

GUNDAGAI RAILWAY BRIDGE AND VIADUCTS – CONVERSION TO RAIL TRAIL

Feasibility Report

01 MAY 2018



Incorporating



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REVISIONS

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1 INTRODUCTION

The timber viaducts and steel bridges spans at Gundagai are located on the non-operational Cootamundra to Tumut branch line. The railway line from Cootamundra, on the Main South line, to Gundagai was opened on 1st June 1886. The extension from Gundagai to Tumut, which includes the viaducts and bridge, was opened on 12th October 1903, with the first train travelling across the structure on 3rd December 1903.

In March 1985, the line was officially closed, following damage to some bridges, and washaway of embankments and cutting instability due to flooding in both August 1983 and January 1984. The last train (a rail motor service) travelled across the Gundagai viaduct on 26th November 1983.

Cootamundra-Gundagai Regional Council engaged Arcadis to undertake the following in relation to investigating the feasibility of incorporating Gundagai Railway Bridge and Viaducts into a possible future rail trail:

- Undertake a site visit to inspect the structure, noting its current condition and other relevant information.
- Preparation of a Feasibility Report.

The following report provides details of the abovementioned scope of work and includes the following two components:

Civil Engineering Component – Arcadis carried out this component of the project, being the site inspection, listing of bridge elements that would require replacement, development of a concept design of a shared path structure across the Murrumbidgee River steel bridge span and timber deck truss approach spans, and preparation of the Feasibility Report.

Cost Estimating Component – MIEngineers (engaged by Arcadis) carried out this component of the project, involving the development of a preliminary cost estimate to rehabilitate the bridge and viaducts, and then to convert these structures for incorporation into a future rail trail.

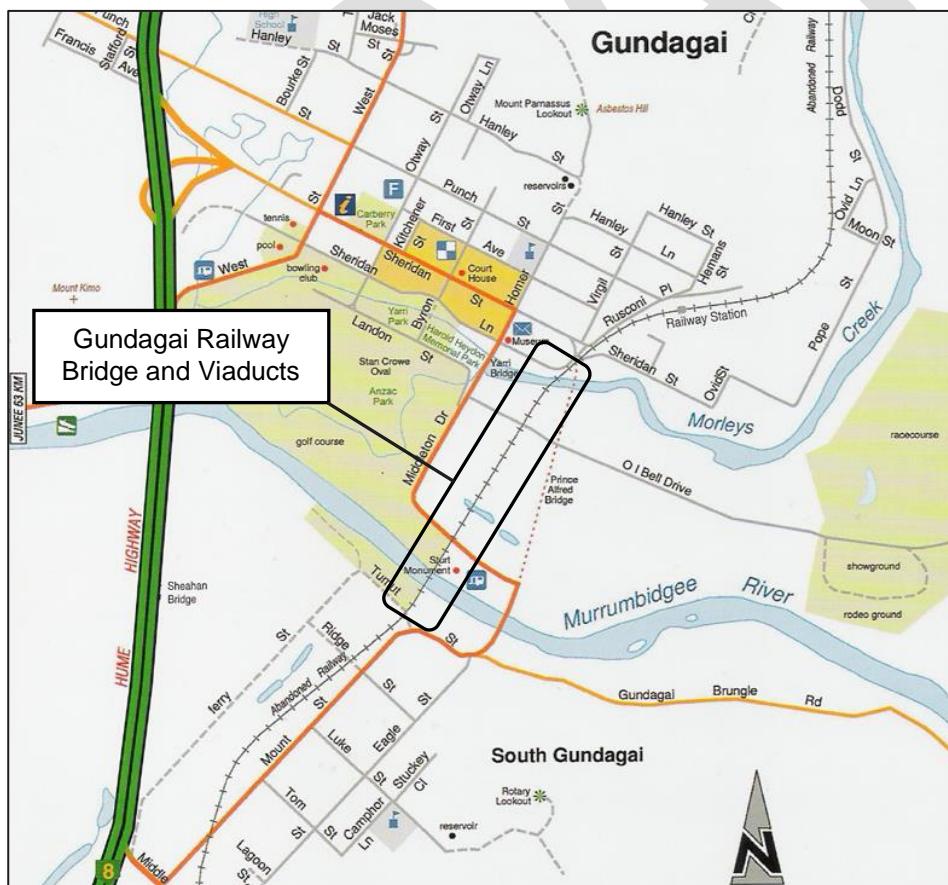


Figure 1 – Locality Plan

2 STRUCTURE CONFIGURATION

The Gundagai railway bridge and viaducts comprises 3 steel spans and 77 timber spans, with an overall length of 924.5 metres and having the following configuration:

No. Spans	Span Length	Span Type	Structure
1	33'6" (10.2m)	Timber deck Howe truss – transom top	Northern Viaduct (72 spans) Total length 768.5m
8	35' (10.7m)	Timber deck Howe truss – transom top	
1	30'6" (9.3m)	Timber deck Howe truss – transom top	
62	35' (10.7m)	Timber deck Howe truss – transom top	
1	68'6" (20.9m)	Steel plate welded through girder – transom top	Approach Span (1 span)
1	200' (61.0m)	Steel hog-back pin-jointed through truss – transom top	River Span (1 span)
1	68'6" (20.9m)	Steel plate welded through girder – transom top	Approach Span (1 span)
4	35' (10.7m)	Timber deck Howe truss – transom top	Southern Viaduct (5 spans) Total length 53.0m
1	33'6" (10.2m)	Timber deck Howe truss – transom top	

The timber viaduct on the northern side of the Murrumbidgee River (Northern Viaduct) crosses two (2) public roads, being O.I. Bell Drive and Middleton Drive, while the timber viaduct on the southern side of the Murrumbidgee River (Southern Viaduct) crosses Tumut Street (now closed to traffic). Public access can essentially be gained to the entire length of both the northern and southern viaducts, except for the length of viaduct within Morleys Creek, continuing to a fence line some 70 metres north of O I Bell Drive. This length of viaduct covers Spans 5 to 16 (inclusive).

The trestles of the viaducts (75 in total, plus 1 supplementary trestle adjacent to Abutment 1) would have been constructed using timber piles driven into the ground. However, it is noted there are 48 trestles that are now supported on concrete sills or walls (possibly 51, as three trestles could not be accessed).

The concrete sills (as distinct from concrete walls) would have been constructed as remediation work for decayed timber piles at the ground line. This was a typical timber trestle repair method used on NSW railways commencing around 1951. It was noted that some of these sills had the year '1963' formed into the concrete surface. In fact, recesses/notches in the timber piles were visible, showing the original cross bracing configuration prior to construction of the concrete sills and reconfiguration of the timber cross bracing.

Trestles 4, 5, 6 and 7 are all located within Morleys Creek. All of these trestles are supported on concrete walls. It is assumed that scouring occurred sometime after the original construction, exposing the previously buried piles. The lower sections of timber piles would likely have been removed and replaced by concrete walls. It is also noted that the two trestles at the lagoon (Trestles 51 and 52) are similarly supported on concrete walls.

