# SYDNEY HARBOUR BRIDGE CYCLEWAY

## Northern Access Project

Design Report

22.11.2021

Civille Djinjama H+N+S+ NEY+PARTNERS SUE ROSEN ASSOCIATES HISTORY HERITAGE RESEARCH

*Nura, or Ngura, are words for Country in several east coast languages used in and around the Sydney area. Country is the lands to which First Peoples belong, yearn for, find healing from, and will return to. Country is the place from which Ancestors originated and still exist within as life-forces. Country cannot be owned or tamed, as Country is also a relationship that must be honoured and nurtured.*

*Using the language for and of Country, we acknowledge the Traditional Custodians of Nura throughout Australia and abroad, and their continuing connection to culture, community, land, sea, and sky. We pay our respect to Elders past, present and future. (Djinjama)*

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# 01

# DESIGN STATEMENT

# 1.1. INTRODUCTION

## The project

Providing connectivity from Alfred St to the Sydney Harbour Bridge cycleway is a key strategic priority for Sydney's active transport network.

The key project objectives, as outlined in the services brief, are to:

- improve cycling mode share;
- reduce number of safety incidents on the Sydney Harbour Bridge cycleway;
- respect heritage and open space amenity;
- provide equity of access; and
- improve performance for customers (cyclists).

This link has a history of more than twenty years of previous project analysis, design options, stakeholder consultation and feedback. The Sydney Harbour Bridge Northern Cycleway Access Project (SHBCA) – North Design Report (the Design Report), produced by TfNSW and their project design team, has produced a clear set of principles and objectives for the project.

We have taken the existing work and reference design as the beginning of our design journey, and focused on further progressing the key design issues. We recognise that the Initial Design Phase is a starting point of this design process, and that the design will be further resolved in collaboration and consultation with TfNSW, key stakeholders including North Sydney Council and Heritage NSW as well as with further input from specialist consultants.

## The site

The spatial quality of the site is strongly connected to the Sydney Harbour Bridge, Bradfield Park, and the surrounding buildings. The existing concrete approach of the Sydney Harbour Bridge provides a beautiful backdrop and clear delineation of the scenery, extending to the south in a dominant but elegant sweeping curve.

Bradfield Plaza and the entrance to Milsons Point Station form the second dominant feature of the site. The two elements complement each other - the classical radial geometry in Bradfield Plaza radiates out from the entrance to Milsons Point Station and is the dominant organising structure of the plaza. The mixed use development on Alfred Street provides a clear boundary to the west.

The new ramp has to respond to the existing and dominant spatial organisation and should not compete with it. We propose a new object that respects the existing hierarchy and that speaks to the dominant urban elements.

***Our design vision is a sensitively and beautifully resolved work of architecture, which addresses the challenges of its heritage and parkland setting, incorporates Designing with Country principles, meets cyclists' needs and the needs of the local community, while also meeting infrastructure design requirements and budgetary constraints.***

## Our response

Our approach has been to develop a design that sensitively and beautifully resolves the cycle ramp and which fits seamlessly in the cultural context of Milsons Point and Bradfield Park.

Our design approach for this project can be condensed into four words: **respect**, **identity**, **integrity** and **honesty**.

1. We **respect** the unique context of the Sydney Harbour Bridge, including its history and cultural heritage. We also **respect** the Bradfield Park, the Milsons Point Station entrance, Kirribilli markets, the community, and stakeholders. These must all be valued for their intrinsic qualities, their knowledge and experience. The addition of the new connection for cyclists should enhance the existing quality of the place, rather than impacting negatively on it.
2. Understanding the **identity** of the place and its people and understanding what this project can signify is key to the success of this project.
3. Keeping the **integrity** and identity of every sub-element of the existing context is the mantra of our design philosophy. In adding new infrastructure into the context of this place we have closely followed the Burra Charter of doing only as much as necessary but as little as possible (Article 3.1) and to care for the place and to make it usable (Article 4.1) so that its cultural significance is retained (Article 2.2).
4. An **honest** approach to the design and construction of the bicycle ramp. It has to have integrity and coherence at every level. Our design for the structure is an honest and contextual response to the project brief and its functional requirements. Our design takes inspiration from the similar **honesty** of the Nawi (bark canoes) which were used for crossing the harbour, and for fishing on Sydney Harbour. Nawis derive their form and aesthetic from their functionality, craftsmanship and materiality. Similarly, our approach is that the integration of Designing with Country must be **honest** and an integral part of the design functionality, rather than an added layer.

# 1.2. DESIGN PRINCIPLES

The proposed design of the structure is a result of consistently applying a key set of principles throughout the whole design process. These principles have been identified to respect and embrace the site's heritage and history, enhance the open space amenity, and retain and enhance legibility to Bradfield Park.

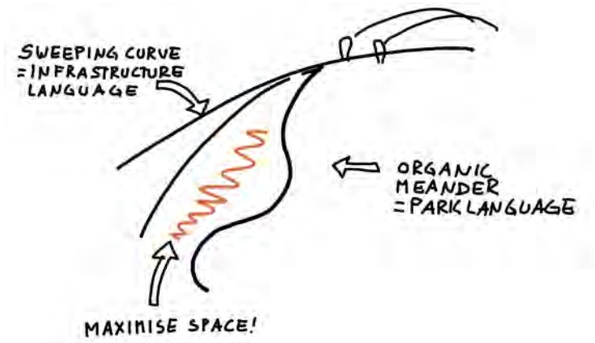
Our core design principles are:

1. The cycle ramp should not compete with the Harbour Bridge, but take a distinct form of its own.
2. The cycle ramp should respect the existing structure of Bradfield Park and maximise useable space within the park.
3. The cycle ramp should be a light and elegant structure, minimising impacts with a gentle, subtle and respectful approach.
4. The cycle ramp should also work as a canopy in the park, providing shade and shelter.

These principles are illustrated and described in further detail on the right.

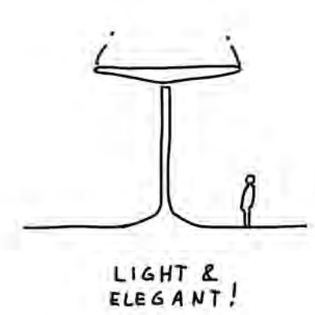
How the ramp is implemented is a critical requisite for the design and the following key design elements have been incorporated into our design of the cycle ramp:

- A smooth alignment of the cycle ramp, responding to the sweeping curve of the Sydney Harbour Bridge.
- A ramp alignment that allows Bradfield Plaza and Milsons Point Station to "breathe", giving space to both the station and the park to respect its legibility.
- The different directions of the ramp provide a new user experience and a sequence of different orientations and views, including views to the park and to the harbour. The experience of views would be enhanced by the addition of a south-facing viewing bay at the top of the cycle ramp.
- The ramp will meet basic active transport design criteria including grades, widths, safety railing as well as further enhancing the cycling comfort and safety by providing decreased gradients at start and end, an alignment that limits the curves to the minimum, provides additional width variations at curves and provides clear sightlines for cyclists.



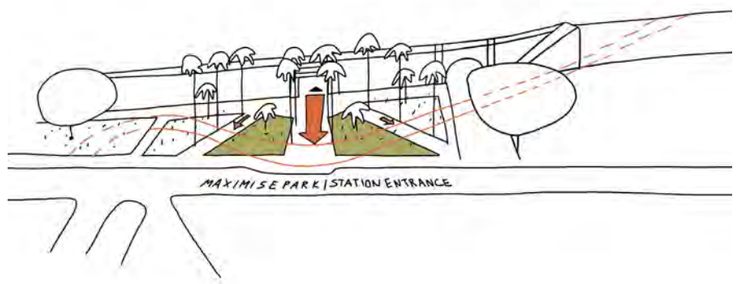

## 1. Two structures

The ramp cannot compete with the dominant sweeping curve of the northern approach of Sydney Harbour Bridge, and its language of city-scale infrastructure. The ramp is a significantly different scale. Its form speaks to the language and structure of Bradfield Park and its radial organisation. The mass of the existing Sydney Harbour Bridge concrete wall is counter-balanced by a light and metallic cycle ramp structure.



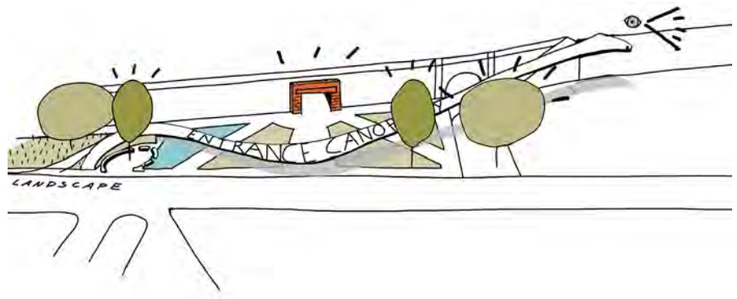

## 3. Light touch

'Light touch' applies to all elements of the project. For the structure, this means an elegant structure that 'floats' in the sky. It also applies to minimising impacts to heritage, views, the existing park and trees, archaeology, and the community. The location requires a gentle, subtle and respectful approach.




## 2. Maximise the park

The new ramp respects the existing layout of Bradfield Plaza and works with the park's radial symmetry. The new ramp maximises the usable space of the park. By aligning the ramp away from the station entrance, closer to Alfred Street, the new ramp respects the heritage of the place and maximises sightlines to the station entrance.




## 4. A canopy for the park

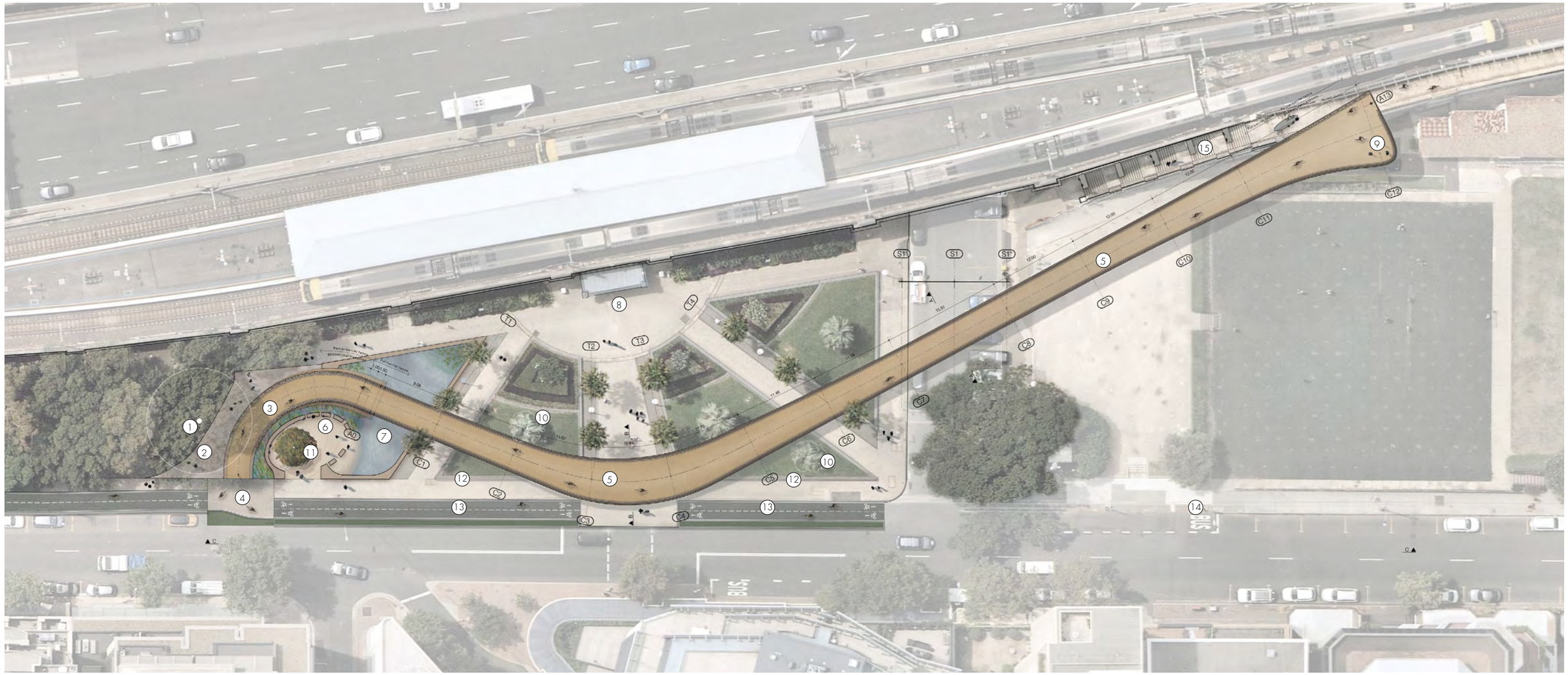
The alignment of ramp is designed to provide a dual role as both cycle ramp and a canopy to the park, marking the entrance to Milsons Point Station. The canopy provides shade and shelter to the park. The underside of the cycle ramp becomes a tectonic expression of the ramp architecture.

# 02

# DESIGN PROPOSAL

Western elevation

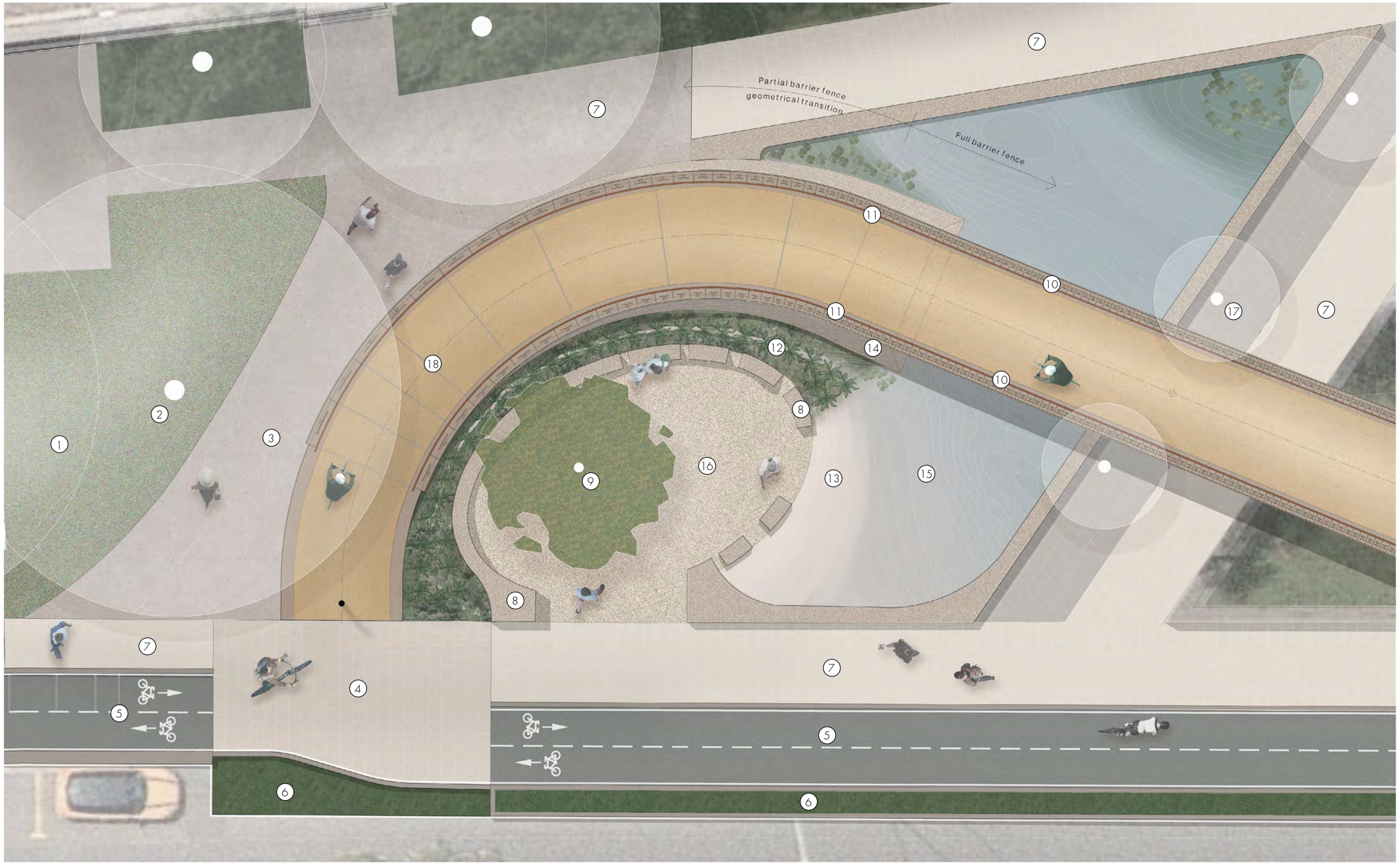
0 10 20 40




General arrangement plan

1. Chinese elm retained
2. New pathway
3. Landing ramp
4. Shared zone
5. Structure
6. Gathering Space
7. Reflection pond
8. Milsons Point station entrance
9. Viewpoint to Sydney Harbour
10. Relocated Jelly Palm
11. Proposed tree
12. Extended wall and turf (optional)
13. Alfred St Cycleway (future scope)
14. Relocated bus stop (future scope)
15. Seating elements incorporated on stairs and concrete ramp removed from stairs (future scope)

0 10 20 40




Detail plan of the abutment

1. Existing grass retained
2. Chinese elm retained
3. Concrete path
4. Shared zone
5. Alfred Street cycleway (future scope)
6. Native planting strip (future scope)
7. Existing pathway
8. Sandstone seating wall
9. Proposed Angophora costata
10. Flow channels to edge of deck
11. Flow diverters to edge of deck
12. Native Rush sandstone channel
13. Sandstone water feature with engravings
14. Sandstone abutment with engravings
15. Reflection pond with native planting
16. Crushed sandstone gathering circle
17. Cabbage tree palms retained
18. Ramp with rumble strips

0 2.5 5 10


MILSONS POINT STATION
LOOK!

