

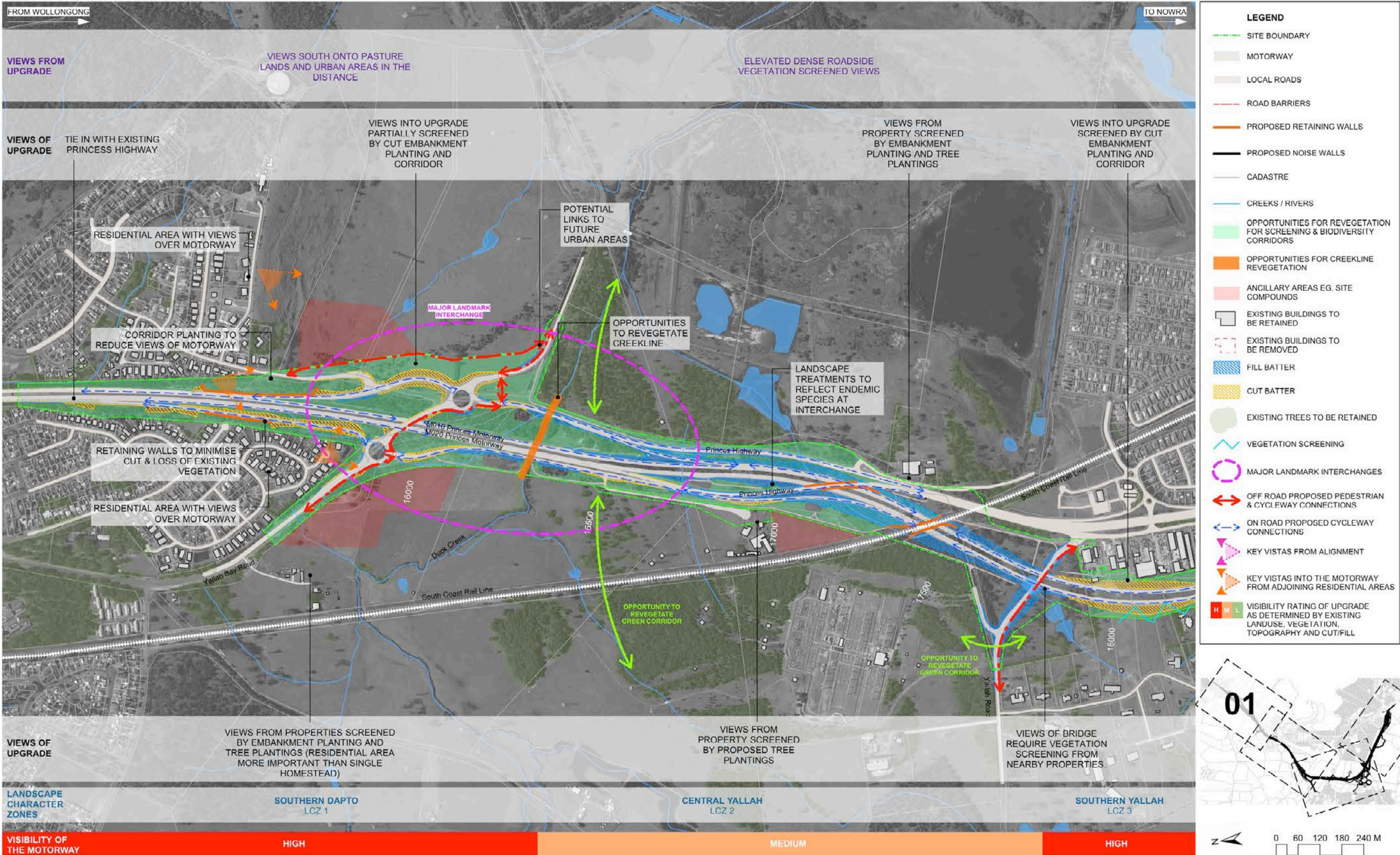
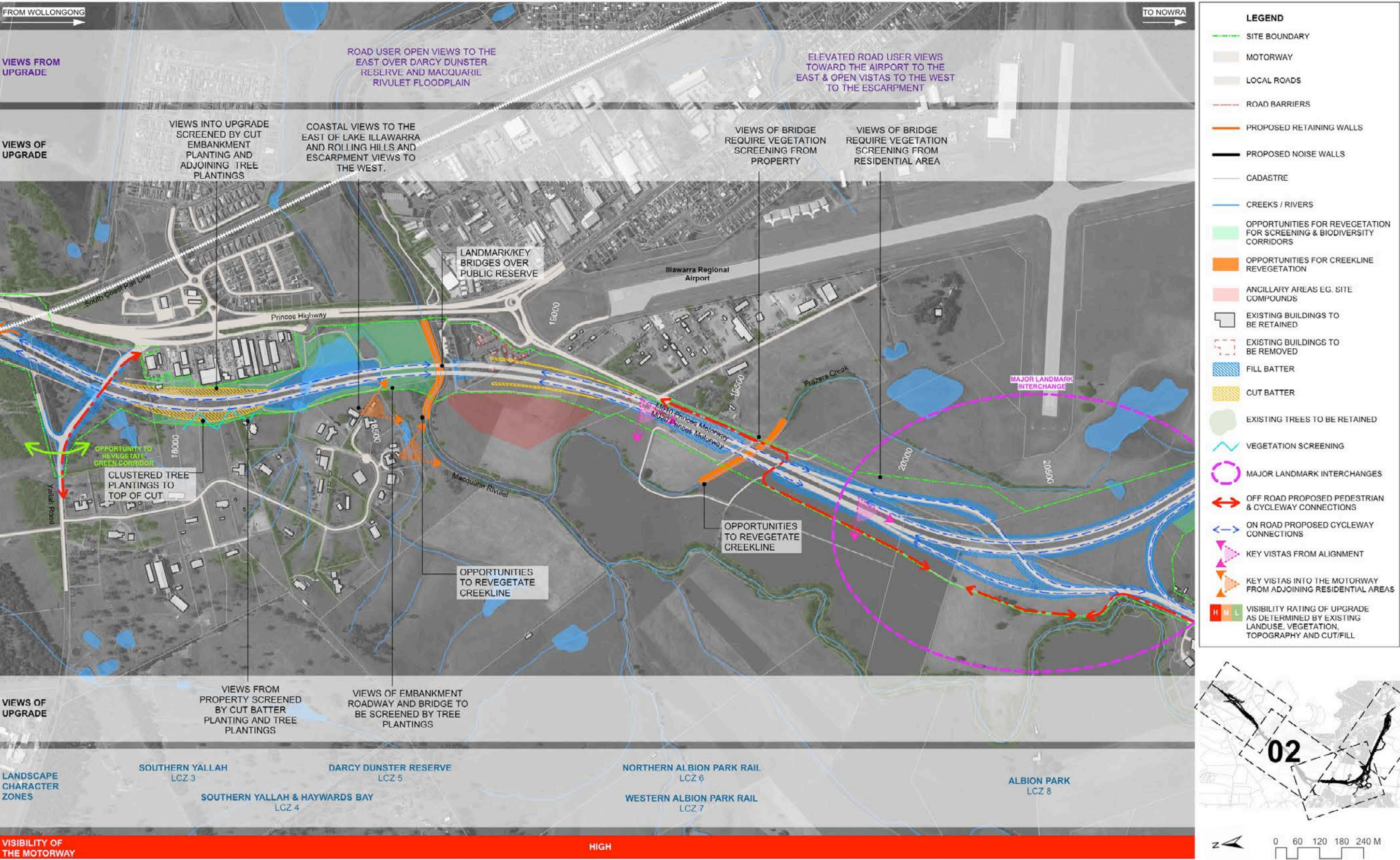
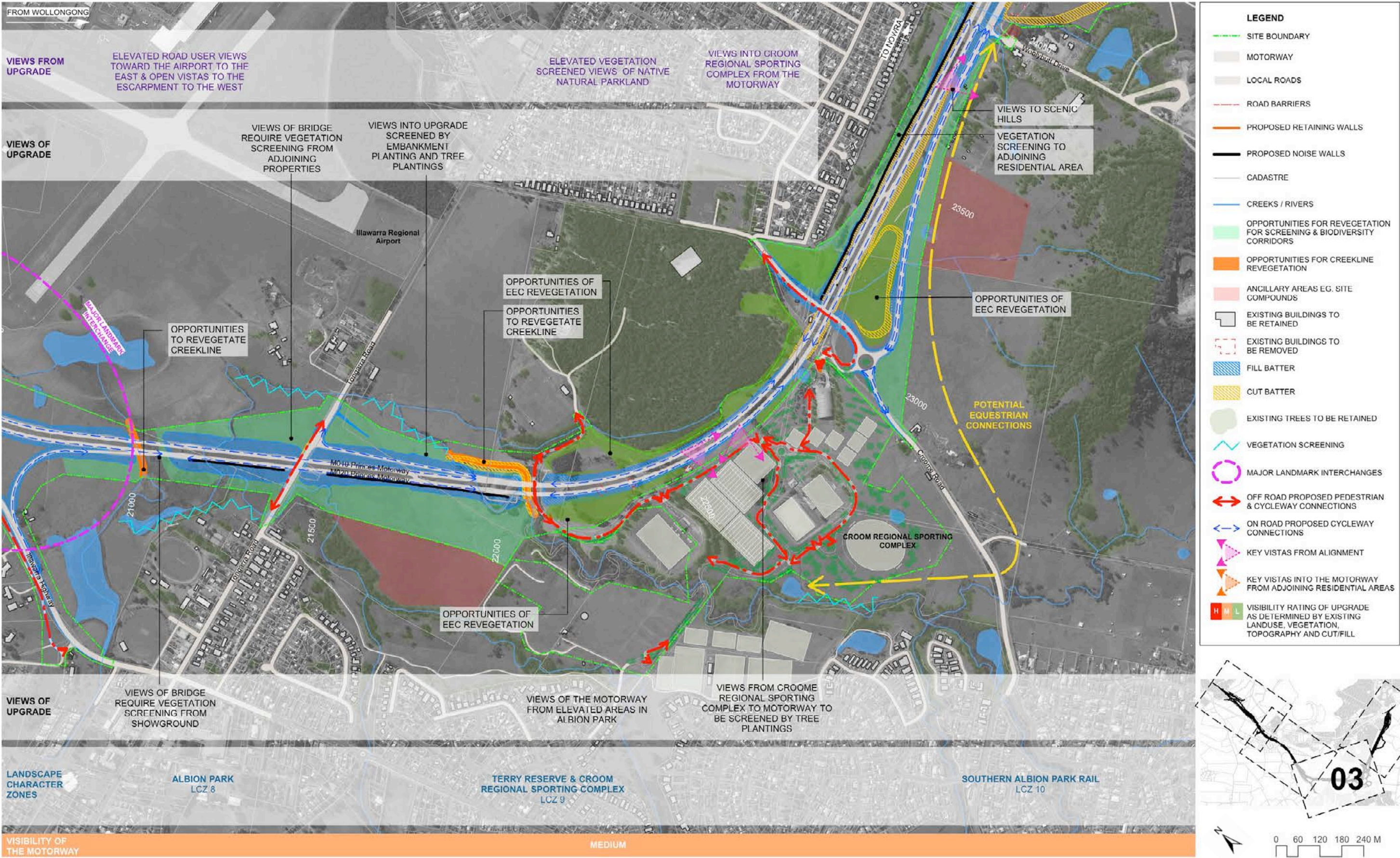
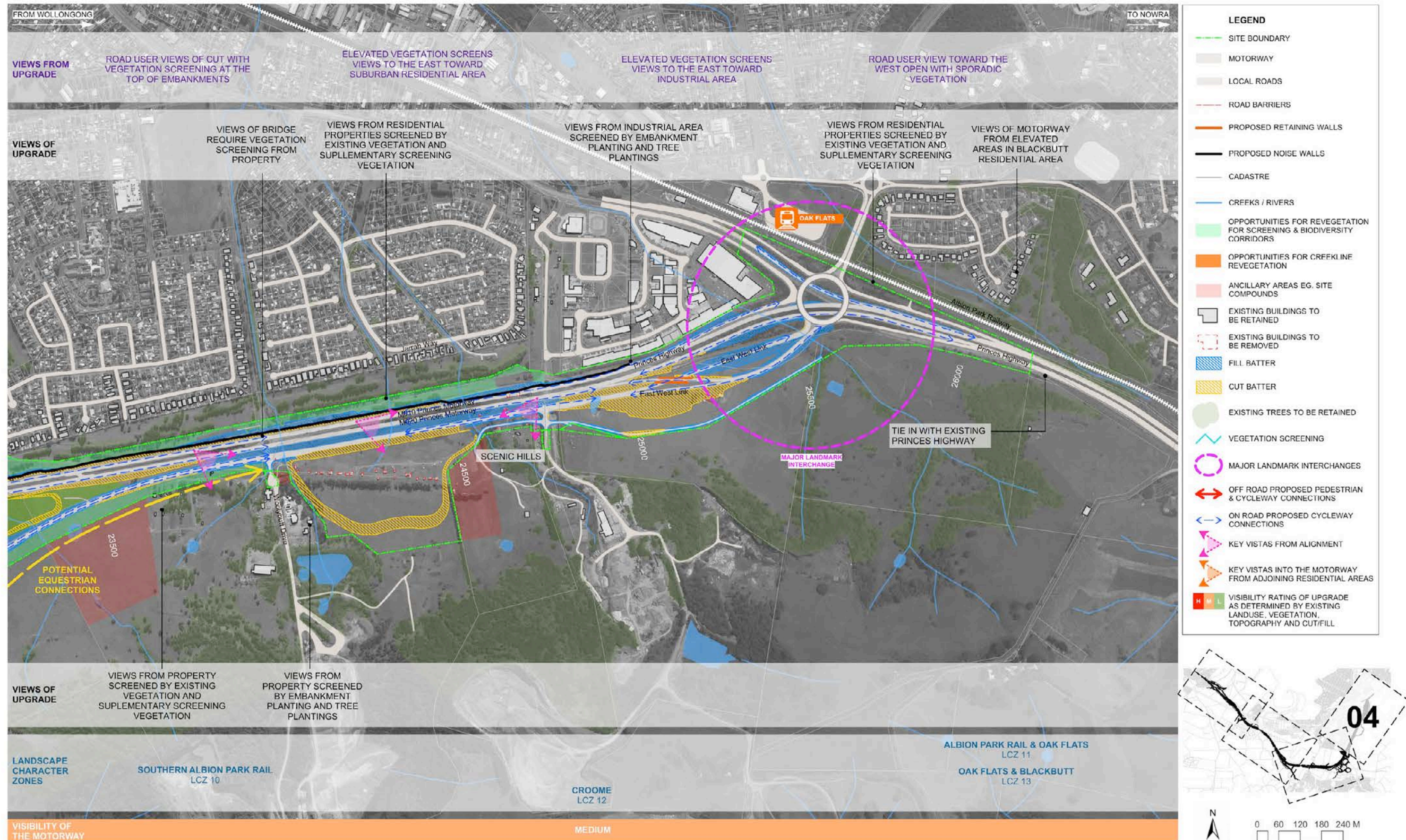


Figure 3-1: Urban and Landscape Design Strategy Plan







Croom Regional Sporting Complex

The motorway alignment would bisect the Croom Regional Sporting Complex. A number of sporting fields and facilities would be directly impacted by the project, including the cricket/AFL oval and the northern extents of the junior rugby league playing fields and netball courts.

To ensure its ongoing use, it is proposed to reconfigure the Croom Regional Sporting Complex. Roads and Maritime has worked closely with Shellharbour City Council and the affected sports clubs to develop a master plan (Figure 5-23) for the reconfiguration of the Croom Regional Sporting Complex that would provide sporting fields and facilities that are commensurate with existing facilities. Roads and Maritime is continuing to work with these groups to minimise impacts on users of the venue during the construction period.

Key project considerations related to the reconfiguration of the Croom Regional Sporting Complex include the following:

- Minimise the visual impacts of the project on the complex
- Address the urban form and function of the new sporting fields and associated buildings and amenities, new internal road structures, pedestrian and cyclist networks and parking.



Figure 3-2: Croom Regional Sporting Complex Existing



Figure 3-3: Croom Regional Sporting Complex Master Plan



Plate 3-1: Croom Regional Sporting Complex Entry



Plate 3-2: BMX course area



Plate 3-3: Adult Cricket / Junior AFL fields



Plate 3-4: Junior Rugby League fields

4. CONCEPT DESIGN

The urban design and landscape concept has been developed based on the objectives and principles described in Chapter 3, to achieve an integrated concept design for the project. This chapter describes the interrelationship between the proposed bridges and road works and the adjoining areas in the form of an indicative urban design and landscape concept plan.

The concept design presented here includes the bridges, retaining walls, noise barriers, cuttings and fill embankments. The structures shown on the drawings in this chapter reflect the current engineering concept design. The landscape concept includes planting to integrate the proposed works with the existing character of the local area, as well as feature planting to define the township entries and other cultural areas.

The urban design and landscape concept identifies a series of recommended works that should occur in conjunction with the construction of the bridges, as well as, surrounding roadworks, within the defined project area. This concept provides the basis for determination of the environmental assessment process, as well as future detailed design and construction documentation.

Further mitigation measures are identified in Chapter 7 of this report, which describes opportunities to better integrate the project into the Albion Park area. The detailed design and documentation of these works, both inside and outside the project area would be the subject of comprehensive consultation with a range of stakeholders including State government agencies, Shellharbour Council, Wollongong Council and the local community.

The concept design seeks to provide a balance between the hard and soft elements of the project. This is achieved through the consideration of multiple design responses to the range of hard elements in the project; walls, bridges, road furniture, drainage basins, cuttings and embankments.

The concept design considers the form, scale and materials of these elements and then incorporates landscape planting to soften the visual impacts of these hard elements on the local landscape over time. In this way, the concept design creates an integrated project which would progressively reflect the existing and future character of the area.

4.1 ROAD DESIGN ELEMENTS

The concept design of the upgrade should respond to the existing landscape character and vegetation communities and will define a methodology for revegetation of the upgrade. This methodology will involve the utilisation of several techniques, which aim to provide a vegetative cover to all surfaces impacted by the works and work in tandem with engineering and drainage design to stabilise the project. The urban design and landscape strategy follows on from the urban design principles and objectives developed in **Section 1** of this report and aims to identify specific direction for the upgrade.

The following strategy expands on the following topics:

- Road formations
- Structures
- Drainage and water quality
- Roadside elements
- Landscape implementation
- Planting.

4.2 ROAD FORMATIONS

Cuttings

Cuttings provide an opportunity to reveal the underlying geology of an area. Exposed rock cuttings can heighten the travel experience and provide the road user with a geological appreciation of the region through which they are passing. The ‘rawness’ and robustness of the material adds drama and texture to the visual landscape, providing a contrast with the smooth and regular form of the materials often associated with roads. Revegetation of cut batters provides additional revegetation opportunities for the upgrade. Major cuttings have been identified at Yallah Road and the East West Link. The following presents possible strategies for dealing with the cuttings in this project:

Cut batter strategy

The design of the cuttings has generally adopted a 2H:1V grade, which optimises the objective to balance cut and fill volumes, provides a low maintenance cut batter slope that integrates with the surrounding landform, allowing the slope to be exposed rock or vegetated. The design allows for revegetation of all cut batters should site conditions, upon excavation, determine this to be a beneficial outcome and as part of the shotcrete minimisation strategy. In some circumstances cut batters would be desirable to reduce the overall project footprint and the amount of existing tree removal.

Low-strength rock

Generally, all 2H:1V cut batters will be revegetated with a mixture of indigenous shrubs and grasses. In certain circumstances, which can only be ascertained upon excavation, sound rock may be uncovered and retained as an exposed finish. This approach aims to remove the need for applying shotcrete to exposed rock areas where significant areas of rock are unsuitable.

Rounding and integration

Upper slopes of all cuts will be set to a grade of 2H:1V in order to be less visible to the road user and to better integrate with existing landform. Rounding of the top edges of the batters will help to integrate the formation with the surrounding landscape.

Batter tail rounding will also be implemented on selected batters, where a series of criteria are developed in order to determine the most effective means and locations of tail rounding were possible and where impacts on existing vegetation and property acquisition are negligible.

