Appendix H – Nowra Bridge adaptive reuse strategic options report




Transport for NSW

Nowra Bridge (BN713) over the Shoalhaven River

Adaptive Reuse Strategic Options

Revision 1

November 2023

Executive Summary

The executive summary provides an overview of the strategic options for the proposed adaptive reuse of the Historic Nowra Bridge in New South Wales, prepared by Focus Bridge Engineering (FBE) for Transport for NSW (TfNSW). The report aims to assist TfNSW in delivering the overall project by providing strategic direction, valuable visualisations, engineering heritage insights, and pragmatic recommendations.

Introduction

In 2018, a decision was made to retain the Historic Nowra bridge and repurpose it as a dedicated pedestrian and cyclist path. This decision was based on the bridge's historical significance and heritage value while also considering the expected benefits and community feedback.

This report has focused on the commitment to preserve and adaptively reuse the bridge as a shared pathway for pedestrians and cyclists. This report details the project objectives, site constraints, existing bridge treatments, adaptive reuse options, engineering heritage planning, and practical recommendations to inform and guide the preparation of a Statement of Heritage Impact (SOHI).

Also addressed is the engineering heritage, including a brief history and significance of the bridge, preliminary heritage significance assessment, mitigation measures, and project proposals with their implications and associated likely heritage impacts.

Nowra Bridge

Nowra Bridge is a historically significant pin-jointed Whipple wrought iron truss bridge spanning the Shoalhaven River. Constructed in 1881, the bridge holds local and state heritage significance as one of the oldest crossings in the region. The Whipple truss configuration is extremely rare in New South Wales, with this particular bridge being the sole remaining example preserved in its original location. It comprises eight Whipple-type truss spans plus an approach span (span 9) on the southern end, with a concrete deck and wrought-iron stringers supported by large-diameter cast-iron piers. The bridge's unique architectural design and sturdy construction make it a captivating symbol of the area's heritage.

Due to the age of the truss bridge, the quality of the existing drawings is somewhat limited. As such, FBE has relied on the available information, site visits and discussions with TfNSW specialists to comprehensively build a 3D model and understand the requirements to repurpose the Nowra truss bridge.

Proposal to adaptively reuse as a footbridge

It's important to clarify that these are strategic options only, designed to allow a comparison of the existing bridge to what may be achieved once the preferred strategic option to upgrade and adaptively reuse has been completed.

The internal TfNSW stakeholder group assessed four options: one involving minimal intervention, two with medium intervention, and one with high intervention. After ranking these options against key criteria and the prescribed weightings, option 2B emerged as the preferred choice. The scope of work for the preferred medium intervention option includes:

- **Bridge deck:** Deck repairs and partial deck removal to facilitate the removal of the existing half-height concrete barrier.
- **Pedestrian balustrade railing**: Installation of a new post and rail system on a vertical upstand.
- **Bridge lighting:** Upgrading pedestrian/ cyclist lighting and adding feature lighting above the pier locations.

- **Potential Option Northern foreshore:** provide opportunity for community viewing areas with potential seating, shade structures etc.
- **Other:** Bridge maintenance, repainting, clip-on walkway removal, utilities relocation, and repairs to wrought iron truss members as required during the protective coating works.

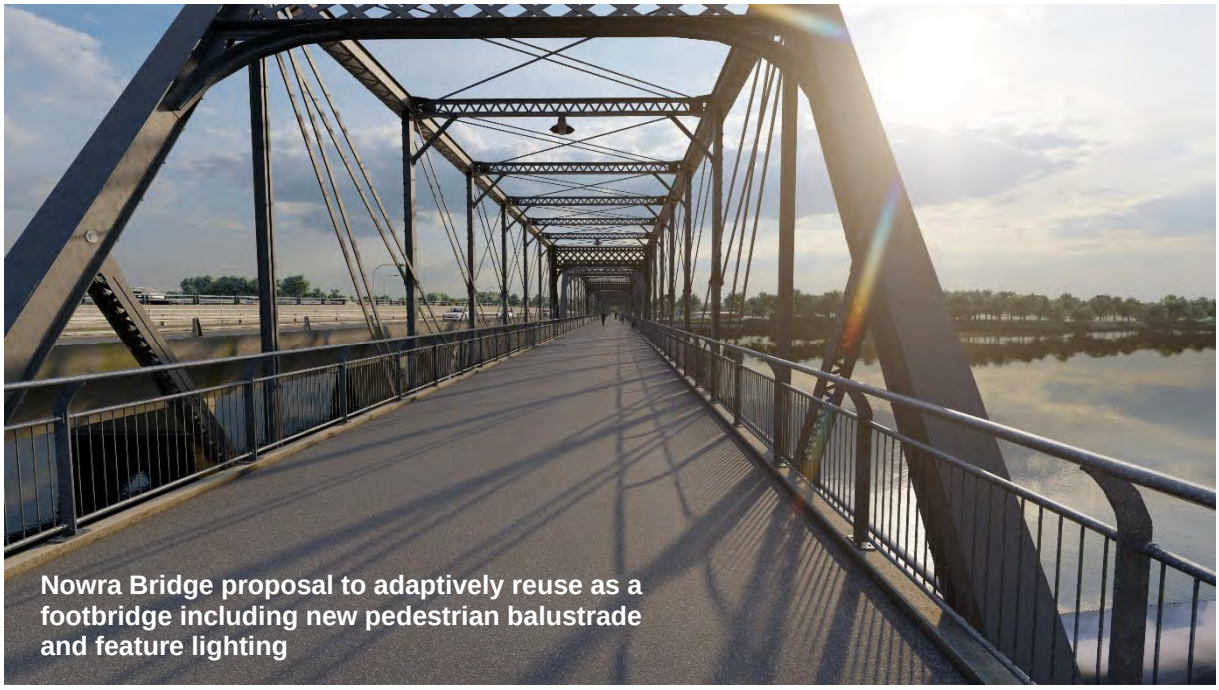
The following 3D visualisations compare the existing bridge in its current condition to strategic design options, demonstrating the possible adaptive reuse outcome.

Visualisations

Nowra Bridge as existing before repainting, removal of the clip-on walkway and services

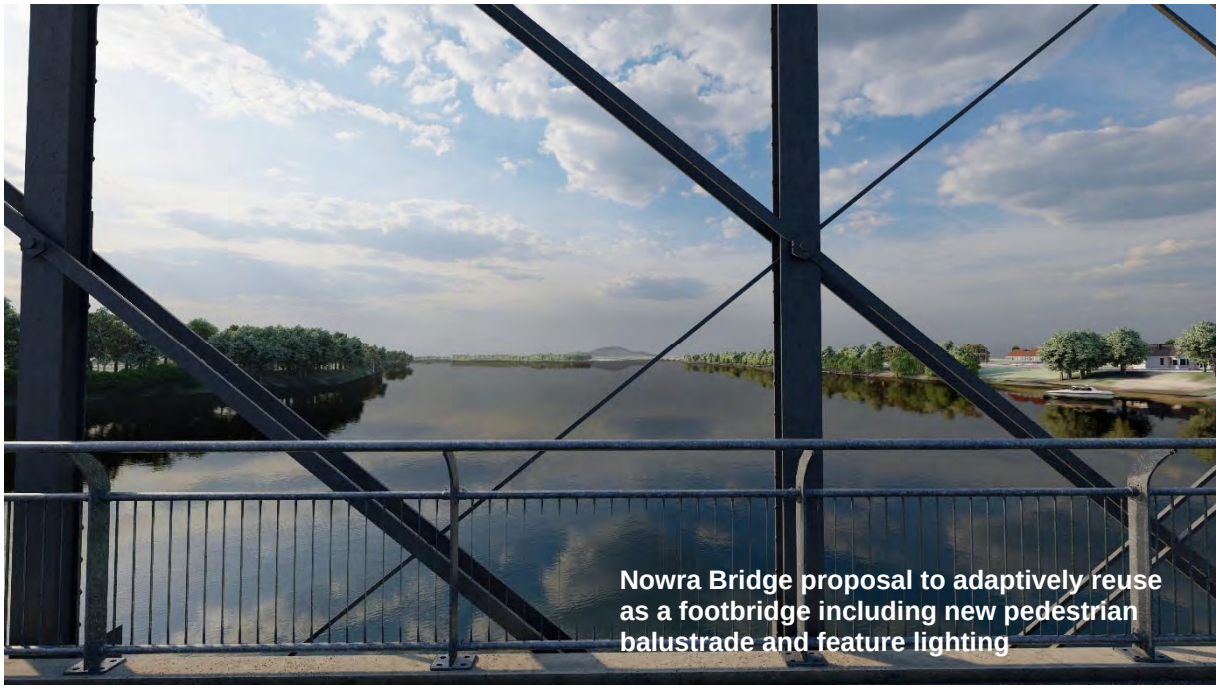
Nowra Bridge proposal to adaptively reuse as a footbridge including new pedestrian balustrade and feature lighting

Nowra Bridge as existing before repainting, removal of the clip-on walkway and services



Nowra Bridge proposal to adaptively reuse as a footbridge including new pedestrian balustrade and feature lighting

Nowra Bridge as existing before repainting, removal of the clip-on walkway and services



Nowra Bridge proposal to adaptively reuse as a footbridge including new pedestrian balustrade and feature lighting


Nowra Bridge as existing lighting


Nowra Bridge proposal to adaptively reuse as a footbridge new pedestrian and feature lighting

Nowra Bridge as existing street lighting

Nowra Bridge proposal to adaptively reuse as a footbridge - new pedestrian and feature lighting

Nowra Bridge proposal to adaptively reuse as a footbridge – Potential viewing and seating area including interpretive signage

Key benefits

Alignment with Objectives, Heritage Value, and Aesthetics in Repurposing the Bridge

Repurposing the bridge from a road bridge to a shared foot and cycleway offers many advantages. Removing the clip-on walkway, replacing the traffic barrier base, and comprehensive rehabilitation collectively enhance the structure's historical and cultural value. These modifications more closely align the bridge with its original design, effectively preserving and accentuating its heritage features.

Furthermore, the new pedestrian balustrade railing is designed to improve openness and connection with the river, augmenting the bridge's relationship with its natural environment. These strategic improvements achieve dual objectives: It makes the bridge more functional and safer as a shared foot and cycleway and offers the potential for reduced long-term maintenance costs. Simultaneously, it elevates the bridge's visual appeal, heritage conservation, and overall engineering value.

Operational and Maintenance Benefits

The proposal aims to make maintenance operations more manageable while ensuring the bridge's long-lasting usability.

Repainting the bridge, repairing trusses, removing the clip-on walkway, and improving access to structural elements are among the key actions that will contribute to the bridge's longevity.

Removing the existing concrete barrier addresses concerns about its long-term durability, offering the possibility of reduced future maintenance costs.

Safety Enhancements, User Comfort and Functionality

Introducing a new pedestrian balustrade railing will provide a safe environment for pedestrians and cyclists alike. Additional upgrades in lighting will improve visibility, thereby reducing the potential for accidents and contributing to an enhanced sense of security.

User comfort and community interaction are further encouraged through northern foreshore improvements like adding shade structures and seating areas.

Conclusion

The project team has explored options to repurpose this historic structure into an ongoing functional, visually appealing, unique landmark. Collaboratively working to assess four intervention levels, TfNSW have recommended strategic option 2B as the preferred proposal. This medium intervention approach balances preserving the heritage significance while enhancing functionality. Introducing a new pedestrian and cyclist balustrade railing system, feature lighting, northern foreshore amenities, and interpretative signage transforms the bridge into an integrated community asset that respects its historical importance.

The key benefits include enhancing the heritage values, visual appearance, safety, maintenance efficiency, and durability whilst providing a cost-effective long-term solution.

Table of contents

Table index

Figure index

Appendices

Appendix A – Visualisations

Appendix B – Maintenance actions as reported in TfNSW L2 Inspection reports

1. Introduction

Focus Bridge Engineering (FBE) has been engaged by Transport for NSW (TfNSW) to undertake the strategic options development and assessment for the adaptive reuse of the Nowra Bridge (also referred to as the Historic Nowra Bridge), NSW, covering:

- Project objectives, constraints, risks, and opportunities.
- Existing bridge treatments (walkway, utilities, repainting, deck, barriers).
- Adaptive reuse options.
- Options report.
- Engineering heritage planning.
- Recommendations to inform and guide the SOHI.

TfNSW will use the findings from this report to assist in recommending a preferred strategic option for the project.

1.1 Overview

The Nowra Bridge over Shoalhaven River is in Nowra, NSW. The approximate bridge location is circled in red in Figure 1-1.

The project is on the Princes Highway in Nowra NSW, about 120 kilometres south of Sydney.

The Princes Highway is the main north-south regional road corridor linking Sydney and Wollongong to the NSW South Coast and north-eastern Victoria. The highway is an important freight, bus, and tourist route for the south coast, particularly beyond Bomaderry, where the existing rail service terminates. It connects Nowra with commercial centres in the region.

The town of Nowra is a regional centre in the Shoalhaven Local Government Area. The crossing of the Shoalhaven River at Nowra comprises three independent bridges, including the Historic Nowra Bridge.

The bridge dates back to 1881 and is a unique and valuable specimen of a pin-jointed Whipple truss bridge. With the new Nowra Bridge opening in February 2023, the Historic Nowra Bridge is no longer used for road traffic.

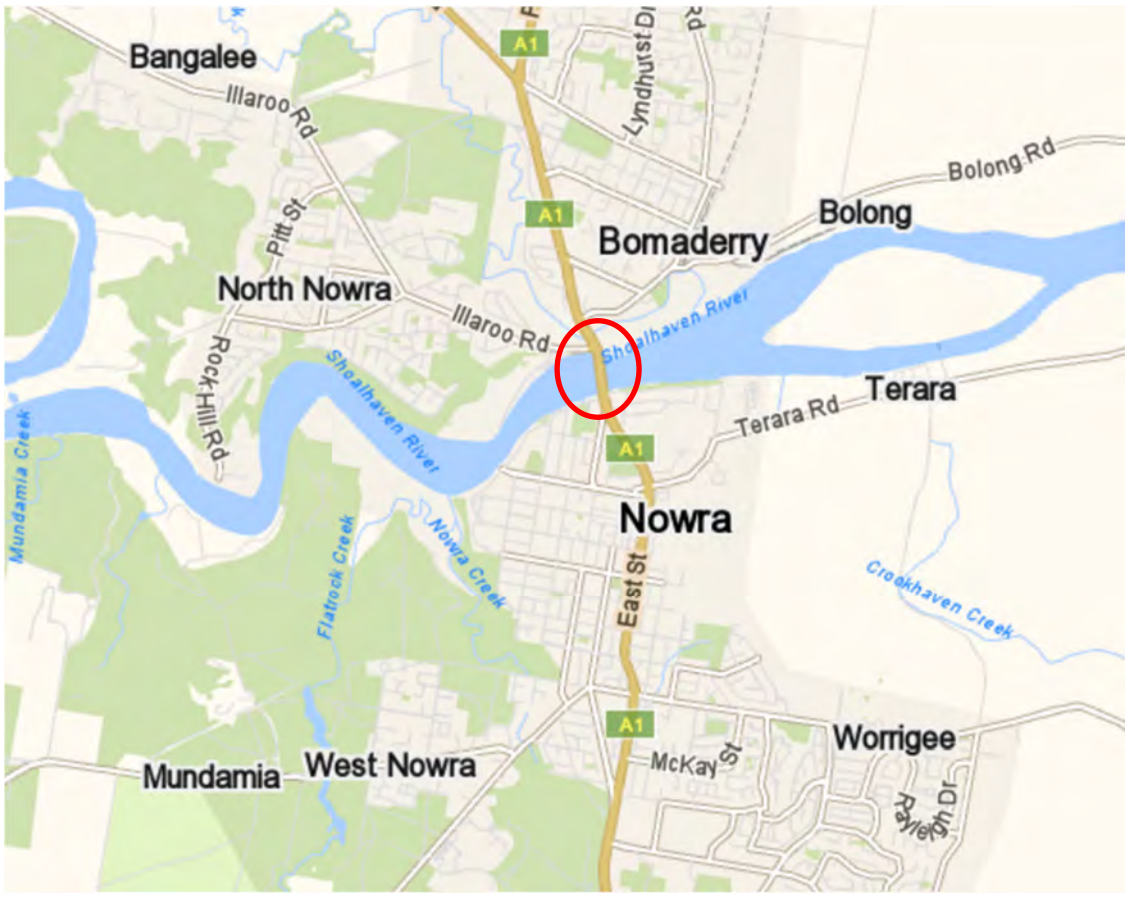


Figure 1-1 Nowra Bridge location plan (Source: Whereis)

1.2 Scope

Focus Bridge Engineering has been engaged to provide an Adaptive Reuse Strategic Options report. This report has been prepared collaboratively with TfNSW.

The scope and report includes:

- Project objectives.
- Site constraints.
- Project scoping, constraints, risks and opportunities associated with strategic treatments (developed in conjunction with TfNSW).
- Consideration of bridge maintenance and improvement treatments such as:
  - Removal of the walkway.
  - Removal of all services.
  - Repainting.
  - Deck treatments, including re-surfacing and renewal options.
  - Movement joint treatments.
  - Removal of top steel traffic barrier rails.
- Adaptive reuse options include but are not limited to:
  - Concrete traffic barriers
  - Potential viewing area(s) on the northern foreshore (TBC).

- Interpretative signage on the northern foreshore.
- Seating, tables, and shade structures.
- Feature lighting.

- Options report including:
  - Preparation of existing bridge model.
  - Preparation of existing and modified bridge heritage strategic sketches, renders, visualisations, and fly-throughs.
  - Brief options analysis, including advantages, disadvantages and indicative cost.
  - Brief strategic options comparative analysis.
  - High-level strategic cost estimates for comparative purposes only.
- Engineering heritage assessment and planning.
  - Brief history and significance.
  - Preliminary heritage significance impacts assessment and mitigation measures.
  - Project proposals (options), their implications, mitigation and heritage impacts.
- A workshop with key internal TfNSW stakeholders to present and recommend preferred strategic adaptive reuse options.
- Recommendations to inform and guide the preparation of a SOHI and REF.

FBE has worked collaboratively with a range of TfNSW subject matter experts (SMEs) throughout the development of this project and the associated report. This includes professionals in urban design, heritage, environment, bridge, and construction. Throughout this document, the term “SMEs” is used interchangeably with “internal TfNSW Stakeholders” to refer to this same group of experts within Transport for New South Wales who possess specialised knowledge or expertise relevant to the project.

1.3 Supplied information

The information supplied by TfNSW is shown in Table 1-1.

Table 1-1 TfNSW supplied documents (Source: TfNSW)

Document or reference	Date	Description
2021008_B00713 Nowra Bridge - condition assessment report for pedestrian use	October 2021	The report provides Technical Guidance regarding the longevity of the paint coating system for the bridge, as well as an evaluation of the bridge’s structural integrity to accommodate future pedestrian usage.

Document or reference	Date	Description
Draft Phase 1 Conservation Management Plan	June 2015	The document serves as a Phase 1 Conservation Management Plan (CMP) for the Nowra Bridge Project, part of the Princes Highway Upgrade. It aims to inform the evaluation of future options for the truss bridge. The objectives of this phase include understanding the bridge's historical and geographical context, preparing a statement on its significance, identifying constraints and opportunities, and developing preliminary conservation policies.
Non-Aboriginal Statement of Heritage Impact	August 2018	The Statement of Heritage Impact (SOHI), prepared by Artefact Heritage on behalf of SMEC, covered the now-completed new bridge project over the Shoalhaven River.
B00713 Nowra Bridge - Condition Assessment Report_ Version 4_ 20221214	14 December 2022	This report evaluates the bridge’s capability to accommodate future pedestrian traffic and contains Technical Recommendations on the paint coating system’s durability and the bridge’s structural suitability.
B00713 OP Evaluation Inspection L3 2014-02-11_report_HF	13 February 2014	Level 3 inspection report.
B0713 OP Evaluation Assessment Draft Special Inspection 2022_01 H Fok	January 2022	The objectives of this investigation were to conduct special inspections and to supervise NDT measurements on selected components chosen from the level 2 inspection report dated 2020. Analytical load assessment of those selected components in “as is” condition To recommend management action and/or rehabilitation options to carry the proposed pedestrian loads.
BN 713 Shoalhaven River bridge August 2022.pdf	August 2022	L2 Inspection Report.
Latest L2 Report 18112021.pdf	11 November 2021	L2 Inspection Report.
0001.404BC.0375_1881.pdf	1881	WAE Drawings.

Document or reference	Date	Description
21217 Nowra Bridge draft HIS 01 08 2022.pdf	April 2022	Draft Aboriginal Heritage Interpretation Strategy.
Attachment K - Independent review of proposed future use of old Nowra Bridge.pdf	June 2017	Independent Review of the Proposed Future Use of the Old Nowra “Whipple” Truss Bridge.
Attachment V - Nowra Bridge Value Management Workshop Report - May 2014.pdf	May 2014	Site options assessment value management workshop report.
Bridge repurposing project - Transport for NSW.pdf	4 February 2022	Shoalhaven City Council Submission Historic Nowra Bridge Repurposing Project.

1.4 General assumptions

FBE has prepared this report based on information provided by TfNSW and others, which FBE has not independently verified or checked beyond the agreed scope of work. Consequently, FBE does not accept liability in connection with any provided information, including any resultant errors and omissions in the report.

This report’s opinions, conclusions and recommendations are based on our assumptions, and FBE disclaims any liability arising from incorrect assumptions.

The following has not been included in our report:

- Dilapidation survey.
- Utility relocation and/or design.
- Allowance for any statutory or regulatory approvals.
- Unknown issues not identified at this strategic stage.

1.5 Specific assumptions

This report has been developed to assist TfNSW in considering adaptive reuse options for the bridge. It is a strategic investigation of options only. It will be an input into the subsequent work to be undertaken by TfNSW, including preparing a Review of Environmental Factors (REF). Consequently, FBE have made the following project-specific assumptions, which include but are not limited to:

- Services and DBYD outcomes, protection and relocation designs are beyond the scope of this report.
- There is no allowance for hazardous materials (such as asbestos), contaminated fill or disposal to specialist licenced landfills contained within the estimate or generally throughout this report.

2. Nowra Bridge

2.1 Description

The Historic Nowra Bridge, located in Nowra, is a significant heritage structure that spans the picturesque Shoalhaven River. Completed in 1881, this bridge holds local and state historical importance as it was one of the oldest crossings in the region. It is a remarkable example of a pin-jointed Whipple truss bridge, showcasing its intricate engineering and architectural design. With its sturdy construction and charming aesthetics, the Nowra Bridge stands as a testament to the rich history and craftsmanship of the area. As an unofficial gateway to the South Coast, the bridge's graceful presence continues to captivate visitors and locals alike.

Figure 2-1 Historic Nowra Bridge (Source: FBE)

The bridge consists of eight (8) Whipple-type wrought iron trusses span and an approach span referred to as span 9. The truss members are constructed from wrought iron, manufactured in the United States, transported to Australia, and assembled locally. The first truss span measures 56.1 m long, while the remaining seven truss spans are 38.5 m long each. The approach span at the Nowra end is a wrought iron plate girder span spanning a length of 15.2 m. There is a combined total bridge length of 341 m.

The bridge's wrought iron truss span deck consists of a concrete deck supported by wrought iron stringers. Wrought iron cross girders transfer the loads on the stringers to the trusses, which support the stringers. Similarly, the approach span 9 deck is also supported by stringers, which are supported by cross girders that transfer the loads to the main plate girders.

