



Artist's impression: Integrated wayfinding and cultural marker - southbound tunnel



11.0 IN-TUNNEL EXPERIENCE

**THE DESIGN APPROACH
CREATES A NEW IDENTITY FOR
THE PROJECT BY PROVIDING
AN INTEGRATED, 'WHOLE OF
PROJECT' DESIGN SOLUTION
THAT WILL CLEARLY BRAND
THE NEW M6 MOTORWAY
WITH A UNIQUE CONNECTION
TO COUNTRY AND PROVIDES
CONTINUITY WITH THE
SYDNEY MOTORWAY TUNNEL
NETWORK.**

Tunnels can be uninspiring and disconnected from time and place. The Project aims to set a new benchmark for improving the travel experience for commuters across Sydney, realising the opportunity to celebrate the Connection to Country, with the use of Aboriginal language and design vernacular, a first for Sydney.

The in-tunnel experience has been developed in a manner that creates a new identity and branding for this new section of motorway, in context of the urban design outcomes and wayfinding devices implemented by the connecting sections of the WestConnex M8 Motorway.

11.1 Design approach

The design approach provides consistency with the WestConnex in-tunnel environment, and creates a new identity for the Project by providing an integrated, 'whole of Project' design solution that will clearly brand the Project as one of the city's new road infrastructure networks.

The following is a clear set of urban design principles that have been defined to achieve the desired in-tunnel experience:

- Provide architectural variation to vertical surfaces of motorway tunnels in order to avoid boredom, fatigue, drowsiness, stress and other physiological risks for tunnel users
- To enhance the overall user experience
- To break up the perceived extent of tunnel and user journeys visually and psychologically
- The tunnel design should attempt to respond to biophysical factors and reflect the local context at ground level
- To consider the integration of lighting, signage and art to enhance travel experience
- To be consistent with the overall vision for the Project.

Overall, the most challenging aspect with the design is the balance between strict adherence to safety regulations and designing a stimulating and engaging environment to enhance the driver experience.

The design outcome includes the following integrated wayfinding elements:

- Short sections that provide visual and architectural variation through the addition of patterned panel inserts
- Wayfinding suburb location markers with integrated feature lighting
- Wayfinding landmarks and destination reassurance markers to provide confidence in route decisions
- Cultural markers combined with location devices with custom indigenous patterning and language in reference to Connection to Country
- Patterned sections designed to highlight traffic merging ahead
- Coloured tunnel lining panels at emergency egress passages and within breakdown bays
- All safety and emergency exit signage requirements
- Integrated feature lighting that complements the wayfinding and decision points throughout the tunnel.

Integration with the wider Sydney network

The urban design approach to the M6 tunnels draws inspiration from the external environment and above ground natural features of the local area, and integrates across the M4 East, M8 Motorway, M4-M5 Link Tunnels and Rozelle Interchange.

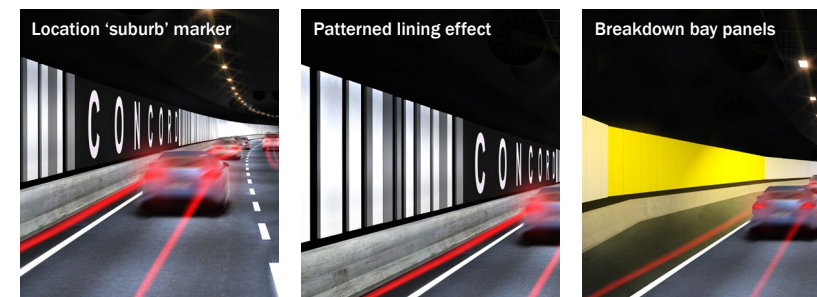
The 'patterned lining effect' (continued from the M4 East, M8 and Rozelle Interchange) emulates the intermittent tempo of the surface, providing visual relief from the monotony of a normal tunnel experience, without causing any undue driver distraction.

Breakdown bay marker panels give a consistent node for motorists across the network.

Location markers provide the key wayfinding device as they reference the suburbs and natural systems that the tunnel user is travelling beneath. M6 Motorway enhanced in-tunnel environment and driver experience.

In addition to the integration across the wider WestConnex network, the M6 tunnels draw on wayfinding principles developed across the various stages of WestConnex by naming the suburb above ground to help orientate the driver.

M4 East urban design treatments



New M5 (M8) urban design treatments



Rozelle Interchange urban design treatments



11.2 Wayfinding

Wayfinding is the process of determining and following a path or route between an origin and a destination. Wayfinding is problem solving and decision making.

The legibility of a route is the ease with which it can become known, or the ease with which relevant cues or features needed to guide movement decisions can be organised into a coherent pattern.

