscape Maintenance Period commences from the Date of Construction Completion and is for a period of 36 months

1.2 Where This Report Applies

This LMP applies to Pacific Highway Upgrade – Oxley Highway to Kundabung between Chainage 750.0 (M110) and 24100 (M220), just north of Barrys Creek.

The approximate locations of the scope of works is illustrated Figure 1.

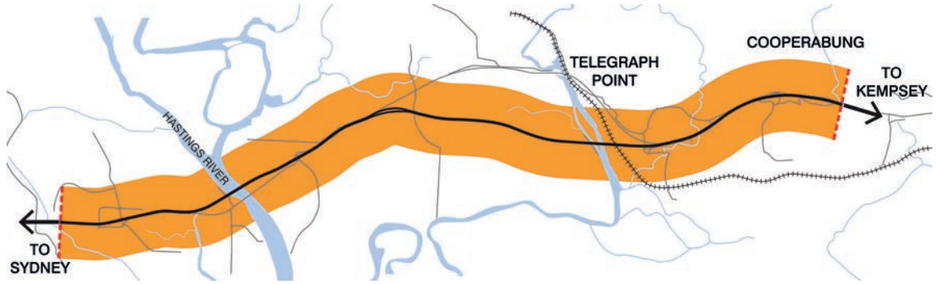


Figure 1: Location of the scope of works

1.3 Landscape Maintenance Responsibility

Two government agencies and the contractor are responsible for the maintenance of roadside landscapes within this LMP:

Agency	Extent of responsibility on Oxley Highway to Kundabung.
Port Macquarie-Hastings Council	Local service roads, roundabouts, intersections and public areas immediately outside of the highway corridor following the 36 month Landscape Maintenance Period. During the Landscape Maintenance Period, the contractor is required to mow grass during establishment only. Thereafter mowing of Council areas is by Council. Council is responsible for the all aspects of the ongoing maintenance of the above listed areas following the 36 month Landscape Maintenance Period. The contractor is not required to remove rubbish other than that generated by themselves. Therefore Council is responsible for rubbish removal throughout and following the Landscape Maintenance Period.
Roads and Maritime	Pacific Highway Corridor Oxley Highway to Kundabung following the 36 month Landscape Maintenance Period. During the Landscape Maintenance Period, the contractor is required to mow during establishment only. Thereafter mowing of the corridor is by Roads and Maritime. The contractor is not required to remove rubbish other than that generated by themselves. Therefore RMS is responsible for rubbish removal throughout and following the Landscape Maintenance Period.
Lend Lease (the contractor)	All- from the commencement of construction until the date of construction completion and for 36 months post completion (The Landscape Maintenance Period) except that the contractor is required to mow grass during establishment only. Thereafter mowing is by others. The contractor is not required to remove rubbish other than that generated by themselves.

1.4 Landscape types to be maintained

Five main landscape types are present. These are:

Landscape Types	
Grass Areas (Mown)	
	Road edge mowing strip Path edge mowing strip Fauna fence maintenance track and clear zone. The contractor is required to mow grass during establishment only. Thereafter mowing is by others

Landscape Types	
Vegetation Areas (Hydromulching or Hydroseeding with rice straw hydromulching over)	
	Trees, shrubs and groundcovers are seeded using Hydroseeding method followed by rice straw hydromulching or hydromulching alone. Species mix varies according to location. The design intent is to allow an easy, quick and repeatable method of establishing vegetation cover with particular concern for soil stability. Where a vegetated area fails (ie scouring, land slippage) the soil profile is reconstructed and re-hydroseeded to re-establish vegetation cover. At specific locations the hydroseeding vegetation is over planted with tubestock tree species. Hydroseeding areas show the following variations, based on the plant species used in specific areas: • Pasture grasses • Native Grasses • Frangible shrubs • Trees and tall shrubs
Planting (Tubestock)	
	Mass planting using tubestocks of tree/tall shrub,frangible shrubs and groundcover species. Planting of tubestocks show the following variations, based on location, function and plant species used in individual areas: Massed tubestocks planted in hydroseeded areas; Massed tubestocks in ponds, wetlands, frog ponds, creek corridors and fauna underpasses Massed tubestocks feature planting in roundabouts, at bridges and sightline zones.
Landscape Planting Beds	
	Landscape planted beds. These vary in appearance from mass plantings of single species (eg. Lomandra sp; Dianella sp) to more complex beds containing advanced trees, low and tall shrubs and ground covers. Planting size includes tubestock - 150mm, 200mm, 25, 35 and 75 litres.
Areas of Special Consideration	
	These spaces may vary in appearance and function and have specific maintenance requirements in addition to other landscape types listed. Batter Re-Vegetation Management Strategy Native Grasses Fauna Underpasses Fauna Fence Water Quality ponds and detention basins Riparian Zones Frog Ponds Glider Crossings

The exact extent of these landscape types is illustrated on the landscape planting and seeding plans.

1.5 Landscape performance outcomes

Planting and seeding must be established and thriving with in excess of 30% growth by the end of the Landscaping Maintenance Period as per SWTC Appendix 15 15.5.6(d).

Revegetation Outcomes

All revegetated areas must be monitored for success of revegetation. Each area revegetated by native seeding must achieve the following minimum standards as assessed at 8 months following revegetation:

- One native plant every 8 m2
- Average minimum height of 10 cm
- 60 % of required native species germinating and growing.

Each area revegetated by native seeding must achieve the following minimum standards as assessed at 12 months following revegetation:

- One native plant every 6 m2
- Average minimum height of 15 cm
- 75 % of required native species germinating and growing.

The above minimum standards must be measured by randomly placed 10 m square grids placed on areas being assessed, with a minimum of 3 randomly placed grids per area. Native planted stock must not be included in plant numbers.

If required minimum standards are not achieved in particular areas, these areas must be treated as a non-conformity.

Also refer to Section 4.1 Batter Re-Vegetation Management Strategy for revegetation areas on slopes 2:1 or steeper.

Planting Outcomes

All areas required to be revegetated by native planting must achieve the following minimum standards within 8 and 12 months of restoration and revegetation:

	8 months of restoration and revegetation	12 months of restoration and revegetation
Minimum plant growth following planting.	20cm	30cm
Minimum plant survival rate	80%	80%

If required minimum standards are not achieved in particular areas, these areas must be treated as a Non-conformity.

Myrtle Rust

Myrtle rust (*Puccinia psidii s.l.*) is a newly described fungus that is closely related to the Eucalyptus/Guava rusts. These rusts are serious pathogens which affect plants belonging to the family Myrtaceae including Australian natives like bottle brush (*Callistemon spp.*), tea tree (*Melaleuca spp.*) and eucalypts (*Eucalyptus spp.*) and is widespread on the eastern seaboard.

Myrtle rust is distinctive in that it produces masses of powdery bright yellow or orange-yellow spores on infected plant parts. It infects leaves of susceptible plants producing spore-filled lesions on young actively growing leaves, shoots, flower buds and fruits. Leaves may become buckled or twisted and may die as a result of infection. Sometimes these infected spots are surrounded by a purple ring. Older lesions may contain dark brown spores. Infection on highly susceptible plants may result in plant death.

Now that myrtle rust is established in NSW responsibilities for its management and control have broadened beyond the Department of Primary Industries and active ongoing management of myrtle rust in NSW is the responsibility of land managers. Myrtle rust has serious implications for the landscaping on the OH2Ku project because many species proposed are from the Myrtle family and hence susceptible to infection. There is also a serious risk of spread from The Project works into adjacent state forests and nature reserves.

National parks, local councils and other organisations that manage tracts of natural vegetation continue to implement biosecurity measures to protect threatened plant species and vegetation communities and to ensure the risk of spread to new areas by workers and visitors is reduced. New hosts and detections in previously uninfected areas of NSW must be referred to the Department of Primary Industries because myrtle rust remains a notifiable pest under the Plant Diseases Act. The final Landscape Maintenance Plan will detail measures to prevent the spread of Myrtle rust.

1.6 Summary table of maintenance required

Maintenance Actions	Tasks	Timeframes / Frequency							
		Weekly	Monthly	Seasonal				As Required	As Specified Below
				Su	Au	Wi	Sp		
All Areas	**(Summarised from Section 2 of this LMP)**								
1. Pruning of Vegetation for Safety	Maintaining driver and pedestrian sightlines								
	Vegetation in intersection traffic islands								
	Pruning trees over carriageways, roads, paths and cycle ways.								
2. Management of Non Frangible Vegetation	Remove woody “non-frangible” vegetation in setbacks								Annually, as needed
3. Noxious Weed Control	Treat noxious weeds according to control category								
4. Rubbish Removal	All rubbish left by contractors to be removed. Site to be left in a clean and tidy condition.								
5. Auditing and Reporting	Audit and report on maintenance and additional works								
Grassed Areas (Mown) Only	**(Summarised from Section 2 of this LMP)**								
1. Mowing	Mow grass to a minimum height of 5cm/ maximum height of 10cm								Every 4 weeks
									Every 6 weeks
									Every 12 weeks
									Every 6 weeks
2. Replacement of Damaged Grass	Re-establish damaged turf.								
3. Weed Control in Grass	Control weeds in turf areas using selective biodegradable herbicides.								

Lend Lease

Maintenance Actions	Tasks	Timeframes / Frequency							
		Weekly	Monthly	Seasonal				As Required	As Specified Below
				Su	Au	Wi	Sp		
4.Watering	Turf must not be allowed to dry out during the establishment period.								
Vegetation areas (Hydroseeding/ hydromulching)	**(Summarised from Section 2 of this LMP)**								
1. Weeding	Weed garden beds (manual or biodegradable herbicide) before weed seed set.								Use biodegradable herbicide only
	Replace landscape plants damaged or killed by herbicide.								Should this happen it suggests improper use. Review manufacturer instructions and application method
2. Herbicide Spraying	Comply with requirements specified in 3.1.1 ‘Herbicide Spraying’ in RMS D&C R178 – Vegetation.								
4. Remove Dead/ Dying Vegetation	Cut back and remove dead, dying planting or planting with poor growth planting material. Do not pull root out. Replace topsoil as required. Prepare topsoil by loosening surface. Ensure topsoil depth is even across affected area and has a smooth transition into the existing vegetation.								

Maintenance Actions	Tasks	Timeframes / Frequency							
		Weekly	Monthly	Seasonal				As Required	As Specified Below
				Su	Au	Wi	Sp		
5. Replacement Hydroseeding/ hydromulching	Reapply seeding as per specification. Seed mix as per vegetation plans and equal to what has been applied previously. Apply sufficient seeding to achieve consistent vegetation cover over affected area	Water replacement plantings weekly							When possible, apply seeding during optimum seasonal conditions
Tubestock areas	**(Summarised from Section 2 of this LMP)**								
1. Weeding	Weed planting area (manual or biodegradable herbicide) before plant flowers.								Use biodegradable herbicide only
	Herbicide application. After spraying lop any dead weeds flush with the ground surface and dispose of cuttings.								
	Replace landscape plants damaged or killed by herbicide.								Should this happen it suggests improper use. Review manufactures instructions and application method
2. Disease and Insect Control	Spraying must only occur on windless days and records of weed conditions must be retained. Sprays should not be used where there is risk of entering a watercourse or wind could cause drifting outside area to be treated.								