View 3 - Artist Impression

Axonometric view of the bicycle ramp

**Gathering space**
Where 'Earth meets Sky', a shaded, circular gathering space is provided around an Angophora costata tree.

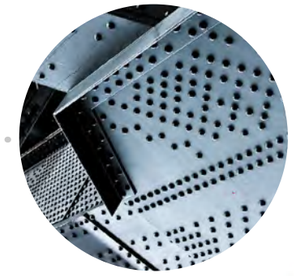
**Living sculpture**
An Angophora tree, native to this area and with great significance in Aboriginal culture, will be planted central in the gathering space.

**Sandstone engravings**
The sandstone abutment and seating around the gathering space will be engraved (to be developed with/by Aboriginal artist). During rain events, water will trickle down these engravings.

**Reflection pond**
A new water feature is proposed to collect stormwater from the structure. The water feature will incorporate locally native rushes and sedges

**Provide maximum space to SHB, station and park**

**Column and stiffeners**
A slender rocker bearing connects the deck with the columns. Stiffeners are welded on the underside of the bridge, providing a texture to the structure. It is a honest and subtle reference to the riveted steel structure of the SHB.



**Viewpoint pedestrians**
Pedestrian look-out and interpretation signage (future scope)
seating elements (future scope)



**Viewpoint cyclists**



**Sweeping curves**
Respecting the heritage, trees and park lay-out.



**Textured columns**
The steel columns with tactile surface reference the Angophora trees, grounded in the place.


**Entrance portico & canopy**
The structure provides a welcoming entrance to Milsons Point Station and maintains clear and generous sightlines to the station's entrance, while providing shelter for the public domain.

**Railing**
The railing will be light with detailing inspired by the Nawi. The pictogram will be developed by an Aboriginal artist.
The integrated lighting in the railing references the lights on the harbour.

# 03

# STRUCTURE

# 3.1. REQUIREMENTS

The Services Brief outlines the design requirements and key considerations for the structural component of the project, which include:

- bidirectional ramp, with minimum 3m clear wide deck and longitudinal gradient of indicative maximum 5% but is generally flatter;
- connects the existing Sydney Harbour Bridge cycleway to a proposed dedicated Alfred Street cycleway;
- retains existing trees and responds to the forecourt geometry and design;
- minimises loss of open space and impact on existing uses such as markets, bocce and the bowling green;
- retains existing important pedestrian movements with a minimum clearance of 2.5m;
- is setback from the heritage listed Sydney Harbour Bridge including the railway station entrance;
- the preferred option is a Linear Option with landing north of Burton Street; and
- changes in direction with a minimum indicative horizontal radius of 10 metres where practicable.

# 3.2. DESIGN RESPONSE

## A Structure of Earth and Sky

As outlined in the Aboriginal Design Report (WSP, 2021) Uncle Chicka Madden talks about Mundoie (Baiame), the Great Sky God and Mother Earth as forming "our connection to country". Uncle Chikka Madden describes how Mundoie is represented in rock carvings as footsteps "coming down to earth".

The cycle ramp forms a similar function connecting cyclists to the ground (Earth) at its northern end, and to the Sydney Harbour Bridge cycleway (the Sky) to the south. The design of the structure itself is inspired by this meta-narrative of Earth and Sky.

The ramp will be constructed in steel, which permits a slender and light structure. The edge has a height of 250 mm and a maximum thickness of 450 mm in the centre of the section. The steel bridge makes it possible to visually reduce the contact between the columns and the ramp. Visually, the ramp is "flying" above the park, detaching it from the ground. It is not read any more as a construction resting on the ground but an object that is liberated from gravity.

The columns are organised on the centreline of the ramp, with a span varying between 10 to 16 metres. In contrast to the connection between the ramp and the deck, symbolically and visually, the columns are related to the earth and are rooted in the ground.

From a structural point of view the columns are clamped to the foundations and there is a hinge at the top of the column realised by a rocker bearing.

The torsion is taken up by the hollow box girder formed by the deck and transmitted to the abutment. In the South abutment the torsion is taken up by a vertical push-pull between column CXX and A02. The efforts transmitted to the Sydney Harbour Bridge structure are minimised, only a vertical reaction and a transversal reaction (wind or seismic load) are transmitted at the bearing. In the North abutment an overlap between the concrete abutment and the steel bridge creates a rigid connection between the two elements.

## Landing in Bradfield Park

Bradfield Park is a beautiful park, encapsulated by the plaza entrance to Milsons Point Station. As outlined above, the design approach to the ramp is to adopt a light and slender structure which touches lightly on Bradfield Park wherever possible.

Where the ramp lands at its northern abutment, the ramp has unavoidable impacts on Bradfield Park. The ramp is a barrier in the parkland space both in the north-south and in the east-west direction. As well as a physical barrier the ramp reduces the usable parkland space as the clearance below the ramp reduces to less than 2m, creating an area of parkland that cannot be used. The landing also needs to respond to the constraints of the park including its pathways, the Chinese elm and pedestrian movement.

Our design approach has been to locate this impact at a natural juncture in the park - the juncture of Bradfield Park North and Bradfield Plaza. The design approach to resolve the ramp landing at this juncture is to ensure the landing responds to the park language of both Bradfield Park North and Bradfield Plaza.

To elegantly resolve the ramp landing, our design response is to incorporate a formal water feature underneath the ramp structure. The water feature allows the retention of the visual language and geometry of Bradfield Plaza as well as maximising views to the station entrance and the Sydney Harbour Bridge, while acknowledging the loss of access and movement to this part of the park.

The design responds to the loss of open space by providing a high quality shady seating area next to the water feature. Our design response is to care for Bradfield Park and to give back to Bradfield Park where the cycle ramp necessitates change.

## "How are you going to leave my Country better than what it was before?"

Michael Hromek challenges us in his Aboriginal Design Report (WSP, 2021) to leave Country better than what it was before. Where change is necessary in Bradfield Park it provides an opportunity to Heal Country through incorporation of materiality, ecology and respect for water resources. Our response to Designing with Country has been to prioritise honesty and an approach with integrity rather than a simple overlay of decoration. The selection of sandstone, the natural sculptural beauty of *Angophoras*, native reeds, and respect for precious freshwater provides us an opportunity to heal, listen to and pay respect to Cammeraigal Country.

## Old and new

As outlined in the previous section the cycle ramp cannot compete with the Sydney Harbour Bridge. It is physically and metaphorically separated from the bridge approach in its form, alignment and language. The ramp provides a clear separation in materials and forms between new and old. It has its own alignment that can be read as a separate urban object of approximately 170m length, clearly demarcated by its north abutment and the Sydney Harbour Bridge wall.

The geometry is built up between two geometrical focal points: the entrance of Milsons Point Station and the beautiful fig tree on Burton street. The result is a strong, elegant, and legible alignment.

# 3.3. MATERIALS & FINISHES

The following sections outline in detail information on the materiality of the deck structure, railing and balustrades, and columns.

## Deck structure

The following details are proposed for the deck structure:

- The deck structure is a closed airtight box-girder. The thickness varies from 250mm at the edge to 450mm in the centre of the section (refer typical cross sections on the following page).
- Longitudinal stiffeners divide the section into nine regular parts. The height of the stiffeners is constant along the length of the cycle ramp. The distance between the stiffener is variable as to keep a regular inter-distance.
- The width is variable, going from a minimum of 3,800mm (comprising 3,000mm clear width plus a 400mm railing and gutter either side) to a maximum of 5,800mm. The initial assumptions of a plate thickness of 18 mm for the deck and the underface and 8mm thickness for the stiffeners gives admissible results in the FEM-calculation.
- The box girder is not accessible, and some part of the welding should be done from outside. We propose to weld the stiffeners partly from the outside on the underside of the bridge (refer Stiffener detail D1-D1 on the following page). These 'dots' are needed for structural reasons and also provide a characteristic texturised underside to the structure, that underlines the shape of the ramp. This also is a subtle reference to the historical riveted steel structure of the Sydney Harbour Bridge. The stiffeners are honest, beautiful and tell the story of the structure's construction.
- The open gutters are placed on both sides of the ramp and bring runoff from the ramp to its northern abutment and the sandstone water feature. The water becomes one of the design elements of the ramp. It is not hidden away but becomes an element of delight in the design of the ramp. It is easily maintainable and controllable.
- The deck is painted on its exterior (noting that no painting is required inside due to its airtight design). The painting complex is undertaken in three layers greater than 360 microns and conforming to ISO 20340 C5I. This provides a lifecycle of at least 25 years before repainting is required.
- The finishing of the deck is a polyurethane finish of minimum of 4mm with a quartz grain inlay (or similar) to obtain a sand-like colour and the required anti slip properties and consistent with the requirements of TfNSW R110 coloured surface coatings for cycleways.

## Balustrade

The following details are proposed for the balustrade of the ramp:

- The balustrade includes a top rail at 1.4m in height and with verticals spaced at 125mm. The design proposed for the top rail references the original railing of the Sydney Harbour Bridge (refer to section 7)
- The vertical poles are alternately 1.4m and 1.1m. The lower poles are terminated with a design specially designed for the ramp. In the current design proposal this pictogram references a paddle used in Nawis. We propose to co-design this element with an Aboriginal artist working with Aboriginal elders and community.

The lower poles and especially the pictogram are directly lit by Puck LED lights embedded in the handrail. The railing is designed to be light and transparent. An example of a similar railing design, designed by Ney + Partners, is included below.

## Lighting - Nawis on the Harbour

The lighting of the ramp is realised by Puck LEDs embedded in the top rail. The lighting works at multiple scales. It provides the functional lighting for the deck to meet the required lighting standards and provides "ambiance" lighting by directing light onto the pictograms. At a broader level the lights can also be read as multiple light dots, referencing the women cooking fish on ochre clay base fires in their nawis on Sydney Harbour.

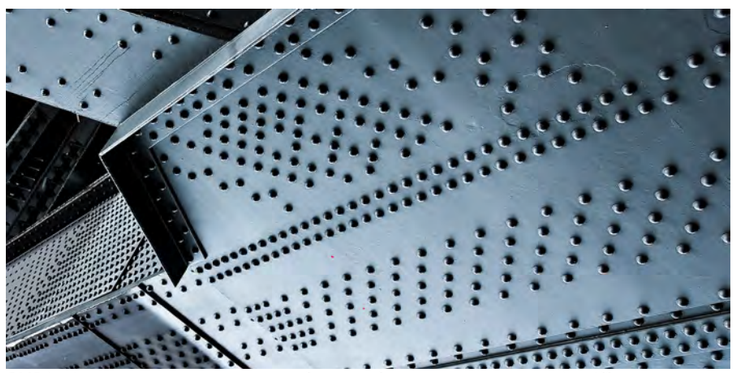
## Lighting to park canopy

Complementary lighting could also be installed in the park to up-light the underside of the deck (the canopy) and the columns. Special zones of the canopy, such as the entrance to the station, could be emphasised at night with up-lights.

The uplights would highlight the structure from underneath, including the columns, similar to the lighting of the approach of the Sydney Harbour Bridge. The stiffeners on the deck would shimmer in this light, reflecting it under different angles, and referencing the nawis on the harbour at night.

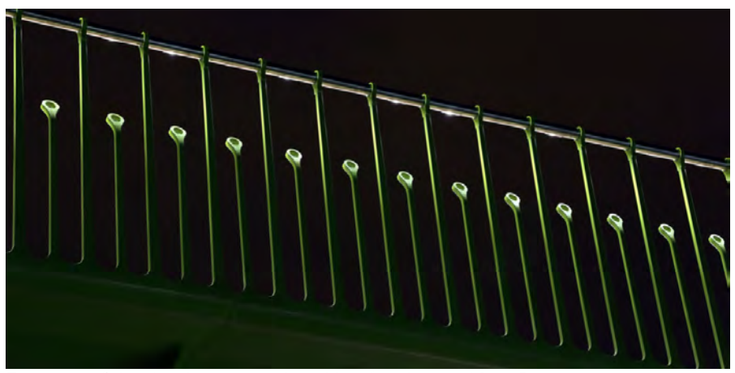
For special festive occasions, a special graphic and colour projection could be made on the whole underface of the ramp, providing another opportunity to tell stories about Country.

The lighting design could be further refined to carefully consider light spill and competition with lighting on the Sydney Harbour Bridge and station entrance.

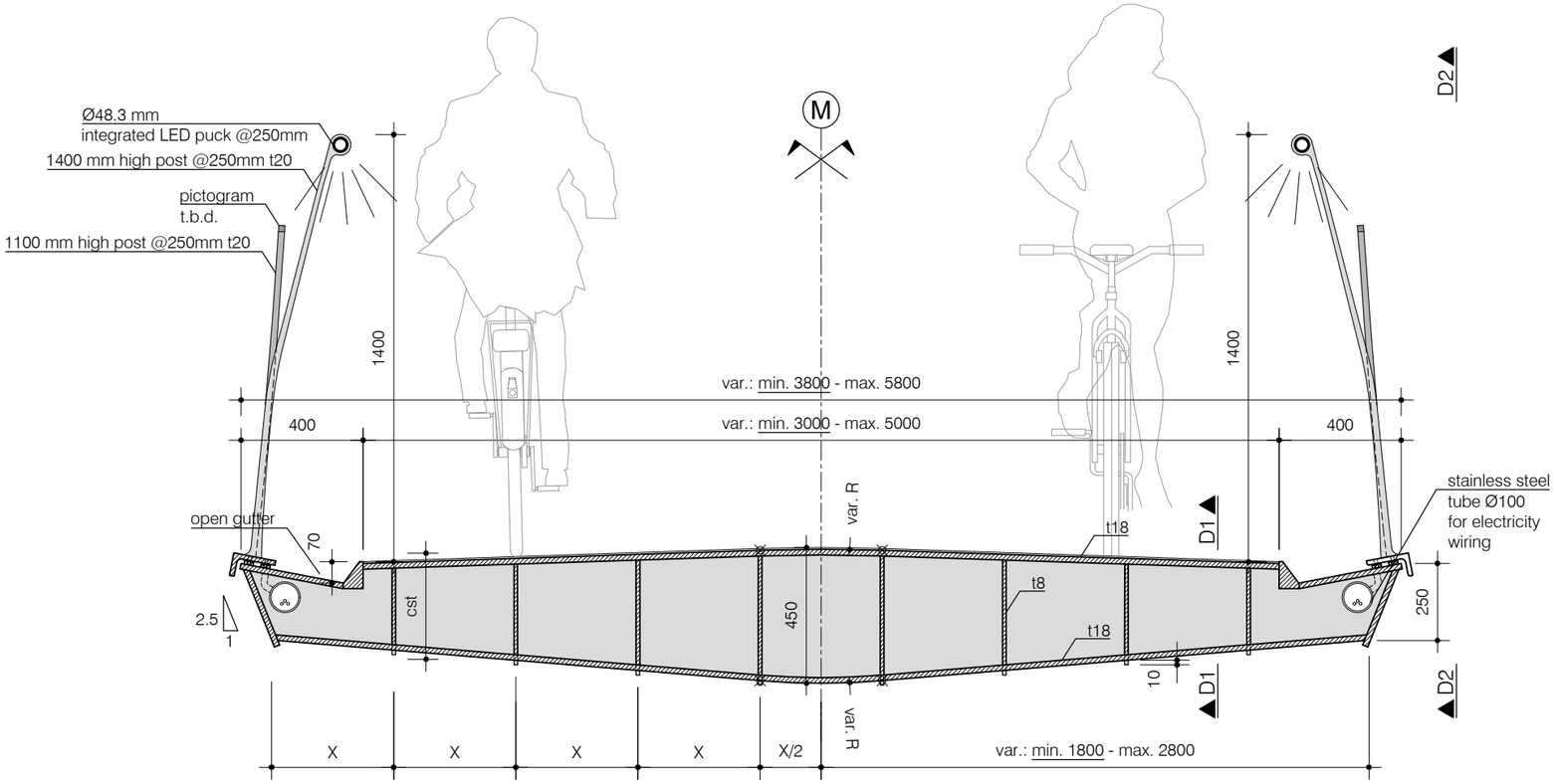


SHB's riveted steel structure as reference for the new structure's stiffeners

Example of 'light' and transparent balustrade (design by Ney+Partners)