The bridge spans are supported by eight piers, each consisting of two cast iron caissons manufactured in Australia.

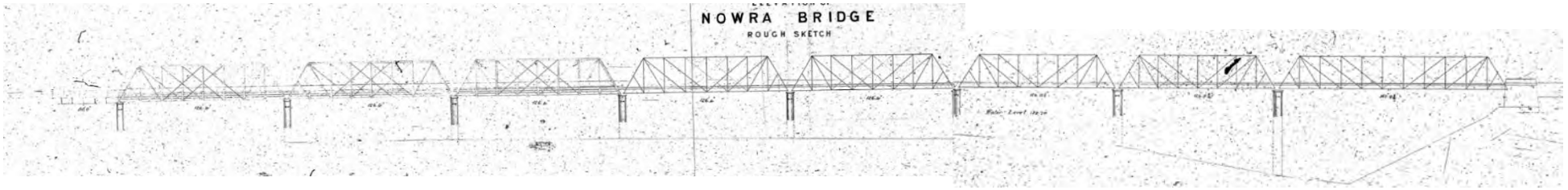


Figure 2-2 Nowra Bridge elevation from downstream (Source: DMR WAE drawings)

Figure 2-3 Nowra Bridge spans from the downstream side (Source: FBE)

2.2 Bridge Information

Due to the bridge's age, detailed information, including the quality of the existing WAE drawings, is somewhat limited. FBE has relied on the available information, site visits and discussions with TfNSW SMEs to prepare this report.

3. Site inspection

The site inspections took place on 29 November 2022 and 19 July 2023 with staff from FBE and representatives from TfNSW. On 19 July 2023, access was available on the road deck as the bridge was closed to traffic. Otherwise, access to the bridge was generally available from the road, deck and ground levels. There were 425 photographs taken, recording as many aspects as possible of the site and bridge.

To ensure consistency of naming conventions with other available TfNSW reports, Span 1 is at the northern (Sydney) end of the bridge, while Span 9 (approach span) is at the southern (Nowra) end.

Inspection details and observations are grouped into superstructure and substructure elements and are provided in the subsequent sections.

A summary of the condition and findings are presented in Table 3-1.

Table 3-1 Summary condition of Nowra Bridge (Source: TfNSW)

Element	Condition/notes
Approach span 9	Good
Road Deck	Fair
Bridge Joints	Good
Pedestrian walkway	Not rated
Traffic Barrier	Not Rated - Corrosion and section loss are noted on the steel twin rail at various locations. Additionally, the modified concrete jersey kerb has cracking and spalling. Span 1 (4th post on the eastern side of the bridge from Abutment A) and Span 9 (3rd post from Abutment B) has the worst reported damage.
Whipple Truss	The condition of the Trusses (bottom bracings, bottom chord, cross girders, diagonal, gusset plates, principals, stringers, top bracings, top chord and verticals) was rated as **"Poor"** by TfNSW. However, the protective coating had a rating of **"Good".**
Bearings	Fair
Piers	Fair
Abutments	• Not Rated. Badly cracked stone pitching at Abutment B (Northern Sydney End) wing wall. • Spalling and broken section of the wing wall at Abutment B end between bridges. • Southern Abutment Nowra End A – New stone pitching as part of the bridge works.

3.1 Superstructure

The bridge superstructure consists of the following key elements:

- Approach span (Span 9).
- Road deck (Expansion joints, seal, reinforced concrete deck, traffic barriers).
- Pedestrian walkway and balustrade railing.
- Wrought Iron 'Whipple Truss' (Spans 1-8).
- Girders and bearings.
- Other key features.

These elements are discussed in further detail in the below sections.

3.1.1 Approach span 9

Approach Span 9 is a 15.2m span made of wrought iron plate girders. Stringers support the deck, which are supported by cross girders, which transfer the loads to the main plate girders. Steel corrugated permanent Armco formwork is in place from deck strengthening undertaken in 1981.

Condition

From the review of level 2 information, essential maintenance items include corrosion, section loss, and a section of damaged concrete kerbing where the steel traffic barrier connects.

Figure 3-1 Approach span 9 (Source: FBE)

Figure 3-2 Soffit span 9 (Source: FBE)

The overall rating has been assessed as **"good"** by TfNSW.

3.1.2 Road deck

Reinforced concrete deck and surfacing

The wrought iron truss span deck consists of a concrete deck supported by wrought iron stringers. Wrought iron cross girders transfer the loads onto the trusses supporting the stringers. The concrete deck has asphalt surfacing. Armco trough-type permanent formwork is also present.

Condition

There may be localised areas of concrete spalling and cracking present in the deck, as reported in the most recent level 2 inspection (TfNSW, February 2014).

Additionally, several areas of asphalt have been noted as failing and require minor to moderate pavement patching and crack sealing repairs.

The overall rating of the concrete deck has been assessed as **"Fair"** by TfNSW.

Figure 3-3 Road deck (Source: FBE)

Bridge joints

Various joint types are noted on the bridge:

- Compression seals (pedestrian walkway).
- Steel-nosed open joints (truss spans).
- XJS polymer nosed expansion joint system at the abutments.

The information available makes it unclear if the joints are working efficiently or as expected.

Condition

The overall rating of the bridge joints has been assessed as **"Good"** by TfNSW.

Figure 3-4 Bridge joint with steel nosing (Source: FBE)

3.1.3 Pedestrian walkway

The clip-on pedestrian walkway on the bridge's eastern side has pedestrian balustrade railing located on either side.

Condition

Its main issues appear to be uneven surfaces and/ or protruding compression seals. Some minor spalls and cracking are also present.

Figure 3-5 Pedestrian Walkway (Source: FBE)

3.1.4 Traffic barrier

The traffic barriers on the bridge consist of a modified concrete jersey kerb base and a twin steel railing connected to the top surface at thickened areas.

Condition

As highlighted in the Level 2 inspection report, corrosion and section loss are noted on the steel twin rail at various locations. Additionally, the modified concrete jersey kerb has cracking and spalling. Span 1 (4th post on the bridge's eastern side from Abutment A) and Span 9 (3rd post from Abutment B) have the worst reported damage. TfNSW conducted a concrete condition survey in 2023 that found no current penetration of chlorides and carbonation to the reinforcing steel. A discussion of the results from the survey and options for remediation are provided in Section 5.2.2.

Figure 3-6 Traffic barrier (Source: TfNSW)

3.1.5 Whipple Truss

The bridge consists of nine spans, eight of which are Whipple trusses and one span made of iron plate girder. The Whipple trusses, constructed using wrought iron, were manufactured in the US, transported to Australia, and assembled on-site. Span 1, located at the Sydney end, measures 56.1m, while spans 2 to 8, comprising the other seven truss spans, are each 38.5m long.

The key elements of the Whipple truss are noted in the various inspection reports and covered more broadly in Section 4.4.

The Whipple truss has a unique design where the inclined members don't connect directly to the adjacent vertical and bottom chord junctions. Instead, they cross over to the second junction and are held in place by Rossette-shaped washers to prevent vibrations.

Several of these washers are broken and need replacement. Additionally, certain diagonals have turnbuckles for tension adjustment that require re-tensioning.

Condition

The condition of the Trusses (bottom bracings, bottom chord, cross girders, diagonal, gusset plates, principals, stringers, top bracings, top chords and verticals) was rated as **"poor"** by TfNSW. However, the protective coating had a rating of **"Good".** Additionally, the Level 2 Inspection notes the following:

"Strengthening of the top chord and verticals at areas around the pin connections, most areas have been rehabilitated but there are some that will need monitoring. Some of the square and plate bracing on the truss are either deformed, loose and have come away form the vertical strut connection. The span 7 and 8 spans seems to have a lot of movement occurring in the deck, with a lot of broken vertical strut washers".

Figure 3-7 Various Views of the Nowra Bridge Whipple Truss (Source: FBE)

Figure 3-8 LHS: Damaged rosette-shaped washers RHS: New Strengthening tension member span 1 (Source: FBE)

3.1.6 Bearings

Each truss span has one pinned bearing and one sliding bearing to accommodate thermal expansion.

Condition

The most recent level 2 inspection (TfNSW, August 2022) found significant damage to spans 3 and 4 locations for bridge bearings, and all five end cross girders require remedial action.

The overall rating of the bridge bearings has been assessed as **"Fair"** by TfNSW.

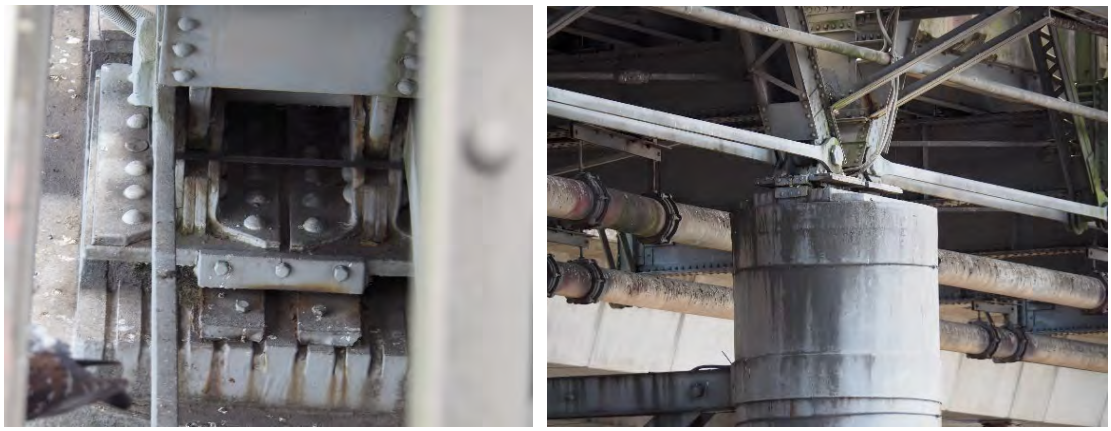


Figure 3-9 Bridge Bearings (Source: FBE)

3.1.7 Other features

Existing Bridge Lighting

Two overhead lights are generally provided per truss situated on the eastern side of the truss and overhanging slightly towards the carriageway.

Figure 3-10 Bridge Lighting (Source: FBE)

Utilities

Several utilities are located on the bridge, and the utility search results are summarised in Table 6-1. It should be noted that some of the assets may have already been relocated to the new bridge (TfNSW to confirm).

Figure 3-11 Utilities located on the bridge (Source: FBE)

Bridge Signage

Low clearance signs are located on the Abutment A end of the bridge. At the time of writing, these signs were planned to be removed.

Figure 3-12 Northern end of the bridge (existing signage) (Source: FBE)

3.2 Substructure

The bridge substructure consists of the following key elements:

- Piers Cast iron (caissons).
- Abutments.

These elements are discussed in further detail in the below sections.

3.2.1 Piers (Caissons)

The bridge is supported by eight piers, each consisting of two cast iron caissons manufactured locally in Australia. The caissons were recently repainted. The Cathodic Protection (CP) protects the piers from further graphitisation and appears to function successfully. The most recent structural assessment has found that the piers have adequate capacity.

Figure 3-13 Bridge piers (Source: FBE)

3.2.2 Abutments

Northern abutment

The northern abutment of the bridge retains much of its original form and fabric, constructed from dressed sandstone blocks set on concrete footings supported by timber piles. The sandstone extends to wing walls on both sides of the abutment. A minor shift at the eastern face has been stabilised with steel strapping. Some of the upper stonework has been displaced due to the installation of pipes under the bridge. Road drainage is integrated into the wing walls, managed by spoon drains on the eastern side and a large-diameter pipe that reroutes water across the western side.

Figure 3-14 Abutment A - Sydney end (Source: FBE and TfNSW)

Southern abutment

The southern abutment, in contrast, has seen extensive alterations. The original structure is believed to be similar to that of the northern abutment. The current configuration supports the two plate web girders on circular concrete piers. The side facing the river has been battered and paved with sandstone, with the pavers likely to have been installed at the time of the adjacent concrete bridge's construction in 1981. This flagging meets an older stone wall, which is thought to date back to when the original wall was replaced. Adjoining this is a subsequent phase of stonework that ends at concrete crib blockwork, which constitutes the eastern edge of the abutment. It is understood that the footpath and some of the stone pitching has been repaired and or cleaned as part of the most recent project.

Figure 3-15 Abutment B - Nowra end (Source: FBE)

Condition

The stone pitching at Abutment B, situated at the northern Sydney end, has not been rated by TfNSW and exhibits severe cracking. There is also evident spalling and damage to sections of the wing wall at this abutment, particularly between the adjacent concrete bridge. On the other hand, the southern Abutment Nowra End A has seen enhancements, with new stone pitching introduced as part of the recent new bridge works.

3.3 Existing condition assessment for pedestrian use

Bridge and Structures (South) prepared the report titled: “Existing Condition Assessment for Pedestrian Use” (TfNSW, March 2022) to assess the condition of the bridge for future pedestrian traffic. This report includes two aspects: an evaluation of the paint coating system’s durability and a structural assessment of the bridge’s capability to accommodate pedestrian traffic in the future.

3.3.1 Summary of findings

Structural assessment

- Truss elements can adequately support pedestrian/cycleway traffic.
- Specified crowd loading of 5 kPa is heavier than current traffic loads on the bridge.
- The downstream walkway was designed for 3 kPa, but bridge elements were assessed for 5 kPa.
- Heavy loading is unlikely in the near future, and associated risks can be managed.

- Most existing damages to truss elements may not require strengthening for pedestrian/cycleway loading.
- Some damages require inspection, including non-destructive testing (NDT), for confirmation.
- Cast iron piers generally have sufficient capacity.

Protective coating assessment

- The existing paint system on the bridge is over 35 years old and consists of zinc-rich epoxy primer, Universal Metal Primer, and two coats of chlorinated rubber.
- Site inspection revealed paint degradation, delamination, metal thickness loss on the underdeck elements, and extensive corrosion at the bottom nodal points of the truss span.
- The condition of the above deck elements appeared to be less degraded, but some locations, especially connections, showed visible ferrous corrosion.
- The chlorinated rubber topcoat has a high percentage of volatile organic compounds and is not environmentally friendly, so it is not commonly used for TfNSW asset maintenance painting.
- The product is supplied through a single source, raising concerns about reliability.
- The piers were recently repainted with the SC7 coating system in accordance with TfNSW specification B220, and further treatment is not expected.

Non-destructive testing (NDT) findings

- NDT (Non-Destructive Testing) of critical elements was performed by Bureau Veritas Asset Integrity (BV) on specific dates.
- The NDT included visual inspection and ultrasonic thickness measurement of nominated bearings and cross girders at spans 1 to 5.
- Ultrasonic testing (UT) was not possible due to the bridge material type (wrought iron), which causes significant attenuation of the UT signal.
- Efforts were made to obtain back wall echo of the 475mm pins, indicating that they have not fully failed circumferentially.
- NDT examinations were limited to areas where corrosion products could be removed, with further restrictions due to internal tie rod arms.
- Limited localised removal of accessible rusts was performed, and no cleaning of scale product was carried out.
- Measurements were estimated using rulers, pit depth gauges, and manual assessment.
- The highest section loss in bearing areas was observed at Span 1 Pier 1 Up-Stream (US), with a 12mm wall thickness loss in a 120mm x 150mm area.
- The highest section loss in cross girder areas was observed at the north side of CG9 in Span 4, where the doubler plate above the cross girder was rusted entirely, and the top flange thickness was reduced to 3.5-8.2mm from the original 10mm thickness in a 70mm x 1300mm area.

3.4 Draft special inspection report

Bridge Assessment and Evaluation (BAE) prepared a report titled “Draft special inspection report” (TfNSW, January 2022), the report focused on investigating the feasibility of converting the road bridge into a pedestrian-only bridge. The objectives were to:

- Conduct a special inspection and supervise NDT measurements on selected components from the level 2 inspection report.
- Perform analytical load assessment of the selected components in their current condition.
- Recommend management actions and/or rehabilitation options to accommodate the proposed pedestrian loads.

3.4.1 Summary of findings

- The inspection found significant damage at two locations in spans 3 and 4 for bridge bearings, and all five end cross girders require remedial action.
- Detailed inspection of the above deck truss members was not conducted within the time constraint.
- Analysis of damaged bridge bearings revealed constraints in repair or replacement due to pin-type bearings and lack of guidance from the AS5100 standard.
- The structural assessment showed the highest average compressive stress at Span 1 U/S bearing at Pier 1, which was 25% overstressed but still acceptable.
- Proposed works include repairs, feasibility investigations, measurements after cleaning, and repair of impact-damaged truss members.
- Repainting the bridge and making repairs would extend its lifespan as a pedestrian bridge.

3.5 Inspections

TfNSW undertakes Level 2 visual inspections every two years as the current business rules require. The last L2 inspection was completed in 2022 and is summarised In Appendix B. The condition summary is provided below in Table 3-2.

Table 3-2 Level 2 inspection condition summary (Source: TfNSW)

BN0713	**Bridge over Shoalhaven River Southbound at Nowra**				**Quantities: TfNSW**			
Inspection Date: 23 August 2022					**Inspector: Steve Watson**			
Code	**Element Description**	**Health Rating**	**Total Qty***	**Unit**	**Estimated quantity or percentage of total in Condition State**			
					1	**2**	**3**	**4**
BEXP	Metal expansion bearing	Fair	18	ea	0	0	18	0
BFIX	Metal Fixed Bearing	Fair	18	ea	0	0	18	0

BN0713	Bridge over Shoalhaven River Southbound at Nowra				Quantities: TfNSW			
Inspection Date: 23 August 2022					Inspector: Steve Watson			
Code	Element Description	Health Rating	Total Qty*	Unit	Estimated quantity or percentage of total in Condition State			
					1	2	3	4
CDSL	Concrete-Deck Slab	FAIR	2,888	m^2	2,853	33	2	0
JCOS	Compression Joint Seal	Good	40	m	0	20	20	0
JNOS	Joint - No Seal	Good	28	m	0	28	0	0
JPOS	Pourable / Cork Joint Seal	Good	6	m	5	0	1	0
MAPP	Approach Carriageway	Good	2	ea	0	1	0	1
MBAT	Batter protection	Good	90	m^2	40	20	30	0
MGCL	General Cleaning	Good	9	ea	0	0	9	0
MMAS	Brick / Masonry / Reinforced Earth	Good	44	m^2	0	34	10	0
MWES	Wearing surface	Good	1,896	m^2	1,856	0	40	0
MWWY	Waterway	As-built	1	ea	1	0	0	0
PBGI	Protective Coating - Beam / Girder (Load Bearing)	Good	1,140	m^2	540	500	60	40
PCBT	Protective Coating - Cables/Hangers/Tension Ties (Not embedded in concrete)	Good	160	ea	0	0	145	15
PCOD	Protective Coating - Corrugated/Orthotropic/etc Deck	Good	2,781	m^2	1,531	1,100	150	0
PDBR	Protective Coating - Diaphragm/Bracing/Secondary Member	Good	300	m^2	76	139	79	6
PPIL	Protective Coating - Pile (including steel-cased concrete pile or caisson)	Good	529	m^2	112	150	247	20
PTBB	Protective Coating - Truss – Bottom Bracings	Good	110	m^2	20	15	68	7

BN0713	Bridge over Shoalhaven River Southbound at Nowra				Quantities: TfNSW			
Inspection Date: 23 August 2022					Inspector: Steve Watson			
Code	Element Description	Health Rating	Total Qty*	Unit	Estimated quantity or percentage of total in Condition State			
					1	2	3	4
PTBC	Protective Coating - Truss - Bottom Chord	GOOD	295	m^2	106	90	97	2
PTCG	Protective Coating - Truss - Cross Girder	GOOD	1,072	m^2	175	153	707	37
PTDG	Protective Coating - Truss - Diagonals	GOOD	290	m^2	202	52	20	16
PTGP	Protective Coating - Truss - Connection Gusset Plates	GOOD	174	m^2	62	43	19	50
PTPR	Protective Coating - Truss - Principal	GOOD	736	m^2	365	312	30	29
PTST	Protective Coating - Truss - Stringers	GOOD	3,337	m^2	1,000	672	1,607	58
PTTB	Protective Coating - Truss - Top bracings	GOOD	993	m^2	443	130	280	140
PTTC	Protective Coating - Truss - Top Chord	GOOD	1,101	m^2	281	435	187	198
PTVT	Protective Coating - Truss - Verticals	GOOD	894	m^2	534	310	41	9
RCMB	Combined Bridge Railing	GOOD	683	m	512	152	19	0
RMET	Metal Railing	GOOD	683	m	343	200	140	0
RPNT	Railing Paint Work	GOOD	683	m	168	275	240	0
SBGI	Steel - Beam / Girder (Load Bearing)	POOR	1,140	m^2	519	520	100	1
SCBT	Steel - Cables/Hangers/Tension Ties (Not embedded in concrete)	POOR	160	ea	1	125	26	8
SCOD	Steel/Aluminium-Corrugated/Orthotropic/etc	FAIR	2,854	m2	2,033	440	381	0

BN0713	Bridge over Shoalhaven River Southbound at Nowra				Quantities: TfNSW			
Inspection Date: 23 August 2022					Inspector: Steve Watson			
Code	Element Description	Health Rating	Total Qty*	Unit	Estimated quantity or percentage of total in Condition State			
					1	2	3	4
SDBR	Steel - Diaphragm / Bracing / Secondary Member	FAIR	662	m2	530	)89	35	8
SPIL	Steel - Pile	GOOD	529	m^2	279	250	0	0
STBB	Steel - Truss Bottom Bracings	POOR	110	m^2	28	40	32	10
STBC	Steel - Truss Bottom Chord	POOR	295	m^2	160	97	23	15
STCG	Steel - Truss Cross Girders	POOR	1,072	m^2	602	410	55	5
STDG	Steel - Truss Diagonals	POOR	290	m^2	191	52	37	10
STGP	Steel - Truss Connection Gusset Plates	POOR	174	m^2	80	75	11	8
STPR	Steel - Truss Principals	POOR	736	m^2	641	40	22	33
STST	Steel - Truss Stringers	POOR	3,337	m^2	2,426	650	211	50
STTB	Steel - Truss Top bracings	POOR	993	m^2	716	230	19	28
STTC	Steel - Truss Top Chord	POOR	1,101	m^2	966	80	42	13
STVT	Steel - Truss Verticals	POOR	894	m^2	596	230	30	38
USPL	Underwater SPIL - Steel Pile	AS-BUILT	296	m^2	296	0	0	0

The L2 inspection rates the following elements as:

3.5.1 Poor condition

- Wrought Iron - Beam / Girder (Load Bearing).
- Wrought Iron - Cables/Hangers/Tension Ties (Not embedded in concrete).
- Wrought Iron - Truss Bottom Bracings.
- Wrought Iron - Truss Bottom Chord.
- Wrought Iron - Truss Cross Girders.

- Wrought Iron – Truss Diagonals.
- Wrought Iron - Truss Connection Gusset Plates.
- Wrought Iron Truss Principals.
- Wrought Iron - Truss Stringers.
- Wrought Iron - Truss Top bracings.
- Wrought Iron - Truss Top Chord.
- Wrought Iron - Truss Verticals.

3.5.2 Fair condition

- Metal expansion bearing.
- Metal Fixed Bearing.

