

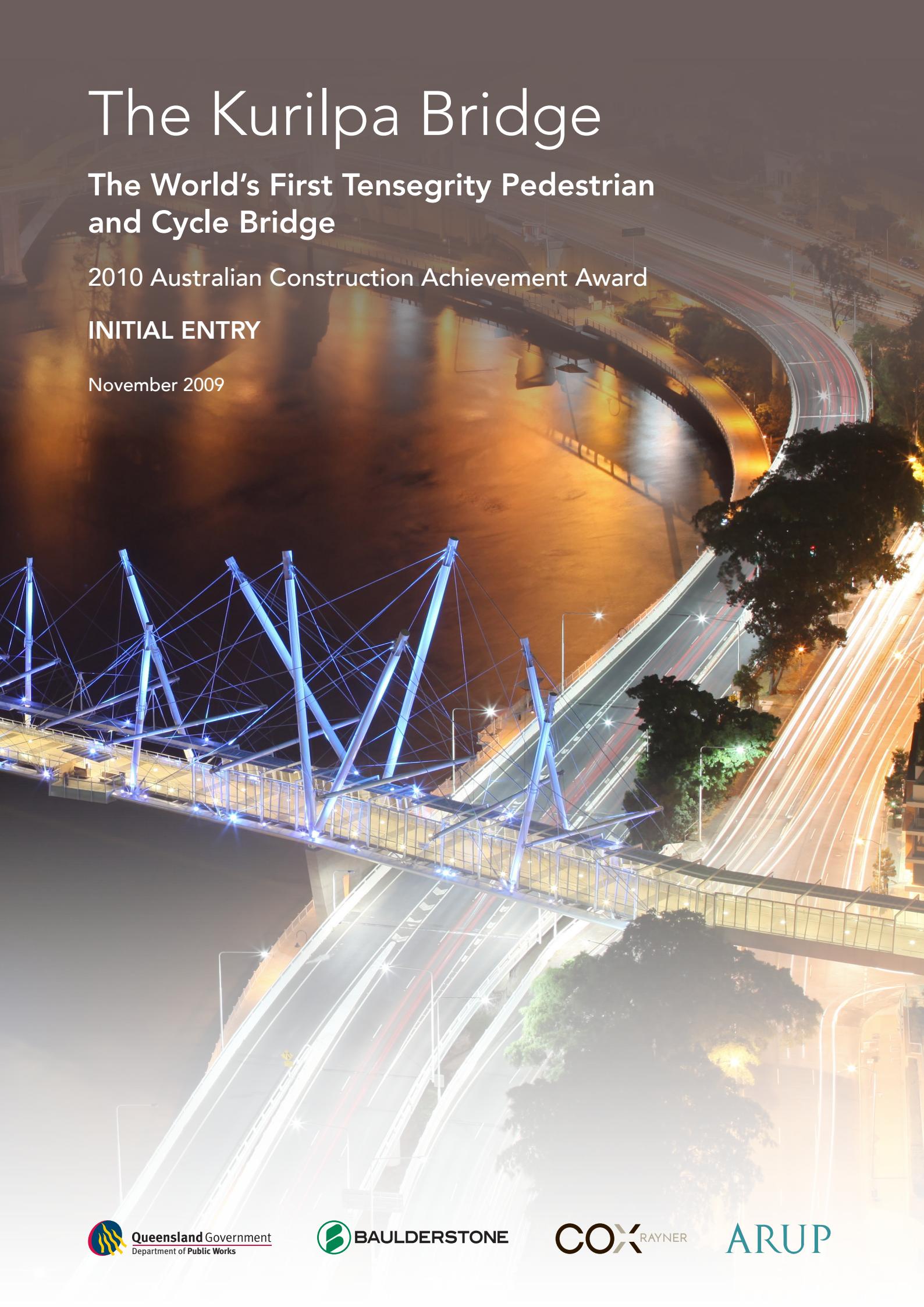
# The Kurilpa Bridge

**The World's First Tensegrity Pedestrian and Cycle Bridge**

2010 Australian Construction Achievement Award

**INITIAL ENTRY**

November 2009



Queensland Government  
Department of Public Works



BAULDERSTONE

COX RAYNER

ARUP



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"We are immensely proud of having had the honour of building one of Queensland's iconic structures. The Kurilpa Bridge is not only a landmark in design, engineering and construction but is making a material difference to people's lives by connecting the Brisbane CBD to the arts and cultural precinct of South Bank."

