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Memorandum

To	Erle Bencich
Copy	Mark Smith, Kathie Ragg
From	Rem Markland
Office	Greymouth
Date	19 June 2024
File/Ref	6-WWES5.02
Subject	Totara Rail Bridge - Summary Assessment 2024

Dear Erle,

As requested, we have completed the summary assessment review for the Totara Rail Bridge. This summary report is to aid Westland District Council (WDC) with determining an appropriate management strategy for this pedestrian structure.

This assessment review was undertaken by Tiaan Kramer, WSP Principal Bridge and Civil Structures Engineer with technical review completed by Anthony Rooke, WSP Team Leader Structures Asset Management and supported by Rem Markland, WSP Senior Engineering Technician. All personnel were involved in the previous assessment of the structure in August 2023.

1.1 Background & Scope

WSP completed a visual inspection, assessment and reporting of the Totara Rail Bridge for WDC in August, 2023[1]. An immediate recommendation of this report was to undertake timber drilling to better understand the condition of all hardwood components and provide greater confidence in the large number of component repair/replacement identified. A timber drilling investigation was completed by an external Contractor, Liddell Contracting[2] circa 2023.

WSP has undertaken a comparison of the timber drilling findings with the visual inspection completed August 2023 in order to update "Priority Groups of Main Truss Members Results" (listed in Table 4 of original report). This memorandum summarises our findings.

1.2 Structure Assessment Summary

1.2.1 Comparison Results

The results of the comparison between WSP's previous visual assessment and Liddell's drilling records are as follows:

[1] 6-WWES3.98 Totara Rail Bridge Assessment 2023_FINAL

[2] *Drilling notes were provided to WSP from WDC to use for reference in completing this summary report, but as WSP were not involved in the drilling investigation they have not been thoroughly reviewed or relied upon for information accuracy.*

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It is to be noted that WSP has not been involved in the drilling investigation works or MSQA. Therefore, the drilling notes supplied by Liddell were only used for reference to these works and were not relied upon for information accuracy. In addition, Liddell's findings did not adopt the same priority classification as WSP's report. It was subsequently assumed that priorities classified as "Urgent" and "High" is equivalent to Liddel's "Replacement" classification.

Table A: Original Table 4 comparison of the main truss member priority groups

	WSP's Priority	Liddel's Priority	
Members	Urgent & High	Replace	Repair
Top Chord	1	16	0
Bottom Chord (pier to pier)	4	n/a	n/a
Struts	30	23	1
Hanger/tension rod	19	35	0
Transom	3	2	6
Deck Cross Bracing	47	26	0
Timber Brace	5	14	0

In addition to the main truss member results, Liddel also recorded the member condition of components not summarised in the original Table 4. These are presented in the table below:

Table B: Recommendation comparison of components not included in the original summarised Table 4

	WSP's Priority	Liddel's Priority	
Members	Replace	Replace	Repair
Timber Thrust Blocks, A-Blocks & Saddle Blocks	29	24	5
Road Beams	2	5	1
Corbels	2	7	1
Solid Blocking & tie Rods	2	4	4
Pier components	15	14	0

These results show that the findings of Liddel's investigation are notably worse than what WSP's visual inspection showed. This subsequently reinforces the previous recommendations made by WSP.

In addition, it was also observed that Liddel's only appeared have drilled a sample of timber members and commented on some steel members. We draw this conclusion on the basis that only 267 of 836 total components (32%) have been commented on in their drilling records. While not clear, their investigation appeared to be focussed on the defective components identified in WSP's visual assessment report. This means that there may still be a significant number of timber components with internal decay that haven't been identified.

1.2.1 Cost Estimates

WSP compiled a cost estimate for repair/strengthening as part of the original visual assessment report (see Table C below for a copy of the original cost estimate).

Table C: Original Cost Estimate for Strengthening or Repair Work

	Time				Total cost over 10+ years
	Immediate	6 months	2 – 10 years	10+ years	
Cost estimate	$150k	$1.814M	$1.530M	$2.125M	$5.619M

These costs will likely be higher due to the increased number of components requiring replacement as identified in Liddel's report.

1.2.1 Summary & Recommendations

As a result, WSP still uphold the recommendations and priorities provided in the original report 6-WWES3.98 Totara Rail Bridge Assessment 2023 dated 21 August 2023. These are:

- A present value end of life (PVEOL) or similar assessment should be undertaken to compare maintenance costs with the cost of establishing an alternative crossing. Given the amount of current deterioration of the bridge and strengthening required, the PVEOL should be used to compare the cost of any repairs against the value of the bridge. As the bridge is now utilised as a cycleway bridge, the replacement value for a cycleway bridge is roughly $2.03M3. Total sum cost of remedial works and future inspections will exceed the replacement value of a cycleway bridge.
- Discussions should be held with Heritage New Zealand Pouhere Taonga (HNZPT) regarding the heritage status of this structure. Strengthening or repair work may be influenced by this as work may result in loss of the historic fabric and character of the bridge. The bridge is not listed as a heritage structure with HNZPT, nor identified as a Historic Place in the WDC District Plan. However, as it was built in the 1800's, it still holds heritage value.
- The existing bridge is potentially at risk to other vulnerabilities which were not investigated or discussed during this visual assessment. Examples of vulnerabilities could include risk to scour, or seismic loading, pile reduction due to abrasion (below the current bed level) and pile damage due to log loading given its demanding operating environment.
- A new structure could be constructed in a location less vulnerable to the environment. This could be further upstream with a cycleway diversion. This investigation is highly recommended to be carried out as a matter of priority.
- Repairs consisting of steel augmentation with protective coating systems would require first minor maintenance within 15-20 years at best in this environment and would add to the ongoing future maintenance costs.

In the interest of public safety we recommend Council considers closing the structure until the Recommendations above are carried out. The bridge should remain closed while the various options are explored.