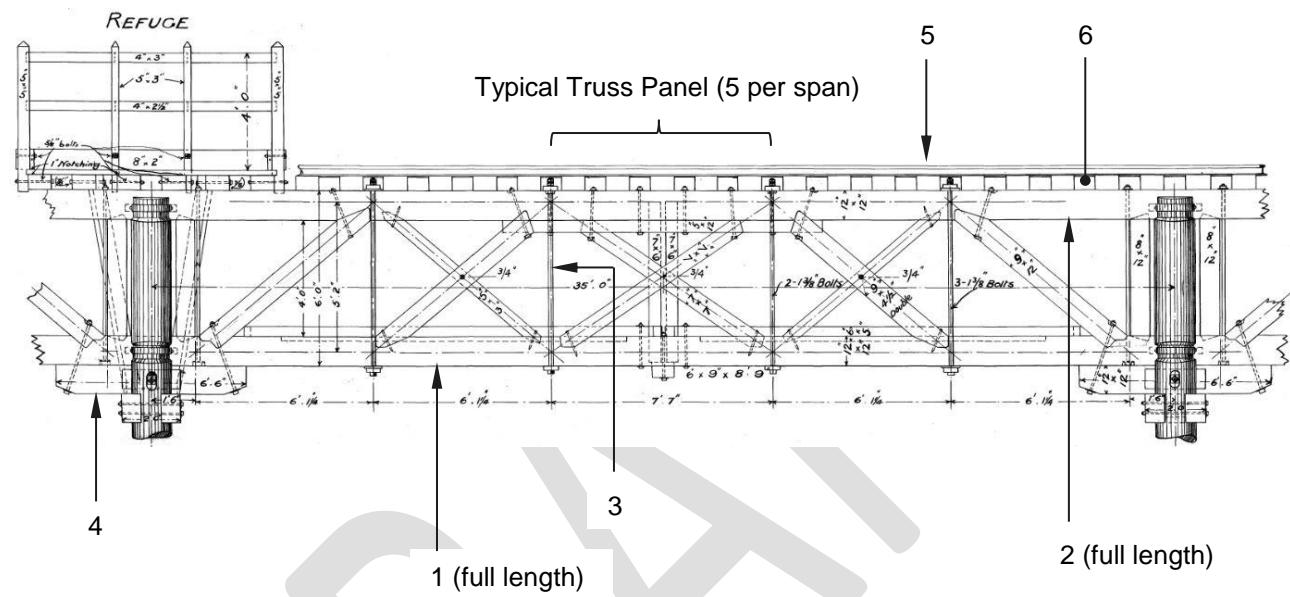
A diagram of the configuration of the existing railway bridge and viaducts is included in Appendix A.

3 BRIDGE COMPONENTS

For the identification of the location of the elements in this bridge, 'railway convention' will be used, whereby spans and supports (abutments and piers) are numbered from the Sydney (that is, Gundagai) end of the viaduct. Also, the Up side represents the left-hand side of the viaduct/bridge when facing Sydney (Gundagai), while the Down side is the opposite side of the viaduct/bridge.

The diagram provided as Appendix A shows the identification system outlined above.

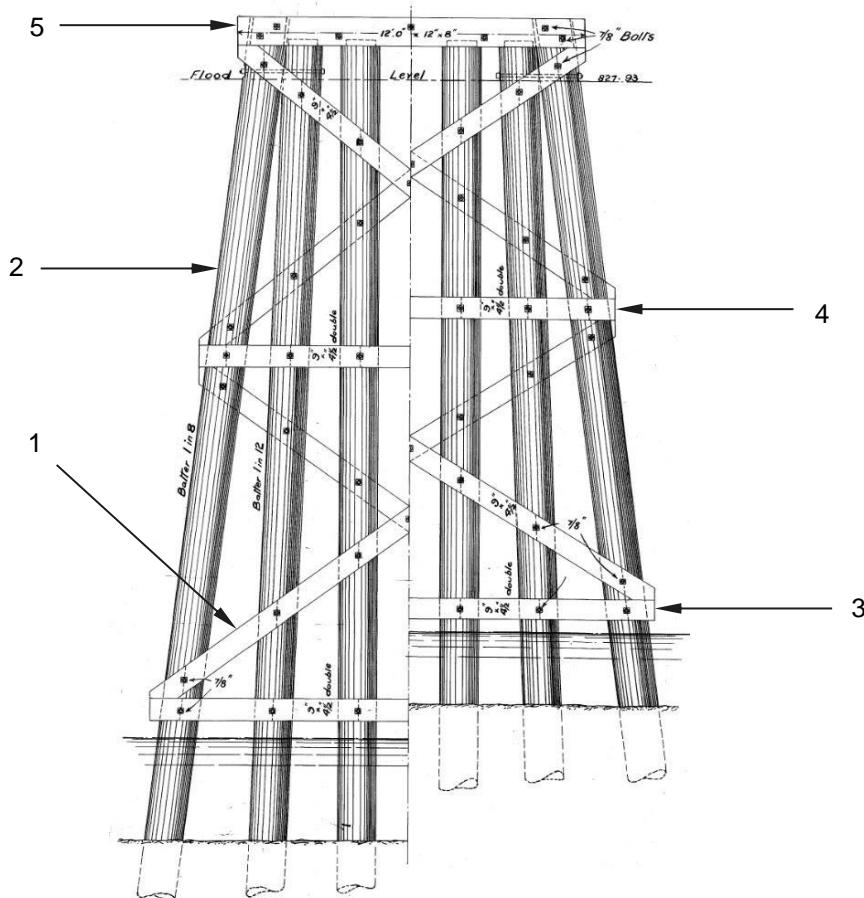
3.1 Viaduct Trusses



Element No.	Description (Material Type)
1	Bottom chord (timber)
2	Top chord (timber)
3	Tie rod assembly (steel)
4	Corbel (timber)
5	Rail (steel)
6	Transom (timber)

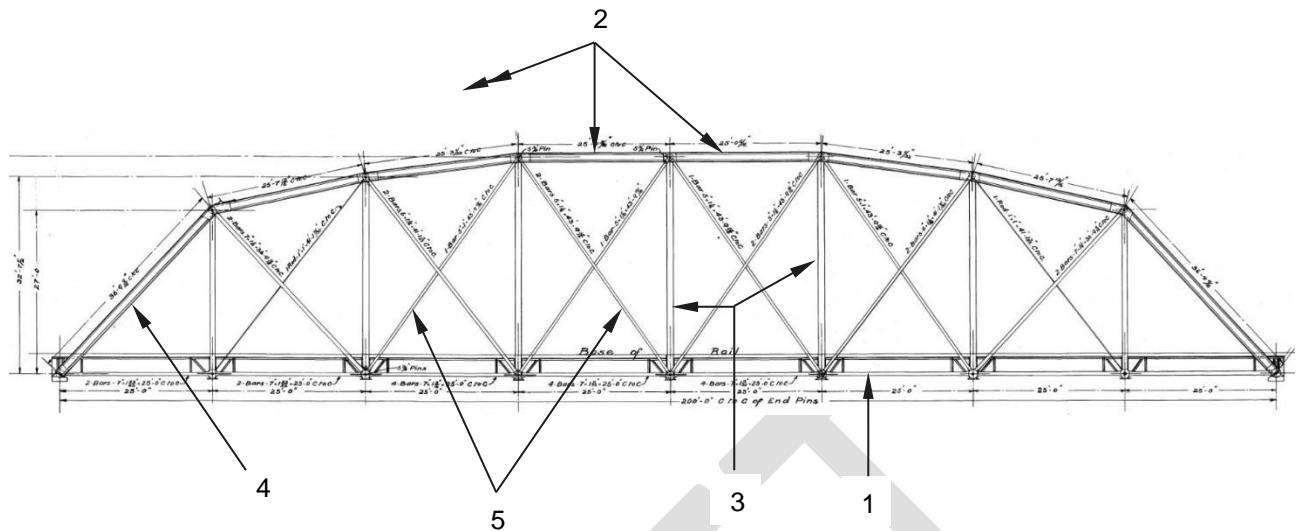
3.2 Viaduct Trestles

Element No.	Description (Material Type)
1	Cross bracing (timber)
2	Pile (timber)
3	Bottom waling (timber)
4	Upper waling (timber)
5	Capwale/headstock (timber)



A six-pile trestle is shown above, however, only Trestles 4, 5, 6, 7, 8, 51, 52, 68, 69, 70 and 71 comprise six piles, and each of these have been modified (at an unknown date) to be supported on a concrete sill (except trestle 8). The remaining 64 pier trestles comprise a 5-pile arrangement.