CUTTING ATTRIBUTE	RECOMMENDATION	RATIONALE
Cutting finish	- Where roadside cuttings are required, the natural rock surface would be maintained wherever possible. Fissures and springs are to be in-filled with either quarry rock, stabilised vegetation or shotcrete. - Where the cutting face needs to be stabilised, rock anchors are preferred over shotcrete as they allow the natural rock to remain visible - Soft rock or topsoil pockets would be revegetated or backfilled with quarry rock - The use of shotcrete is to be avoided unless absolutely necessary and its use would be limited to fissures only. Where shotcrete is required, its application is to be designed to minimise its visibility. Techniques include matching the colour and texture of the concrete to the surrounding rock, and recessing the shotcrete from the cutting face. Refer the Roads and Maritime's <i>Shotcrete Design Guidelines</i> - Revegetation of cut batters would be undertaken where rock is very weak or friable and likely to require substantial stabilisation. Rock surface would then be ripped and a soil medium and vegetative overlay provided.	- Maintaining the natural rock cutting face allows the geological character of the local landscape to be expressed in the highway corridor, providing a strong sense of place - Exposure of rock face and use of quarry rock sourced from the site provides a consistency of rock colour.
Cutting profile	- Cutting angles would be as steep as possible, while taking into account the geotechnical constraints of each particular cutting location - Tails of cuttings are to be shaped back into the existing landform and progressively laid back in order to integrate with the existing contours.	- Steep cutting angles would reduce the overall footprint of the cutting, which in turn would minimise impacts on the surrounding landscape - Batter rounding, both over and back allows for less abrupt integration with existing landform and reduces visible impact when viewed from expected road user viewing angles.
Shoulder of cutting	Would be rounded and revegetated where residual topsoils present.	- Rounding visually softens the edges of cut batters to assist with better integration with existing landform - Rounding and revegetation of cuttings would assist with integration of the cutting with the surrounding landscape.
Toe of cutting	Wherever possible, provide space at the base of cuttings for grassing. In such cases, over-excavation is required to provide a suitable depth planting medium.	- Grassing at the base of cuttings allow the cuttings to be integrated with the character of the surrounding landscape - A grassing area at the base of a cutting can also function as a space to capture any loose material that is eroded from the cutting before it reaches the road surface.

Table 4-1: Landscape formations

Embankments

Embankments are potentially highly visible formations which need to be sensitively integrated with surrounding landforms and be revegetated in order to minimise visual contrast with the surrounding landscape type and vegetation patterns.

The design of embankments has generally adopted a 2H:1V grade, which optimises the desire for steepness in order to minimise the construction footprint, with the need to balance cut and fill volumes and to provide a low maintenance slope that integrates with the surrounding landform and can be successfully vegetated.

In visually exposed locations such as flood plain embankments have been flattened to 4H:1V in some instances, in order to minimise the visual contrast of the upgrade and enable the use of mixed grasses and trees that are more in keeping with the landscape character of these areas.

Shotcrete

Typically there are two scenarios where shotcrete application would be required on an upgrade. These locations are:

- Expected locations where shotcrete has been pre-determined as the preferred solution
- Unexpected locations discovered during construction.

The application of shotcrete should be minimised on the project through careful management of horizontal and vertical alignment during detailed design. Therefore shotcrete will only be used in unexpected locations uncovered during excavation and in accordance with the Shotcrete guidelines.

LOCATION	RECOMMENDATION	RATIONALE
Generally	• Reduce footprint by steepening fill batters to maximum grade of 2H:1V • Revegetate with applied topsoil and either mulched planting or hydroseeding • In open areas, limit tree planting to clusters to ensure vistas are maintained through to the broader landscape.	• Views from the road improve the driving experience, sense of place and orientation • Views of the road can be improved where the embankments are integrated with the existing landscape through shaping and revegetation.
In bushland areas	• Minimise the loss of bushland by steepening fill batters to maximum grade of 2H:1V • Application of Bushland Reconstruction technique utilising seed material embedded in existing topsoil, mulched tree material including seed, shredded trunk and branch material for stabilisation and soil ameliorants.	• Minimising the physical footprint of the highway reduces the need for clearing of native vegetation in bushland areas • Revegetation of embankments allows for better integration of the embankments with the character of the surrounding landscape.
Outside of bushland areas	• The response would depend on the specific landscape characteristics of each embankment location of the project. Nonetheless, in all cases embankments would be vegetated using planting that corresponds to the adjoining landscape. • Two general responses are recommended: ▫ Where the existing landform is relatively flat and space permits, provide a flatter embankment profile (eg 2H:1V) to better fit with the surrounding landform ▫ Where the existing landform is steep or where space is limited, provide steeper embankments to minimise extent. In all cases a minimum angle of 2H:1V is preferred to facilitate planting.	• Minimising the physical footprint of the highway reduces impacts on adjacent landscape • Where views of highway seen as substantial, flattening of batters would assist with visual mitigation.
In agricultural areas	• Minimise the loss of arable and scenic land by steepening fill batters to maximum grade of 2H:1V • It may prove beneficial to flatten out batters on the western side of the Frazers Creek Floodplain in order to integrate with localised land forms. This requires a detailed analysis in future stages.	• Arable land close to settlements is highly valued • Cultural views associated with rural settlements provide a 'sense of place' • Revegetation (grassing) of embankments would allow for better integration of the embankments with the character of the surrounding landscape, particularly where outside of the road corridor boundary fence.

Table 4-2: Landscape formations

4.3 STRUCTURES

Bridges

- There are 13 major bridge structures that form part of the proposed motorway, which would include:
- Bridges to carry the motorway over local roads
 - A bridge to carry the motorway over the South Coast Railway Line
 - Bridges to carry the motorway over watercourses
 - Bridges to carry local roads and ramps over the motorway.

- In line with the Roads and Maritime to the Bridge Aesthetics design guidelines; the overarching urban design approach to the design of bridges will be to:
- Design the visual expression of bridge structures to be simple and streamlined
 - Develop a consistent language of bridge elements such as piers, parapets and barriers, in order to visually unify the bridges along the upgrade
 - Utilise consistent structural elements, such as girders and piers, for the bridges within each group
 - Develop a consistent design language for bridge elements common to the bridges in each group
 - Assess Flooding Impacts on the local area and identify required bridge types
 - Assess OLS Requirements and Limitations
 - Develop strategies to incorporate East-West connectivity for current and future land use.

- The bridge superstructures (the portion of the bridge that is supported on piers and abutments) would vary. The superstructure types proposed include;
- Spaced plank bridges
 - Super T bridges.

- These bridges include;
- BR01 - Duck Creek south of the interchange at Yallah
 - BR02 - Duck Creek south of the interchange at Yallah
 - BR03 - South of the interchange at Yallah
 - BR04 - North of the existing Yallah Road
 - BR05 - Proposed Yallah Road alignment
 - BR06 - Macquarie Rivulet
 - BR07 - North of Albion Park
 - BR08 - Albion Park
 - BR09 - Frazers Creek north of Tongarra Road
 - BR10 - Tongarra Road
 - BR11 - Frazers Creek at Croom Regional Sporting Complex
 - BR12 - Croome Road
 - BR13 - Oak Flats Interchange.

CREEK CROSSING NUMBER	CHAINAGE	DESCRIPTION	LENGTH (M) APPROX
BRIDGES OVER CREEK CROSSINGS & OVERPASSES			
01	16300	Bridge on the motorway northbound carriageway over Duck Creek	45
02	16350	Bridge on the Princes Highway over Duck Creek	30
03	17150	Bridge on the motorway over northbound carriageway	140
04	17450	Bridge on the motorway over the South Coast Railway Line	65
05	17800	Bridge over the motorway at Yallah Road	84
06	18600	Twin bridges on the motorway over the Macquarie Rivulet	215
07	19600	Twin bridges on the motorway over Frazers Creek	160
08	20350	Bridge over the motorway for southbound exit ramp at Albion Park	58
09	21000	Twin bridges on the motorway over Frazers Creek	108
10	21450	Twin bridges on the motorway over Tongarra Road	37
11	22100	Twin bridges on the motorway over Frazers Creek and Croom Regional Sporting Complex access road	72
12	23100	Bridge over the motorway at Croome Road	54
13	25100	Bridge on the motorway for East West Link over the northbound entry ramp at Oak Flats	60

Refer to Sections and Elevations pg. 56

Table 4-3: Urban design objectives and principles for bridges over creek crossings



Plate 4-1: Precedent of Retaining Walls in Cut



Plate 4-2: Precedent of Retaining Walls in Fill



Plate 4-3: Precedent of Noise Walls

Retaining walls

Retaining wall locations have yet to be determined but typically the only situation which will require a retaining wall is in a location of a cut embankment, in order to minimise its required extents.

The Urban design approach to the design of retaining walls will be to:

- Utilise materials appropriate to the residential context of Albion Park, for example, a combination of split-faced and smooth-faced blockwork in a light colour
- Applied finishes (such as painting) are to be avoided.

This is to create a site specific design response, which allows the wall to individually respond to the local landscape character. A light coloured blockwork will contrast with the character of the industrial grey concrete of the nearby road and rail viaducts and in order to avoid long term ongoing maintenance, applied finishes are to be avoided.

Retaining walls in cut and associated with overbridge abutments and the underpass, should comprise of precast concrete fascia panels with a high quality form work finish. Where visible from the main alignment or local roads, walls should be finished with concrete fascia panels. (Plate 4-1 and 4-2)

Noise walls

Noise wall locations have been nominated and will require mitigation for road user and local residents. Noise walls are to be designed in accordance with the Roads and Maritime Noise Wall Design Guidelines and the outcomes of acoustic studies recently undertaken.

Generally the approach taken is to design out the need for walls through the adoption of vegetated mounds.

As part of the works, a number of existing noise walls of different styles would need to be slightly relocated and replaced due to the widening of the entry and exit ramps.

A lightweight concrete panel is proposed as a replacement for existing walls and is proposed to become the predominant noise wall material utilised along the motorway. These walls will provide a backdrop to the planted corridor edges and are proposed to be painted a colour that better blends with the existing setting. (Plate 4-3)

4.4 DRAINAGE AND WATER QUALITY

Major drainage and flood mitigation structures

Much of the project would be in a flood-affected area, and the project may have an impact on flood storage and flood behaviour within local catchments.

The project would traverse the catchments of Duck Creek, Macquarie Rivulet and Frazers Creek. These catchments extend from the steep Illawarra escarpment (to the west) to the relatively flat floodplains that drain to Lake Illawarra (to the east). Due to the topography and relatively small size of the catchments, floods tend to peak and subside relatively quickly, with flooding typically occurring for hours rather than days or weeks, as can occur in larger inland catchments.

The design for the project flood management structures is responsive to the varying hydraulic characteristics for the three catchments that the project would traverse. In particular:

- The northern part of the project area is hilly and would require large cuts, which would require drainage
- The central part of the project area contains sections of flat floodplain that would require a separate approach to the drainage and water quality design to deal with uncertain natural flow paths and challenges in achieving minimum grades for pipes and channels.

The project aims to provide a motorway that would be less flood-affected than the existing road network, which is subject to periodic road closures along the Illawarra Highway (Terry Street) and the Princes Highway. The project would provide a main carriageway that would achieve at least a 1 in 20 year ARI flood immunity – that is, it would not become flooded in a flood event expected to occur more than once every 20 years.

Urban design input	Urban design strategy
• Assist the drainage designers with designing drainage structures that are sensitively located and finished • Design open drainage that is responsive to water sensitive urban design principles and visually sensitive	• Minimise existing vegetation removal • Ensure visual impact mitigation measures are employed in the design.

Table 4-4: Urban design drainage strategies

4.5 ROADSIDE ELEMENTS

Safety Barriers

Safety barriers along the road side generally would consist of a combination of Twin Bridge rail barriers and ‘W’ beam guard rails, as verge width is limited. Other barriers include Monowills steel tube barriers where pedestrian or maintenance staff safety is a potential issue.

Headlight Glare Attenuation

Headlight glare requires mitigation in certain circumstances to reduce light glare to oncoming traffic, local residents and other sensitive receivers. Screen planting would be provided in several locations in order to mitigate headlight glare.

Fencing

Fencing on the upgrade is likely to consist of road corridor boundary fencing and fauna fencing. To minimise fencing requirements a combined boundary/ fauna fence could be employed in some locations. The design of the fence would be finalised in the detailed design stage and would be subject to approval by relevant authorities.

It is also likely that some fencing may need to be replaced, modified or repaired as a result of the upgrade. These fences would primarily be associated with strips of private property that would be acquired for road widening. Fencing should be designed to match existing property fencing, which are predominantly of a rural style. Many of these fences will be replaced over time when the area becomes increasingly urbanised.

Bus shelters

Bus shelters should be a contemporary design to the approval of, and installed by, Shoalhaven and Wollongong Councils. Locations should be designed to suit existing and planned bus routes.

Variable Message Signs

Variable message signs (VMS) display traffic related advice to motorists, such as traffic delays, severe weather conditions, maintenance operations, incident reporting and incident management. They comprise a steel pole and electronic sign board structure that requires a substantial engineering design component. The selection, placement and assessment of VMS structures is guided by the Roads and Maritime TDT 2005/02b *Guidelines for the location and placement of variable message signs document* (Roads and Traffic Authority, 2008)

4.6 LANDSCAPE IMPLEMENTATION

Planting and revegetation assists with the integration of the upgrade with the surrounding landscape, by responding the existing character of the place as well as the existing vegetation communities that are (or were), present. The landscape strategy works in combination with the landscape formations design and landscape character and visual impact assessment to complete the overall picture for the upgrade. The planting and revegetation design also aims to minimise the potential ecological impacts of the upgrade by stabilising earthworks, reinforcing habitat corridors, rehabilitating denuded rural creek lines and substantially contributing to revegetation along the entire length of the upgrade.

Objective	Urban design strategy
Provide a well-vegetated corridor that integrates the highway with the surrounding landscape and provides motorists with a ‘sense of place’.	• Planting and revegetation mixes will respond to endemic vegetation communities and therefore strengthen the existing character of the place.
Strike a balance between screening the highway from sensitive viewing locations and maintaining key vistas from the highway.	• Planting and revegetation mixes will respond to landscape types: ▫ Open floodplain - clustered trees in floodplains will help mitigate the visual impact when viewed from a distance. ▫ Rural/ residential - Screen planting will be located adjacent to local residences.
Revegetation or planting of all areas affected by construction of the upgrade.	• All affected areas will be revegetated.
Revegetation of residual land created by the upgrade so that it can remain viable for private ownership, productive uses eg agriculture, or for environmental offsets.	• Land affected adjacent to rural areas will generally be revegetated with pasture grasses.
Use of EEC species as a revegetation technique for offline sections of highway that pass through bushland.	• This will ensure that appropriate species will regenerate in sensitive bushland areas. • Cost benefit to the project
Provision of planting in highway medians to minimise the visual scale of the highway and minimise headlight glare for road users.	• Maintain naturalistic feel and avoid over use of architectural solutions.
Revegetation of outside/ low side verges to allow better stabilisation and filtering of sediment and nutrients.	• Minimise sediment-laden runoff into landscape areas and catchments.

Table 4-5: Urban design planting strategies

Landscape implementation methods

The landscape project for the upgrade will comprise the following key methods:

- Planting – Trees, shrubs and groundcovers, including mulching and temporary staking
- Revegetation – Seeding, including hydromulching, direct seeding and compost blanket
- Revegetation – Bushland reconstruction
- The location of these methods will be based on a combination of:
- Landscape character type ie Rural/ residential, floodplain, forest and riparian zone
- Adjacent existing vegetation community
- Surface type eg cut batter, embankment, open channel etc.

Progressive installation

Landscape finishing works will be completed progressively throughout the duration of the project. Typically, as cut and fill formations are completed, topsoil will be installed as soon as practicable to the formations. All topsoiling and revegetation work will be coordinated with the earthworks program to suit the construction sequence and prevailing weather conditions.

As topsoiling in individual areas is completed, they will either be:

- Hydromulched/ hydroseeded with grass and shrub mixes, including annual cover crop species that will generate quickly to assist in stabilising the embankments and reduce erosion risk
- Hydroseeded with annual cover crop species (where the final treatment is to occur later or in bushland reconstruction areas)
- Direct seeded with grass species (verges and flatter batter-to-boundary areas)
- Mulched and planted with containerised plant stock.

Early works

Where possible in areas that can be fenced off during all or early stages of the construction program, early works planting may be possible and will be explored, particularly in relation to rip-line planting areas outside of cut and fill operations (batter-to-boundary areas).

Planting on embankments

Planting will comprise indigenous and bioregional tree, shrub and groundcover species suited to the area and application. Given shrub and groundcover species endemic to the local vegetation communities require an established canopy for survival, it is proposed to use regionally native species that are suited to the area and able to establish in a reconstructed environment.

Ground and topsoil preparation for planting areas is similar to revegetation areas.

Broad-acre tree planting in rip-lines

Along the upgrade the design proposes the planting of trees outside of landscape formations but generally within the clearing boundary eg within areas of existing pasture within the road corridor. These areas will be cultivated ‘ripped’ to a depth of 400 millimetres to allow better root establishment.

Planting in basins

Only the basin rim and outside banks are to be planted. The designed permanently wet areas are not to be planted or mulched as:

- This will increase the potential for eroded materials to clog the basin
- Water loving riparian plants will most likely establish of their own accord if the conditions are appropriate and will not survive if planted when the basin is dry.

In these locations, vegetation may have been stripped, however existing (site) topsoil remains relatively intact:

- Vegetation removed including clearing and grubbing
- Area chain dragged to remove loose coarse material and to create a suitable surface for planting works
- Topsoil supplementation where ground requires minor filling
- Area ripped to depth of 400 mm where tree planting is to occur, or 200 mm where other revegetation is to occur
- Apply covercrop to surfaces that would be exposed for extended periods of time.

Verge landscape preparation

For outside and median verges that are not to be sealed and where soft landscape treatments are required, the following planting and seeding preparation will occur:

- Subsoil not to be aerated due to compaction requirements
- Distribute and spread the topsoil to 1.5 times the required depth
- Lightly tamp the topsoil with the underside of an excavator bucket (only where large disturbances have occurred and filling undertaken)
- Lightly track-roll the surface to create a furrowed surface that traps moisture and reduces rill erosion
- Apply covercrop, preferably in conjunction with ultimate revegetation treatment.

For verges in cut that are to be planted, a similar planting preparation will occur to batters and embankments.

Creek bank landscape preparation

Where creek banks are to be planted, the following preparation will occur:

- Assessment of existing vegetation and removal of weed species only to direction of project ecologist
- Identification and protection of existing species for translocation.

4.7 PLANTING

Planting

The general approach to the planting design for this project is to integrate any new planting into the existing landscape setting and to further define and reinforce the landscape character of the Albion Park bypass. In order to do this the planting must strike a balance between screening the works from sensitive visual receptors and maintaining and enhancing key views and vistas to the surrounding landscape. Refer to Table 4-2 for indicative plant species.

Planting Design Principles

The planting concept has been guided by the following design principles:

- Retain existing woodland planting where possible
- Revegetation of all areas affected by the new works
- Revegetation of residual land affected by the works that would not be viable for amalgamation
- Provision of ‘gateway’ planting at the interchanges and important cultural areas to provide visual landmarks and enhance local identity
- Provision of tree planting in verges wherever possible to help minimise the visual scale of the Albion Park bypass
- Provision of planting on fill embankments and shallow cut batters to stabilise the earthworks, minimise their visual impact and integrate them with the character of the surrounding landscape
- Provision of planting to screen the works from sensitive adjacent land uses where applicable
- Use of provenance plant material (plants grown from locally collected seeds) wherever possible for all native plantings, in particular native revegetation.

At the detailed planting design stage, which would include further refinement of the plant species selection, particular consideration should be made for ongoing maintenance requirements. Principles include:

- Selection of plant species that are robust, non-invasive and not fire promoting
- Use of local provenance plant material for native revegetation plantings
- Exclusion of all species on weed lists applicable to the local area

- Placement and species selection for planting within the motorway corridor (eg medians and verges) to be in accordance with clear zone and sight stopping distance requirements.

Interchanges Planting Treatment

The planting at the interchanges would generally comprise of Woodland species to replace those being removed for the widening, lengthening and realignment of the entry and exit ramps.

