Section C Bridges and retaining walls

Above: This existing bridge on SH2 at Tauranga has a simple tapered column form that is a good precedent for the TEL. The open abutment optimises views along the highway while the shallow deck emphasises the horizontality of the structure.

Below: Brunswick to Yelgun, Pacific Highway, NSW Australia. The setback below the parapet both breaks down the apparent depth of the structure and creates visual interest through the shadow line. The effect is streamlined and elegant.

Because the only retaining walls proposed for the TEL are combined with bridges they are discussed in this section. Design principles are provided for structures, parapets, lighting and drainage; and additional detail is provided where appropriate within the description of each bridge for abutments, the shape of piers, safety barriers / railings and screens.

Urban design principles

The key urban design principles for all bridges are as follows:

- Design structures and landscapes that enhance context and the driver experience. Make the bridge as simple and elegant as possible to complement the landscape.
- Provide open abutments to allow open views to the landscape and better visibility to the road beyond
- Fully landscape sloped abutments to provide continuity to landscape treatments, with a simple paved slope as a secondary alternative (see photograph left).
- Ensure that bridge drainage is integral to and concealed within the bridge structure.

- Reinforce the horizontal character of the rural condition in the structures located along the road corridor, through:
  - Simplicity and consistency in detailing
  - Careful consideration in the structural design and detailing to ensure that the eye focuses on horizontal nature of the bridge deck:
    - Super-T precast structures to eliminate the need for headstocks and to enable simple, elegant reverse tapered columns are an optimal design solution.
    - The use of columns except at Kaitina River. Columns are recommended over wall type piers, which create a strong sense of enclosure that is at odds with the overarching design concept to keep the travel experience as open as possible to reflect the landscape character.
  - Simplicity in the design of headstocks (if used) to reflect the horizontal nature of the rural setting

Median treatment

- F-type (solid) barriers are only to be used at the base of columns (or piers) of bridges on the project. For the balance of the corridor, an open character will be reinforced by means of a wire rope barrier to the median
- Medians will be sealed except at the northern end of the corridor where width permits, where they will be planted as a interim measure to allow for further improvements.

Parapets

Parapets are to be:

- fully visible, with a clean continuous line that is not obscured or interrupted by non-structural elements
- as simple as possible, with straight, clear edges to help distinguish them a foreground elements
- carefully proportioned in depth in relation to deck and superstructure
- sloped inwards towards the deck at the top in order to minimise staining from rainwater (SH20 / Hillsborough Road)

- continuous past abutments; wire rope barriers overlap
- designed with minimum embellishments, with any surface treatment or texture used only to reinforce the horizontality and clean lines of the bridges.
- except where 820mm F-type barriers are required for noise mitigation, parapets comprise a metal rail and post system atop a concrete barrier, to maximise views from highway bridges over the landscape.

B1 – Bridge at Sandhurst Drive Interchange

Sandhurst Drive is a grade separated interchange that provides access to the urban area to the north in Papamoa and an industrial area (including Te Maunga sewage and stormwater treatment plant) to the south. It comprises a bridge over the TEL and ECMT rail corridor with four on/off ramps.

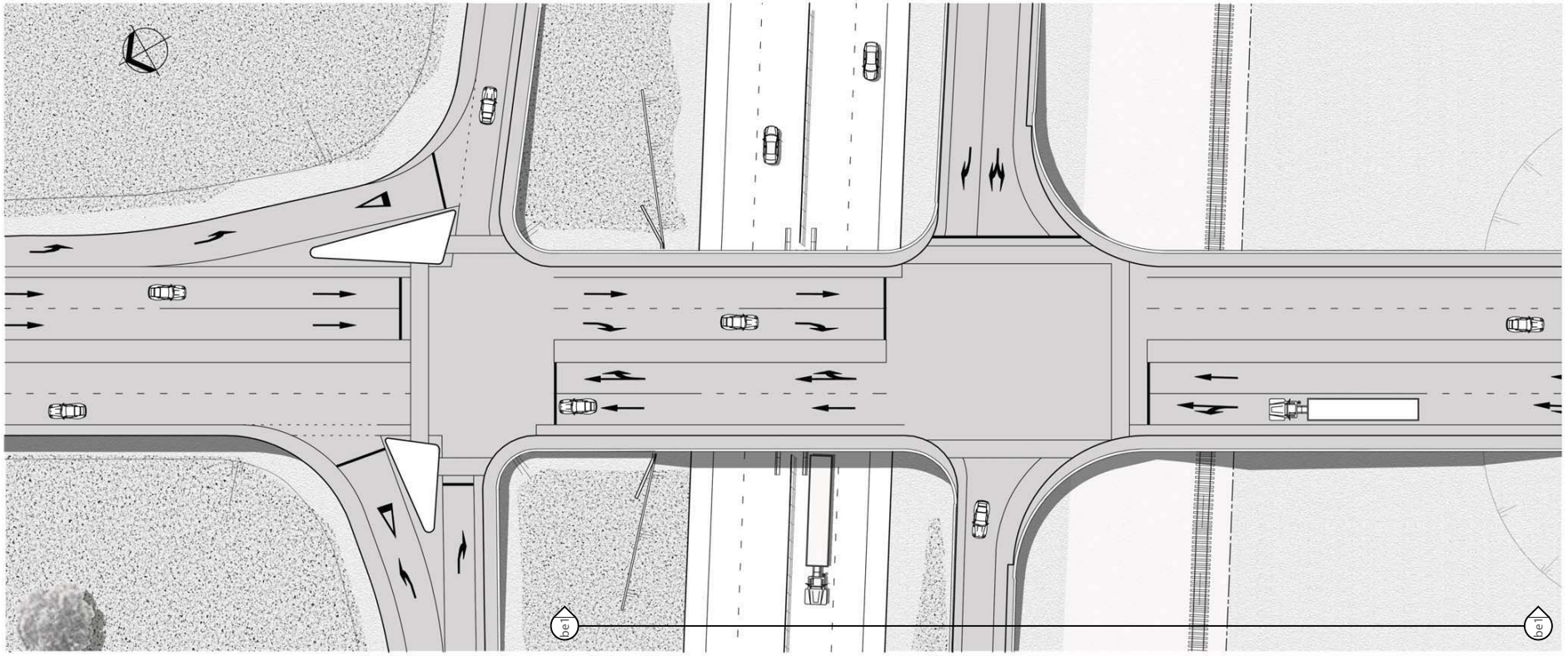
Traffic flows are significantly different on the north and south Sandhurst Road approaches to the TEL. The southern side connects into a small business node and the Tamaphore marae with a small cluster of houses. The northern side serves a residential population of some 15,000 - 20,000 people in one of the fastest-growing areas in the country. Slip lanes are therefore provided on the northern side and not on the southern side.