Route learning and route following strategies help build up cognitive maps, which are the internal representation of perceived environmental features and the spatial relations among them.

These environmental experiences show us how to learn routes. We become aware of landmarks that may be in close proximity or in the distant environment, and these can be used for orientation or priming us for upcoming decision points.

Location and destination markers

Location and destination markers act as anchor points for organising other spatial information into a layout.

In this case they act as strategic foci to orientate the driver before they enter the 'route guidance' phase, and to reassure them of their destination after the exit has been taken.

Markers and landmarks can be used to segment a journey, helping to break down a long tunnel into more manageable units. This gives the driver a sense of distance travelled and provides intermediate destination points along the route. Research has shown that reducing the perceived length of the tunnel experience presents significant psychological benefits to drivers.

In effect, we want a marker to become the point of departure at the beginning of a smaller section of the journey that leads towards the exit and to evoke a sense of arrival after the end of that journey.

Route guidance

On an approach to a decision point, i.e. a tunnel exit ramp or lane diverge in the mainline, it is important to guide drivers towards the correct lane over an extended distance to minimise potentially dangerous lane weaving.

Clear, unambiguous graphics that are distinct from those used in other sections of the tunnel should be used to reinforce the message that a decision point is approaching.

Research has shown that improving drivers' confidence in their route decision has psychological benefits and can improve traffic flow along the ramp incline. The graphics should be designed in such a way that gives drivers a sense of:

- Distance to the decision point
- Time
- Speed.

Route Guidance

The exit path graphics are individual to each tunnel exit and are essential in assisting drivers to find the correct lane during the decision period.

By introducing the exit path graphic gradually and increasing the frequency and intensity of the graphic over an extended distance - as it nears the diverge point in the tunnel - the exit path lengthens the period over which drivers may make their lane decision and can reduce dangerous lane weaving.

The progression of the exit path graphic is designed to help drivers better judge distance, speed and time to the exit. The exit path graphic continues past the diverge point to reinforce the link between the graphic and the exit.

Reassurance - 'Destination marker'

The destination markers graphics anchor the end of each wayfinding module and are the final stage in driver orientation, giving confirmation of the intended destination and reassuring the driver that the journey through the tunnel network has been successful.

11.3 Wayfinding Strategy

The wayfinding strategy has been specifically developed for an in-tunnel environment by a multidisciplinary team of urban designers, lighting and colour specialists and wayfinding experts.

The aim is to use three distinct wayfinding concepts to answer the three important questions facing tunnel users:

- Where am I?
- Where am I going?
- Have I gone the right way?

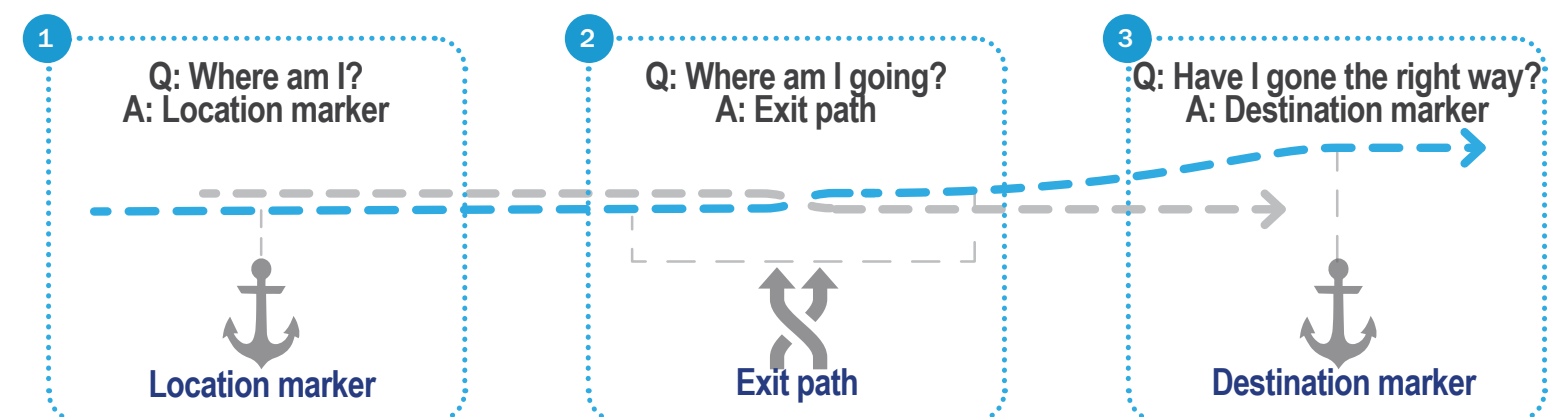
Wayfinding strategies that rely on colour or number-based route guidance systems alone must be fully coordinated across all past, present and future WestConnex tunnels in order to remain legible. By anchoring each wayfinding module with a distinct landmark, in this case the use of the 'location marker', we reduce the reliance on colour to establish location and to identify the route to an upcoming decision point or exit.