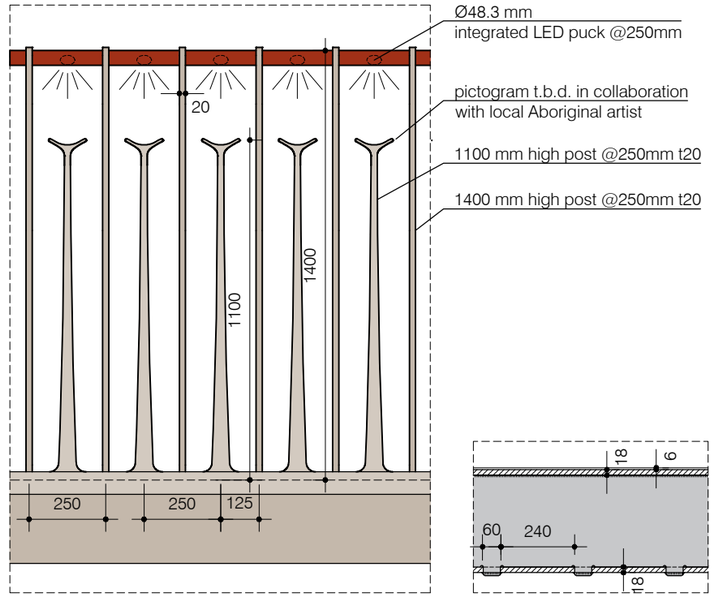


Example of lighting integrated in railing (design by Ney+Partners, photo by Toshio Shibata)




## Typical cross-section A-A (minimal width)

Scale 1/20



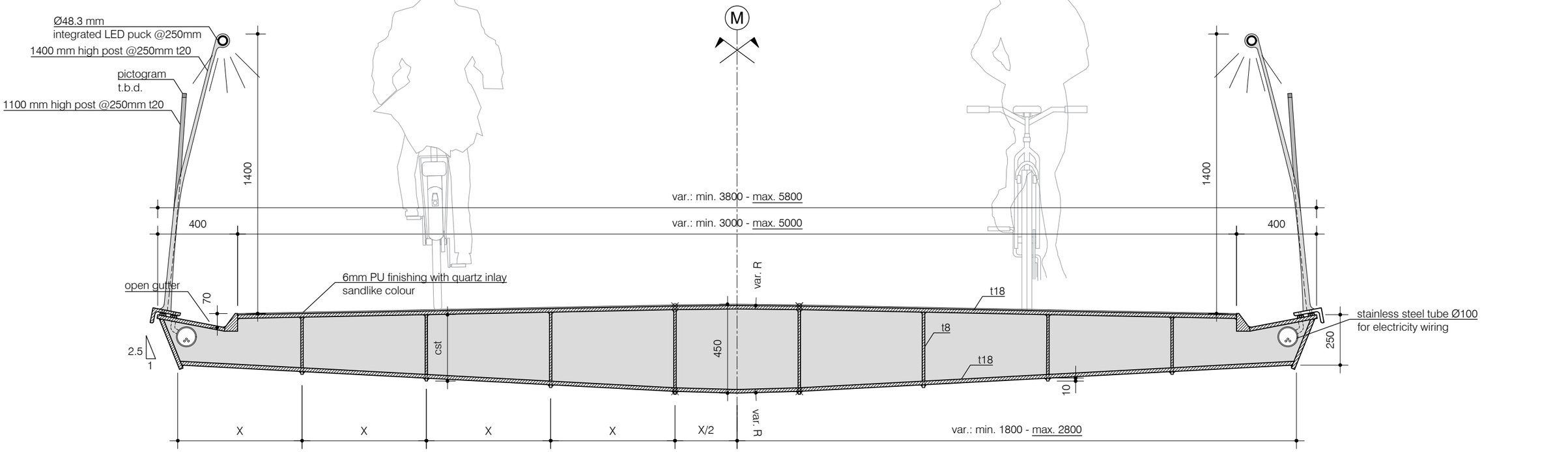

## Elevation barrier fence D2-D2

Scale 1/20




## Stiffener detail D1-D1

Scale 1/20




## Typical cross-section B-B (maximal width)

Scale 1/20

0 0.5 1 2 M

## Columns

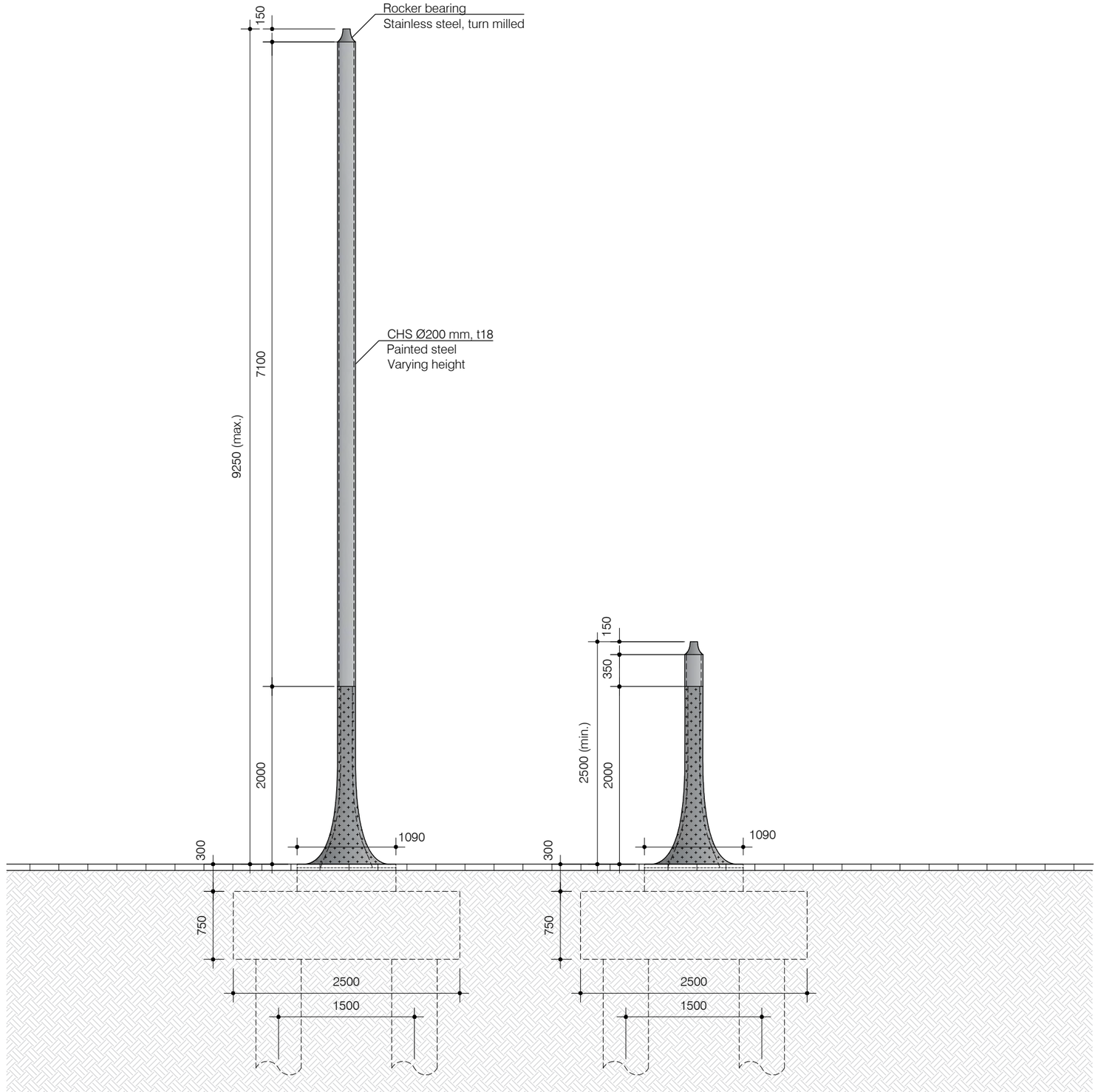
The columns are realised with an upper turn milled rocker bearing, a circular hollow section for the main part of the column, and a cast steel foot.

It is proposed that the cast footing component of the column, approximatively two metres in height,  has a special texture in relationship with the specificity of the object.

The lower part of the column is in direct relationship with pedestrians at the plaza level. Pedestrians can touch it and discover the texture of the column up close. The tactility and the relationship of the column to the earth are important design features.

In the current design, the foot of the column references the trunks of the *Angophora costata*, a tree native to the area and with significant meaning to the Aboriginal community - referencing the mother tree  and signifying the matriarchal Country. The tactile nature of the design references the tactile nature of the *Angophora costata* trunk.  We propose that this special feature be co-designed with a local Aboriginal artist working with Aboriginal elders and community.

***Angophora costata* trunk - inspiration for the columns**




Column (maximal length)

Scale 1/50

Column (minimal length)

Scale 1/50

0 1 2

# 3.4. SUSTAINABILITY & CONSTRUCTABILITY

## Sustainability

Steel is a sustainable and durable material with the following advantages:

- The steel structure is light, which influences all aspects of the design including the bearings, the foundations and the interaction with the existing Sydney Harbour Bridge approach wall. A lighter material allows for less material use, less energy for the production and building of the structure and reduced $CO_2$ emissions.
- A steel bridge has about 50% less $CO_2$ emissions than a concrete bridge.
- Steel can be recycled or re-used at the end-of-life of the structure. In contrast, the scrap value of concrete is minimal.
- The durability and robustness of steel bridges has been proven over time and the detailing of the cycle ramp will ensure that the cycle ramp has a long lifecycle.
- The detailing of the structure ensures a robust structure and relatively low maintenance regime for the structure.

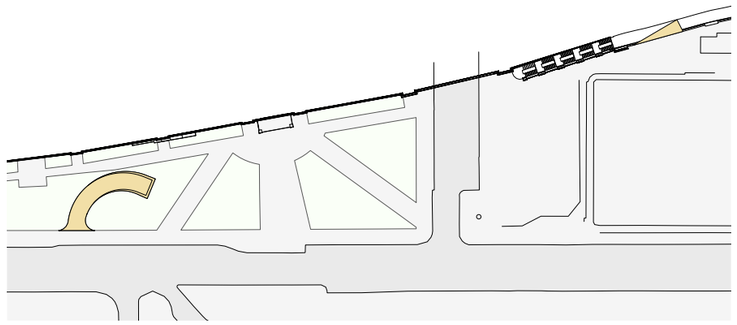
## Construction

The structure can be installed quickly with minimal disruption to the existing park and public domain.

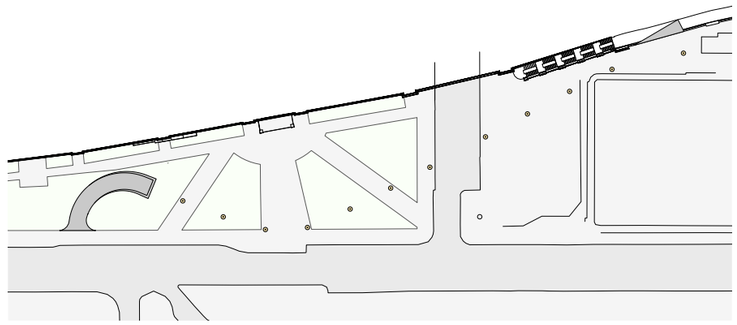
It is proposed that the cycle ramp will be prefabricated in a workshop in segments of approximately 30 metres in length and transported to site. The segments of a maximum weight of 60 tonnes are lifted on temporary piers by mobile cranes.

The connection of the different 30 metre length segments is done by welding on site. It is estimated based on previous experience that the time is approximately one week per joint. In total four joints would have to be welded on site.

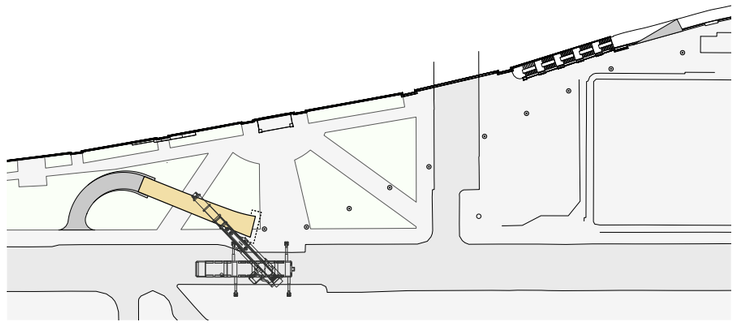
During the works pedestrian connections to Milsons Point Station can be kept in service throughout the works.



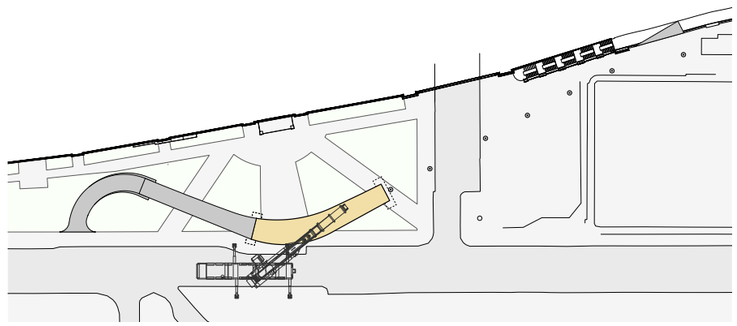
Step 1 Construction of northern abutment



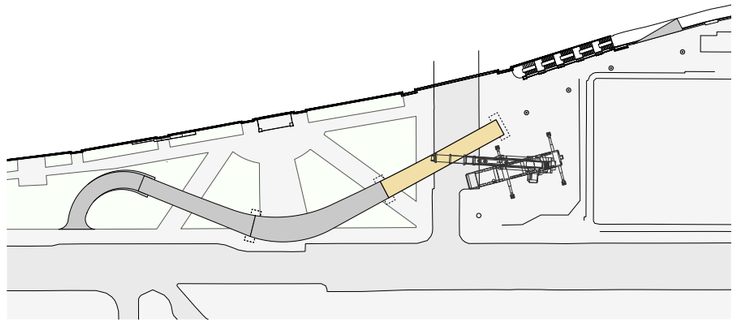
Step 2 Install columns



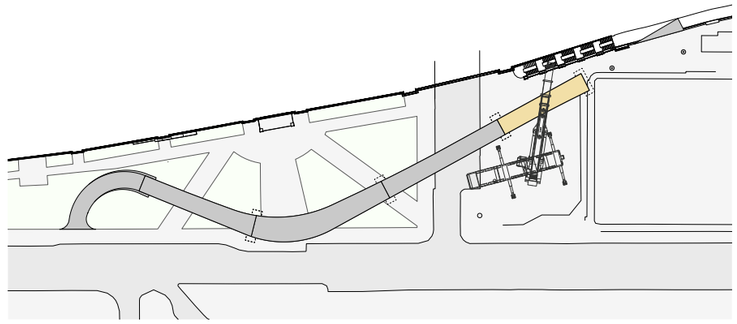
Step 3 Installation of segment 1



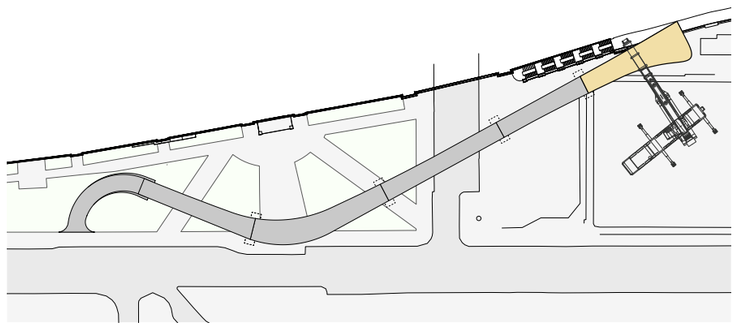
Step 4 Installation of segment 2



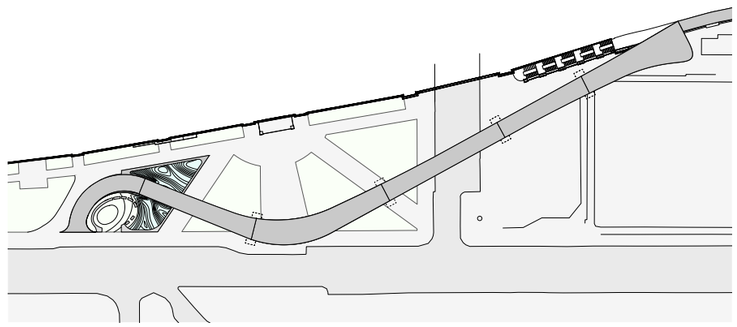
Step 5 Installation of segment 3



Step 6 Installation of segment 4



Step 7 Installation of final segment and linking slab



Step 8 Completion of landscape works

# 3.5. STRUCTURAL DESIGN

## Structural design of the cycle ramp

The structural component of the bicycle ramp is a hyperstatic structure with a length of approximately 150m. The structure consists of a closed box girder supported by steel columns, defining twelve spans of variable length (from 10.27m to 18.40m). The box girder has a symmetrical cross-section with a constant height of 450mm in the centre and 250mm at the edge. The closed box girder has a variable width ranging from 3.80m to 6.00m. The width is divided into nine segments with longitudinal stiffeners of constant height. These stiffeners are welded from inside to the upper flange and from outside on the lower flange.

At the junction with the Harbour Bridge, the footbridge is supported on the existing bridge (A13) and a column C12. The bearing on the Sydney Harbour Bridge allows the free expansion of the structure in the longitudinal direction, it takes up a vertical reaction and a transversal horizontal reaction. On the northern abutment, the steel footbridge is rigidly fixed to the concrete abutment.

To validate the main dimensions of the bicycle ramp, a 3D model was produced using the Sofistik 2020 finite element software. The structure was modelled using beam elements for the cross-section of the bridge and the columns. A static load calculation, a stability calculation and an eigenvalue calculation were performed. The calculations are in accordance with the Australian Standards (AS 1170) for the design assumptions and verification of the structure.