Maintenance Actions	Tasks	Timeframes / Frequency							
		Weekly	Monthly	Seasonal				As Required	As Specified Below
				Su	Au	Wi	Sp		
3. Mulching	Re-apply mulch to individual Tubestock and maintain to a depth of 75 mm min Do not apply mulch in areas within water zone ie: ponds, creek lines and wetlands								Every two years
4. Removal of Dead / Dying Plant Material	Remove dead or dying planting material and replace.								
5. Replacement Plantings	Replace failed plantings with specified species and densities.								Within 28 days of detection
	Water replacement plantings for 12 weeks.								
6. Timber Stakes	Check and repair timber stakes if damaged or removed prior to plant establishment.								
	Remove timber stakes.								As required until final removal at 12 months after planting
7. Fertilising and Pruning	Fertilise all plantings at specified rates.								At time of planting
	Prune all plantings in specified manner:								Refer All Areas, Point 1

Maintenance Actions	Tasks	Timeframes / Frequency							
		Weekly	Monthly	Seasonal				As Required	As Specified Below
				Su	Au	Wi	Sp		
Landscape Bed Plantings Only	**(Summarised from Section 2 of this LMP)**								
1. Weeding	Weed planting area (manual or biodegradable herbicide) before plant flowers.								Use biodegradable herbicide only
	Herbicide application. After spraying lop any dead weeds flush with the ground surface and dispose of cuttings.								
	Replace landscape plants damaged or killed by herbicide.								Should this happen it suggests improper use. Review manufactures instructions and application method
2. Disease and Insect Control	Spraying must only occur on windless days and records of weed conditions must be retained. Sprays should not be used where there is risk of entering a watercourse or wind could cause drifting outside area to be treated.								
3. Mulching	Reapply mulch to maintain a depth of 75 mm min.								Every 2 years
4. Removal of Dead / Dying Plant Material	Remove dead or dying planting material and replace.								
5. Replacement Plantings	Replace failed plantings with specified species and densities.								Within 28 days of detection
	Water replacement plantings for 12 weeks.								

Maintenance Actions	Tasks	Timeframes / Frequency							
		Weekly	Monthly	Seasonal				As Required	As Specified Below
				Su	Au	Wi	Sp		
6. Timber Stakes	Check and repair timber stakes if damaged or removed prior to plant establishment.								
	Remove timber stakes.								As required until final removal at 12 months after planting
7. Fertilising and Pruning	Fertilise all plantings at specified rates.								
	Prune all plantings in specified manner:								
	Trees								refer All Areas Point 1
	Tall / Medium / Low Shrubs								After Flowering. Allow to grow to full potential
	Climbers								Once per year. Allow to grow to full potential
	Groundcover / Tussocks								After Flowering. Allow to grow to full potential Every 4 years
Areas of Special Consideration	**(Summarised from Section 2 of this LMP)**								
1. Refer Section 4									

2.0 Maintenance Actions

The Roads and Maritime Pesticide Use Notification Plan must be followed prior to herbicide application

A draft plan is available on the Roads and Maritime Website at:

http://www.rta.nsw.gov.au/environment/downloads/pesticide_use_notification_plan_dl1.html

Maintenance actions to be undertaken under this LMP are divided into two categories based on which landscape type is being maintained:

- Actions for All Areas;
  - Actions that apply to ALL landscape types / areas.
- Specific Actions for Different Landscape Types.
  - In addition to actions that apply to all landscape types / areas, these actions are applied to a specific landscape type.

2.1 All Areas

The following maintenance actions are to be implemented by all maintenance authorities (with reference to 5.1.3 Maintenance Responsibilities) across all areas of this LMP.

Pruning of Vegetation for Safety

Carry out all pruning in accordance with AS 4373.

Pruning to maintain driver sight lines; pruning to remove dead wood from over hanging paths, cycle-ways and roads.

Prune to an extent where this will not re-occur as a problem in the period to next routine maintenance without compromising overall form and growth potential of plant.

Actions Required		Frequency
Maintaining driver sight lines		
Within the sightline zone, prune all roadside vegetation, to a height of 300mm, when:		
Vegetation obscures any part of horizontal railing of safety barriers, when viewed from approaching traffic within 300 m of all intersections and access roads.		Monthly
Pruning trees over carriageways, roads, paths and cycle ways		
Prune all roadside vegetation over carriageways, roads, paths and cycle ways when it is:		
Carriageways / Roads:	Lower than 5.5 m above carriageway;	As required
Paths and Cycle ways:	Lower than 3.3 m above path or cycleway	
All areas:	Overhanging dead / diseased/ badly damaged trees or limbs	

Lend Lease

Management of Non Frangible Vegetation

To ensure that non frangible vegetation is removed in dangerous areas in accordance with Roads and Maritime safety standards.

Actions Required	Frequency
Remove woody regeneration / woody weeds (ie. where trunk diameter exceeds 150 mm measured at 300 mm from the ground) in setback area by manual removal if present in the following areas:	Annual
Setbacks from edge of travel lane: With safety rail present: • 5.5m. With no safety rail present, setback varies as follows: • <=60 km/h speed zones: 3 m • <=80 km/h speed zones: 5 m • <=100 km/h speed zones: 9 m • <=110 km/h speed zones: 11 m	

Noxious Weed Control

Noxious weeds continuously controlled as per legal requirements.

Actions Required	Frequency
Continuously suppress and destroy, in accordance with their control category, the growth of all declared noxious weeds where present or where they establish. Refer to OH2Ku Weed Management Plan Rev 2 November 2013 Of particular concern are; The areas planted with Pasture Grass. These areas must remain free of noxious weeds, in particular Giant Parramatta Grass; All areas where site topsoil has been respread.	Monthly
Declared noxious weed species within the area are listed in Appendix 2 – Noxious Weed Species and Control Categories.	

Rubbish Removal

Litter and roadside debris removal.

The contractor is not required to remove rubbish during the Landscaping Maintenance Period.

Actions Required	Frequency
No action required The contractor is not required to remove rubbish removal during the Landscaping Maintenance Period except for rubbish left by themselves within the Landscape Planting area. Recycle or dispose of rubbish in a responsible manner. Leave the site in a clean and tidy condition.	Nil

Auditing and Reporting

Regular auditing and reporting on maintenance works and additional works required.

Actions Required	Frequency
Inspection of entire site to report on LMP maintenance compliance, report and enact remedial works.	Monthly
An auditing and reporting form is to be provided monthly and submitted within four days of each maintenance inspection. The report must include date of visit, maintenance works completed, maintenance works in progress and maintenance works required. The report must give details of damaged, dead or missing plants and show their locations on the relevant sheets of the Design Documentation. The report must also identify separately any damage to landscape planting which has not been caused by you.	

2.2 Specific Landscape Types

Grassed (Mown) Areas

The following maintenance actions are to be implemented by all maintenance authorities in grassed (mown) areas. The contractor is not required to perform routine mowing of verges.

The extent of grassed (mown) areas are illustrated on the LMP Landscape Plans (Appendix 1).

Mowing

Maintenance of grasses areas for neat appearance and to maintain groundcover.

Actions Required	Frequency
Remove litter prior to mowing. Mow grass at rest area picnic and transpiration areas to a min height of 50 mm and max height of 100 mm. Do not scalp grass. Clippings to remain where they fall except that: road surfaces, drains, footpaths, picnic areas and cycle paths shall be swept or raked clear of clippings and these clippings shall be removed from site.	Spring – Every 6 weeks Summer – Every 4 weeks Autumn – Every 6 weeks Winter – Every 12 weeks

Replacement of Damaged Grass

Replacement of grass damaged by vehicles or other disturbances.

Actions Required	Frequency
Re-establish grass cover immediately after damage / death / removal. Use originally specified species.	As Required

Weed control in Grass

Ensure that grass remains weed free.

Actions Required	Frequency
Control, through the use of selective herbicides, the establishment and growth of weed species in turf. Herbicide use to be in accordance with regulation rates and manufacturers recommendations. Dye (colour: red) is to be added to herbicides to show extent of treated area.	Monthly

Lend Lease

Watering

Actions Required	Frequency
Turf must not be allowed to dry out during the establishment period and must maintain a discernable level of moisture until established.	As required

2.3 Vegetation Areas (Hydroseeding and hydromulching)

The following maintenance issues and actions are to be implemented by all maintenance authorities in vegetation (Hydroseeding/hydromulching) areas.

The extent of vegetation areas is illustrated on the LMP Landscape Plans (Appendix 1)

Weeding

To ensure that environmental and noxious weeds do not reproduce within vegetation areas and compete with vegetation.

Weeding and weed control is considered to be a critical maintenance action.

Actions Required	Frequency
Prevent reproduction of weeds by destroying seedlings and established weeds before seed set or other propagules form. Weeds to not exceed 10% cover in any 50m² area.	Monthly
Herbicide application must occur before weed seed set. Non-target species and areas must be reinstated if damaged by herbicide application.	
Herbicide use to be in accordance with regulation rates and manufacturers recommendations.	
Dye is to be added to herbicides to show extent of treated area.	
Use of bio-degradable herbicide is encouraged	

Herbicide Spraying

Herbicide use must comply with the requirements as specified in 3.1.1 ‘Herbicide Spraying’ in RMS D&C R178 – Vegetation.

Mulching

Maintain an adequate level of mulch in planted beds where these are located within otherwise seeded areas, to maximise soil binding, water conservation and weed suppression.

Actions Required	Frequency
Mulch is applied as part of the Hydroseeding/Hydromulching application process. Maintain mulch in planted beds in otherwise seeded areas to a depth of minimum 75mm through periodic applications.	As required

Removal of Dead / Dying Plant Material

To remove dead or dying plant material from landscapes. May be required as plantings mature, after damage or adverse environmental conditions.

Actions Required	Frequency
Clear dead vegetation from areas showing poor growth or damage and replace all lost topsoil. Remove dead or dying plant material only if contact between re-applied Hydroseeding/ hydromulching and ground will not occur. Preference is to slash and leave existing dead or dying plant material to act as additional mulch material	As required.

Replacement Hydroseeding/hydromulching

To ensure that the density and species of established plant material is maintained.