It is important to note that while a common design language is important to the overall urban design of the tunnel experience, the landmark element or 'location marker' must be separate and distinct from the route guidance, so that the two elements can be employed in isolation where necessary without contradicting the overall wayfinding strategy.

To distinguish between landmark and route guidance elements, different colours need to be used for each element, including different graphics, shapes or textures.

The location markers graphics developed for the M4 East, M8 and Rozelle Interchange tunnel wayfinding strategy anchor the beginning of each wayfinding module and are the essential first stage in driver orientation, giving them a clear sense of their current location and distance travelled through the overall tunnel network.

Location markers should be positioned at approximately one kilometre before the diverge point in the tunnel. Travelling at 80 kilometres per hour, drivers will have approximately 45 seconds in which to make a decision between a location marker and an exit



11.4 Connection to Country and cultural interpretation

In conjunction with the wayfinding strategy, the Project has enriched the in-tunnel experience by integrating Connection to Country and cultural interpretation elements in the form of cultural markers, to celebrate and acknowledge the Aboriginal Country, culture and people.

Cultural markers

Indigenous patterning and text has been adopted on all graphics panels, which are co-located with location markers at various points throughout the tunnel.

The patterning is a translation of the important thematics established by the Elders, in particular 'a place of water and sand', 'a place of important totems'. The direction of the linework of the tiles connects to Country through its orientation:

- the horizontal lines represent earth and water
- the vertical lines represent sky
- the wave line connects with the constant flow of water.

The colours of the panels relate to fresh water and salt water, which have their own quality and variations of blue and green. The southbound tunnels that lead to Kamay / Botany Bay have adopted the salt water theme, while the northbound tunnels that lead away from Kamay / Botany Bay have adopted the fresh water theme. This is complemented by sand yellow colour used for the text reflecting on the 'Place of Water and sand'.

Language derived from Bidjigal Country is shared by Knowledge Holders to celebrate this Country and educate users of the tunnel as they move across and under the landscape. The direction of travel to and from Gadigal and Bidjigal Country has influenced the sections of words that reflect key totems and marine life that is significant to this place.

The following words have been selected and sourced from the *Dharug language - 'William Dawes Notebooks on the Aboriginal Language of Sydney, 1790-1791'* for use within the tunnel environment with support from the Knowledge Holders:

Southbound (arrival to Bidjigal Country) - Salt water theme

- Bidjigal - notional point of entry to Country
- Barong (Kingfish)
- Gawura (Whale)
- Burra (Eel).

Northbound (arrival to Gadigal Country) - Fresh water theme

- Gadigal - notional point of arrival at the M8 Motorway connection
- Barong (Kingfish)
- Waradial (Mullet)
- Bidjigal - notional point of departure at the President Avenue Portal.

A diagrammatic layout is provided in *Section 11.6* outlining the locations of each of the selected words.



Figure 11-1: Interpretive themes embedded into the design of the tunnel elements

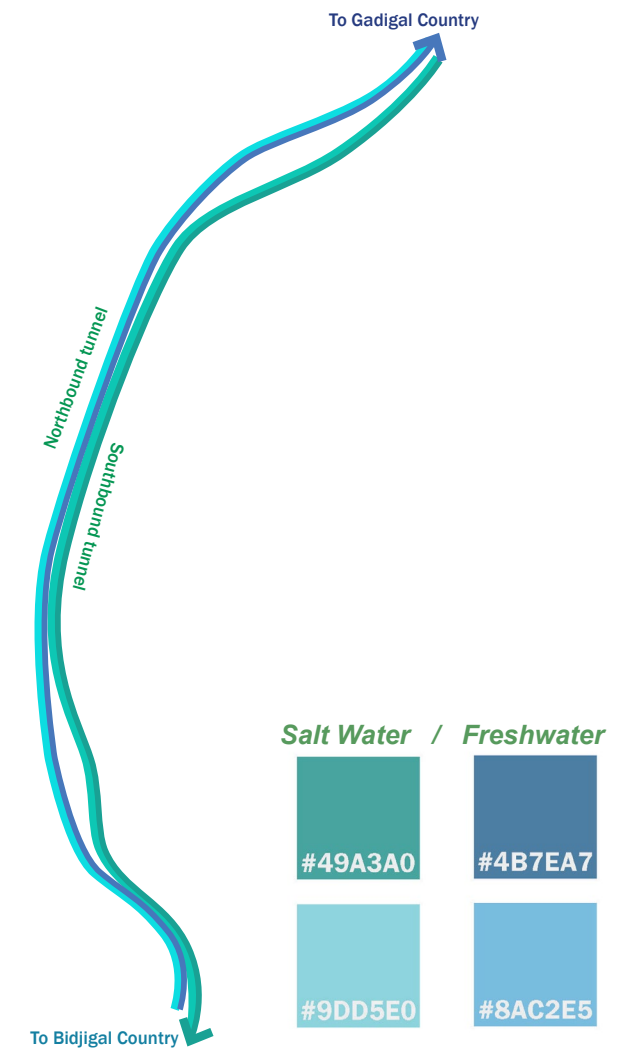
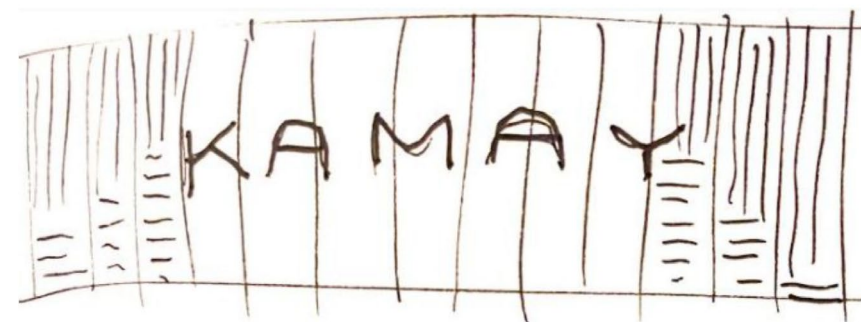