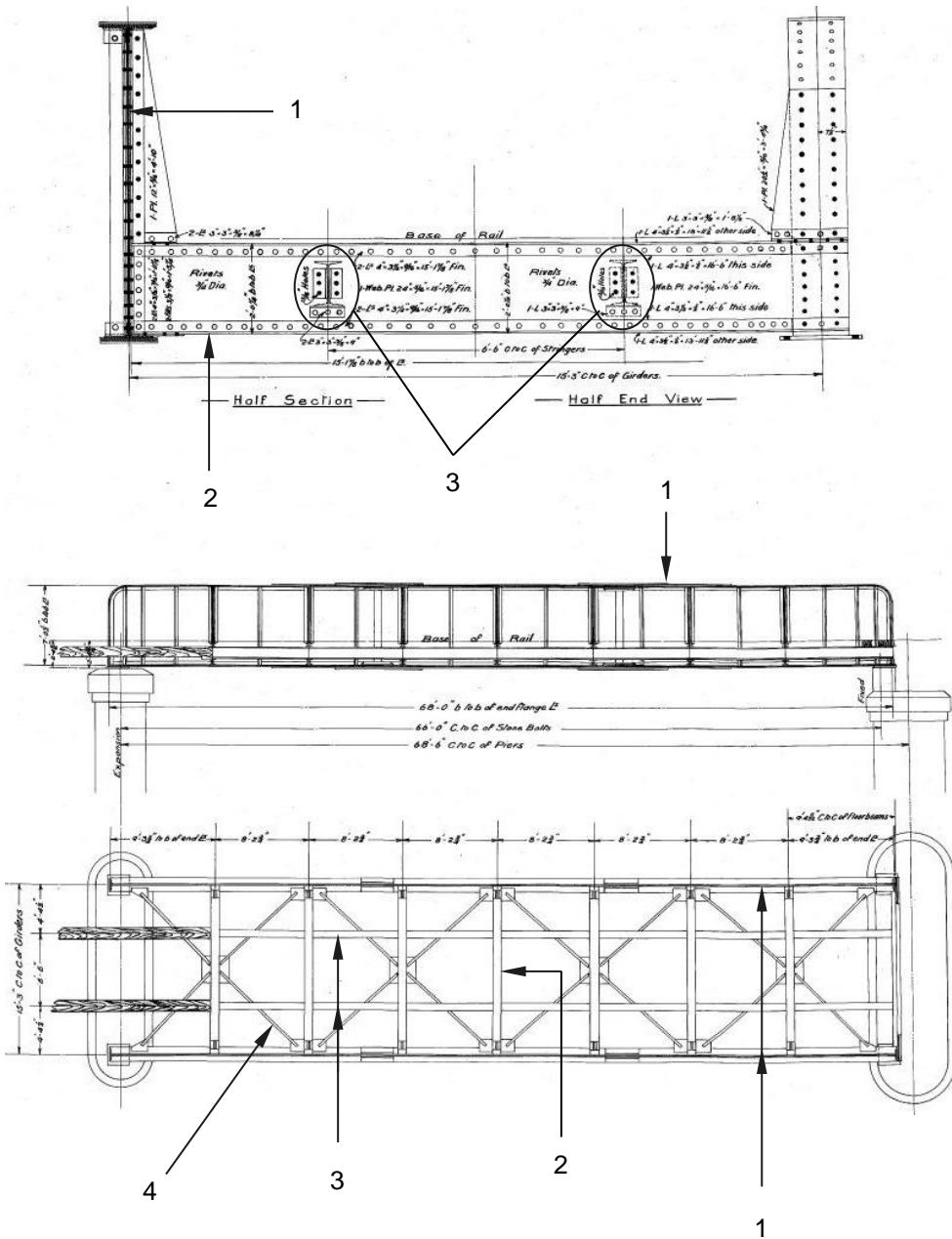
3.3 Steel Truss



Element No.	Description (Material Type)
1	Bottom chord member (steel)
2	Top chord member (steel)
3	Vertical (steel)
4	End post (steel)
5	Diagonal (steel)

3.4 Steel Through Girder

Element No.	Description (Material Type)
1	Main girder (steel)
2	Cross girder (steel)
3	Stringer (steel)
4	Wind bracing (steel)



3.5 Bridge Piers

The four piers that support the three steel spans are essentially mass concrete (that is, no reinforcement) walls, with rounded ends for water flow purposes.

4 STRUCTURE CONDITION

4.1 General

A basic visual inspection from ground level of the timber viaducts and steel bridge spans was undertaken on 8th February 2018 by Ken Maxwell, bridge engineer and Technical Director, Bridges at the Sydney office of Arcadis. Apart from the length of the structure (approximately 925 metres), there was no safe way to cross the bridge at rail level due to the decayed and/or loose and unstable timber transoms and even potentially suspect truss members. In addition, there are safety barriers erected at both ends of the viaduct to prevent unauthorised access to the top of the viaducts.

This inspection work essentially served to update a similar inspection carried out by Ken Maxwell on 20th November 2010 for ARTC, involving the identification of significant degradation zones in the structures.

It is noted that the extent of the condition of the timber elements is not fully known following a basic visual inspection, as timber deterioration in the form of pipe rot (refer Figure 2) is not evident from a basic visual inspection, as it is an internal defect. Only ground-penetrating radar techniques or timber drilling would reveal such hidden timber deterioration.



Figure 2 – Typical Decay Mechanisms in Timber Bridge Elements: Pipe Rot (left), Trough Rot (right)

It is assumed that the entire structure would not have had any form of maintenance since 1984, following closure of the line.

The following defects were found to be typical throughout the timber truss spans of the viaducts:

- Transoms severely weathered and split. Also, transoms are ‘bunched up’ at a number of locations.
- Vertical rods loose at some timber truss spans (evidenced by gap between plates and underside of bottom chord).

A selection of inspection photographs is included as Appendix B.

4.2 Northern Viaduct

The ‘Northern Viaduct’ comprises the timber truss spans located on the Gundagai town side of the Murrumbidgee River.

4.2.1 Timber Trusses

The Northern Viaduct comprises seventy-two (72) timber Howe deck truss spans that cross the Murrumbidgee River floodplain. These trusses were found to be generally in poor to fair condition. However, there were some bottom chord truss members that appeared weathered on their outer face.

Apart from entire loss of protective paint coating and surface corrosion, the steel or wrought iron suspension rods appeared to be generally in fair to good condition.

Of the 72 spans, only five (5) on the southern side of Morleys Creek could not be viewed, due to restricted access.