3.5.3 Good condition

- Compression Joint Seal.
- Joint - No Seal.
- Pourable / Cork Joint Seal.
- Approach Carriageway.
- Batter protection.
- General Cleaning.
- Brick / Masonry / Reinforced Earth.
- Wearing surface.
- Protective Coating.
    - Beam / Girder (Load Bearing).
    - Cables/Hangers/Tension Ties (Not embedded in concrete).
    - Corrugated/Orthotropic/etc. Deck.
    - Diaphragm/Bracing/Secondary Member.
    - Pile (including cast iron cased concrete pile or caisson).
    - Truss – Bottom Bracings.
    - Truss - Bottom Chord.
    - Truss – Cross Girder.
    - Truss – Diagonals.
    - Truss - Connection Gusset Plates.
    - Truss – Principal.
    - Truss – Stringers.
    - Truss - Top bracings.
    - Truss - Top Chord.
    - Truss – Verticals.

- Combined Bridge Railing.
- Metal Railing.
- Railing Paint Work.

3.5.4 As-built

- Concrete deck slab.
- Waterway.

3.5.5 Maintenance actions

The L2 report outlines the defects and required maintenance actions for Nowra Bridge and can be found in Appendix B. Previous repairs and maintenance works.

Table 3-3 summarises the maintenance and rehabilitation since the bridge's construction.

Table 3-3 Previous repairs and maintenance works Nowra Bridge (Source: TfNSW)

Year	Description
1950	• The original timber deck was replaced with a corrugated steel deck filled with asphalt, and a walkway was attached to the downstream side.
1981	• Asphalt was replaced with concrete, traffic barriers were installed, and the walkway was upgraded to the existing condition. The deck was strengthened to support NAASRA 1976 loading in accordance with drawings 0001 404BC0372.
1984	• Superstructure steel works repainted.
1997	• A heavy vehicle impact damaged truss span 1 on the downstream side. • Several damaged members of the truss were partially replaced.
2010	• A cathodic protection system was installed to protect the cast iron piers from further graphitisation.

4. Heritage

4.1 Heritage listings

The Nowra Bridge holds multiple listings and registrations. It is included in the TfNSW S170 register with the database number 4301658. It is also listed in the Shoalhaven LEP 2014 with the LEP number 402 and the RNE.

Additionally, the bridge appears on the Illawarra REP No. 1. Notably, it earned a place on the National Trust Register in 2014.

A summary of listings are provided in Table 4-1.

Table 4-1 Summary of heritage listings for the Nowra Bridge (Source: Artefact Heritage)

Type	Name	Heritage Listing	Heritage Significance
Statutory	Nowra Bridge over the Shoalhaven River	TfNSW Heritage and Conservation Register (s170 under the Heritage Act) #4301658	State
Statutory	Old Nowra Road Bridge – across Shoalhaven River	Illawarra REP No. 1. 14236	Not stated
Statutory	Shoalhaven Bridge	Shoalhaven Local Environmental Plan 2014 # 402	Local
Non - Statutory	Nowra Road Bridge	Register of the National Estate #15932	Not stated

4.2 History of metal truss bridges in NSW

Cardno MBK completed the Study of Heritage Significance of Pre-1930 RTA Controlled Metal Road Bridges in NSW in 2001. The following is an extract from their historical review, which can be found on the TfNSW website:

https://www.transport.nsw.gov.au/system/files/media/documents/2023/bridge-types-historical-overviews-2006-pre1930metal.pdf

The chronological list of metal bridges supplied with the Brief provides a convenient framework for this historical review for which there are the following principal papers:

- *The First 60 Years of Metal Bridges in New South Wales (Fraser D.J. 1986).*
- *Moveable Span Bridges in New South Wales prior to 1915 (Fraser D.J. 1985).*
- *Curved-tracked Bascule Bridges in New South Wales and their relationship to the Cardioid (M A B Deakin and D. J. Fraser 1995).*
- *The Roadmakers (Department of Main Roads New South Wales 1976).*

- *Bridge Building in New South Wales 1788-1938 (Department of Main Roads New South Wales).*
- *All About Bridges (Department of Main Roads New South Wales 1970).*
- *Issues of Main Roads (Department of Main Roads New South Wales).*
- *Highway Bridge Construction. The Practice in New South Wales 1924 six-part series (Percy Allan 1924).*

Other references are cited where they are relevant. However, the supplied list does not indicate what type of bridge each entry is (arch, truss, girder/beam or moveable span), nor the material used (cast iron (CI), wrought iron (WI) or steel). This limits the ability of the list to convey a historical overview or to give any evidence of trends in the use of each type of bridge.

Table 4-2 Types, materials and eras of metal bridges in NSW (Source: Cardno)

Number	Sub-type	Age	Material
Arch Bridges			
1	*N/A*	*1889*	*CI*
Trusses Bridges			
27 total		*1865 – 1930*	*WI then steel*
Including 14	*Lattice trusses*	*1874 - 1893*	*WI*
Movable Bridges			
Seven total		*1888 - 1906*	*WI then steel*
Including	*Lift*	*1888*	*WI*
Including 1	*Swing*	*1903*	*Steel*
Including 2	*Bascule*	*1905 - 1906*	*Steel*

Examples of the different types of metal bridges from the 2001 Cardno study.

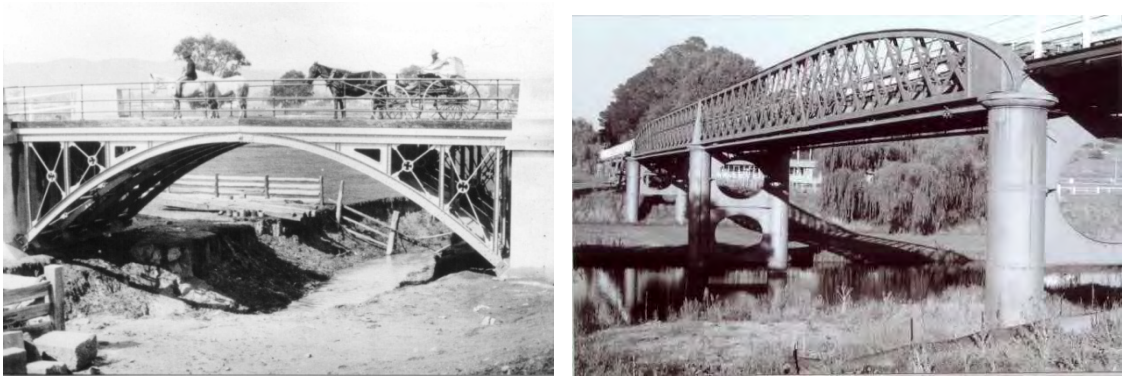


Figure 4-1 The Albury Arch and typical lattice truss (Source: TfNSW)

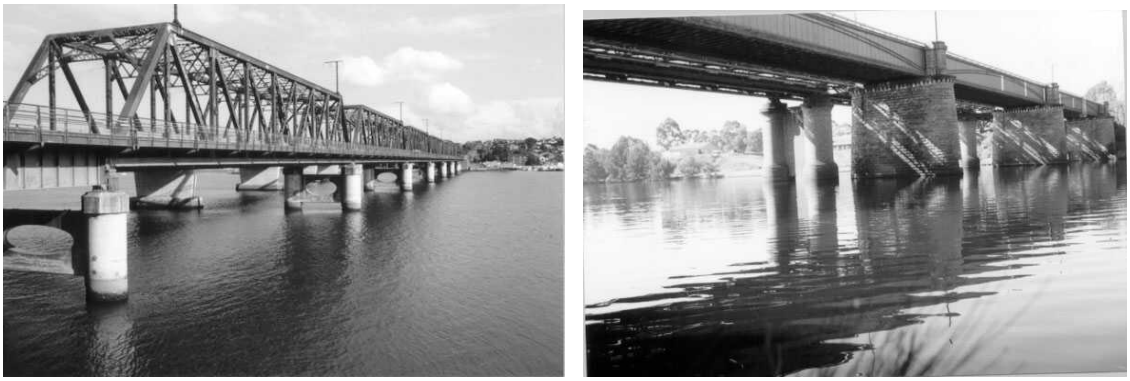


Figure 4-2 Overhead braced truss and Nepean girder, Penrith (Source: TfNSW)

Figure 4-3 Steel beams at Wallarah Creek and lift Bridge at Brewarrina (Source: TfNSW)

In addition to the principal 51 bridges, the RTA supplied details of 32 similar metal bridges under the control of other agencies, such as the Rail Access Corporation and local councils, which are for comparative purposes in assessing the heritage rankings of the 51 bridges. These other bridges are included, where relevant, in the historical review. This review is not simply a presentation of dates and technical facts. It is a component of a broader history in which politics, economics, social inputs, personalities and technological innovations are as important as the technical history, and more so on occasion. For example, the timber beam bridge was the most common form of road bridge in colonial New South Wales (Cardno MBK 2000). These bridges were cheap and easy to build based on the availability of high-quality local hardwoods, such as Ironbark. Although their long-term maintenance costs were to prove high, they became the foundation bridge structure for the developing network of roads (and railways) and by 1900 represented 87% of the road bridge population (PWD Annual Reports). Timber truss bridges, in contrast, comprised approximately 10%.

The cause for this dominance of timber was formalised by government decree in 1861 when the enormous costs of John Whitton's imported wrought iron railway bridges at Menangle, Penrith, and Goulburn had the potential to bankrupt the fragile economy of New South Wales. Only metal bridges with essential technical merits were approved, and only during the boom years of the 1880s was there a significant use of major metal bridges, particularly the lattice trusses. The depression of the early 1890s further restricted the use of metal bridges until the economic recovery began around 1895, by which time steel, also an expensive import, had displaced wrought iron.

Despite establishing a steelworks at Lithgow in 1908, followed by the BHP steelworks at Newcastle in 1916, local production did not meet local needs until the mid-1920s. In the case of the railways, an extensive program of brick arches compensated for the limited steel supply for bridge construction.

4.3 History of the Nowra Bridge

Below is an excerpt from the Draft Conservation Management Plan (CMP) (Artefact Heritage, June 2015) that provides a concise overview of the design, construction, and completion history.

4.3.1 1876-1881: Design and construction

In 1876, planning for the construction of a timber bridge over the Shoalhaven River began. The initial budget for the bridge was £1200. However, additional funds were provided in 1878, and the timber bridge design was overturned in favour of an iron bridge. The reasons behind the additional funding and design variation are unknown. However, a timber bridge was likely seen as impractical for the predicted use of the bridge. For example, the number of piers required for a timber truss bridge far exceeded those needed for an iron bridge. Therefore, a timber truss bridge would have made river navigation difficult. At the time, the timber beam bridge was the most common form of bridge construction in 19th-century NSW. This was primarily due to the high availability of hardwoods, meaning they were inexpensive and easy to construct (although repair and maintenance costs were high). The popularity of timber bridges was so high that by 1900, they represented 87 per cent of NSW's road bridges. As a result, wrought iron and steel bridges from this period are rare.

A newspaper article dated 1879 outlining the bridge's tender process described the overall construction cost to be £28,368. This cost was estimated by Edge Moor Iron Works Company, who had guaranteed the bridge would comfortably 'carry a rolling load of 38½ tons on a wheelbase of 11½ feet, followed by a train of one ton per lineal foot. In comparison, the British-designed bridge was tendered at the cost of £35,758 and could only carry 'two 35-ton tank engines on a wheelbase of 11 feet each, with a one ton per foot train to follow'.

The bridge was designed by prominent Pittsburg-born bridge builder 'C Shaler Smith Engr'. C Shaler Smith was well-known for designing and overseeing the construction of 'some of the major viaducts, swing, and fixed span bridges in the United States, Australia, and Peru during the post-Civil War period. The construction and planning of the bridge would be a significant engineering feat for the time due to difficulties stabilising its footings into the riverbed, which was deep and rocky. The through bridge design was also an essentially American design form, which had been used since the 1840s.

The bridge truss was designed and built in America (by the Delaware-based Edge Moor Iron Works Company) rather than Britain. The use of American bridge designs was especially controversial as NSW was a British colony, and railway technology had been pioneered by the British, most famously in India. The use of American designs was seen as a breakaway from tradition and likely considered unpatriotic.

The bridge was considered an engineering innovation, and upon Whipple's death in 1888, his obituary in Engineering News noted, "The death of Squire Whipple removes from the engineering world a man who by his individuality and originality practically created the modern art of bridge construction; not only in substituting iron for wood in bridges but in also pointing out the law governing the distribution of strain in framed structures and the proper proportioning of the various members in such structures."

The Whipple truss has a pin-jointed lower chord, meaning the bridge has a double intersection truss where diagonals are arranged so that each diagonal spans two panels from the top to the bottom chord. The eight main spans are supported on eight pairs of cast iron cylindrical piers and a wrought iron girder approach span at one end. The Whipple truss design is considered to be a subclass of the Pratt truss bridge, as its diagonal members are designed to work in

tension. The seven trusses of the bridge reflect the American tradition of using large pins at the joints of each diagonal, a practice that significantly reduced assembly and erection times.

4.3.2 1881: Completion of the bridge

When the truss bridge was completed, it was the longest bridge funded by the then Public Works Department, with an overall length of 309 metres. The department was justifiably proud of its investment and displayed one of the Whipple truss spans at the Sydney International Exhibition in 1879. During its construction, the banks of the Shoalhaven River were described as a 'scene of bustle and energy. Offices, storeroom, blacksmith's forge, wharf, roadway, gigantic heaps of broken metal, and the fair lines of the abutment in progress all attract the eye of the visitor and incite his surprise as to how, by the aid of about thirty hands, so much could be accomplished in so brief a period of time.'

The truss bridge (then known as the Shoalhaven Bridge) was opened in 1881, 600 metres west of the Bomaderry Ferry Wharf. Over 6000 people attended the ceremony led by Hon. John Lackey, NSW Minister for Public Works. Once completed, the bridge acted as a 'unifying entity', bringing north and south Shoalhaven together 'economically, politically and socially'.

4.4 Whipple Truss

The Draft Conservation Management Plan (CMP) (Artefact Heritage, June 2015) also includes additional information regarding the development and realisation of the Whipple Truss design and is provided below.

4.4.1 Origin of the bridge design

Truss bridges were a popular bridge form through the nineteenth century. An efficient bridge form is created by widely separating the top chord, which carries compression, from the bottom chord, which carries tension. Connecting the top and bottom chord are vertical and diagonal members which carry either tension or compression depending on where they are in the truss. Also, some elements carry reversing forces depending on where the load is placed on the bridge. With railway loadings, there tends to be a distributed set of axles over a long length, whereas vehicular bridges may be subjected to a similar load layout from a string of cars but may also get a fairly concentrated loading from a single truck, for example. The nineteenth century saw many truss configurations developed, used, and/or patented. The Whipple Truss, patented in 1847 by Squire Whipple, was a variation of the Pratt Truss. It is similar to the Pratt Truss, but instead of the diagonals connecting to the foot of the adjacent vertical, they cross two bays to the foot of the next vertical. This arrangement was particularly effective for long railroad bridges where the tall clearance height meant that the diagonals were at an efficient angle, and the structural redundancy increased the overall stiffness of the truss.

Squire Whipple was born in Hardwick, Massachusetts, in 1804. He trained at Fairfield Academy and then graduated from Union College as a civil engineer. He took out several patents between 1840 and 1872, with the Whipple Truss being patented in 1847. This truss form was considered to give a stronger and more rigid truss form than the Pratt Truss but at the expense of slightly higher complexity and construction cost. The form became the preferred truss in the USA, particularly for long-span (up to 300 feet or 91 metres) railroad and road bridges. By the turn of the century, fashion had turned to the Parker truss, which remained dominant until the 1940s."

Figure 4-4 Whipple Truss Nowra Bridge (Source: FBE)

4.5 Assessment of significance

Items assessed against the State Heritage Reister (SHR) criteria:

Table 4-3 Heritage NSW inventory assessment (Source: Heritage NSW)

Criteria a	*Historical significance*	*The item is of historical significance as the first bridge crossing at Nowra was completed in 1880 and designed by the former American civil engineer and specialist bridge engineer, C Shaler Smith. At its construction, it was the second-largest metal truss bridge in Australia and the largest built by the Public Works Department. The pairs of cast iron piers are original and were supplied locally by the Atlas Foundry, Sydney. It is the only American, pin-jointed Whipple truss in service in New South Wales.*
Criteria b	*Historical Association*	*The structure has associations with American civil engineer and specialist bridge engineer, C Shaler Smith.*
Criteria c	*Aesthetic significance*	*The bridge exhibits the technical excellence of its design, as all of the structural detail are clearly visible. In the context of its landscape it is visually attractive and has strong aesthetic lines. Unlike most bridges, it is particularly striking to those who use the bridge because it is such a long bridge and users are enveloped in the truss. The bridge is set in a very wide section of the river. Due to its length and type it is a landmark structure, a gateway to the South Coast.*
Criteria d	*Social significance*	*The bridge is a local landmark valued by locals and tourists as it is a major crossing of the Shoalhaven River and its construction contributed significantly to the social*

		and commercial development of the South Coast district of New South Wales.
Criteria e	*Research significance*	*The bridge is the only American pin-jointed Whipple truss in service in New South Wales. Also unique was the use of steel, imported from the USA, some 14 years ahead of its general use in New South Wales.*
Criteria f	*Rare assessment*	*This bridge is the only American-style, pin-jointed Whipple truss in service in NSW.* *This item is assessed as historically rare at a State level. It is assessed as aesthetically rare at a State level. This item is assessed as socially rare at a State level.*
Criteria g	*Representativeness*	*This item is assessed as historically representative at a State level. This item is a is assessed as aesthetically representative at a State level. This item is assessed as socially representative at a State level. This item is assessed as scientifically representative at a State level*
	Integrity/Intactness	*Intact*
	Assessed significance	*LOCAL significance (Shoalhaven).*

4.6 Statement of significance

An extract from The Heritage NSW Statement of Significance (Heritage NSW, 03 October 2017) is provided below:

> *"The Shoalhaven Bridge is one of the most important examples of Victorian early long-span bridge construction remaining in Australia. Its siting has dominated the development of the region. Continuing demonstrated social value. An isolated example of American engineering in New South Wales and representative of its type kind, which demonstrates the state of industrial development in New South Wales during the 1870s. Local significance (Shoalhaven)."*

Figure 4-5 Early photograph of Nowra Bridge (Source: Shoalhaven Historical Society)

4.7 Preliminary schedule of significant forms and fabric

The preliminary schedule of significant forms and fabric may change during the development of the SOHI.

4.7.1 Criteria for assigning levels of significance to bridge elements

To facilitate a better understanding of the manner in which each of the elements of a bridge contributes to its overall significance, it is a valuable management tool to separate a bridge into its components and examine the heritage significance of each. This process allows for a more informed analysis of what constitutes significant form and fabric or what fabric is of little significance or intrusive.

Table 4-4 Grading system used for heritage significance (Source: Heritage NSW)

Grading	Justification	Status
EXCEPTIONAL	Rare or outstanding element directly contributing to an item's local or State significance.	Fulfils criteria for local or State listing.
HIGH	High degree of the original fabric. Demonstrates a key element of the item's significance. Alterations do not detract from significance.	Fulfils criteria for local or State listing.
MODERATE	Altered or modified elements. Elements with little heritage value but which contribute to the overall significance of the item.	Fulfils criteria for local or State listing.
LOW	Alterations detract from significance. Difficult to interpret.	Does not fulfil criteria for local or State listing.
INTRUSIVE	Damaging to the item's heritage significance.	Does not fulfil criteria for local or State listing.

Table 4-4 above provides a guide to grading the significance of items or places of heritage value and is directly derived from Guidelines for assessing places and objects against the Heritage Council NSW criteria (Department of Planning and Environment, May 2023).

4.7.2 Schedule of significant forms and fabric, Nowra Bridge

Artefact Heritage

A summary of previous work by Artefact Heritage includes a schedule of significance and grading of individual forms and fabric (Artefact Heritage, June 2015). This is reproduced in Table 4-5 below.

Table 4-5 Grading of the individual forms and fabric (Source: Artefact Heritage)

Bridge component	Justification	Grade
Trusses	The truss spans, being of Whipple truss configuration, are very rare in the New South Wales context, being one of very few constructed and the only bridge remaining in-situ and trafficable. In combination with the use of pin connections, the through Whipple trusses deserve a grading of Exceptional in the State's inventory of bridges. Alterations to the truss form would seriously detract from the uniqueness of the bridge overall.	Exceptional
Entry portals	The truss spans, being of Whipple truss configuration, are very rare in the New South Wales context, being one of very few constructed and the only bridge remaining in-situ and trafficable. In combination with the use of pin connections, the through Whipple trusses deserve a grading of Exceptional in the State's inventory of bridges. Alterations to the truss form would seriously detract from the uniqueness of the bridge overall.	High

Bridge component	Justification	Grade
Truss compression members	Their configuration and detailing are consistent with many truss bridges of the era. However, the truss members are important visual elements of the bridge and contribute to its overall significance.	High
Truss tension members	The use of tension ties with forged eye ends, connecting pins and turnbuckle adjusters all contribute to the grading of these elements as having High significance. Aesthetically, the use of slender tension members instead of the more normal (for the period) stocky members for both tension and compression allows the intended structural behaviour of the trusses to be read clearly.	High
Truss secondary details	The circular cast iron rosettes are an eye-catching detail of the trusses when viewed up close, as possible from the walkway. Unfortunately, the choice of material, being quite brittle, was not a good one for these elements, and many of them have failed, whilst others on the entry portals have been removed. Their grading of significance is High due to their high aesthetic value, but in any reuse scheme, it would be necessary to replace them using a more impact-resistant material such as steel, possibly with a Teflon lining or similar to avoid the wear currently taking place.	High
Decking	The current deck is not original and is of no particular engineering or aesthetic significance, suggesting a grading of Little significance. However, the New Jersey kerb with its RHS steel rails is regarded as Intrusive despite having been necessary to allow the bridge to operate to current design standards. Its aesthetics are certainly quite different from the original lattice fencing of the bridge as-built. In any scheme looking to restore period authenticity to the visual appreciation of the bridge from the deck level, reconfiguration of these kerbs should be considered.	Intrusive
Footway/ Pedestrian Walkway	The footway, whilst being of great amenity, does impair the visual appreciation of the bridge when viewed from downstream, particularly as the handrailing's are painted white, thus contrasting with the standard grey of the bridge metalwork. They are thus graded as Intrusive, and it is suggested that reuse options looking to restore the heritage integrity of the bridge should consider options for removing the footway. (It is acknowledged that the views from the footway provide a more expansive feel than those provided from the bridge deck itself, and judgement would be required in balancing these competing values)	Intrusive

Bridge component	Justification	Grade
Southern approach span	The southern approach span does incorporate original fabric, and substantial modifications detract from its significance.	Moderate
Piers	The piers of the bridge were constructed using caissons sunk and excavated using the pneumatic system of balancing internal air pressure against external water pressure. This construction method proved to be dangerous on a day-to-day basis but also injurious to health, often resulting in the bends. The long-term success of these caissons when subjected to high flood and other loads requires them to be graded as having High significance.	High
Northern abutment	Despite sitting on timber piles for more than 100 years, the high quality of the stonework and relatively good integrity provide a reason for grading this abutment as having High significance, worthy of being part of this important structure.	High
Southern abutment	Being highly modified and reconstructed using a variety of materials, including concrete. Existing services have also disturbed parts of this abutment.	Intrusive
Bearings and expansion joints	The expansion joints, being of recent origin, have little significance. However, the bearings, being part of the intact fabric of the truss bridge, have High significance and provide opportunities to see the style of fixed and expansion bearings being specified by the USA bridge industry at the time.	High

4.8 Peer review

As part of this report, a peer review of the Artefact Heritage significance assessment has been undertaken as presented in Table 4-6. Typically, TfNSW has advised adopting any prior assessments to avoid altering previous appraisals whenever possible.