Kind regards,

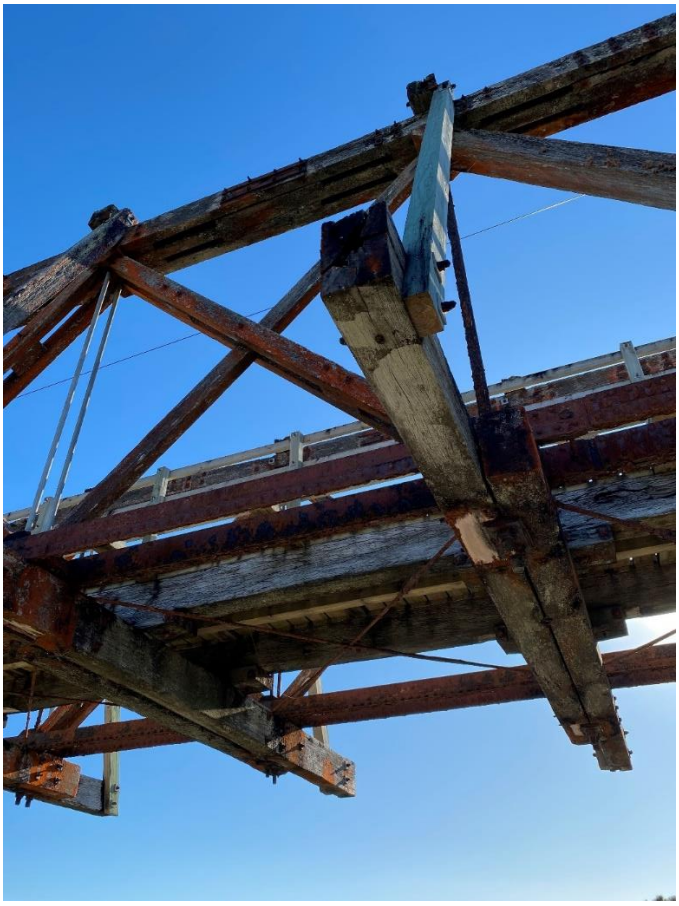
Rem Markland

Senior Engineering Technician

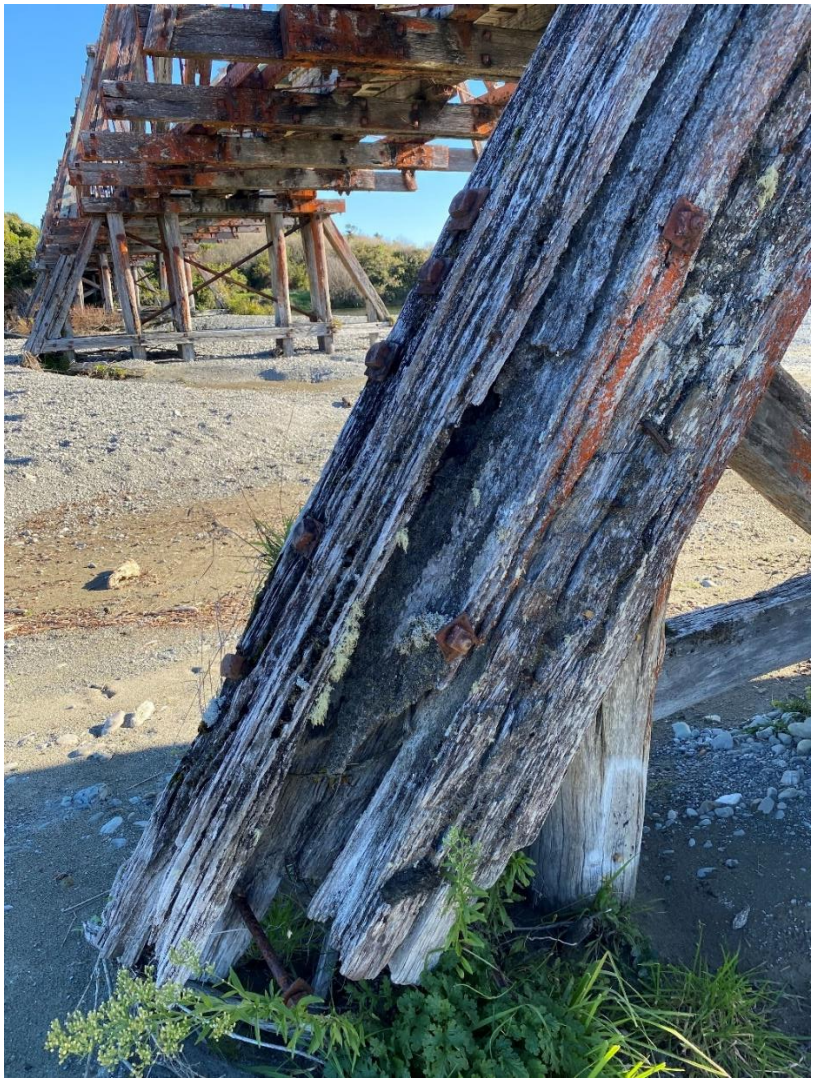
Top Cord Surface loss
Saddle block split in timber and timber decay.

Raking pile timber split and timber decay.

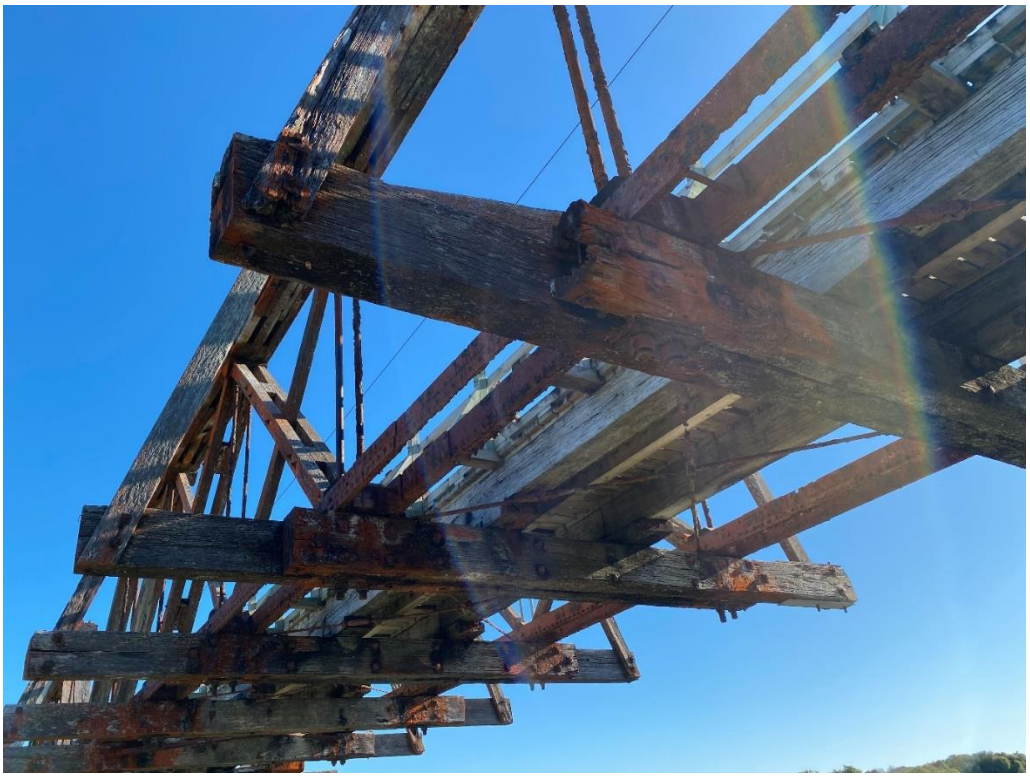
Raking pile timber surface decay



Transom end timber decay.



Raking pile timber decay.



Transom Timber decay and timber split

Cross bracing corroded away.

Timber loss and decay.

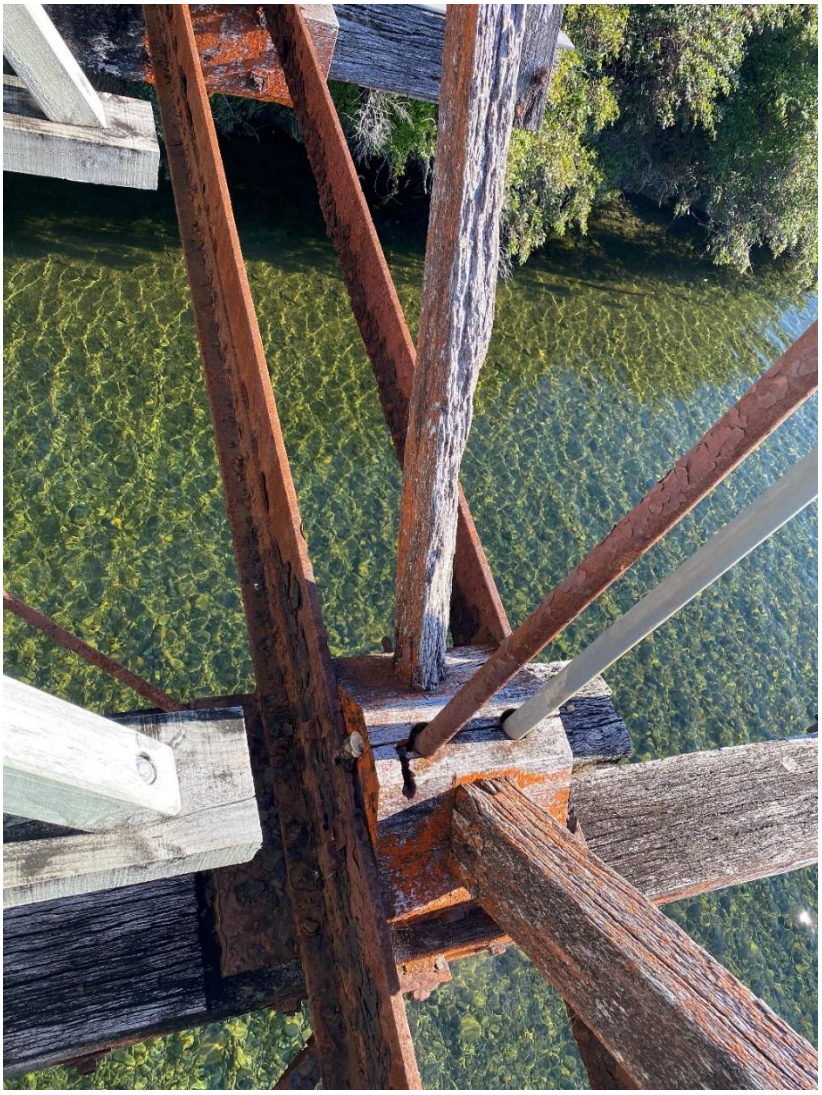
Previous repair to transom end.
More timber decay present

Steel cross bracing needs replacing

Transom timber end decay
Bottom cord corroded. Previous repair visible

Timber thrust block decay and timber split.
Steel tension rods corroded.