Details of the defects at the timber trusses of the Northern Viaduct are as follows:

- Span 4 (Down side truss) – Top and bottom chord fractured (near Trestle 4). Refer Plate 1, Appendix B.
- Span 25 (Up side truss) – Top chord of 2nd panel and top chord of 4th panel severe decay (total loss of timber). Bottom chord weathered and split. Refer Plate 2, Appendix B.

- Span 30 (Up side truss) – Severe decay of top chord at 4th panel point.
- Span 49 – Detached bottom chord cross beam.
- Span 51 – Total fracture of bottom chords of each truss (at mid-span). Refer Plate 3, Appendix B.
- Span 54 – Up side bottom chord decayed at interface with missing corbel (at Trestle 53). Bottom chord has dropped onto cap sill following loss of corbel. Refer Plate 4, Appendix B.
- Transoms severely weathered and split throughout length of viaducts and bridge spans. Also, transoms are ‘bunched up’ at a number of locations.

4.2.2 Timber Trestles

There are seventy-one (71) timber trestles plus one (1) supplementary timber trestle. Forty-four (44) are supported on concrete sills, which are footings typically provided as an upgrading measure when the piles decay around ground level.

The timber trestles were generally found to be in poor to fair condition, although it was noted that the bottom walings were typically in a deteriorated condition.

Details of the defects at the timber trestles of the Northern Viaduct are as follows:

- Trestle 16 – Decayed bottom waling and decayed upper cross-bracing. Refer Plate 5, Appendix B.
- Trestles 17 to 22 (inclusive) – Decayed bottom walings. Refer Plate 6, Appendix B.
- Trestle 23 – Broken cross-bracing. Refer Plate 7, Appendix B.
- Trestle 24 – Severely weathered bottom walings. Cross-bracing broken (on one side).
- Trestle 26 – Severely deteriorated bottom waling. Refer Plate 8, Appendix B.
- Trestle 27 – Severely deteriorated/missing timber at bottom waling.
- Trestle 29 – Severely deteriorated bottom waling.
- Trestle 39 – Down side column has vertical split. Also, severe decay at top. Refer Plate 9, Appendix B.
- Trestle 50 – Totally deteriorated bottom walings and severely deteriorated mid-height waling. Refer Plate 10, Appendix B.
- Trestle 54 – Cross-bracing cut. Mid-height waling decayed.
- Trestle 55 – Cross-bracing and bottom waling decayed.
- Trestle 56 – Cross-bracing and bottom waling decayed.
- Trestle 62 – Bottom waling decayed (at Up side end only).
- Trestle 64 – There is soil built up to the level of the bottom timber walings, potentially causing decay to these timber elements.

4.2.3 Timber Abutment

- Sydney abutment (Abutment 1) dilapidated – In poor condition and is partially collapsed, piles broken, timber sheeting fractured. It is noted there is a supplementary timber trestle located close to the defective abutment, to provide additional support close to the end of the truss. Refer Plate 11, Appendix B.

4.3 Main River Spans

The main river spans comprise a single steel pin-jointed hog-back truss span across the Murrumbidgee River, flanked by a single steel through girder approach span.

4.3.1 Steel Truss

- Span 74 (truss) – Apart from loss of protective paintwork on all steel elements, and subsequent surface rust throughout, the steel truss span appeared (from a distance) to be in fair to good condition. Refer Plate 13, Appendix B.

4.3.2 Steel Through Girder

- Span 73 (half-through girder) – Steelwork appeared (from a distance) in fair to good condition, apart from loss of paintwork throughout and subsequent surface rust throughout. Refer Plate 12, Appendix B.
- Span 75 (half-through girder) – Steelwork appeared (from a distance) in fair to good condition, apart from loss of paintwork throughout and subsequent surface rust throughout. Refer Plate 14, Appendix B.

4.3.3 Concrete Piers

The four (4) piers are mass concrete walls with rounded ends for water flow advantages. All appeared to be in fair to good condition.

4.4 Southern Viaduct

The ‘Southern Viaduct’ comprises the timber truss spans located on the South Gundagai township side of the Murrumbidgee River.

4.4.1 Timber Trusses

The Southern Viaduct comprises five (5) timber Howe deck truss spans. These trusses were found to be generally in poor to fair condition.

There is significant sag of the Up side truss of Span 78, which is the middle span of the five spans of the Southern Viaduct. It was noted that the Up side bottom chord truss end at Trestle 77 has decayed, resulting in dislodgement of the end post of the truss and disconnection with the bottom chord of the adjacent truss span, thereby causing it to sag, but still resting on the corbel. Essentially, the triangulated truss members have lost their ‘tightness’ and the entire truss has deflected like a beam element.

Also, the span above Tumut Street (Span 80) appears distorted/twisted. The reason, however, is not obvious, although it may have been constructed on superelevation, as the viaduct is on a horizontal curve at the Tumut end.

Apart from entire loss of protective paint coating and surface corrosion, the steel or wrought iron suspension rods appeared to be generally in fair to good condition.

Details of the defects at the timber trusses of the Southern Viaduct are as follows:

- Span 78 – Up side truss sagging.
- Span 78 – Up side bottom chord crushed (near Trestle 78).
- Span 78 – Up side bottom chord entirely decayed locally (near Trestle 77).

4.4.2 Timber Trestles

There are four (4) timber trestles and all are supported on concrete sills that project above ground level.

The timber trestles were generally found to be in poor to fair condition, although it was noted that the bottom walings were typically in a deteriorated condition.

Details of the defects at the timber trestles of the Southern Viaduct are as follows:

- Trestles 76, 78 and 79 – Headstock deteriorated at ends.

4.4.3 Timber Abutment

- Country abutment (Abutment 2) dilapidated – In poor condition with dislodged and broken timber sheeting, embankment scoured out during 2012 flood.
- Abutment 2 – Headstock deteriorated at ends.

4.5 Summary

Overall, the timber viaducts vary from poor to fair in condition, and the steel spans are in fair to good condition.

5 RAIL TRAIL DECKING SYSTEM

5.1 Geometric Details

The 'desirable minimum width' is 2500 mm for shared paths under the category of 'local access path' in Table 7.4 of the Austroads document entitled *Guide to Road Design Part 6A: Pedestrian and Cyclist Paths*.

For the proposed rail trail decking across Gundagai viaducts and bridge, a horizontal distance between handrails of 2500 mm is proposed.

5.2 Handrails

For the required configuration of the handrailing system, clause 16.2.2 of AS 5100.1:2017 *Bridge design Part 1: Scope and general principles* is the recommended guiding document.

For bridges where cyclists will be present, the minimum barrier height shall be 1.4 m from the walkway surface.

5.3 Design Loading

For pedestrian bridges, the live load is determined in accordance with Figure 8.1, AS 5100.2:2017 *Bridge design Part 2: Design loads*, whereby the load intensity is based on the loaded area. Depending on the loaded area considered, the maximum design live load intensity is 5kPa (unfactored).

5.4 Slip Resistance

For slip resistance of the pedestrian surface, materials used shall conform to AS/NZS 3661.2:1994 *Slip resistance of pedestrian surfaces Part 2: Guide to the reduction of slip hazards*, taking into consideration the slope of the surface.

5.5 Decking System

The concept decking systems assume the retention of the existing rails, inner guardrails and timber transoms and comprise one of the following materials:

- Timber decking planks; or
- Fibre reinforced polymer decking planks; or
- Recycled plastic decking such as Enduroplank™.