Actions Required	Frequency
Replace failed seeding areas as determined by the revegetation outcomes below. Densities and species used are to be in accordance with those specified in the original landscape plans. Water replacement seeding for a minimum of 12 weeks after planting. Replace all lost topsoil.	As Required Weekly
The species density and species selections specified for each area of landscape covered by this LMP are provided in Appendix 1 – Landscape Plans	

Revegetation Outcomes

Refer section 1.4

2.4 Planting Areas (Tubestock)

The following maintenance issues and actions are to be implemented by all maintenance authorities in plantings (Tubestock).

The extent of plantings (Tubestock) are illustrated on the Landscape Planting and Seeding Plans.

Weeding

To ensure that environmental and noxious weeds do not reproduce within planted areas and compete with plantings.

Weeding and weed control is considered to be a critical maintenance action.

Actions Required	Frequency
Prevent reproduction of weeds by destroying seedlings and established weeds before seed set or other propagules form. Weeds to not exceed 10% cover in any 50m² area.	Monthly
Herbicide application must occur before weed seed set. Non-target species and areas must be reinstated if damaged by herbicide application. Remove by hand any weeds which cannot be controlled by herbicide. Ensure that the entire weed including all roots is removed. Dispose of the weeds off site.	As required
Herbicide use to be in accordance with regulation rates and manufacturers recommendations. Herbicide use must comply with the requirements as specified in Clause 4.5 Weed Control in RMS D&C R179 – Landscape Planting.	
After spraying, lop any dead weeds flush with the ground surface and dispose of the cuttings.	
Dye is to be added to herbicides to show extent of treated area.	
Use of bio-degradable herbicide is encouraged	

Lend Lease

Disease and Insect Control

Plants must be sprayed with pesticides to control disease and insect infestation when and where identified.

Actions Required	Frequency
Spraying must only be undertaken on windless days (wind speeds of less than 10km/hr). Records must be retained of the following: Type of chemical to be used; Plant species to be treated; Extent of the infestation and; Timing of the proposed application. Spraying must not be undertaken where there is a risk that pesticide could enter into a watercourse or when wind conditions could cause drift outside of the area to be treated.	As required.

Mulching

Maintain an adequate level of mulch in planted beds to maximise water conservation and weed suppression.

Actions Required	Frequency
Maintain mulch depth to min 75 mm though periodic applications. Use same mulch as originally specified in each planting.	As required.
Mulch is to be applied to all existing and new planting (Tubestock).	
Do not apply mulch to those areas of planting (Virotube) with the water line at creek lines, ponds and wetlands	

Removal of Dead / Dying Plant Material

To remove dead or dying plant material from landscapes. May be required as plantings mature, after damage or adverse environmental conditions.

Actions Required	Frequency
Remove dead or dying plant material.	As required.
Replacement of plantings in accordance with actions listed in Replacement Plantings (below)	

Replacement Plantings

To ensure that the density and species of established plant material is maintained.

Actions Required	Frequency
Replace failed, missing, senescent or damaged plantings. Densities, sizes species and varieties used are to be in accordance with those specified in the original landscape plans. Plant all plants in accordance with RMS D&C R179 'Table R179.4 – 'Planting Hole Dimensions' as well as the Landscape Planting Details. Reinstate any disturbed areas.	Within 28 days of detection.
Water replacement plantings for a minimum of 12 weeks after planting.	Weekly.
The species density and species selections specified for each area of landscape covered by this LMP will be provided in the Landscape Plans	

Planting Outcomes

Refer section 1.4

Timber Stakes

To replace Timber stakes when damaged and to remove when no longer required.

Actions Required	Frequency
Replace timber stakes (for trees and shrubs) if damaged or removed prior to plant establishment. Replace with same or equivalent stake.	As required until final removal at 12 months after planting.

2.5 Landscape Bed Plantings

The following maintenance issues and actions are to be implemented by all maintenance authorities in landscape bed plantings.

The extent of landscape bed plantings are illustrated on the Landscape Planting and Seeding Plans.

Weeding

To ensure that environmental and noxious weeds do not reproduce within planted areas and compete with plantings.

Weeding and weed control is considered to be a critical maintenance action.

Actions Required	Frequency
Prevent reproduction of weeds by destroying seedlings and established weeds before seed set or other propagules form. Weeds to not exceed 10% cover in any 50m² area.	Monthly
Herbicide application must occur before weed seed set. Non-target species and areas must be reinstated if damaged by herbicide application. Remove by hand any weeds which cannot be controlled by herbicide. Ensure that the entire weed including all roots is removed. Dispose of the weeds off site.	
Herbicide use to be in accordance with regulation rates and manufacturers recommendations. Herbicide use must comply with the requirements as specified in Clause 4.5 Weed Control in RMS D&C R179 – Landscape Planting.	
After spraying, lop any dead weeds flush with the ground surface and dispose of the cuttings.	
Dye is to be added to herbicides to show extent of treated area.	
Use of bio-degradable herbicide is encouraged	

Disease and Insect Control

Plants must be sprayed with pesticides to control disease and insect infestation when and where required.

Actions Required	Frequency
Spraying must only be undertaken on windless days (wind speeds of less than 10km /hr). Records must be retained of the following: Type of chemical to be used; Plant species to be treated; Extent of the infestation and; Timing of the proposed application. Spraying must not be undertaken where there is a risk that pesticide could enter into a watercourse or when wind conditions could cause drift outside of the area to be treated.	As required.

Mulching

Maintain an adequate level of mulch in planted beds to maximise water conservation and weed suppression.

Actions Required	Frequency
Maintain mulch depth to min 75 mm through periodic applications. Use same mulch as originally specified in each planting.	As required.
Mulch is to be applied to beds at edges of roads, paths and verges.	

Removal of Dead / Dying Plant Material

To remove dead or dying plant material from landscapes. May be required as plantings mature, after damage or adverse environmental conditions.

Actions Required	Frequency
Remove dead or dying plant material.	As required.
Replacement of plantings in accordance with actions listed in Replacement Plantings (below)	

Replacement Plantings

To ensure that the density and species of established plant material is maintained.

Actions Required	Frequency
Replace failed, missing, senescent or damaged plantings. Densities, sizes species and varieties used are to be in accordance with those specified in the original landscape plans. Plant all plants in accordance with RMS D&C R179 'Table R179.4 – 'Planting Hole Dimensions' as well as the Landscape Planting Details. Reinstate any disturbed areas.	Within 28 days of detection.
Water replacement plantings for a minimum of 12 weeks after planting.	Weekly.
The species density and species selections specified for each area of landscape covered by this LMP will be provided in the Landscape Plans	

Timber Stakes

To replace timber stakes when damaged and to remove when no longer required.

Actions Required	Frequency
Replace timber stakes (for trees and shrubs) if damaged or removed prior to plant establishment. Replace with same or equivalent stake.	As required until final removal at 12 months after planting.

Planting Outcomes

Refer section 1.4

3.0 Horticultural Maintenance of Plantings

Horticultural maintenance of advanced plantings to ensure the long life and maintenance of form.

The following tables outline the standards required for pruning and fertilising all Landscape Planter Bed or Feature Plantings.

3.1 Feature Planting-Trees

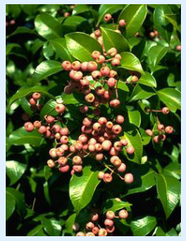
Botanic Name	Common Name	Pruning Type
Allocasuarina torulosa	Forest She Oak	B
Acmena smithii	Lilly Pilly	A
Eucalyptus resinifera	Red Mahogany	A
Eucalyptus acmenoides	Cabbage Gum	A
Melaleuca quinquinervia	Broad-leaved Paperbark	B
Jagera pseudorhus	Foambark	B
Lophostemon confertus	Brush Box	A

For all tree species, the following fertilising and pruning is required:

Apply the following fertiliser to all species:	
Fertilising	Frequency
60 grams slow release fertiliser per plant. N:P:K ratio– 18:3:10	Annually. Applied Late Spring.

Prune species as per appropriate type:		
Pruning		Frequency
A	Prune to remove split leaders, remove dead limbs, and remove heavily damaged limbs. As maturity permits prune lower branches to collar to 5.5 m above ground level where these overhang carriageways and roads. In other areas, prune lower branches to 3.3m above ground level.	As required.
B	Prune to remove split leaders, remove dead limbs, and remove heavily damaged limbs. As maturity permits prune lower branches to 1 m above ground level	As required.

Lend Lease

Plant Palette - Feature Planting: Trees			
			
Allocasuarina torulosa	*Acmena smithii*	*Eucalyptus resinifera*	*Eucalyptus acmenoides*
			
Jagera pseudorhus	*Lophostemon confertus*	*Melaleuca quinquinervia*	

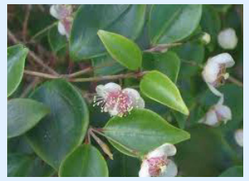
3.2 Feature Planting-Shrubs

Botanic Name	Common Name	Pruning Type	Max. Height (m)
Archirodomyrtus beckleri	Rose Myrtle	C	4
Backhousia myrtifolia	Carroll	C	5
Banksia spinulosa var.collina	Hairpin Banksia	C	4
Tabernaemontana pandacaqui	Banana Bush	C	2.5
Callistemon salignus	Willow Bottlebrush	C	2.5
Cordyline stricta	Narrow-leaved Palm Lily	C	2
Guioa semiglauca	Guioa	C	6
Leptospermum polygalifolium	Lemon-scented Tea-tree	C	2.5
Melaleuca nodosa	Flax-leaved Paperbark	C	6
Wilkea huegeliana	Veiny Wilkea	C	4

For all shrub species, the following fertilising and pruning is required:

Apply the following fertiliser to all species:	
Fertilising	Frequency
20 grams slow release fertiliser per plant. N:P:K ratio– 18:3:10	Annually. Applied Late Spring.

Prune species as per appropriate type:		
Pruning	Frequency	
C	Prune evenly to promote compact shape (to specified max. height). Remove 200 to 300mm (depending on vigour of previous plant growth) length of branches all around the plant. Only required where specimens exhibit "legginess"	Annually. Late Spring

Plant Palette - Feature Planting: Shrubs			
			
Archirhodomyrtus beckleri	*Backhousia myrtifolia*	*Banksia spinulosa var. collina*	*Tabernaemontana pandaqui*
			
Callistemon salignus	*Cordyline stricta*	*Guioa semiglauca*	*Leptospermum polygalifolium*
			
Melaleuca nodosa	*Wilkea huegeliana*		

3.3 Feature Planting-Ground Covers / Low Tussocks

Botanic Name	Common Name	Pruning Type
Carex appressa	Tall Sedge	N/A
Crinum pedunculatum	Swamp Lily	N/A
Dianella caerulea	Spreading Flax Lily	N/A
Gahnia clarkei	Tall Saw-Sedge	N/A
Isolepis inundata	Swamp Club-rush	N/A
Juncus usitatus	Common Rush	N/A
Lomandra longifolia	Spiny-headed Mat-Rush	N/A
Lomandra hystrix	Mat Rush	N/A
Phylidrum lanuginosum	Frogmouth	N/A
Schoenus melanostachys	Black Bog-rush	N/A
Zieria smithii	Sandfly Zieria	N/A

For all groundcover and low tussock species, the following fertilising and pruning is required:

Apply the following fertiliser to all species:	
Fertilising	Frequency
10 grams slow release fertiliser per plant. N:P:K ratio– 18:3:10	Annually. Applied Late Spring.