Steel cross bracing corroded. Needs replacing



Loss of section on timber strut.

Steel cross bracing corroded. Needs replacing

Saddle block needs replacing.

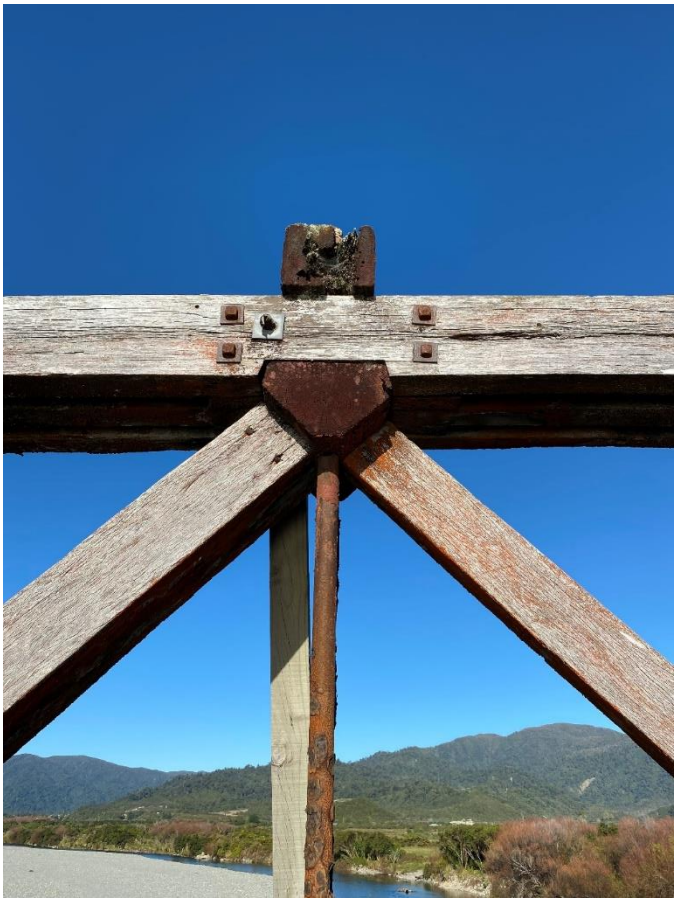
Saddle block split

Bottom cord corroded, needs replacing

Bottom cord corroded, needs replacing.
Cross bracing corroded needs replacing

Saddle block decay and split.

Tension rods corroded.
Previous repair to transom. Needs more repairs.
Decay to timber strut.



Saddle block timber split.

Centre strut timber decay.

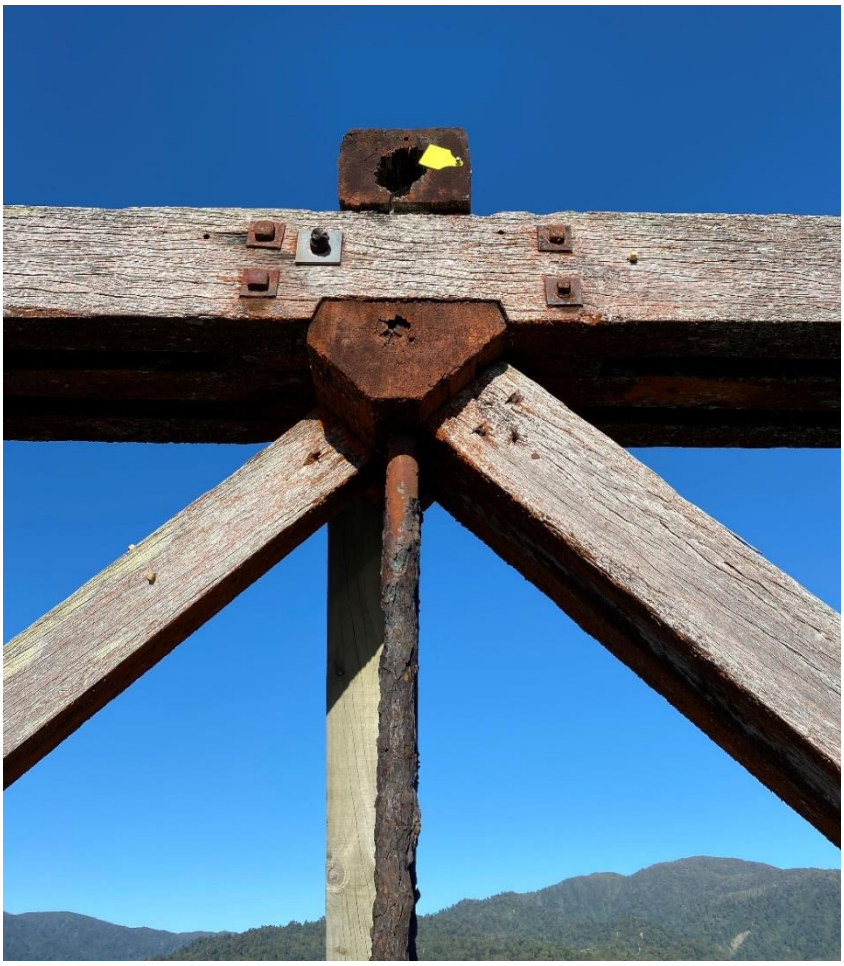
Bottom cord corroded. Needs replacing

Bottom cord corroded. Needs replacing.

Tension rods corroded. Needs replacing

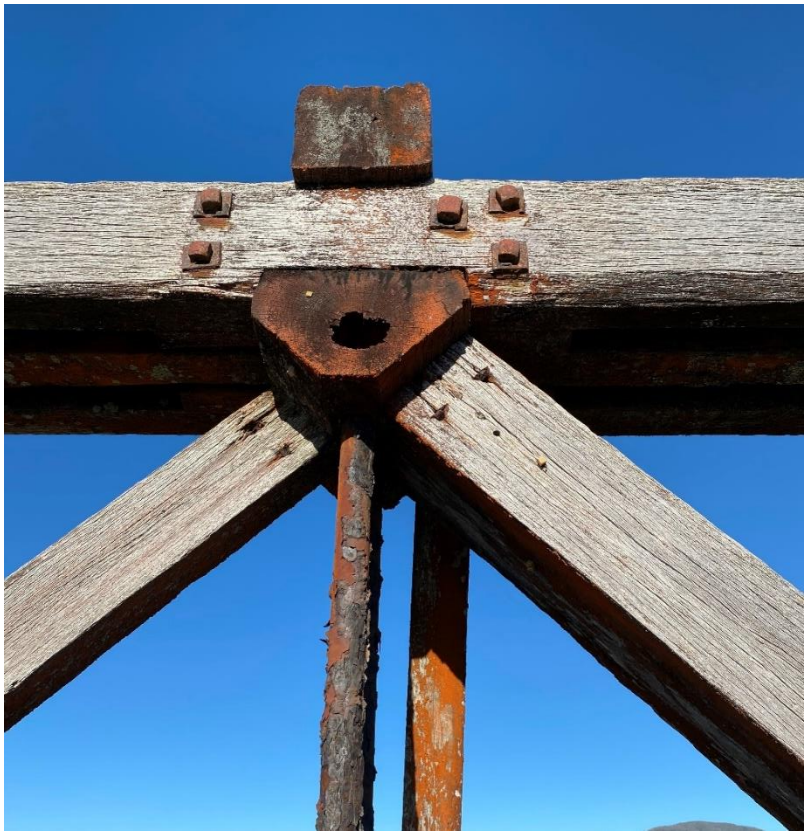
Saddle block timber decay.
Tension rod corroded.

Bottom cord corroded. Previous repair visible.



Saddle block with tunnel rot.

Surface loss on timber strut



Tiber A block with tunnel rot.

Timber thrust block with timber decay.