The highway corridor is constrained in width in this location. It is bounded to the south by the existing ECMT rail corridor. The topography of the area is relatively flat.

The design intent for all bridges and retaining walls is to create structures and landscapes that enhance the context and the driver experience. These structures are to be as simple and elegant as possible to complement the landscape.

- At Sandhurst Drive, the experience of the underpass references the adjacent built up context with full height abutment walls framing the sides of the underpass.
- A simple three column arrangement with a chamfered edge pile cap beam supports the bridge midspan. Ideally there would be a separation between the main structure and the finer expressed edge of the deck.
- A solid barrier of maximum height 800mm with a rail above maintains views out over the bridge for the motorist, cyclists and pedestrians, reinforcing the expansive landscape experience.

BRIDGE 1 - SANDHURST DRIVE ELEVATION (BE1)



Tauranga Eastern Link

ECMT railway corridor

BRIDGE 1 - SANDHURST DRIVE PLAN (BP1)

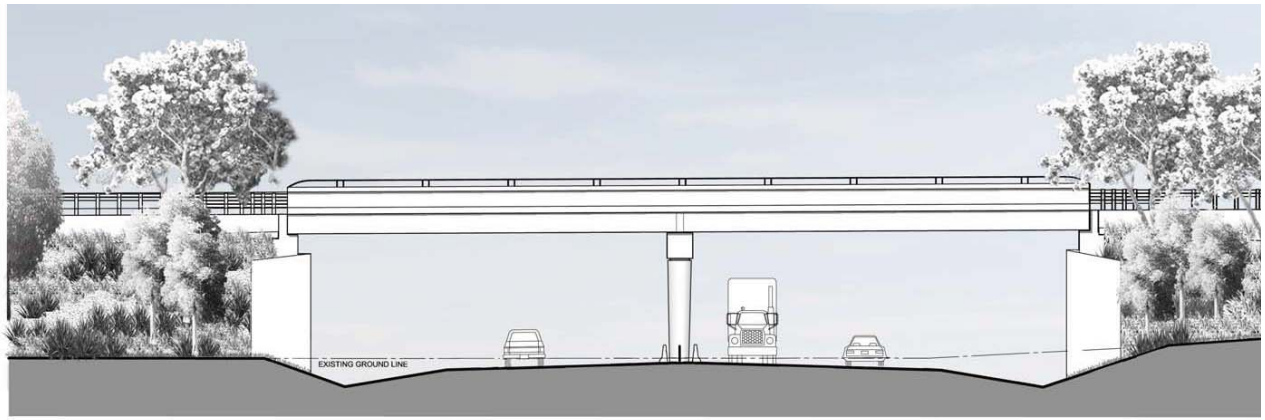
0 5 10 15 20 25m

N

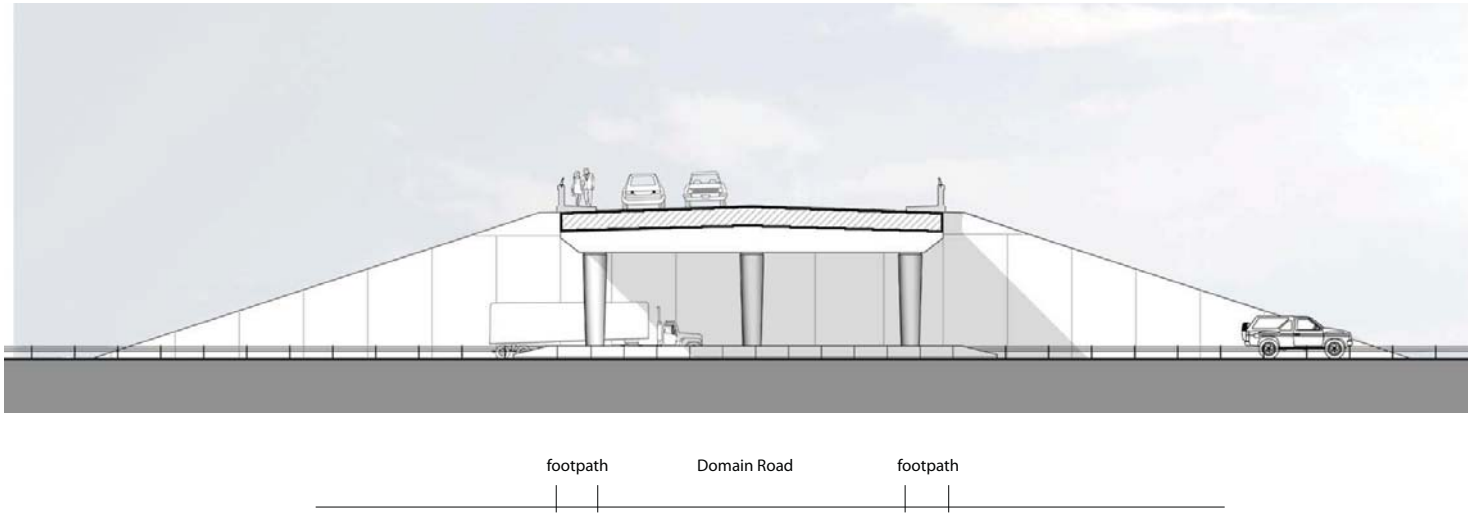
B2 – Bridge at Domain Road Interchange

The Domain Road grade separated interchange comprises a three lane wide bridge with two roundabouts, four on/off ramps and connections to Domain Road, Tara Road and SH2. It is currently located within a relatively flat rural area but will provide future access to residential land further north of Domain Road.