Table 4-6 Summary of heritage significance gradings (Source: FBE)

Bridge component	Heritage significance grading by Artefact	Departure from Artefact Heritage finding (Y/N)
Trusses	Exceptional	N
Entry portals	High	N (see explanation 5.8.1)
Truss compressions members	High	N
Truss tension members	High	N
Truss secondary details	High	N
Decking	Intrusive	N
Footway	Intrusive	N
Southern approach span	Moderate	N
Piers	High	N
Northern abutment	High	N
Southern abutment	Intrusive	N
Bearings and expansion joints	High	N
Bridge plaque	High	Not included (see 5.8.2)

4.8.1 Entry portals

The entry portals have high aesthetic value due to their intricate detailing, aligning with the period's emphasis on embellished metalwork. Removing the original cresting diminishes their historical authenticity, preventing an “exceptional” rating. Vehicle impact damage and visible heavy corrosion compromise the structural and aesthetic integrity, reducing the heritage grading.

Artefact Heritage’s assessment indicates that while the end portals exhibit high artistic merit, the loss of original features, damage, and corrosion prevent them from receiving an “exceptional” heritage significance grading.

4.8.2 Bridge plaque

The bridge plaque on a decorative sandstone post at the southern approach near the junction of the footpath reads:

> *"Designed and constructed by Edgemoor Iron Co, of Delaware USA, this bridge was commenced on 5 July 1879. The longest bridge then built for the Public Works Department, it was officially opened by Hon. John Lackey, NSW Minister for Works, on 1 August 1881 before 6000 people. One of its Whipple truss spans was displayed at the 1879 Sydney International Exhibition.*"

The plaque was erected to celebrate Australia's Bicentenary in 1988 by the Department of Main Roads and the National Roads and Motorists Association (NRMA). The stone features the same four-leaf decoration found at various locations on the truss.

Figure 4-6 Bridge plaque (Source: FBE)

Original fabric

Although not an original bridge component, the steel plaque has been unaltered since 1988; however, the original sandstone fabric matches the fabric of the northern abutment's construction.

Significance

Captures essential historical and engineering details of the 1881 bridge.

Accessibility

It is conveniently located for pedestrian viewing, facilitating public engagement.

Given these considerations, the plaque aligns well with the criteria for HIGH significance grading.

4.8.3 Schedule of significance forms and fabric, Nowra Bridge

Trusses

The form and fabric of the wrought iron pin-jointed Whipple Truss is of EXCEPTIONAL significance.

The Whipple truss spans of the bridge are extremely uncommon in New South Wales, with very few of them ever constructed. Until recently, this bridge was the only one still existing and used for traffic. The use of pin connections in the through Whipple trusses adds to their significance, warranting an exceptional grading in the State's bridge inventory. Any modifications to the truss design would significantly diminish the bridge's overall uniqueness.

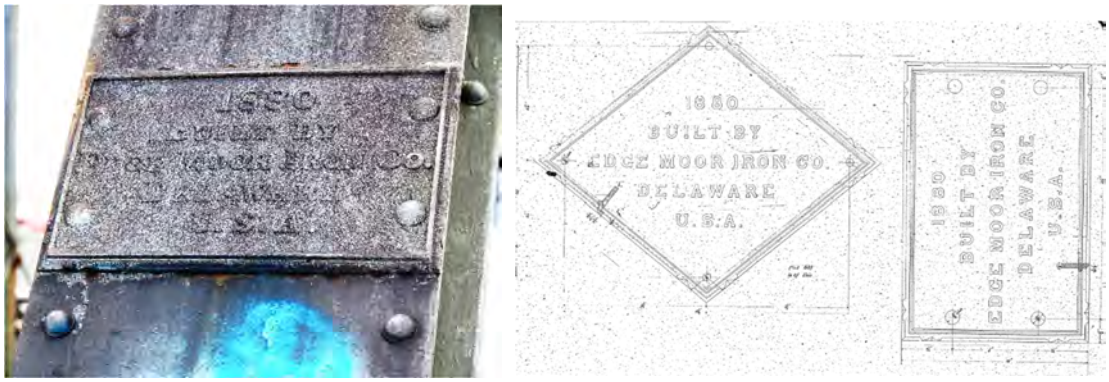


Figure 4-7 Bridge date plaque and associated drawing extract (Source: FBE and TfNSW)

Figure 4-8 Various aspects of the Nowra Bridge Whipple Truss (Source: FBE)

Figure 4-9 Various Aspects of the “Pin Connection” Whipple Truss (Source: FBE)

Entry portals

The form and fabric of the bridge entry portals are of HIGH Significance. They play a critical role in the Whipple Truss design and contribute significantly to the bridge's overall appeal.

Structurally, the purpose of the portals is to transfer lateral wind and stability loads from the top frame of the truss to the bottom frame and, ultimately, to the substructure. The overhead latticework functions as a beam to stiffen this action, while curved corner bars also enhance the lateral response. Critically, these features provide additional stiffness to end principals, preventing buckling while improving the end portal's transverse (sway) stiffness and strength. Thus, the portals are decorative and serve essential functional roles.

In the design of the Nowra Bridge, the architect chose to enhance its appearance with decorative elements. These included three-leaf cutouts in the corner plates, four-leaf cutouts over the lattice truss, and cast iron rosettes at lattice bracing connection points. Originally, each portal featured non-structural vertical cresting decorations adorned with four-leaf cutouts and spear points. However, these embellishments and rosettes no longer exist today.

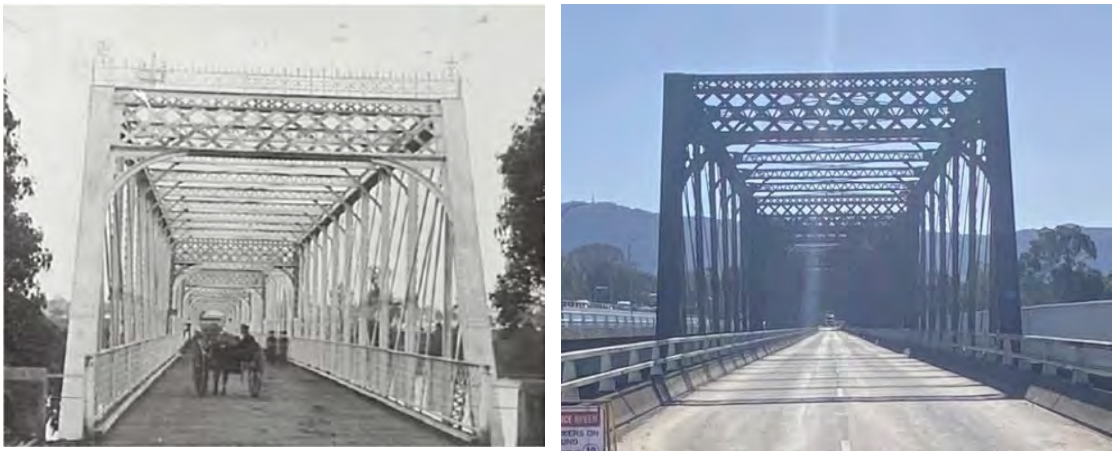


Figure 4-10 LHS: LHS Early Photo of Entry Portal, RHS: Entry Portal as currently exists (Source: Shoalhaven Historical Society, FBE)

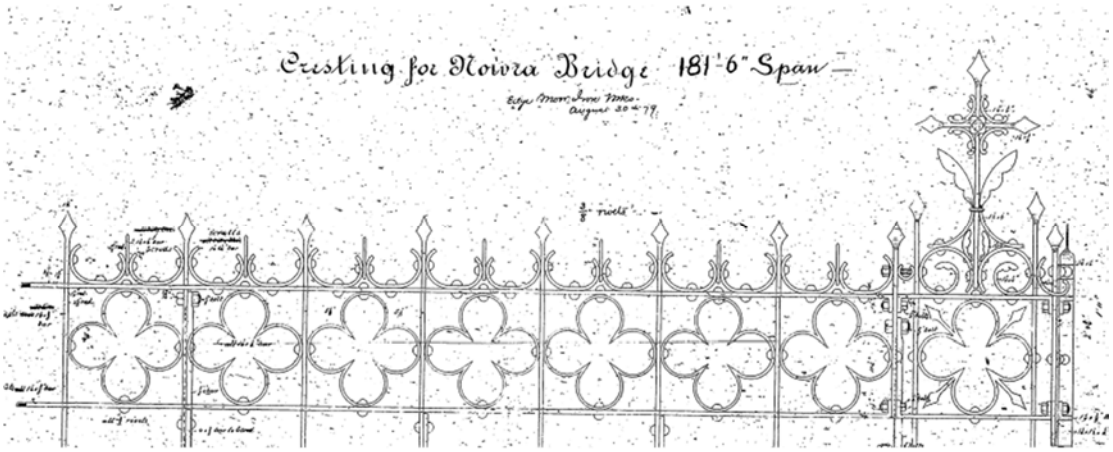


Figure 4-11 WAE Drawing four leaf cutouts and spear points) (Source: DMR)

Truss elements – compression members

The form and fabric of the bridge truss compression members are of HIGH significance.

Although their configuration and detailing align with many truss bridges from the era, the truss members of this bridge hold particular importance as they serve as crucial visual elements, significantly contributing to its overall significance.

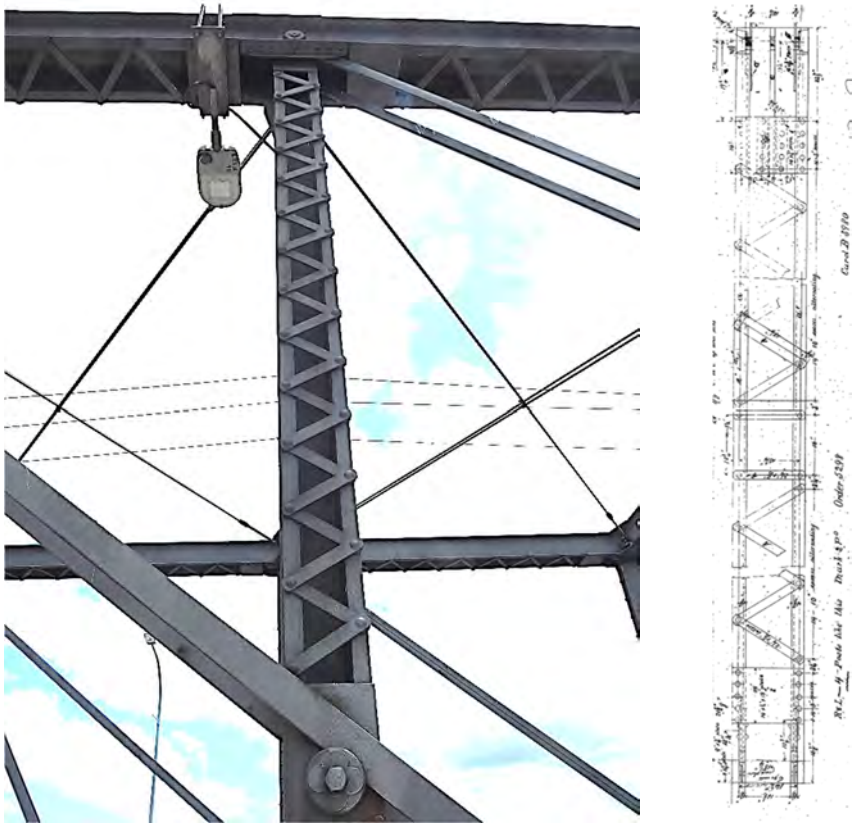


Figure 4-12 Truss compression members (Source: FBE and WAE drawings)

Truss elements – tension members and associated elements

The form and fabric of the bridge truss tension members and associated elements are of HIGH significance.

Tension ties with forged eye ends, connecting pins, and turnbuckle adjusters contribute significantly to these elements' high grading. Aesthetically, the slender tension members, unlike the more typical stocky ones of that period, allow for clear visibility of the truss.

The circular cast iron rosettes are captivating details of the trusses, especially when viewed up close from the walkway. However, their choice of material, being brittle, proved unfortunate as many of them failed, and some were removed from the entry portals. Despite this, their significance remains high due to their aesthetic value.

Figure 4-13 Tension member rosettes, LHS: broken, RHS: as-built condition (Source: FBE)

Bridge deck

The form and fabric of the reinforced concrete deck members are rated as INTRUSIVE.

The present deck is not original and holds no particular engineering or aesthetic significance. The modified New Jersey kerb, featuring RHS steel rails, is considered Intrusive, even though it was necessary to meet current design standards for the bridge's operation. Its appearance differs significantly from the original lattice barrier present when the bridge was built.

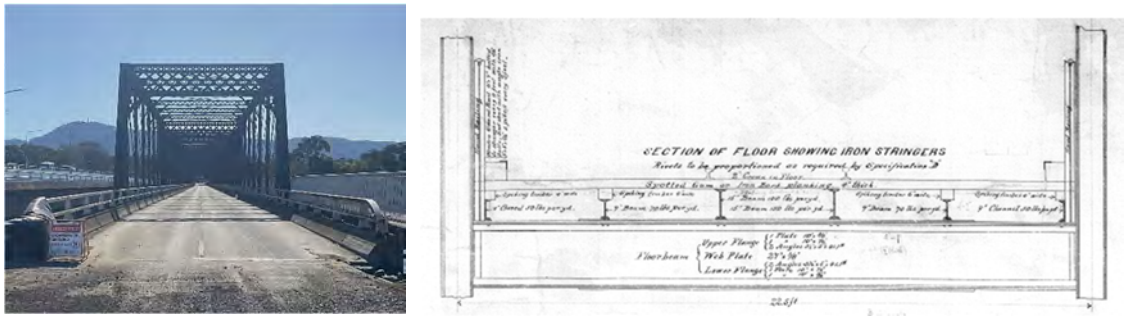


Figure 4-14 Left: Bridge in current form Right: DMR WAE Bridge Deck (Source: FBE, DMR)

Pedestrian clip-on walkway

The form and fabric of the pedestrian walkway is rated as INTRUSIVE.

The clip-on pedestrian walkway added to the bridge's downstream side was required for the safe passage of pedestrians and has impacted the visual appearance of the bridge, particularly when viewed from the eastern side.

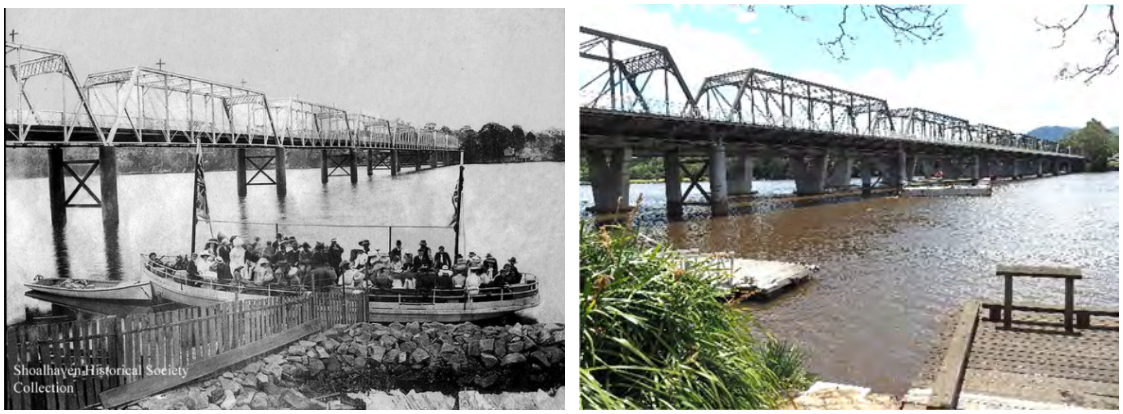


Figure 4-15 Left: Early photo Nowra Bridge Viewed from SE Side Right: Present Day (Source: Shoalhaven Historical Society, FBE)

Figure 4-16 LHS: Recent View of the Bridge from Northern Approach RHS: Historical Photo (Source: Google Maps 2022, Shoalhaven Historical Society)

The southern approach span 9

The form and fabric of the Approach Span 9 is rated as MODERATE.

While the southern approach span does include the original fabric, the significance of these elements is diminished by the substantial modifications made to the structure and adjacent abutment.

Figure 4-17 Span 9 (Source: FBE)

Piers

The form and fabric of the bridge piers are rated as HIGH.

The bridge's piers were built using caissons that were screwed down and excavated through pneumatic processes, which involved balancing internal air pressure against external water pressure. These caissons are classified as having High significance due to their durability and structural reliability.

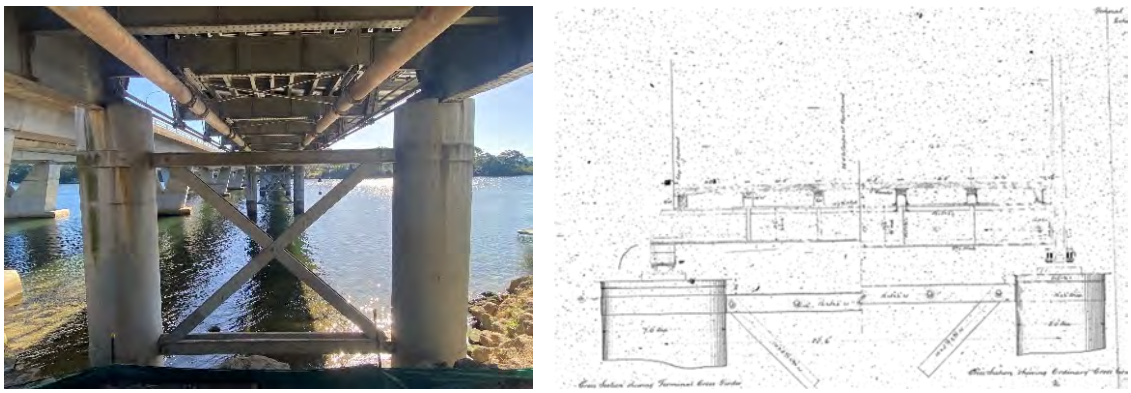


Figure 4-18 LHS: Bridge Piers viewed from the southern abutment RHS: Excerpt from DMR WAE Drawings (Source: FBE and DMR)

Northern abutment

The form and fabric of the northern abutment are rated as HIGH.

The abutment's high-quality stonework and relatively well-preserved integrity justify its grading as having High significance. Its remarkable condition adds value to the overall importance of the structure, making it a worthy and integral part of the bridge.

Figure 4-19 Northern Bridge Abutment (Source: FBE)

Southern abutment

The form and fabric of the south abutment are rated as INTRUSIVE.

Figure 4-20 Southern Bridge Abutment (Source: FBE)

This abutment has undergone extensive modifications and reconstructions involving diverse materials, including concrete. Additionally, existing services have further disrupted certain sections of the abutment.

Bearings and expansion joints

The form and fabric of the bearings expansion joints are rated as HIGH.

The recently installed expansion joints hold little significance, given their recent origin. However, the bearings, which form part of the original fabric of the truss bridge, are of High significance. They offer valuable insights into the style of fixed and expansion bearings specified by the USA bridge industry during that period, presenting unique opportunities for observation and study.

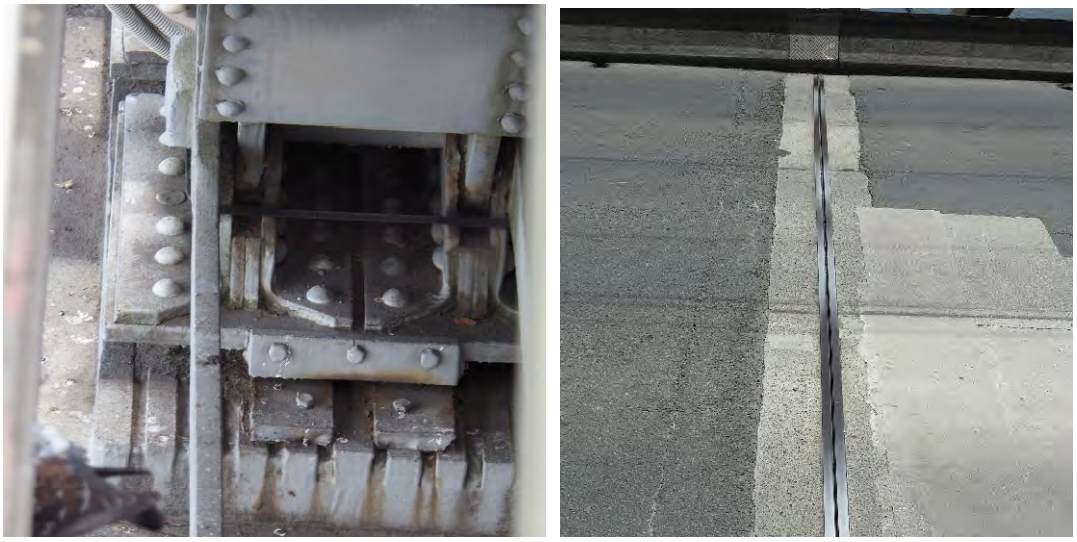


Figure 4-21 LHS: Bridge Bearing RHS Bridge Joints (Source: FBE)

5. Project considerations

5.1 Site inspection and start-up meeting

On 19 July 2023, a site inspection and workshop were held with TfNSW representatives.

5.2 Existing bridge condition

The bridge's existing condition and load rating will play a significant role in determining how the bridge is to be maintained, rehabilitated, strengthened or capacity upgraded.

5.2.1 Pedestrian loading

The conversion of the bridge from traffic to pedestrian loading necessitates carefully assessing new loadings and their impact on the bridge's structural integrity. The previous indications from TfNSW suggest that the new pedestrian loadings (5KPa) exceed the initial traffic loading intended for the bridge.

While TfNSW has expressed confidence in the bridge's ability to withstand these increased pedestrian loadings, it is essential to perform a thorough verification process to ensure the structure's safety and stability. TfNSW's Bridge Assessment team will conduct the verification process.

5.2.2 Condition of the existing concrete barrier

TfNSW surveyed the modified New Jersey Kerb barriers and found no current penetration of chlorides and carbonation to the reinforcing steel. Despite this, TfNSW recommends implementing mitigation measures for long-term performance. Two options are proposed for mitigating chloride-induced corrosion.

Option A - Conventional patch repair with in-patch anodes

This option involves removing deteriorated and sound concrete until new reinforcement is found.

This short-term solution lasts about 5-10 years and involves applying a protective surface treatment to slow down further corrosion. This treatment may increase chloride content near the reinforcement.

Option B - Electrochemical chloride extraction

This option involves the removal of deteriorated concrete only and the installation of a temporary electrochemical system. The process typically takes 6-8 weeks and lasts 15-20 years. A similar protective surface treatment as Option A is required post-extraction. However, the process requires careful monitoring. Designing an efficient system can mitigate the risk of increasing chloride content near the reinforcement.

Both options necessitate a protective surface treatment consisting of a solvent-based hydrophobic impregnation system or an anti-carbonation surface coating after primer application.

The choice between the options may hinge on factors like the desired longevity of the repair, time constraints, and potential for chloride migration.

5.3 Statutory approvals

A Review of Environmental Factors (REF) and associated specialist studies would be required for the planning and approvals process.

The construction activities would be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*.

5.4 Heritage

The existing road bridge is not listed on the State Heritage Register but is listed on the TfNSW S170 Heritage and Conservation Register and the State Heritage Inventory.