Project Number: 6-WWES3.98

Totara Rail Bridge

Visual Assessment 2023

21 August 2023

CONFIDENTIAL

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Document History and Status

Revision	Date	Author	Reviewed by	Approved by	Status
0	21/8/2023	E Wilson	A Kuek	M Smith	FINAL

Revision Details

Revision	Details

This report ('Report') has been prepared by WSP exclusively for Westland District Council ('Client') in relation to the visual assessment of the Totara River Rail Bridge ('Purpose') and in accordance with the Offer of Service with the Client dated 17 March 2023. The findings in this Report are based on and are subject to the assumptions specified in the Offer of Service dated 17 March 2023. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

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Executive Summary

The current condition of the Totara River Rail Bridge was inspected and assessed based on the pedestrian/cyclist demand load it is subjected to. This involved a structural assessment of the main truss members to determine the allowable section loss through decay, and a site inspection to visually estimate the current condition of each member.

The cost estimate schedule for repair work is shown in *Table 1* below. The cost estimate schedule was developed using rough cost estimates for the main truss components, and high-level estimates for other cost components not assessed through this scope of work.

No specific investigation or design was undertaken for this scope of work.

Table 1. Totara Bridge Cost Schedule Estimate for Strengthening or Repair Work

	Time				Total cost over 10+ years
	Immediate	6 months	2 – 10 years	10+ years	
Cost estimate	$150k	$1.814M	$1.530M	$2.125M	**$5.619M**

Recommendations

- Drilling is strongly recommended to determine the specific condition of each member.
- A present value end of life (PVEoL) assessment to compare maintenance costs over time against replacement cost is recommended.
- Heritage aspects and requirements should be discussed with Heritage New Zealand Pouhere Taonga (HNZPT) and considered in respect to repairs to the structure.

Other Considerations

- The bridge will remain to be subject to vulnerabilities not identified during this work, such as scour, seismic loading, pile reduction due to abrasion (below the current bed level) and pile damage due to log loading given its demanding operating environment.
- A new structure could be in a location less vulnerable to the environment. This could be further upstream with a cycleway diversion.
- Repairs consisting of steel augmentation with protective coating systems would require first minor maintenance within 15-20 years at best in this environment and would add to the ongoing future maintenance costs.

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1 Introduction

1.1 Scope of Works

WSP NZ Ltd (WSP) was engaged by Westland District Council (WDC) to investigate and assess the current condition of the Totara River Rail Bridge (Totara bridge). The purpose of this work is to understand the remaining life of the structure, particularly the main truss members, and to determine recommended improvements to ensure the main truss members are structurally adequate for the pedestrian/cyclist load demand they are subjected to. The scope of works carried out involved the following.

1 Structural Assessment on the main truss members to identify required capacity.
2 Visual inspection of the bridge members to assess current condition.
3 Developing a cost estimate schedule for repair work required.

1.2 Previous Inspection

In 2010, MWH undertook a baseline Structural Condition Assessment on the Totara bridge for WDC. The tabled site notes established during this baseline assessment were utilised for the current scope of works to identify the magnitude of member condition deterioration. The previous assessment report conducted by MWH can be found in Appendix A.

1.3 Bridge Inspection

The inspection was carried out over three days on 10, 11, and 12 May 2023 respectively. The inspection consisted of systematically inspecting each member from the cycleway bridge deck, and the riverbed where practicable. Site notes from the previous MWH inspection component condition schedules were updated during the inspection, utilising this as a condition baseline from 13 years ago. The truss components were inspected in detail and the other components inspected in less stringent detail.

2 Bridge Description

The Totara bridge is located approximately 3 km from Ross, in the Westland Region. The bridge was built circa 1909 and once formed part of the Hokitika to Ross Railway Line which closed in 1980. The Totara bridge is now a part of the West Coast Wilderness Cycle Trail. Figure 1 below shows the general location of the bridge, in relation to the Ross township.

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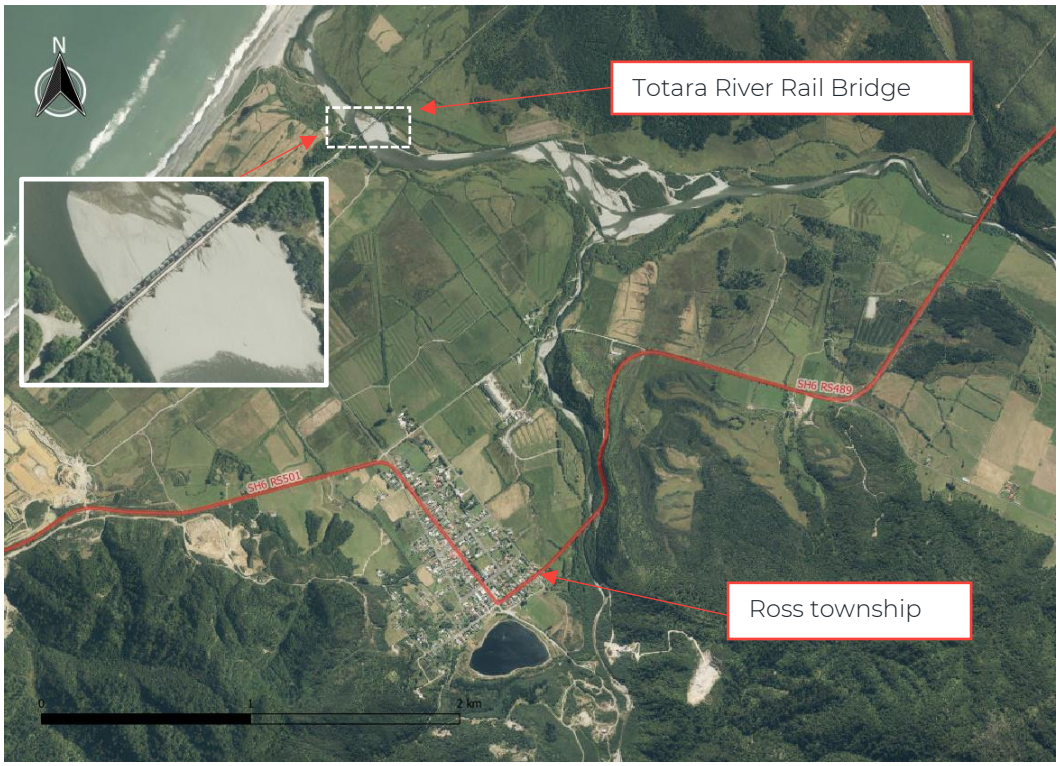

Figure 1: Aerial image mapping of site location of Totara River Rail Bridge
- (QGIS NZ Imagery Basemap, (Nov 2016))

Totara bridge is around 130m meters in length and comprises of nine spans; the first two spans at each end are simply supported timber land spans and the central five spans are typical Howe Trusses designed by the New Zealand Public Works Department. The central truss spans are around 24.4 m in length each. The bridge is predominantly constructed with imported Mixed Australian Hardwood (MAH) beams and piles and have been in service for 114 years.

The naming convention adopted for this assessment was to label the supports “A” through to “J”, with “A” the northernmost abutment, closest to Hokitika and on the true right of the river, and “J” the southernmost abutment, closest to Ross on the true left of the river. The spans of the bridge were labelled as the supports they spanned; from span “AB” between support “A” and “B” and so on.

Figure 2 below is a photo of the bridge towards the upstream direction, also showing the current location of the river channel, and the vegetation around the outside supports.