The loads considered are:

- Deadweight (with a 5% allowance for welds and paint)
- The crowd load, estimated at 5 kN/m² given the span of the structure
- The different cases of temperature load (uniform, gradient, etc.)
- The different cases of wind loading
- A settlement of 10mm of each of the supports independently
- Seismic action on the structure

Under combinations of loads at the ultimate limit state, the stresses remain within the prescribed limits taking into account the effects of shear lag. Under variable load combinations at the SLS, the maximum vertical deformation observed in the middle of the span is 22mm, which is below the limit value of 61mm corresponding to 1/300th of the length between supports for the span concerned.

The critical point at the SLS is the limitation of the rotation of the bridge around its longitudinal axis under torsional load (load on one side of the bridge). The maximum rotation under the characteristic SLS-Q is 14mrad, corresponding to a maximum deflection of 40mm.

The connections between deck and columns are realised by a rocker bearing, allowing a free rotation in every direction. The columns consist of a 200mm diameter steel tube with a sheet thickness of 18mm. They are rigidly fixed at the base, with the lower part made of cast steel flaring to a diameter of 1,050mm. The maximum normal force in the most stressed column is 1,292kN for a height of 8.25m, leading to a unity check of 0.9 considering the buckling modes.

## Summary of structural geometry and design

Geometry

- Total length : 174.1 m
- Abutment length (North): 23.9 m
- Length of the steel structure : 150.3 m
- Total deck width: 3.8 to 6.0 m
- Path width : 3.0 to 5.2 m
- Box girder height : 0.45 m
- Height of columns : 2.5 to 9.25 m
- Weight of the steel structure : 286.0 kg

Internal and resultant forces

- My min moment on supports : -2,525 kNm
- Moment My max in span : 2,516 kNm
- Moment Mz min/max at the abutment : -5,580 / +5,698 kNm
- Torsional moment Mt min/max : -1,267 / +1,519 kNm
- Min normal force N in the box girder : -498 kN
- Resultant Pz max on support C1 to C12: 1,292 kN
- Resultant Pz max on the Harbour Bridge A13 : 592 kN
- Resultant Py min/max on the Harbour Bridge A13 : -208 / +208 kN

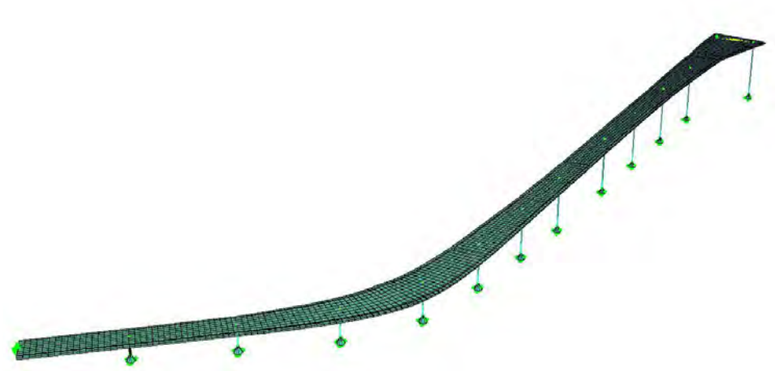
Stresses and deformations

- Maximum deflection under variable loads : 22 mm ~ L/800
- Maximum rotation under variable loads : 14 mrad
- Longitudinal expansion : +92 mm / -57 mm
- Maximum compressive stress in the box girder: 156 Mpa (ULS)
- Maximum tensile stress in the box girder : 122 Mpa (ULS)
- Maximum equivalent Von Mises stress : 157 Mpa (ULS)

Eigenmodes

- Frequency of the first transverse eigenmode: 0.78 Hz
- Frequency of the first torsional eigenmode: 3.10 Hz
- Frequency of first vertical eigenmode: 5.03 Hz

Refer Attachment C - Structural Design Calculations for a further details of calculations and modelling outputs.



**Sofistic Model - refer Attachment C for further details of calculations and modelling outputs.**

# 04

# PUBLIC DOMAIN

# 4.1. ANALYSIS & APPRECIATION

## Community and open space

Bradfield Park is an important open space for the local community providing a contrast from the surrounding urban environment. The land uses adjacent to the park include commercial and mixed use buildings along Alfred Street to the west and the Sydney Harbour Bridge approach to the east. Both of these elements provide strong built form, a defined spatial edge and linear structure to Bradfield Park. In this clearly defined urban context, Bradfield Park provides both visual relief and a place of passive and active recreation. As is typical of central parks located in dense urban environments, Bradfield Park is valued for a wide range of features and diverse community uses.

Our understanding of the variety of uses and values, and its urban context, is encapsulated in the public domain site analysis diagram (right) and is further discussed below.

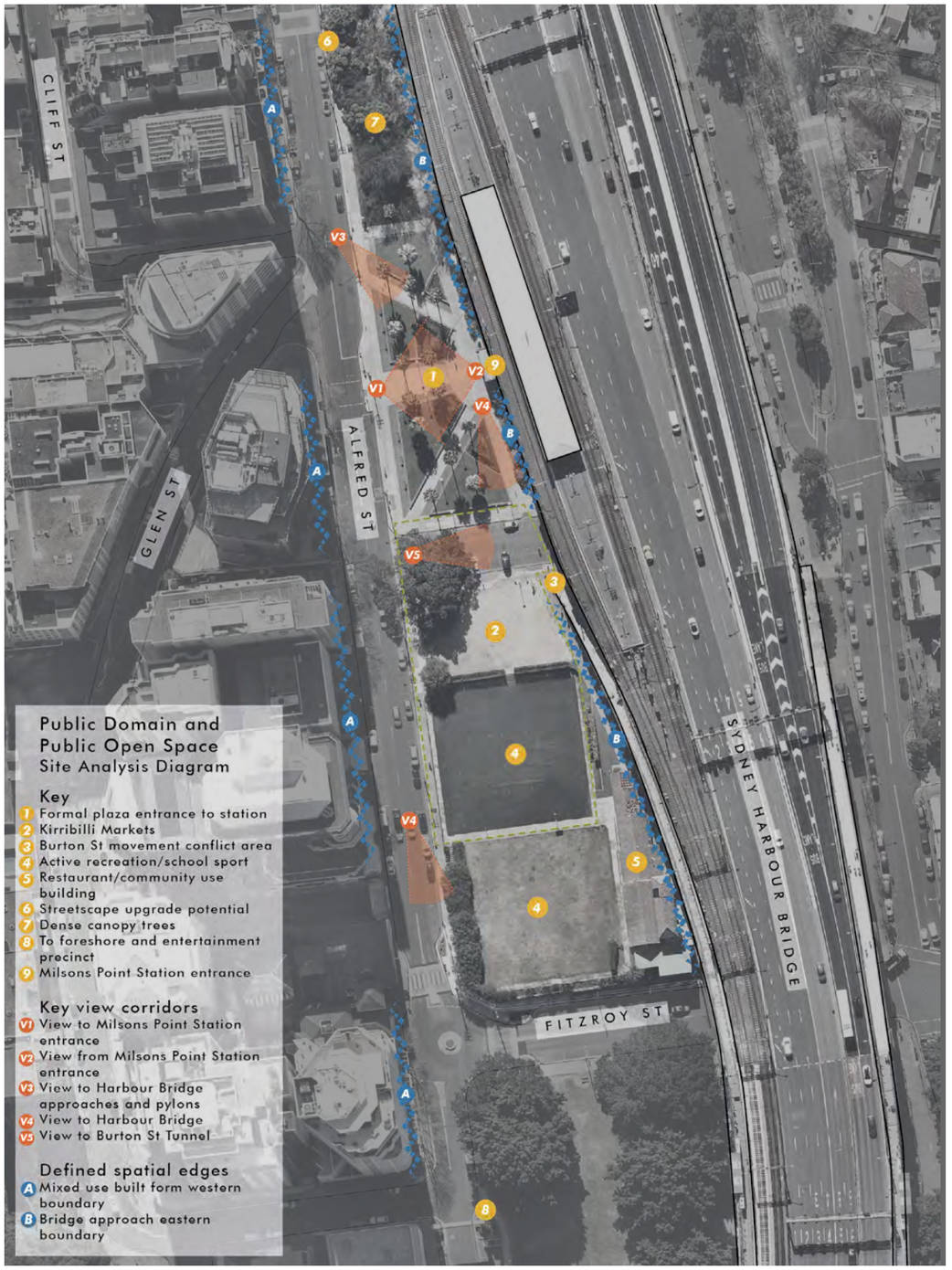
As noted in the Masterplan, Bradfield Park has clearly defined zones with distinct characteristics, to which the cycle ramp design responds. The cycle ramp is bounded by Bradfield Park North with its lawns enclosed by dense canopy trees, seating, paths, sculptures and heritage terrace housing interpretation. The interface of the landing of the cycle ramp and its impact on the functioning and safety of the northern part of the park has been carefully considered to ensure that it retains its highly valued passive recreation values. A particular consideration in this location is the potential for conflict between cyclists exiting from the ramp, potentially at speed, and pedestrians and park users.

Bradfield Park Plaza is centred on the Milsons Point Station entrance. It is a formal plaza with radial geometry responding to the station entrance. The plaza is dominated by raised turf planters bisected by pedestrian paths, flanked by cabbage palms.

The cycle ramp also traverses over the granite surface of the bocce court and Kirribilli markets within Bradfield Park Central. It also traverses over the access road to the existing community hall and restaurant.

Where the cycle ramp traverses the plaza in front of the station entrance, it has the potential for the most significant impacts on Bradfield Park. This includes visual impacts to the Sydney Harbour Bridge including the approach and pylons, and visual impacts to the Milsons Point Station entrance. The ramp also has the potential to impact on the physical experience of the station forecourt including shadowing, sight lines, and the physical locations of the structural columns will have a direct impact on the plaza.

The design approach to the ramp has been to carefully consider these physical and visual impacts as well as impacts on the current passive recreation uses and overall amenity of the plaza. Our design approach has been to carefully consider the siting and alignment, character, form and scale of the ramp and its supporting structure within the defined context of Bradfield Park.



Public domain and public open space site analysis diagram

# 4.2. PRINCIPLES

## Key principles for the public domain

Our overarching principle for the design of the cycle ramp within Bradfield Park is a light touch to the park.

Our key principles to achieve a light touch to Bradfield Park in the public domain are:

1. Respect the Place
2. Work with 'the fold'
3. Express change
4. Resolve movement conflicts

These principles are illustrated and described in further detail on the right.

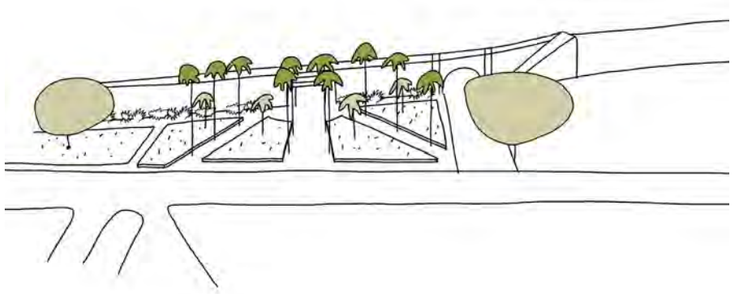
Where the cycle ramp traverses over Bradfield Park we are able to achieve minimal physical disruption to the park. The key features of the Bradfield Park Plaza and Central precincts can be retained, including the existing trees, existing paths, raised planters and existing soft and hard landscaping.

Where the ramp traverses over these sections of the park the key physical impact is the support columns for the ramp. To achieve a light touch with the columns two principles have been adopted: (1) use of a slender column, similar in width to the existing light poles and signage poles; and (2) careful attention to placement of the columns. The physical and visual permeability of the park is retained.

Where the new cycle ramp structure 'lands' in the park, modifications to the public domain are inevitable. In this location the park must accommodate the landing in an appropriate way.

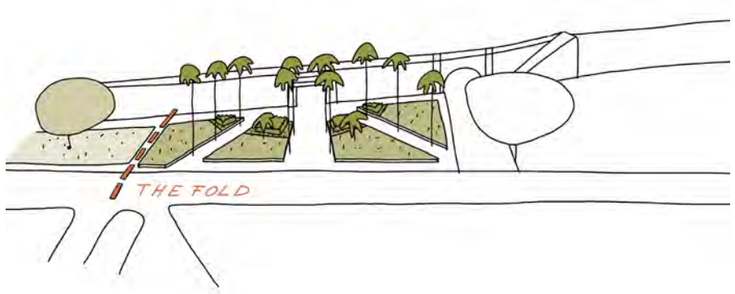
Our design beautifully expresses this landing place, where 'earth' meets 'sky'. A 'light touch' in this location would not adequately resolve the impacts on the park that the landing of the cycle ramp creates, both in its elevation and in its alignment. To acknowledge the impact on the park, our design proposes a beautiful new space within the park that responds to the cycle ramp structure.

Our design proposes to integrate the abutment and landing into the park by carefully locating the position of the landing point on the fold between the formal layout of the plaza and the more informal layout of Bradfield Park North. The landing is transformed from an intrusive element in the park into a place of delight. An arc of seating, a special sculptural tree (*Angophora costata*), soft landscaping and a water element provide an intimate, shady and cool place.



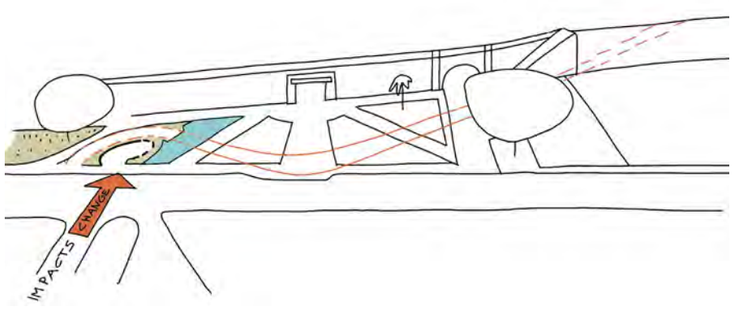
### 1. Respect the place

Sydney Harbour Bridge, Bradfield Park and Milsons Point Station form an important heritage precinct, that is well-used and well-loved by the community and stakeholders. Our 'light touch' approach also applies to the public domain; we respect the place and minimise disruption to it. We respect what is there now and also what there was before by bringing back important features of Country and stories of that place.



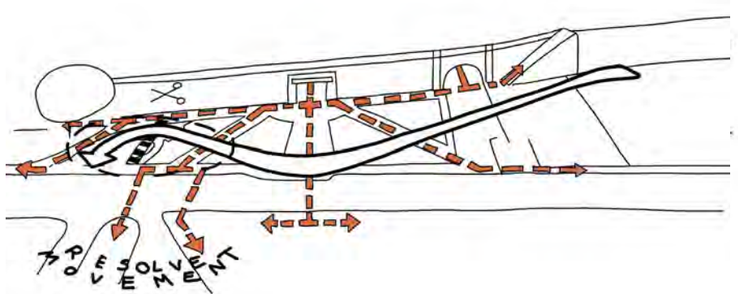

### 2. Work with 'the fold'

Bradfield Park has a clear separation, or 'fold' between the informal parkland landscape to the north and the formal plaza in front of the station entrance. Locating the ramp landing at 'the fold' allows the ramp to integrate into the landscape of the park by responding and expressing this juncture in the park in the language of the landing.




### 3. Express change

Where the cycle ramp lands in the park, this area needs most attention to ensure its integration with the park. Rather than allowing the landing and its surrounds to become a 'dead space' in the park, the parkland design responds to the ramp landing. The abutment becomes a beautiful place of delight, an intimate garden in the park to gather and relax. An elegant water feature resolves the lack of access while providing delight.



### 4. Resolve movement

There is potential conflict between cyclists and pedestrians at the landing on the Alfred St footpath. Our analysis shows there is significant pedestrian movement along the Alfred St eastern footpath, with pedestrians travelling to the station and Burton St tunnel. To resolve this conflict we provide a new pathway that wraps around the Chinese Elm. This pathway offers an alternative for pedestrians to avoid the point of conflict with cyclists using the ramp. This is discussed further in section 5.

# 4.3. DESIGN RESPONSE

## The columns

To minimise the physical and visual impact of the columns on Bradfield Park, their design and placement has been carefully considered. The first element as outlined in Section 3 is a considered structural design response which minimises the diameter of the columns. Their slender 200mm diameter is similar to the existing light and signage poles. It is also similar to the diameter of the existing cabbage palms.

The slender width of the columns allows the columns to integrate well with the existing vertical elements in the park and streetscape.

The considered structural design has also minimised the number of columns required. For example, the ramp only requires three columns to the south of Burton Street. In the existing streetscape and central park there are currently more than a dozen vertical elements including signage, light poles, electrical poles and parking meters. Similarly within the plaza there are more than fifteen existing vertical elements, including signage and lighting and ten cabbage palm trunks.

The design response for the columns is also to carefully consider the spacing and placement of the columns such that they are on the same alignment as the existing street signs, light poles, tree planting and street furniture, wherever possible. This allows the columns to seamlessly integrate into the public domain, particularly from a visual perspective.

Along Burton Street the poles are aligned with the existing street signs and electricity poles. Within the plaza the poles are aligned with the palms, light poles and signage along the radial pedestrian paths.

The design response, including slender poles, well-spaced and carefully placed, allows a substantial reduction in visual impact from the columns. This can be clearly seen in the photomontages, particularly View 2 looking towards Milsons Point Station entrance.

The alignment of the poles also enables minimal disruption to pedestrian movement and overall movement through the park and the streetscape.