6. Site constraints

6.1 General

The scope of work is limited to:

- Barrier upgrades.
- Removal of the clip-on walkway.
- Bridge lighting.
- Bridge maintenance works and repainting of the bridge.
- Signage.
- Potential options for the northern foreshore seating and viewing area.

6.2 Public Utilities

Enquiries were made to public utilities and other authorities via Dial Before You Dig request job reference 3349509. The results are summarised in Table 6-1.

Table 6-1 Dial-before-you-dig summary (Source: FBE)

Public utility	Status
Shoalhaven Water	Affected – 2 outfall mains along the Bridge
Telstra	Potentially affected within approaches.
Jemena Gas	Affected – High-pressure steel main along the Bridge
Endeavour Energy	Affected – Power cables, north end of the Bridge
AARN	Affected – Fibre optic asset along the Bridge
TfNSW	Unaffected
NBN	Affected – Communication cables
Optus	Unaffected – utilities likely carried by the adjacent Bridge

While this report does not delve into the scoping and design of service protection and relocations, it is important to acknowledge that such considerations play a significant role in the overall project. Assessing the potential extent of services protection and relocation required for the project is crucial for ensuring a smooth construction process.

It is evident that a considerable number of services are involved. These services can encompass various utilities such as water supply, gas pipelines, electrical cables, telecommunications networks, and sewage systems. These services within the project area require careful planning to ensure their protection and relocation.

Proper coordination with relevant utility companies, local authorities, and other stakeholders will be vital to determine the most suitable strategies for protecting or relocating the services.

6.3 Access

In the future constructability context outlined in this report, access to the bridge will be feasible from both extremities of the structure. Additionally, access will extend to the ancillary site located to the north, identified for potential future reuse or as a community facility. This planned arrangement will enable construction personnel to easily enter the site, utilising designated access points at either end of the bridge and adjacent water areas where necessary. This approach facilitates the effective coordination of construction activities, optimising the flow of equipment, materials, and workers.

7. Adaptive reuse strategic options

7.1 General

A summary of strategic options, including the scope of work and the advantages and disadvantages, is provided in Table 7-1, Table 7-2, Table 7-3,Table 7-4 and is discussed in further detail in the below sections.

7.1.1 Criteria

The criteria for assessing each option were agreed upon with the internal TfNSW stakeholder group at various meetings and workshops. Additionally, rankings and scores are discussed in further detail in Section 11 of the report and are as follows:

Heritage Values

The assessment of heritage values is detailed in the Multicriteria section of the report, where different options are evaluated based on their impact on heritage preservation and potential enhancements to the bridge element in question.

Visual quality

This criterion assesses various options based on visual quality and alignment with the bridge's design and intended use.

Maintenance and durability

This criterion focuses on the long-term viability of the option. It considers the likelihood of durability issues and the maintenance efforts required.

Construction risk

This criterion assesses the potential challenges during the construction phase. It considers factors like constructability (how easily the option can be built), safety risks associated with construction activities, and environmental risks.

Cost

This criterion evaluates the financial implications associated with each option. It considers the feasibility and affordability of constructing the option, considering the required resources, technical expertise, and overall difficulty. The scores indicate the level of financial investment and technical complexity associated with implementing each option. The evaluation of this criterion aids in determining the economic viability and feasibility of each option within the project's budget and constraints.

Table 7-1 Bridge adaptive reuse strategic option 1 (Source: FBE)

Advantages	Disadvantages
Option 1 – Minimum Intervention **Scope of work** • **Road Traffic Barrier** - Do nothing. • **Bridge Deck** - Do Nothing. • **Lighting Design** - Retaining existing lighting. • **Northern foreshore** –interpretive signage. **Other** – Minor routine bridge maintenance as required.	
Heritage Values • By not undertaking extensive modifications, the heritage value of the bridge can be preserved. • This approach acknowledges the importance of maintaining the bridge's original design and historical significance.	It would not necessarily align with some the preliminary CMP policies. This is covered in greater detail in Section 8.
Visual quality Nil	• The existing dilapidated appearance would be retained, and additions that reduce the visual quality of the bridge, such as the pedestrian walkway, overhead lighting and exposed wiring, would remain. • It might continue to exhibit signs of wear and aging, affecting its overall aesthetic appeal and potentially impacting the surrounding area's visual quality. • The public's use experience (pedestrians and cyclists) would not be enhanced when using the bridge and open space on the northern foreshore once opened.
Maintenance and durability Nil	• This may increase by not addressing immediate or longer-term maintenance items.
Construction risk • Low due to limited scope of work.	N/A
Cost • Opting for minimal or no maintenance would likely result in lower immediate costs.	• The whole-of-life costs may increase significantly due to a lack of maintenance.

Advantages	Disadvantages
• There would be reduced expenses related to inspections, repairs, or structural improvements.	
Other	• Safety standards for pedestrians and cyclists would not be achieved. Other areas of the bridge could be compromised over time due to the lack of regular inspections and necessary repairs. • Community objectives would not be achieved (safe shared pathway, seating and shaded area, improved user experience).

Table 7-2 Bridge adaptive reuse strategic option 2A (Source: FBE)

Advantages	Disadvantages
Option 2A Medium Intervention (Retain the existing concrete barrier base) The proposed scope of works for option 2A includes: • **Bridge Deck** - Minor maintenance. • **Pedestrian Balustrade Railing** – New post and rail system located on top of the existing concrete barrier base. • **Bridge lighting** o Pedestrian lighting – upgrade existing lighting to new and relocate to a central position. o Feature lighting – Locate feature lighting onto bridge piers to illuminate the truss and lattice sections. • **Northern foreshore** – Seating, shaded area and Interpretive signage. • **Other** – Bridge maintenance and repainting, removing the existing clip-on walkway, relocation of utilities.	
Heritage Values • Modification of existing bridge barriers. By situating the new post and rail system atop the existing concrete barrier base, the option respects the original design elements while modernising for current needs. This is a balance between conservation and adaptation. • Pedestrian Lighting - Upgrading and centralising the existing lighting system improves safety and visibility without compromising the historic aesthetic of the bridge. • Feature Lighting - Installing feature lighting on the bridge piers to highlight the truss and lattice sections adds visual interest while drawing attention to the craftsmanship and engineering legacy of the bridge. • Removal of the clip-on walkway - The removal of recent additions like a clip-on walkway can restore the bridge to a form closer to its original state, enhancing its heritage value. • Rehabilitation works - Rehabilitation efforts as part of this option will not only extend the functional lifespan of the bridge but also maintain its historical character, thereby	• Limited visual enhancements. • It may not address underlying durability issues, affecting the long-term preservation of the bridge. • Minimal modern interpretation. • May not completely align with all of the preliminary CMP policies. This is covered in greater depth in Section 8.

Advantages	Disadvantages
fostering a sense of continuity and connection to the past.	
Visual quality • It adds to the bridge's visual appeal and can create a more enjoyable user experience. • Adding feature lighting will augment and accentuate specific elements of the bridge, especially during nighttime hours. • Northern foreshore shade and seating can enhance user comfort and accessibility, fostering a sense of community use.	The bespoke barrier system consists of an older lower (concrete) segment and a contemporary upper steel portion in this option. Consequently, the visual transparency of the barrier would not be maximised to enhance the public's experience, and its visual appeal might not match a specialised pedestrian balustrade railing system.
Maintenance and durability • Routine repairs to carriageway surfacing. • Removal of the clip-on walkway. • Repairs to existing barrier and truss structure (repairs and painting).	• This option would not improve the condition of the deck and parts of elements (stringers and cross beams) supporting the deck. • Currently, the clip-on walkway provides potential maintenance access to the eastern truss, and it will be lost following the removal. • The poor condition of the existing concrete barrier may require local concrete repairs to enable the installation of the new pedestrian/bicycle barrier system.
Construction risk • The modified barrier system would provide the required safety for pedestrians and cyclists. • Removing the walkway eliminates any existing risks associated with the clip-on structure. • Leaving the existing half-height concrete barrier to support the new steel pedestrian/bicycle rails and posts would be sustainable by reducing the use of new materials and by decreasing the amount of site work, resulting in a smaller carbon footprint generated by construction works.	• There will be safety risks associated with clip-on structure removal works. For example: o Working at heights. o Falling objects. o Working around services. o Noise and vibration. o Lifting. o Manual handling. • The potential presence of lead paint and asbestos poses a risk to workers.

Advantages	Disadvantages
	• Working above water to remove the clip-on walkway poses some environmental risks, which must be managed, for example: o Water contamination (caused by the blasting and painting process). o Noise and dust. o Oil leaks associated with the plant doing the work. • Coring in existing concrete barriers to install new steel posts holding down encompasses a risk of clashing with existing reinforcement. • Maintaining standard spacing between new pedestrian/bicycle barrier posts on existing concrete barrier layout. • Heights access would be required for demolition works of the clip-on walkway.
Cost • This option offers cost advantages by avoiding needing a full barrier replacement. • Installing a new top rail on the existing barrier reduces material and labour costs while improving safety. • Not undertaking major deck modifications saves on expenses associated with deck replacement. • Implementing pier lighting to illuminate the bridge truss provides cost advantages compared to advanced lighting systems. Targeted lighting elements achieve an enhanced visual appearance at a lower cost. • Addressing maintenance and repairs allows for cost-effective, proactive measures instead of extensive reconstruction.	
Other • Installing a new top rail on the existing barrier improves safety by providing better pedestrian protection. • This modification helps meet project objectives related to safety and enhances the overall functionality of the bridge.	No intervention: Doing nothing for the deck might mean that any issues or bridge deck durability are not addressed. This lack of intervention may lead to continued degradation or deterioration of the deck over time.

Advantages	Disadvantages
Lighting **Walkway Lighting** • Upgraded pedestrian walkway lighting ensures the minimum standard PP2 is achieved while enhancing bridge aesthetics. **Pier lighting** • Implementing preferred pier lighting to illuminate the bridge truss enhances the visual quality and aesthetics of the bridge, especially during nighttime.	

Table 7-3 Bridge adaptive reuse strategic option 2B (Source: FBE)

Advantages	Disadvantages
Option 2B Medium Intervention (Concrete barrier base removal) The proposed scope of works for option 2B includes: • **Bridge Deck** - Minor maintenance and partial deck removal to facilitate the removal of the existing concrete barrier base. • **Pedestrian Balustrade Railing** – New post and rail system located on a vertical upstand. • **Bridge lighting** o **Pedestrian lighting** – upgrade existing lighting to new and relocate to a central position. o **Feature lighting** – Locate feature lighting above the bridge piers and along the truss at key locations. • **Northern foreshore** – Seating, shaded area, and Interpretive signage. • **Other** – Bridge maintenance and repainting, removing the existing clip-on walkway, relocation of utilities, repairs to damaged wrought iron members. Refer to the figures and the sections below for the details of this option.	
Heritage Values • Partial deck removal - Allows for using materials that better preserve the bridge's structure over the long term while still retaining portions of the original deck, thus maintaining a connection to its past. • Removal of the concrete barrier base - Offers the opportunity to introduce a new railing system that is safer and more visually appealing, creating a new aesthetic that complements the bridge's historic value. • Pedestrian Lighting - Smart, energy-efficient lighting can offer improved visibility while being less intrusive, allowing the historical features to stand out. • Feature Lighting - Highlight the architectural elements of the bridge, adding another layer of visual interest without altering its core structure. • Enhanced northern foreshore - The upgraded viewing platforms and interpretive signage can offer a modern, educational	• During the deck/ barrier removal process, there is a greater likelihood of damaging underlying stringers beneath the concrete bridge.

Advantages	Disadvantages
interface that amplifies the heritage significance of the bridge. • Option 2B, while possibly offering improved visual and functional appeal, carries its own set of heritage-related and structural risks that differentiate it from Option 2A.	
Visual Quality • The full-height pedestrian balustrade barrier maximises its visual transparency, enhancing the experience for pedestrians and cyclists and providing greater openness and connection with the river. • This will benefit and enhance the user experience while crossing the bridge and create a new positive contribution for Nowra, including when viewed from the river foreshores. • Eliminating the clip-on walkway would unveil particular east truss facades, potentially resulting in a positive visual effect. • Adding feature lighting will augment and accentuate specific elements of the bridge, especially during nighttime hours. • The designated viewing and seating zone on the northern foreshore will further create chances to observe the bridge from distinct vantage points.	Nil
Maintenance and Durability • Routine repairs to carriageway surfacing. • Removal of the clip-on walkway. • Additionally, this option offers greater access to the edge stringers and truss elements. • The concerns for the existing concrete road barrier base would be eliminated.	• This option would not improve the condition of the deck and parts of elements (stringers and cross beams) supporting the deck. • Currently, the clip-on walkway provides potential maintenance access to the eastern truss, and it will be lost following the removal.
Construction risk • The new pedestrian balustrade barrier system would provide the required safety for both pedestrians and cyclists.	• There will be significant risks associated with clip-on structure removal works. • The potential presence of lead paint and asbestos poses a risk to workers .

Advantages	Disadvantages
• Removing the walkway eliminates any existing risks associated with the clip-on structure. • Since the existing concrete barrier base will be removed, the new Pedestrian Balustrade Railing will be more straightforward to fabricate and install. • Longer-term benefits in terms of the durability of existing edge stringers and truss elements.	• Working above water to remove the clip-on walkway poses some environmental risks, which must be managed. • Access would be required to work at heights for the demolition of the clip-on walkway. • Greater demolition works associated with the existing concrete barrier base and partial deck removal. • More dust and noise could be generated during barrier demolition works.
Cost • Implementing pier lighting to illuminate the bridge truss provides cost advantages compared to advanced lighting systems. Targeted lighting elements achieve an enhanced visual appearance at a lower cost. • The partial removal of the deck to expose the outside stringers may lead to better maintenance outcomes for the bridge, reducing the overall whole-of-life costs. • Addressing maintenance and repairs allows for cost-effective, proactive measures instead of extensive reconstruction.	
Other • Installing a new top rail on the existing barrier improves safety by providing better pedestrian protection. • This modification helps meet project objectives related to safety and enhances the overall functionality of the bridge. • Northern foreshore shade and seating can enhance user comfort and accessibility, fostering a sense of community use. • Undertaking necessary maintenance works, such as removing existing walkways or addressing maintenance requirements, ensuring the bridge remains in good condition.	

Table 7-4 Bridge adaptive reuse strategic option 3 (Source: FBE)

Advantages	Disadvantages
Option 3 – Higher level Intervention The proposed scope of work for Option 3 includes the following: • **Bridge Deck** - replacement with a new lightweight concrete bridge deck and anti-slip surfacing. • **Pedestrian Balustrade Railing** – New post and rail system located on a vertical upstand (as per Option 2B). • **Bridge lighting** o **Pedestrian lighting** – upgrade existing lighting to new and relocate to a central position, additional lighting within the barrier handrail. o **Feature lighting** – Locate feature lighting above the bridge piers location to illuminate the truss and lattice sections. Additional feature lighting is located along the bridge truss. • **Northern forshore** – Seating, shaded area, and Interpretive signage. • **Other** – Bridge maintenance and repainting, removing the existing clip-on walkway, relocation of utilities, repairs to damaged wrought iron members.	
Heritage Values • Enhanced Preservation - The new lightweight concrete bridge deck is likely to be more durable, helping to prolong the bridge's lifespan. • Aesthetic Opportunities - The new post and rail system, along with the added feature lighting, can be designed to complement the historical aesthetics, potentially enhancing the bridge's visual appeal. • Adaptive Reuse - Repairs to damaged wrought iron members and removal of the existing clip-on walkway can be seen as a form of adaptive reuse, keeping the structure relevant while preserving its historical significance. • Public Engagement - Northern foreshore features like seating and interpretive signage offer ways for the public to engage with the bridge's history. • Offers the greatest visual appeal and structural longevity enhancements.	• Structural Risks- With a higher level of intervention comes an increased risk of damaging original elements, such as wrought iron members.
Visual Quality • The pedestrian balustrade barrier, extending to its full height, enhances the	• There are no disadvantages with this option.

Advantages	Disadvantages
visibility beneath the bridge. It creates a feeling of airiness, openness, and connection with the river. • Eliminating the clip-on walkway would unveil particular east truss facades, potentially resulting in a positive visual effect. • Adding additional feature lighting and effects will augment and accentuate specific elements of the bridge, especially during nighttime hours. • The designated viewing and seating zone on the northern foreshore will further create chances to observe the bridge from distinct vantage points. • Replacing the current concrete deck with new lightweight concrete and non-slip surfacing will enhance the overall appearance of the deck surface.	
Maintenance and durability • Replacement of the concrete deck and existing concrete road barrier will improve longevity and reduce overall maintenance. • Better access to the top surface of the wrought iron stringers • Removal of the clip-on walkway. • The concerns for the existing concrete road barrier would be eliminated.	• Currently, the clip-on walkway provides potential maintenance access to the eastern truss, and it will be lost following the removal. • With significant lighting enhancement, there will be more lighting elements to maintain in the future.
Construction risk • The new pedestrian balustrade barrier system would provide the required safety for both pedestrians and cyclists. • Removing the walkway eliminates any existing risks associated with the clip-on structure. • Enhanced lighting would provide better visibility during dark hours, resulting in better safety. • The new Pedestrian Balustrade Railing will be more straightforward to fabricate and install.	• The potential presence of lead paint and asbestos poses a risk to workers. • Working above water to remove the clip-on walkway poses some environmental risks, which must be managed. • Access would be required to work at heights for demolition of the deck and walkway. • Greater demolition works. • More dust and noise are generated through the works.

Advantages	Disadvantages
• Longer-term benefits in terms of the durability of existing edge stringers and truss elements and the concrete deck.	
Cost Nil	• Option 3, involving higher-level intervention, will incur higher costs than other options. • The extensive modifications, rehabilitation efforts, advanced lighting systems, and deck replacement can contribute to increased project expenses.

7.2 Strategic Option 1 – Minimum intervention

7.2.1 Scope of work

The minimum intervention option proposes minimal scope, including leaving the extant clip on walkway in place. The existing deck and lighting would remain, and only minimum routine maintenance works are proposed to improve safety. The proposed scope of works would, therefore, involve:

- Barrier - Do minimal (routine maintenance).
- Bridge Deck - Do minimal (routine maintenance).
- Lighting Design - Retaining existing lighting with repairs and upgrades as required.
- Northern foreshore – Potential Interpretive signage.
- Other - Minor routine bridge maintenance.

Routine bridge maintenance is generally covered in detail in the L2 Inspection reports and covers item such as:

- Cleaning (removal of rubbish, dirt and debris, fixing blocked scuppers)
- Repair broken bridge joint nosing.
- Paint patching
- Removal of loose or broken concrete
- Tightening fasteners
- Greasing bearings and other components
- Repair and cleaning of electrical fittings
- Repair wearing surfaces
- Maintenance of Cathodic protection system (system checks etc.)

Routine maintenance does not encompass rehabilitation or significant maintenance and repairs.

7.2.2 Advantages and disadvantages

The advantages and disadvantages are covered in Table 7-1 above.

7.3 Strategic Option 2A – Medium intervention with existing barrier modification

There are two proposed medium-intervention options. The primary distinction between the two concerns the pedestrian balustrade railing, specifically whether to reuse or remove the existing concrete barrier base. Another significant difference is the partial removal of the concrete deck, which would facilitate the removal of the concrete barrier base.

The advantages and disadvantages of each option are explored in greater detail below. In summary, Option 2B offers superior durability, visual appeal, and safety outcomes, whereas Option 2A is associated with lower short-term costs and simplified constructability.

7.3.1 Scope of work

The proposed scope of works for option 2A includes:

- Bridge Deck - Minor maintenance.
- Pedestrian Balustrade Railing – The new post and rail system will be located on top of the existing concrete barrier base.
- Bridge lighting
    - Pedestrian lighting – upgrade existing lighting to new and relocate to a central position.
    - Feature lighting – Locate feature lighting onto bridge piers to illuminate the truss and lattice sections.
- Northern foreshore – Seating, shaded area and Interpretive signage.
- Other – Bridge maintenance and repainting, removing the existing clip-on walkway, relocation of utilities.

Refer to Figure 7-1 and Figure 7-2 and the sections below for the details of this option.

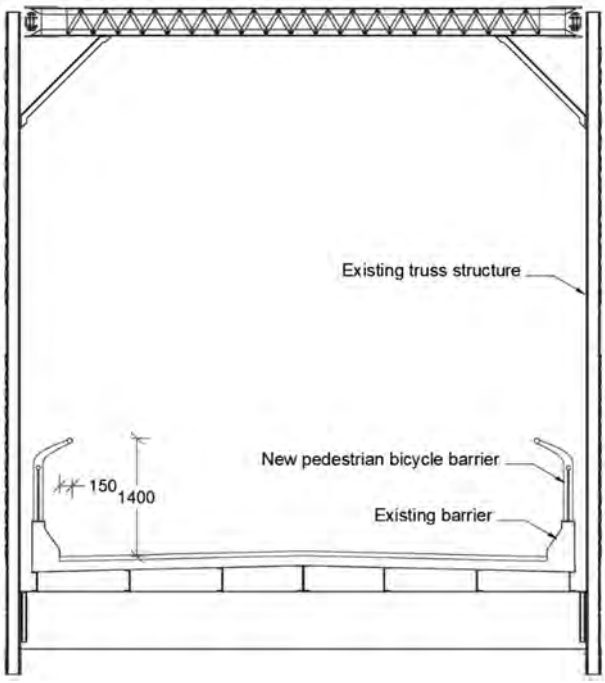


Figure 7-1 Option 2A – Cross section (Source: FBE)

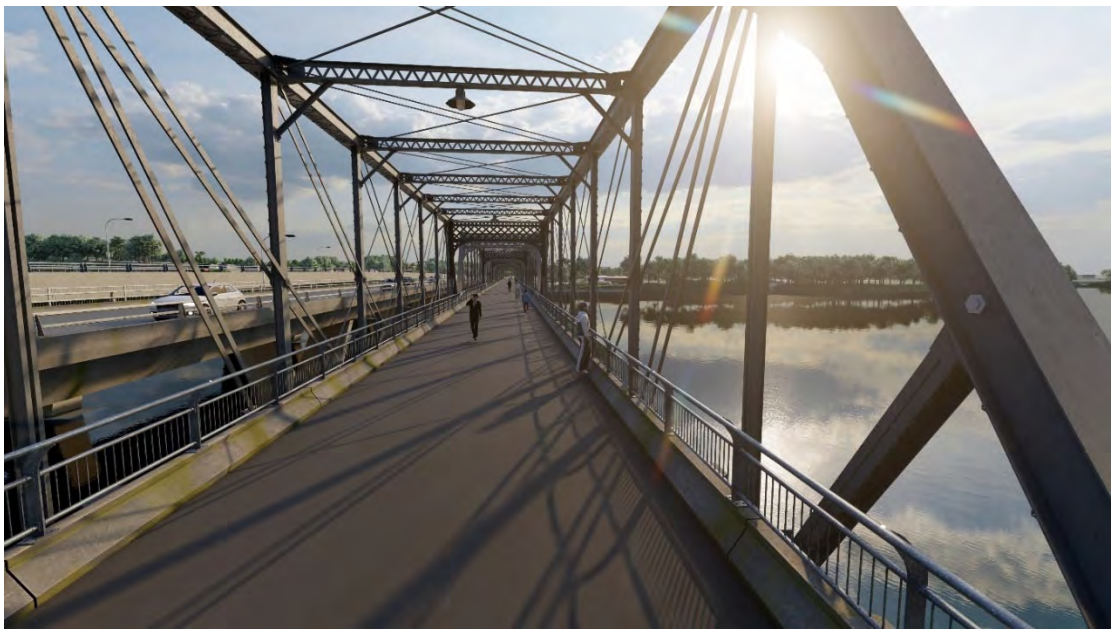


Figure 7-2 Option 2A Visualisation (Source: FBE)

7.3.2 Pedestrian balustrade railing and deck

Medium intervention Option 2A proposes to reuse the existing lower concrete part of the barriers and install a modified proprietary pedestrian/bicycle steel post and rail balustrade system on top.