The plantings in these locations would consist of massed colourful Woodland shrubs, planted in mixed swathes to capture their contrasting colour and texture to the existing bushland character of the interchanges. In the foreground, accent planting of Gynea lily and *Hardenbergia* will provide splashes of intense seasonal colour and year round textural contrast.

The locations for these treatments at the interchanges would need to have good sight distances in order to get the benefit of signalling the interchanges, while not impacting on motorist sightlines to the ITS infrastructure. Species selection would need to consider microclimatic conditions caused by aspect, slope, adjoining surfaces, and land use, as well as soil conditions and maintenance requirements.

Main Line Motorway Works

Revegetation with Woodland species (including grasses, groundcovers, and shrubs, depending on sight line requirements) in roadside areas to reduce perceived corridor width.

- Revegetation with Woodland species in areas unaffected by utilities and infrastructure, maintaining sightlines to these elements and considering clearance requirements
- Screen planting against new retaining and noise walls to reduce their visual dominance and soften the edge effect of straight lines adjacent to the Albion Park bypass
- In areas where noise walls are close to carriageway reduce visual dominance by strip planting between noise walls and carriageway where practicable.

Plant Mixes

Swamp Forest & Floodplain Planting

Planting within floodplain and swamp communities is predominantly located around the Macquarie Rivulet and the ephemeral wetlands adjacent to Tongarra Road.

The mix is made up of a dense tree layer, including; Swamp Mahogany, Paperbark, Swamp Oak and Red Mahogany. Smaller trees and shrubs such as Willow Bottlebrush, Hill Banksia and Long Leaved Wattle provide an understorey, with the groundcover comprised of sedges and grasses including but not limited to, Tall Sedges, Saw-Sedge, Common Rush and Ivy-Leaved Violet. This mix mirrors the Swamp Sclerophyll Forest on Coastal Floodplains of the South East Corner Bioregion.

Feature Planting

Feature planting is proposed in both the widened medians located at CH20500 and within roundabouts. Feature planting at roundabouts locations will take into consideration sight lines. A collar ring of low ground covers, consisting of *Hardenbergia* and a plant mix located centrally consisting of Gynea Lily, *Callistemon* and *Leptospermum*, to adhere to sight line requirements. No trees would be planted within the roundabouts.

Within widened median areas, feature planting has been proposed, in the form of larger clusters of tree plantings including Fig Trees and Arancaria species have been proposed amongst low feature plant mix plantings. In order to assist with the maintaining and enhancing of key views and vistas to the surrounding landscape



Plate 4-4: Adjacent to recently upgraded Princes Highway near Gerringong Feature Planting

Woodland Planting

Revegetation within Woodland Planting zones consists of a mix of Tree, Shrub and Groundcover species. It is used frequently throughout the road corridor in areas where screen planting is required, Batter to boundary planting, widened medians, as well as areas with adjacent similar character. The Mix is made up of Small and Large woodland tree species including but not limited to, Spotted Gum, Blueberry Ash, Narrow leaf Ironbark, Grey box and Turpentines. Smaller trees and shrubs make up the underplanting, including; Hairpin Banksia, Flax-Leafed Wattle, Juniper Grevillea and Spreading Bush Pea. Groundcovers within this mix aim to replicate local native species, such as, Spreading Flax-lily, Muave Flax-Lily, Blady Grass and Mat-Rush.

Pasture Planting

Pasture Planting is generally located within disturbed areas to be reconstructed following construction, within dry basins and in areas of adjacent pasture planting, as well as within the medians. The Mix is made up of groundcover species including but not limited to, Wallaby Grass, Clustered Rush, Weeping Grass and Tussock Grass.

Endangered Ecological Community Local Species Planting

Planting within these areas is focused on protecting existing ecological resources. They aim to re-establish Endangered ecological community species and related community species. The character of these specie plantings aim to establish additional areas of vegetation to complement the surrounding ecology with a mix of tree, shrub and groundcover plantings endemic to the locale.



Plate 4-5: *Eucalyptus tereticornis*



Plate 4-6: *Eucalyptus moluccana*



Plate 4-7: *Corymbia maculata*



Plate 4-8: *Eucalyptus crebra*



Plate 4-9: Feature planting species, from top, left to right: *Ficus macrophylla*, *Araucaria heterophylla*, *Hardenbergia violacea*, *Leptospermum* 'Merinda', *oryanthes excelsa*, *Callistemon* 'Great Balls of Fire'



Plate 4-10: Woodland species, from top, left to right:
Acacia parramattensis, *Eleocarpus reticulatus*, *Ceratopetalum gummiferum*, *Dillwynia sieberi*, *Bursaria spinosa*, *Themeda australis*, *Dianella longifolia*, *Lomandra multiflora*

BOTANICAL NAME	COMMON NAME	MATURE HEIGHT	MATURE SPREAD
PLANT MIX 1 - SWAMP FOREST / FLOODPLAIN PLANTING			
Trees			
<i>Casuarina glauca</i>	Swamp Oak	20m	8m
<i>Eucalyptus robusta</i>	Swamp Mahogany	20m	5m
<i>Eucalyptus resinifera</i>	Red Mahogany	20m	8m
<i>Eucalyptus tereticornis</i>	Forest Red Gum	20m	8m
<i>Melaleuca quinquenervia</i>	Broad Leaved Paperbark	15m	5m
Shrubs			
<i>Acacia longifolia</i>	Long Leaved Wattle	6m	3m
<i>Banksia oblongifolia</i>	Dwarf Banksia	3m	2m
<i>Banksia spinulosa</i> var. <i>collina</i> *	Hill Banksia	2m	2m
<i>Callistemon citrinus</i>	Crimson Bottlebrush	2m	2m
<i>Callistemon pachyphyllus</i>	Wallum Bottlebrush	1.5m	1.5m
<i>Callistemon salignus</i>	Willow Bottlebrush	7m	3m
Groundcovers			
<i>Carex appressa</i>	Tall Sedge	-	-
<i>Gahnia clarkei</i>	Tall Saw-Sedge	-	-
<i>Gahnia sieberiana</i>	Red-Fruit Saw-Sedge	-	-
<i>Juncus usitatus</i>	Common Rush	-	-
<i>Lomandra longifolia</i> subsp. <i>longifolia</i>	Spiny Headed Mat-Rush	-	-
<i>Viola hederacea</i>	Ivy-Leaf Violet	-	-

PLANT MIX 2 - FEATURE PLANTING			
<i>Doryanthes excelsa</i>	Gynea Lily	2m	3m
<i>Callistemon</i>	‘Great Balls of Fire’	1.5m	1.5
<i>Leptospermum</i>	‘Merinda’	1m	1m
<i>Hardenbergia violacea</i>	Native Violet	-	-

Table 4-6: Indicative revegetation plant species list

BOTANICAL NAME	COMMON NAME	MATURE HEIGHT	MATURE SPREAD
PLANT MIX 3 - WOODLAND PLANTING			
Trees			
<i>Acacia parramattensis</i>	Sydney Green Wattle	8m	5m
<i>Corymbia maculata</i>	Spotted Gum	30m	8m
<i>Elaeocarpus reticulatus</i>	Blueberry Ash	8m	6m
<i>Eucalyptus crebra</i>	Narrowleaf Ironbark	20m	8m
<i>Eucalyptus moluccana</i>	Grey Box	20m	10m
<i>Eucalyptus punctata</i>	Grey Gum	30m	12m
<i>Eucalyptus teretecornis</i>	Forest Red Gum	35m	12m
<i>Exocarpos cupressiformis</i>	Cherry Ballart	7m	5m
<i>Syncarpia glomulifera</i>	Turpentine	5m	3m
Shrubs			
<i>Acacia linifolia</i>	Flax-leafed Wattle	2m	2m
<i>Banksia spinulosa</i>	Hairpin Banksia	2m	2m
<i>Bursaria spinosa</i>	Australia Blackthorn	2m	2m
<i>Ceratopetalum gummiferum</i>	NSW Christmas Bush	7m	3m
<i>Dillwynia sieberi</i>	Prickly Parrot Pea	1.5m	1m
<i>Grevillea juniperina</i>	Juniper Grevillea	1.5m	2m
<i>Hakea sericea</i>	Bushy Needlewood	2m	2m
<i>Indigofera australis</i>	Australian Indigo	2.5m	2m
<i>Kunzea ambigua</i>	Tick Bush	3m	2m
<i>Leptospermum juniperinum</i>	Prickly Tea Tree	2m	1.5m
<i>Leptospermum polygalifolium</i>	Lemon Scented Tea Tree	3m	2m
<i>Persoonia linearis</i>	Narrow-leaved Geebung	3m	2m
<i>Pimelea linifolia</i>	Rice Flower	1.5m	1.5m
<i>Pultenaea microphylla</i>	Spreading Bush Pea	2m	1.5m
Groundcovers			
<i>Dianella longifolia</i>	Spreading Flax-lily	-	-
<i>Dianella revoluta</i>	Mauve Flax-lily	-	-
<i>Echinopogon caespitosus</i>	Tufted Hedgehog Grass	-	-
<i>Imperata cylindrica</i>	Blady Grass	-	-
<i>Lomandra multiflora</i>	Mat-rush	-	-
<i>Microlaena stipoides</i>	Weeping Grass	-	-

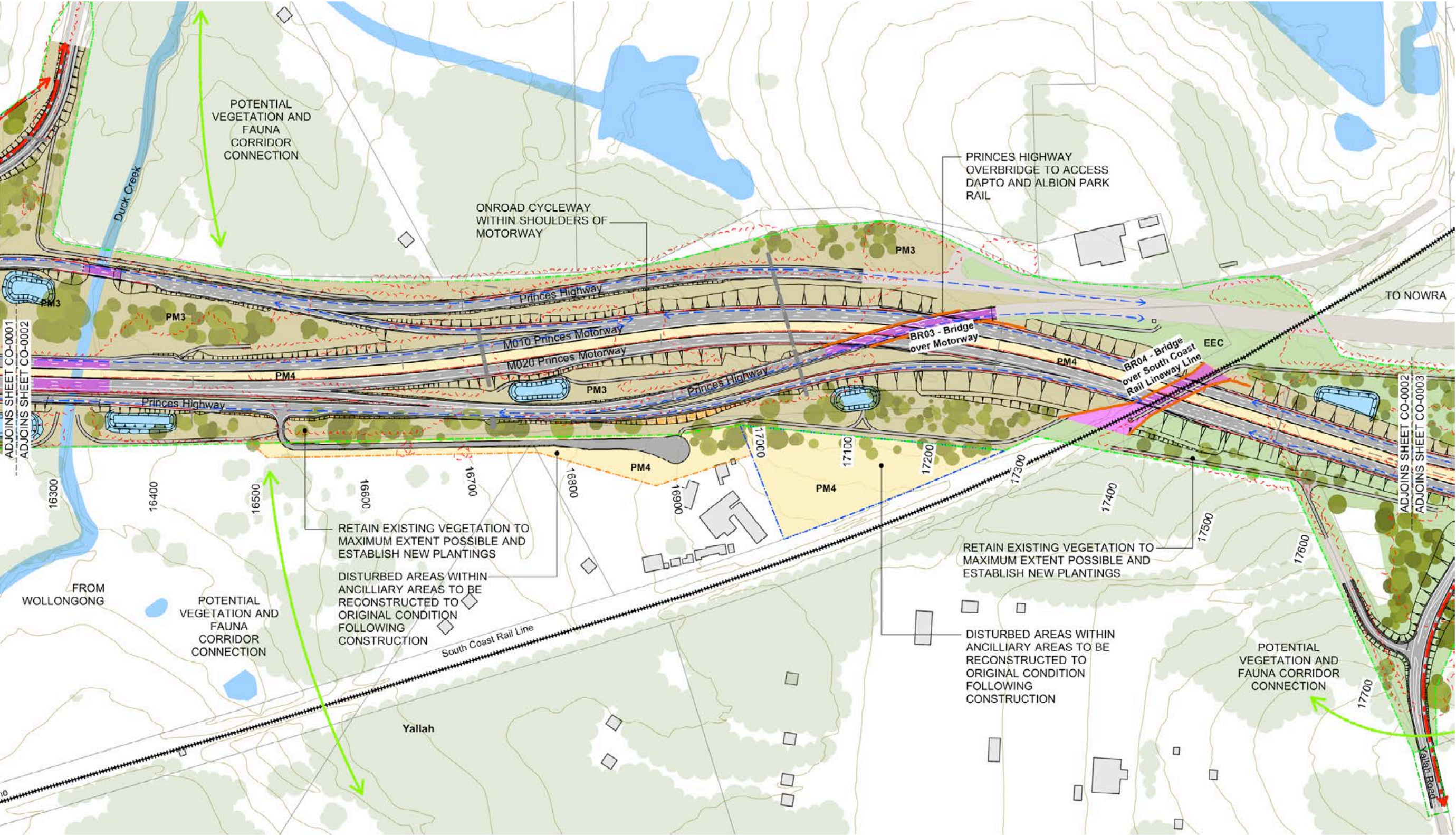
4.8 CONCEPT DESIGN DRAWINGS

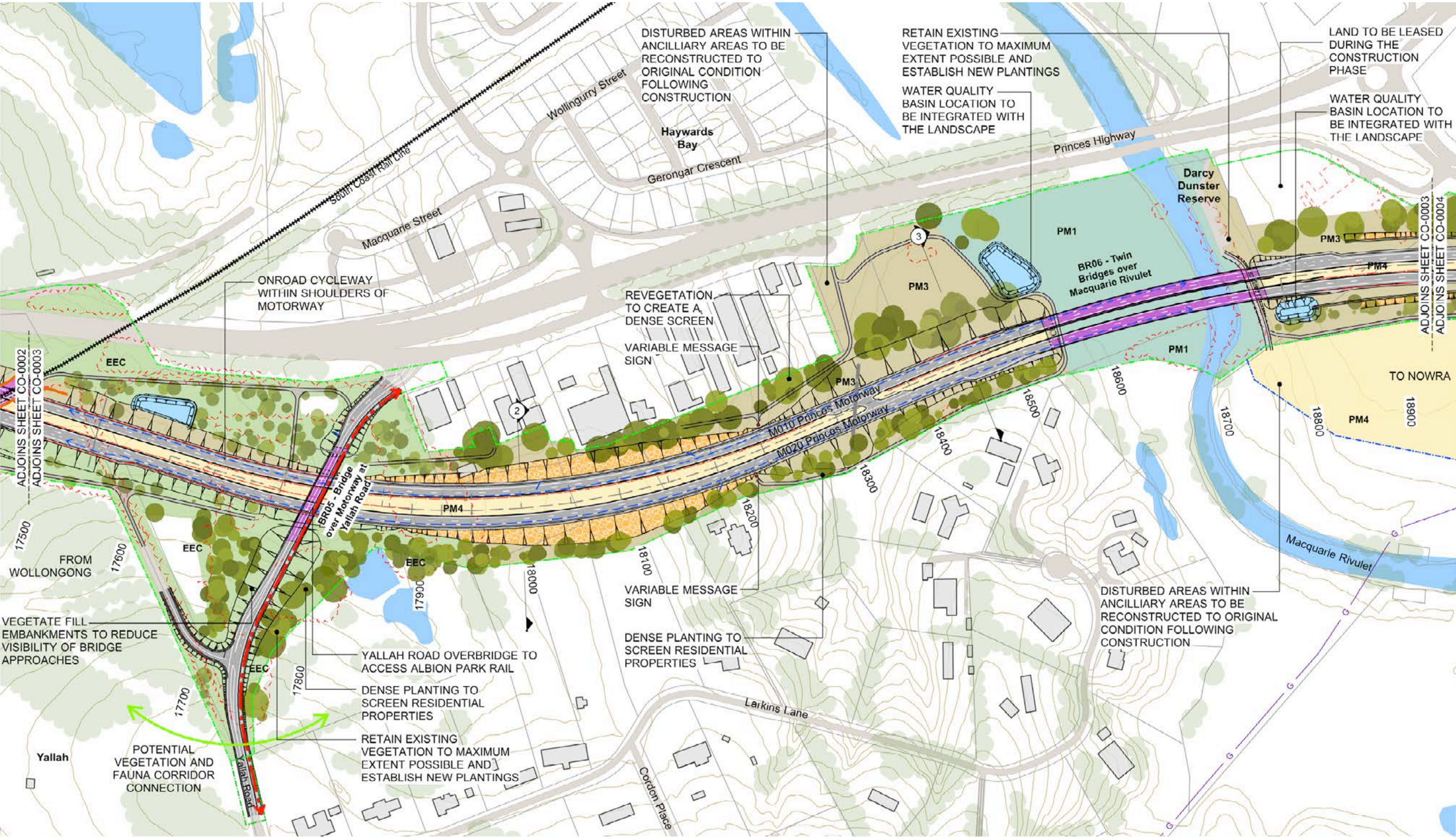
This section presents the concept design drawings for the Albion Park Rail bypass, this includes;

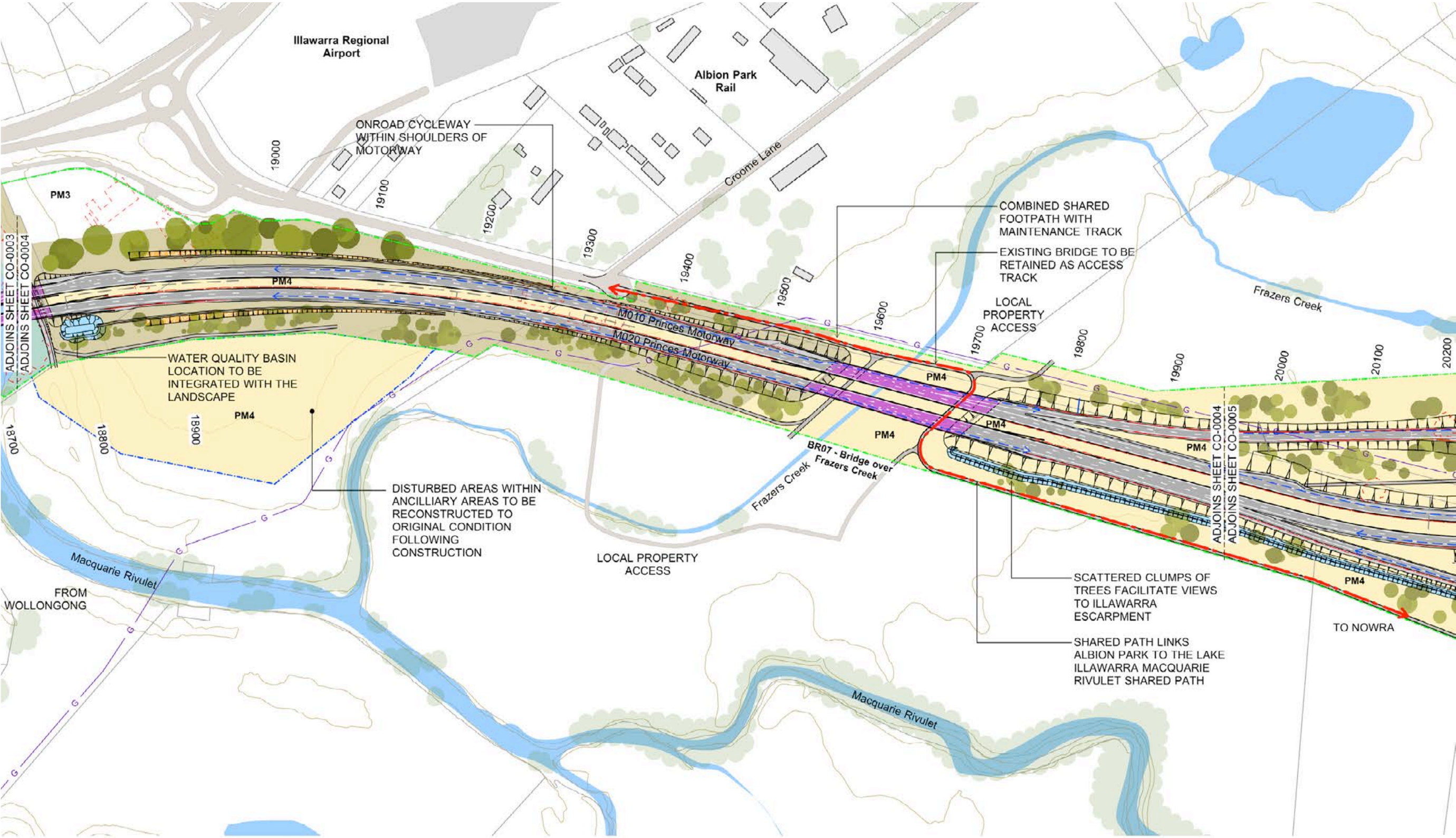
- Road Planting Plans
- Cross Sections
- Bridge Design Longitudinal and Cross Sections
- A concept design for Croom Regional Sporting Complex (CRSC) is attached to this report in Appendix 1.