## The landing

The design proposes that the park responds to the landing through the introduction of three key elements: (1) a new path to resolve conflict; (2) a new meeting space and place for relaxation within the park, responding to the alignment of the cycle ramp; and (3) an elegant water feature responding to the formal geometry of the plaza and resolving the dead space and loss of pedestrian access created by the impacts from the low clearances of the cycle ramp as it approaches the ground.

The design acknowledges the change imposed on the park caused by the cycle ramp and responds to this by creating a space of delight in the public domain. The new gathering space is embraced by an elegant meander of the cycle ramp, and marks the landing of the cycle ramp. The structure of the abutment and the landing creates a partially enclosed intimate space within the park.

The space is provided with seating to take advantage of the shade from the existing beautiful Chinese elm with its aesthetic form, reaching out to the edge of the space. Shade is also provided through a new *Angophora costata*, a tree with a delightful sculptural form and with spiritual significance to the Cammeraigal people.

The *Angophora* and the gathering space pulls the landing into the northern part of the park, creates a delightful space within the park and softens the cycle ramp landing within the park.

The new space in the park replaces a short path that is currently little used. This path is effectively relocated north of the ramp to provide it with an important movement role in the park. This is discussed in more detail in section 5.

## Water feature

In contrast to the gathering space, the water feature responds to the formal plaza and its geometry. The water feature plays an important role in retaining the radial symmetry of the parkland. The raised flat surface of the water feature echoes the raised planter beds in the plaza and its geometry completes the radial symmetry.

The reduced vertical clearance of the ramp as it comes down to the ground prevents movement through this space and its close proximity to the ground also prevents effective use of this space. This could be resolved by enclosing the ramp, however the nature of the alignment in this location means that a substantial portion of enclosed ramp would substantially restrict views to the approach of the Sydney Harbour Bridge and the station entrance.

Hence the water feature plays an important role in completing the radial symmetry of the plaza and providing a visual connection to the Sydney Harbour Bridge approach and the station entrance from Bradfield Park and Alfred Street.

The surface of the water also allows for the beautiful interplay of light and reflection of the underside of the ramp and the expression of the stiffeners on the underside. The reflective surface also provides an experience for cyclists using the ramp providing context cues to slow down as they enter the park.

The water feature also complements the gathering space by providing an engaging edge, which provides opportunities for a sculptural element.

# 4.4. MATERIALS & FINISHES

## Local sandstone

The materiality of the gathering space and water feature is to be locally sourced high quality sandstone. It is proposed to construct the seating, water feature, the supports of the landing and the surrounding walls out of carved and sculpted sandstone blocks. It is proposed to select sandstone colours which are relatively light and slightly muted in colour.

Sandstone speaks to the materiality of Cammeraigal Country. Sandstone also references the colours, including the occasional discolouration and staining, of the concrete approach walls of the Sydney Harbour Bridge.

It is also proposed to construct the surface of the seating area as crushed sandstone providing accessibility while allowing for a change in surface material and the familiar soft crunching sounds of walking in sandstone country.

## Cycle path

It is proposed to construct the landing component of the cycle path using concrete, with a colour oxide to match the sandstone colour of the polyurethane coating of the cycle ramp and using a top seeded with a local sandstone aggregate.

Local coastal sandstone - a connection to Country

# 4.5. SUSTAINABILITY

## Nurturing water

Taking inspiration from the theme of 'Earth - Sky', it is proposed to collect the water from the cycle ramp and direct this to the water feature in the park - where Earth and Sky meet. The approach respects the preciousness of water and the Cammeraigal nurturing of fresh water resources.

Rainwater from the ramp is collected in open drainage channels that are integrated into both sides of the ramp structure. Water from the ramp is then directed from the two approximately 300 square metre ramp catchment areas into a sculptural sandstone element.

From the drainage channels on the cycle ramp, the delivery of water to the water feature is delightfully expressed in two components - vertical and horizontal. First, rainwater is expressed vertically as the rainwater delivered from the drainage channel is discharged over and down etched sandstone faces of the abutment and the sandstone walls of the landing. Second, water is expressed horizontally as it flows through a sandstone channel planted with rushes at the base of the sandstone wall. The rush-filled sandstone channel filters and polishes the water, conveying the water into the water feature.

During times of rain and the interaction with water, the muted colours of sandstone are transformed and the subtle variations in colour are highlighted by the water and its movement across the surface of the sandstone.

During large rain events, water overflows from the water feature into an overflow weir, ensuring that excess water from the ramp drains safely back to the stormwater system when necessary.

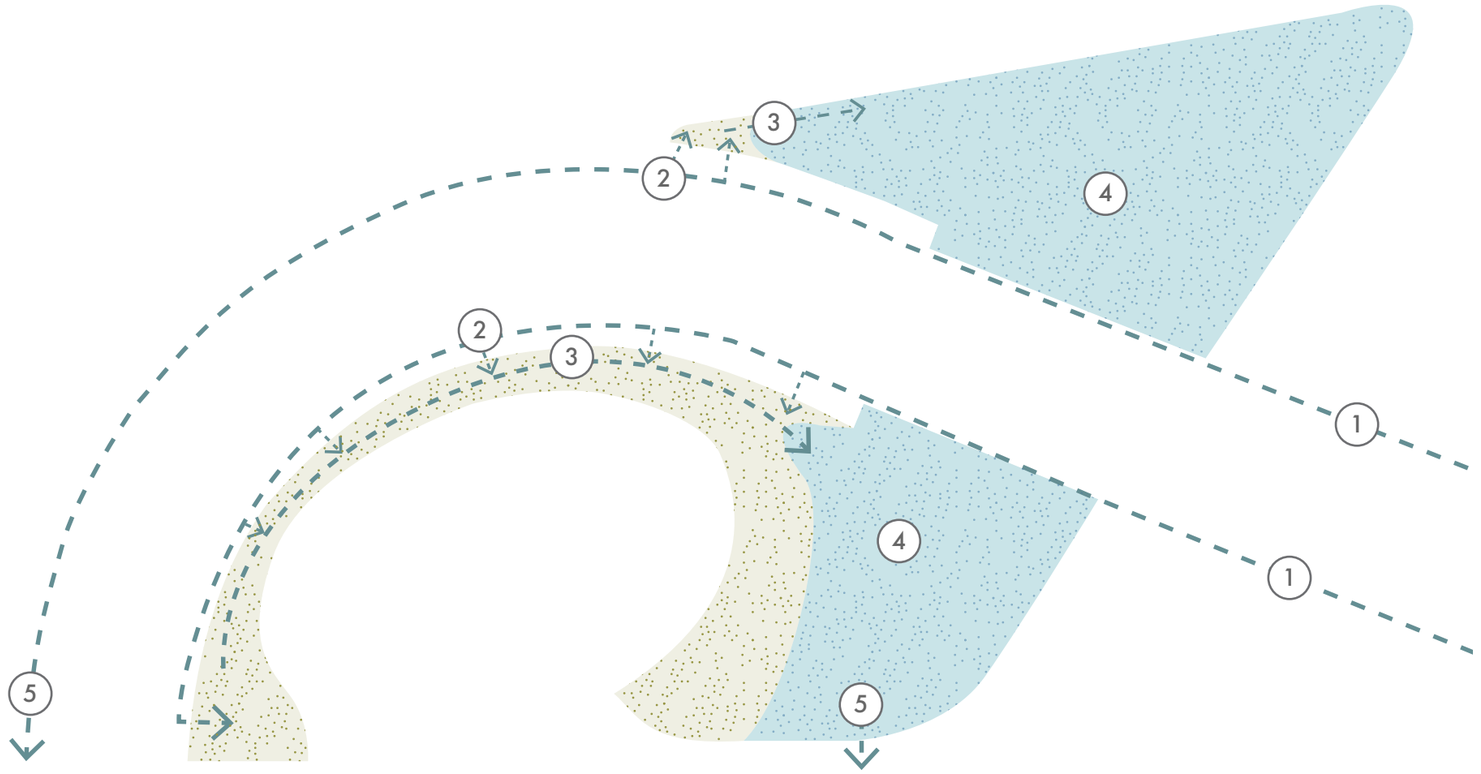
The water feature would have relatively shallow water, with depths kept to less than 300mm to ensure that the water feature is safe for the community.

## Microclimate and cooling

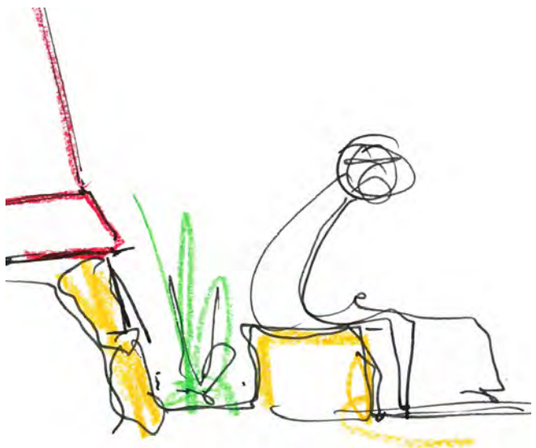
The water feature and sandstone channel provides cooling of the local microclimate. Evaporation from the water feature helps to create this cooling effect.

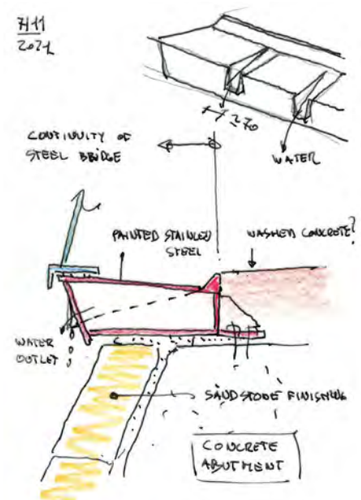
The harbour breezes will also help to cool Bradfield Plaza as they pass over the water feature and cool the warmer winds.

This is an important feature in the plaza space as the current palms provide limited shade to the plaza and the cooling from the water feature will contribute to the liveability of the public domain for the community.




Water flow diagram






Sketch of the sandstone channel with native Rush | Detail sketch of the flow diverters

1. Drainage channel
2. Flow diverters
3. Native Rush sandstone channel
4. Sandstone water feature
5. Overflow to stormwater

## Ecology

It is proposed to reference the beautiful and distinctive *Angophora* Foreshore Forests located along the harbour edges of Northern Sydney. This includes the sculptural *Angophora* tree as well as the use of locally native rushes from the Foreshore Forest vegetation community. It is proposed to use locally native rushes with a distinctive upright form, *Schoenus melanostachys* and *Lepidosperma laterale*, within the sandstone channels. These rushes are commonly found growing in poor soils and on sandstone clifftop environments.

Within the ecology it is proposed to include locally native lilies including nardoo (*Marsilea drummondii*) as well as locally native rushes.

The water feature provides potential habitat for small animals including lizards, dragonflies and damselflies.

## Shade analysis

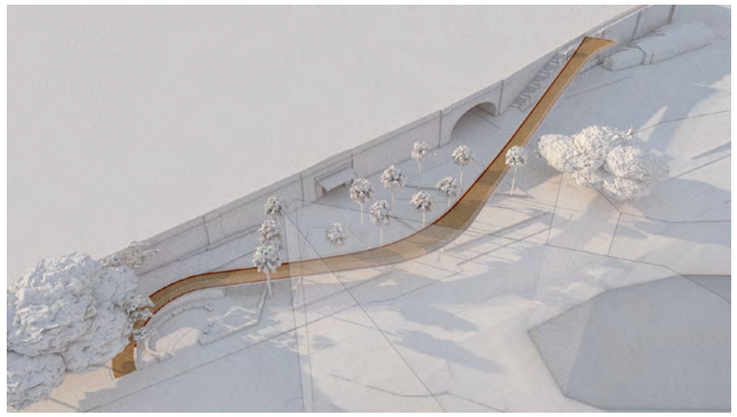
The shade analysis for the cycle ramp is shown in the diagrams on the right, including diagrams for winter and summer solstice. The shade diagrams show that in winter the plaza space is predominantly in shade at 9am and 3pm. At midday in the winter the additional width of the ramp provided along the Alfred Street footpath provides additional shading to the footpath rather than to the park. The alignment of the ramp means that large areas of the plaza space closer to the station entrance retain good access to sunlight.

In winter, the seating space around the landing will provide an excellent location to catch the afternoon sun. The rest of the park is shaded by the adjacent buildings on Alfred St while the seating space receives full sun. The water feature will also receive good light, creating a place to enjoy a sunny winter afternoon.

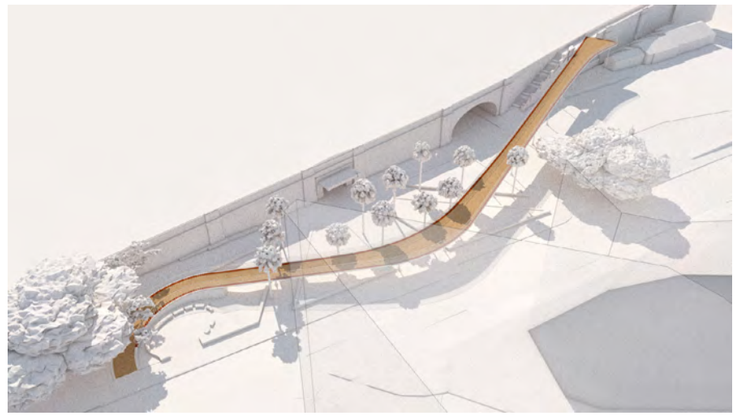
The shade analysis diagram shows that in summer:

- At 8am the ramp predominantly provides shade to the Alfred St footpath.
- At midday the ramp provides shade directly beneath itself, including generous shade to Alfred St, and will provide a place to be out of the sun while waiting to cross at the lights or a spot to sit on the seating wall to have lunch.
- The Chinese elm will create a shady seating space by the water feature in the morning through to the early afternoon
- At 4pm shade in the park is dominated by the adjacent buildings. The seating area remands in the sun providing a potential place to sit on a cooler summer evenings.

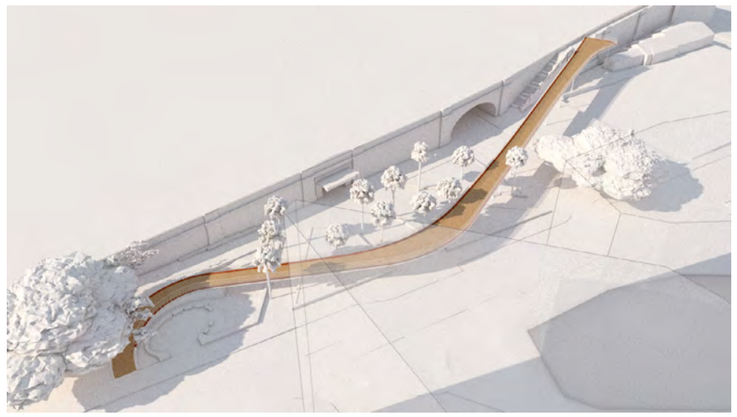
Generally the alignment of the ramp means that there is minimal impact to the bocce court in Bradfield Central. In winter the large open space means that sun can be easily found while in summer the ramp will likely provide welcome shade to the exposed open areas of the bocce court.



Shade study analysis diagram: 21 June - 9:00am

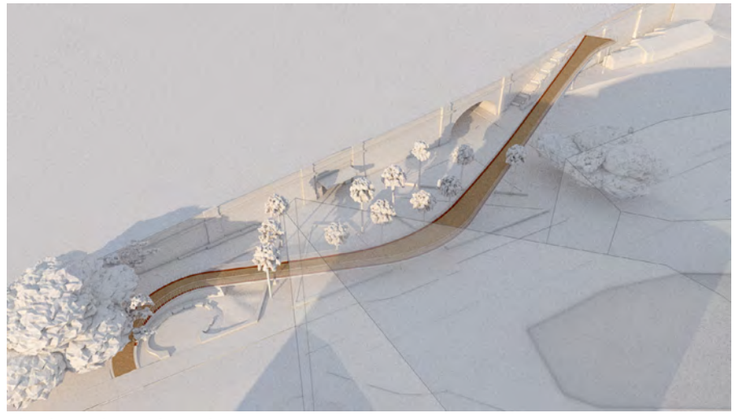


Shade study analysis diagram: 21 December - 8:00am

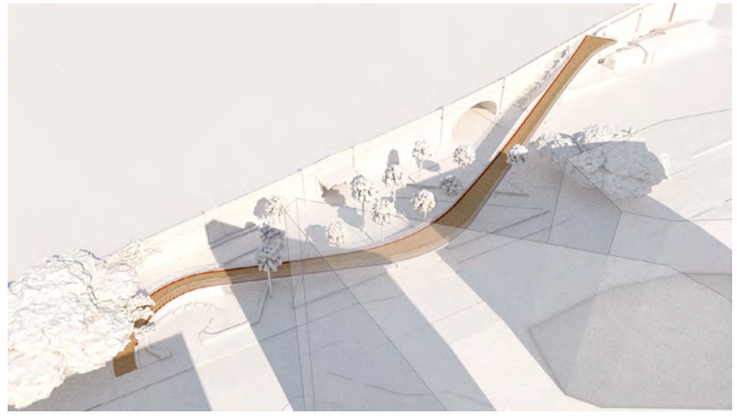


Shade study diagram: 21 June - 12:00pm

Shade study analysis diagram: 21 December - 12:00pm



Shade study analysis diagram: 21 June - 3:00pm



Shade study analysis diagram: 21 December - 4:00pm

# 4.6. FUTURE OPPORTUNITIES

## Tree Sensitive Design

The proposed ramp lands in proximity to the existing Chinese elm on the northern edge of Bradfield Plaza. The Chinese elm has a beautiful form and it is to be retained as part of the design. To minimise the grade of the ramp in the final section of the landing the overall ramp is located in proximity to the Chinese elm. Part of the ramp is located in the Tree Protection Zone (TPZ) and to minimise the impact of the structure it is proposed to undertake a Tree Sensitive Design approach. Our current approach has been informed by advice from Andrew Morton, a qualified arborist. The approach would include:

- airspading or similar the existing roots of the Chinese elm in the location of the landing
- 3D digital mapping of the roots, including all roots above a nominated size
- design of piers or similar for the landing to avoid the tree roots in the TPZ
- use of micropiles or similar around existing tree roots to ensure minimal impact to tree roots.