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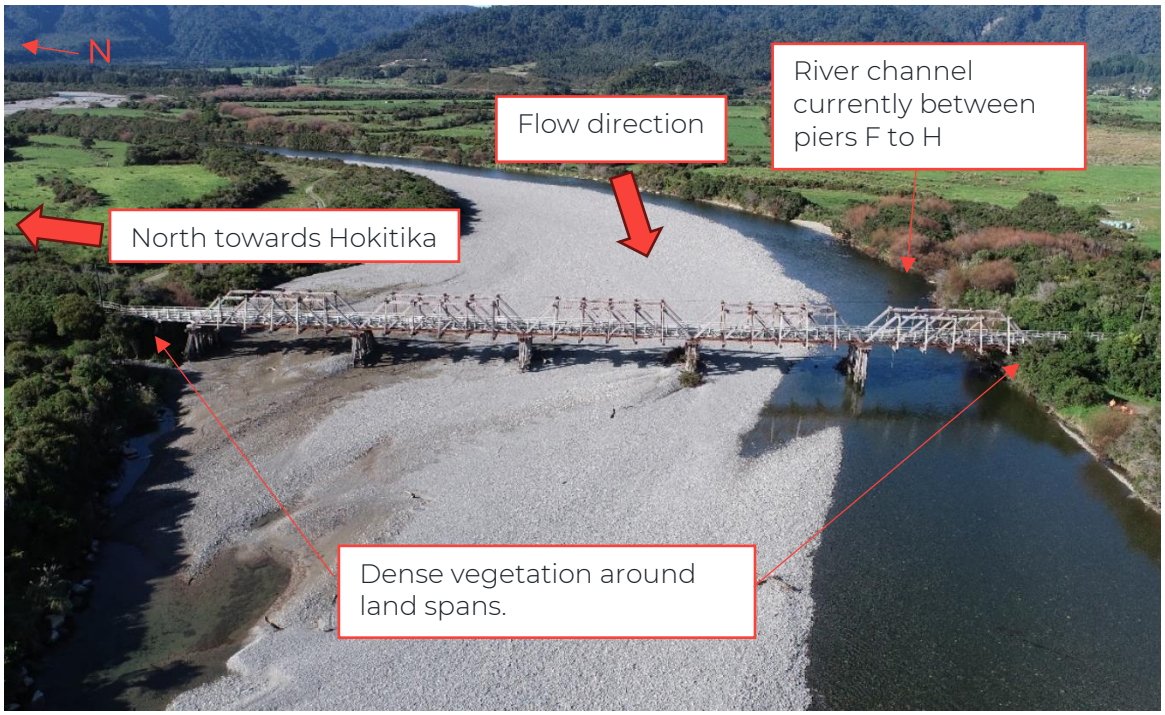

Figure 2. Overview photo of the Totara Bridge showing general site conditions

As seen in Figure 2 above, the central five spans are truss spans which were the main consideration for this structural assessment. These five truss spans assumed the typical design as shown in the elevation below (Figure 3). Also in this figure are the component labels adopted from the MWH assessment and used as naming convention.

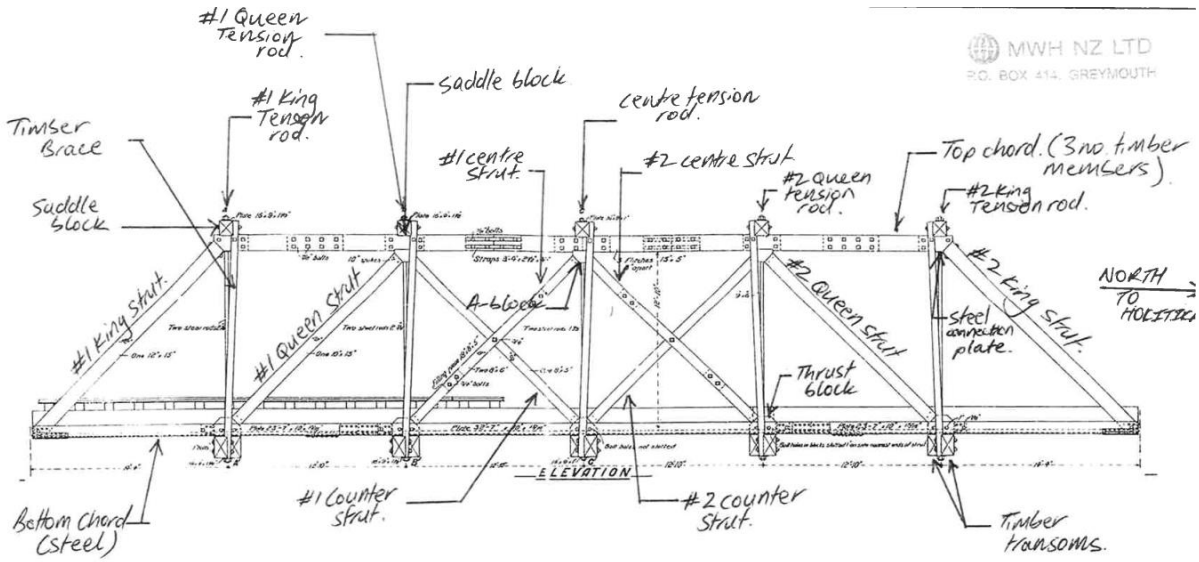

Figure 3. Typical truss elevation showing naming conventions.

3 Structural Assessment

3.1 Structural Assessment Threshold Capacities

The structural assessment was undertaken to determine the threshold section capacity of the main truss members. The threshold capacities for each member can be seen below in *Table 2*. They reflect the tolerance against section loss/decay and represent the minimum acceptable

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residual capacity of each member to provide adequate strength for the cycleway load demand. The full assessment report can be found in Appendix B. The assessment only considered the main truss members and did not consider secondary members or connections.

Table 2. Minimum Required Threshold Capacities Determined through Structural Assessment of Main Truss Members Under Pedestrian/Cyclist Loading Demand

Member	Threshold Capacity
Top Chord	55%
Bottom Chord	50%
King Strut	70%
Queen Strut	75%
Centre Strut	55%
Counter Strut	50%
Hanger/tension rod	50%
Transom	55%
Deck Cross Bracing	50%
Timber Brace	50%

4 Bridge Inspection

Member condition was visually estimated (i.e. interior defects cannot be quantified) during the site inspection. As condition was only visually assessed on site, specific investigation such as drilling will be required to determine specific condition.

4.1 Inspection Methodology

During the site inspection, the deterioration of each member was visually estimated as a percentage of its original condition. Member conditions were allocated into four priority categorisations, which reflect the level of deterioration and/or the capacity requirements determined form the structural assessment. The four priorities, timeframes for intervention, and descriptions are listed below.

1 **Urgent Priority – to be repaired or replaced within 6 months.**
Critical deterioration of the member, requiring immediate replacement due to extent of section loss or other visible defects.
OR
Impact on member capacity, estimated as greater than 10% below the threshold capacity, requires further investigation[1].

2 **High Priority – to be repaired or replaced within 2 years.**
Deterioration is visually significant and requires further investigation in the immediate future. This may show that repair /replacement is required.
OR
Impact on member capacity, estimated as 0% to 10% below the threshold capacity, requires further investigation[1].

3 **Medium Priority – to be repaired or replaced between 2 – 10 years.**

[1] Further investigation of timber components likely to require drilling.

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Minor repair required or monitor through future inspections.
OR
Impact on member capacity, estimated as 0% to 20% above the threshold capacity.

4 **Low Priority – to be repaired or replaced in 10+ years or as deterioration progresses.**
Lightly deteriorated members.
OR
Impact on member capacity, estimated as greater than 20% above the threshold capacity.

Members identified in the urgent or high priority level should undergo specific investigation to determine capacity of the member. If threshold capacity has been reached, repair or replacement is required. It is anticipated that the condition of specific elements proposed for repair is verified at the time of scoping for each tranche of repair work.

4.2 Site Inspection Exclusions

The main objective was to inspect and assess the truss elements. The simply supported spans and substructure were also inspected, but in less detail. There are several aspects which were excluded from the site inspection as listed below.

- Timber members were not drilled to determine interior deterioration. Members were only visually inspected.
- The existing ground below piles was not excavated for inspection.
- Road beams were only inspected from the riverbed due to the cycleway deck covering the deck from above.
- Span GH was not inspected from the riverbed due to the river channel, with span FG inspected from the edge of the river channel.
- The packers between the pile cap and the beam corbels, perpendicular to the corbels were generally not inspected due to not easily being visible.
- The top side of the top chords were unable to be visually inspected. UAV footage was able to be reviewed to confirm their condition.
- The cycleway elements appear to generally be in good condition; however, they were not inspected in detail as they are beyond the scope of the work.

4.3 Site Inspection Results

The full set of site notes from the site inspection is included in Appendix C. General comments from the site visit, and deterioration trends observed since the previous inspection are provided below in Table 3. Appendix D includes photos which demonstrate defects and signs of decay typically observed during the site inspection.