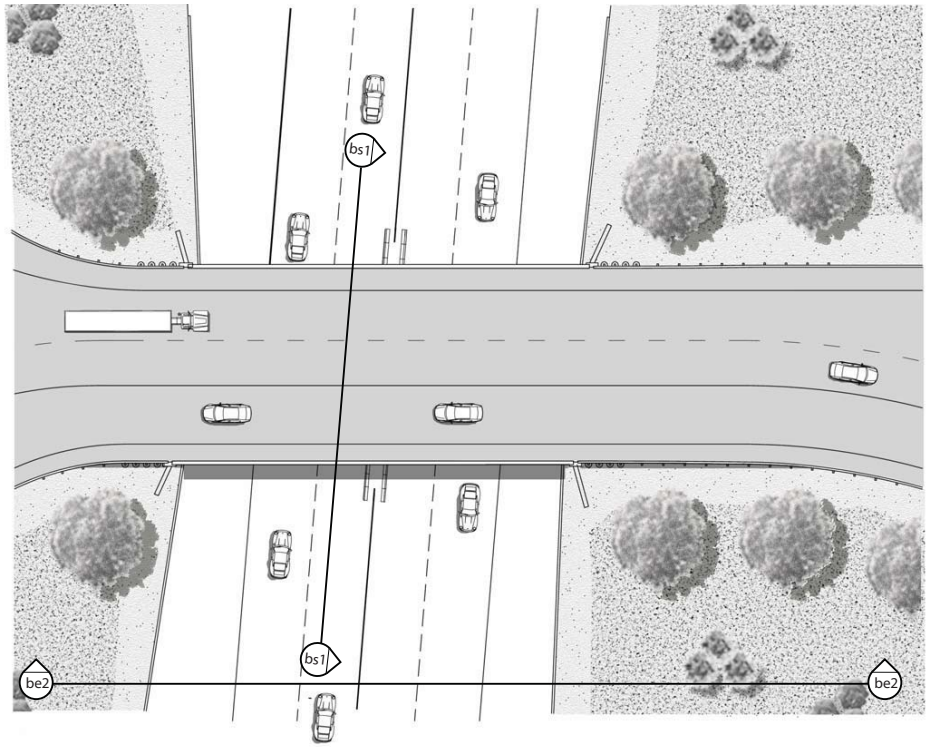
- This interchange is located in an urban area and therefore the design response is consistent with the Sandhurst Drive Interchange. The underpass therefore continues the contained experience of the Sandhurst design, with closed abutments to the north and south.
- Three columns (preferably tapered) support the pier capping beam which in turn supports the deck. The chamfered edge of the pier beam attempts to refine the solidity of the structure when approached along the TEL.
- A solid barrier with a rail above maintains views out over the bridge for the motorist, reinforcing the expansive landscape experience.



BRIDGE 2 - DOMAIN ROAD ELEVATION (BE2)



BRIDGE 2 - DOMAIN ROAD SECTION (BS1)



Tauranga Eastern Link

BRIDGE 2 - DOMAIN ROAD PLAN (BP2)

0 5 10 15 20 25m N

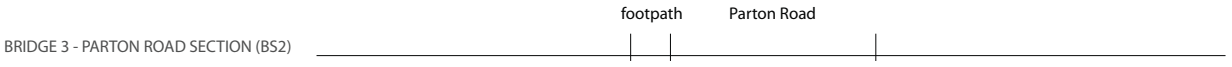
A single wire rope barrier will provide the median barrier for all of the highway except at bridges, where there is a solid F-type barrier on each side of the central column. The wire rope barrier has low visual impact, but consideration should still be given to the colour of the posts which can present as a solid line when viewd obliquely.

These examples from the Hillsborough / SH20 interchange show the desired combination of solid barrier and single rail. The upward slope of the top surface is a positive refinement, and the transition to an open wire fence is handled well, with the geometry of the top rail picked up in the profile of the fence.

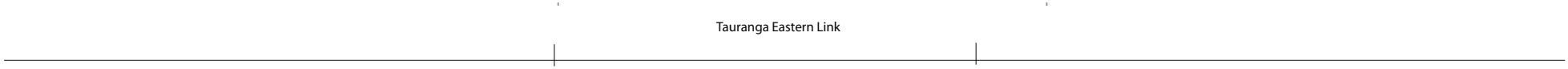
B3 – Bridge at Parton Road

The Parton Road underpass will provide access to a mix of recreation, rural, commercial and residential land to the north and rural land to the south. The topography is relatively flat and this is a point where there are expansive rural views.

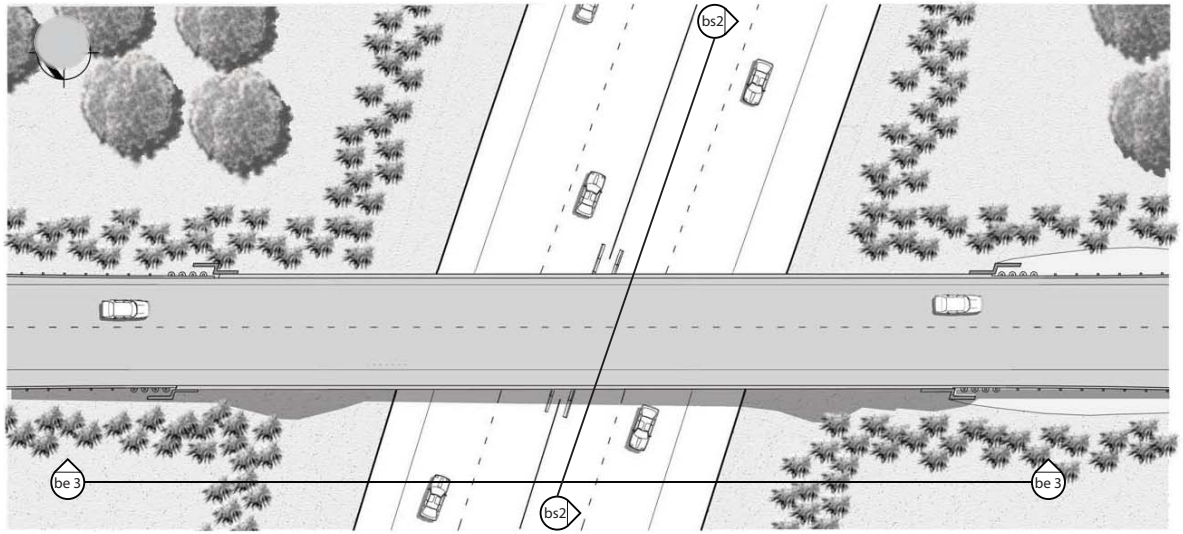
- Open abutments reinforce the rural context.
- Three tapered columns midspan support the pier capping beam which in turn supports the deck. The chamfered edge of the pier beam attempts to refine the solidity of the structure when approached along the TEL.
- A metal rail and post system mounted on a TL4 concrete barrier protects the pedestrian / cycle path on the north side of the bridge while maximising views for pedestrians, cyclists and motorists.