The works include:

- Removal of the existing twin railing and removal of the current HD bolts.
- Core and chemically anchor the new HD bolts at approximately 2.0 m spacing (to meet the standard spacing of the proprietary product).
- Install modified proprietary pedestrian/bicycle barrier.
- Apply protective coating or sealant to the concrete surface.

7.3.3 Clip-on pedestrian walkway removal

The existing redundant clip-on pedestrian walkway will be removed to improve the bridge's overall aesthetics, and the impacted services will be relocated. The modifications to achieve this are as follows:

- The frame supporting the walkway will be altered, with the vertical gusset plate remaining on the bridge and a short section of diagonal angles at the bottom. These diagonal angles will be cut off flush with the gusset plate.
- All other frame elements will be removed entirely, ensuring the bridge’s clean and visually appealing appearance.
- The clip-on walkway removal potentially reduces routine maintenance while improving the overall longevity of the bridge.

7.3.4 Lighting

Pedestrian lighting

The pedestrian lighting will undergo a significant upgrade to comply with the minimum Australian Standards (AS/NZS 1158.3.1:2020) and meet class PP2 requirements. To achieve this, the lights will be moved to the centreline of the walkway, and the fixtures will be replaced with new ones.

Furthermore, to enhance the aesthetics and safety of the bridge, the electrical cabling will be rerouted to the underside of the existing concrete deck. The individual cabling runs will be discreetly hidden behind the wrought iron sections of the truss members, maintaining a clean and uncluttered appearance while ensuring efficient functionality.

Feature lighting

This option will consist of new lighting fixtures positioned above the bridge piers on both the upstream and downstream sides. These fixtures will be strategically oriented to direct their illumination vertically upwards, effectively spreading light across the wrought iron lattice and end portals, accentuating their beauty and design.

Furthermore, it's essential to consider the ease of accessing the lights for routine maintenance tasks. To achieve this, it is advisable to ensure the lights are accessible from the bridge deck. This approach may eliminate the need for rope access along the sides of the bridge. Consideration should also be given to positioning the lights to avoid potential vandalism.

Lighting location

Details of preliminary locations of where lighting will be positioned is provided in the sketch below. Further details will be provided during the detailed stages of this project.

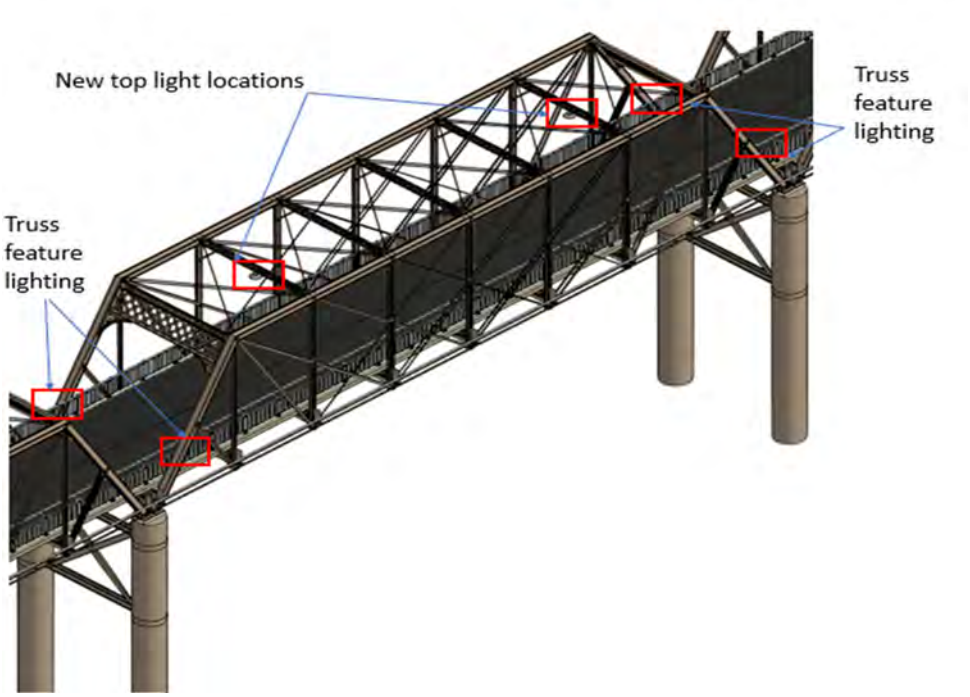


Figure 7-3 Approximate lighting locations option 2A (Source: FBE)

Figure 7-4 Feature lighting as viewed off the bridge (Source: FBE)

7.3.5 Maintenance and repainting

Under this chosen option, the entire bridge's accessible metal elements will undergo repainting, and necessary repairs and replacements will be made to the damaged wrought iron sections and lattice components highlighted in this report's earlier sections.

Additionally, the existing clip-on walkway will be removed from the bridge, and a portion of the support bracket will be removed to enhance the bridge's aesthetics, giving it a more streamlined and visually appealing appearance.

Other maintenance would include:

- Concrete repairs to the existing barrier to improve condition and enable the installation of new posts.
- Routine repairs to surfacing in the existing carriageway to improve safety.
- Routine repairs to existing movement joints, where required to improve safety.

7.3.6 Northern foreshore

This option provides the option for the potential viewing area on the northern foreshore to foster a stronger sense of community connectedness and embrace heritage. This area is anticipated to include seating and shade structures strategically positioned to optimise the views. Additionally, the indicative scope aims to complement this experience by installing heritage interpretive signage, thereby enhancing the visit for tourists and visitors who admire the bridge. These elements are part of an indicative scope and may be confirmed or adjusted as the project develops.

The proposed potential improvements are anticipated to include:

- Building a viewing platform on the northern foreshore.
- Incorporating heritage interpretive signage to enrich the overall experience.
- Soft Landscaping as required.

- Lighting as required.

Figure 7-5 Indicative potential option for a viewing and seating area incorporating interpretive signage on the northern foreshore (Source: FBE)

7.3.7 Utilities

Utility relocations and modifications for this option are as follows:

- Three (3) off-electrical street lighting cables will be moved underneath the deck.
- Small gas pipe underneath bottom chord at east elevation to stay in place.
- The Cathodic Protection tray and cables will be relocated underneath the truss from the bridge's east side.
- Two redundant asbestos pipes underneath the deck will be permanently removed.

7.4 Advantages, disadvantages and opportunities

The advantages and disadvantages are discussed below.

7.4.1 Heritage values

Advantages

This option entails modifying the existing bridge barriers, removing the clip-on walkway, and performing rehabilitation works. These actions are expected to positively influence heritage values as follows:

- Modifying existing bridge barriers - By situating the new post and rail system atop the existing concrete barrier base, the option respects the original design elements while modernising for current needs. This is a balance between conservation and adaptation.
- Pedestrian Lighting - Upgrading and centralising the existing lighting system improves safety and visibility without compromising the historic aesthetic of the bridge.
- Feature Lighting - Installing feature lighting on the bridge piers to highlight the truss and lattice sections adds visual interest while drawing attention to the craftsmanship and engineering legacy of the bridge.

- Removal of the clip-on walkway - The removal of recent additions like a clip-on walkway can restore the bridge to a form closer to its original state, enhancing its heritage value.
- Rehabilitation works - Rehabilitation efforts as part of this option will not only extend the functional lifespan of the bridge but also maintain its historical character, thereby fostering a sense of continuity and connection to the past.

Disadvantages

- Limited visual enhancements.
- It may not address underlying durability issues beneath the bridge deck, affecting the long-term preservation of the bridge.
- Minimal modern interpretation.

7.4.2 Visual quality

Advantages

- Adds to the bridge's visual appeal and can create a more enjoyable user experience.
- Adding feature lighting will augment and accentuate specific elements of the bridge, especially during nighttime hours.
- Northern foreshore shade and seating can enhance user comfort and accessibility, fostering a sense of community use.

Disadvantages

The bespoke barrier system consists of an older lower (concrete) segment and a contemporary upper steel portion in this option. Consequently, the visual transparency of the barrier would not be maximised to enhance the public's experience, and its visual appeal might not match a specialised pedestrian balustrade railing system.

Opportunities

Section 9 of this report delves into opportunities for enhancing the visual aspects of the barrier. It delves into the arrangement of barrier posts and different options for coatings.

7.4.3 Maintenance and durability

Advantages

The durability of the existing bridge would be moderately improved due to:

- Routine repairs to carriageway surfacing.
- Removal of the clip-on walkway.
- Repairs to existing barrier and truss structure (repairs and painting).

Disadvantages

- This option would not improve the condition of the deck and parts of elements (stringers and cross beams) supporting the deck.
- Currently, the clip-on walkway provides potential maintenance access to the eastern truss, and it will be lost following the removal.
- The poor condition of the existing concrete barrier may require local concrete repairs to enable the installation of the new pedestrian/bicycle barrier system.

7.4.4 Construction risks – safety, environmental and constructability

Advantages

- The modified barrier system would provide required safety for both pedestrians and cyclists.
- Removing the walkway eliminates any existing risks associated with the clip-on structure.
- Enhanced lighting would provide better visibility during dark hours, resulting in better safety.
- Leaving the existing half-height concrete barrier to support the new steel pedestrian/bicycle rails and posts would be sustainable by reducing the use of new materials and by decreasing the amount of site work, resulting in a smaller carbon footprint generated by construction works.

Disadvantages

- There will be safety risks associated with clip-on structure removal works. For example:
    - Working at heights.
    - Falling objects.
    - Working around services.
    - Noise and vibration.
    - Lifting.
    - Manual handling.
- The potential presence of lead paint and asbestos poses a risk to workers.
- Working above water to remove the clip-on walkway poses some environmental risks, which must be managed, for example:
    - Water contamination (caused by paint etc.).
    - Noise and dust.
    - Oil leaks associated with the plant doing the work.
- Coring in existing concrete barriers to install new steel posts holding down encompasses a risk of clashing with existing reinforcement.
- Maintaining standard spacing between new pedestrian/bicycle barrier posts on existing concrete barrier layout.
- Heights access would be required for demolition works of the clip-on walkway.

Opportunities

- Protection against climbing must be addressed as part of the detailed design.
- Methodology, like scanning, to identify existing reinforcement locations will avoid the risks of clashes with existing reinforcing steel.

Advantages

This option presents cost benefits by avoiding complete barrier replacement. Adding a new top rail to the existing barrier reduces material and labour expenses while enhancing safety. By not making major deck modifications, costs linked to deck replacement are saved. Introducing pier lighting for bridge truss illumination offers cost advantages over advanced lighting systems.

Focused lighting enhances aesthetics at a reduced cost. Prioritising maintenance and repairs enable cost-effective, proactive approaches instead of extensive reconstruction.

7.5 Strategic Option 2B – Medium intervention removal of existing road barrier

Medium intervention Option 2B proposes removing existing road barriers, including partial removal of the concrete deck to facilitate barrier removal.

7.5.1 Scope of work

The proposed scope of works for option 2B includes:

- Bridge Deck – minor maintenance and partial deck removal to facilitate the removal of the concrete barrier base.
- Pedestrian Balustrade Railing – new post and rail system located on a vertical upstand.
- Bridge lighting:
    - Pedestrian lighting – upgrade existing lighting to new and relocate to a central position, lighting within the handrail.
    - Feature lighting – locate feature lighting above the bridge piers and along the truss at critical locations.
- Northern foreshore – Seating, shaded area and Interpretive signage.
- Other – Bridge maintenance and repainting, removing the existing clip-on walkway, relocation of utilities, repairs to damaged wrought iron members.

Refer to the figures and the sections below for the details of this option.

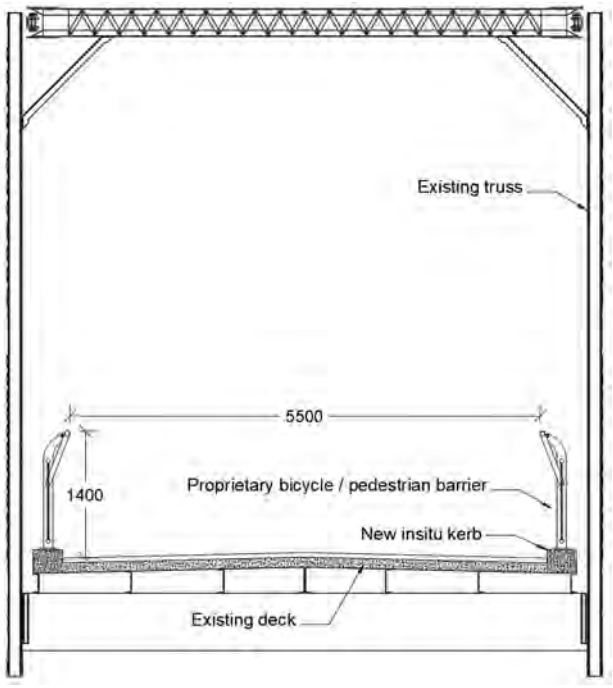


Figure 7-6 Option 2B Cross Section (Source: FBE)

Figure 7-7 Option 2B Visualisation (Source: FBE)

7.5.2 Pedestrian balustrade railing and deck

Medium intervention Option 2B includes removing the existing barriers' lower concrete portion and a deck section. This removal will be accomplished by making a vertical cut in the deck close to the inner face of the barrier, which will help with the overall demolition process. The works include:

- Demolition of the existing concrete barrier and partial removal of the deck.
- Install proprietary pedestrian/bicycle barrier.

7.5.3 Clip on pedestrian walkway removal

As per Option 2A.

7.5.4 Lighting

As per Option 2A.

7.5.5 Maintenance and repainting

As per Option 2A.

7.5.6 Northern foreshore

As per Option 2A.

7.5.7 Utilities

As per Option 2A.

7.6 Advantages, disadvantages and opportunities

7.6.1 Heritage values

Advantages

This option entails clip-on walkway removal, replacement of the existing concrete barrier base and twin rail and rehabilitation works. These actions are expected to influence heritage values positively as follows:

- Partial deck removal - Allows for using materials that better preserve the bridge's structure over the long term while retaining portions of the original deck, thus maintaining a connection to its past.
- Removal of the concrete barrier base - Offers the opportunity to introduce a new railing system that is safer and more visually appealing, creating a unique aesthetic that complements the bridge's historic value.
- Pedestrian Lighting - Smart, energy-efficient lighting can offer improved visibility while being less intrusive, allowing the historical features to stand out.
- Feature Lighting - Highlight the architectural elements of the bridge, adding another layer of visual interest without altering its core structure.
- Northern foreshore - The upgraded potential viewing area and interpretive signage can offer a modern, educational interface that amplifies the heritage significance of the bridge.
- Option 2B, while possibly offering improved visual and functional appeal, carries its own set of heritage-related and structural risks that differentiate it from Option 2A.

Disadvantages

- During the deck/ barrier removal process, there is a greater likelihood of damaging underlying stringers beneath the concrete bridge.

7.6.2 Visual quality

Advantages

- The full-height pedestrian balustrade barrier maximises its visual transparency, enhancing the experience for pedestrians and cyclists and providing greater openness and connection with the river.
- This will benefit and enhance the user experience while crossing the bridge and create a new positive contribution for Nowra, including when viewed from the river foreshores.
- Eliminating the clip-on walkway would unveil particular east truss facades, potentially resulting in a positive visual effect.
- Adding feature lighting will augment and accentuate specific elements of the bridge, especially during nighttime hours.
- The designated viewing and seating zone on the northern foreshore will further create chances to observe the bridge from distinct vantage points.

Disadvantages

There are no disadvantages with this option.

Opportunities

Section 9 of this report delves into opportunities for enhancing the visual aspects of the barrier. It delves into the arrangement of barrier posts and different options for coatings.

7.6.3 Maintenance and durability

Advantages

The durability of the existing bridge would be moderately improved due to:

- Routine repairs to carriageway surfacing.
- Removal of the clip-on walkway.
- Additionally, this option offers greater access to the edge stringers and truss elements.
- The concerns regarding the existing concrete road barrier would be eliminated.

Disadvantages

- This option would not improve the condition of the deck and parts of elements (stringers and cross beams) supporting the deck.
- Currently, the clip-on walkway provides potential maintenance access to the eastern truss. This would be lost following its removal.

7.6.4 Construction risks – safety, environmental and constructability

Advantages

- The new pedestrian balustrade barrier system would provide the required safety for both pedestrians and cyclists.
- Removing the walkway eliminates any existing risks associated with the clip-on structure.
- Enhanced lighting would provide better visibility during dark hours, improving safety.
- Since the existing concrete barrier base will be removed, the new Pedestrian Balustrade Railing will be more straightforward to fabricate and install.
- Long-term benefits in terms of the durability of existing edge stringers and truss elements.

Disadvantages

- There will be significant risks associated with clip-on structure removal works.
- The potential presence of lead paint and asbestos poses a risk to workers.
- Working above water to remove the clip-on walkway poses some environmental risks, which must be managed.
- Special access would be required for demolition works of the clip-on walkway.
- Greater demolition works associated with the existing concrete barrier base and partial deck removal.
- More dust and noise were generated throughout the works.

Advantages

Implementing pier lighting for bridge truss illumination offers cost advantages over advanced lighting systems. Focused lighting elements enhance visuals at a lower expense. Partial deck

removal to expose stringers may improve maintenance outcomes and lower whole-of-life costs. Prioritising maintenance and repairs enables cost-effective, proactive approaches instead of extensive reconstruction.

7.7 Strategic Option 3 – Higher level intervention

Higher-level intervention proposes to remove existing deck and road barriers and install a proprietary pedestrian/bicycle system.

7.7.1 Scope of work

The proposed scope of work for option 3 includes the following:

- Bridge Deck – replacement with a new lightweight bridge deck and anti-slip surfacing.
- Pedestrian Balustrade Railing – New post and rail system located on a vertical upstand (as per Option 2B).
- Bridge lighting:
    - Pedestrian lighting – upgrade existing lighting to new and relocate to a central position, additional lighting within the barrier handrail.
    - Feature lighting – Locate feature lighting above the bridge piers location to illuminate the truss and lattice sections. Additional feature lighting is located along the bridge truss.
- Northern foreshore – Seating, shaded area and Interpretive signage.
- Other – Bridge maintenance and repainting, removing the existing clip-on walkway, relocation of utilities, repairs to damaged wrought iron members.

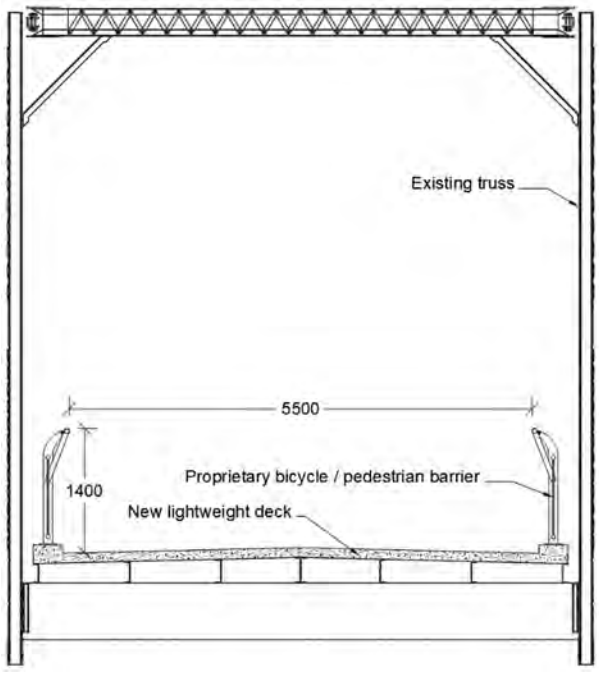


Figure 7-8 Option 3 – Cross section (Source: FBE)

Figure 7-9 Option 3 – Visualisation (Source: FBE)

7.7.2 Pedestrian balustrade railing and deck

The works include:

- Demolition of the bridge deck.
- Form, reinforce, and pour a new lightweight concrete bridge deck and barrier upstand.
- Install proprietary pedestrian/bicycle barrier.

7.7.3 Clip on pedestrian walkway removal

As per Option 2a and 2b.

7.7.4 Lighting

For option 3 the following scope is proposed.

Pedestrian lighting

This option involves enhancing the current lighting system by replacing it with modern fixtures, which will then be strategically repositioned to a central location for optimal illumination. Furthermore, innovative lighting elements will be seamlessly integrated into the balustrade railing. These additions will elevate the lighting's aesthetic appeal and offer the possibility of incorporating captivating visual effects into the feature lighting design.

Feature lighting

This option entails positioning the feature lighting above the bridge piers, precisely aimed to illuminate both the truss and lattice sections. This strategic placement will effectively showcase the intricate design elements of the bridge's structure. In addition, supplementary lighting fixtures will be introduced onto the truss to accentuate pivotal architectural components. This approach will enhance visibility and allow for incorporating a spectrum of colours and dynamic lighting effects, adding an extra layer of visual interest to the bridge's aesthetic presentation.

7.7.5 Maintenance and repainting

As per Option 2A and 2B.

7.7.6 Northern foreshore

As per Option 2A and 2B.

7.7.7 Utilities

As per Option 2A and 2B.

7.8 Advantages, disadvantages and opportunities

7.8.1 Heritage values

Advantages

This option entails clip-on walkway removal, replacement of the existing concrete decking with lightweight concrete, and rehabilitation works. These actions are expected to influence heritage values positively as follows:

- Enhanced Preservation - The new lightweight concrete bridge deck is likely to be more durable, helping to prolong the bridge's lifespan.
- Aesthetic Opportunities - The new post and rail system, along with the added feature lighting, can be designed to complement the historical aesthetics, potentially enhancing the bridge's visual appeal.
- Adaptive Reuse - Repairs to damaged wrought iron members and removal of the existing clip-on walkway can be seen as a form of adaptive reuse, keeping the structure relevant while preserving its historical significance.
- Public Engagement – Northern foreshore features like seating and interpretive signage offer ways for the public to engage with the bridge's history.
- Offers the greatest visual appeal and structural longevity enhancements.

Disadvantages

- Structural Risks - With a higher level of intervention comes an increased risk of damaging original elements, such as wrought iron members.

7.8.2 Visual quality

Advantages

- The pedestrian balustrade barrier, extending to its full height, enhances the visibility beneath the bridge. It creates a feeling of airiness, openness, and connection with the river.
- Eliminating the clip-on walkway would unveil particular east truss facades, potentially resulting in a positive visual effect.
- Adding additional feature lighting and effects will augment and accentuate specific elements of the bridge, especially during nighttime hours.
- The designated viewing and seating zone on the northern foreshore will further create chances to observe the bridge from distinct vantage points.

- Replacing the current concrete deck with new lightweight concrete and non-slip surfacing will enhance the overall appearance of the deck surface.

Disadvantages

There are no disadvantages with this option.

Opportunities

Section 9 of this report delves into opportunities for enhancing the visual aspects of the barrier. It delves into the arrangement of barrier posts and different options for coatings.

7.8.3 Maintenance and durability

Advantages

The durability of the existing bridge would be significantly improved due to:

- Replacement of the concrete deck and existing concrete road barrier.
- Better access to the top surface of the wrought iron stringers.
- Removal of the clip-on walkway.
- The concerns about the existing concrete road barrier would be eliminated.