The pedestrian path works are also located in close proximity to the tree including within the TPZ and a portion within the Structural Root Zone. Based on advice from Andrew Morton the following tree sensitive design has been recommended for the path works.

- path structure to be self-supporting concrete laid on ground (avoid any edge restraints)
- where roots are encountered the sub-base material (e.g. gravel) is to be placed around the existing roots and the roots are to be retained.
- as the roots are structural roots, porosity for air or water is not a critical requirement
- if this approach is followed encroachment up to 1.2m into the SRZ is likely to be acceptable

It is also proposed to relocate two existing Jelly palms. Advice from Andrew Morton is that it is generally acceptable to move Jelly palms and Andrew has previous experience successfully relocating Jelly palms in the local area. The relocation will depend on the soil depth and type. It is also noted that the southern most Jelly palm appears in poor health. It may be possible to relocate one of the Jelly Palms to this location.

## Glare, noise, and light spill on adjacent properties

It is proposed to minimise impacts on adjacent properties from lighting of the structure through the use of directional LED lights, which focus light onto the ramp structure and minimise light glare and spill. The glare and spill of light is also minimised by the location of the LED lights in the handrails, minimising the height of the lighting and eliminating the need for light poles for the ramp. During future design stages a lighting specialist will provide specific advice on the lighting design to ensure that there are minimal impacts from lighting of the cycle ramp. During future design stages consideration will also be given to ensuring that the polyurethane surface finish does not create glare from the surface.

Noise from cyclists on the ramp is not anticipated to be significant compared to the ambient noise from the adjacent railway line which is located at a similar level and which is also unattenuated. As the bridge cycleway is also considered mostly a commuter route the majority of use is during daylight hours when there is also noise from other sources. Based on time of use cycle data provided by TfNSW, the use of the ramp between the hours of 11pm and 5 am is expected to be less than 3% of the total use (less than ten cyclists a day based on current use).

Use of seating walls - Market day October 14 2021

## Activation of stairs

As the existing stairs are no longer required for the bridge cycleway it is proposed to re-purpose these as a unique seating area in the plaza. The stairs complement the popular seating area in the Burton St arch road closure. Stairs naturally lend themselves to an informal location for seating as well as an urban play space. Works would be minimal and respectful of their cultural heritage. Works would include a de-cluttering of existing elements (concrete ramp used by the cyclists, pipe work possibly redundant, old handrails and similar), restoration of the stair, the lamp as well as inclusion of a number of simple seating elements to complement the space.

At the top of the ramp it is proposed to reuse the existing cycleway balustrade as a new balustrade separating the cyclists from the new pedestrian area. At the base of the re-purposed balustrade a step could be provided allowing people to look out over the re-located balustrade.

## Expanding the terraced lawns

A potential future opportunity is to expand the existing raised planter terraces to create a new uniform edge to Bradfield Park. Observations on site indicate that the walls around the raised lawns are used as informal seating walls. The long lengths of wall mean that there is ample space for informal seating, which overlaps with the limited shade provided by the palms and hence the walls are generally preferred for seating. It is proposed to retain some accessible seating within the plaza and on Alfred Street. Expanding the terraced lawns would provide more usable green space in the park and provide more opportunities for sitting on the lawns either in shade or in sun depending on the weather. It is noted that the potential to expand the lawns may be limited by the location of services along Alfred St.

## Story-telling and wayfinding

There are opportunities for story telling through interpretive signage and wayfinding. It is proposed that interpretive signage would be incorporated into the key gathering spaces created including at the seating space and water feature, at the viewing point where the cycle ramp meets the harbour bridge cycleway as well as where the columns land in the plaza.

Wayfinding would also be incorporated into the overall design. Wayfinding would include standard signage for those exiting or entering the cycle ramp, helping to direct cyclists north or south along Alfred St. Wayfinding would also include cues for pedestrians to walk around the exit/entrance of the cycle path and to use the alternate path as well as additional wayfinding for pedestrians.

# 05

# ACCESS & MOVEMENT

# 5.1. ANALYSIS & APPRECIATION

## Pedestrian movement

The project is located at a multi-modal transport node with diverse user movement and access requirements. Milsons Point provides a high quality walking environment which is supported by its access to a variety of local retail, services and public transport destinations as well as Kirribilli markets on market days. The high level of pedestrian activity within the local streets also includes significant pedestrian movement to Milsons Point Station by local residents, workers, school children and the wider community.

To gain a better understanding of pedestrian movement through this space, pedestrian counts through Bradfield Plaza and Alfred Street were undertaken in five separate two hour blocks during the design phase. There were undertaken at different times of the day and week (refer diagrams on the right). The count data shows pedestrian movements per hour and the results have been scaled up by 1.6, to account for the post-Covid reduction in use of public transport compared to pre-Covid data. This scaling factor was determined from Apple and Google mobility data. Both indicated that during the days of the pedestrian counts public transport use across Sydney was approximately 60% of the pre-Covid levels. Google published a mobility data report for North Sydney Council area showing that public transport use in the area was on average 50% lower than pre-Covid baseline during the monitoring period, suggesting that the pedestrian numbers shown here could be an underestimate.

A key statistic that the count data illustrates is the pedestrian movements through the station forecourt area is more than 550 pedestrians during weekday peak hour (and 600 on weekends). This is in comparison to approximately 300 cyclists using the bridge cycleway during this same weekday peak hour period. Hence the mitigation of impacts of the cycle ramp landing on pedestrians is critical in the design of the cycle ramp.

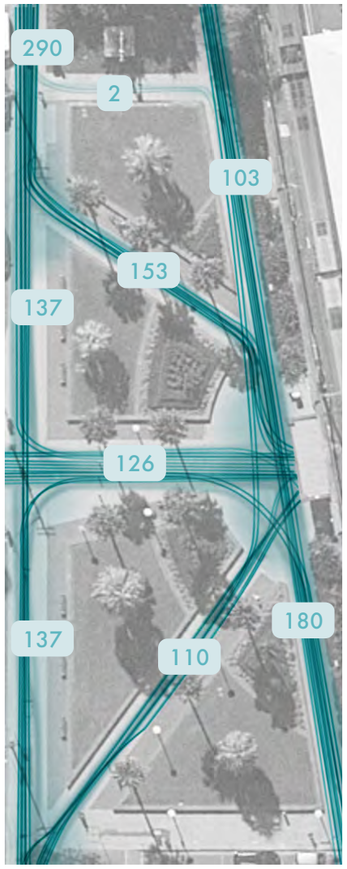
The count data shows that the movement through the plaza to the station entrance is diverse with:

- 13% accessing the station directly from the northern path
- 15% accessing the station directly from the north-western path
- 36% accessing the station directly from the western path
- 17% accessing the station directly from the south western path
- 19% accessing the station directly from the southern path

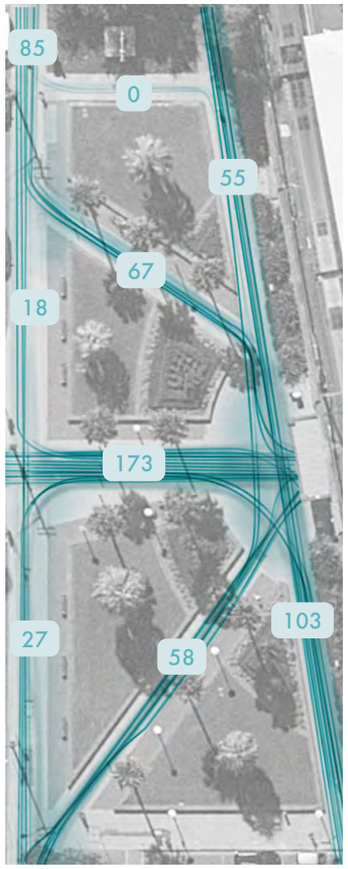
The count data also confirms that the northernmost east-west path is not well used and removing this path will have minimal impact on pedestrian movements through the park.

While counts were not undertaken on a market day, anecdotal evidence from the most recent market day (14th October) is that there are substantially higher pedestrian movements during market days.

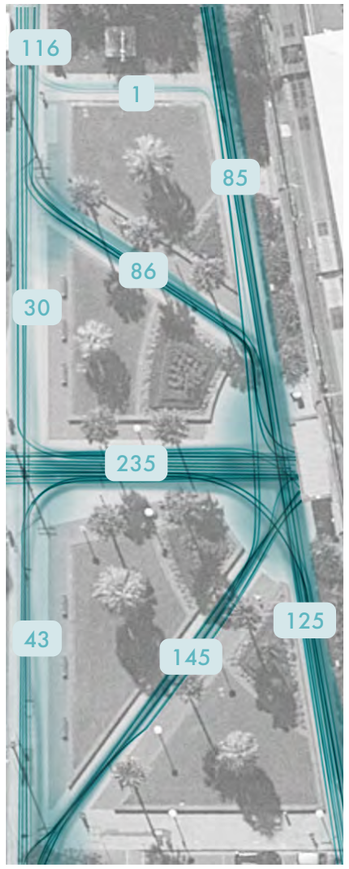
Pedestrian movement diagrams - pedestrian movements per hour for each path in the plaza



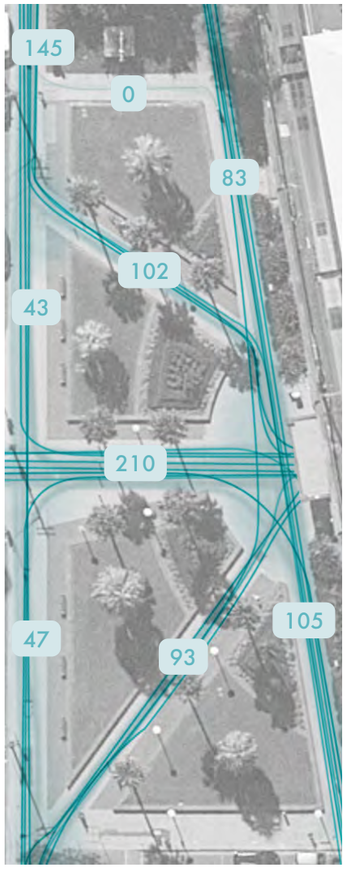

Sunday 12PM - 2:00PM




Monday 8AM - 10AM




Wednesday 4PM - 6PM




Tuesday 8AM - 10AM

# 5.2. PRINCIPLES & DESIGN RESPONSE

## Cyclists

The proposed cycle ramp infrastructure will substantially enhance the riding experience of a broad diversity of cyclists using the Sydney Harbour Bridge cycleway. The cycleway is well used by cyclists during their daily commute to work, as well as for recreational rides around Sydney Harbour. The proposed design improves the existing infrastructure by:

- Reducing the time taken to reach the bridge cycleway with a smooth transition from street level to bridge level
- Improving accessibility and safety for cyclists, by eliminating the need to traverse steep and slippery steps with bikes
- Eliminating conflicts with pedestrians and other vehicles at the bottom of the existing stairs and at the Alfred and Burton St intersections, particularly on market days

Daily cycle count data provided by TfNSW shows that the ten-year (2010-2019) average number of cyclists using the Sydney Harbour Bridge cycleway is approximately 2,000 cyclists per weekday. There is an uneven split with approximately 1,160 cyclists southbound and 840 cyclists northbound on weekdays. Weekend patterns in cycle data show that the number of cyclists using the bridge cycleway is approximately half that of weekday counts.

Analysis of hourly counts for cyclists' movements indicates the greatest number of movements are between 6am and 8am in the morning, and 4pm and 6pm in the evening. During peak hour commutes over the ramp, there would be:

- 06:00 – 07:00, 16.5% of daily cyclists, 330 cyclists per hour
- 07:00 – 08:00, 17.5% of daily cyclists, 350 cyclists per hour
- 16:00 – 17:00, 15% of daily cyclists, 300 cyclists per hour
- 17:00 – 18:00, 12% of daily cyclists, 240 cyclists per hour

Cyclist count data undertaken by North Sydney Council indicates that there are approximately 20% of cyclists using the bridge cycleway who use Burton St tunnel. Hence, approximately 60 cyclists per hour during peak hour would use the Alfred St cycleway southbound to Burton St from the ramp. This creates a potential conflict point both at the Alfred St signalised pedestrian crossing as well as between cyclists and bus passengers at Burton St and Alfred St.

The City of Sydney's cycling census data from 2010-2019 shows there is a strong climbing trend in the uptake of cycling. This climb peaked in 2014 and again in 2019 (pre-pandemic). However, the Sydney Harbour Bridge cycleway data shows a steady decline from the 2014 peak usage, indicating that something is deterring cyclists from using the bridge cycleway. This is likely due to the existing stairs at Milsons Point. The new bicycle ramp will likely attract more cyclists to cross the harbour and it has been estimated that the cycle ramp would double cycle use on the bridge cycleway. This predicted increase in cycle use also increases the potential for conflict in Bradfield Park between cyclists and pedestrians.

## Design for all users and minimise conflict

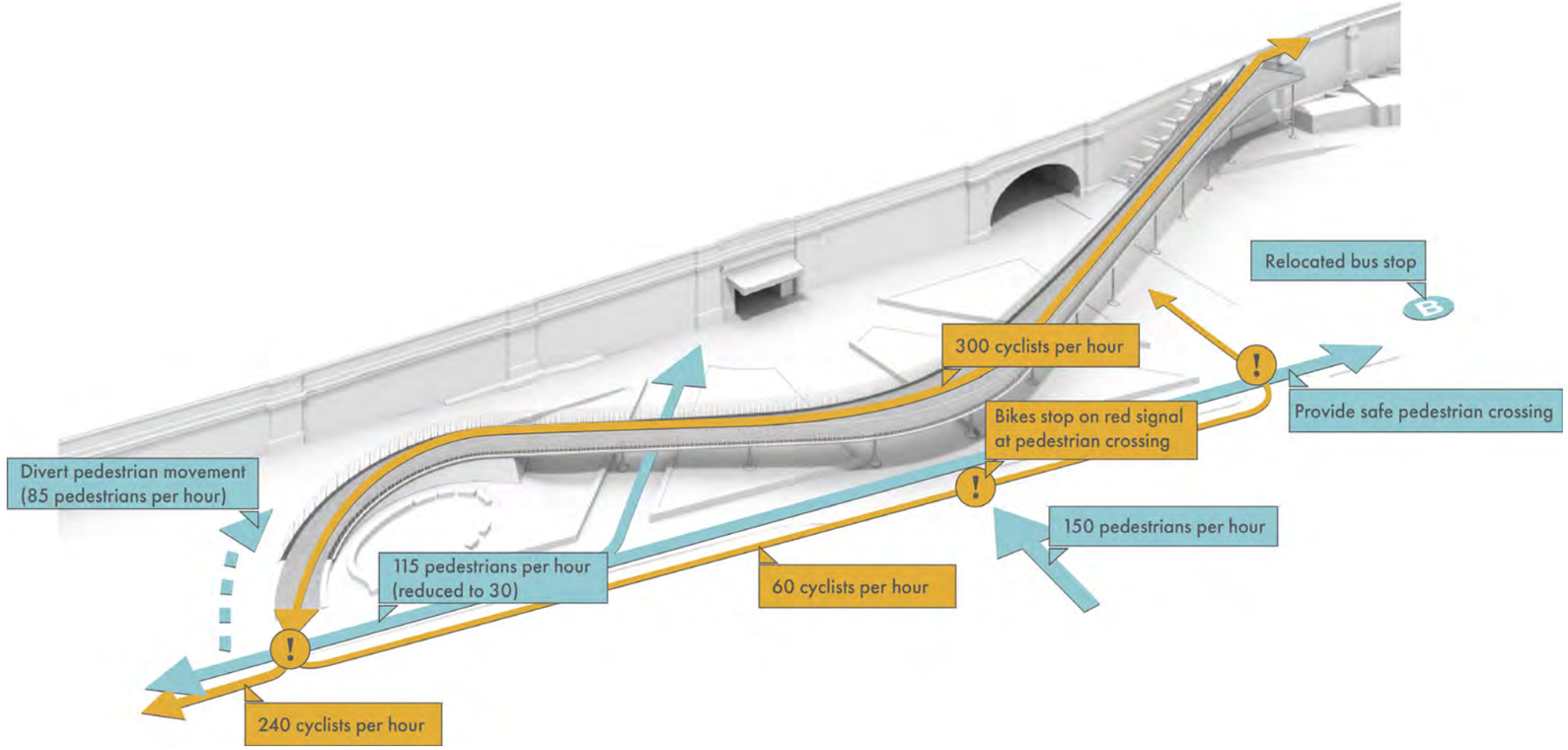
Our design approach is to design for all users of the plaza, including the elderly and less mobile, noting that pedestrian use of the plaza is high and walkability is a key feature of Milsons Point. While the preferred linear ramp reduces conflict at Burton St, it creates a potential conflict zone further north at the landing. Our count data shows that during peak hours approximately 75% of the conflicts between pedestrians and cyclists can be avoided. 75% of the pedestrians are moving between the Alfred St northern footpath and the station entrance (or Burton St tunnel). Providing an alternate path immediately to the north of the landing can significantly reduce the conflict between pedestrians and cyclists.