BRIDGE 3 - PARTON ROAD SECTION (BS2)



BRIDGE 3 - PARTON ROAD ELEVATION (BE3)



Tauranga Eastern Link

BRIDGE 3 - PARTON ROAD PLAN (BP3)

0 5 10 15 20 25m N

Continuous planting through open abutments strengthens a sense of visual continuity for the 'green' edges of the motorway. Careful selection of plant species together with adequate drainage will support this condition

B4 – Bridge over Kaituna River

The Kaituna River Bridge is a four-lane wide bridge with median barrier and 3 metre wide cycle lane on the northern side. It will be a two-lane bridge in Phase 1, which is illustrated here. The bridge carries the TEL over the Kaituna River, the river flood control embankments (stop-banks) and a boat access ramp in front of the northern stop-bank. It provides a significant new driver experience with views down both stretches of the river.

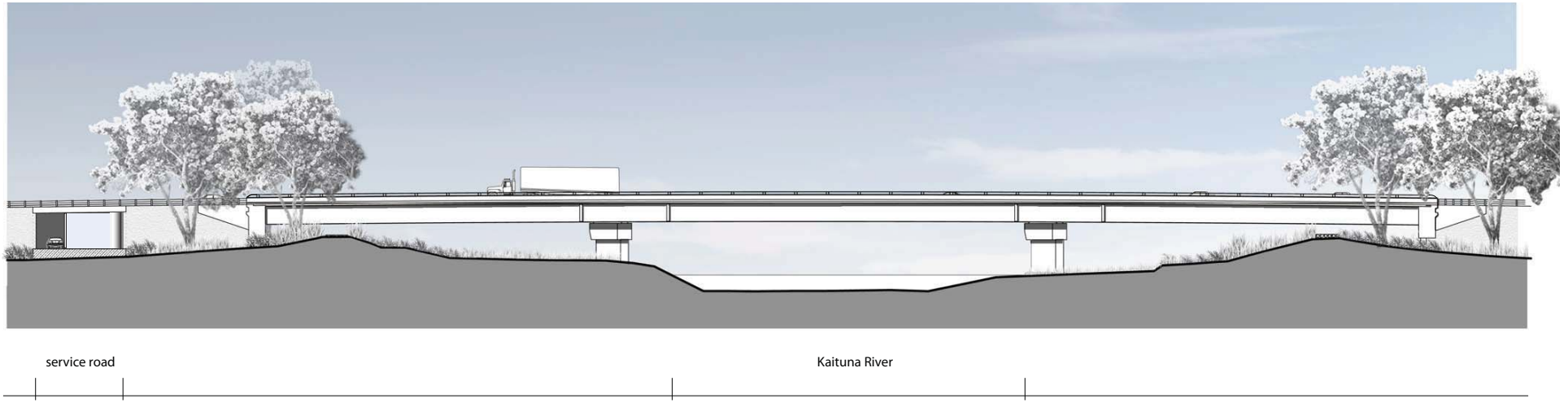
Piers are strongly recommended in this location because they result in less turbulence in the water. They are proposed to be wall type, supported on pilecaps. Concrete barriers are kept as low as possible to enable the viewer to experience river views.

The Regional Council resource consent for the Kaituna River bridge is conditioned upon the provision of riverbank erosion protection. Rock rip rap is recommended to be placed along the banks for a minimum distance of 100 metres in each direction, in such a way that the finished product is consistent with the existing native grasses. Regeneration is expected to occur natually on the upper part of the bank outside the tidal influence.

The span arrangement has been chosen to achieve the following objectives:

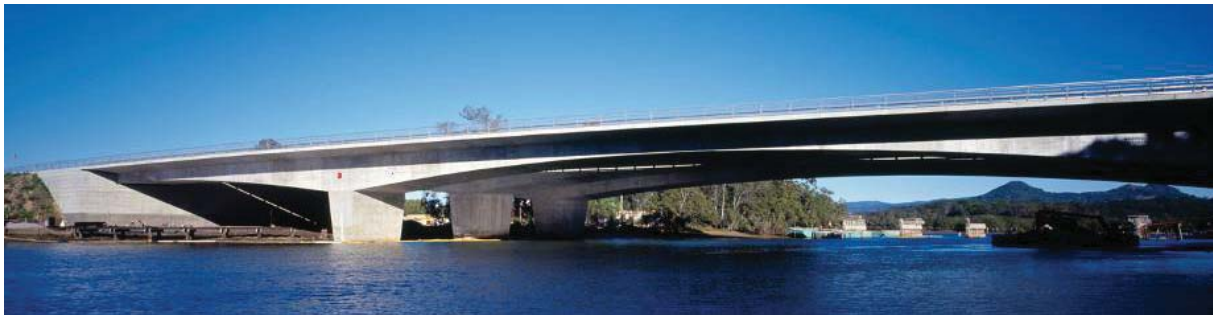
- minimise the elevation of the highway and the height of the approach embankments.
- avoid constructing foundations in the main river channel
- have no more than two piers between the stop-banks;
- avoid constructing foundations close to the stop bank footprints (to minimise the risk of destabilisation), and ;
- provide the necessary freeboard to the superstructure during flood;
- provide vertical clearance to the stop-banks.

The service road is currently shown within an underpass. This is not the preferred option for cycle and pedestrian movement due to the tightness of the underpass and the lack of clear sightlines to the entries and through the curve of the service road. If an additional land span to the bridge can provide sufficient height for the service road to be open rather than enclosed, this would be preferred.