In order to use transverse decking planks (whether timber or composite fibre), joists will be required to be installed on top of the existing timber transoms, running parallel to the rails, in three lines. These joists may either comprise timber (200 mm x 75 mm) or fibre reinforced polymer rectangular hollow sections (200 mm x 100 mm bonded rectangular beams).

Kerbs are proposed along both edges of the deck (minimum height 100 mm), to provide a stable attachment for the handrailing.

Timber transoms are typically 2850 mm in length. The rail size likely across Gundagai viaducts and bridge is 53 kg/m (107 lb/yard), whereby the height from top of rail to top of transom is 170 mm. Hence, joists 200 mm in height would provide sufficient clearance for the propose transverse decking to clear the existing rails.

It is envisaged that the decking system and handrailing will be similar to that installed across Waterford Black Bridge in Ontario Canada (refer Figure 3).

The proposed decking system is shown in Figure 4. Although this shows the decking installed on the timber truss spans, the same principle applies to the steel main spans over Murrumbidgee River.



Figure 3 – Waterford Black Bridge, Ontario Canada

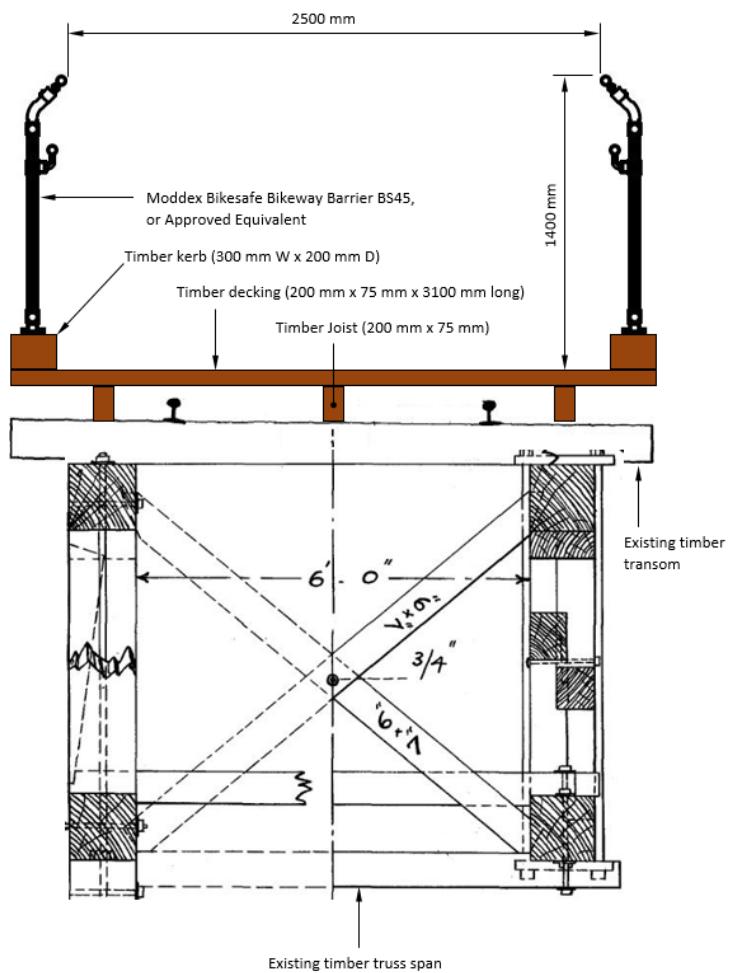


Figure 4 – Proposed Decking System for Gundagai Viaducts (Timber Truss Span Shown)

The concept decking system shown in Figure 4 would be superimposed onto the existing timber transoms across the timber truss spans (refer Figure 5) and across the steel through girder and steel truss spans (refer Figure 6).



Figure 5 – Top of Typical Timber Viaduct Spans



Figure 6 – Top of Steel Bridge Spans

6 REHABILITATION OF VIADUCTS

Prior to the installation of a shared path decking system on the viaducts and bridge, the rehabilitation of the timber truss viaduct spans (including timber pier trestles and timber abutments) are required to be undertaken.

From ground level, Arcadis undertook a basic visual inspection only of the viaducts and bridge, which was all that was required in the scope of work. This type of inspection only provided a general appreciation of the condition of the viaducts, as timber deterioration is often hidden within the timber element itself.

Notwithstanding, it was evident that many timber elements were in an advanced state of deterioration, and that replacement of those elements on a like-for-like basis would be recommended.

Essentially, the only way of quantifying the amount of deteriorated timber to be replaced is to estimate this in terms of a percentage.

Section 3 of this document contains descriptions of the bridge components.

6.1 Timber Truss Spans

There are 78 timber truss spans in total, each comprising 2 timber top chords (full length elements), 2 timber bottom chords (full length elements), 16 timber diagonals (4 are double members), 12 steel tie rod assemblies (comprising 1, 2 and 3 bolts), 2 timber wind braces, 4 timber end posts, 2 timber cross-bracing elements (at mid-span), 1 timber bottom chord connection element (at mid-span).

The indicative cost estimate is based on replacing 30% of all timber truss elements that make up the truss spans, including corbels.

Typical Timber Truss Span (February 2018):



6.2 Timber Pier Trestles & Abutments

There are 2 abutments and 75 timber trestle piers. The timber pier trestles typically comprise 5 timber piles, except for 11 of the taller trestles, which comprise 6 timber piles (refer section 4 of this document). The length of the pile above ground level (and to about 1 metre below ground level) usually deteriorates.

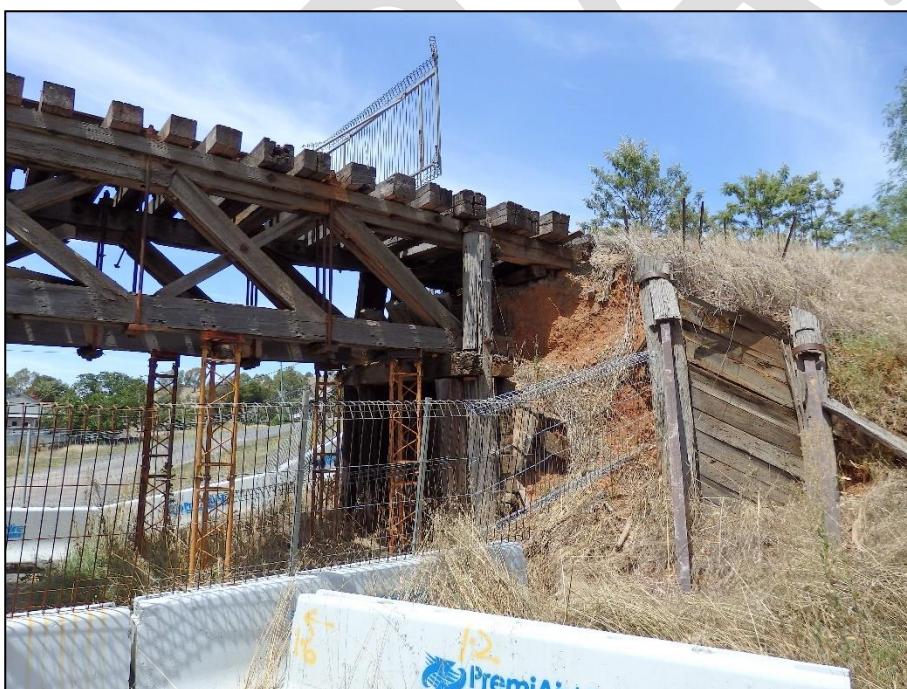
Typically, the deteriorated length of pile is removed and a new length of timber is spliced in position with a timber column of the same/similar diameter (refer section 5 of this document for an illustrated example).