Figure 11-3: In-tunnel colour strategy

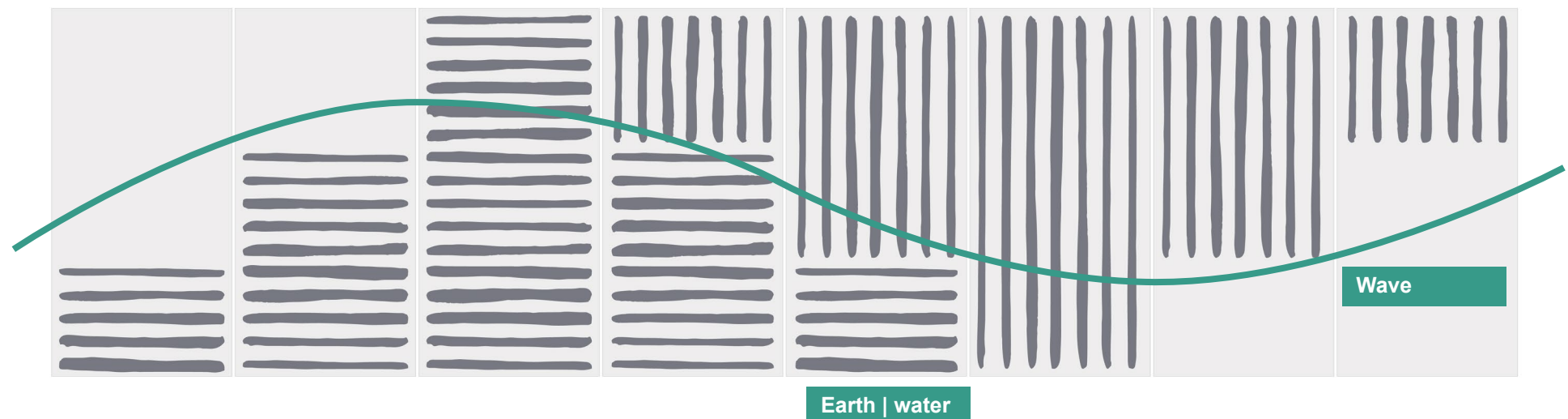


Figure 11-2: Initial sketch and design intent for line based pattern motif for graphic tunnel panels

11.5 In-tunnel environment considerations

Visual fixation

A major safety issue with long motorway tunnels occurs where a driver stares straight ahead, developing visual fixation or 'tunnel vision'. The lack of visual stimuli within a regular tunnel adds to this tendency as the walls typically present a monotonous white surface devoid of any colour, texture or shape.

The longer this phenomenon continues, the more the driver begins to suppress any surrounding visual stimuli.

Several classic psychophysical studies have shown that when spatial attention is focused to the point that visual fixation occurs, reduced processing of peripheral visual stimuli may lead to an effective narrowing of the 'functional visual field'. In the context of a motorway tunnel, this would mean drivers could potentially begin to ignore signs and road markings.

Reflectivity and the limitations on colour selection

The average colour reflectance must provide 60-80% reflection to minimise additional lighting required to operate the tunnel safely. As a result, there is a limitation on the use of saturated colour within the tunnel environment. The colours selected for use in the panel graphics have been carefully calculated to conform to the operating requirements.