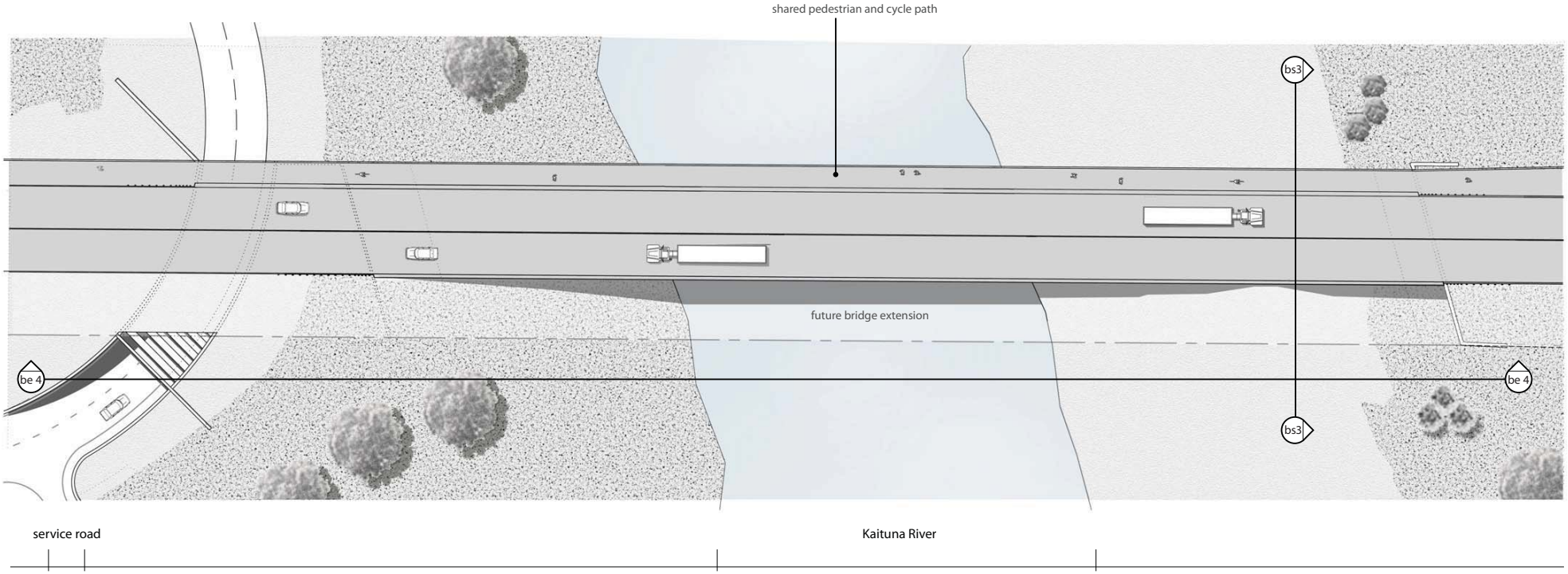


BRIDGE 4 - KAITUNA RIVER ELEVATION (BE4)

Section C Bridges and retaining walls



Brunswick to Yelgun, Pacific Highway, NSW Australia: This elegant pair of bridges over the Brunswick River in NSW locates piers out of the waterway for minimal enviromental impact. The design also recesses the main structure below the slim edge of the deck carrying pedestrian and cycle traffic and features open railing to provide elevated views over the river and surrounding countryside.



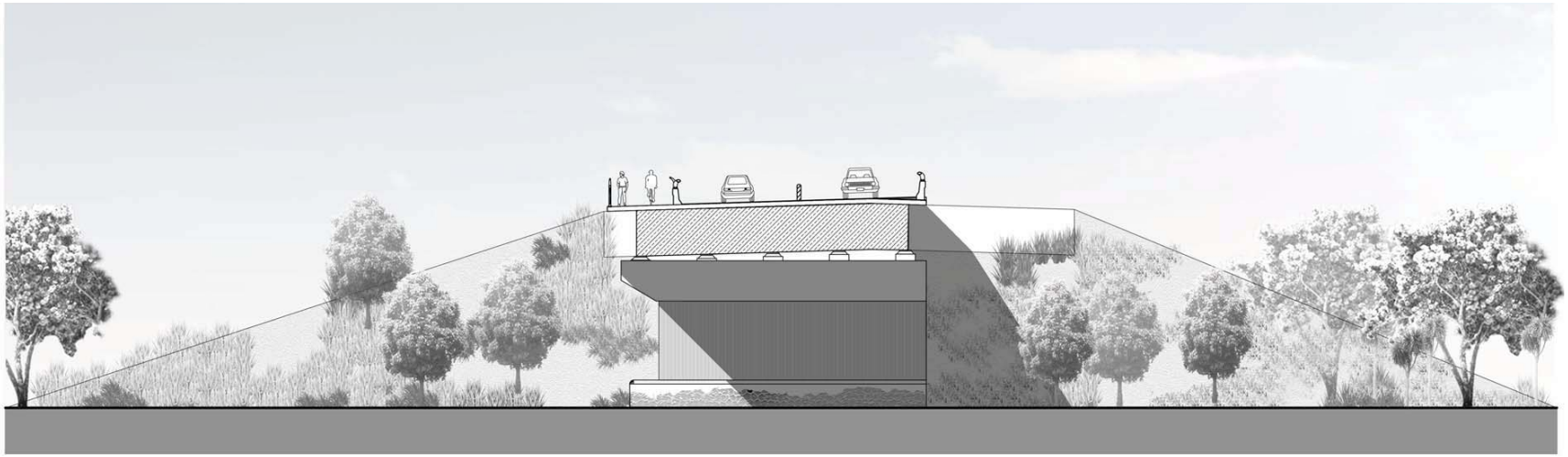
BRIDGE 4 - KAITUNA RIVER PLAN (BP4)

0 5 10 15 20 25m

B4 - Kaituna River bridge

Brunswick to Yelgun, Pacific Highway, NSW Australia: this is a good precedent for an open rail to the shared pedestrian and cycle path on the Kaituna River bridge that will open up new views along the river.

The railing in this location will be specified to ensure that views to the signficant Kaituna riverbank area and towards the Reserve are as open as possible.



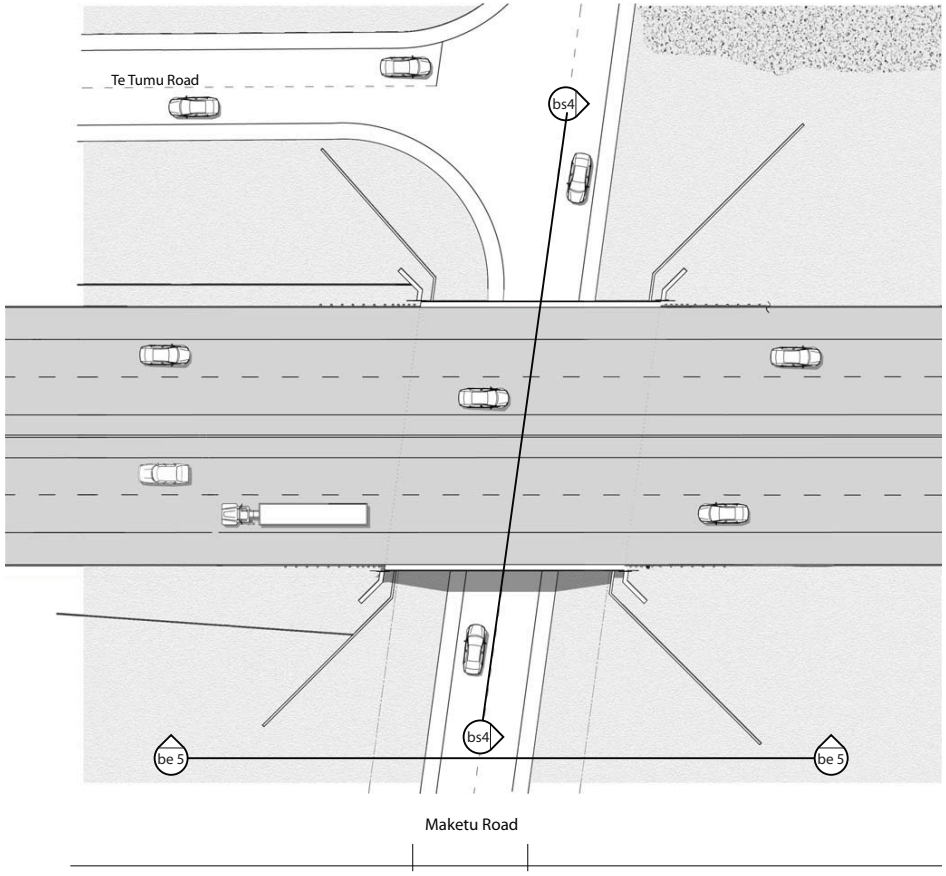
BRIDGE 4 - KAITUNA RIVER SECTION (BS3)