The indicative cost estimate is based on replacing 30% of all timber pier trestle elements (including piles, cross-bracing, headstocks and walings) and replacing both timber abutments in their entirety.

Sydney Abutment (February 2018):



Country Abutment (February 2018):



As a comparison, the following photo is of the Country abutment at Gundagai in November 2010.

Country Abutment (November 2010):



Typical Timber Trestle (February 2018):



6.3 Timber Transoms

As the proposed shared path decking system will be supported by the timber transoms (larger version of sleepers), it is recommended that many of these be replaced, as they are very likely in deteriorated condition. As the overall length of the bridge and viaducts is approximately 925 metres, it is estimated that

there are around 1,850 timber transoms that the existing rails are attached to (assuming transoms are spaced at 500 mm).

The indicative cost estimate is based on replacing 50% of all timber transoms. Transoms are typically 250 mm W x 165 mm D x 2850 mm long.

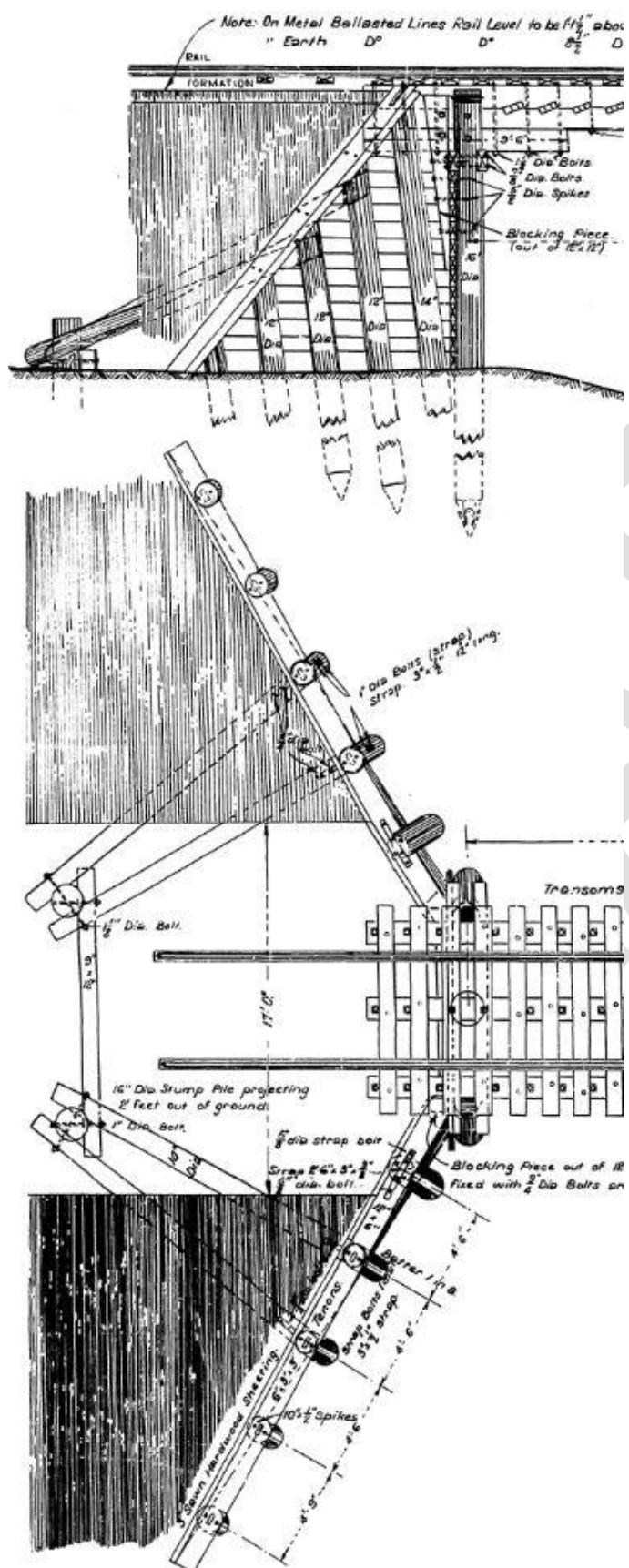


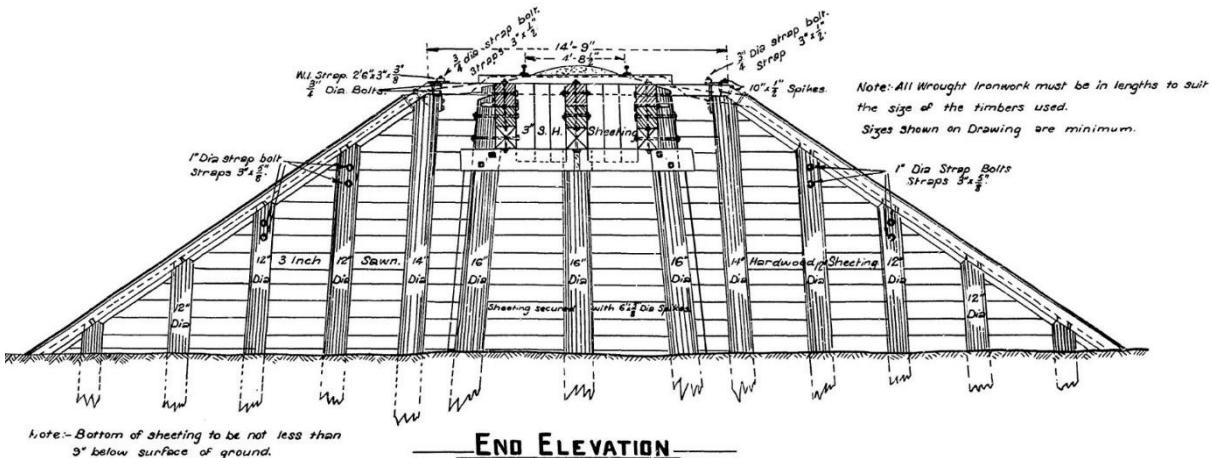
6.4 Structure Rehabilitation Examples

Replacement of timber piles:



Abutment rehabilitation would be essentially based on the following drawing extracts:





7 INDICATIVE COST ESTIMATES

For the indicative cost estimates, two components of costings were determined, as follows:

- Rehabilitation of the existing timber viaducts.
- Installation of decking and handrailing for a shared path rail trail along the entire viaducts and bridge spans.

The indicative cost estimates were prepared by MIEngineers. Cost estimate details are included as Appendix C. The proposed methodologies for the rehabilitation of the timber viaducts and the subsequent installation of the timber decking for shared path conversion were developed by MIEngineers.

The rehabilitation works and the timber decking installation were based on the first principle approach of cost estimating. This includes the supply and delivery of timber decking materials and proprietary Moddex Bikesafe Bikeway barriers, which were supported with quotations from suppliers. However, the supply costs of timber elements for the rehabilitation works were based on the rate derived from the supply of timber for the bridge decking works.

7.1 Rehabilitation of Viaducts

Estimating the extent of rehabilitation required is somewhat challenging when based on a ground-level visual inspection only. For rehabilitation of the timber viaducts, it was assumed that a percentage of the total amount of timber would require replacement. As for the steel spans, they generally appeared in fair to good condition, apart from paint loss throughout and consequent surface rust.