Our design response includes a new pedestrian path, incorporating tree sensitive design, immediately north of the landing, allowing the majority of pedestrians to avoid crossing

## Control speeds

The conflict in the shared zone at the end of the landing is exacerbated by the potential for cyclists to be exiting the ramp at speed through the shared zone. Cyclists also have the potential to be travelling at speed downhill southbound along Alfred St. To assist with the climb up the ramp cyclists will naturally tend to prefer to maintain momentum. While this is generally desirable for cyclists, in this location it would reduce safety for pedestrians. Our design response is to control speeds of cyclists through:

- adopting a curved geometry in the landing to inherently reduce downhill speeds
- signage restricting cycling speeds within the shared zone
- incorporating rumble strips into the landing and Alfred St southbound cycleway to alert cyclists to the speed restrictions




Cyclists & pedestrian movement & conflict diagram (peak hour movement)

# 5.3. CYCLE RAMP DESIGN

## Alfred St cycle path and footpath considerations

As part of our design approach we have undertaken an initial review of the Alfred St cycleway design as provided by TfNSW. During the current design process we have not been able to undertake a substantive review of the Alfred St cycleway, however we make the following observations on its design and considerations for future design:

- Immediately north of the landing, the Alfred St cycleway is proposed to fit within a street which retains two travel lanes (suitable for buses) and parking lanes on both sides of the street. This requires a narrowing of the Alfred St footpath from currently more than 3m to approximately 1.8m in width to accommodate the cycleway. This reduction in footpath width needs to be carefully considered given its current high use and contribution to walkability.
- The reduction in width of the footpath has the potential to exacerbate conflict at the end of the landing. Narrowing the footpath immediately north of the landing effectively funnels people at the conflict zone. Also the perception from a pedestrian perspective as a cyclist crosses the shared zone is that the path is fully impeded. The treatment of this zone and its interface between the cycle ramp landing, the cycleway and the footpath needs careful detailing. There is a risk in this shared zone, given the potential speeds and potential conflict, that there will be a wider community demand to have a cyclist dismount zone in this location.
- The design of the cycleway at the signalised pedestrian crossing on Alfred St opposite the train station currently suggests a shared zone. Due to the high use of this signalised crossing it is recommended that cyclists using the Alfred St cycleway also have a red signal to allow pedestrians to safely cross, giving clear right of way to pedestrians crossing the road.
- Clearly delineating the cycle path as grade separated from the footpath at the signalised pedestrian crossing also reduces the risk of pedestrians standing in the shared zone waiting to cross Alfred Street and reduces conflict in this zone.
- Relocating the pedestrian crossing push-button to the outer edge of the cycle path to avoid pedestrians having to cross the cycle path to push the button.
- The bus stop will be relocated south of Burton St, increasing pedestrian movement across Burton Street. A pedestrian crossing at this location could be considered to prioritise pedestrian movement to and from the train station

## Design principles

The design of the cycle ramp is based on providing

- a ramp that is safe and comfortable for all ages and abilities
- provision of adequate width and minimising steep grades wherever possible
- a design that clearly communicates the correct speeds to travel
- a relatively direct route from Alfred St to the bridge cycleway
- highly attractive cycleway design which respects the inherent qualities of Bradfield Park and the Sydney Harbour Bridge

## Cycle ramp path exit/entrance alignment

The key starting point in the design of the cycle path at the entrance/exit to Alfred St was that the alignment at the landing had to be perpendicular to the Alfred St footpath and road alignment. Any other alignment would increase the potential for conflict with pedestrians using the Alfred St footpath and Bradfield Park. Also, approximately 20% of cyclists are expected to head southwards from the ramp, to use the Burton St tunnel (or approach the ramp from the south).

This requirement necessitates a cycle path alignment that has a horizontal curve prior to the junction with Alfred St. This is incorporated into the landing area.

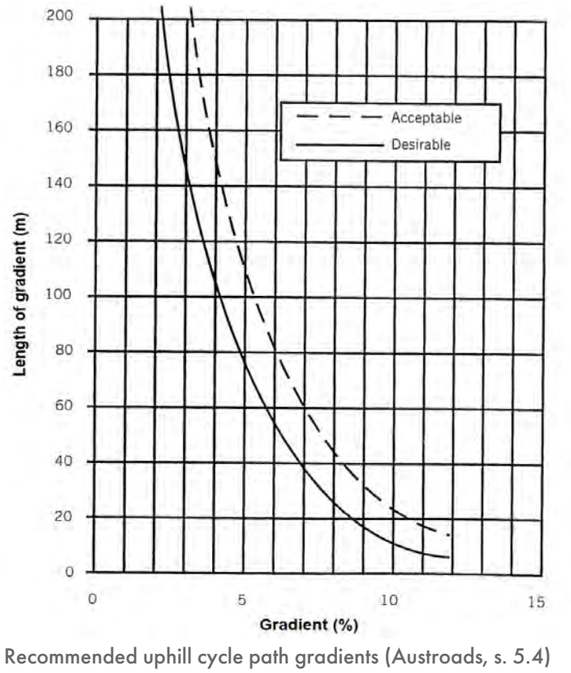
## Cycle ramp path width

The design has carefully considered the cycleway 'clear path' width on the ramp. Section 5.1.5 of Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling ('Austroads') recommends a minimum two-way path has a desirable minimum width of 2.5m. 2.5m is recommended as the minimum width for two way cyclist peak hour volumes up to 600 per hour. As the current demand is approximately 300 and is anticipated to double, the minimum width based on Austroads is 2.5m. A minimum clear path width of 3m has been adopted for the cycle ramp.

Wider cycle paths are generally desirable with higher cyclist volumes and on steeper gradients as this leads to greater differences in speeds between cyclists.

The width of the path increases from 3.4m after the abutment, to 5.8m approximately midway along its length, to allow for increased potential for passing.

The width of the ramp needs to be balanced with the impacts on Bradfield Park and impacts on pedestrian movements. At the entrance/exit to the ramp a wider path was not considered appropriate as the design intent is to reduce speeds in this location for cyclists exiting the ramp.




**Recommended uphill cycle path gradients (Austroads, s. 5.4)**

## Cycle ramp path grades

The design of the cycle ramp has carefully considered grades. The design of the cycle ramp includes, at the northern end, a short section of 2% grade before a 20m section of 5.8% grade to approximately the end of the abutment. The remaining approximately 150m length of the ramp climbs continuously at approximately 2.6% to the bridge cycleway. At the top, it incorporates an inset section for a smooth transition onto the bridge cycleway, which continues to climb from here.

The short section of steeper grade has been deliberately designed at the beginning of the ramp to meet the requirement for clearance over the existing pedestrian paths. Being located near the beginning of the climb, cyclists may have some momentum and more capacity to cycle uphill.

Section 5.4 of Austroads provides recommended lengths for uphill grades. It shows that grades of approximately 5.8% are desirable for path lengths less than approximately 50m and are acceptable for path lengths of approximately 80m. As the section of steeper 5.8% grade is only for 20m this is considered consistent with Austroads.

It also shows that grades of approximately 2.6% are desirable for path lengths less than approximately 170m. As the total length of the ramp is approximately 170m, this is considered consistent with Austroads.

Section 5.4.3 of Austroads recommend that downhill gradients steeper than 5% should not be provided for safety unless it is unavoidable. Where this cannot it be provided

Austroads recommends providing additional path width and recovery area adjacent to the outside of the curve where possible and where not possible adequate sight distance and appropriate delineation and warning signs.

Where the ramp is 5.8% grade, the design incorporates a 3.3m clear width to provide additional width for safety on the steeper downhill section while balancing the physical geometrical constraints, horizontal curvature, the existing Chinese elm as well as the overall vertical alignment. Sightlines have also been provided with clear visibility to all parts of the entire ramp. The light and transparent railing allows cyclists to be clearly seen from the approach into the landing.

## Horizontal curvature radii

Austroads section 5.3 recommends where possible a generous alignment consisting of straights and large radius curves is desirable, which provides good sightlines and comfort of riding. The design of the ramp has adopted this with:

- a 70m straight section from the bridge cycleway to the point opposite the Milsons Point Station entrance
- a generous radius opposite the station entrance, transitioning from a radius of 86m tightening to 24m before expanding to 86m radius
- an approximate 20m length straight section from here to the landing
- an approximate 20m section of 12m radius at the landing

Austroads section 5.3 recommends that the minimum radius for a design speed of 24km/hr is 10m. The tightest radius in the proposed cycle ramp is 12m at the landing and hence is consistent with this. This tighter radius has been designed to assist in slowing down cyclists before they cross the Alfred St footpath shared zone. The radius for the remaining part of the cycle ramp has been designed for a minimum of 30km/hr.

Refer to the unrolled alignment drawing in Attachment A for a complete overview of grades and radii.

To provide additional accessibility particularly for less experienced and less able cyclists the ramp widens in the main curve to a generous 5.8m in width. This allows less able cyclists to slow down and even if necessary (e.g., for beginner riders) to take a rest and put the feet down, while still allowing for other cyclists to easily pass in both directions. This location has been carefully considered:

- It is approximately half the elevation gain that is required (2.5m out of a total of 5m)
- It is located where the ramp is designed to provide a canopy to the park, providing shelter, and where the extra width has minimal impact on shading of the park below.

## Balustrades

Due to the height of the cycle ramp above the ground, a full safety barrier is proposed for the majority of the ramp. In accordance with section 5.5.3. of Austroads this includes

- a 1.4m height 'full barrier fence'
- inclusion of a cyclist deflection rail ('rub rail') incorporated into the top rail, at 1.4m height and above the height of handlebars
- a spacing between vertical balustrades of less than 125mm
- no horizontal elements which can be used as footholds lower than 1m
- allowance for a minimum of 400mm clearance between the vertical balustrade and the clear path width

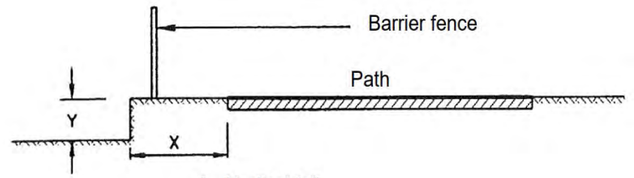
At the landing, the barrier fence transitions from a full barrier fence to a partial barrier fence. This occurs where the height of the ramp is approximately 1.5m above the ground, in accordance with Austroads (partial barrier fence required at vertical fall heights less than 2m). This transition occurs in the fence through a gradual widening of the distance between the vertical balustrades from 125mm to approximately 1m apart over approximately 15m of the ramp length. This provides for an elegant transition from the full barrier fence to the partial barrier fence while still providing safety on the curve of the ramp.

At the landing the partial barrier fence transitions to no barrier fence once the height of the ramp above the ground is less than approximately 200mm.

## Vertical clearance

Vertical clearances of 2.5m have been provided to the pedestrian paths below the cycle ramp in accordance with Austroads section 5.5.2. As outlined in the previous pages the existing northern east-west path, which is not well used, is to be removed and replaced with a path to the north of the landing.

Vertical clearance to the Chinese elm has also been considered for the cycle path. The existing height of the lowest branch in proximity to the landing of the Chinese elm has not been surveyed in 3D. Measurements taken on site indicate that the branch is approximately 3m above the existing ground level at its lowest point. Without the 3D survey it is not possible to accurately determine the height of the lowest branch in relation to the height of the cycle path but it is expected that the branch may encroach into the 2.5m clearance. Where possible the branch will be retained. Discussions with qualified arborists from TreeIq and Earthscape have indicated that the branch could be removed if required, without impacting on the health of the tree and that the best location to do this is just above the branch collar.




A. Vertical fall

| | X (m) | Y (m) |
|---|---|---|
| Fence not required* | <2 | <0.25 |
| Partial barrier fence required | <5 | 0.25 to 2 |
| Full barrier fence required | <5 | >2 |

* Batter off the surface where fall is within 1 m of path.

Barrier fence requirements (section 5.5.3 Austroads)

## Throw screens

Throw screens have been considered as part of the design process. The alignment of the cycle ramp has retained a minimum 3m distance from the Sydney Harbour Bridge and the railway line similar to the reference design.

An initial assessment of throw screens has been undertaken. The cycle ramp passes over a low speed local road Burton St and over Alfred St footpath. The cycle ramp has a buffer from the carriageway of Alfred Street by the width of the separated cycle path as well as a portion of the footpath. The ramp also has good passive surveillance and is in a well lit environment.

Bridge Technical Direction BTD 2012/01 has also been considered. An initial high level risk assessment indicates that it is marginal whether a safety screen is required. The factors mitigating against the need for a throw screen include - minor road or footpath below; good adjacent lighting and passive surveillance from the surrounding streets and adjacent buildings. Key factors increasing the risk according to the BTD are proximity to local schools, hotels and other similar trip generators. It is considered that these factors can be mitigated against (e.g. CCTV if incidents occur) and at this stage of design a throw screen has not been considered necessary.

## Drainage

An initial estimate has been made of the capacity of the open channel to convey runoff from the 2x300sqm catchment. The 1% AEP flows from the 300 sqm catchments have been estimated at approximately 20 L/s using the Rational Method and a rainfall intensity of 265mm/hr. The 400mm wide drainage channels at approximately 2.7% grade have the capacity to convey approximately 20 L/s. Hence at this stage of design the drainage channels are considered sufficient to convey the 1% AEP flows from the cycle ramp.

# 06

# CONNECTING TO COUNTRY

# 6.1. APPROACH

Our design approach embraces Designing with Country to acknowledge and celebrate Country. Through our design, we celebrate Aboriginal culture, stories and people. The initial process with the local Knowledge holders has identified themes important to the Gadigal and Cammeraygal Elders and the design has drawn upon a number of themes to translate into the cycle ramp design.

In our approach, we integrate Designing with Country into the fabric of the active transport infrastructure. We see the ideas presented by the Elders during the Initial Design Phase and the ideas in the Aboriginal Design Principles report as a springboard for our design approach and we propose to continue collaborating with the Elders to translate these ideas and themes into the design elements as the design progresses.

We are grateful for the time provided by the Elders and have greatly valued their time, knowledge, and experience. We also recognise that in the compressed four week design process opportunities for co-design have been limited.

Our approach as noted in previous sections in the report has been to identify key elements and opportunities for engagement with Aboriginal Elders and Aboriginal artists to co-design specific elements of the cycle ramp, including the balustrade and its lighting elements, the base of the columns where they 'touch' the ground, and the sandstone water feature. We propose in the future design stages to continue the co-design process of these elements of the project and would welcome the opportunity to further develop these ideas.

# 6.2. DESIGN THEMES

## Connecting Place

The cycle ramp operates as the connecting piece between earth and sky and Uncle Dennis spoke about this point between earth/water and sky as being important as that is where creation occurs.

The cycle ramp speaks to connecting the two parts; the connection between earth and sky, north and south of the harbour and past and present.

The cycle ramp creates two distinct languages and experiences. The ground or earth level is the grounding place where there is the opportunity to tell stories, create sticking points and engage with Country, the stories and histories of this place.

The sky or cycleway level is faster, a transitional space where the references to this place are more abstract and graphical.

The cycle ramp also brings people from the ground up to a vantage point 'in the sky', where there are inspiring views over both Gadigal and Cammeraygal Country.

The story of Earth and Sky has formed one of the inspirations of the design. As shown in the figure below the structure embodies the idea of the deck as a 'floating' object above the ground and part of the sky. This is accentuated in the design through a slender connection between the column and the deck. The deck is floating above the ground and becomes part of the sky. The balustrade is designed to be transparent.

The columns in contrast are 'grounded' in the Earth and are a solid presence on the ground plane, with the connection to the ground clearly visible and articulated. Where the columns are grounded they reference *Angophora costata*. The unique form, shape, colour and tactile nature of the *Angophora costata* are beautiful elements that can be incorporated into the design where the column is grounded.

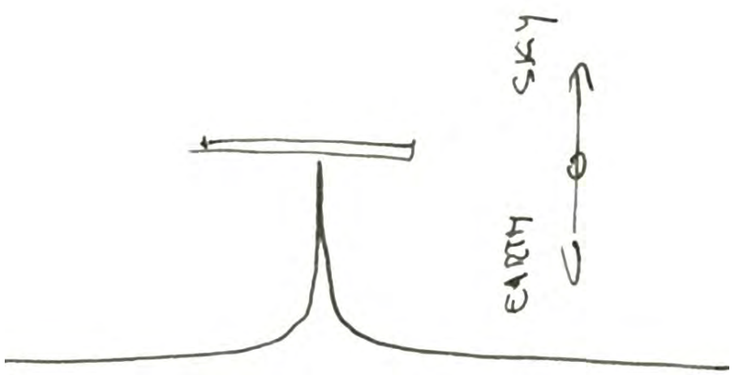
The detailing of the columns provides a canvas for telling stories within Bradfield Park and provides an opportunity to create a 'sticking point' - a place to engage, listen and learn about this place. For example, during the design process Uncle Dennis shared the story of how women would sit on the buttresses of the *Angophora* trees during women's time and when they were pregnant and the columns provide opportunities to tell stories such as these.