0 2.5 5 7.5 10 12.5m

B5 – Maketu Road overbridge

The Maketu Road overbridge is a single 22.4 metre, simply supported span with a total deck width of 25.3 metres. It provides access to Maketu Road to the east and SH2 to the west.

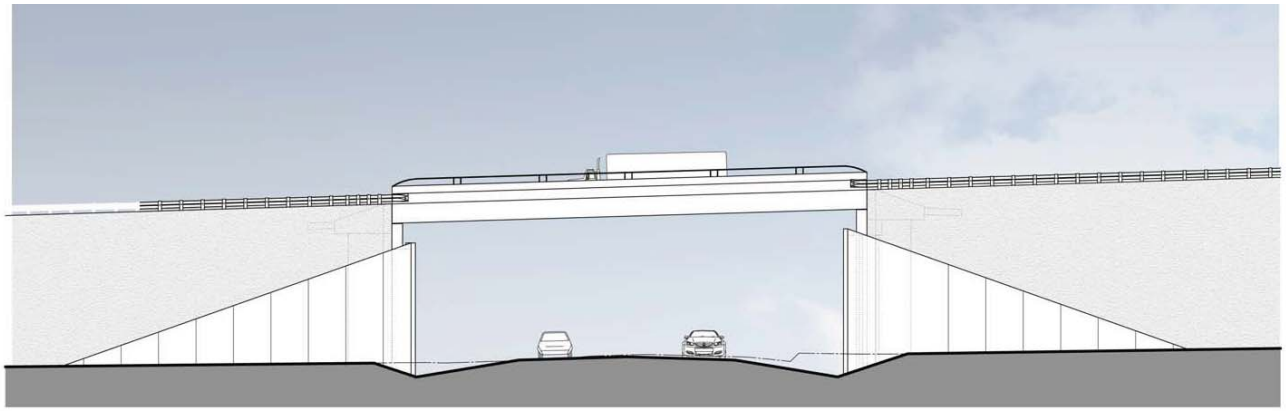
- The TEL passes over the Maketu Road which becomes a closed abutment underpass.
- Views out over the rural area are maintained with the use of a solid barrier to maximum 800mm, surmounted by a single rail.
- The MSE wall is viewed closely from Te Tumu to Maketu Link road as well as Maketu Road itself and therefore will be detailed in consideration of the proximity of passing vehicles. Refer to the design principles and design development drawings on pages C-14 and C-15.



BRIDGE 5 - MAKETU ROAD PLAN (BP5)

0 5 10 15 20 25m N

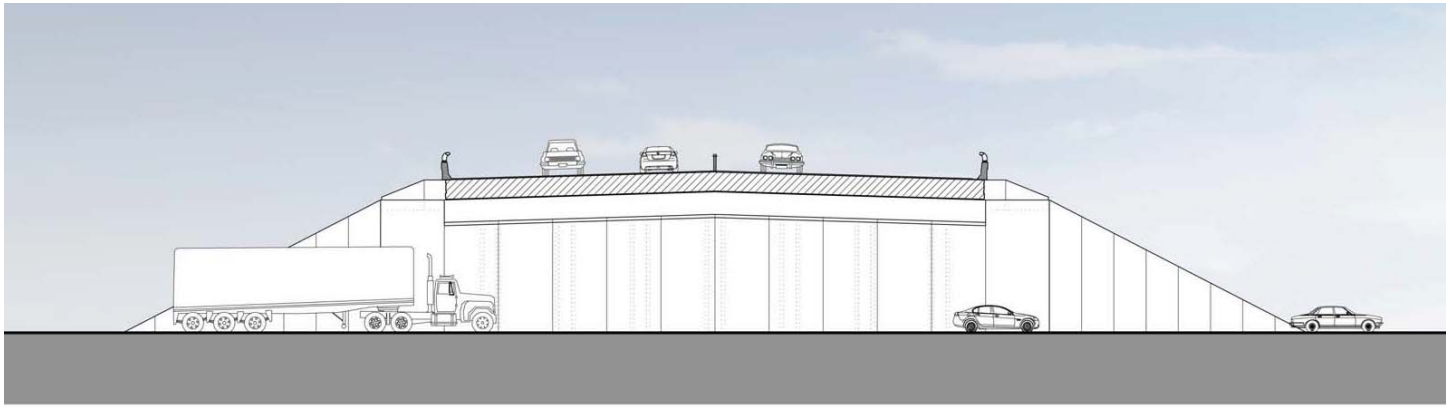
B5 - Maketu Road Overbridge



Maketu Road

BRIDGE 5 - MAKETU ROAD ELEVATION (BE5)

0 2.5 5 7.5 10 12.5m



Tauranga Eastern Link

BRIDGE 5 - MAKETU ROAD SECTION (BS4)