To develop an indicative cost estimate, the following rehabilitation assumptions were applied:

- Replacement of 30% of all timber truss elements that make up the truss spans, including corbels.
- Replacement of 30% of all timber pier trestle elements (including piles, cross-bracing, headstocks and walings) and replacing both timber abutments in their entirety.
- Replacement of 50% of all timber transoms.

The indicative cost estimate for the rehabilitation of the timber viaducts is **\$13,660,000**, which includes a contingency of 40%.

7.2 Installation of Decking System

The indicative cost estimate includes the installation of decking and handrailing for a shared path rail trail along the entire viaducts and bridge spans, totalling approximately 925 metres, based on the arrangement shown in Figure 4 of this document.

The indicative cost estimate for the supply and installation of a shared path decking system is **\$5,955,000**, which includes a contingency of 40%.

7.3 Summary

The overall indicative cost estimate to rehabilitate the timber viaducts and install a shared path decking system across the entire Gundagai viaducts and bridge spans is **\$19,615,000**, which includes a contingency of 40%.

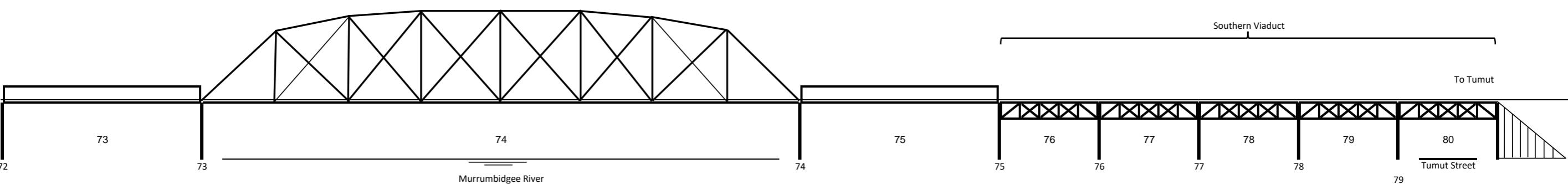
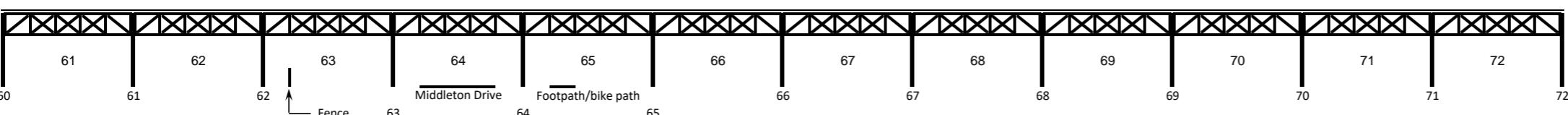
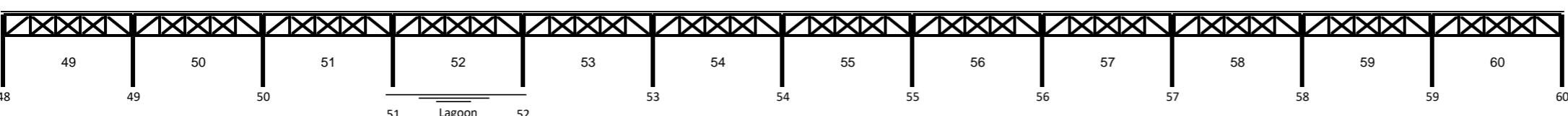
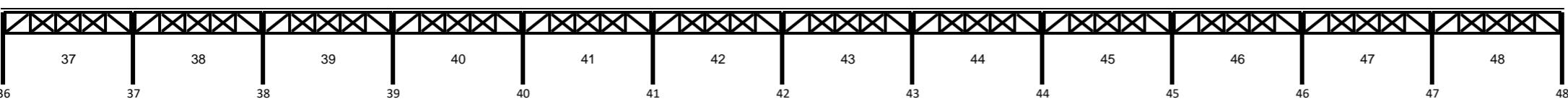
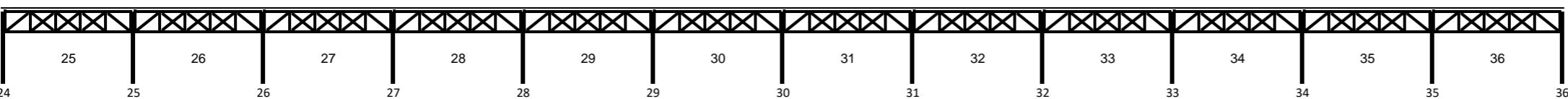
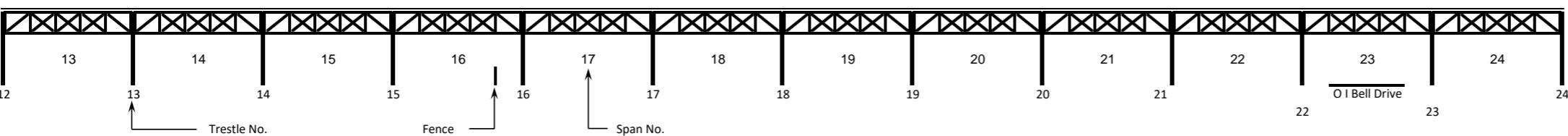
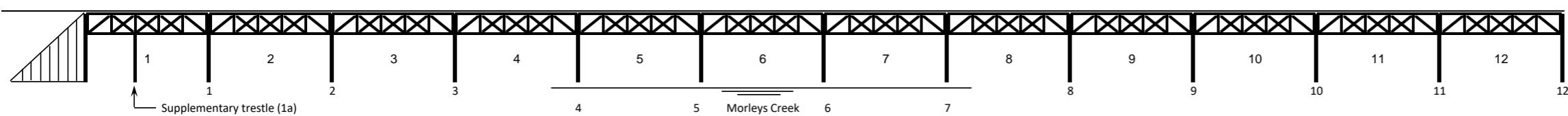
APPENDIX A

Schematic Representation of Bridge and Viaducts

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GUNDAGAI RAILWAY BRIDGE AND VIADUCTS

From Cootamundra



Northern Viaduct

To Tumut

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APPENDIX B

Inspection Photographs



Plate 1 – Fractured Top & Bottom Chords, Span 4, Down Side Truss (near Trestle 4)



Plate 2 – Severe Decay at Top Chord, Span 25, Up Side Truss



Plate 3 – Fractured Bottom Chord, Span 51, Up Side & Down Side Trusses



Plate 4 – Missing Corbel & Bottom Chord Decayed, Span 54 (at Trestle 53), Up Side Truss



Plate 5 – Decayed Upper Cross-Bracing, Trestle 16



Plate 7 – Decayed Bottom Walings (Typical for Trestles 17 to 22 (inclusive))



Plate 8 – Broken Lower Cross-Bracing, Trestle 23



Plate 9 – Severely Deteriorated Bottom Waling, Trestle 26



Plate 10 – Split & Decay, Down Side Pile, Trestle 39



Plate 11 – Deteriorated Mid-Height Walings, Trestle 50



Plate 12 – Dilapidated Abutment 1



Plate 13 – Span 73



Plate 14 – Span 74



Plate 15 – Span 75



Plate 16 – Sagging Up Side Truss, Span 78



Plate 17 – Bottom Chord Crushed, Up Side Truss (near Trestle 78), Span 78



Plate 18 – Bottom Chord Decayed, Up Side Truss (near Trestle 77), Span 78



Plate 19 – Dilapidated Abutment 1

APPENDIX C

Indicative Cost Estimates

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Gundagai Railway Bridge - Rehabilitation Works
Indicative Cost Estimate of Rehabilitation Works of Timber Elements