Table 3. General Site Comments

Member	Comments
All timber members	Significant deterioration and end decay, especially where in permanent shade. Timber elements weathered on top surfaces, ponding water leading to decay. Decay in timber components is often internal and not visible on the surface. Drilling required to quantify degree of deterioration.
All steel components	Since last inspection, the steel components have deteriorated significantly. Many deck plan bracing rods broken, bottom

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Member		Comments
		chord and hanger rod members at or approaching critical levels of deterioration. Note that deterioration of steel components is easier to assess visually.
Trusses	Hanger/vertical tension rod	Tension rod corrosion advancing. Bottom plates of tension rods corroded.
	Timber Saddle block	Significant deterioration saddle block end decay in downstream faces. Downstream ends of saddle blocks heavily decayed (>50%).
	Bottom Chord	Significant deterioration.
Beams	Corbels	Significant deterioration of packers below beam corbels. Corbels had corroded bolts and nuts.
	Deck bracing	Significant deterioration bracing (plan) rods. Bracing couplers heavily corroded.
Piers	Pile	Top of piles decayed. Vegetation debris on piers E, F, G causing minor local scour currently. Possible bank escarpment around Pier H but currently well vegetated above. Dry bed level approx. 600 mm below bottom of whalings at bridge, slight local depression compared to upstream and downstream.
	Whalings	Significant deterioration whaling timbers.
	Pile cap	Significant deterioration of pier cap timbers (end splitting), and packers between pile caps decayed.

The sum of the members for each priority group is shown in Table 4 below. Truss members which were replaced since the previous inspection were not included as they had not yet exhibited signs of deterioration.

Table 4. Priority Groups of Main Truss Members Results

	Priority			
Member	Urgent	High	Moderate	Low
Top Chord	0	1	15	24
Bottom Chord (pier to pier)	0	4	6	0
Struts	10	20	26	24
Hanger/tension rod	6	13	40	29
Transom	0	3	9	38

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	Priority			
Member	Urgent	High	Moderate	Low
Deck Cross Bracing	40	7	9	3
Timber Brace	0	5	4	19
Sum	56	53	109	137

5 Cost Estimates

5.1 Rough Order Cost to Strengthen

Without undertaking specific design, only rough order cost estimates can be provided. The rough order cost for repairing each member types were developed and are shown below in Table 5.

Table 5. Rough Order Unit Costs for Member Repair

Item	Rough Order Unit Costs (+/- 25%)
Preliminary & General	10% of the overall project costs.
Access for repairs	$100k
Cranage	$100k (estimated as $1k/day for 100 days)
Top Chord	$7k (each)
Bottom Chord	$45k (per side)
King Strut	$8.5k (each)
Queen Strut	
Centre Strut	
Counter Strut	
Hanger	$5.5k (each)
Transom	$15k (each)
Deck Plan Cross Bracing	$5.5k per brace rod (single)
Timber Brace	$3.5k (each)

The rough order costs listed above will require review when specific investigation and design has been carried out to increase accuracy. The rough order costs for access and cranage of components are indicative only and will be subject to change based on specific work to be undertaken during each tranche of repair work. Repetitive access to spans during each tranche of work will reincur the cost of establishing access.

The rough order unit costs in Table 5 above were used to estimate the rough order cost for each of the four priority categories, and these are shown in Table 6. The number of components requiring strengthening or repair is subject to change following specific investigation, such as drilling, to determine specific component condition.

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Table 6. Rough Order Costs for Each Priority Group

Item		Priority (timeframe)			
		Urgent (6 months)	High (2 years)	Moderate (2-10 years)	Low (10+ years)
Preliminary & General		$68k	$94k	$191k	$234k
Access for repairs[2]		$200k	$200k	$200k	$200k
Members	Top Chord	$0	$7k	$105k	$168k
	Bottom Chord	$0	$180k	$270k	$0
	Struts	$85k	$170k	$221k	$204k
	Hanger/tension rod	$33k	$72k	$220k	$160k
	Transom	$0	$45k	$135k	$570k
	Deck Cross Bracing	$220k	$39k	$50k	$17k
	Timber Brace	$0	$18k	$14k	$67k
SUM		$606k	$821k	$1.367M	$1.558M

5.2 Cost Estimate Schedule

The basis used to develop the cost estimate schedule is described below.

- It is strongly recommended to undertake drilling to specifically investigate the condition of each member. Results from drilling are required to accurately scope and design repair requirements. From detailed design a more accurate strengthening or replacement schedule can be developed.
- To reduce cost incurred for access and cranage, it is recommended to undertake the urgent and high priority work simultaneously. The potential economic benefit of grouping these works could be around $200k or potentially more due to time and resource efficiencies.
- For preliminary budgeting, it is recommended to allocate a percentage of the expected cost of repair work under the moderate priority as contingency for members which, following drilling investigation, may become high priority work.
- Strengthening costs have been estimated for the main truss members only. In addition to these costs, secondary components, connections, the sub-structure, piles, simply supported spans etc will also have strengthening or replacement needs. A high-level estimate for the strengthening or replacement has been allocated for these components but remain indicative until further investigation is undertaken to determine specific condition and required work. A high-level estimate of $250k in the high priority timeframe (2 years), and $300k in the moderate priority timeframe (2-10 years) has been allocated. These are high level estimates made under the assumption these components do not urgently need repair, and reflects continuation of deterioration over time, with a greater number of components requiring strengthening in the two-to-ten-year timeframe.
- It should be noted that the piles are of concern and the cost of underpinning, if required, would significantly increase the overall cost.

[2] The access and cranage costs represent site costs which will be incurred during each tranche of repair work, the estimated costs are indicative only and will be subject to change based on specific work which will be undertaken during each tranche of repair work.

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On the basis listed above, the cost estimate schedule shown is shown in Table 7 below was developed.

Table 7. Cost Estimate Schedule for Required Strengthening

Timeframe	Description	Cost Estimate
Immediate	$150k – indicative cost for recommended drilling investigation.	$150k
6 months	$606k – Urgent priority components. $821k – High priority components. Recommend undertaking high priority work at the same time as the urgent priority for economic efficiencies. $137k – 10% of moderate priority components. This is a contingency amount in place for the components which may move from moderate to high priority following drilling investigation. $250k – indicative estimate for the urgent or high priority components of the secondary truss components, the sub-structure, simply supported spans etc.	$1.814M
2-10 years	$1.230M – Moderate priority components minus the 10 percent considered in the first tranche of repair works. Residual moderate components will likely hold up and not require strengthening or replacement until further along towards the 10-year timeframe. $300k – indicative estimate for the moderate priority components of the secondary truss components, the sub-structure, simply supported spans etc. Ongoing monitoring should be undertaken to ensure rate of deterioration does not increase requiring earlier intervention.	$1.530M
10+ years	$2.125M – Low priority components which are at low risk of reaching threshold capacity. Ongoing monitoring should be undertaken to ensure rate of deterioration does not increase requiring earlier intervention.	$2.125M
TOTAL	Excluding detailed design and construction monitoring.	$5.619M

Please note, the rough cost estimates are within +/- 25% accuracy. The high-level estimates for the other cost components are indicative only.

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6 Assessment Summary

General findings from the visual site investigation identified all timber members had significant deterioration and end decay, especially where in permanent shade. Since the previous inspection undertaken by MWH in 2010, the steel components have deteriorated significantly. Many deck plan bracing rods are broken, the bottom chord and hanger rod members are at or approaching critical levels of deterioration.

The cost estimate schedule developed for the bridge is shown in Table 6 above and has been developed from visual site inspection, rough order unit costs for repairing the main truss members, and high-level estimates for other cost components. Drilling is required to specifically identify the condition of each component to determine components requiring strengthening or replacement. The cost estimate schedule is subject to change following specific investigation and design.

7 Recommended Actions

- Drilling is strongly recommended to specifically identify the condition of each component to determine which components require strengthening or replacement. The cost estimate schedule is subject to change following specific investigation and design.
- A present value end of life (PVEOL) or similar assessment should be undertaken to compare maintenance costs with the cost of establishing an alternative crossing. Given the amount of current deterioration of the bridge and strengthening required, the PVEOL should be used to compare the cost of any repairs against the value of the bridge. As the bridge is now utilised as a cycleway bridge, the replacement value for a cycleway bridge is roughly $2.03M[3]. Total sum cost of remedial works and future inspections will exceed the replacement value of a cycleway bridge.
- Discussions should be held with Heritage New Zealand Pouhere Taonga (HNZPT) regarding the heritage status of this structure. Strengthening or repair work may be influenced by this as work my result in loss of the historic fabric and character of the bridge. The bridge is not listed as a heritage structure with HNZPT, nor identified as a Historic Place in the WDC District Plan. However, as it was built in the 1800's it holds heritage value.