0 2.5 5 7.5 10 12.5m

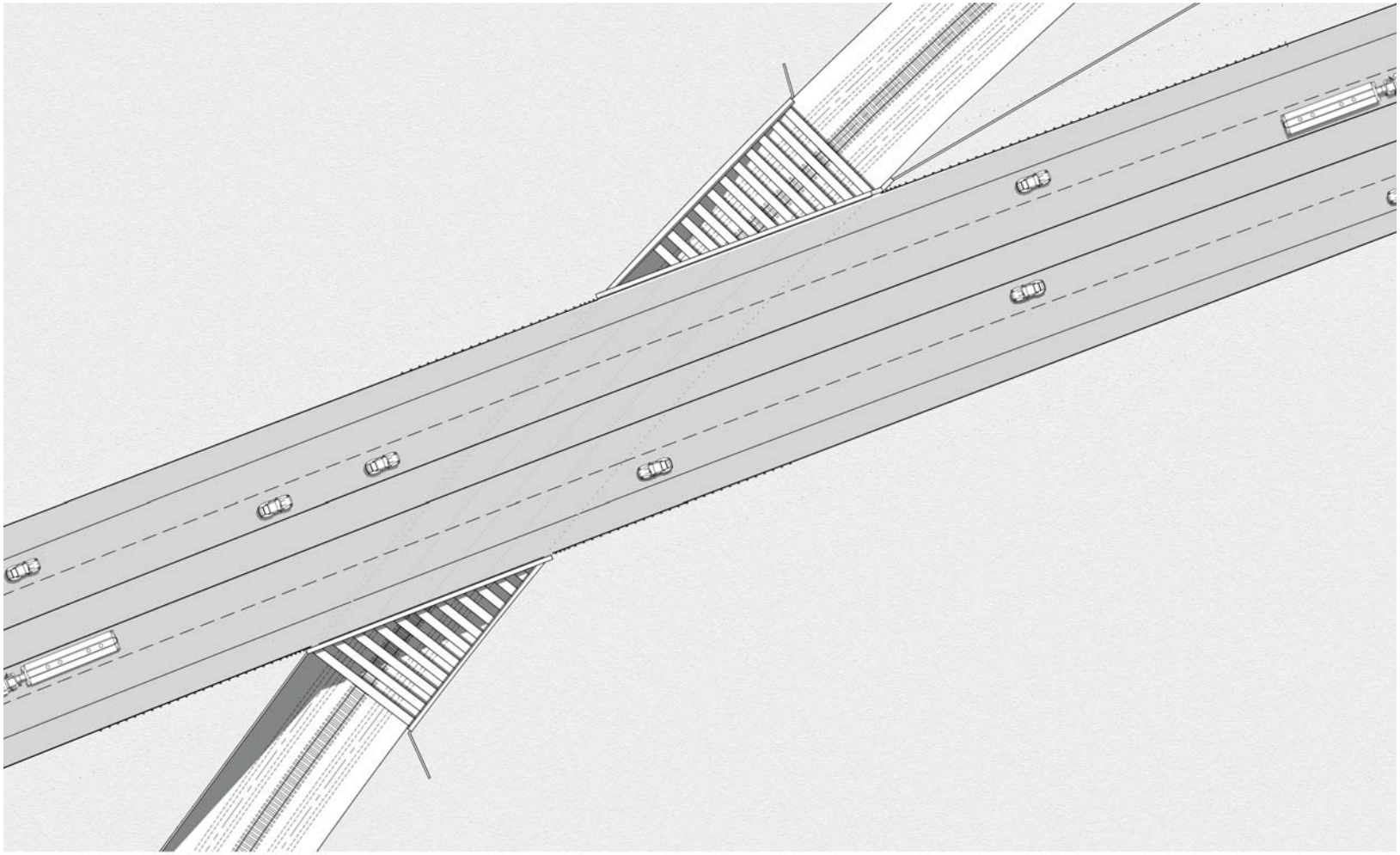
B6 – ECMT Rail Overbridge

The TEL passes over the East Coast Main Railway line on the ECMT rail Overbridge, a single 52.4m simply supported span with a 60 degree skew. The total width is 25m perpendicular to the road centreline.

The span was chosen to provide adequate space for the future doubling of the rail trackplus a service lane. The position of the future track is not known so additional clearance has been allowed for on both sides of the existing track. The current rail corridor is approximately 30 to 40m wide at this location but a reduced corridor of at least 20m has been agreed in principle with Ontrack (the same rail corridor width as provided for at Sandhurst Drive).

The travel experience for drivers on the TEL will largely uninterrupted at the Rail Overbridge.

- Both abutments are closed type with MSE retaining walls in front of the independent piled bridge supports.
- The MSE walls are visible only from the train, within the cut and at speed, and simple (if any) detailing is appropriate.



Retaining Walls

The design principles for retaining walls have been developed from and support the route design principles in Section B and the landscape design concept in Section G. They also reference the design treatment for the Harbour Link project. The design of retaining walls is to:

- reinforce connections to the Harbour Link to the north of this project
- visually integrate retaining wall finishes and detailing with the landscape design
- design individual walls to both reflect the 'family' of finishes that gives consistency to the highway experience, and to respond to the particular context: its topography, vegetation, history and land use character.
- minimise the visual impact of retaining wall structures by designing them with a balance of vertical and horizontal elements
- tilt walls back up to 5 degrees from vertical
- where possible use landscaping to reduce their apparent mass and scale.

The corridor is generally wide enough to support a more 'natural' approach to modifying the landscape, through providing gently sloping batters rather than retaining walls. Where there are retaining walls, there is an important distinction to be made between the different experience of them by the highway user and local resident. This distinction is between:

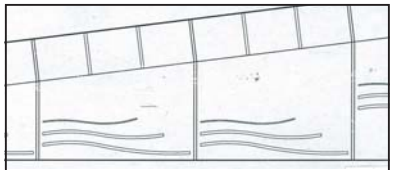
- walls that adjoin and are seen from the highway
  - two long low walls between (roughly) Bruce Road and Kairua Road
  - bridges at Sandhurst Drive and Domain Road
- walls that are seen from local roads, public spaces and the railway
  - Kaituna River bridge and underpass, Maketu Road and ECMT rail overbridges.

Refer to Section D: Noise Walls for a location plan of the retaining walls and barriers.

Design inspiration

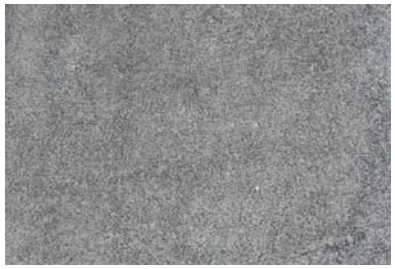
The previous design for the Harbour Link project included wavy vertical striations and a fluid wave formation (see below). This is referenced but adapted to the rural context of the TEL in a horizontal wave pattern on noise and retaining walls.

The design concepts are intended to interpret rather than 'picture' the landscape - the elements are designed to be simple and consistent, not to not draw attention to themselves but to respond to and create a setting for the landscapes they sit within.

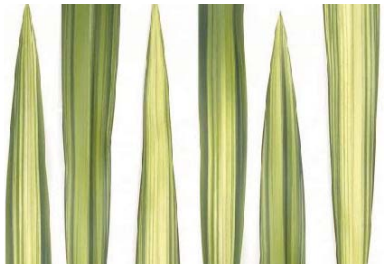


The earlier design for the Harbour Link project is not recommended for the TEM, but is adapted and included along with the other visual and landscape cues of the rural landscape

Exposed stone on the Papamoa hills above the TEL corridor give a design cue to emphasise the horizontal quality of the landscape by creating a definite base to retaining walls, using exposed aggregate as the 'ground' and a finer grain concrete finish above.