## Matriarchal Country

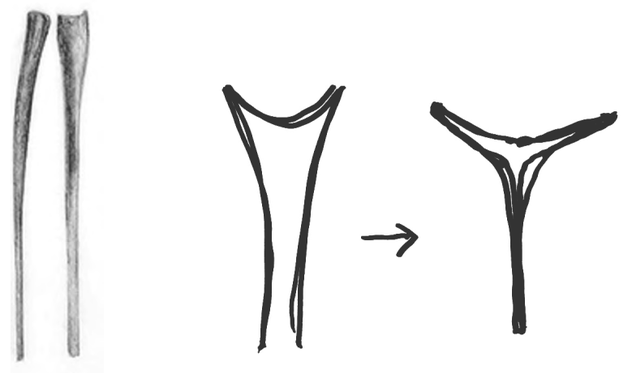
Uncle Dennis emphasises that Cammeraygal Country is Matriarchal Country and this is reflected in the design. Women play an invaluable role in Aboriginal culture and communities, they are the backbone of the communities. The bridge has the opportunity to speak about the role and respect of Aboriginal women in the community; as creators, carers, and fisherwomen.

The references to Matriarchal Country in the design include the *Angophora costata* as part of the columns and the inclusion of these sculptural trees in the design itself. Uncle Dennis Foley shared during the design process how *Angophoras* are a being which represent women and the direct inclusion of *Angophoras* provides opportunities for telling these stories and sharing this knowledge.

It is also told through the expression of the nawis which is discussed further in the following section.




The columns of the structure are strongly connected to the Earth, while the deck 'floats' above it in the Sky



The initial 'pictogram' in the balustrade is inspired by nawi paddles

## Nawi

The nawi is the connection and link which once brought the two sides of the harbour together. The Nawi is an important theme of this place because it provides the opportunity to tell many stories. The nawi speaks to

- the ingenuity of Aboriginal culture to understand Country;
- the materials and trees used to craft bark canoes, and
- how to use materials of Country in a way to design and build a structure.

Furthermore, it speaks to knowledge of Country in how the nawis were used, utilising the currents and tides to reach different points across the harbour.

The nawi also speaks to the values of Aboriginal communities that lived and travelled along the harbour. The value of sharing the nawi across Clans, to use to cross the harbour and our collective values of looking after one another and looking after Country. As Michael Hromek notes in the Aboriginal Design Principles report "the women were the masters of the canoe or Nawi" and the nawi provides a reference Cammeraygal Country as Matriarchal Country.

The nawi has inspired the design of the cycle ramp. The beautiful form of the nawi is embodied in its design for movement, its fluid lines and lack of sharp edges, its curved forms, and the expansion and contraction of those forms. The overall structure of the cycle ramp references these forms in its design. The ramp is also designed for movement and with fluid lines and with its graceful curved form expanding and contracting. Similar to the nawi, the cycle ramp is honest and designed for what it is.

The balustrade has also been inspired by the nawi. The beautiful forms of the nawi paddle have inspired the design of the vertical elements of the balustrade. The forms of the paddle have been abstracted to create a functional, light and transparent balustrade.

The women fishing on the Harbour at night with fires built on ochre clay bases on the canoe floors creates a beautiful image of lights dotted on the harbour. The nawis as places of cooking has inspired the lighting of the structure. Puck LED-Lights integrated into the top rail will guide cyclists by night and through directional lighting onto the lower vertical balustrade can form a beautiful form of lighting to the cycle ramp.

## Grounded in Country

Where the cycle ramp touches the ground it is proposed to ground the structure in the rich materiality of Cammeraygal Country and the harbour foreshore.

The harbour foreshore is sandstone country, a remnant of a freshwater river valley that carved its way through the sandstone formed from deposited alluvial river sand millions of years before. The river valley was drowned by rising seawater levels approximately 15,000 years ago. As the sea levels rose the saltwater rose up the sandstone cliffs, drowning out the former river valley. The water level stabilised and reached its current levels some 6,000 years ago.

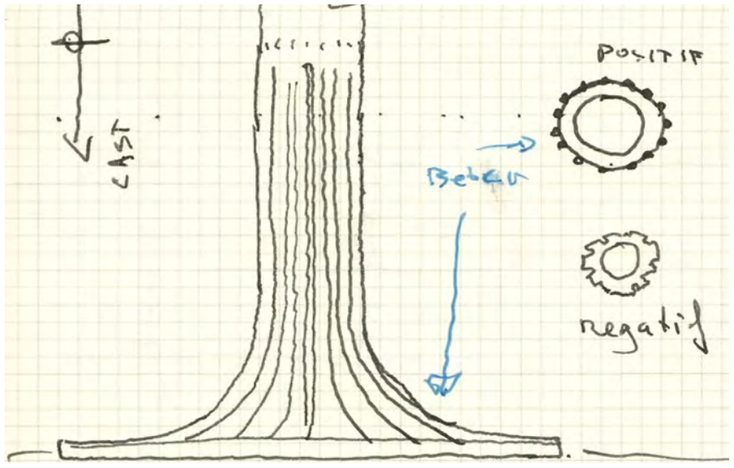
Sandstone is ideal for carving and rock art and the Cammeraygal inscribed important cultural carvings throughout Country, including the whale carving at Balls Head. Sandstone also retains grinding grooves where tools were produced and sharpened.

Where the cycle path reaches the ground it is expressed in the language of sandstone. The sandstone forms the supports for the cycle path and becomes a potential canvas for sandstone carving and etching along the abutment.

The sandstone abutment also includes a resting place with sandstone seating and a crushed sandstone surface. This space provides a special placed for an *Angophora costata*. *Angophora costata* grow on sandstone headlands by wrapping their roots on, into and around the sandstone. We have referenced the relationship between sandstone and *Angophoras* by placing the *Angophora* in crushed sandstone and within the sandstone abutments and seating and adjacent to the sandstone water feature.

In the Aboriginal Design Report Uncle Dennis Foley states that "Acknowledging Country is all about sharing, firstly fresh water...". The water feature on site is a special element that not only references Caring for Country but implements this approach on site through capturing, filtering and storing the water that drains from the cycle ramp. The water is retained on site in a sandstone water feature that is inspired by and references the shape and form of axe grinding grooves after rain. By sharing the water on site in the water feature it also tells the story of the preciousness of water, the preciousness of the local ecology and the importance of looking after Country.

The materiality and form of the water feature references axe grinding grooves




The columns are inspired by *Angophoras* and their grounding on sandstone

*Angophora* growing on and around sandstone

# 07

# HERITAGE

# 7.1. HERITAGE VALUES

The construction of the Sydney Harbour Bridge was a pivotal moment in Australia's history. The aspirational program of works achieved an internationally recognisable 'symbol of progress and a vision of the future splendid.'

The Sydney Harbour Bridge has been facilitating road, rail, cycle and pedestrian movement across the harbour since 1932. The western footway of the Bridge was converted to bicycle-only use in the 1970s but is now becoming unfit for purpose due to growth of use and changes to user demography. Driven by necessity, the linear cycleway option, proposed to relieve this issue, has the potential to impact significant fabric, character, and views.

Borne of the Sydney Harbour Bridge scheme, the site of the proposed cycle ramp is steeped in cultural significance. The appreciation of its exceptional value is evidenced by heritage listings affirming its significance at national, state and local levels.

Fundamental to our design approach is the conservation of the heritage significance of the place, which includes:

- The Sydney Harbour Bridge approaches, road and rail viaducts (including Burton Street Bridge Stairs)
- Milsons Point Railway Station group
- Bradfield Park

The site's heritage features are integral to its sense of place. This identity is not only generated by its distinctive fabric and form, but by an appreciation of its landscape setting and views.

Breathtaking for locals and internationals alike, the views to and from the site are significant and vast. The eye is naturally drawn to marvel at the engineering achievement that is the Sydney Harbour Bridge. Significant views exist to, from and within Bradfield Park, Milsons Point Station (forecourt, entrance, and platforms), the surrounding streetscapes, and Sydney Harbour.

The site also has significant value to the community as an open space for recreation and as a place of gathering. The project must also conserve this historic function and seek ways to improve the public domain.

Change in this space requires a light and respectful touch; as much as necessary, but as little as possible.

# 7.2. GUIDING PRINCIPLES

The Sydney Harbour Bridge is a national icon with an international reputation. There is no competing with its indomitable presence; success will lie in subtlety, in the unobtrusive. We recognise we are introducing an infrastructural element to an exceptionally significant and complex heritage site; there can never be a declaration of 'no adverse impact'. However, it is through cautious and respectful design, informed by heritage best practice, that we can mitigate impacts to create a suitably sympathetic cycleway solution that is deferential to its unique context.

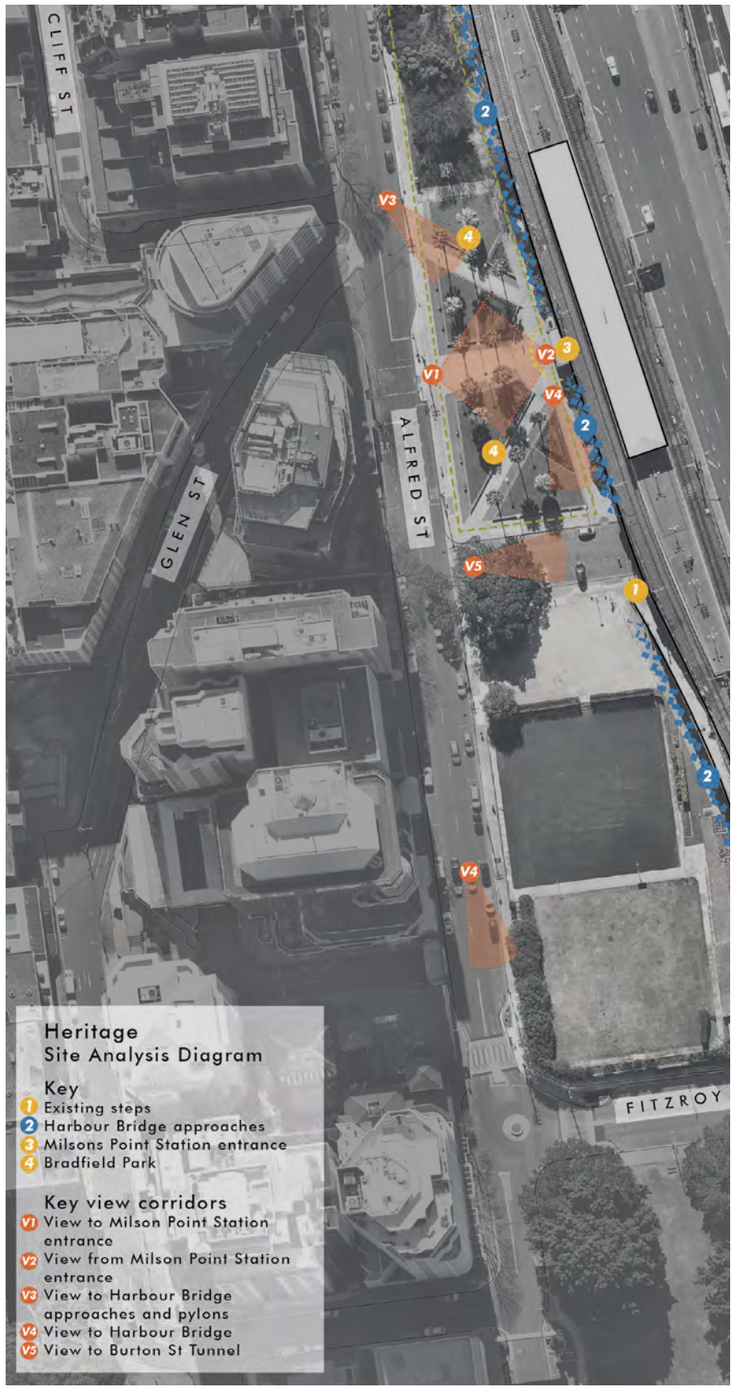
The following heritage principles were foundational to our approach and have guided the coalescence of the design. The cycleway should be designed to:

- Conserve the Sydney Harbour Bridge and approaches as the dominant element in the landscape.
- Be immediately recognisable as new work, but not be incongruous in context.
- Minimise impact on significant fabric, setting, and character of the Sydney Harbour Bridge, Milsons Point Station and Bradfield Park, including changes being reversible if required.
- Minimise impacts on views to the Sydney Harbour Bridge and approaches, Milsons Point Station and Bradfield Park: to, from and within.
- Re-use significant fabric and adapt redundant spaces
- Minimise impact on potential archaeology.
- Provide added value and enhance the public domain
- Be a vehicle for interpretation.

Using these to frame thought toward the concept, key design directions formed:

- Speak a similar architectural language to the Sydney Harbour Bridge without resorting to mimicry
- Be as transparent as possible to conserve views
- Allow plenty of space around Milsons Point Station entrance
- Respect the geometry and formal garden character of the forecourt
- Sit lightly at all connection points

The primary objective is to design a cycleway ramp that meets both the technical criteria and heritage requirements. While there are peripheral treatments proposed (adaptation of the bridge stairs, water feature and abutment landscaping etc.), these are optional and not critical to the realisation of the cycleway structure.



Heritage site analysis diagram

# 7.3. DESIGN RESPONSE

The heritage conservation framework of the site is contained in various heritage listings and management documents; principal among these is the Sydney Harbour Bridge Conservation Management Plan. In evaluating the merit of the concept design, we also looked to the articles the Burra Charter, to ensure that the design response is respectful of the significance of the place. Common conservation premises emerge:

- As much as necessary, but as little as possible
- Consider cumulative effect of change on significance
- Facilitation of historic use
- Conservation of the integrity of the fabric, form and setting of the place
- Retention of key views
- Changes to be identifiable as new work
- Aspire to reversible change, sited in areas where the significance/fabric etc. can tolerate it
- Removed fabric belongs to the place
- Interpretation be provided to enhance understanding and engagement

The concept design responds to the key heritage imperatives of the site in the following ways:

The ramp is sited to that it is removed as far as possible from the Sydney Harbour Bridge viaduct wall and Milsons Point Station entrance, preserving the legibility of the Bridge's sweeping curve, appreciation of its scale, and the spatial volume of the Milsons Point Station forecourt. The line taken requires the slight relocation of only three palm trees. The sweeping apex at the junction of the central radial pathway with the Alfred Street footpath reinforces the symmetry of the station forecourt, while providing a canopy for shelter along its length.

The concept conserves the traditional routes of pedestrian movement throughout the site and minimises the loss of open space for recreation and community use. The setting of Bradfield Park is enhanced by the creation of the water feature at the base of the abutment which neatly provides a stormwater management solution and prevents the creation of a 'dead space'.

The slender support columns have been sensitively placed to achieve harmony with the enduring geometric layout, and where possible, avoid potential archaeological features; remnants of properties demolished to allow the construction of the Bridge approach. Appropriate interpretation of these footprints/subdivision patterns would complement the existing installation in Bradfield Park North.

Steel will be the material used for the cycleway deck, columns and railings. This speaks to the materiality of the Bridge while possessing high construction value, being conducive to off-site prefabrication. Being strong and light, only simple footings are required, and the slim profile of the columns reduces the size of these, and thus the extent of earthworks. Installed rather than constructed, minimal installation time, reduced need for heavy machinery, and no formwork required for uprights reduces undue impact, collateral damage of fabric and setting, and disruption to the business- as-usual functions of the place.

Crucially, the deck is lean. The open, streamlined form minimises obstruction of views to the Bridge and its surrounds. The railing is designed to maximise transparency and reduce excessive bulk and scale by hosting integrated lighting. The experience of views would be enhanced by the addition of a south-facing viewing bay at the top of the cycle ramp, and the potential for an elevated lookout for pedestrians at the top of the Burton Street stairs. Wending its way to Alfred Street, the cycleway will also create new and unique view corridors through which to frame the Bridge and surrounds.

The detailing of the cycleway ramp is restrained and elegant in its subtlety. The underside of the deck is textured with honest evidence of its welded bracing, much as the Sydney Harbour Bridge proudly bears its rivets. The profile of the railing evokes a sense of the original Sydney Harbour Bridge walkway railings, while connecting to Country through the use of a stylized symbol of a the nawi paddle.

The muted, earthy colours applied to the deck, columns and railing are drawn from the trunk of the Angophera costata; a mother tree, locally native to the north shore of the harbour. These complement the warm neutral palette of the Bridge viaduct and tiling in Milsons Point Station.

The connection of the cycleway ramp to the Sydney Harbour Bridge viaduct sees the re-use of the section of removed wall in situ ensuring this fabric endures and continues to serve the Bridge. The deck will 'hover' over the Bridge, anchored by one bearing at the corner.

Overall, the proposed cycleway ramp adds to the aesthetic and cultural values of the place, and will integrate with the existing heritage fabric with minimal disturbance or loss. By delivering a concept with elegant simplicity and clean lines, imbued with Aboriginal cultural insights, the character of the site will be universally enhanced.

**Our design references the original railing of the Sydney Harbour Bridge (NSW State Archives and Records, Sydney Harbour Bridge Photographic Albums, 19 January 1932, Series 12685)**


**Our design respects Bradfield Park's original layout and design intent. (NSW State Archives and Records, Sydney Harbour Bridge Photographic Albums, 19 May 1932, Series 12685)**

Team Civille

Djinjama

H+N+S+ +

NEY +PARTNERS

SUE ROSEN ASSOCIATES
HISTORY HERITAGE RESEARCH