Prune species as per appropriate type:		
Pruning		Frequency
D	Prune evenly to a height of 300mm above ground.	Every 2 years in April.
E	Mowing	Refer Native Grasses in Areas of Special Consideration

Lend Lease

Plant Palette - Feature Planting: Ground Covers/Low Tussocks



Carex appressa



Crinum pedunculatum



Gahnia clarkei



Dianella caerulea



Isolepis inundata



Juncus usitatus



Lomandra hystrix



Lomandra longifolia



Phylidrum lanuginosum



Ziera smithii



Schoenus melanostachys

4.0 Areas of Special Consideration

The following maintenance issues and actions are to be implemented by all maintenance authorities in areas of special consideration.

The extent of special are illustrated generally on the LMP Landscape Plans

4.1 Batter Re-Vegetation Management Strategy

To ensure batter stability through the successful establishment of vegetation.

A batter management strategy is recommended as part of the long-term management of the road edge. The strategy will be audited and revised as experiences demands.

Activity	Intervention	Repair Standards
1. Topsoil and Hydroseeding	Where areas larger than riling occur After previous option fails	Reapply topsoil as specified in Landscape Plans and is finished evenly and matches existing ground levels. Vegetation is established and binds soil within first growing season.
2. Topsoil and hydroseed	At areas where riling only occurs	After initial growing season or next failure. Vegetation is established and binds soil within first growing season, halting riling.
3. Engineered solutions may include anchor mat, or meshes	At slopes of 1.5:1 or steeper After previous options fail	Apply topsoil type to ensure successful vegetation growth. Topsoil depth as per the anchor mat manufactures recommendations. Vegetation is established and binds soil within first growing season.
4. One of the previous treatments plus Tubestock planting	After previous options fail and only in those areas where tree planting is permitted ie not interfering with sight-lines or within a setback zone	Vegetation is established and binds soil within first growing season.
5. Lastly shotcrete (although shotcrete is not preferred and would require urban design treatments to be visually acceptable)	After previous options fail	

The cause of rilling should be identified and rectified before reapplication of topsoil etc.

All plant species, Hydroseeding and Tubestock to be as per Landscape Planting and Seeding Plans

Geo-technical advice is recommended for each situation to identify potential variations in the physical properties of the underlying geology which may impact on the practicality of planting vegetation community type on a single cut batter. Final plant selection was varied to match the final exposed geological properties without variation to the design intent as best as possible.

Final plant selection for use at these locations should be as per the Landscape Planting and Seeding Plan to match those species in the existing adjacent vegetation community and that tolerate drier conditions due to potentially lower or non-existent water table.

Lend Lease

4.2 Native Grasses

To ensure that native grasses are maintained in a way that supports their survival and persistence in the landscape.

Actions Required	Frequency
Mow all areas of native grasses flatter than 3H:1V. Do not mow during flowering and seeding. Where mowing is required at this time, mow in a pattern that allows sections of at least 50% of any given area to persist with flowering seed heads. Maintain length not less than 200mm.	Minimum of once per year to a maximum of two times per year
Native Grass Areas steeper than 3H:1V (and including all other areas where burning may replace mowing as a management tool) may be maintained by controlled / planned fire according to ecological and catchment requirements; in some communities, no planned fire will be applied, but in other areas fire will be applied within a defined fire frequency range and prescription. The action must be co-ordinated with Roads and Maritime, Rural Fire Service and Local Council.	As required
The species density and species selections specified for each area of landscape covered by this LMP will be provided in the Landscape Plans	

4.3 Fauna Underpasses

To ensure that the integrity of the fauna overpass is maintained.

Actions Required	Frequency
Remove all plant growth from fence ie; vine growth	As required
Remove all fallen branches and tree limbs that are leaning or resting on or against the fence	As required
Maintain the grassed access path to maintain height to 300mm max.	As required
Provide surveillance for evidence of predators such as foxes, cats and wild dogs and report to DEC if suspected.	monthly
Maintain fauna refuge poles poles, frog pipes and ponds in good condition and repair where necessary	As required
The species density and species selections specified for each area of landscape covered by this LMP will be provided in the Landscape Plans	

4.4 Fauna Fence

To ensure that the integrity of the fauna fence is maintained.

Actions Required	Frequency
Remove all plant growth from fence ie vine growth	As required
Remove all fallen branches and tree limbs that are leaning or resting on or against the fence	As required
Maintain height of planting to maximum 300mm in height within 3 metres of the non-road side of the fence	As required
Maintain height of planting to maximum 300mm in height within one metre on the road side of the fence except where shown on plan.	As required
Remove all naturally occurring tall shrub and tree species within 3 metres either side of the fence.	As required
The species density and species selections specified for each area of landscape covered by this LMP will be provided in the Landscape Plans	

4.5 Water Quality Ponds and Detention Basins

To ensure that the integrity of the transpiration area is maintained.

Actions Required	Frequency
Maintain grass species as per Grassed (Mown) Areas	Refer Grassed (Mown) Areas
Macrophyte Zones should require no special attention except through periods of prolonged drought when local tree species may colonise the basins and affect their performance. Remove tree species which may have germinated from basins.	As required
The species density and species selections specified for each area of landscape covered by this LMP will be provided in the Landscape Plans	

4.6 Threatened Species

Actions Required	Frequency
Care is to be taken not to harm threatened flora within the road corridor. The location of all the threatened species is to be documented along with a monitoring report as per Appendix 14 of the SWTC to be issued of all individual threatened species covered in the EMP which is part of the project Maintenance Manual	Annually

4.7 Site Works

There are a number of areas where “Extent of works to be confirmed on site” This work is documented below.

Actions Required	Frequency
1. Batch Plants 2. Compounds 3. Stockpiles 4. Other areas	
Adjust extent of landscape works on site to suit. Some sites listed above will be in place during the maintenance period, after which the they will be the subject of further landscape remediation	Completion of works

4.9 Riparian Zones

To ensure that integrity of riparian zones is maintained for resilience to flooding.

Actions Required	Frequency
Remove all rubbish and fallen branches to prevent the blocking of bridges or culverts. Remove rubbish from vegetated zones.	As required
Inspection following abnormal rainfall events to assess any damage caused by increased flows. Take remedial action as for All Areas, replacement plantings, horticultural maintenance of plantings and batter re-vegetation management strategy.	As required
Repair organic fibre mesh where damage or lifting has occurred.	As required
The species density and species selections specified for each area of landscape covered by this LMP are provided in the Landscape Plans – refer Appendix A.	

Lend Lease

Appendices

Appendix A – Landscape Plans

- To be provided during final design period.

Appendix B – Noxious Weed Species

- Refer to Weed Management Plan.

Appendix C – Monthly Maintenance Report

F.9.1 Landscape Management Requirements for Feature Planting at Blackmans Point Interchange

Generally

The feature planting at Blackmans Point Interchange has been designed for low maintenance. This is achieved by:

- Choosing hardy endemic species suited to the conditions and known to establish and perform well in landscape situations
- Using plant spacings at densities that will exclude weeds
- Using tree spacing that accommodates mowing/slashing machinery
- Minimising the use/occurrence of short-lived species, which might otherwise be low-maintenance
- Minimising the issue of overhanging branches by ensuring that tall eucalypts are not planted unless there is a minimum width of 15m
- Using woodchip mulch for all plantings to a minimum thickness of 75mm to suppress weed germination and maintain soil moisture.

The landscape management for the Interchange Feature Planting will be carried out during the establishment maintenance period. Thereafter, the landscape management will be carried out as per the Landscape Maintenance Plan.

The Interchange will be maintained for a period of 36 months after the date of construction completion. The landscape maintenance program will be outlined in the Landscape Maintenance Plan for The Project and will include the following items as a minimum requirement during the maintenance period:

- **Watering** - Planted and seeded areas will be watered regularly to ensure continuous healthy growth
- **Weeding and rubbish removal** - Hand rubbish and weed growth that occurs throughout all contract areas will be removed. This will be executed weekly so that at least the landscape contract areas may be observed in a completely clean and tidy condition
- **Replacement** - Feature plantings which die or fail to thrive or are damaged or stolen will be immediately replaced with plants of same size and quality
- **Stakes and ties** - Stakes and ties will be adjusted and/or replaced where required, and remove at the end of the maintenance period if directed by the principal
- **Pruning** - Pruning work shall be implemented to maintain dense foliage growth and encourage suitable growth habits. An approved wound dressing, such as “Colgraft” shall be applied to all cut surfaces in accordance with the manufacturers’ instructions. Pruning will be conducted in spring
- **Mulched surfaces** - Mulched surfaces shall be kept in a clean and tidy condition. Reinstate depths of mulch as specified so that at the end of the maintenance period the mulch is left at the specified depth
- **Spraying** - Insecticide and fungicide spraying, if considered necessary, shall be carried out in accordance with the manufacturers’ instructions. The landscape contractor shall treat all occurrences of insect attack or disease amongst the plant material. The requirement for spraying will be assessed at least monthly.

G Headlight Screens

G.1 Urban Design Philosophy for the Headlight Screen Design

The headlight screen design described below embodies the overall urban and landscape design philosophy established for The Project, that is, the design is elegant, visually recessive in form and appearance, aesthetically pleasing and maintains an acceptable standard of appearance over time. The design team reviewed each headlight screen location in detail to try and achieve the best outcome for The Project. Design proposals were evaluated with a view to achieving the requested decreasing order of preference of:

1. Landscape as a screen - possible only where there is greater than 13 metres horizontal separation between the Main Carriageway and the Service Road or other Local Road
2. Structural headlight screens.

G.2 Proposed Headlight Screen Design

There is only one headlight screen in The Project, located along the highway, between the highway and a service road. The screen is 2.5 metres high above pavement surface level, as required under SWTC Appendix 9.9(b).

The location and extent of the headlight screen is shown on the headlight screen location plan (Figure D.2.1).