Flax milling around Kaituna River, and the remaining flax that is a strong element of the landscape along the route, particularly in riverine and wetland areas, has been represented in the vertical weaving of the retaining wall pattern, and is also picked up, in a simplifed form, in the pattern of the noise walls.



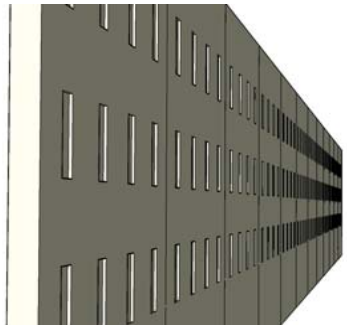
Striations on the ground created by the criss crossing of drainage channels through the landscape are also referenced through the vertical striations on retaining and noise walls.

The remnant dunes and alluvial geology underpin the coastal character of the area, and the texture of sand patterning is also abstracted in the noise wall patterns.

Retaining wall design development

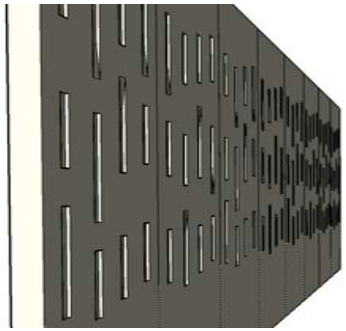
The Urban and Landscape Design Framework is an evolving document. The design of retaining and noise walls is expected to be detailed in the next stage of the project. For the purpose of the Framework, three initial options exploring patterning of the retaining walls were developed, drawing their inspiration from the landscape cues, and provide the basis for taking the design forward.

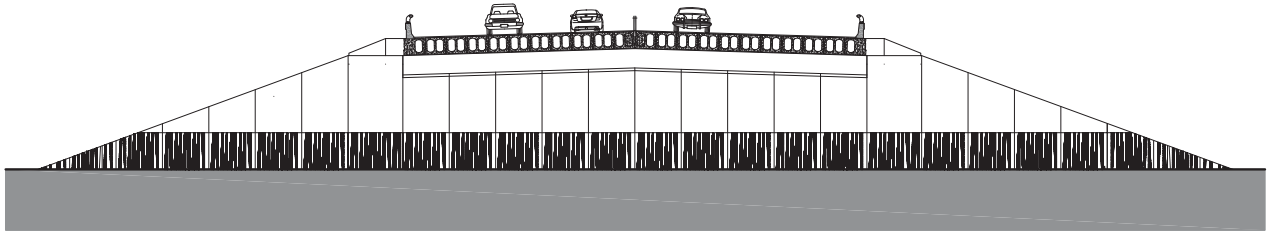
All three options employ a heavier base and a lighter 'top' to the retaining wall, grounding the wall and using the horizontal datum to reduce its apparent height and bulk. Colour is introduced through materials in the aggregate, not through adding pigments. A refinement of option 3 is shown below, where a seemingly random 'wave' of vertical elements laid along the length of the wall picks up on the sand patterning texture.



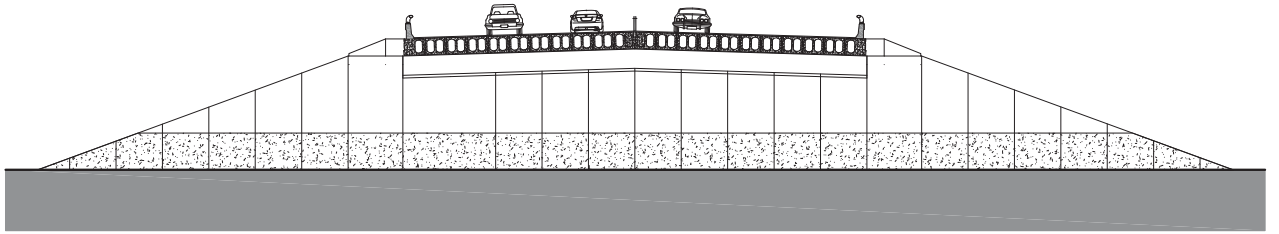
Option 3a - Regular vertical striations

Option 3b - Wave form striations

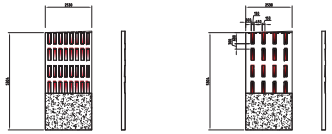




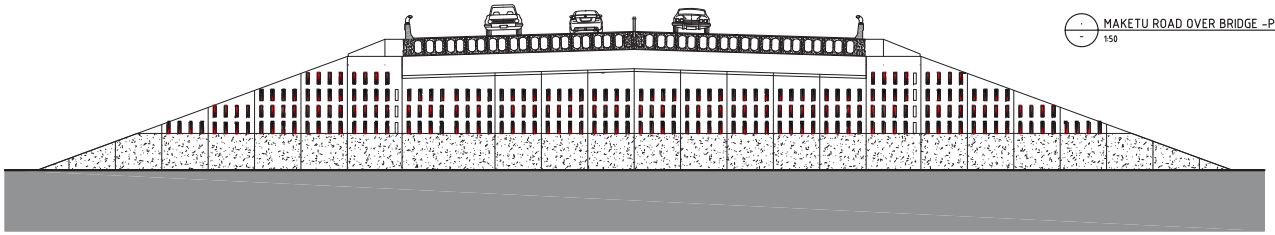
MAKETU ROAD OVER BRIDGE -PANEL ELEVATION OPTION 1 - FLAX REFERENCE
1:50



MAKETU ROAD OVER BRIDGE -PANEL ELEVATION OPTION 2 - EXPOSED AGGREGATE TO BASE
1:50



MAKETU ROAD OVER BRIDGE -PANEL ELEVATION AND SECTION
1:50



MAKETU ROAD OVER BRIDGE -PANEL ELEVATION OPTION 3 - EXPOSED AGGREGATE AND VERTICAL WEAVE
1:50

Section C Bridges and retaining walls

Clockwise from above:

Westlink M7, NSW Australia. The wall on the left is tilted back slightly, reducing the sense of containment

Pacific Highway, Brunswick to Yelgun, NSW Australia. Variety in size and depth of the pattern elements is combined into a balanced overall composition.

Hamilton north. Contrasting texture and colour, with a heavier, darker base combined with a smooth finish above, creates interest and 'grounds' the wall.