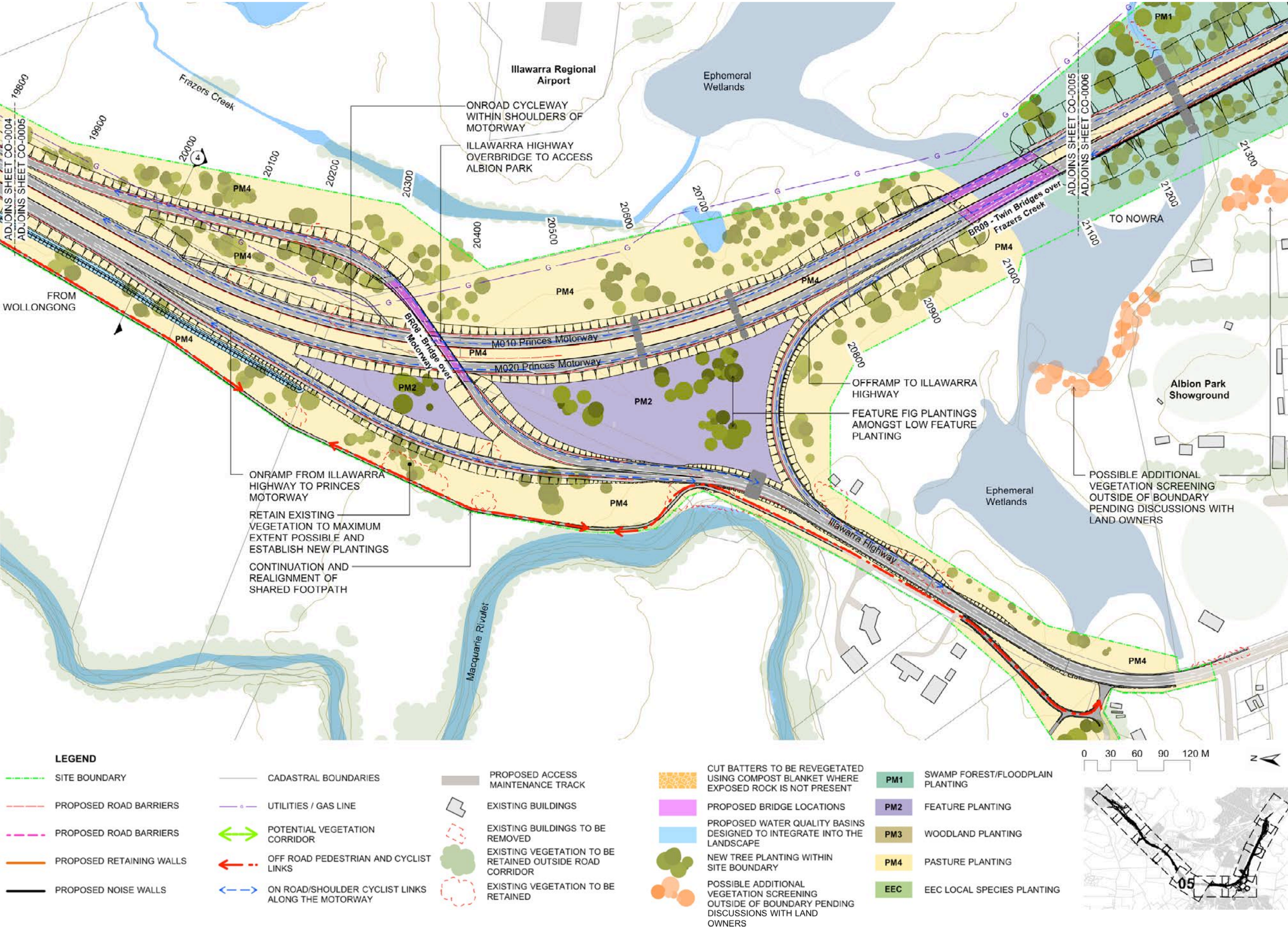
BOTANICAL NAME	COMMON NAME	MATURE HEIGHT	MATURE SPREAD
PLANT MIX 4- PASTURE PLANTING			
Groundcovers			
<i>Austrodanthonia spp.</i>	Wallaby Grass	-	-
<i>Entolasia stricta</i>	Wiry Panic	-	-
<i>Juncus vaginatus</i>	Clustered Rush	-	-
<i>Microlaena stipoides</i>	Weeping Grass	-	-
<i>Poa labillardieri</i>	Tussock Grass	-	-
<i>Poa siebriana</i>	Grey Tussock Grass	-	-
PLANT MIX 5 - EEC LOCAL SPECIES			
Trees			
<i>Angophora floribunda</i>	Rough-barked Apple	30m	20m
<i>Eucalyptus tereticornis</i>	Forest Red Gum	20m	8m
<i>Corymbia maculata</i>	Spotted Gum	30m	15m
<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	20m	8m
<i>Eucalyptus eugenoides</i>	Narrow-leaved Stringy bark	20m	12m
<i>Eucalyptus moluccana</i>	Grey box	20m	10m
<i>Corymbia henryi</i>	Large-leaved spotted gum	30m	10m
<i>Corymbia intermedia</i>	Pink Bloodwood	20m	10m
<i>Eucalyptus siderophloia</i>	Northern Grey Ironbark	20m	10m
Shrubs			
<i>Bursaria spinosa</i>	Blackthorn	2m	2m
<i>Acacia implexa</i>	Hickory Wattle	6m	3m
<i>Acacia mearnsii</i>	Black Wattle	10m	5m
<i>Daviesia ulicifolia</i>	Gorse bitter pea	2m	1m
<i>Dillwynia sieberi</i>	Prickly Parrot Pea	1.5m	1m
<i>Jacksonia scoparia</i>	Dogwood	4m	2m
<i>Leucopogon juniperinus</i>	Prickly beard-heath	1m	1m
<i>Ozothamnus diosmifolius</i>	White Dogwood	1.5m	1m
Groundcovers			
<i>Eustrephus latifolius</i>	Wombat Berry	-	-
<i>Glycine clandestina</i>	Twining Glycine	-	-
<i>Glycine tabacina</i>	Pea Glycine	-	-

	SITE BOUNDARY		CADASTRAL BOUNDARIES		PROPOSED ACCESS MAINTENANCE TRACK		CUT BATTERS TO BE REVEGETATED USING COMPOST BLANKET WHERE EXPOSED ROCK IS NOT PRESENT		PM1	SWAMP FOREST/FLOODPLAIN PLANTING
	PROPOSED ROAD BARRIERS		UTILITIES / GAS LINE		EXISTING BUILDINGS		PROPOSED BRIDGE LOCATIONS		PM2	FEATURE PLANTING
	PROPOSED ROAD BARRIERS		POTENTIAL VEGETATION CORRIDOR		EXISTING BUILDINGS TO BE REMOVED		PROPOSED WATER QUALITY BASINS DESIGNED TO INTEGRATE INTO THE LANDSCAPE		PM3	WOODLAND PLANTING
	PROPOSED RETAINING WALLS		OFF ROAD PEDESTRIAN AND CYCLIST LINKS		EXISTING VEGETATION TO BE RETAINED OUTSIDE ROAD CORRIDOR		NEW TREE PLANTING WITHIN SITE BOUNDARY		PM4	PASTURE PLANTING
	PROPOSED NOISE WALLS		ON ROAD/SHOULDER CYCLIST LINKS ALONG THE MOTORWAY		EXISTING VEGETATION TO BE RETAINED		POSSIBLE ADDITIONAL VEGETATION SCREENING OUTSIDE OF BOUNDARY PENDING DISCUSSIONS WITH LAND OWNERS		EEC	EEC LOCAL SPECIES PLANTING

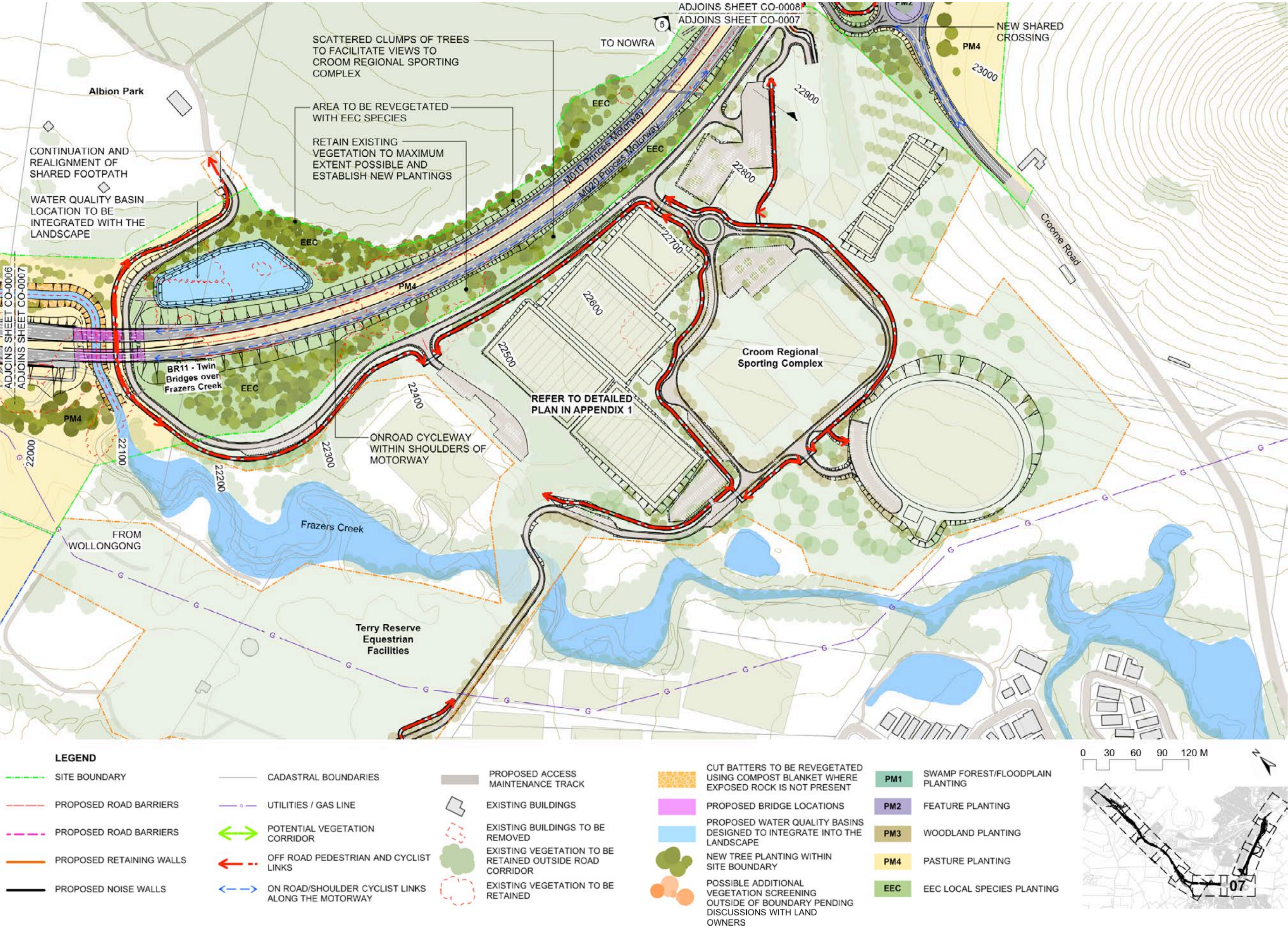


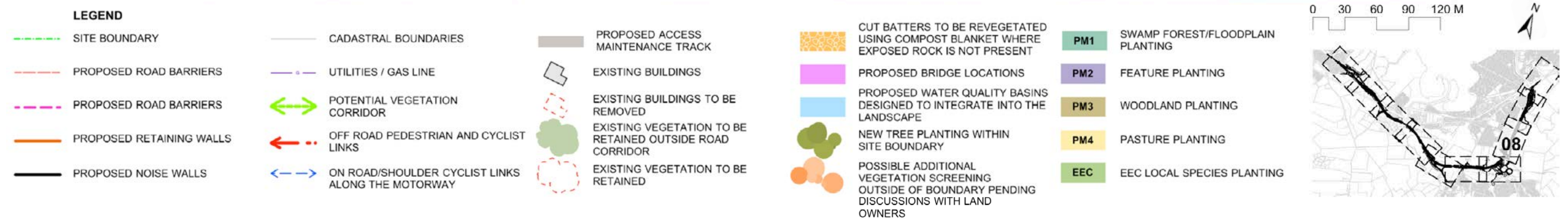
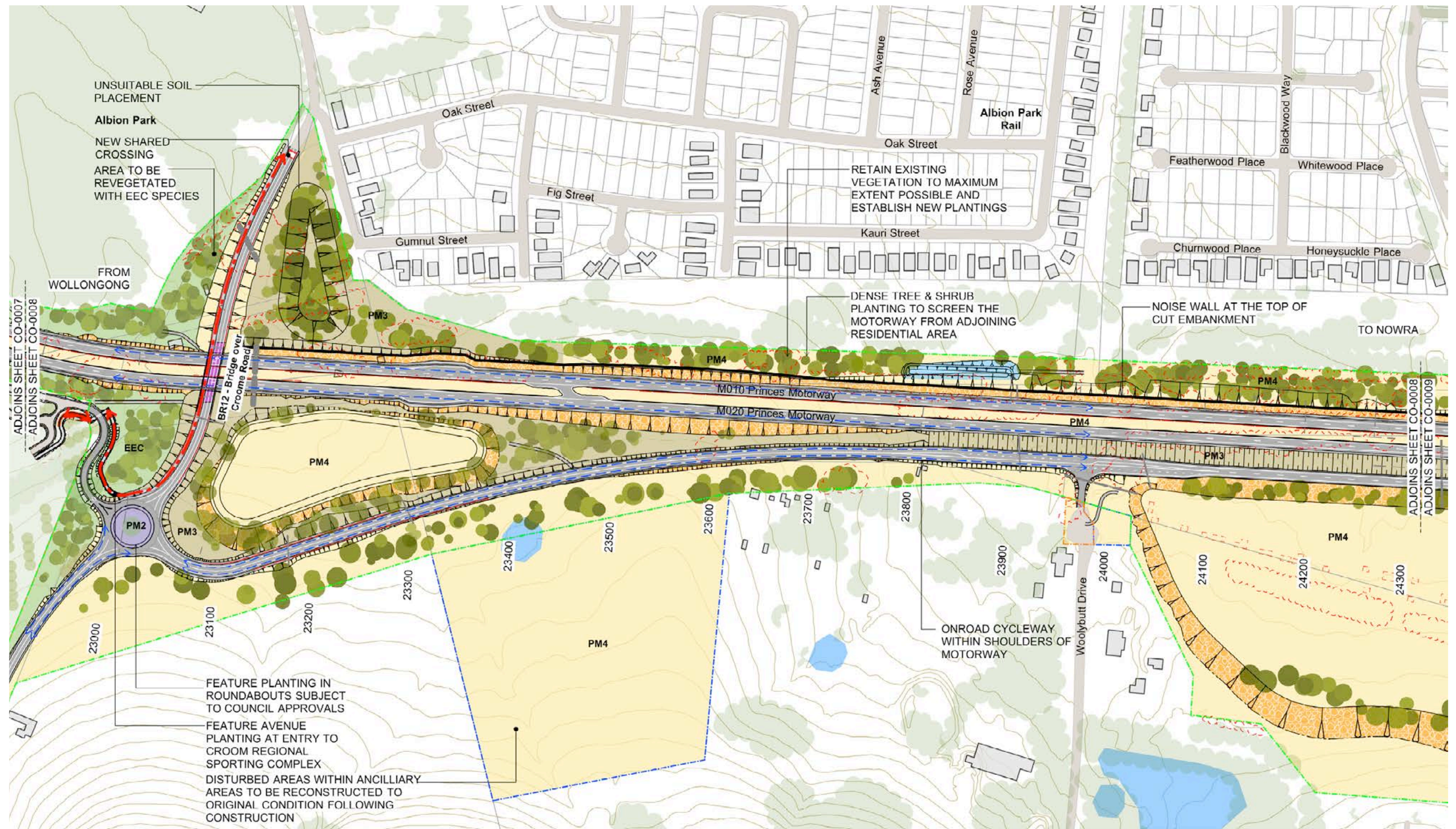


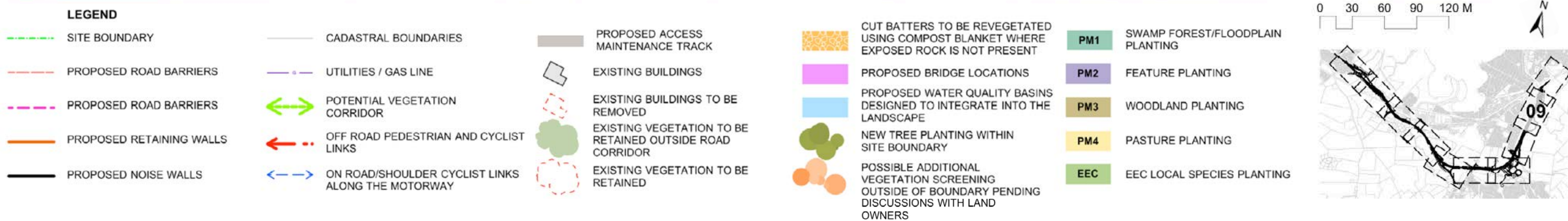
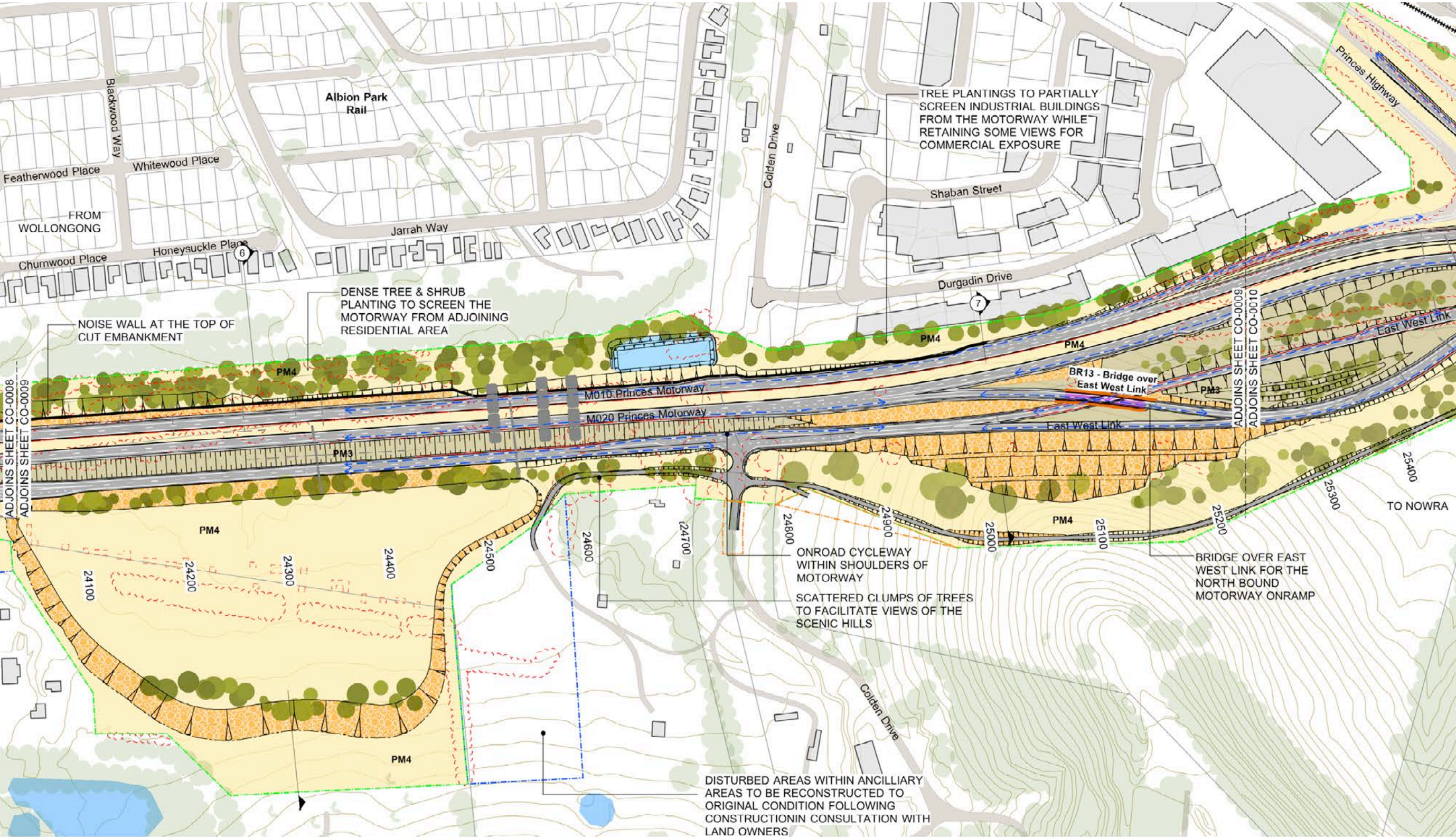