The design of the headlight screen comprises a powdercoated lightweight steel structure with louvred mesh which is oriented so that it blocks the light from oncoming vehicles in adjacent lanes, but maintains transparency for vehicles travelling in the opposite direction. The key design aspects and panel design of the headlight screens are described below:

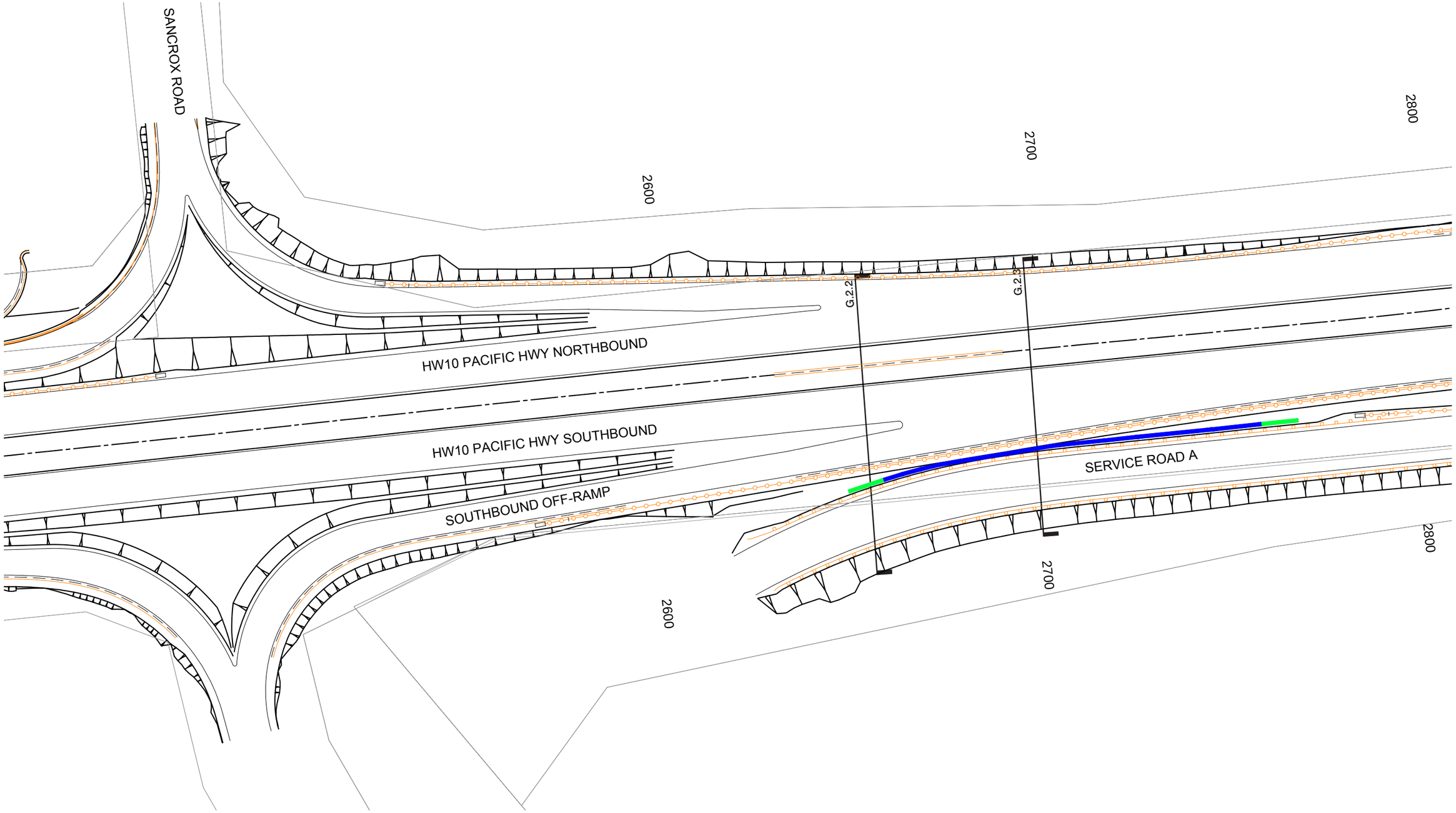
- The horizontal alignment of the screens is parallel to the outside edge of the Service Road carriageway and is located as close as possible to this edge to maximise planting width to the highway side, taking in to account deflection zones for traffic barriers
- Tussock grass plantings are proposed to:
  - Provide a backdrop to the screen
  - Provide a tall grass that reduces the apparent height of the screen
  - Hide the post footings
  - Ensure that no maintenance is required, so that the screen will not be damaged by mechanical hand slashers.
- The screens “emerge” out of the ground at both ends - a concrete end detail provides the transition from the metal screen to the ground surface. Concrete will be natural colour and smooth off-form finish as per RMS Specification (B80)
- Generally the topography is flat for the vertical alignment of the screen. The top surface of the screen achieves a continuous flowing line through to the three panel termination detail with a concrete end post anchor
- All screens are constructed of expanded metal mesh, oriented so as to block oncoming headlight glare yet still provide some translucency and lightness to the structure. The mesh will be powdercoated midnight blue to provide a recessive colour
- Expanded metal mesh panels are provided between each pair of steel T-section galvanised support posts. The steel posts extend above the panel top edge to provide a vertical emphasis to the screen
- Two vertical steel angles provide intermediate support between posts with the screens fixed at these points. The two steel angles reinforce the vertical emphasis through having the same width as the posts
- Steel channels provide concealed horizontal fixing points for the screen top and bottom of each expanded mesh panel
- Fixings are concealed by the steel channels
- The steel posts are bolted to the top of a concrete footing. This allows for ease of construction and limitation of damage on site
- The panel design provides an equivalent appearance in design quality on both sides. The highway side has the flange of the T-section visible and the Service Road side has the thin edge of the web
- The uneven surface of the mesh will discourage graffiti in the first instance. For maintenance purposes where graffiti is applied, the areas will be painted with a colour to match midnight blue

The panel design accommodates all the required panel heights for the transition at the ends, providing fabrication and construction advantages.

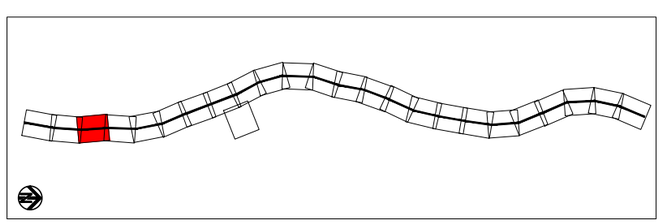
Headlight Screen Schedule

Wall Number	Station (Approximate)		Carriageway Side	Full Height (2.5m) Length	Termination Panel Length (Height Varies)
	From	To			
HS01	2645	2766	Southbound	121	9.7m each end

The following plans, sections, three dimensional sketches and elevations illustrate the typical panel designs and termination details. Refer Figures G.2.1 to G.2.8.



HEADLIGHT SCREEN - LOCATION PLAN



HEADLIGHT SCREEN - TRANSITION

HEADLIGHT SCREEN - 2.5m HIGH

0 50m

Figure G.2.1 Headlight Screen: Location Plan 1

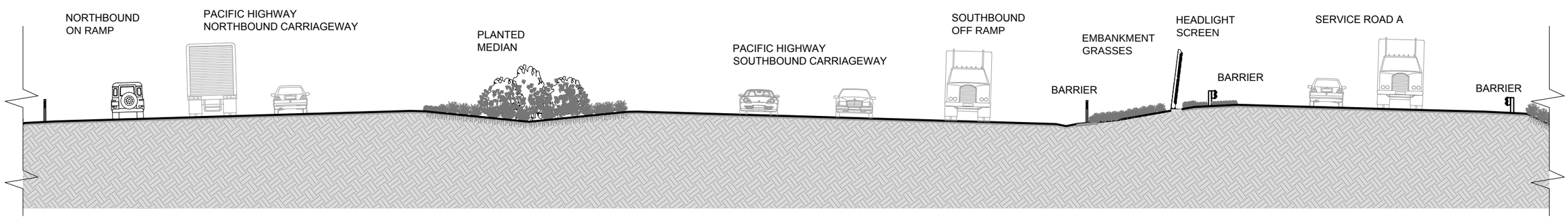


Figure G.2.2 Headlight Screen: Cross Sections at Station 2km650

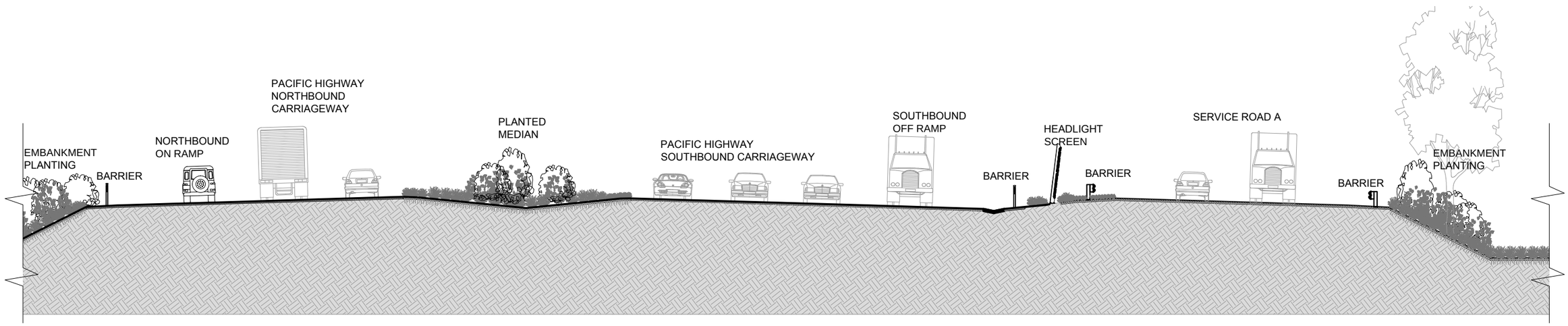
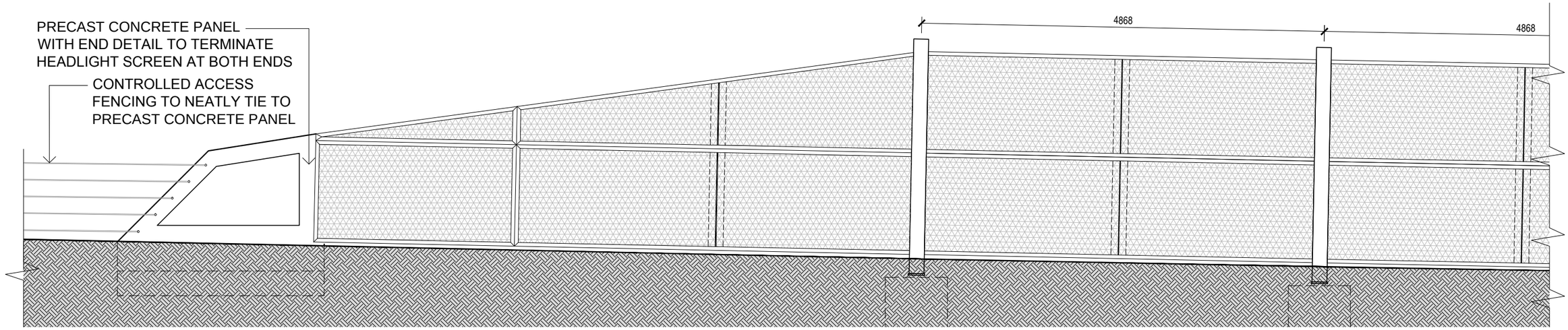
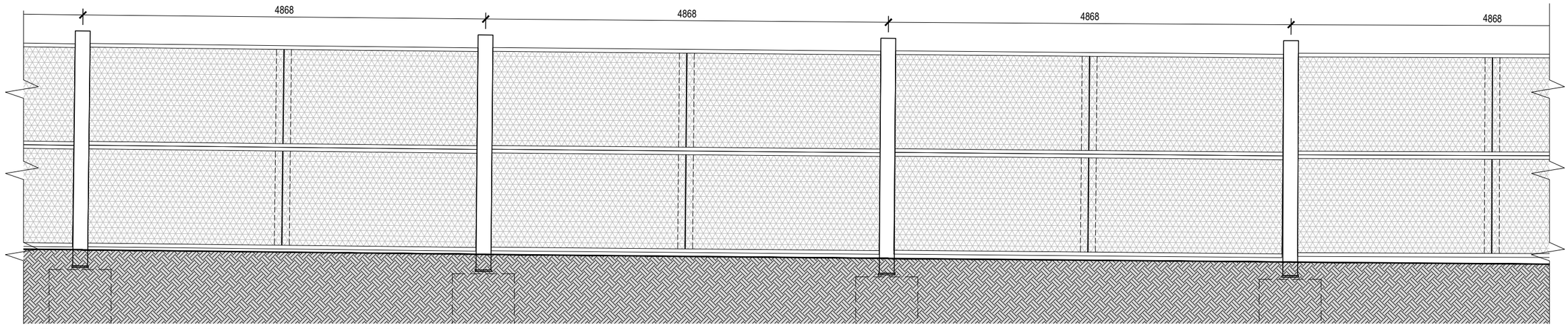