Item	Description	Quantity	Unit	Rate	Amount
1	Timber Truss Spans				
a)	Supply and delivery of top and bottom chord -12"x12"x35'	94	no.	\$5,670	\$532,980
b)	Supply and delivery of diagonal vertical cross bracing (various sizes)				
i)	9" x 12" x 9'	94	no.	\$1,094	\$102,836
ii)	4 1/2" x 9" x 9'	187	no.	\$410	\$76,670
iii)	3" x 5" x 9'	94	no.	\$152	\$14,288
iv)	7" x 7" x 9'	94	no.	\$496	\$46,624
c)	Supply and delivery of tie rods	468	no.	\$544	\$254,592
d)	Supply and delivery of end posts 8" x 12" x 6'	94	no.	\$648	\$60,912
e)	Supply and delivery of horizontal wind braces 5" x 6" x 12'	47	no.	\$405	\$19,035
f)	Supply and delivery of cross bracing at midspan 7" x 6" x 6'	47	no.	\$284	\$13,348
g)	Supply and delivery of bottom chord connection element at midspan 7" x 6" x 6'	23	no.	\$284	\$6,532
h)	Supply and delivery of top stiffeners 5" x 12" x 12'	48	no.	\$810	\$38,880
i)	Supply and delivery of bottom stiffeners 5" x 6" x 32'	48	no.	\$1,080	\$51,840
j)	Supply and delivery of corbel 12" x 12" x 6.5'	45	no.	\$1,053	\$47,385
2	Timber Pier and Abutment Trestles				
a)	Supply and delivery of timber piles	124	no.	\$2,025	\$251,100
b)	Supply and delivery of cross bracings, upper and bottom walings 9" x 4 1/2" x 10'	360	no.	\$456	\$164,160
c)	Supply and delivery of capwale/headstock 12" x 8 " x 12'	45	no.	\$1,296	\$58,320
3	Timber Transoms				
a)	Supply and delivery of timber transoms 9' 6" x 6" x 10'	925	no.	\$641	\$592,925
4	Supply of Miscellaneous Materials for Timber Replacement				
a)	Supply of miscellaneous materials	24	no.	\$2,700	\$64,800
5	Design and Documentation of Methodology of Timber Rehabilitation Works				
a)	Design and engineering works	1	item	\$39,150	\$39,150
6	Procurement, Fabrication and Delivery of Structural Steel Portal Frames for the Rehabilitation Works, including Ancillary Items				
a)	Structural steel column support for top and bottom chords	10	t	\$10,125	\$101,250
b)	Structural steel beam support for top and bottom chords	5	t	\$10,125	\$50,625
c)	Structural steel column support for bearers supporting the timber transoms	4	t	\$10,125	\$40,500
d)	Structural steel bearer supporting timber transoms	5	t	\$10,125	\$50,625
e)	Diagonal bracings for structural steel column support	8	each	\$1,620	\$12,960
f)	Flat jacks, copper tubing, valves and hydraulic oil	64	no.	\$540	\$34,560
g)	Bolts, nuts and washers	1,000	units	\$14	\$13,500
h)	Precast concrete blocks for structural steel column footings	8	no.	\$675	\$5,400

7	Equipment and Minor Tools				
a)	Elevated working platform	24	months	\$44,550	\$1,069,200
b)	Franna Cranes	24	months	\$45,857	\$1,100,568
c)	Tray truck with hiab	24	months	\$25,769	\$618,456
d)	Mobile scaffolding access	24	months	\$3,037	\$72,888
e)	Minor tools and hire equipment	1	item	\$81,000	\$81,000
8	Rehabilitation of Trusses, Transoms and Pier Trestles				
a)	Replacement of timber elements for timber truss spans and timber transoms - 30% only	24	no.	\$97,118	\$2,330,832
b)	Replacement of timber pile columns and bracings - 30% only	25	no.	\$66,218	\$1,655,450
9	Disposal of Timber Elements				
a)	Transport and disposal of timber trestles	124	no.	\$286	\$35,464
b)	Transport and disposal of timber elements	2,714	no.	\$17	\$46,138
	Total				\$9,755,793
	Contingency 40 %				\$3,902,317
	Total Indicative Price including Contingency				\$13,658,110

Assumptions:

Based on a single construct only contract

Unit rate per board feet of timber is based on actual supply costs of timber decking for pedestrian and cyclist bridge

Estimate excludes EPA waste levy for disposal of material off site

Estimate based on a contract duration of 24 months

Base date is Q2/2018

Excludes GST and inflation

Excludes non construction costs for concept design, detailed design and superintendence

Gundagai Railway Bridge - Cyclist and Pedestrian Bridge Decking
Indicative Cost Estimate of Timber Decking System for Pedestrian and Cyclist Shared Path

Item	Description	Quantity	Unit	Rate	Amount
	Area of the bridge	2,313.00	m²	\$1,839.09	\$4,253,808
1	Supply and Delivery of Timber Decking Elements				
a)	Supply and delivery of timber decking elements	925	m	\$1,400	\$1,295,000
2	Supply and Delivery of Moddex Bikeshare Bikeway Balustrade				
a)	Supply and Delivery of Moddex Bikeshare Bikeway Standard Balustrade Top Mount	1,850	m	\$428	\$791,800
3	Design and Documentation of Methodology of Installation of Timber Decking and Moddex Bikeshare Balustrade				
a)	Design and engineering works	1	item	\$39,150	\$39,150
4	Equipment and Minor Tools				
a)	Elevated working platform	47	week	\$10,125	\$475,875
b)	Franna Cranes	47	week	\$10,424	\$489,928
c)	Tray truck with hiab	47	week	\$5,857	\$275,279
d)	Mobile scaffolding access	47	week	\$277	\$13,019
e)	Minor tools and hire equipment	1	item	\$157,950	\$157,950
5	Installation of Timber Decking and Moddex Bikeshare Bikeway Barriers				
a)	Supply, fabrication, installation, removal and re-installation of safety screens on timber viaduct	1,647	m	\$95	\$156,503
b)	Supply, fabrication, installation, removal and re-installation of safety screens on the steel structure bridge	203	m	\$213	\$43,154
c)	Supply, installation and removal of temporary sheet covering on timber transoms	925	m ²	\$47	\$43,475
d)	Trim top of timber transoms and level ready to receive timber joist	2,775	m	\$53	\$147,075
e)	Install timber joists	2,775	m	\$40	\$111,000
f)	Install timber decking and kerbs	925	m	\$108	\$99,900
g)	Install Moddex Bikeshare Bikeway Barriers	1,850	m	\$62	\$114,700
	Total				\$4,253,808
	Contingency 40 %				\$1,701,523
	Total Indicative Price including Contingency				\$5,955,331

Assumptions:

Based on a single construct only contract

Estimate excludes EPA waste levy for disposal of material off site

Estimate based on a contract duration of 47 weeks

Base date is Q2/2018

Excludes GST and inflation

Excludes non construction costs for concept design, detailed design and superintendence