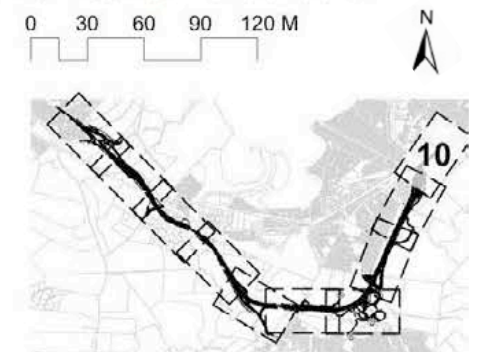
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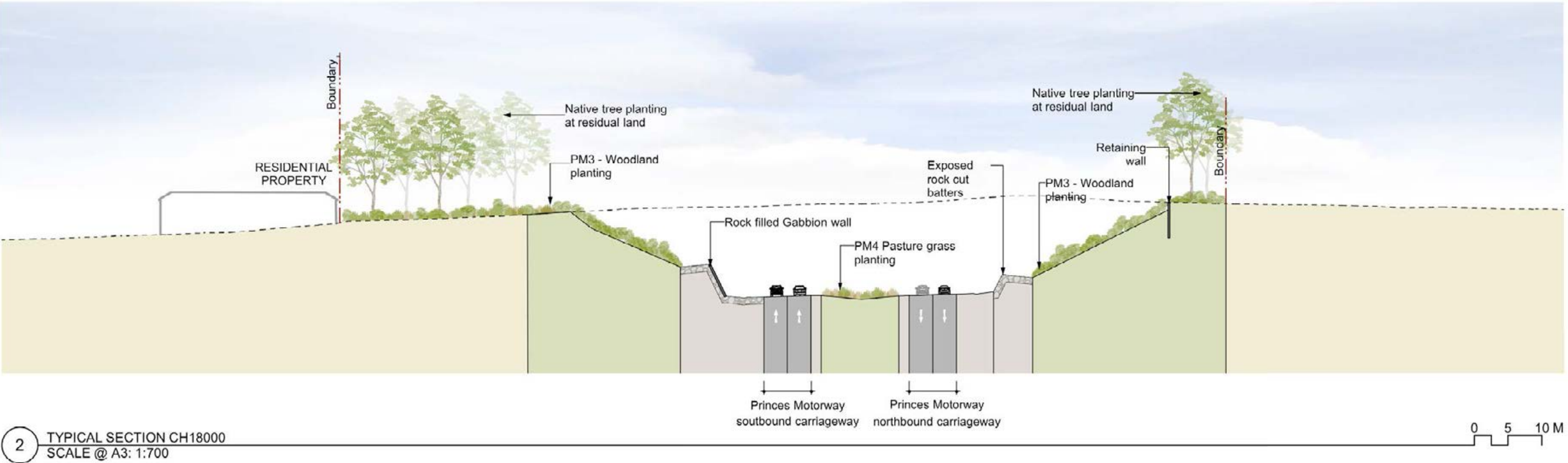
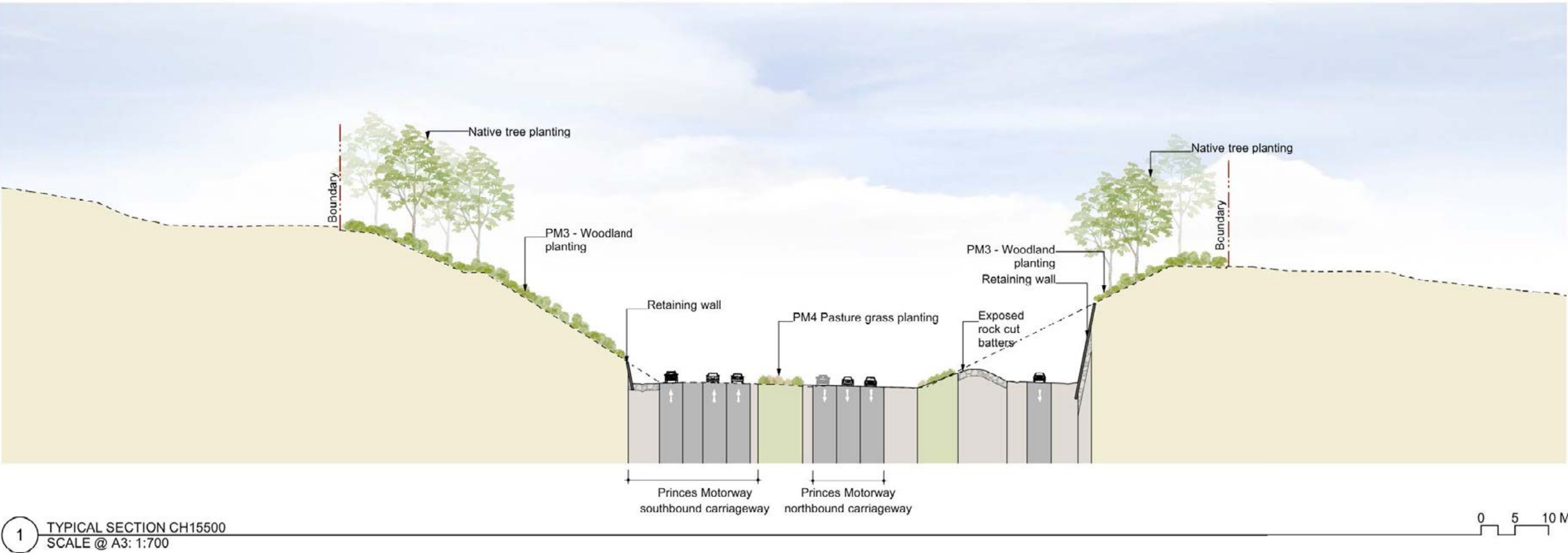
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|--|--------------------------|--|---|
| | SITE BOUNDARY | | CADASTRAL BOUNDARIES |
| | PROPOSED ROAD BARRIERS | | UTILITIES / GAS LINE |
| | PROPOSED ROAD BARRIERS | | POTENTIAL VEGETATION CORRIDOR |
| | PROPOSED RETAINING WALLS | | OFF ROAD PEDESTRIAN AND CYCLIST LINKS |
| | PROPOSED NOISE WALLS | | ON ROAD/SHOULDER CYCLIST LINKS ALONG THE MOTORWAY |

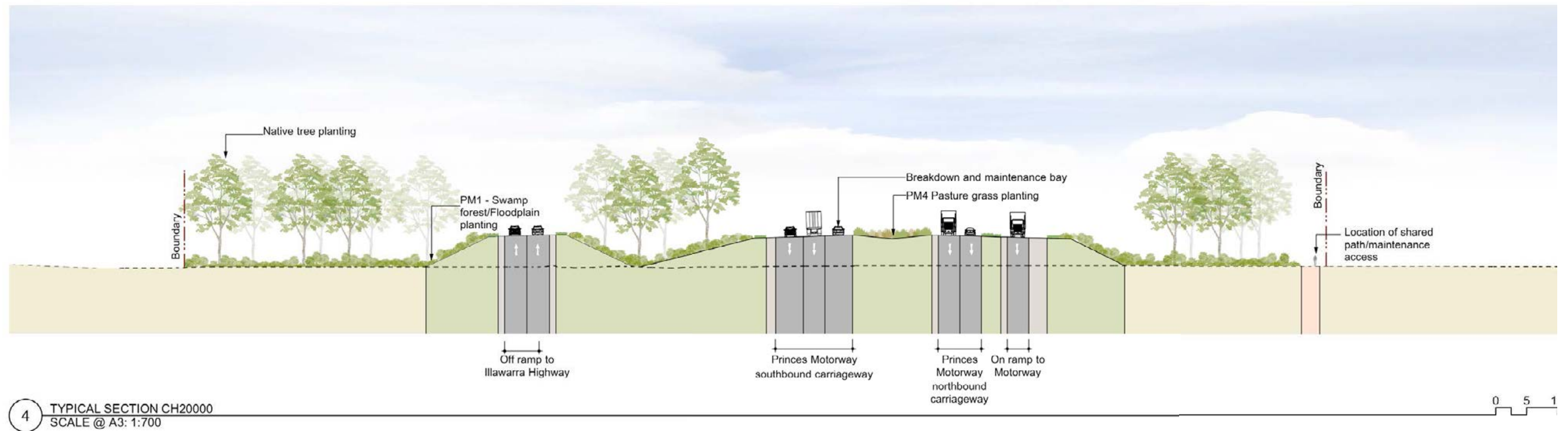
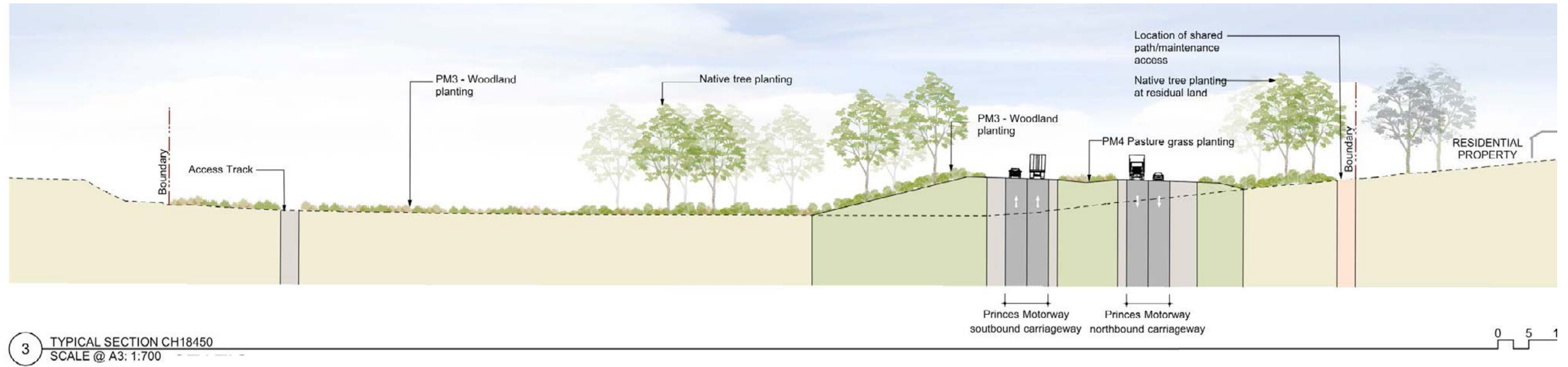
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| | PROPOSED ACCESS MAINTENANCE TRACK |
| | EXISTING BUILDINGS |
| | EXISTING BUILDINGS TO BE REMOVED |
| | EXISTING VEGETATION TO BE RETAINED OUTSIDE ROAD CORRIDOR |
| | EXISTING VEGETATION TO BE RETAINED |

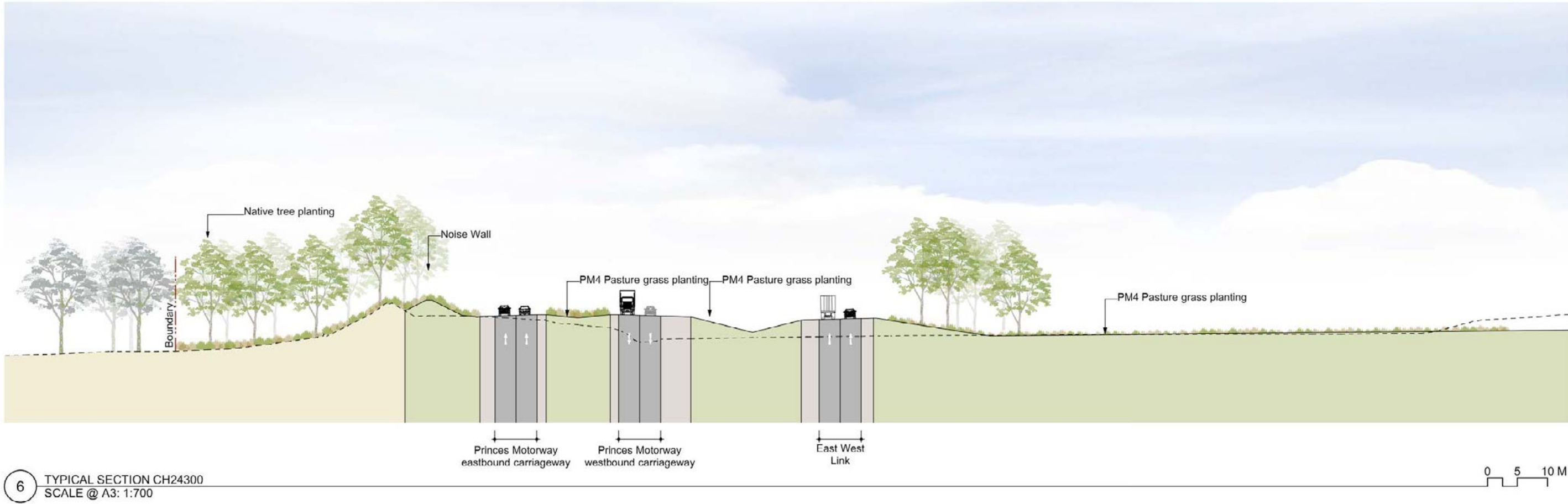
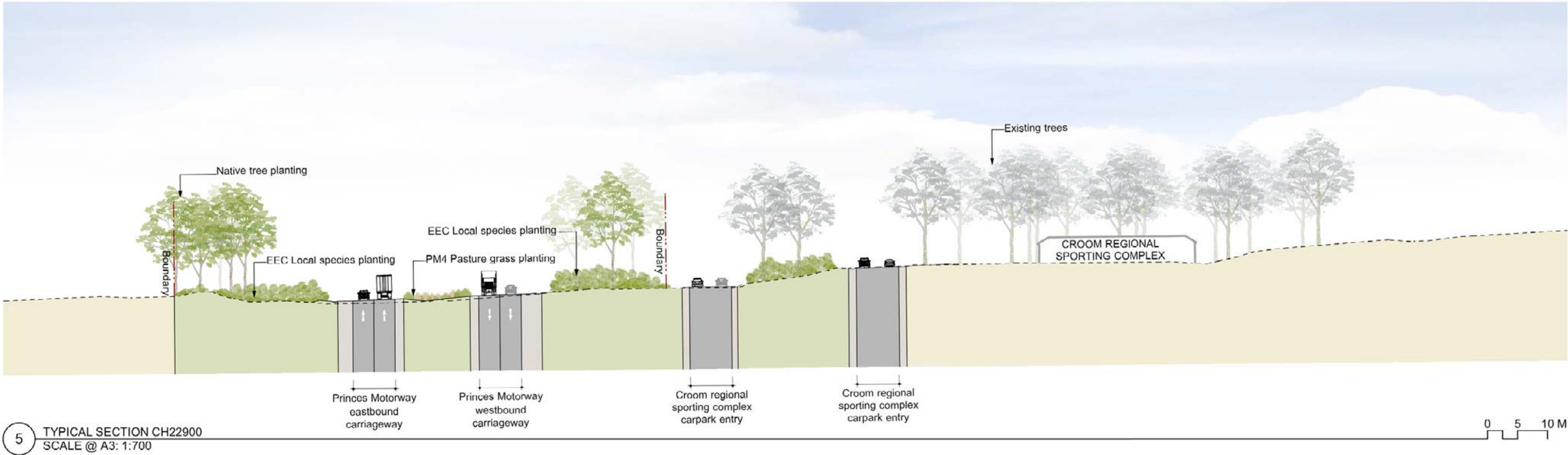
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|--|---|
| | CUT BATTERS TO BE REVEGETATED USING COMPOST BLANKET WHERE EXPOSED ROCK IS NOT PRESENT |
| | PROPOSED BRIDGE LOCATIONS |
| | PROPOSED WATER QUALITY BASINS DESIGNED TO INTEGRATE INTO THE LANDSCAPE |
| | NEW TREE PLANTING WITHIN SITE BOUNDARY |
| | POSSIBLE ADDITIONAL VEGETATION SCREENING OUTSIDE OF BOUNDARY PENDING DISCUSSIONS WITH LAND OWNERS |