*Stephen Green, General Manager Queensland, Baulderstone Pty Ltd*

## 2010 ACAA ENTRY FORM

We submit the following entry for consideration for the 2010 Australian Construction Achievement Award.

| <b>DETAILS OF ENTRANT</b>                                     |  |
|---|--|
| Name of organisation:<br>Baulderstone Pty Ltd                 |  |
| Address:<br>Level 3, 44 Musk Avenue, Kelvin Grove, Queensland | Postcode:<br>4059                                  |
| Contact name:<br>Carla Carroll                                | Title:<br>Marketing and Communications Coordinator |
| Telephone:<br>07 3835 0582 / 0417 623 832                     | Facsimile:<br>07 3832 0269                         |
| E-mail:<br>ccarroll@baulderstone.com.au                       |  |

| <b>PROJECT DETAILS</b>  |  |
|---|--|
| Project title:<br>World's First Tensegrity Pedestrian and Cycle Bridge - The Kurilpa Bridge   |  |
| Location:<br>The Kurilpa Bridge links Brisbane CBD to the new Millennium Arts Precinct and Queensland Cultural Centre at South Bank on one side of the Brisbane River to Tank Street on the city side catering in time to 36,000 pedestrians and cyclists each week.                                    |  |
| Summary of scope of work<br>(maximum of 50 words please):<br>The Kurilpa Bridge is a fusion of art and science to create a unique structure.  |  |
| This bold design and construction is the result of a creative partnership inspired by the concept of tensegrity, a modern art form and structural system to build the world's first tensegrity pedestrian and cycle bridge. (50 words)  |  |
| Contract value:<br>AUD\$55 million  | Contract type:<br>Fixed Lump Sum, Design and Construct Contract                |
| Contract period:<br>October 2007 to September 2009  | Date of substantial completion:<br>Substantial completion by 30 September 2009 |
| Purpose of project:<br>Kurilpa Bridge completes an important connection between the cultural precinct at South Brisbane to the Brisbane CBD. It completes a pedestrian and cycle loop connecting Brisbane CBD to the popular arts, cultural and lifestyle precinct, South Bank and the Goodwill Bridge. |  |
| Name of client/principal:<br>Queensland State Government, Department of Public Works  |  |
| Address:<br>GPO Box 2457 Brisbane Queensland  | Postcode:<br>4001  |
| Contact name:<br>Jeff Griffin   | Title:<br>Executive Director, Strategic Projects                               |
| Telephone:<br>(07) 3224 4916  | Facsimile:<br>07 3225 8105   |
| Email:<br>jeff.griffin@publicworks.qld.gov.au   |  |

**ENTRY FORM****PROJECT TEAM:**

|                           |   |
|---------------------------|---|
| Construction Managers:    | Baulderstone Pty Ltd                                    |
| Contractor's Design Team: | Cox Rayner - Architects<br>ARUP – Engineers             |
| Construction Authority:   | Queensland State Government, Department of Public Works |

## Entry Declaration Project Details

We are duly authorised to submit this entry on behalf of the Entrant named on this form and:

- Agree to abide by the rules and conditions governing the Australian Construction Achievement Award as set out in this document, including payment of final entry fees if selected as a finalist;
- Declare that the construction of project works was the direct responsibility of the Entrant; and
- Declare that substantial completion of the project has been achieved in the 12 months prior to 30 September 2009.

## Delivery

The entry form, four (4) hard copies and one (1) electronic copy of the initial entry are to accompany this form and be forwarded to:

Ms Colleen Mays  
Australian Construction Achievement Award  
C/-Engineers Australia  
Engineering House  
11 National Circuit  
BARTON ACT 2600

To arrive not later than 5pm on 11 November 2009.

Entry forms should be accompanied by the initial entry fee of \$1,100 (incl GST).

Signature:



Date:

10 November 2009

Name (printed):

Stephen Green

Title (Managing Director or equivalent):

Director and General Manager Queensland

Company:

Baulderstone Pty Ltd

## Evaluation Criteria

### 1. Outcomes achieved against planned targets for key project parameters

- Have met or exceeded expectations in all KRAs
- Demonstrate initiatives and achievements that have contributed to building the future of the construction industry

Unique and iconic

An imperative of the design was for it to be unique and iconic – with the result being a **world's first tensegrity pedestrian and cycle bridge**.

Kurilpa Bridge sets a new standard in design and construction in Queensland, nationally and internationally.

Delivered on time

Kurilpa Bridge was delivered to meet a critical time frame for the Queensland Government. It was officially opened on 4 October 2009, in time for Queensland's Sesquicentenary (150<sup>th</sup> Anniversary) celebrations.

The Premier of Queensland, Anna Bligh, officially opened the bridge as part of a 'family celebration day'.

Delivered to budget

We provided the option of a traditional managing contract sum or a fixed lump sum design and construct contract, with the latter contract type accepted.