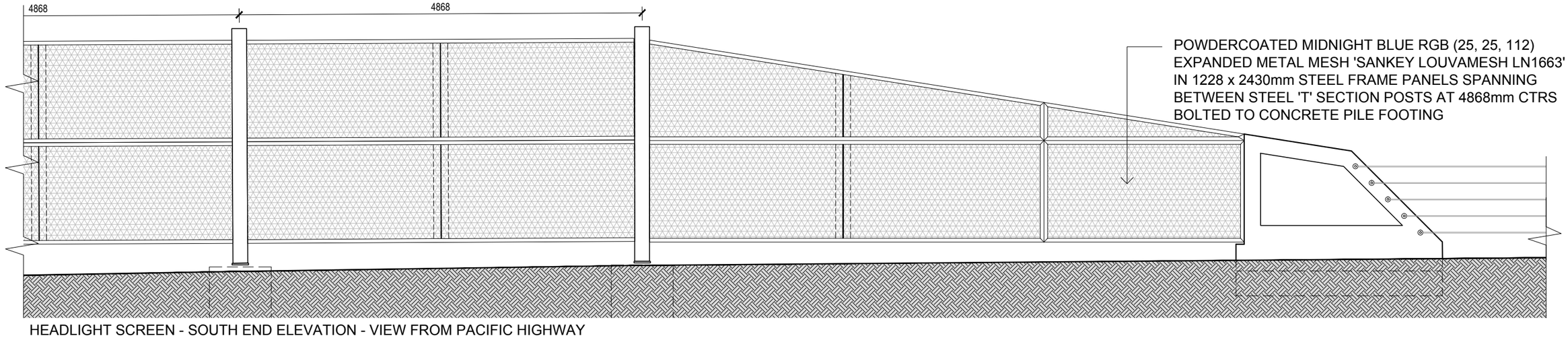
Figure G.2.3 Headlight Screen: Cross Sections at Station 2km700



HEADLIGHT SCREEN - NORTH END ELEVATION - VIEW FROM PACIFIC HIGHWAY

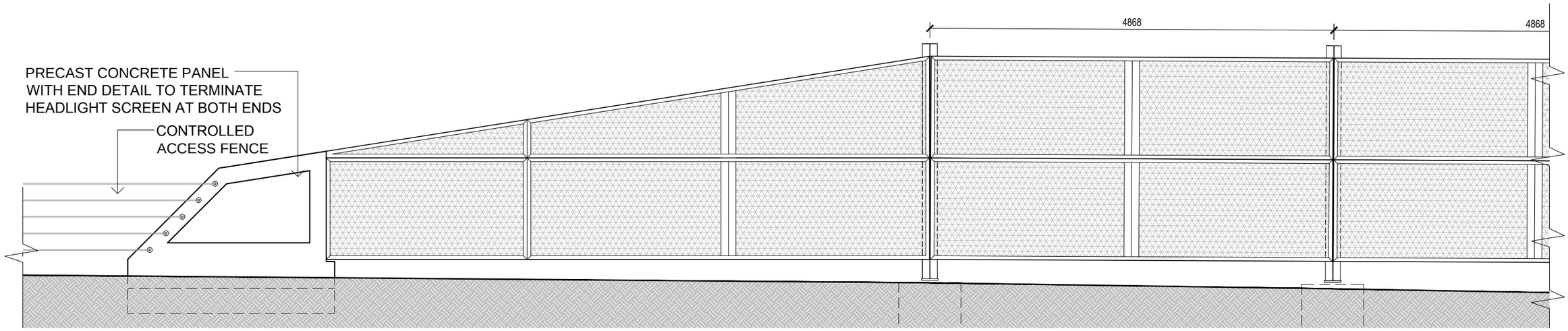


HEADLIGHT SCREEN - TYPICAL MIDSECTION ELEVATION - VIEW FROM PACIFIC HIGHWAY

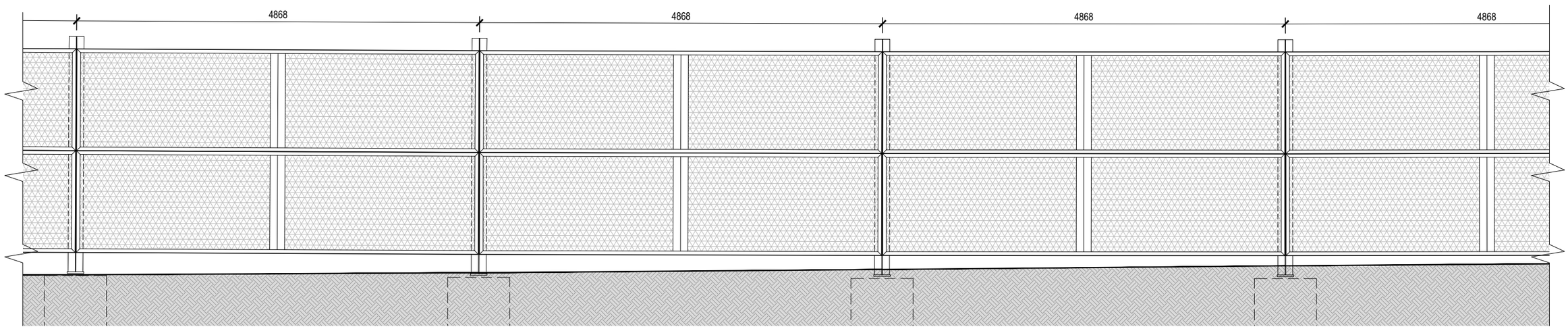


HEADLIGHT SCREEN - SOUTH END ELEVATION - VIEW FROM PACIFIC HIGHWAY

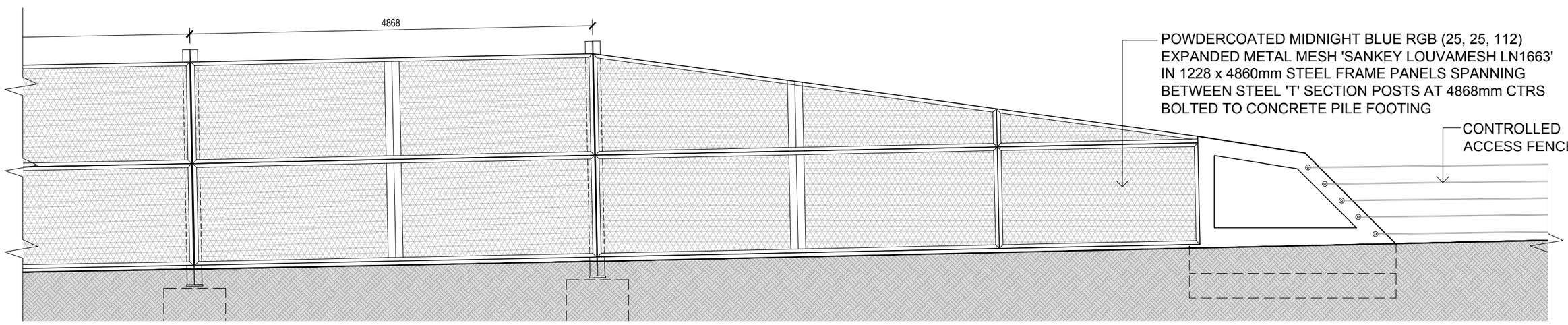
Figure G.2.4 Headlight Screen: Elevations Sheet 1