Retinoscopic perception

Retinotopic perception is the mechanism by which the human eye identifies and tracks objects in space. The eye can make 3-4 movements per second between objects when visual stimuli is present.

To stimulate retinotopic activity and attempt to delay the onset of visual fixation, a series of 'bottom-up sensory-driven elements' such as simple graphics made up of colours and basic geometric shapes have been introduced to the tunnel wall panel design.

Coloured panels with patterned sequences throughout the tunnel provide a very low level of competing visual stimuli for the driver which, while non-distracting, can help to break visual fixation by stimulating retinotopic activity, reduce the monotony of the tunnel, and delay driver fatigue.

Pattern density

Humans are able to perceive and organise objects into a number of visual groups. This allows us to readily form groups from parts of an image that are similar in colour, or similar in texture.

Continuity of colour is extremely important, meaning that objects with colour fragments that are joined to form an extended body of colour become the dominant objects in the overall visual group.

Standard TfNSW road signage typically consists of white text on a green background with a white border, often with a blue symbol such as the Airport icon. All the colour fragments on a TfNSW sign join to form an extended body of colour. Similarly, the textured pattern on the tunnel panel graphics have been designed to contain a colour to white space ratio, so that they can be perceived and grouped with the signs.

11.6 Application of in-tunnel wayfinding, Connection to Country and cultural interpretation

Within the M6 tunnel environment, there are two distinct route options:

- 1 M8 Westbound to:
 - President Avenue
 - M6 Southbound (future extension).
- 2 President Avenue to:
 - M8 Eastbound.

The in-tunnel urban design treatment have been choreographed to align with the wayfinding principles and cater for the needs of motorists on each different route. The diagrams below show an overall schematic of the proposed wall graphics for the Project tunnels. Also shown on the diagrams are the existing graphics in the adjoining M8 tunnels.

The cultural interpretation devices are also overlaid on the adjacent diagram to illustrate the general arrangement.

M8 Westbound to President Avenue

Coming from the M8 travelling westbound, the motorist is presented with one route decision – to take the exit to the M6 or continue west on the M8. Once on the M6, the motorist will also be presented with a decision to take the President Avenue exit or continue south to M6 Stage 2 in the future motorway extension.