With the addition of only two Principal directed variations to enhance the bridge, these being solar panels and additional canopies to the viewing platforms and time lost due to wet weather; the project was delivered on time and on budget.

Considers our cultural heritage

Kurilpa is the name for the area the bridge spans and is indigenous for 'place of the water rat'.

The name was selected following a public naming competition and in consultation with the Turrbill and Jagera clans who lived in the area. Both clans were consulted from the very beginning due to the land being utilised for the bridge landing.

Indigenous stories can be read at various points along the bridge and form an important component of the public art.

Optimal functionality

The bridge design encourages **people to enjoy the experience of crossing the bridge and the features of the river and views**.

Views of the river can be seen from two large viewing platforms, and an all-weather canopy covers for the entire length of the bridge.

The bridge complies with the '1 in 20' gradient for 'Persons with Disabilities' while information and directional signs are enhanced by the inclusion of Braille.

## EVALUATION CRITERIA

## 1. Outcomes achieved against planned targets for key project parameters (continued)

No environmental incidences 

There were no environmental incidences during construction. The Environmental Management Plan used environmental alternatives such as the use of biodegradable hydraulic fluid. Work on the bridge access ramps was undertaken over and adjacent to sensitive mangrove vegetation which was not damaged during construction. Successful relocation of the very prominent Poinsettia trees was also undertaken.

A safe work environment 

All staff and contractors received training as a part of the company wide Safety Matters Program.

Critical Risk Standards were established for the project and reviewed monthly in an effort to eliminate hazards to the worker and general public. Safe access was maintained for the duration of the project for all road, pedestrian and river traffic.

The project achieved three hundred & seven days without a single lost time injury (LTI).

A sustainable bridge 

A key initiative was to assist the State Government to deliver on the "Toward Q2: Tomorrow's Queensland plan to reduce Queensland's carbon footprint".

Working with our design partners we have met this need through solar panels that produce 100% power required to light the bridge and LED lighting.

Stakeholder satisfaction 

*"The location and complexity of the bridge necessitated detailed and ongoing consultation with a diverse range of stakeholders which Baulderstone managed through a comprehensively researched and executed plan.*

*Traffic management for diversion of the Riverside Expressway and vibration monitoring during the Picasso Exhibition at the Gallery of Modern Art were two exemplar highlights."<sup>1</sup>*

Specific components of the design brief 

- Minimum clear width of 6.5 metres between hand rails;
- 50% of the deck width for its full length has an all weather cover and shade;
- Additional viewing platforms and rest stop were provided to those specified;
- CCTV coverage of the entire structure;
- Access for emergency vehicles to the entire length of the bridge;
- Clearance of the Riverside Expressway and river traffic whilst achieving disability access requirements and maximum grades; and
- Screens to ensure privacy and safety of users of adjacent buildings, roadways and paths.

<sup>1</sup> Quote provided by stakeholder: Glen Bourner, Associate, RCP – Project Managers on behalf of Public Works

## Evaluation Criteria

### 2. Complexity, difficulty and optimisation of the construction task

Address construction complexity in key areas such as:

#### Design

The Kurilpa Bridge is the **world's first tensegrity pedestrian and cycle bridge**.

Using an artistic array of cables and flying steel spars, the elegant colonnade provides the strength and stiffness required for the 425 metre long bridge to span the Brisbane River.

#### Unique risks

This was a bold design inspired by the concept of tensegrity, a modern art form and structural system, to achieve a **world first design feat** requiring clever planning at every stage of design and construction.

The original project tender submission by the project team was a pre-concept that revolved around artist impressions, engineering drawings and cost estimates based on experience. During the establishment phase the project was scoped in more details progressing from a design competition winning scheme into a complete concept design so that we could more accurately offer a Lump Sum price.

#### Interfaces

The bold design is a **fusion of art and science**. The tensegrity architectural and engineering system is a synergy between balanced tension and compression components which have been combined in such a way that the main supports appear to be floating.

The design is reminiscent of the ropes and spars of old sailing ships. The tension ties and cables used form a three dimensional array that appears different from every angle. No two parts of the bridge are alike yet they all form part of a single cohesive structure.

#### Logistics

Success of the whole project was dependent on precise planning. **We weren't just building a bridge; we built something people had 'no concept of' in the heart of their City.**

Our first role was to communicate the design to each of over 50 stakeholders and to bring them along the journey of design and construction with us. Those interfaces were our greatest challenge.



## EVALUATION CRITERIA

## 2. Complexity, difficulty and optimisation of the construction task (continued)

The project team provided daily updates, and fielded all manner of requests. For example, we rescheduled project plans to facilitate access to the adjacent Commonwealth Law Courts during special legal cases.

This project was built during the peak of the construction period in Queensland.