HEADLIGHT SCREEN - SOUTH END ELEVATION - VIEW FROM LOCAL SERVICE ROAD A

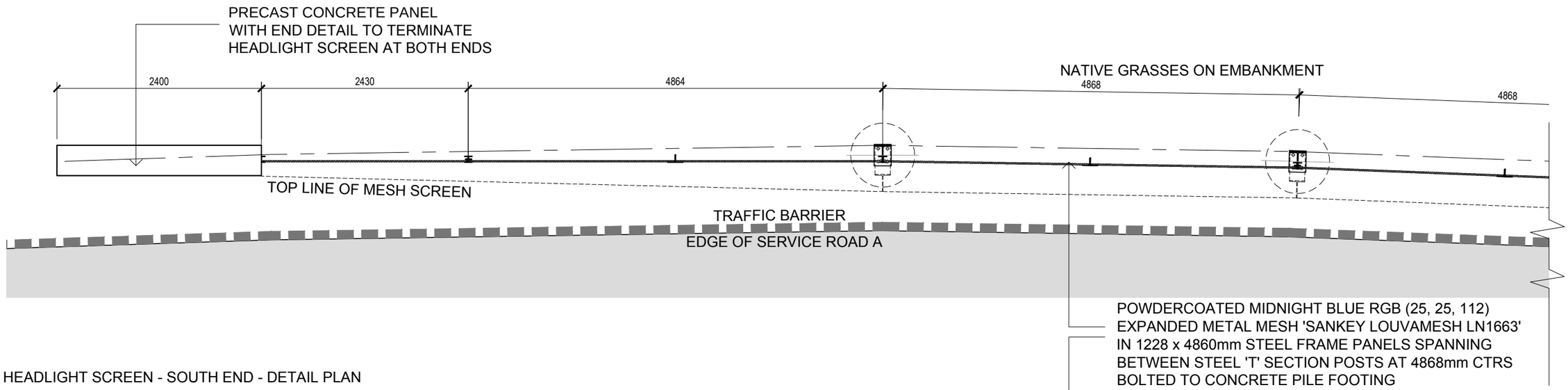


HEADLIGHT SCREEN - TYPICAL MIDSECTION ELEVATION - VIEW FROM LOCAL SERVICE ROAD A

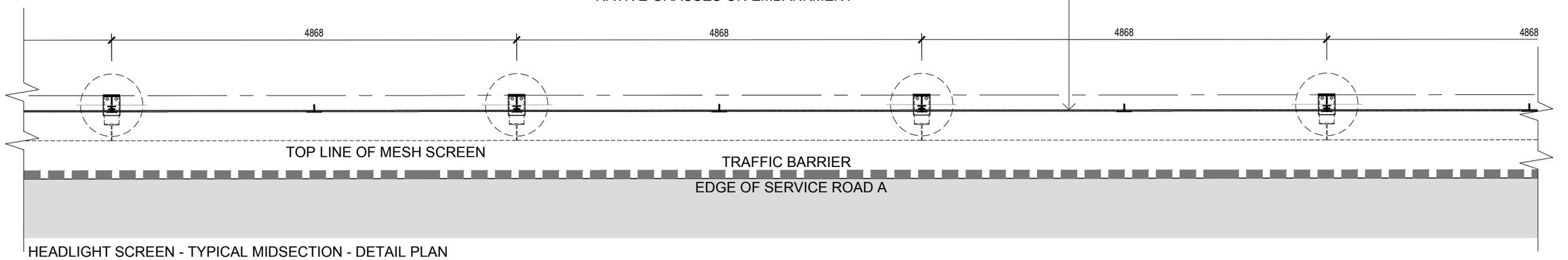


HEADLIGHT SCREEN - NORTH END ELEVATION - VIEW FROM LOCAL SERVICE ROAD A

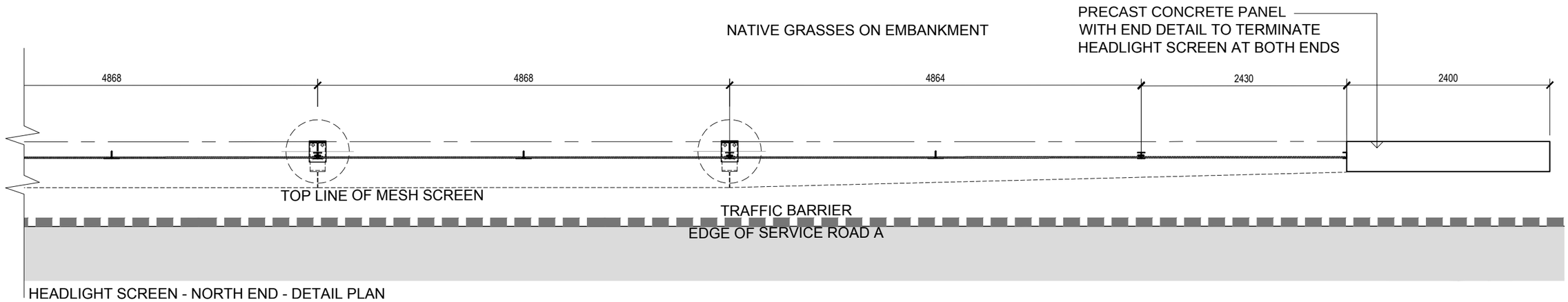
Figure G.2.5 Headlight Screen: Elevations Sheet 2



HEADLIGHT SCREEN - SOUTH END - DETAIL PLAN



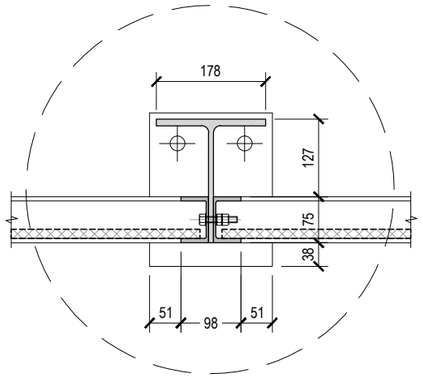
HEADLIGHT SCREEN - TYPICAL MIDSECTION - DETAIL PLAN



HEADLIGHT SCREEN - NORTH END - DETAIL PLAN

Figure G.2.6 Headlight Screen: Detail Plan

0 2.5m



HEADLIGHT SCREEN - SECTION A

HEADLIGHT SCREEN - SECTION B

HEADLIGHT SCREEN - DETAIL 1

PACIFIC HIGHWAY
SOUTHBOUND OFF-RAMP

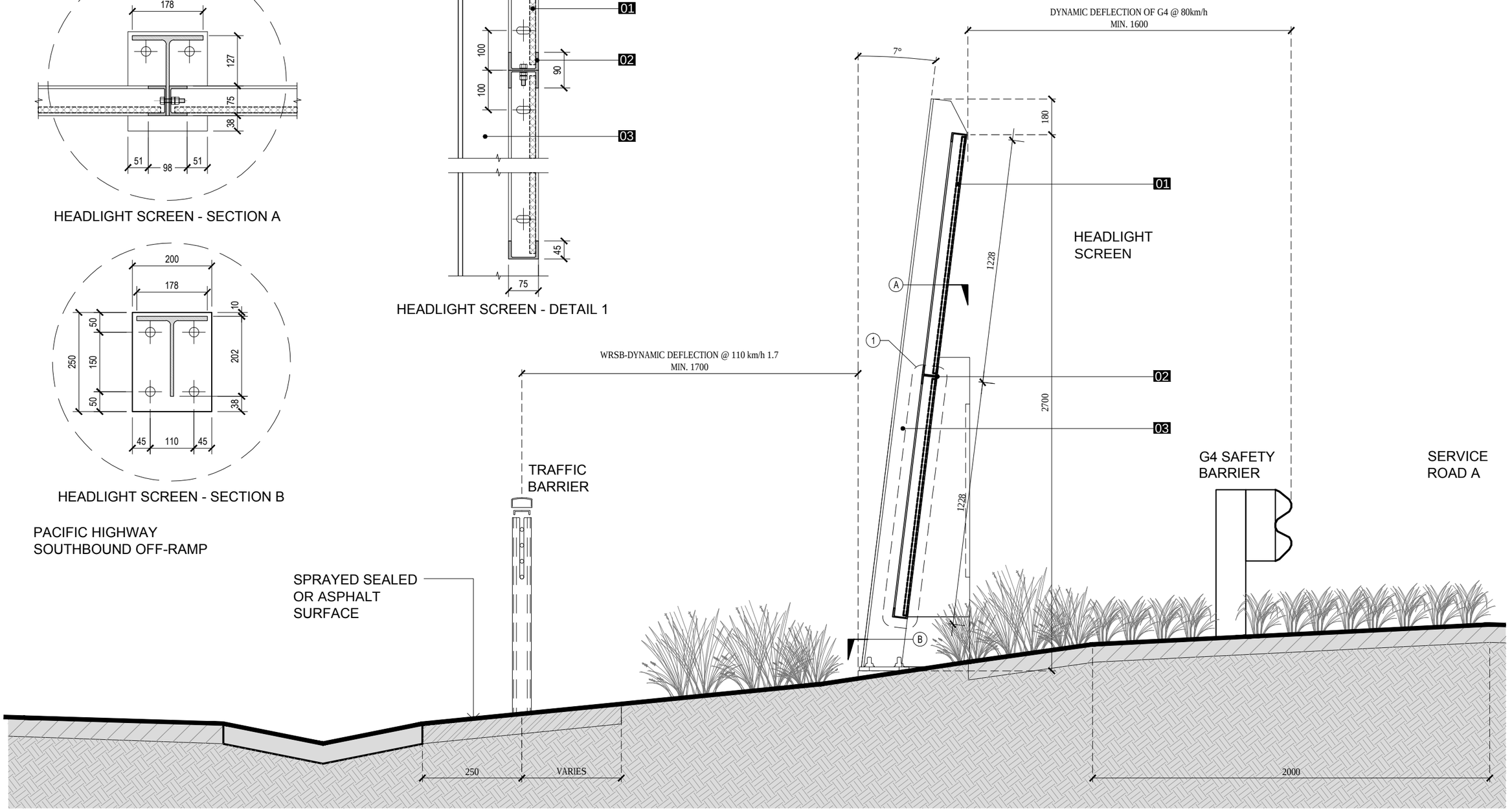
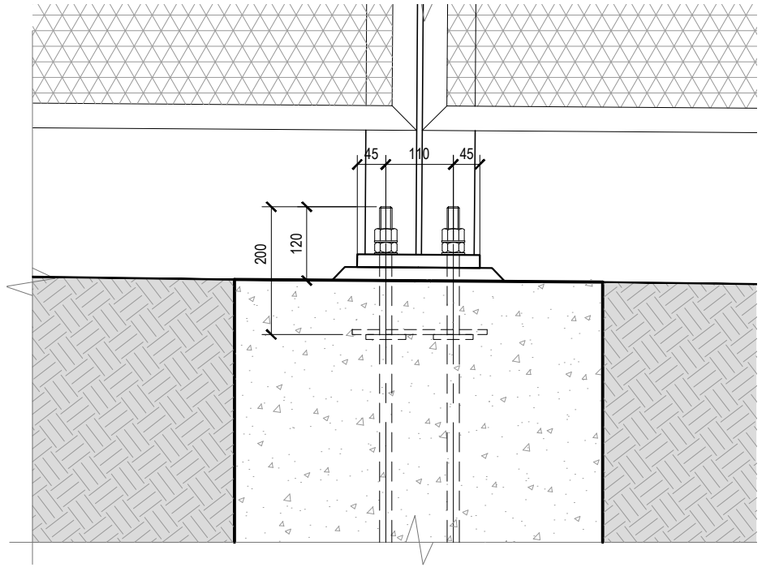
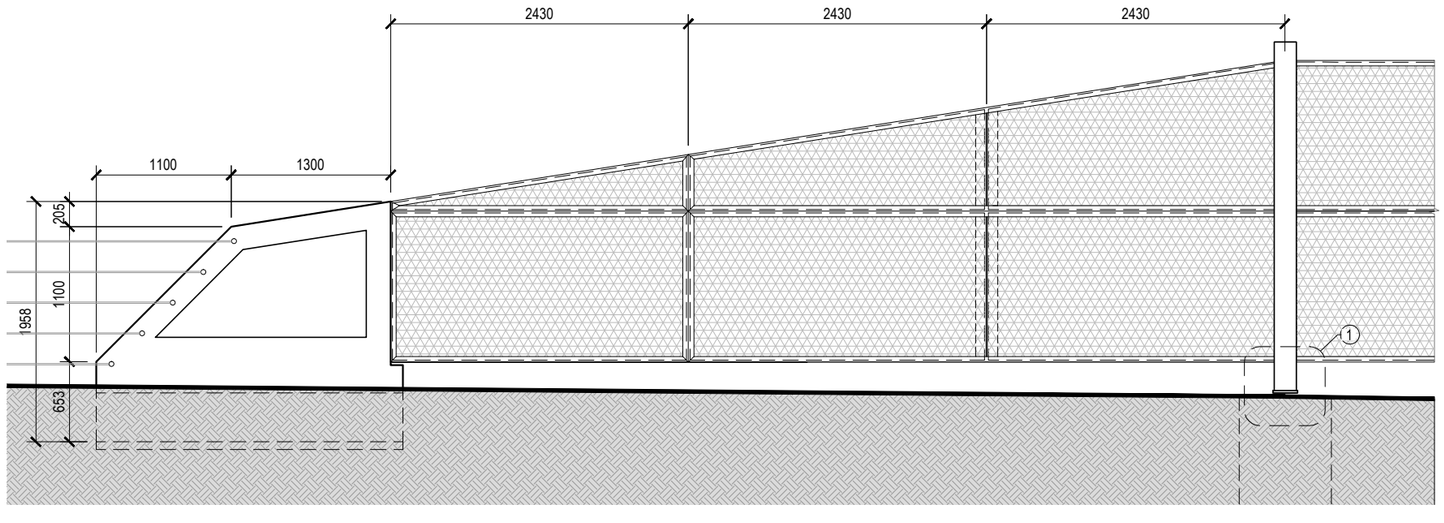