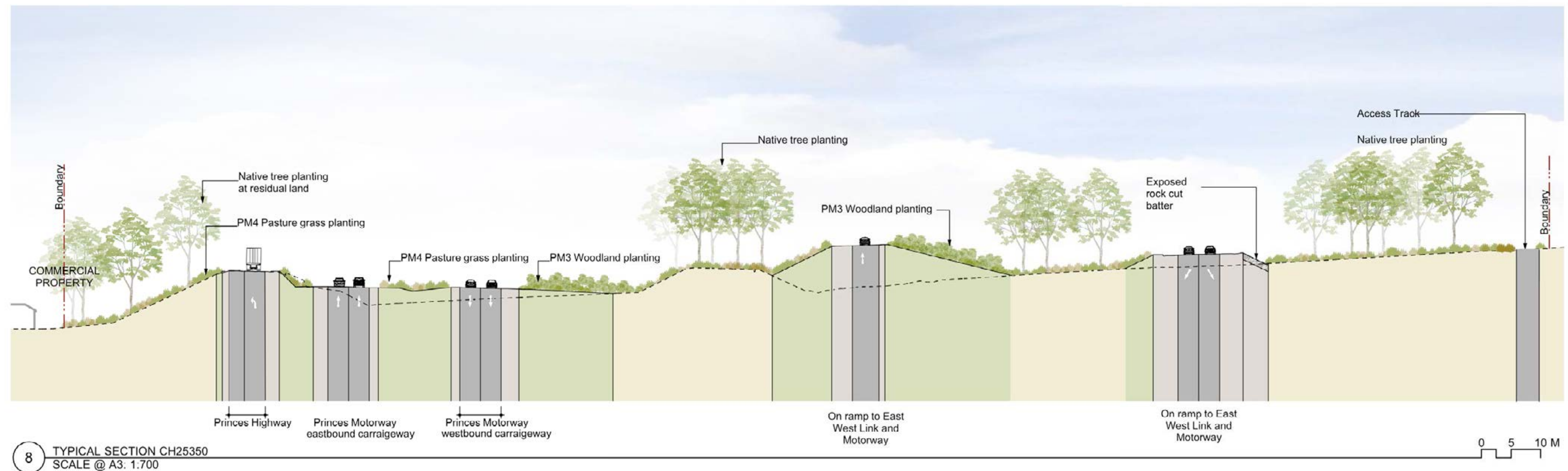
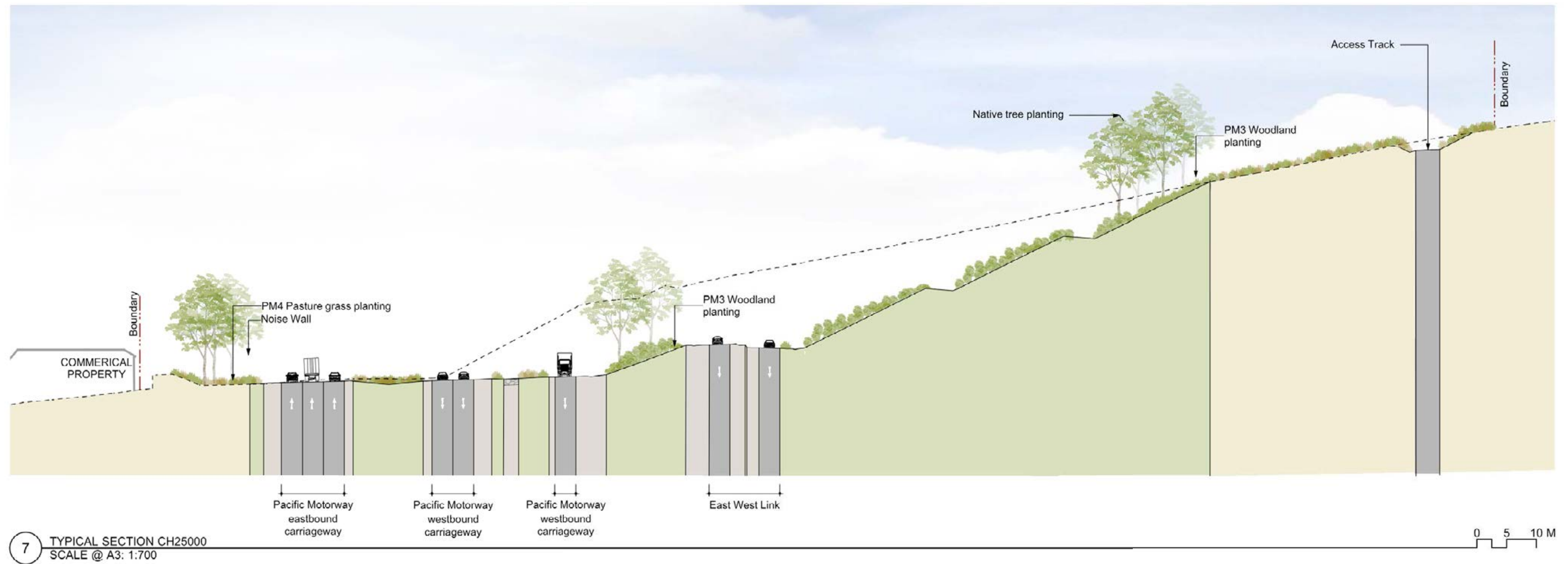
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|--|--------------------------------------|
| | PM1 SWAMP FOREST/FLOODPLAIN PLANTING |
| | PM2 FEATURE PLANTING |
| | PM3 WOODLAND PLANTING |
| | PM4 PASTURE PLANTING |
| | EEC EEC LOCAL SPECIES PLANTING |

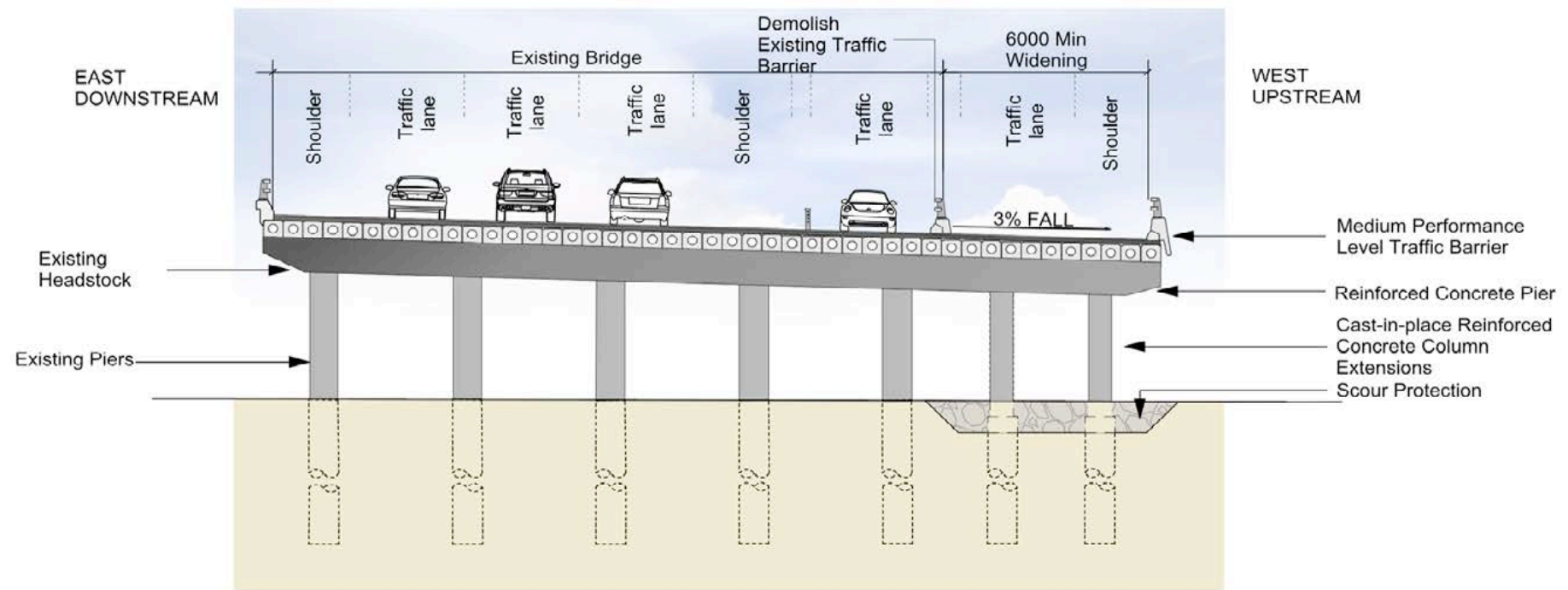




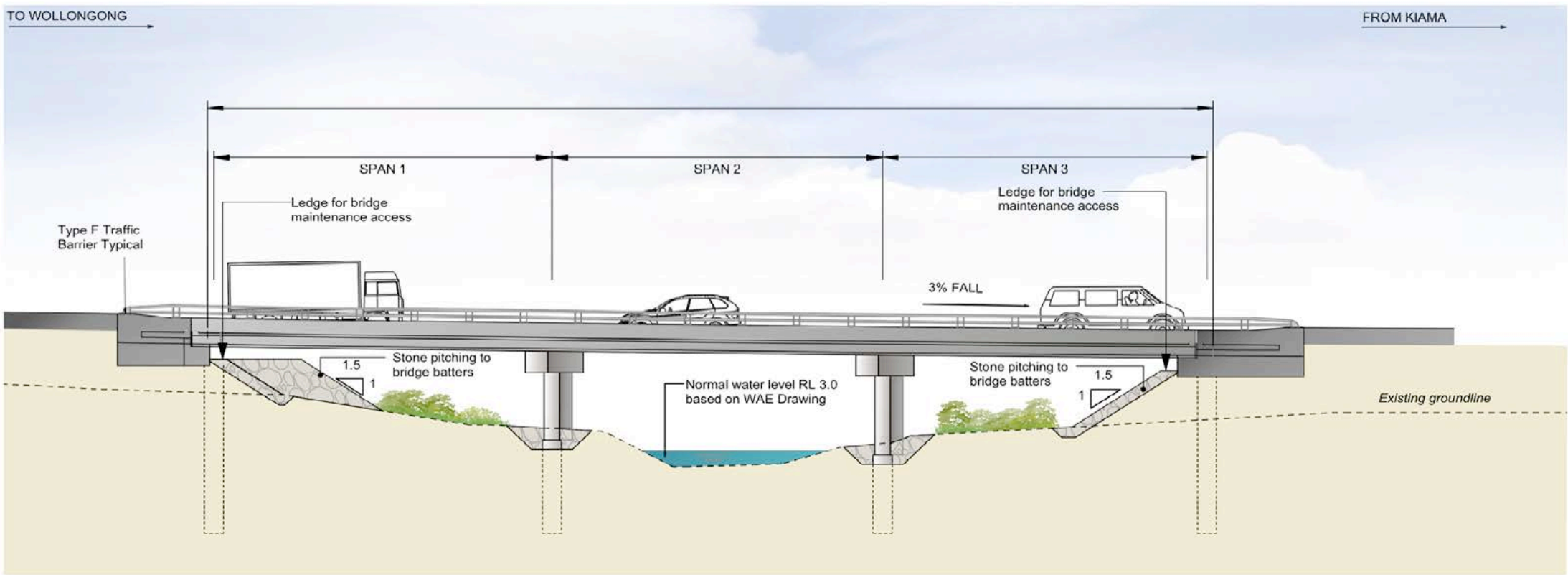








1 BR01 - CH 16300: BRIDGE OVER DUCK CREEK
CROSS SECTION SCALE @ A3: 1:200



2 BR01 - CH 16300: BRIDGE OVER DUCK CREEK
LONGITUDINAL SECTION SCALE @ A3: 1:250

BR01 - Bridge on the motorway northbound carriageway over Duck Creek

Duck Creek south of the interchange at Yallah
(16.6 kilometres south of Wollongong)

Indicative Length: 45 metres

Indicative Number of spans: 3

Bridge Type: Pre-stressed concrete plank

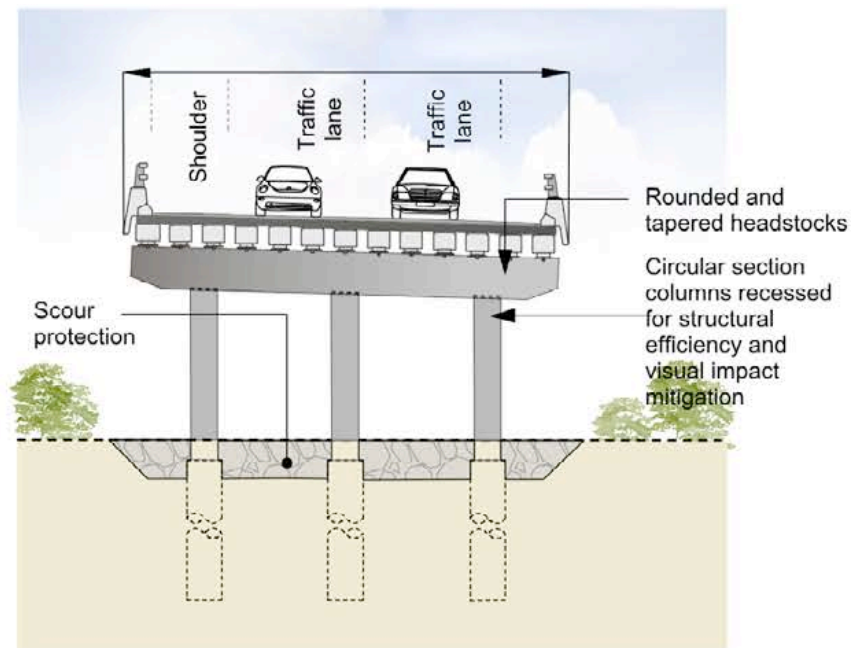
BR02 - Bridge on the Princes Highway over Duck Creek

Duck Creek south of the interchange at Yallah
(16.6 kilometres south of Wollongong)

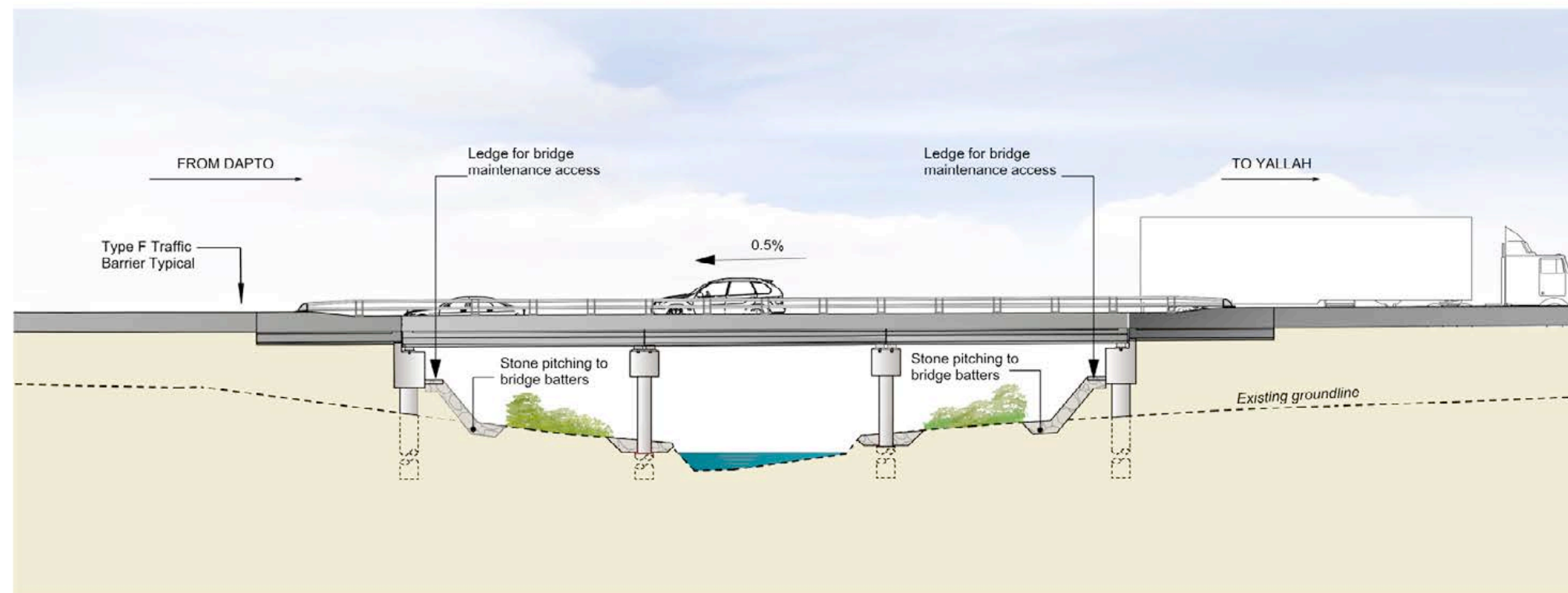
Indicative Length: 30 metres

Indicative Number of spans: 3

Bridge Type: Pre-stressed concrete spaced plank



3 BR02 - CH 16400: BRIDGE OVER DUCK CREEK
CROSS SECTION SCALE @ A3: 1:200



4 BR02 - CH 16400: BRIDGE OVER DUCK CREEK
LONITUDINAL SECTION SCALE @ A3: 1:250

BR05 - Bridge over the motorway at Yallah Road

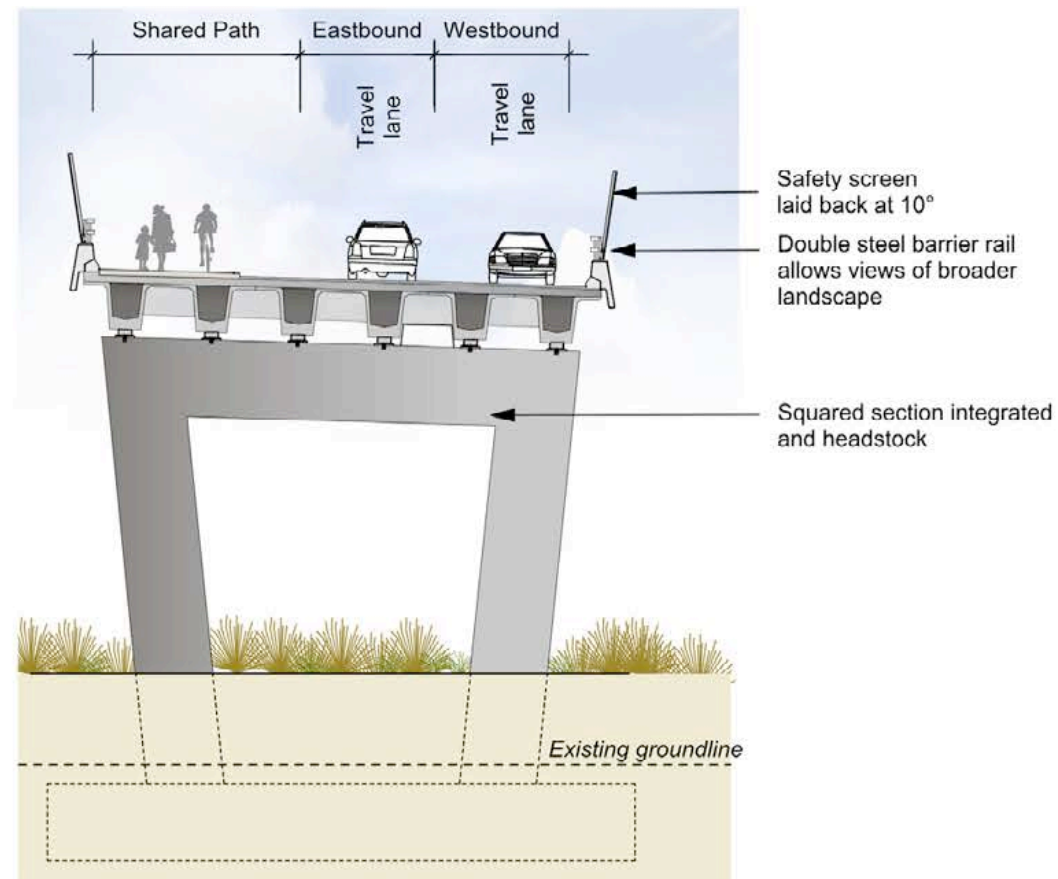
Proposed Yallah Road alignment

(18 kilometres south of Wollongong)