Disadvantages

- Currently, the clip-on walkway provides potential maintenance access to the eastern truss, which will be lost following the removal.
- With significant lighting enhancement, there will be more lighting elements to maintain.

7.8.4 Construction risks – safety, environmental and constructability

Advantages

- The new pedestrian balustrade barrier system would provide the required safety for pedestrians and cyclists.
- Removing the walkway eliminates any existing risks associated with the clip-on structure.
- Enhanced lighting would provide better visibility during dark hours, improving safety.
- The new Pedestrian Balustrade Railing will be more straightforward to fabricate and install.
- Longer-term benefits include the durability of existing edge stringers, truss elements, and the concrete deck.

Disadvantages

- There will be significant risks associated with clip-on structure removal works.
- The potential presence of lead paint and asbestos poses a risk to workers.
- Working above water to remove the clip-on walkway poses some environmental risks, which must be managed.
- Special access would be required for demolition works of the deck and walkway.
- Greater demolition works.
- More dust and noise are generated through the works.

8. Preliminary conservation policy comparative assessment

8.1 Background

The Draft Conservation Management Plan (CMP), prepared by Artefact Heritage (Artefact Heritage, June 2015), provides a framework in Section 6.1 for the ongoing conservation and potential redevelopment of the Nowra Bridge. This section outlines the preliminary conservation policies to safeguard the heritage significance of the bridge.

A high-level assessment of the proposed strategic adaptive reuse options have been comparatively assessed against the preliminary conservation policies stipulated in the CMP. Table 8-1 presents a “traffic light” rating system for a basic but somewhat objective comparison.

8.2 Policies excluded from the comparison

Preliminary Policies 3, 5, 9, and 10 are not applicable for the comparative assessment of adaptive reuse options for the Nowra Bridge for the following reasons:

- Policy 3 is procedural, guiding future updates to the CMP rather than assessing adaptive reuse options.
- Policy 5 focuses on routine monitoring for maintenance, not on evaluating adaptive reuse options.
- Policy 9 mandates heritage impact assessments for any proposed changes, a step required after selecting a preferred adaptive reuse option.
- Policy 10 relates to finalising the CMP after the decision-making process.

These policies are geared towards post-assessment actions and ongoing management, not the direct comparison of adaptive reuse options.

8.3 Findings and discussion

The assessment demonstrates that Options 2B and 3 align with conservation policies, offering a comprehensive approach to heritage preservation, safety, and accessibility. Option 2A, while meeting safety standards, may incur higher long-term maintenance, which TfNSW considers less than ideal.

Option 1 has a minimal intervention strategy that leads to conflicts with essential policies, particularly in preservation, maintenance, and safety, and lacks a forward-looking conservation plan. Consequently, with their more proactive approaches, Options 2A, 2B, and 3 are more in keeping with the proposed long-term conservation and community use.

8.4 Discussion on the alignment with the CMP’s preliminary conservation policies

8.4.1 Routine maintenance

Routine maintenance items are detailed in the Level 2 Inspection reports (TfNSW, February 2014), typically encompassing activities such as cleaning scuppers, removing debris, minor patching of concrete and pavement, maintaining electrical fittings and fixtures, conducting cathodic protection testing, tightening fasteners, paint repairs, and removing graffiti. Notably,

routine maintenance does not encompass rehabilitation or significant maintenance and repairs. For instance, a comprehensive blast and repaint of the bridge would not fall within the scope of routine maintenance. Failure to undertake major maintenance or repairs for aging structures often leads to rapid deterioration, compromising safety and intended functionality.

8.4.2 Preliminary Policy 1 - Overall preliminary conservation policy

"The truss bridge at Nowra should be conserved as a place of State significance, primarily through its preservation and maintenance. The introduction of new materials will be used only where it is essential for the conservation of cultural significance or for essential management tasks such as safety code compliance."

Option 1

Option 1 proposes a minimal intervention approach involving only routine maintenance, which does not align with the conservation objectives of Preliminary Policy 1.

Preliminary Policy 1 states that the truss bridge at Nowra should be conserved as a place of State significance, primarily through its preservation and maintenance. It allows using new materials only when essential for cultural significance or safety code compliance.

Unfortunately, Option 1 falls short of these conservation objectives. Routine maintenance alone does not adequately address the preservation and maintenance requirements highlighted in Preliminary Policy 1. The focus on routine maintenance neglects the comprehensive care and potential necessary interventions to preserve the bridge in appearance and condition in accordance CMP objectives.

Option 2A

While Option 2A suggests a more comprehensive approach than Option 1, its alignment with Preliminary Policy 1 is compromised by the decision to retain the existing concrete barrier. This could increase the risk of deterioration to the bridge, as the barrier may not provide the necessary protection or support the required for long-term preservation. Consequently, the bridge's cultural significance and structural integrity might be at risk, which would not fully adhere to the principles of preservation and maintenance as set out in Preliminary Policy 1.

Option 2B

Option 2B takes a further step towards the objectives of Preliminary Policy 1 by possibly incorporating a combination of preservation, maintenance, and selective enhancement with new materials. This approach would maintain the bridge in its current state and involve restoration and reconstruction efforts where necessary for its cultural significance or safety compliance.

Option 3

Option 3 represents a more extensive intervention strategy, albeit at a significant cost, which could fully embrace Preliminary Policy 1. This option involves significant conservation work, including the introduction of new materials and techniques to preserve the bridge. If Option 3 is implemented with a focus on heritage values, it offers a robust conservation plan that not only preserves but potentially enhances the bridge's heritage status for the longer term.

8.4.3 Preliminary Policy 2 - Recognising State Significance

The Nowra Bridge is recognised as a place of State heritage significance, and the future conservation and management of the place must be in accordance with this recognised significance.

Option 1

Under Preliminary Policy 2, the objectives may only be partially met with Strategic Option 1 – Minimum intervention due to the following:

- Limited Scope – The approach prioritises essential maintenance over significant conservation, potentially compromising long-term heritage value.
- Preservation of Current State – "Do minimum" actions for the barrier and bridge deck may neglect opportunities to enhance the bridge's heritage integrity.
- Interpretive Signage – While positive, signage alone may not fully convey the bridge's historical importance as a State-significant site.
- Routine Maintenance – Focused on upkeep rather than heritage conservation, this may not align with the broader objectives of recognising and preserving the State significance.

Option 2A

Option 2A, while taking a step beyond minimal intervention, still presents challenges under Preliminary Policy 2. Retaining the existing concrete barrier under this option may not sufficiently protect the bridge against future deterioration. Although there may be some efforts towards conservation, the risk of degradation threatens the long-term heritage integrity and value, suggesting that the objectives of recognising and preserving the bridge's significance may not be entirely achieved.

Option 2B

Option 2B appears to be more in line with Preliminary Policy 2. This option includes a broader scope of work that may remove future maintenance risks associated with the concrete barrier, while improving visual and heritage outcomes. Therefore, Option 2B is expected to recognise and uphold the bridge's State significance, ensuring that future interventions contribute positively to its heritage value and integrity.

Option 3

Option 3 is likely the most comprehensive approach in terms of conservation and management, fully supporting the objectives of Preliminary Policy 2. This option would involve extensive preservation measures while also focussing on long-term conservation. Option 3 would ensure that the bridge management strategy is in accordance with its recognised significance and project objectives.

8.4.4 Preliminary Policy 4 - Conservation of the structure

"The bridge should be conserved through preservation and ongoing maintenance. The introduction of new materials will be permissible only where essential for the conservation of cultural significance and where it is essential to the continuing safe operation of the structures."

Option 1

Under Preliminary Policy 4, the minimal intervention approach could lead to accelerated deterioration, necessitating future, more invasive and costly interventions, which would be against this policy. Minor routine bridge maintenance may not sufficiently address identified issues, conflicting with the policy's call for a maintenance schedule. Additionally, the approach likely falls short of the community objectives for maintaining or improving the bridge as a functional and attractive structure.

Option 2A

Option 2A favours an approach that includes retaining the existing concrete barrier and may not fully align with Preliminary Policy 4. The potential for increased deterioration due to this barrier could necessitate the introduction of new materials or more extensive interventions in the future, which would only be permissible under the policy if they are essential for the conservation of the bridge's cultural significance or safety. The policy's emphasis on preservation and ongoing maintenance suggests a need for a more proactive approach than Option 2A appears to offer, raising concerns about its adequacy in conserving the structure.

Option 2B

Option 2B may offer a more suitable strategy in line with Preliminary Policy 4. This option could involve a more detailed maintenance schedule and the careful introduction of new materials when essential for conservation or safety. By proactively addressing the bridge's preservation needs, Option 2B could ensure the bridge's structural and cultural integrity is maintained, aligning with the policy's conservation and safe operation requirements.

Option 3

Option 3 would appear to be the most comprehensive in terms of meeting the requirements of Preliminary Policy 4. This option would likely involve a thorough maintenance regime and could include significant conservation measures, possibly involving introducing new materials and techniques to preserve the bridge’s cultural significance and safety. By fully addressing both the preservation and maintenance aspects, Option 3 would be in alignment with the policy’s directives for conserving the structure.

8.4.5 Preliminary Policy 6 - Maintenance and management of curtilage

The area to the east of the bridge and around the two ends of the bridge are to be maintained free from any new constructions and the incursion of any vegetation, which will inhibit the safe operation of the structure and the visual aspect of the structure.

Option 1

Option 1, which advocates for minimal intervention, effectively maintains the status quo and does not propose any new developments or enhancements to the area around the Nowra Bridge. This approach would not conflict with Preliminary Policy 6 – Maintenance and management of curtilage – as it does not introduce any new constructions or vegetation that could impact the bridge's safe operation or visual integrity.

However, the lack of any change under Option 1 means that the current condition of the bridge surroundings would remain unchanged. This may not facilitate or meet other policies or project objectives.

Option 2A, 2B and 3

The potential option of developing a seating and viewing area under these options would need to be carefully managed to ensure it does not conflict with Preliminary Policy 6. While enhancing the visitor experience, it must not introduce new constructions or allow vegetation that could affect the bridge's safe operation or visual integrity.

The challenge will be to balance amenity improvements with the policy’s requirements to maintain the bridge's surroundings.

8.4.6 Preliminary Policy 7 - Safety Infrastructure

"The upgrading of safety infrastructure may be essential to Roads and Maritime maintaining the current use of the bridge in the future. The upgrading of pedestrian safety barriers on the walkway and crash barriers on the carriageway, will need to be undertaken within the constraints on significance of the structure."

Option 1

For Preliminary Policy 7, the minimal intervention approach raises concerns about meeting current safety standards, particularly for the road traffic barrier, which would likely conflict with the policy's requirements for pedestrian safety upgrades. The absence of any upgrades to safety barriers could also be at odds with this policy, especially as the existing barriers do not meet current safety standards. Furthermore, the lack of amenities like a viewing area on the bridge's northern foreshore could be considered a safety issue, as visitors might enter unsafe areas for a better view. This approach fails to meet community objectives for a safe and enjoyable public space.

Option 2A

While Option 2A may meet the immediate safety criteria set out in Preliminary Policy 7, the key disadvantage lies in the potential for increased future maintenance demands. If the safety upgrades under this option could lead to a cycle of frequent maintenance, which may be more disruptive and costly over time.

Option 2B

Option 2B, with its more thorough approach to upgrading public safety infrastructure, would likely meet the safety criteria effectively. However, the degree of future maintenance required could still be a concern. Ensuring that the upgrades are durable and low-maintenance would be crucial to avoid excessive future upkeep, which could otherwise detract from the practical benefits of this option.

Option 3

Option 3 would encompass the most extensive safety infrastructure upgrades. This option would have the potential to address all necessary safety concerns comprehensively, including the introduction of modern safety features that are sympathetic to the bridge's heritage status. By thoroughly upgrading safety infrastructure within the constraints of the bridge's significance, Option 3 could be fully in accordance with Preliminary Policy 7, enhancing the bridge's safety profile for the long term.

8.4.7 Preliminary Policies 8 - Interpretation

"The bridge should be interpreted as a place of State cultural significance in its own right. Interpretation should aim at being low key and low maintenance. Consideration should be given to extending pedestrian access to the bridge, and the reserves around the approaches, taking advantage of the visual aspects of the bridge, and placing the bridge in context with the Shoalhaven River and surrounding areas or items of heritage significance."

Option 1

Option 1, with its minimal intervention strategy, does not satisfy Preliminary Policy 8. While it would likely maintain a low-key approach to interpretation, the lack of development could mean missing opportunities to enhance interpretation and pedestrian access. This option may not take

full advantage of the bridge's visual aspects or its context within the Shoalhaven River and surrounding areas, potentially leaving the bridge's story underrepresented.

Option 2A, 2B and 3

Options 2A and 2B could provide a more balanced approach, potentially enhancing interpretation and access while still adhering to the low-key and low-maintenance directive of Preliminary Policy 8. This option might better utilise the bridge's setting and heritage context, offering visitors a more engaging experience that communicates the bridge's state significance without imposing high maintenance demands.

Table 8-1 Comparison of options against preliminary conservation policies (Source: FBE)

Policy	Heading	Strategic Option			
		1	2A	2B	3
1	Overall preliminary conservation policy	●	●	●	●
2	Recognising State significance	●	●	●	●
3	How this document should be used	n/a	n/a	n/a	n/a
4	Conservation of the structure	●	●	●	●
5	Monitor vehicular impacts	n/a	n/a	n/a	n/a
6	Maintenance and management of curtilage	●	●	●	●
7	Safety infrastructure	●	●	●	●
8	Interpretation	●	●	●	●
9	Heritage impact assessment	n/a	n/a	n/a	n/a
10	Completion of management documentation	n/a	n/a	n/a	n/a

Key:

● Does not meet the preliminary policy

● Partially meets the preliminary policy

● Meets or exceeds the preliminary policy

n/a - not applicable

9. Opportunities – pedestrian balustrade

9.1 Balustrade railing coatings

9.1.1 General

Opting for different coatings for the pedestrian balustrade railing offers a dual benefit of durability and visual charm. Various coating choices possess unique attributes that cater to these aspects. Coatings vary in resistance to salt spray, chemicals, and abrasion. Durable and corrosion-resistant coatings, such as powder coating or galvanisation, shield the railing against weather-induced rust and damage. This heightened durability preserves the balustrade's structure and appearance, extending its lifespan and minimising maintenance or replacement needs.

The selection of coatings has a substantial impact on the balustrade's aesthetics. Coatings are available in an array of colours, textures, and finishes. Choosing coatings that harmonise with the bridge's overall design creates a visual cohesion between the railing and the structure. For instance, a sleek, glossy coating complements modern designs, while textured or matte finishes enhance traditional or rustic aesthetics. The right coating choice enhances the bridge's visual appeal, fostering an inviting atmosphere for pedestrians.

9.1.2 Galvanising

Galvanising involves applying a layer of zinc to the surface of the metal through a process called hot-dip galvanisation. This coating provides exceptional corrosion resistance, making it suitable for outdoor applications. It creates a uniform, silver-grey finish that can add an industrial or modern touch to the railing.

Figure 9-1 Pedestrian balustrade railing Dunbogan Bridge (Source: FBE)

9.1.3 Protective paint coating

Applying paint coatings allows for a wide range of colour and finish options. High-quality paints formulated for outdoor use can protect against rust and environmental elements. Glossy, matte, or textured finishes can be chosen to match the desired visual style of the bridge.

Figure 9-2 Painted Bridge Railing and Elements (Source: FBE)

9.1.4 Zinc alloy coatings

Zinc alloy coatings, such as zinc-nickel or zinc-aluminium, combine the benefits of zinc's corrosion resistance with other elements for improved durability. These coatings can provide a range of finishes, from metallic to matte, offering protection and visual variety.

9.1.5 Powder coating

Powder coating involves applying a dry powder to the surface and curing it using heat. This process creates a durable, chip-resistant, and colourful finish. Powder coatings come in an extensive palette of colours and textures, allowing customisation to match the bridge's design.

Figure 9-3 Powder-coated steel walkway (Source: Unknown)

9.1.6 Stainless steel

Stainless steel has a modern and sleek appearance that contrasts with the traditional aesthetics often associated with heritage bridges. The reflective and contemporary nature of stainless steel might clash with the historical character of the Nowra Bridge, potentially diminishing its authenticity and visual harmony within its surroundings.

Figure 9-4 Stainless Steel Bridge Railing (Source: Unknown)

9.2 Design

9.2.1 General

In design, nuanced approaches such as the pedestrian balustrade railing can significantly elevate the structures' visual appeal. Exploring design elements like eliminating vertical posts, varying the spacing of vertical members, and even adjusting their angles can contribute to the bridge's architectural aesthetics. However, these design choices must be carefully balanced with considerations for deflection limits to ensure structural integrity and safety. Careful consideration must also be given to the potential risks of climbing, vandalism, and maintenance requirements.

9.2.2 Vertical posts

The decision to omit vertical posts from the balustrade design introduces an open and unobstructed visual aspect. This modernises the bridge's appearance, promoting a sense of spaciousness. An example is provided in Figure 9-5.

Figure 9-5 Pedestrian balustrade railing at Echuca Campaspe River (Source: TfNSW)

9.2.3 Spacing of vertical members

Introducing variations in the spacing of vertical members imparts an artistic and dynamic element to the balustrade design. This creates visual rhythm and intrigue, breaking away from uniformity. An example of this is provided in Figure 9-6.

Figure 9-6 Pedestrian Balustrade Railing – Echuca over the Murray River (Source: TfNSW)

9.2.4 Angles of the vertical member

Further enriching the visual appeal, varying the angles of vertical members adds a unique dimension to the bridge's design. This introduces playfulness and complexity to the structure's aesthetics.

Figure 9-7 Pedestrian balustrade Old Windsor Bridge Span 1 (Source: TfNSW)

9.2.5 Original lattice railing design

It's also worth considering the lattice design of the original 1881 bridge. This historical reference may inspire a design that pays homage to the past while embracing contemporary aesthetics.

Evaluating the lattice pattern's adaptability within modern materials and engineering standards is crucial for achieving a harmonious blend of heritage and innovation.

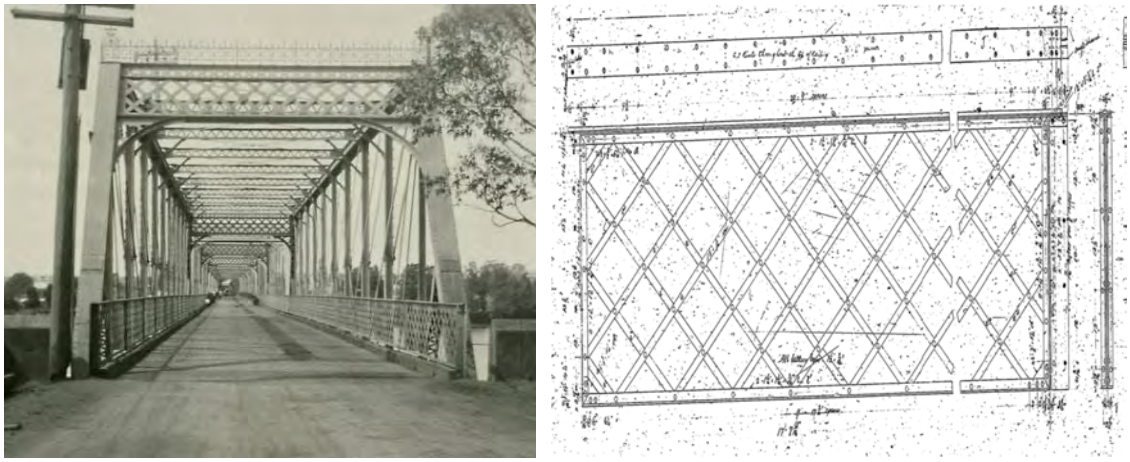


Figure 9-8 Original lattice bridge railing (Source: TfNSW)

9.2.6 Issues to consider

Throughout these design explorations, the careful consideration of deflection limits remains pivotal. Deflection plays a crucial role in both aesthetics and structural integrity. Adopting a holistic approach ensures that the bridge radiates visual allure and fulfils Australian Standard requirements. Striking a harmonious balance among these considerations will yield a balustrade design that serves as an architectural statement and provides the necessary security and stability for a fully functional bridge.

Additionally, it is imperative to address the associated risks, including concerns about vandalism and unauthorised climbing over the railing. These factors should be factored into the design to deter such activities and ensure the safety of users. Moreover, maintenance concerns must also be considered during the design phase to ensure the longevity and optimal performance of the balustrade over time.

9.3 Pedestrian lighting

Replacing traditional overhead lighting with handrail lighting for pedestrian areas offers a fresh perspective on urban design.

By seamlessly incorporating illumination into the surroundings, this approach not only elevates the visual appeal and safety of the area but also streamlines maintenance, thereby mitigating disruptions to the existing infrastructure.

Nonetheless, striking an equilibrium between these enhancements and the associated installation costs is imperative.

The figures below detail the impacts of combining pedestrian walkway lighting with feature lighting.

Figure 9-9 Handrail lighting without feature lighting (Source: FBE)

Figure 9-10 Handrail lighting combined with feature lighting (Source: FBE)

10. Comparative cost estimates

10.1 Discussion

For the Nowra Bridge Project, the internal TfNSW stakeholder team was presented with indicative cost estimates for each of the four strategic options under consideration. It's important to note that these cost estimates, at this current stage, are for comparison and relativity purposes only. While the absolute value estimates for each option may evolve as the project moves forward, the relative order of magnitude between the options is expected to remain consistent. As more information becomes available and the project progresses, additional work will be needed to refine these cost estimates. A summary of the cost information, intended solely for comparison purposes, has been presented in Table 10-1.

Painting costs were excluded. However, this wouldn't change the relative magnitude between Options 2A, 2B and 3.

Table 10-1 Relative costs (Source: FBE)

Option No.	Description	Relative Costs
Option 1	Minimal intervention – routine maintenance actions	1X
Option 2A	Medium intervention – New pedestrian barrier rail on top of existing barrier base	4.45X
Option 2B	Medium intervention – New proprietary pedestrian balustrade barrier on reinforced concrete kerb	4.75X
Option 3	Higher level intervention – Deck replacement and proprietary pedestrian balustrade barrier on reinforced concrete kerb	8.83X

11. Multi-criteria assessment of strategic options

11.1 Overview and aim

The Multi-Criteria Analysis (MCA) for the Nowra Bridge Project aims to evaluate the various strategic options using a comprehensive set of factors. These factors include cost and other important elements such as construction risk, heritage values, visual quality, and maintenance and durability. By assessing each option against these multiple criteria, the MCA offers a more holistic view of the potential impacts and benefits, aiding in more informed decision-making. This approach differs from the quantitative comparative cost assessment in Section 11, which focuses solely on numerical cost estimates for each option without considering the other qualitative factors considered in the MCA.

11.2 Process

The multi-criteria assessment (MCA) for the Nowra Bridge adaptive reuse project entailed a well-organised and cooperative strategy for appraising different options.

The process for the multi-criteria assessment was as follows:

- The project team established a set of criteria to guide the evaluation process.
- The team engaged in conversations to determine the scoring methodology for each criterion, assigning relative importance.
- Various options were examined and scored against the established criteria.
- Multiple sessions, including meetings and workshops, were held to thoroughly discuss and refine the assessment process.
- The assessment process was informed by data and details provided by the project team, including sketches, photos, visualisations, and day and nighttime renders.
- The collaborative approach fostered collective decision-making, resulting in an option that best aligned with project goals and constraints.