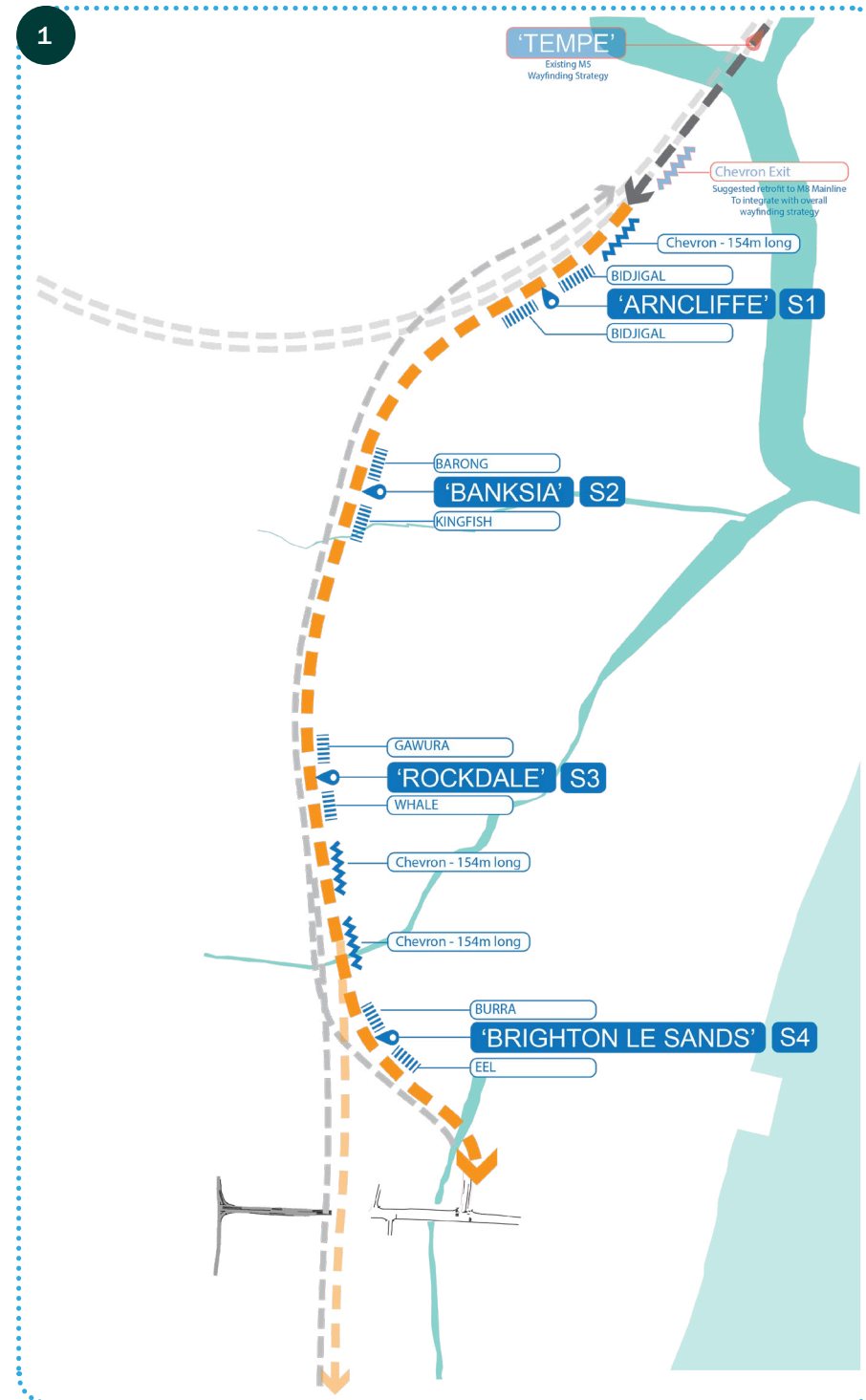


Figure 11-4: In-tunnel wayfinding strategy - southbound. (Future M6 corridor alignment shown indicatively for illustrative purposes only)

President Avenue to M8 eastbound

Coming from President Avenue, the motorist is presented with one route decision – to continue on the M8 eastbound.