### Construction challenges

Building a bridge of this complexity would have been difficult in a greenfield site however we built it in a tightly controlled environment in the central CBD; over a thriving commercial and recreational river; and across the busiest road corridors in Queensland; with minimum disruption and zero obstruction.

In order to construct the permanent piles, pile cap and pier a temporary platform was constructed over five phases of work using cantilevered steel grillage.

Worldwide research was conducted to demonstrate the vibration induced by pile driving would not have detrimental effects on the Picasso Exhibition in the adjacent Gallery of Modern Art.

Construction teams worked at night requiring extensive night time traffic diversions over a period of 12 months.



### Sustainable solutions

A photovoltaic system consisting of 84 solar panels were installed on the canopy of the bridge. The solar panels provide an average daily output of 100 kilo Watt hours (kWh). **This represents a saving of around 39.6 tonnes of carbon emissions each year.**

All of the power required to light the bridge in its standard mode is provided by solar energy with any surplus power being returned to the main electricity grid.

**It is believed that no other bridge in the world supplements its power to such an extent.**

### Creative design solutions

Engineering design of the innovative and complex structure involved sophisticated and comprehensive non-linear analyses at every stage of the erection.

Complex static and dynamic structural analyses was undertaken to confirm adequate strength and stiffness and wind tunnel testing to understand wind effects.

Close collaboration between designers and constructors enabled the bridge to be cantilevered out from each of the two major river piers effectively using the permanent structure to support itself and to prestress the main cables using the self-weight of the structure.

The eccentricity of the riverside pier to the direction of the bridge required a twisted pier configuration, allowing a 400mm clearance between the pier and Riverside Expressway.

In May 2009 the two halves of the bridge met precisely as predicted by computer modelling.

## Evaluation Criteria

### 3. Leadership and management of the project delivery

When is a bridge more than a bridge?  
When it is public art

Kurilpa Bridge is fast becoming a shining example of world class innovative design – a new icon for Brisbane, that provides a key connection from the city to Brisbane's highly awarded arts, cultural and leisure precinct.

The addition of a DMX controlled lighting system provides spectacular lighting for special city-wide festivals or events.

Kurilpa Bridge is a fitting piece of public art aptly positioned alongside the stunning architecture of the Gallery of Modern Art.

Leading the world in design and construction

As a world's first our work has helped secure Australia, Queensland and Brisbane on the world stage in terms of design and construction.

In less than 4 weeks after opening, the Department of Public Works has received over 20 international enquiries regarding the design and construction from the USA, UK, Europe and Asia.

Environmental impacts

A voluntary Impact Statement was carried out before works commenced, which resulted in mitigation plans for marine impacts, such as silt booms and key working areas in the river.



EVALUATION CRITERIA

3. Leadership and management of the project delivery (continued)



## Evaluation Criteria

### 3. Leadership and management of the project delivery (continued)

It is all about relationships...

#### (i) With our Project Team

The complexities of working on a world-first project required a close working relationship with the design team: Cox Rayner, Arup, and the client Department of Public Works. **This relationship enabled us to deliver a complex world's first project on time and on budget to the highest possible standards.**

#### (ii) Engaging our stakeholders

Building across an active commuter, commercial and recreational river and above a major freeway meant engaging our stakeholders to ensure effective communication.

Every morning contact was made with more than 50 stakeholders including Queensland Department of Transport and Main Roads, Brisbane City Council, the Riverside Expressway Interfacing Authority, Brisbane Metropolitan Management Centre, Brisbane River Harbourmaster, Emergency Services, Law courts, neighbouring construction, and the local adjacent park users and general community.

#### (iii) Managing the health, safety and motivation of our most important people

We challenged our staff to share health and safety ideas; kept a register of these ideas and recognised those who 'thought outside the square'.

For example, our site office was located within the adjacent park and our driveway crossed a pedestrian/cyclist walkway. A staff idea resulted in mirrors and infrared alarms strategically placed to help vehicles enter and exit the site compound.

Prior to the official opening construction workers were invited to an on-site BBQ attended by the Minister for Public Works, who individually thanked staff for their support.

#### (iv) Having an harmonious worksite

We had no adverse industrial issues on site.

#### (v) Training and developing long term skills

We exceeded the recognised training requirement of 10% of work time for training.

We employed apprentices and provided training schedules to up-skill staff. At any time there were 2 to 4 cadet engineers working on the project.

#### (vi) Giving back to the community

An online auction was held to provide the opportunity for a member of the public to be first to walk across the bridge with \$10k raised for the Leukaemia Foundation.

The project team raised funds for a range of charities including \$14K toward a cure for Multiple Sclerosis.





**BAULDERSTONE**

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