7.1 Other Considerations

- The existing bridge is potentially at risk to other vulnerabilities which were not investigated or discussed during this visual assessment. Examples of vulnerabilities could include risk to scour, or seismic loading, pile reduction due to abrasion (below the current bed level) and pile damage due to log loading given its demanding operating environment.
- A new structure could be in a location less vulnerable to the environment. This could be further upstream with a cycleway diversion.
- Repairs consisting of steel augmentation with protective coating systems would require first minor maintenance within 15-20 years at best in this environment and would add to the ongoing future maintenance costs.

[3] Replacement Value (non-depreciated, based on cycleway dimensions)
Deck area = 2m wide x 145m long = 290m2
Replacement rate = $7,000/m2 (From Waka Kotahi valuation rates June 2022)
Replacement value = $2.03M
Waka Kotahi valuation rates are likely higher than the cost of a cycle bridge but provide an indicative value for the cost estimate for a replacement cycleway bridge.

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Appendix A
MWH Assessment Report

MWH

BUILDING A BETTER WORLD

REPORT

Totara River Bridge
Structural Condition Assessment - Preliminary

Prepared for Westland District Council

AUGUST 2010

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This disclaimer shall apply notwithstanding that the report may be made available to other persons for an application for permission or approval to fulfil a legal requirement.

QUALITY ASSURANCE STATEMENT

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REVISION SCHEDULE

Rev No	Date	Description	Prepared By	Reviewed By	Approved By
1	Dec 09	Draft for Client Comment	JD	JS	J Strange
2	Aug 10	Final	JD	JS	J Strange

WESTLAND DISTRICT COUNCIL

Totara River Bridge
Structural Condition Assessment – Preliminary

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 Executive Summary

This report was prepared for the Westland District Council to assess the structural condition of the Totara River Bridge.

The on-site visual condition assessment showed that there are considerable variations in the condition of the various structural members. A large portion of the structural members are in sound condition and require only treatment to treat decay and weathering that has occurred and to prolong the life of the members. A small portion of the members have undergone significant decay and corrosion and now require replacement. The remaining members require further investigation to determine if treatment or replacement is required.

Intrusive investigations and detailed structural analysis were not carried out as part of this assessment.

We recommend the following processes be carried out to determine the extent and cost of renewal and maintenance works on the bridge:

1. Carry out a structural assessment
2. Carry out intrusive investigation
3. Prepare recommendations for remedial and maintenance works to the bridge
4. Prepare rough order cost estimates for the renewal and maintenance works

2 Introduction

As requested by Westland District Council, MWH New Zealand Ltd carried out a visual baseline inspection of the Totara River Bridge.

The Totara River Bridge formed part of the Hokitika to Ross Railway Line which was closed in 1980. Westland District Council are proposing to use this bridge as a pedestrian / cycle bridge as part of a proposed cycle way between Hokitika and Ross.

3 Inspection

A visual baseline inspection was carried out over eight days on 19, 20, 21, 23, and 27 October and 03, 25, and 26 November. The inspection was carried out by John Strange and Jason Davidson. Assistance for inspection was provided by the following:

- Dean Arthur (Due West Ltd) - assistance with safety ropes and lines for all work at heights.
- Dave Hawes (Department of Conservation) - assisted with the inspection on 19 October to provide input into inspection and recording techniques, based on his previous experience with similar structures whilst working for NZ Rail and the Department of Conservation.

4 Bridge Description

The Totara River Bridge is the southernmost rail bridge on the old Hokitika to Ross Railway. The Railway was opened on 01 April 1909 following completion of the Totara River Bridge and closed 71 years later in November 1980[1]. Some time following the closure of the railway from Hokitika to Ross, the railway lines and decking on the Totara River Bridge were removed.

1. Mahinapua Creek Railway Bridge – Conservation Plan prepared by Chris Cochran, 30 July 1999

Following removal of the decking (sleepers) only the main longitudinal beams were left remaining. The bridge currently has a timber barrier / balustrade fixed to the downstream beam (refer Figure 4-4). We understand that the Westland District Council had this installed to enable walking access to be maintained across the bridge as the bridge is regularly used by a local farmer to access his land and livestock on the northern side of the Totara River.

The Totara River Bridge is a nine span timber bridge constructed predominantly of what we understand to be Australian Hardwood timbers, and "steel" bracing and tension members. There was a transition from the use of black iron to steel during the period from 1880 to 1910 and during this period it was common for both materials to be used in construction.

The bridge is made up of nine spans with the first two spans constructed using simply supported timber beams and the central five spans, being much longer are Howe Trusses. Figure 4-1 on the following page shows a typical Howe Truss and Table 4-1 below shows the construction of each span.

Table 4-1 : Bridge Spans

Span Number	Structure Description
Span #1	Simply supported timber beams
Span #2	Simply supported timber beams
Span #3	Howe Truss (Standard Railway 80ft truss)
Span #4	Howe Truss (Standard Railway 80ft truss)
Span #5	Howe Truss (Standard Railway 80ft truss)
Span #6	Howe Truss (Standard Railway 80ft truss)
Span #7	Howe Truss (Standard Railway 80ft truss)
Span #8	Simply supported timber beams
Span #9	Simply supported timber beams

The bridge superstructure is supported on timber piers. The timber piers supporting the longer Howe truss spans (river spans) consist of ten piles and the piers supporting the shorter simply supported spans (land spans) and forming the abutment walls consist of five and three piles respectively. Figures 4-2 and 4-3 on the following pages show typical piers supporting both river and land spans.

The hardwood piles forming the piers appear to have been driven and all piles generally have markings to enable the depth of pile below ground level to be determined.

A plan of the bridge which outlines the numbering system for the piers and spans etc is included in Appendix A of this report and Appendix B includes a typical drawing of an 80ft span Howe Truss.

Figure 4-1 : Typical Howe Truss Span (Span 6 – Downstream)

Figure 4-2 : Typical End Span (Spans 8 and 9 – Southern End)

Figure 4-3 : Typical River Pier (Pier No. 7)

Figure 4-4 : Typical View North Along Bridge

5 Bridge Inspection

5.1 Inspection Methodology

The structural inspection of the bridge involved visually inspecting all members / elements. In addition to the visual inspections, timber members were "hammer tested" to check for signs of internal decay. This involved striking the timber members with a hammer and listening to the pitch of the sound which alters with changes in timber density. Intrusive investigations were not carried out as part of these inspections.

In addition to this, excavations were carried out by Westroads Ltd with an excavator down alongside a number of piles to check the condition of these piles at and below existing ground level.

This inspection methodology was used to classify members into the following three categories:

1. ***Member sound, treatment only required***: Members in this category are typically sound and may or may not exhibit one or more of the following signs of decay:
    - No, or limited, signs of centre decay
    - No, or limited, sign of end decay
    - Minor isolated pocket decays
    - Minor surface weathering / decay
    - Minor splitting and associated decay
    - Corrosion of steel members

    In some instances, an assumption has been made during the inspection as to the required member capacity for the intended future use of the structure. Taking this into account some members with greater decay / corrosion have been classed as "sound – treatment only" if they appear to have a sufficient amount of redundancy. For example a steel member with corrosion that has reduced the cross section considerably but which is likely to have sufficient redundancy for the intended future use of the structure.
2. ***Further investigation required***: Members in this category are suspect and exhibit one or more of the following signs of decay:
    - Signs of centre decay where the extent of the decay is unknown (i.e. dull sound)
    - Significant end decay extending into / along member where the extent is unknown
    - Significant pocket decays where the depth / extent is unknown
    - Significant splitting and / or decay where the depth / extent is unknown
    - Heavy corrosion of steel members

    Further investigation is likely to involve core drilling of timbers to assess the extent of any decay and in a number of cases will also include a structural load assessment to determine the required size of members.
3. ***Member requires replacement***: Members in this category are typically heavily decayed or corroded. The following criteria has been used to classify members into this category and further investigation (i.e. structural calculations) may be required to confirm assumptions that have been made:
    - Steel members with >50% loss of cross section
    - Timber members that are decayed to an extent where treatment is no longer an option, i.e. large centre decays reducing cross section

The above classifications do take into account the intended future use of the structure, being a pedestrian / cycle bridge. These classifications therefore take account of the significant redundancies in some members and some assumptions have been made on site as to the required capacity / size of some members for the intended future use of this structure.

Figures 5-1 to 5-4 below and on the following pages show the classification of some structural members.