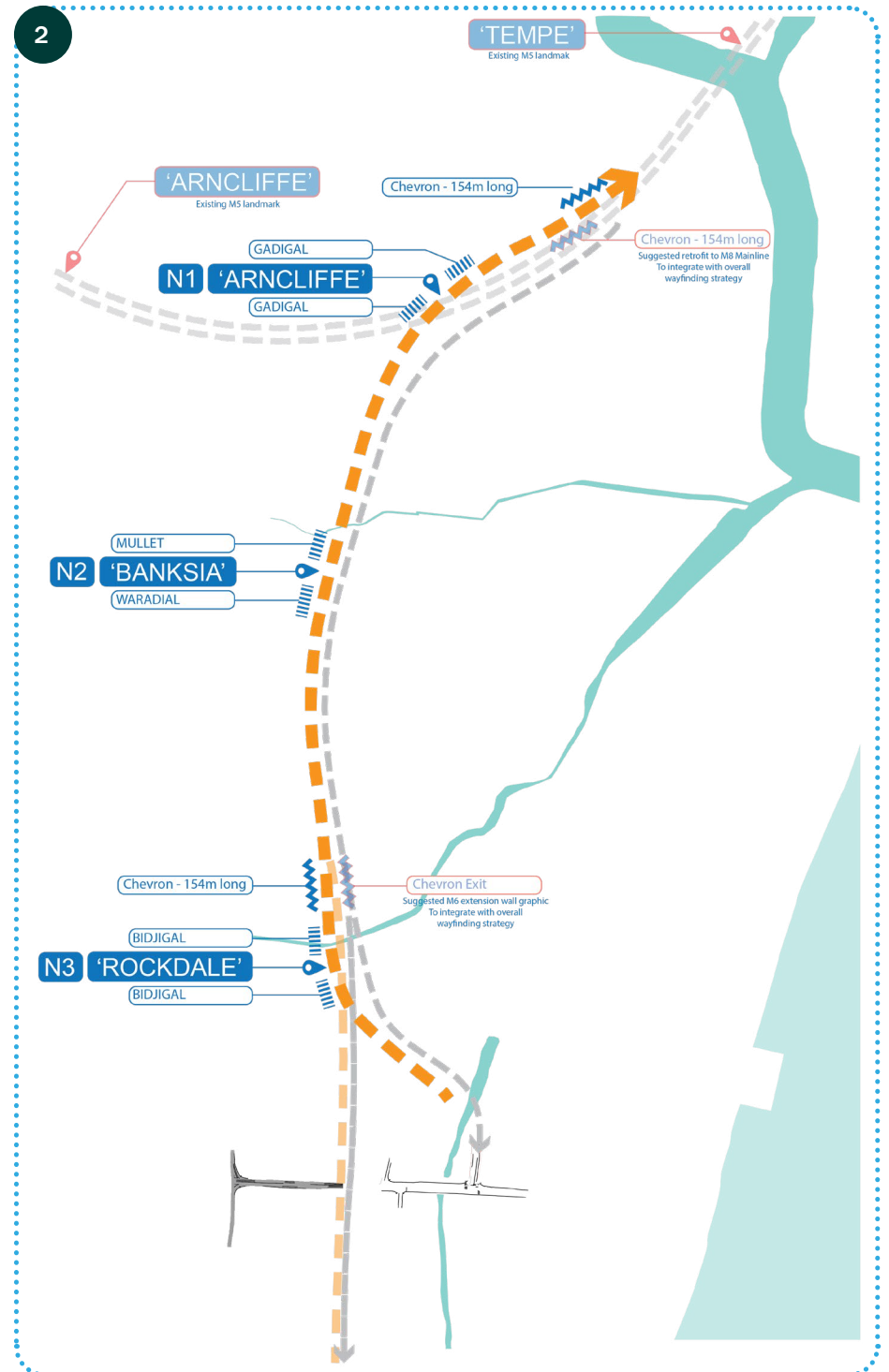


Figure 11-5: In-tunnel wayfinding strategy - northbound (Future M6 corridor alignment shown indicatively for illustrative purposes only)



Artist's impression: Integrated wayfinding and cultural marker - northbound tunnel

11.7 Graphic tunnel panels and integrated feature lighting

The following section provides illustrations of the various graphic panel treatments proposed within the tunnel environment.

11.7.1 Location and cultural markers

The location marker acts as a 'you are here' sign on the tunnel wall. The main feature is a suburb identifier supergraphic printed on the tunnel wall panels such as 'ARNCLIFFE'. The text should be elongated (roughly three times normal length) to be legible at speed and at an oblique angle.

As reflection on Country, on either side of the location marker is the cultural marker, in both the Indigenous (Darug) language and its English translation. The entire effect is unified by a continuous backdrop derived from Indigenous patterning and the use of symbolic colours.

There are four proposed location and cultural markers for the southbound carriageway:

Bidjigal | Arncliffe | Bidjigal
Barong | Banksia | Kingfish
Gawura | Rockdale | Whale
Burra | Brighton-Le-Sands | Eel.

There are three proposed location and cultural markers for the northbound carriageway:

Gadigal | Arncliffe | Gadigal
Waradial | Banksia | Mullet
Bidjigal | Rockdale | Bidjigal.

11.7.2 Integrated feature lighting

Lighting strategies have been developed to potentially reduce the impacts of driver monotony within tunnels, to retain driver concentration.

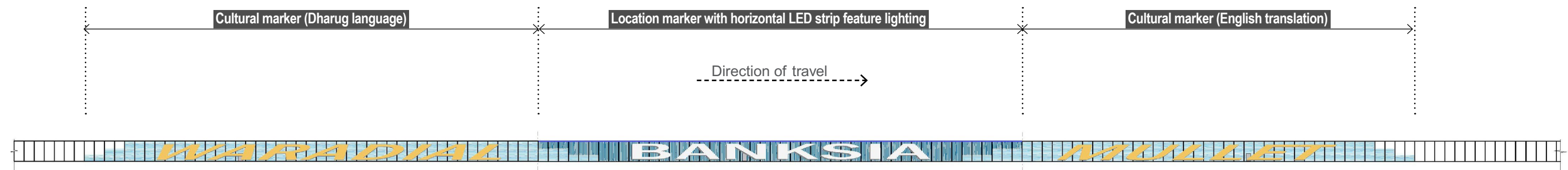
In conjunction with specific feature lighting in the dive linings at each tunnel portal, the in-tunnel design features have lighting integrated above the top of the tunnel lining panels at all location and cultural markers.

The feature lighting generally comprises a continuous 100 millimetres wide LED strip light with variable colours (RGBW). When combined with the graphic panels, the feature lighting will create a contrast to the standard white panel and provide a subtle variation in visual rhythm and a more engaging drivers experience.

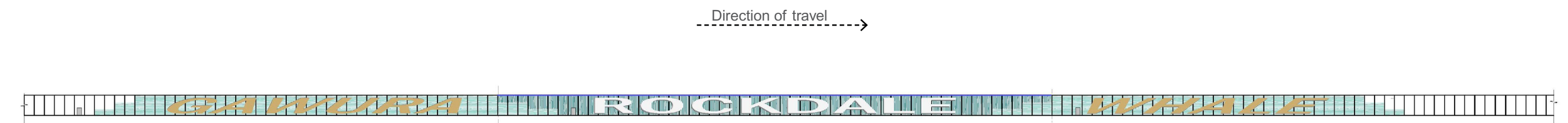
The combination of these tunnel elements provide a subtle change in character that relates to a specific function or location and adds to the overall tunnel experience and complements the wayfinding strategy.