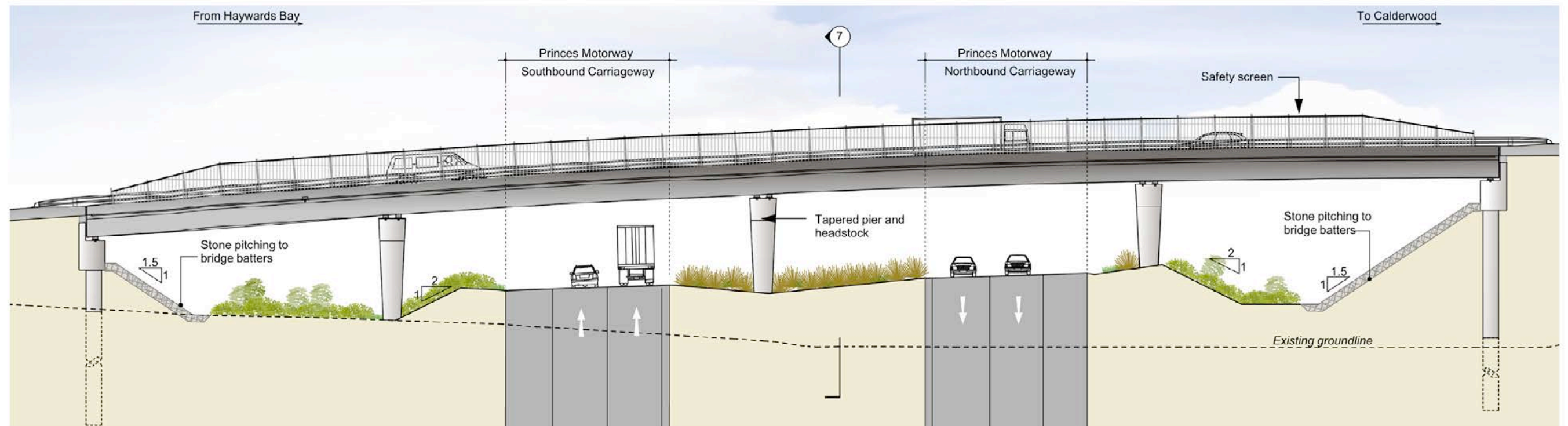
Indicative Length: 97 metres

Indicative Number of spans: 4

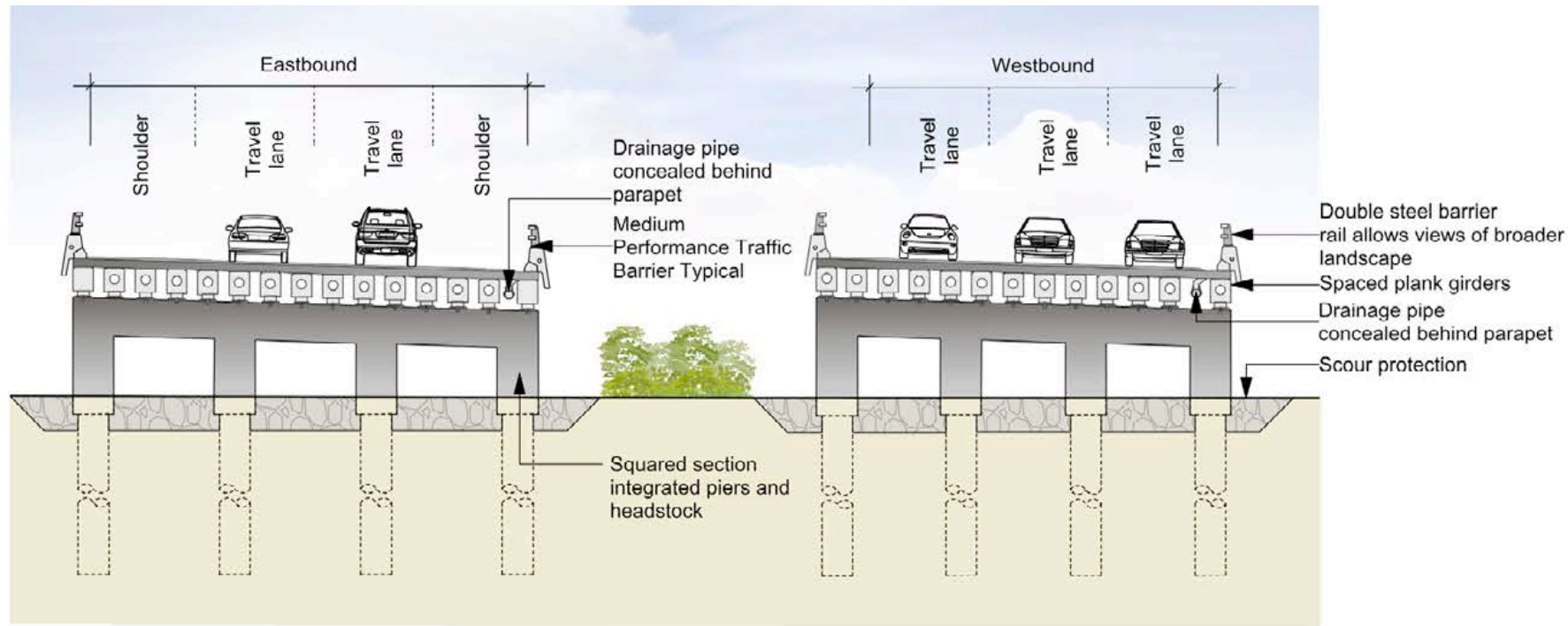
Bridge Type: Pre-stressed concrete Super T



6 BR05 - CH 17700: BRIDGE OVER MOTORWAY AT YALLAH ROAD
CROSS SECTION SCALE @ A3: 1:200



7 BR05 - CH 17700: BRIDGE OVER MOTORWAY AT YALLAH ROAD
LONITUDINAL SECTION SCALE @ A3: 1:300

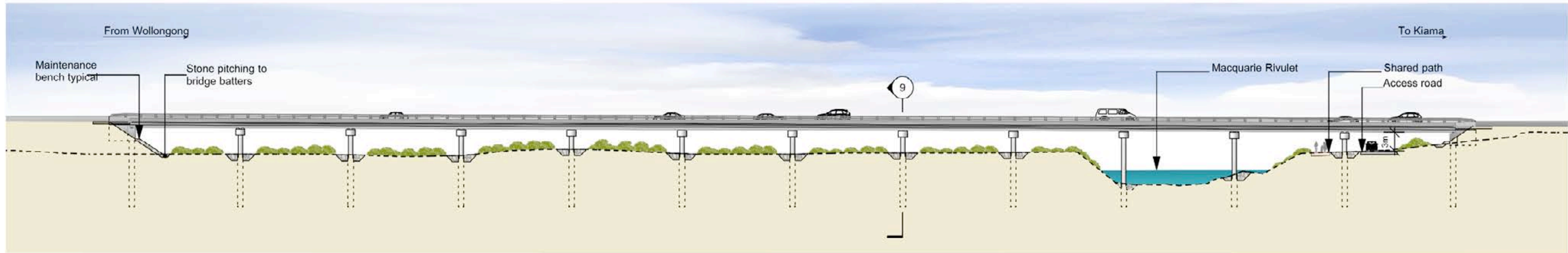


BR06 - Twin bridges on the motorway over the Macquarie Rivulet

Macquarie Rivulet
(18.9 kilometres south of Wollongong)

Indicative Length: 215 metres
Indicative Number of spans: 12
Bridge Type: Pre-stressed concrete spaced plank

8 BR06 - CH 18600: TWIN BRIDGES OVER MACQUARIE RIVULET
CROSS SECTION SCALE @ A3: 1:200



9 BR06 - CH 18600: TWIN BRIDGES OVER MACQUARIE RIVULET
LONITUDINAL SECTION SCALE @ A3: 1:700

BR07 - Twin bridges on the motorway over Frazers Creek

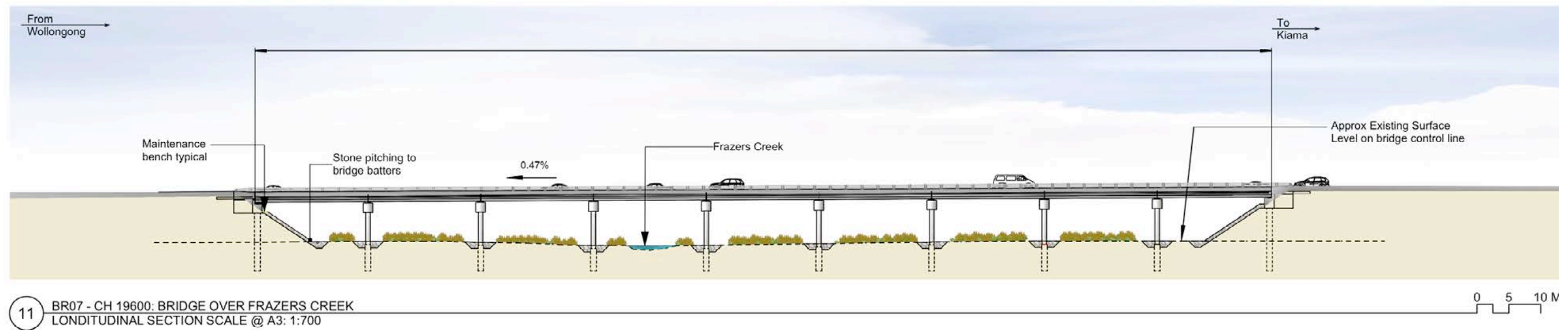
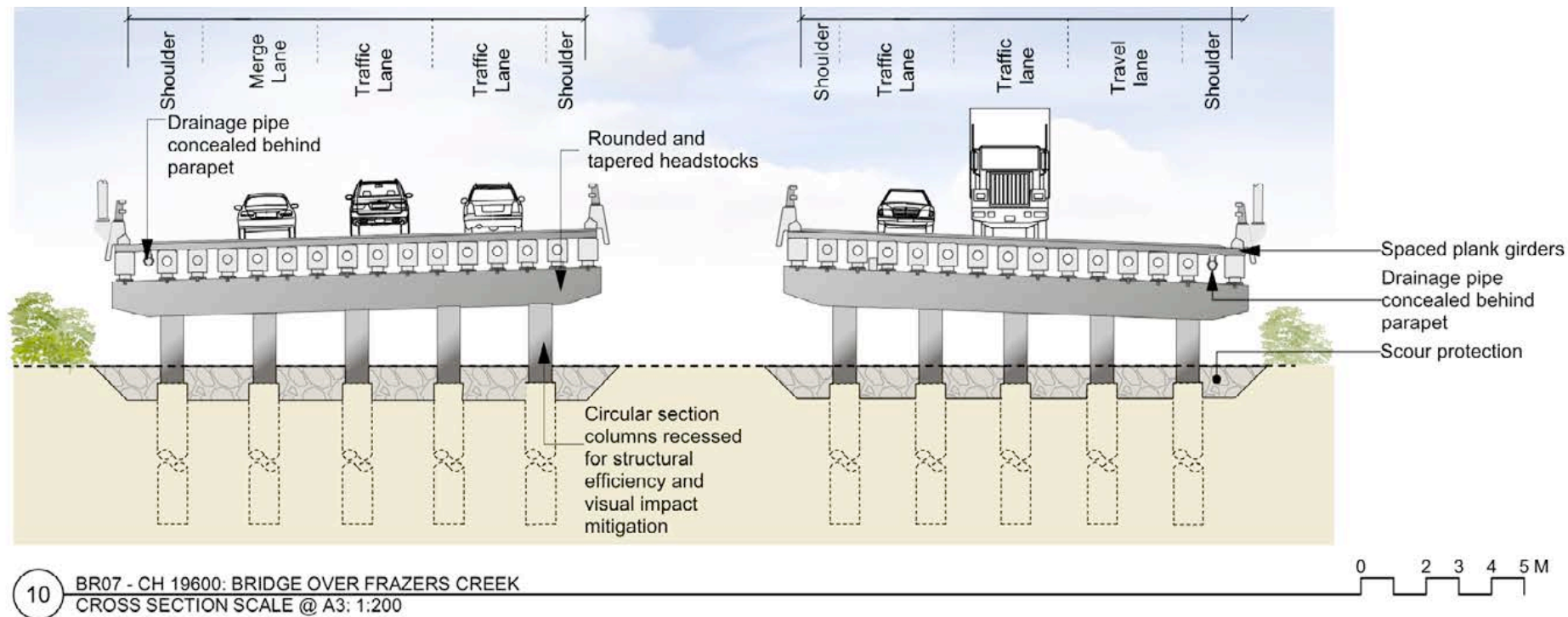
North of Albion Park

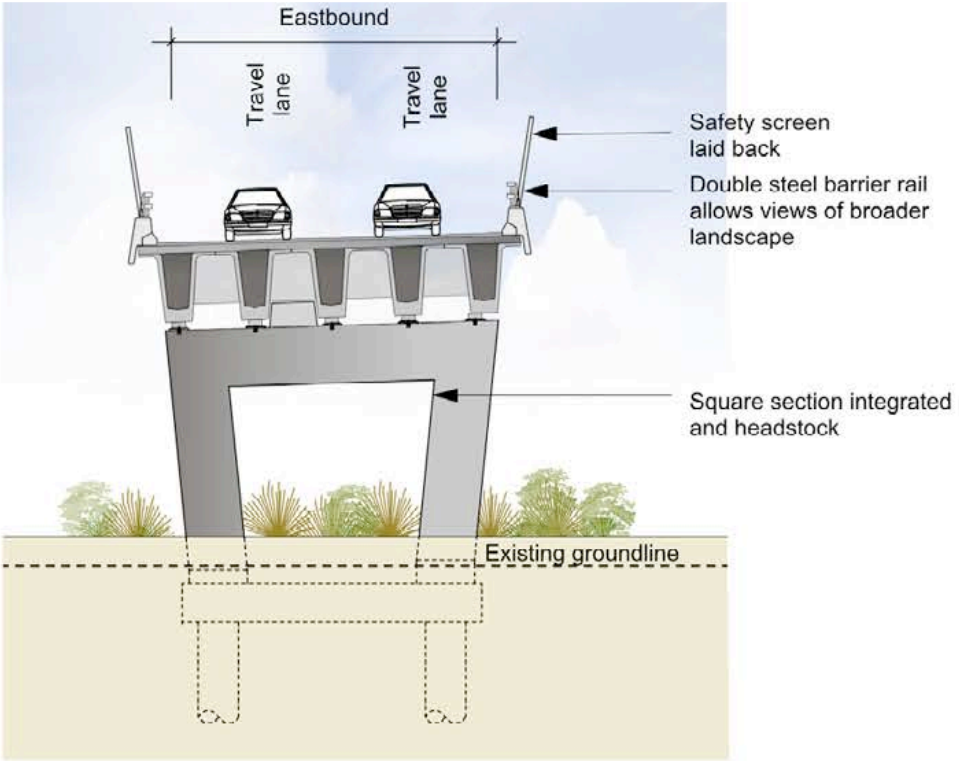
(19.9 kilometres south of Wollongong)

Indicative Length: 160 metres

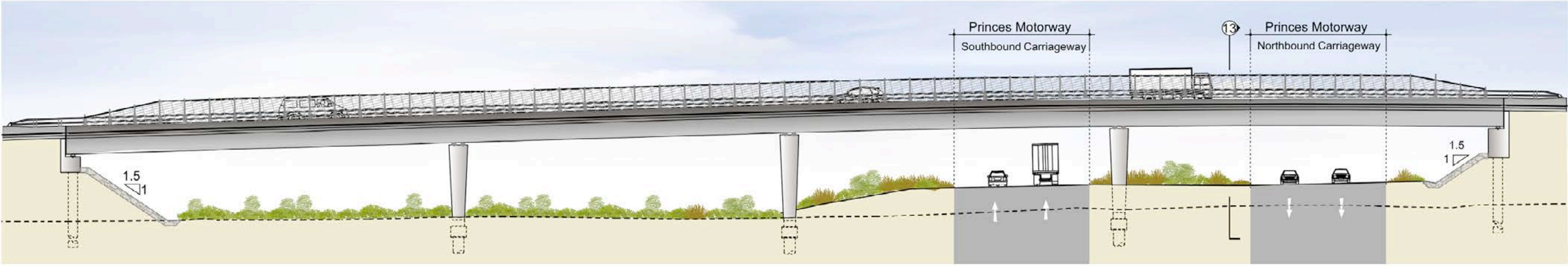
Indicative Number of spans: 9

Bridge Type: Pre-stressed concrete spaced plank





12 BR08 - CH 20300: BRIDGE OVER PROPOSED PRINCES MOTORWAY
CROSS SECTION SCALE @ A3: 1:200



13 BR08 - CH 20300: SOUTHBOUND MOTORWAY OVER THE MOTORWAY
LONITUDINAL SECTION SCALE @ A3: 1:400

BR08 - Bridge over the motorway for southbound exit ramp at Albion Park

Albion Park
(20.7 kilometres south of Wollongong)
Indicative Length: 70 metres
Indicative Number of spans: 4
Bridge Type: Pre-stressed concrete Super T

BR09 - Twin bridges on the motorway over Frazers Creek

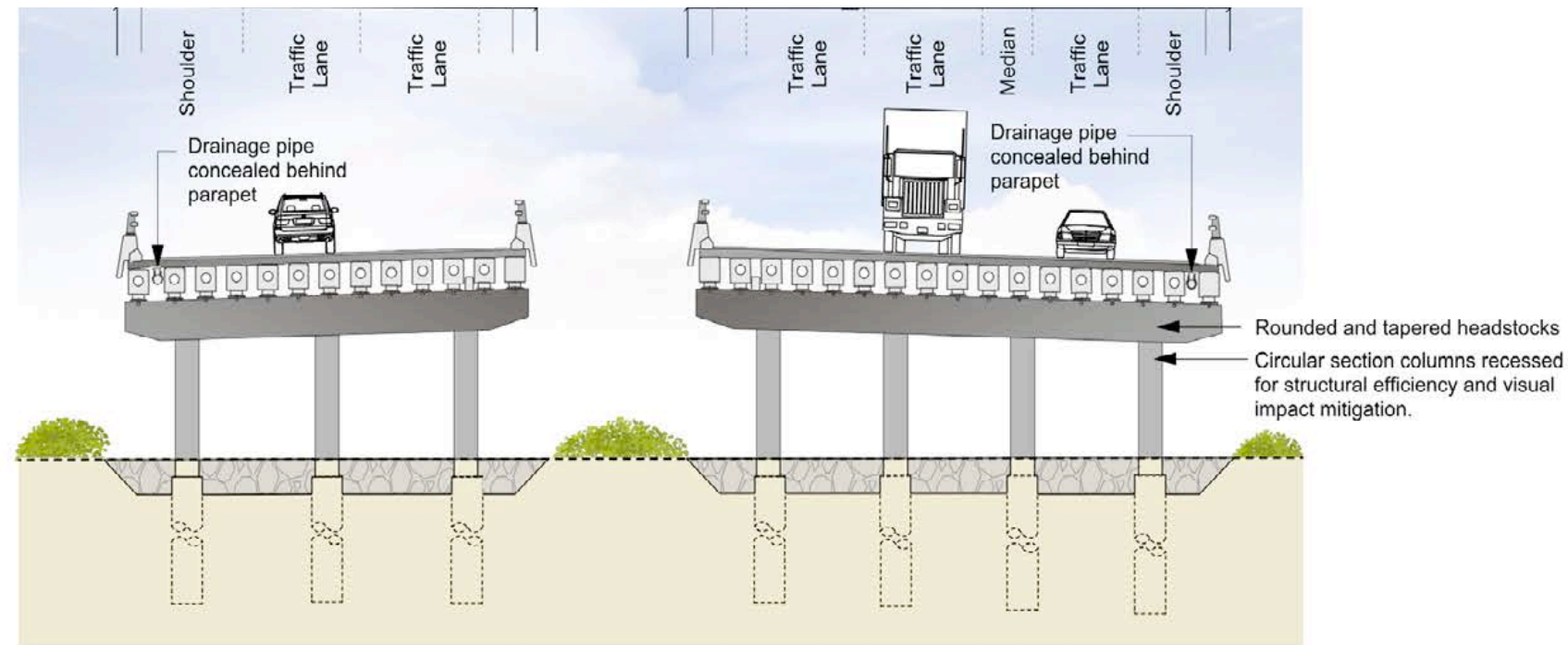
Frazers Creek north of Tongarra Road

(21.1 kilometres south of Wollongong)