11.3 Criteria and weightings

The criteria and weightings used in the assessment are presented in Table 11-1.

Table 11-1 Criteria and weightings (Source: FBE)

Description	Criteria	Weighting
Heritage values	**Score of 1**: The option significantly impacts heritage and has no beneficial outcomes or enhancements to the bridge element under consideration. **Score of 2:** The option has minimal heritage improvements or beneficial outcomes or enhancements to the bridge element under consideration. **Score of 3:** The option has moderate heritage improvements or beneficial outcomes or enhancements to the bridge element under consideration. **Score of 4:** The option has good heritage improvements and enhances the bridge element under consideration. **Score of 5**: The option has good heritage improvements and enhances the bridge element under consideration.	10%
Visual quality	**Score of 1:** The option is visually unappealing and does not fit with the bridge and usage. **Score of 2:** The option is somewhat visually unappealing and needs some design changes to fit with the bridge and usage. **Score of 3**: The option is acceptable visually, but it does not stand out or enhance the bridge and usage. **Score of 4**: The option is visually pleasing and enhances the bridges and usage. **Score of 5:** The option is visually stunning and significantly enhances the bridge and usage.	10%
Maintenance and durability	**Score of 1:** The option is likely to experience significant durability issues, and it is unlikely to last long without significant repairs and replacement. **Score of 2**: The option is somewhat durable, but it will require significant repairs and replacement over time. **Score of 3:** The option has moderate durability, and it will require some repairs and replacement over time. **Score of 4**: The option is relatively durable, and it will require minimal repairs and replacement over time. **Score of 5:** The option is very durable, and it is unlikely to require any significant repairs or replacement over time.	10%

Description	Criteria	Weighting
Construction risks – safety, environmental, constructability	**Score 1:** Very low combined score; significant challenges in constructability, safety, and environmental risk, with high potential for adverse outcomes. **Score 2:** Low combined score; considerable difficulties expected in constructability, safety, and environmental risk, requiring extensive planning and mitigation measures. **Score 3:** Moderate combined score; moderate challenges anticipated in constructability, safety, and environmental risk, manageable through standard practices and controls. **Score 4:** High combined score; few obstacles expected, with satisfactory levels of constructability, safety, and environmental risk. **Score 5:** Very high combined score; excellent feasibility, safety, and minimal environmental risk, ensuring efficient and secure project execution.	20%
Cost	**Score of 1:** The option is very difficult and costly to construct and requires significant technical expertise and resources. **Score of 2:** The option is somewhat difficult and costly to construct, requiring some technical expertise and resources. **Score of 3:** The option has moderate constructability and requires some technical expertise and resources. **Score of 4:** The option is relatively easy and affordable to construct and requires minimal technical expertise and resources. **Score of 5**: The option is very easy and affordable to construct and requires minimal technical expertise and resources.	50%

Results of the assessment

Table 11-2 offers a simplified traffic light comparison of the considered adaptive reuse strategic options for Nowra Bridge. The qualitative approach in this table is subjective and intended solely for contrast. It's important to note that these scores were collaboratively assigned within the internal TfNSW stakeholder group and deliberated over multiple sessions to ensure a comprehensive evaluation.

Strategic option 2B scored highest against both weighted and unweighted criteria and is therefore preferred.

11.4 Discussion

11.4.1 Cost criteria versus construction risk criteria

The "cost" criteria is weighted at 50%, making it the most significant factor in the overall evaluation. It aims to assess the economic feasibility of each strategic option, including how difficult and costly it is to construct, as well as the level of technical expertise required.

“Construction risk” criteria evaluate the challenges associated with each option's constructability, safety, and environmental risk for the Nowra Bridge Project. It has a weighting of 20% and deals specifically with the level of difficulty and risk involved in constructing the project from the perspectives of safety, environmental impact, and general constructability.

While both consider construction aspects, "Cost" is primarily financial, and "Construction risk" evaluates the project's broader challenges and risks. Their different weightings also highlight the greater emphasis on cost in decision-making.

Table 11-2 MCA Nowra Bridge Adaptive Reuse (Source: FBE)

Item No.	Option	Heritage values	Visual quality	Maintenance and Durability	Construction risk (Safety, Environmental, constructability)	Cost	Unweighted		Weighted	
							Overall score	Ranking unweighted	Overall score	Ranking
	Weighting	10%	10%	10%	20%	50%				
Option 1 - Minimum Intervention										
	Barrier - Do nothing **Bridge Deck** - Do Nothing **Lighting Design** - Retaining existing lighting **Other** - Routine bridge maintenance	2	1	2	4	3.5	2.8	4	3.1	3
Option 2a - Medium Intervention										
	Barrier - Preferred Option 1 **Bridge Deck** - Minor maintenance **Lighting Design** - Pier feature lighting **Other** - Routine bridge maintenance, removal of clip-on walkway, total bridge repaint and repairs	4	4	3	3	3	3.5	2	3.2	2
Option 2b - Medium Intervention										
	Barrier - Option 5 **Bridge Deck** - Partial removal **Lighting Design** - Pier feature lighting **Other** - Routine bridge maintenance, removal of clip-on walkway, total bridge repaint and wrought iron repairs, off bridge seating and shade area	4	4.5	4	2.5	3	3.7	1	3.3	1
Option 3 - High Intervention										
	Barrier - Barrier Removal Option 5 **Bridge Deck** - Remove and replace with a lightweight concrete deck **Lighting Design** - Comprehensive lighting enhancements **Other** - Significant bridge rehabilitation and maintenance	4	4	4	2	1.5	3.3	3	2.4	4

The future management decisions for Nowra Bridge remain the responsibility of TfNSW. Any selection of one strategic option over another or recommendations to do so do not form part of this report.

12. Conclusion

The project team has explored various strategic options to transform this historic structure into a functional, visually appealing landmark. Through a collaborative effort between internal TfNSW stakeholders, four distinct intervention levels have been assessed, each carrying its own implications for heritage values, visual quality, maintenance, construction risk, cost, and more.

After a thorough evaluation, strategic option 2B, representing a medium intervention approach involving concrete barrier base removal, has emerged as the preferred choice. This option balances preserving the bridge's heritage significance and enhancing its functionality and aesthetics to meet contemporary demands. By introducing elements such as a new post and rail system, improved lighting, seating, shade areas, and interpretive signage, option 2B transforms the Nowra Bridge into a bridge that respects its history and serves as an inclusive community space.

The benefits of the preferred strategic option extend across multiple dimensions. It respects and enhances the bridge's heritage values, visually enriches its appearance, increases maintenance efficiency, reduces construction risks, presents cost-effective solutions, and contributes to the safety and comfort of pedestrians and cyclists.

13. Next steps

The next steps for the project are to be confirmed with TfNSW internal stakeholder team. However, this would include the finalisation of the SOHI and REF.

14. References

Artefact Heritage. (August 2018). *Non-Aboriginal Statement of Heritage Impact.* Sydney: Artefact Heritage.

Artefact Heritage. (August 2018). *Nowra Bridge Project - Non-Aboriginal Statement of Heritage Impact.* Pyrmont, NSW, 2009: Artefact Heritage.

Artefact Heritage. (June 2015). *DRAFT Phase 1 Conservation Management Plan.* Rose Bay, NSW 2029: Artefact Heritage.

Australian Bureau of Statistics. (2021). *2541, NSW 2021 Census All Persons Quickstats*. Retrieved from Australian Bureau of Statistics: https://www.abs.gov.au/census/find-census-data/quickstats/2021/POA2541

Department of Planning and Environment. (May 2023). *Assessing heritage significance - Guidelines for assessing places and objects against the Heritage Council of NSW criteria.* Parramatta NSW 2124: Environment and Heritage Group, Department of Planning and Environment.

Focus Bridge Engineering (FBE). (December 2022). *Fee Proposal for Nowra Bridge – Adaptive re-use as a footbridge.* Newcastle, NSW: FBE.

Heritage NSW. (03 October 2017). *State Heritage Inventory - Shoalhaven River Bridge - Victorian wrought iron bridge*. Retrieved from Heritage NSW: https://www.hms.heritage.nsw.gov.au/App/Item/ViewItem?itemId=2390714

TfNSW. (August 2022). *Bridge Inspection Report.* Kiama: TfNSW.

TfNSW. (February 2014). *Structural Inspection and Assessment Report - Level 2.* Parramatta: TfNSW.

TfNSW. (January 2022). *Draft Special Inspection Report.* Parramatta: TfNSW.

TfNSW. (July 2022). *Historic Nowra Bridge - Community Consultation summary Report.* Sydney NSW: TfNSW.

TfNSW. (March 2022). *Existing Condition Assessment for.* Parramatta: TfNSW.

TfNSW. (October 2021). *Existing Condition Assessment for Pedestrian Use.* Parramatta: TfNSW.

Appendices

Appendix **A** – Visualisations

Nowra Bridge as existing before repainting, removal of the clip-on walkway and services

Nowra Bridge - Adaptive Reuse Option 2A

Nowra Bridge - Adaptive Reuse Option 2A and 2B Lighting

Nowra Bridge - Adaptive Reuse Option 2B and 3

Nowra Bridge - Adaptive Reuse Option 3 - Lighting

Appendix **B** – Maintenance actions as reported in TfNSW L2 Inspection reports

Table C-1 Maintenance Actions (Source: TfNSW)

Element Code/ Description	Activity Description	Required Action	Qty	Risk
BEXP	Repair Bridge Bearing	• Major corrosion on the expansion bearing seized.	18 each	Medium
BFIX	Repair Bridge Bearing	• Major corrosion on the bearings and guides on bearings.	18 each	Medium
CDSL	Repair Concrete, minor	• Concrete infills around the pedestrian railing posts are breaking up and loose at all spans due to movement of the bridge / vibration. • Minor spalled area on the footpath slab at span 2 near pier 2 100 x 100. • Minor spalling on the pedestrian deck span 4 – 2 off 200 x 100. • Spalling on the pedestrian deck on span 6 – 100 x 100. • Cracked / broken concrete kerb at railing post on span 9 (No. 3 post from Abutment B) - • The Abutment B end of the footpath has a large lateral crack 100mm from the end of the footpath.	2 m2	Low
CDSL	Monitor Bridge Element	• The footpath is dipping on the outside edge at Abutment A span 1. • The deck at Abutment A has major movement under traffic - loose lindaptors at cross girder No. A. • Lateral cracking going across the footpath areas is prevalent at post locations on all spans. • A lateral crack 100mm from the end of the pedestrian footpath at Abutment B.	1 each	Low
JCOS	Repair Bridge Joint	• Torn compression seal at pier 1 in both lanes. • Pier 3 joint is very tight - unable to assess the condition of the rubber seal.	3 each	Low

Element Code/ Description	Activity Description	Required Action	Qty	Risk
		• The compression seal at pier 7 pedestrian deck is loose and needs to be glued down as it is creating a trip hazard - see photo.		
JNOS	Repair Bridge Joint	• The concrete nosing at Abutment A is cracked in the fast and slow lanes. • Moisture is getting onto the Abutment A headstock and wall from the joint above. • No joint at pier 8, but moisture is getting onto the pier 8 U/S column. • The Abutment B nosing on the span 9 side is breaking up in the wheel path.	3 each	Low
JPOS	Repair Bridge Joint	• The Abutment B XJS nosing on the bridge side has broken in the slow lane wheel path.	1 each	Medium
MAPP	Repair Sign	• Need to update the "no fishing" signs at Abutment A and B approaches (RTA old sign).	2 each	Low
MAPP	General Cleaning	• The area at Abutment A needs to be rehabilitated. • - possibly from the contractor.	1 each	Low
MAPP	Provide Scour Protection	• The area above the new Abutment B retaining wall has been protected with shotcrete but further work is required. • Settlement of the approach footpath of up to 35mm at the end of the bridge is visible - major trip hazard up to 35mm on outer edge.	1 Each	Medium
MBAT	Repair Masonry and Brick	• Badly cracked stone pitching at Abutment B crib wall. • Spalling and broken section of the crib wall at Abutment B end between bridges.	6 m2	Low
MGCL	Remove Graffiti	• Need to remove graffiti off the A-B principle at span 4 D/S side.	1 m2	Low

Element Code/ Description	Activity Description	Required Action	Qty	Risk
MGCL	Vegetation Control	• Need to clear away trees growing close to the bridge at Abutment A U/S and D/S and Abutment B.	2 each	Low
MGCL	General Cleaning	• Need to clear away a large build up of sediment and tree debris at Abutment A around the bearings and cross girder. - see photo. • Need to clear away large build up of pigeon droppings and nests over the whole bridge - see photo. • Areas need to be cleaned away from between the principals and cross girders at each span prevalent at the footpath side. - see photo. • Need to clear away rubbish dropped off the footpath at the vertical struts (through lattice) on all spans. • Clean away moss growing and sediment on the footpath under the pedestrian railing prevalent at all spans. - see photo. • Need to clean sediment from pier 5 joint – see photo. • Clean a lot of moss growing on the slow lane traffic barrier - see photo. • Need to clear away sediment sitting on the bottom flange of the beam No. 1 and 2 at Abutment B end. - see photo. • Need to clean sediment and lichen off the top of the Abutment B span 9 cross beam - see photo.	9 Each	Low
MMAS	Repair Masonry and Brick	• Major vertical cracking and cracking of the joints in the Abutment A sandstone block wall (up to 20mm wide) on the D/S side.	10 m2	Low
MWES	Minor Pavement Patch	• The construction joint of the deck in span 1 (saw cut) is breaking up in the slow lane . • The AC is cracked and breaking out at the pier.	40 m2	Low

Element Code/ Description	Activity Description	Required Action	Qty	Risk
		• 2 joint in the slow lane. • Due to high movement of the deck in the centre of span 4 a concrete slab has been installed - this is now cracking up in the slow lane kerb side and fast lane near the centre line. • AC is breaking out on the span 6 side of the pier 5 joint in the fast lane. • The AC is cracked in span 6 slow lane approximately 3 metres from pier 5 joint. • AC breaking out in span 7 slow lane - a lot of movement felt in this span. - • AC badly cracked up at the pier 6 slow lane span 6 side 2.5m from the pier in the slow lane extending 3.0m. • AC breaking up at the end of the patch at pier. • 6 - no expansion / movement - 500 x 200. • * AC breaking out in span 7 slow lane at pier 8. a lot of movement felt in this span. - • * AC on the deck at Abutment B is breaking up in the slow lane. • * AC breaking up on the Abutment B slow lane approach at the end of the bridge.		
PBGI	M743 Application of Stripe, Build and Topcoats	• Flaking paint and surface corrosion on span 9 girders.	100 m2	Low
PCBT	M778 Steel Structural Elements, Other Specific Maintenance	• Minor surface corrosion is visible on many of the top and bottom pins (unable to fully inspect the top side of pins).	120 each	Medium

Element Code/ Description	Activity Description	Required Action	Qty	Risk
PCOD	Miscellaneous repairs	• Deck bolts connection the steel deck to the stringers are broken throughout the bridge.	9 items	Low
PCOD	M743 Application of Stripe, Build and Topcoats	• Surface corrosion on areas where kerb/deck sits on the outside stringers. Areas at open joints are being affected by moisture.	138 m2	Medium
PBGI	M743 Application of Stripe, Build and Topcoats	Flaking paint and surface corrosion on span 9 girders.	100 m2	Low
PCBT	M778 Steel Structural Elements, Other Specific Maintenance	• Minor surface corrosion visible on many of the top and bottom pins (unable to fully inspect top side of pins).	120 Each	Medium
PCOD	Miscellaneous repairs	• Deck bolts connection the steel deck to the stringers are broken throughout the bridge.	9 items	Low
PCOD	M743 Application of Stripe, Build and Topcoats	• Surface corrosion on areas where kerb/deck sits on the outside stringers. Areas at open joints are being affected by moisture.	138 m2	Medium
PDBR	M743 Application of Stripe, Build and Topcoats	• Surface corrosion on bracing on piers 3 - 8. • Surface corrosion visible on top angles on footpath brackets.	85 m2	Low
PPIL	M743 Application of Stripe, Build and Topcoats	• Surface areas on pier 3 - 8 steel caissons is cracked, flaking or faded with surface corrosion. • 2.0 metres above low tide - in the process of repainting.	397 m2	Medium
PTBB	M743 Application of Stripe, Build and Topcoats	• Surface corrosion is visible on most bottom bracing - mainly on the edges and connections. (see spreadsheet). • Crevice corrosion at cross girder connection U/S and D/S on all spans.	80 m2	Low

Element Code/ Description	Activity Description	Required Action	Qty	Risk
PTBC	M743 Application of Stripe, Build and Topcoats	• Areas on the bottom chord plates have surface corrosion, mainly on the inside at the pins.	189 m2	Low
PTCG	M743 Application of Stripe, Build and Topcoats	• Spot corrosion is visible on most cross girders. • Visible surface corrosion on specific areas of the cross girders.	860 m2	Low
PTDG	M743 Application of Stripe, Build and Topcoats	• Areas of the bracing (square and plate) have surface corrosion at pin locations and at the centre area. • A lot of rust staining occurring at the 3rd and 4th vertical from the square bracing connection on most spans in both fast and slow lanes sides.	57 m2	Low
PTGP	M743 Application of Stripe, Build and Topcoats	• Surface corrosion is visible mainly on gusset plates at cross girders, principals and on top gussets at lateral bracing.	50 m2	Medium
PTPR	M743 Application of Stripe, Build and Topcoats	• Surface corrosion is most visible at connection with bottom chords and bearing plates - visible at all piers U/S and D/S. • Other smaller areas of flaking paint on principals.	322 m2	Medium
PTST	M743 Application of Stripe, Build and Topcoats	• Spot corrosion visible on both old and new stringers (more prevalent on old stringers top and bottom flanges).	1665 m2	Medium
PTTB	M743 Application of Stripe, Build and Topcoats	• Surface corrosion and crevice corrosion on front bracing (each span), lateral bracing and diagonal bracing.	420 m2	Low
PTTC	M743 Application of Stripe, Build and Topcoats	• Areas of top chord have no paint visible. • Surface and crevice corrosion visible on top plates on all spans U/S and D/S - see spreadsheet.	820 m2	Medium

Element Code/ Description	Activity Description	Required Action	Qty	Risk
		• Crevice corrosion at the principle pin connections on all spans U/S and D/S.		
PTVT	M743 Application of Stripe, Build and Topcoats	• Peeling paint on the 8th vertical span 1 slow lane. • Surface corrosion is visible on the inside (top and bottom ends) of most struts (at pin location). • Areas of collision damage need repairing.	360 m2	Medium
RCMB	Repair Concrete, minor	• Broken concrete plinth on the span 1 slow lane (4th post from pier 1) - see photo. • Spalled and delaminated areas on the outside face of the kerb. • DOWNSTREAM side:- • span 1 bay 2 and 10 outside - see photo. • span 3 bay 6 and 7 outside. • Pier 3 at joint outside. • span 4 bay 5. • span 7 bay 6,7 and 8. UPSTREAM side. • span 1 bay 8 inside face (accident damage.	19 m2	Low
RMET	Repair Bridge Railing	• Damage pedestrian end post and approach at Abutment A (post is loose) • Surface corrosion visible on areas of the pedestrian railing on all spans. • A lot of the pedestrian railing posts are loose at connection with the beams on the underside. • Loose traffic barrier bolt at span 2 near pier. • slow lane. • Missing railing bolts on the pedestrian railing at pier 5 top and	140 m	Low

Element Code/ Description	Activity Description	Required Action	Qty	Risk
		bottom (both sides), a lot of movement of the bridge is visible at this area.		
RPNT	M743 Application of Stripe, Build and Topcoats	• Paint on the pedestrian railing is no longer effective in all span (major spot corrosion). • Scratched areas on the traffic railing barrier - mainly from vehicle damage. • Surface corrosion and section loss on the top surface of the bottom railing at pier 5.	515 m2	Low
SBGI - Steel - Beam / Girder (Load Bearing)	Repair Bridge Railing	• Damage pedestrian end post and approach ARC fencing at Abutment A (post is loose). • Surface corrosion is visible on areas of the pedestrian railing on all spans. • A lot of the pedestrian railing posts are loose at connection with the beams on the underside. • Loose traffic barrier bolt at span 2 near pier 2 slow lane • Missing railing bolts on the pedestrian railing at pier 5 top and bottom (both sides), a lot of movement of the bridge is visible at this area.	140 m	Low
RPNT	M743 Application of Stripe, Build and Topcoats	• Paint on the pedestrian railing is no longer effective in all span (major spot corrosion). • Scratched areas on the traffic railing barrier, mainly from vehicle damage. • Surface corrosion and section loss on the top. • Surface of the bottom railing at pier 5.	515 m2	Low
SBGI	M778 Rehabilitate Structural Steel Element	• Areas of corrosion at the connection with the cross beams on span 9.	681 m2	High

Element Code/ Description	Activity Description	Required Action	Qty	Risk
		• Section loss on the top and bottom flanges on girders No. 1 and 2 at Abutment B. • Minor corrosion of the top and bottom flanges.		
	M778 Steel Structural Elements, Other Specific Maintenance	• Old and new section loss is visible on bottom. • Pin connections - further investigation is required. • Minor section loss on some of the top pins.	34 Each	High
	M778 Rehabilitate Structural Steel Element	• Areas of corrosion (section loss) of the corrugated sheeting is visible at the connection with the outer stringers and at the open joints. (pier1,3,5,7 and 9). • Flat plate at the underside of the open joints is badly corroded in kerb areas. • Bolt connections from the stringers to the deck area have broken/missing. Lindaptors have been put in place for this problem.	381 m2	Low
	M778 Rehabilitate Structural Steel Element	• Areas of corrosion on the lateral and cross bracing at 3-8 piers (including spacer blocks). • Corrosion mainly visible in the areas of connection to the steel caissons.	130 m2	Medium
	Monitor Bridge Element	• The caissons on pier 5 and 6 downstream have vertical cracking visible - strengthening has been carried out with a yoking system. • No further cracking visible. • Some rust nodes visible on pier 3 - 8 caisson • columns in the tidal zone.	6 Each	Low
	M778 Rehabilitate Structural Steel	• Surface corrosion on bottom bracing in all spans – edges.	82 m2	Medium

Element Code/ Description	Activity Description	Required Action	Qty	Risk
	Element	• Crevice corrosion and minor section loss at the connections with the cross girders on all spans.		
	M778 Rehabilitate Structural Steel Element	• The areas of section loss mainly on the inside of the bottom chords at the pin connections on all spans.	135 m2	Medium
	M778 Rehabilitate Structural Steel Element	• Section loss in the corners (top and bottom) 470 m2 206266 of most cross girders U/S and D/S, mainly at areas where connections to the struts occur. • Crevice corrosion at some cross girders on the top and bottom flanges (see spreadsheet). • Major surface corrosion and section loss on the top flange at Abutment B span 9 between No. 2 and 3 cross girders.	470 m2	Medium

Focus Bridge Engineering

Suite 21, 235 Darby Street, Cooks Hill, NSW 2300
E: mail@focusbridges.com W: www.focusbridges.com

Job number: 220333

Rev No.	Authors	Reviewed		Authorised		
		Name	Signature	Name	Signature	Date
A	J O'Connor F Tomczak	M Tilley C Everett		M Tilley		14/08/23
0	J O'Connor F Tomczak	TfNSW	*On file*	M Tilley	*On file*	12/09/23
1	J O'Connor	TfNSW	*On file*	M Tilley	*On file*	06/11/23

www.focusbridges.com

NSW GOVERNMENT