Figure G.2.8 Headlight Screen: Typical Section at 2km700



HEADLIGHT SCREEN - DETAIL 1 - BASE FOOTING SECTION DETAIL



TERMINATION DETAIL - VIEW FROM PACIFIC HIGHWAY

Figure G.2.9 Headlight Screen - Base Footing: Details

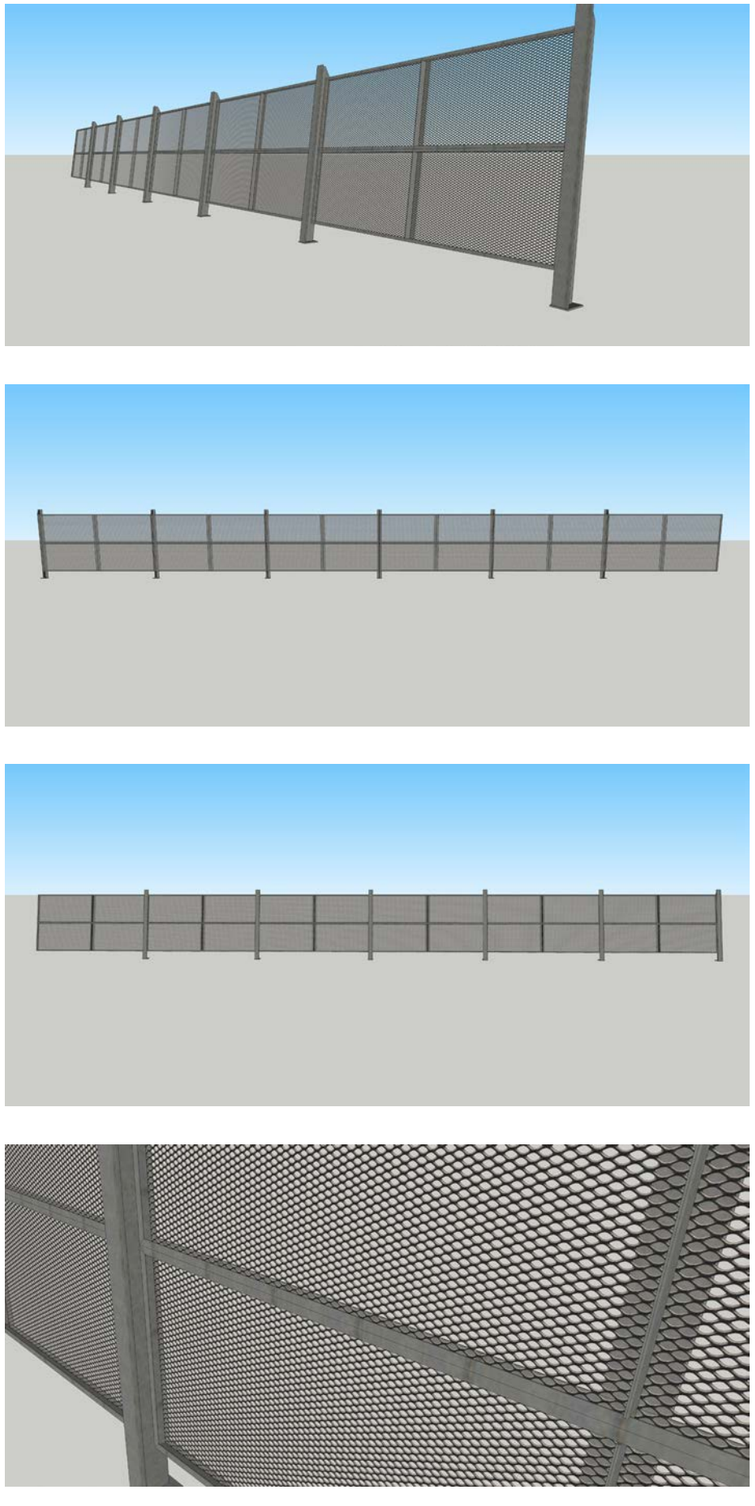


Figure G.2.10 Headlight Screen - 3D images

H.1 Lighting and Light Fixtures

H.1.1 Road Lighting

Roadway lighting is required at Blackmans Point interchange only.

The typical pole is 9.0m tall and the integrated outreach arm is generally 4.5m. They are steel with a galvanised finish. The pole is circular, tapered and has a "slip base", which allows it to fall under collision impact. It is an RMS approved item supplied by Ingal EPS or RMS approved equivalent. The typical luminaire is a 250W HPS Roadster supplied by Sylvania Lighting or RMS approved equivalent.



Roadway pole and outreach arm, luminaire and "slip base".

H.2 Cyclists and Pedestrians

A footpath will be constructed on Haydons Wharf Road Overbridge providing safe access to foot traffic via a 2.0m wide concrete path with pram ramps at crossings.

On the Pacific Highway main alignment, a 2.5 m wide sealed shoulder has been provided along the outside of the travel lanes to cater for cyclists. Signposting and crossing points will be at the entry and exit ramps.

H.3 Bus Interchange and Bus Shelter

Refer Figure H.3.1.

Bus facilities have been provided on Blackman's Point Road approximately 240 metres east of Blackmans Point Interchange.

A bus shelter is required with the following requirement:

- Minimum size five metres x three metres
- Minimum seating eight people
- Pitched steel roof
- Anodised aluminium finish (maintenance free)
- Engineer certified.

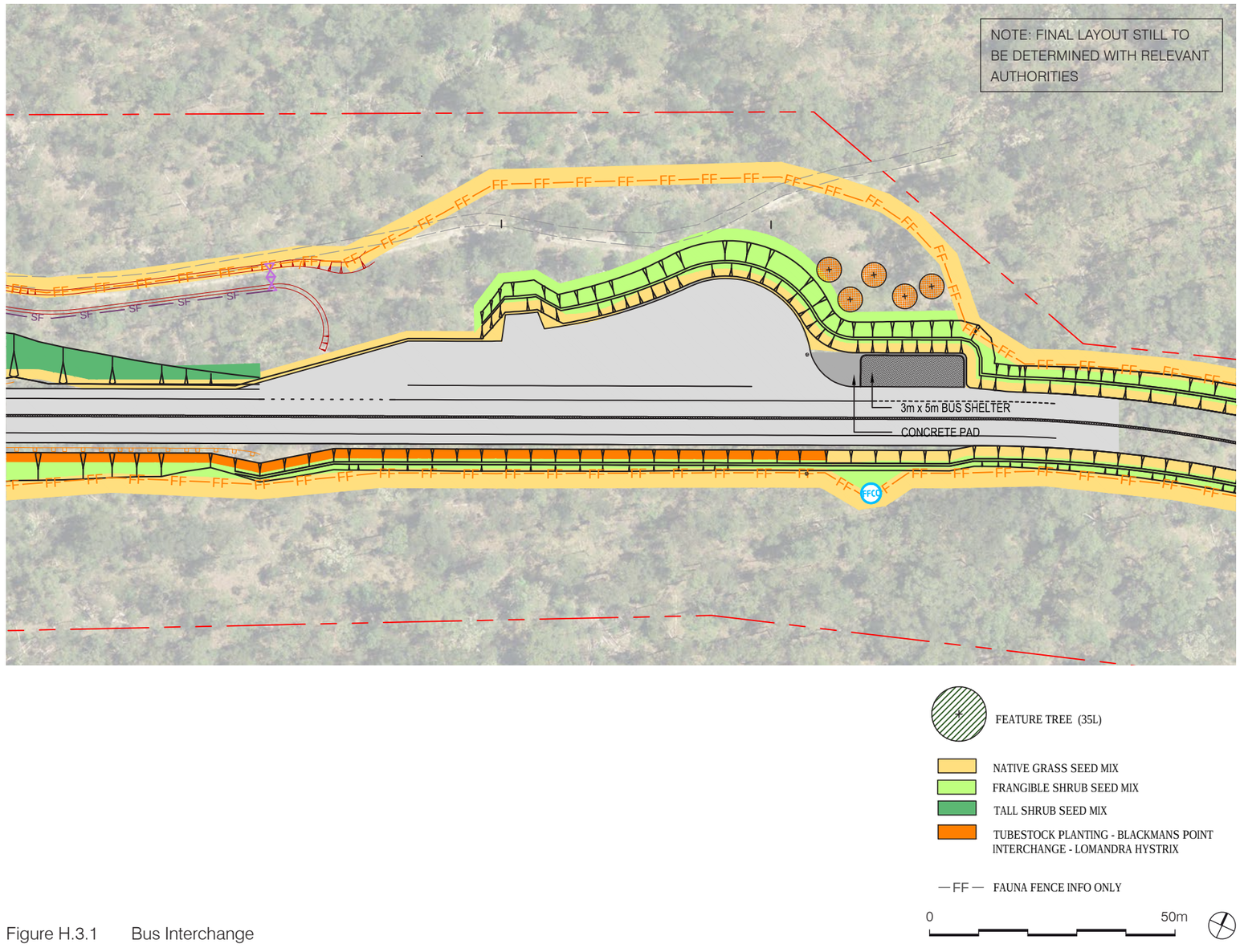


Figure H.3.1 Bus Interchange

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