Tunnel lighting is a specialist activity that is required for the safe and effective operation of the motorway and will be implemented in accordance with the following standards:

- AS/NZ 1158.5:2014 Lighting for roads and public spaces - tunnels and underpasses
 - TfNSW Specification - R158 Road tunnel and underpass lighting.
- The location of the feature lighting is shown on the elevations below.



Freshwater (northbound) location cultural marker example



Saltwater (southbound) location and cultural marker example

Figure 11-6: Cultural marker configurations. Example of freshwater and saltwater colour combinations

11.7.3 Exit Markers

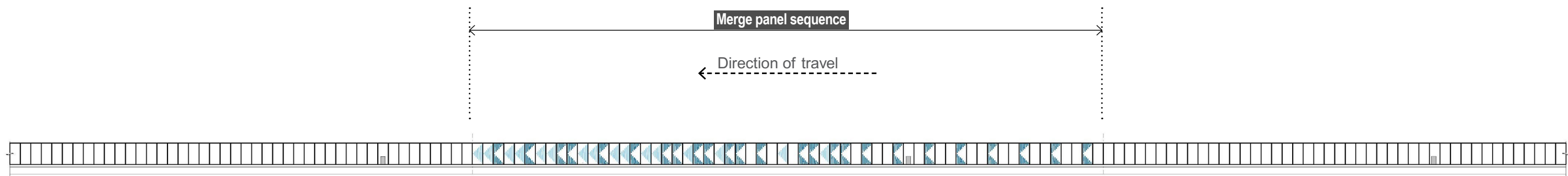
The exit path graphics are individual to each tunnel exit and are essential in assisting drivers to find the correct lane during the decision period.

Patterning is based on an important tool used in this Country for thousands of years; a boomerang. It's pointed end gives indication of direction, and the hand drawn quality / imperfect line gives interest.

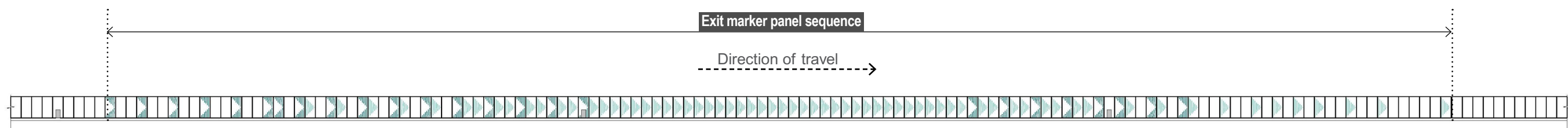
By introducing the exit path graphic gradually and increasing the frequency and intensity of the graphic over an extended distance - as it nears the diverge point in the tunnel - the exit path lengthens the period over which drivers may make their lane decision and can reduce dangerous lane weaving. The progression of the exit path graphic is designed to help drivers better judge distance, speed and time to the exit. The exit path graphic continues past the diverge point to reinforce the link between the graphic and the exit.

11.7.4 Reassurance / destination marker

The reassurance / destination markers will follow on from every exit marker as the final stage in driver orientation, giving confirmation of the intended destination and reassuring the driver that the journey through the tunnel network has been successful. Both the location marker and reassurance marker adopt the same graphic.



Freshwater (northbound) merge panel example



Saltwater (southbound) exit marker example

Figure 11-7: Exit marker and merge panel configurations

11.8 Standard (non-feature) tunnel panel treatments

The tunnel lining panels are proposed to be a steel panel with a vitreous enamel coating. The panels have a standard face size of 2400mm high x 1200mm wide and are prefabricated into cassettes with fixing notches ready for quick and easy installation.

The panels will extend to 3500mm above the road pavement, supported on a steel sub-frame, and will be used throughout the tunnel interiors, consistent to the other tunnels of Sydney.

11.8.1 Standard panels

Standard panels will be coloured white to maximise the reflectance value which therefore minimises the amount of roadway lighting required within the tunnel environment.



Artist's impression: Driver in-tunnel experience with standard white tunnel lining panels

11.8.2 Breakdown bays

To improve safety and driver awareness of tunnel facilities, the tunnel breakdown bays will be highlighted in yellow by sections of patterned tunnel lining panels. The pattern on the breakdown bay panels will feature the same mosaic design of coloured dots adopted within the M8 Motorway.



Artist's impression: Breakdown Bay tunnel lining panels

11.8.3 Emergency cross passages

Tunnel cross passages will feature a valance panel arrangement with smaller panels to conceal cable trays in a 'Jade Green' colour to comply with 'AS 2700:2011 G21 Jade'. All blockwork or concrete return faces within the cross-passage niche will also be painted in a 'Jade Green' colour.

Details illustrating typical appearance of the cross passages are shown in the adjacent images.



Artist's impression: Typical emergency cross passage to provide safe and legible egress