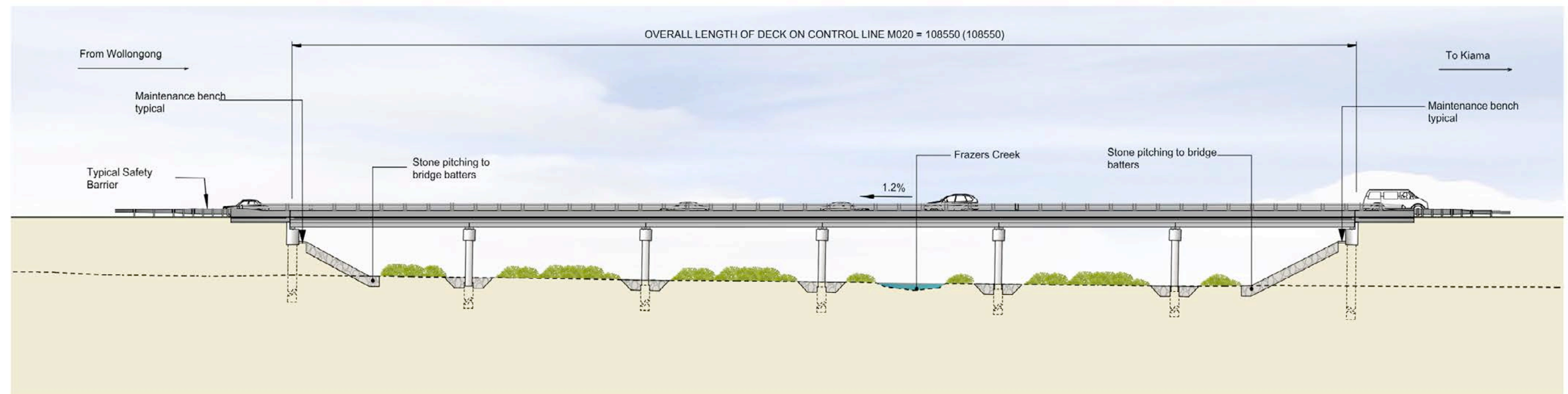
Indicative Length: 108 metres

Indicative Number of spans: 6

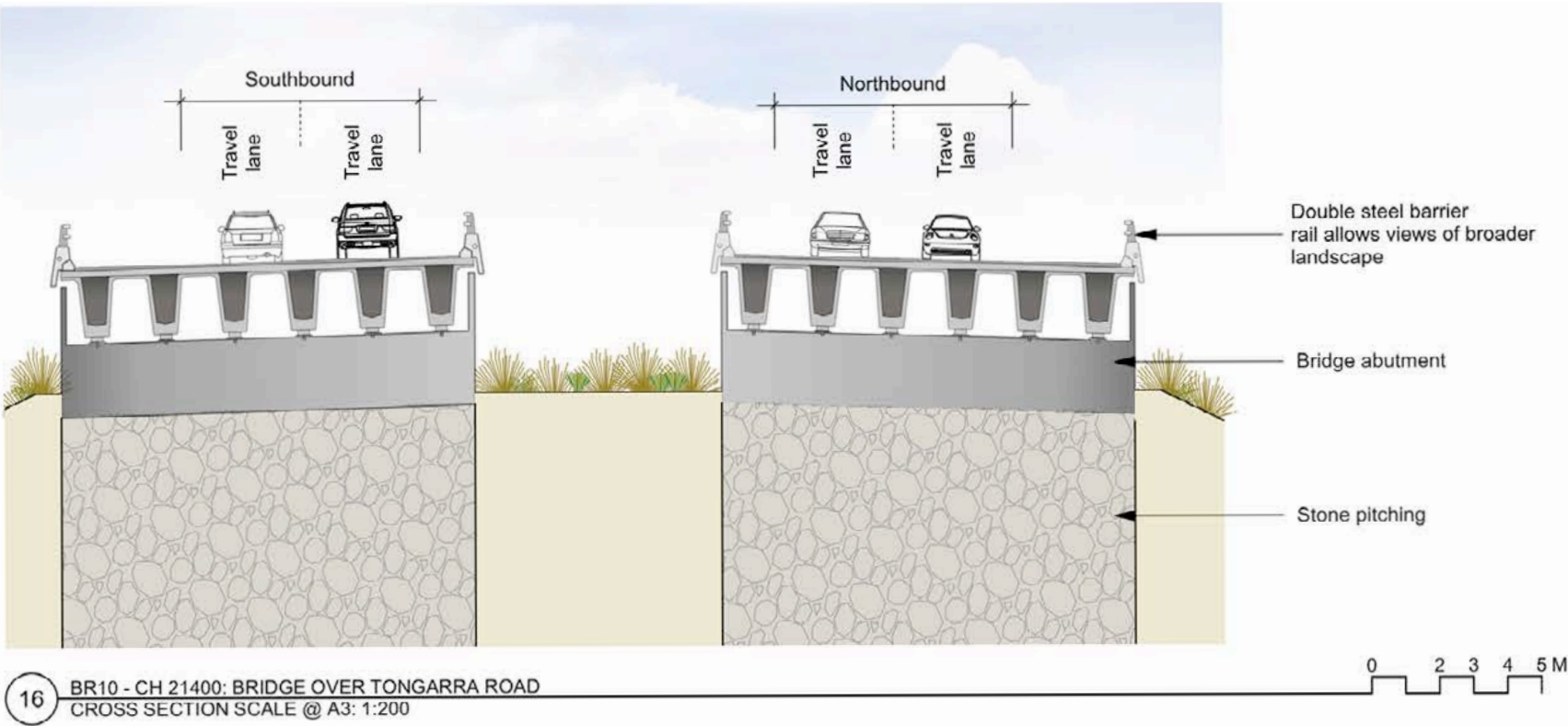
Bridge Type: Pre-stressed concrete spaced plank



14 BR09 - CH 21000: TWIN BRIDGES OVER FRAZERS CREEK
CROSS SECTION SCALE @ A3: 1:200

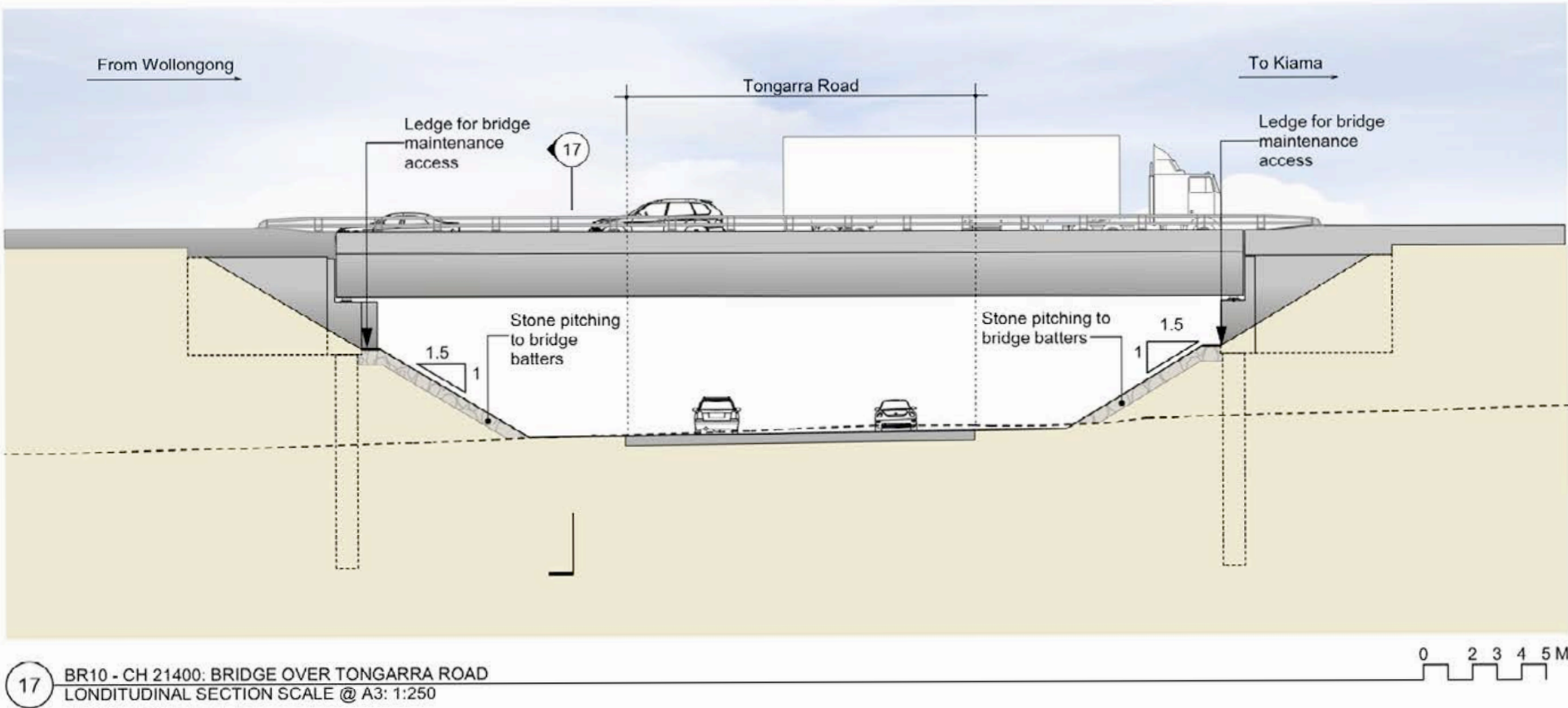


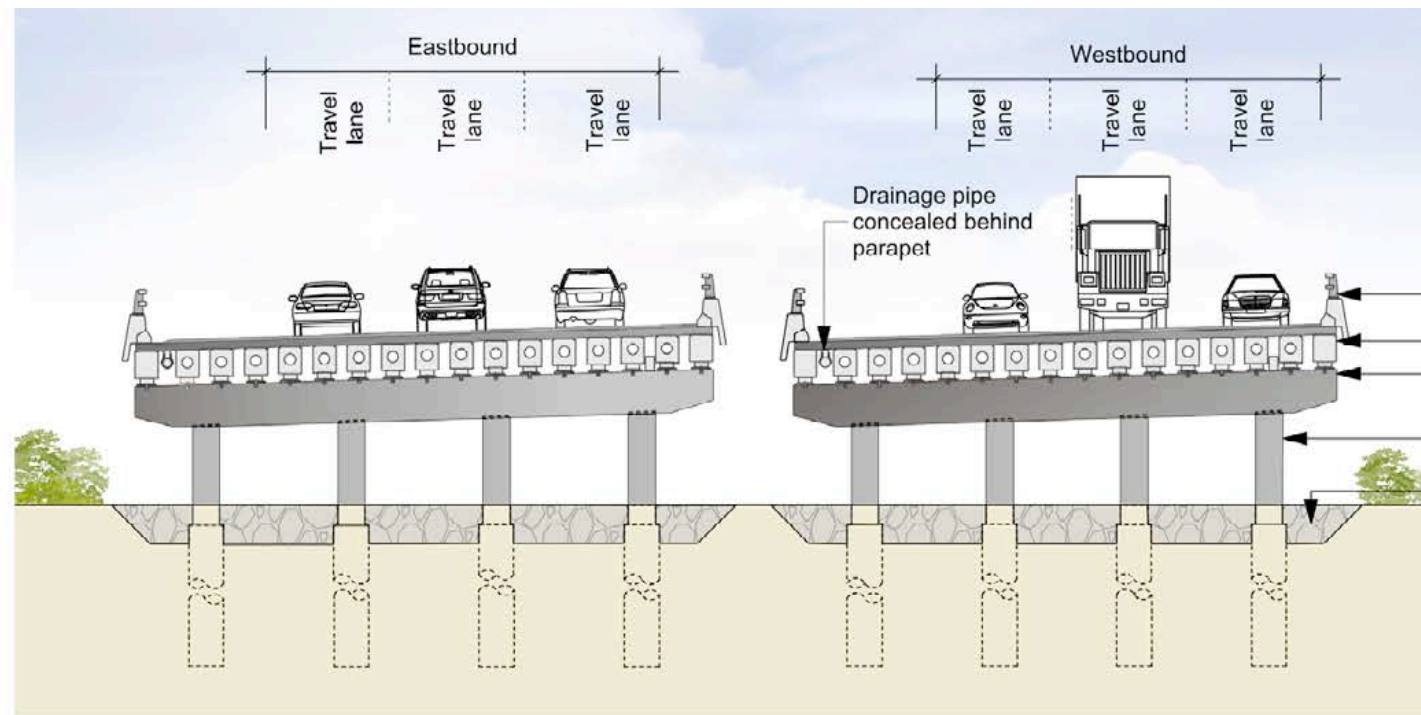
15 BR09 - CH 21000: TWIN BRIDGES OVER FRAZERS CREEK
LONGITUDINAL SECTION SCALE @ A3: 1:400



BR10 - Twin bridges on the motorway over Tongarra Road

Tongarra Road
(21.8 kilometres south of Wollongong)
Indicative Length: 37 metres
Indicative Number of spans: 1
Bridge Type: Pre-stressed concrete Super T





BR11 - Twin bridges on the motorway over Frazers Creek and Croom Regional Sporting Complex access road

Frazers Creek at Croom Regional Sporting Complex, south of Tongarra Road
(21.8 kilometres south of Wollongong)

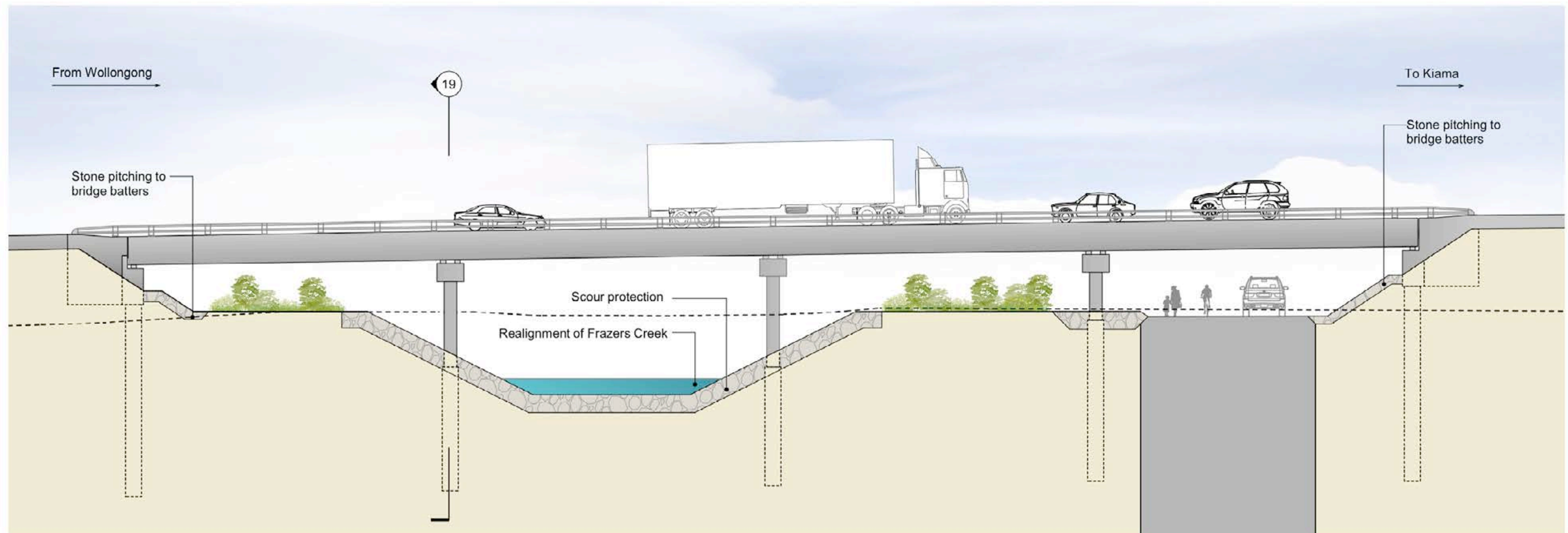
Indicative Length: 72 metres

Indicative Number of spans: 4

Bridge Type: Pre-stressed concrete spaced plank

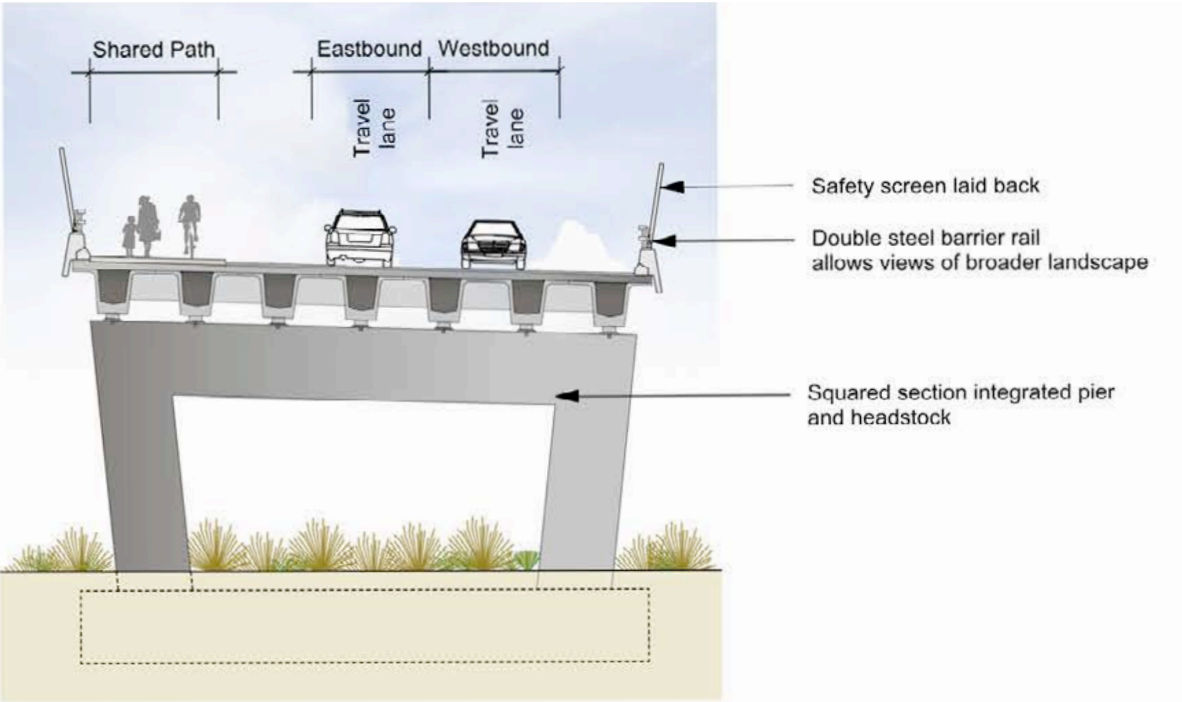
18 BR11 - CH 22100: TWIN BRIDGES OVER FRAZERS CREEK
CROSS SECTION SCALE @ A3: 1:200

0 2 3 4 5 M

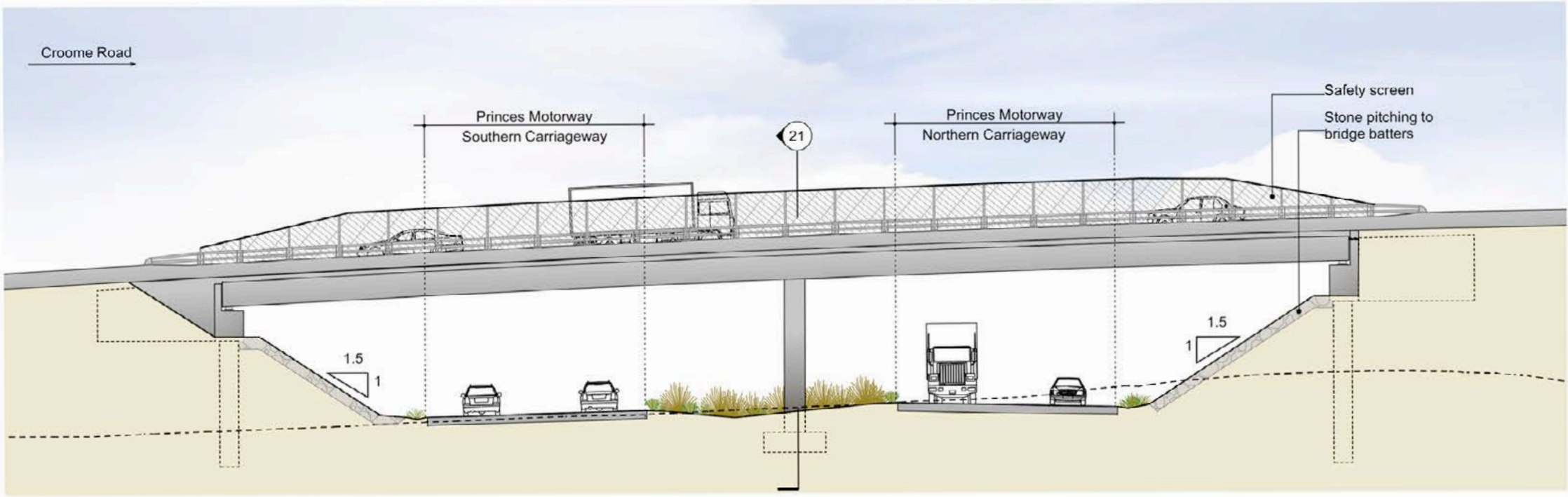


19 BR11 - CH 22100: TWIN BRIDGES OVER FRAZERS CREEK
LONGITUDINAL SECTION SCALE @ A3: 1:250

0 2 3 4 5 M



20 BR12 - CH 23000: BRIDGE OVER CROOME ROAD
CROSS SECTION SCALE @ A3: 1:200



21 BR12 - CH 23000: BRIDGE OVER CROOME ROAD
LONITUDINAL SECTION SCALE @ A3: 1:250

BR12 - Bridge over the motorway at Croome Road

Croome Road
(23.4 kilometres south of Wollongong)
Indicative Length: 54 metres
Indicative Number of spans: 2
Bridge Type: Pre-stressed concrete Super – T

BR13 - Bridge on the motorway for East West Link over the northbound entry ramp at Oak Flats

Oak Flats Interchange

(25.4 kilometres south of Wollongong)

Indicative Length: 60 metres (length of underpass)

Indicative Number of spans: 1

Bridge Type: Pre-stressed concrete spaced plank