Figure 5-1 : Top Chord of Timber Trusses – Minor Weathering / Splitting Only, "Sound"

Figure 5-2 : Saddle Block – Large Centre Decay Back Beyond Tension Rod, "Requires Replacement"; A-Block (Top Thrust Block), "Sound"

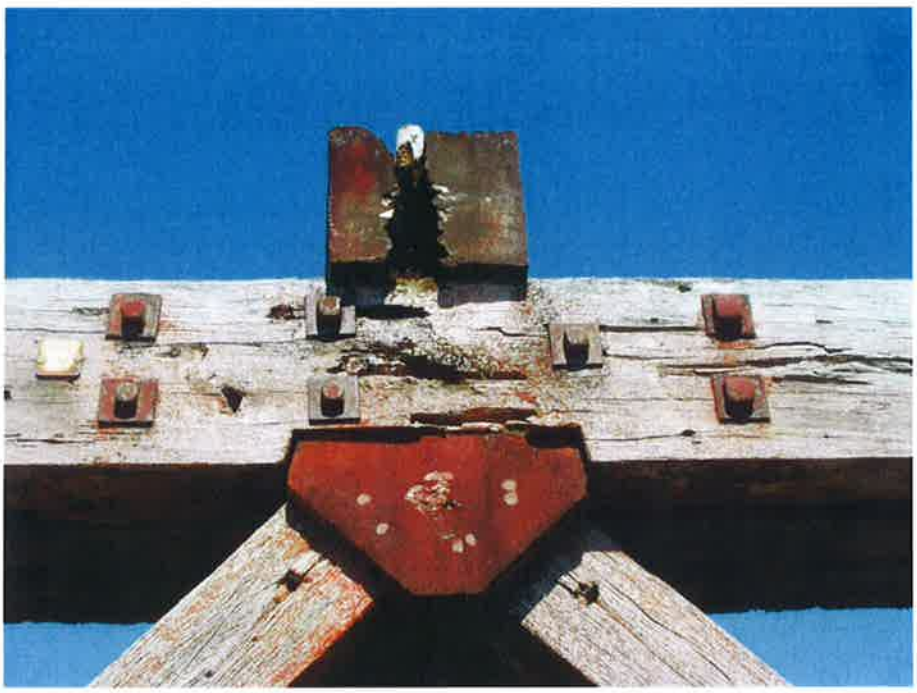


Figure 5-3 : Lateral Braces – Members Completely Decayed at Ends, "Requires Replacement"

Figure 5-4 : King Strut – Significant Surface Decay, Pocket Decay and Splitting, "Investigate Further"

The structural inspections were carried out by John Strange (Senior Engineer) and Jason Davidson (Structural Engineer). Dave Hawes (Department of Conservation) also spent one day (19 October 2009) on site assisting with the structural inspections.

5.2 Inspection Results

The structural inspection of the bridge showed that there is considerable variation in the condition of the various structural elements. When this structure was in service it was subject to regular checks and maintenance by Railways. When timber members were replaced by Railways, the date was chiselled into the surface of the new timber to indicate its age. There are a large number of timber members that have been replaced with dates ranging from 1928 for the earliest replacements to 1978 for the last members replaced before closure of the railway line. A number of those members replaced have been replaced with second hand members, denoted by an "SH" chiselled into the face of the member with the date of replacement. Many of these timber members that have been replaced, and particularly those replaced toward the end of the bridges service period, are in noticeably better condition than those older timber members.

As a result of the exposed location of the bridge in close proximity to the sea, some elements have undergone significant weathering, particularly where they face the prevailing westerly winds. Steel elements including cross bracing, tension rods, bottom truss chord and bolts are typically heavily corroded. Timber members show various signs of decay including surface decay and weathering (particularly on faces exposed to the prevailing weather), small isolated pocket decays typically where there are penetrations in the wood surface allowing moisture into the timber, end decays where the ends of the timber members are exposed to the weather and centre decays where the softer centre of the hardwood timber members have started to decay.

Detailed inspection results are included in Appendices C, D, E and F of this report.

6 Recommendations

We recommend that to more accurately quantify the extent and cost of remedial and maintenance works required to bring this structure up to a standard suitable for a pedestrian / cycle bridge, the following works be carried out:

1. ***Structural Assessment:***

Carry out a desktop structural assessment to determine required sizes of members (steel and timber) for the future intended purpose of the structure.

This would include modelling the bridge to assess loads through individual members and connections and enable treatment or replacement of members to be more accurately quantified.

2. ***Intrusive Investigation:***

Following determination of member and connection requirements by structural assessment, those members currently classified as "investigate further" could be investigated by intrusive methods to confirm whether or not they meet structural requirements. If so they would be reclassified as "treatment required" and if not would be reclassified as "require replacement".

Investigation would involve carrying out core drilling of timber members.

3. ***Recommendations for Renewal / Maintenance Works***

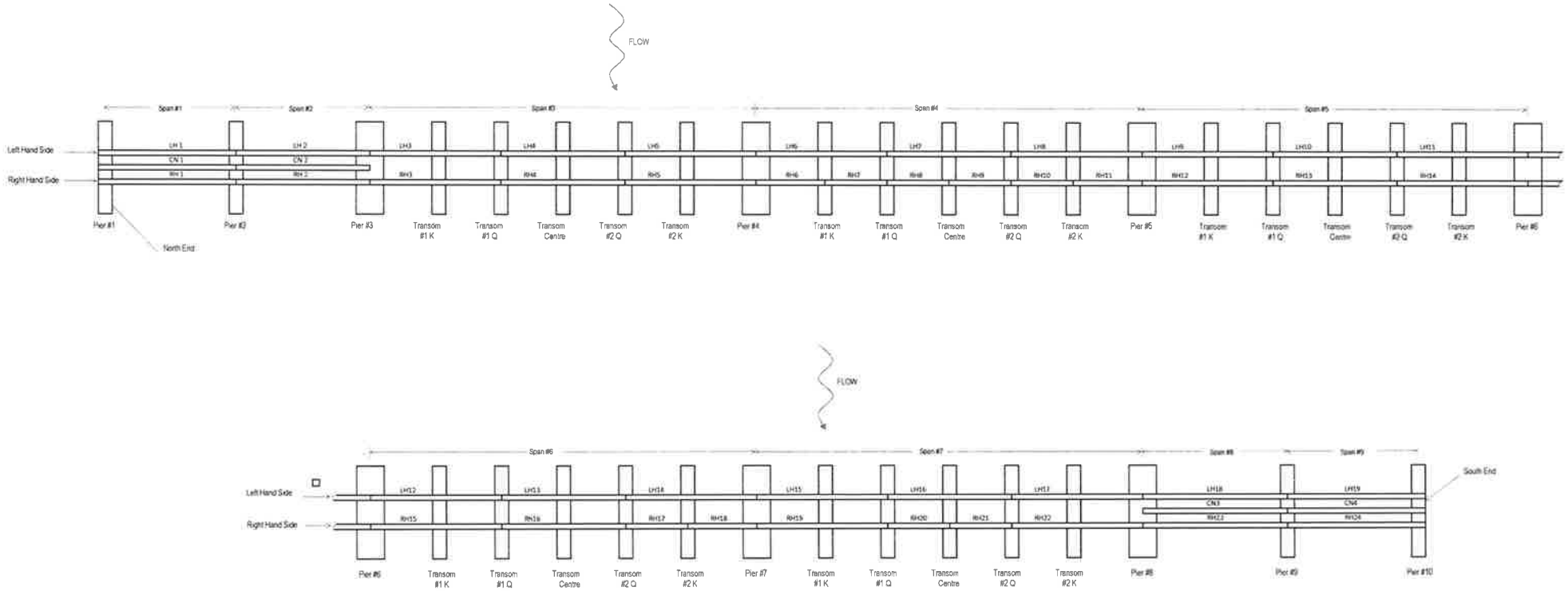
Prepare recommendations for renewal and maintenance works. These recommendations would be classified as immediate, short term and long term

4. ***Rough Order Cost Estimates***

Prepare rough order cost estimates for renewal and maintenance works.

Appendix A:

- **Indicative Plan of Totara River Bridge**
- **Pier Pile Plan**
- **Truss Elevation**
  (3 pages total)



PLAN - TOTARA RIVER BRIDGE

MWH

BUILDING A BETTER WORLD

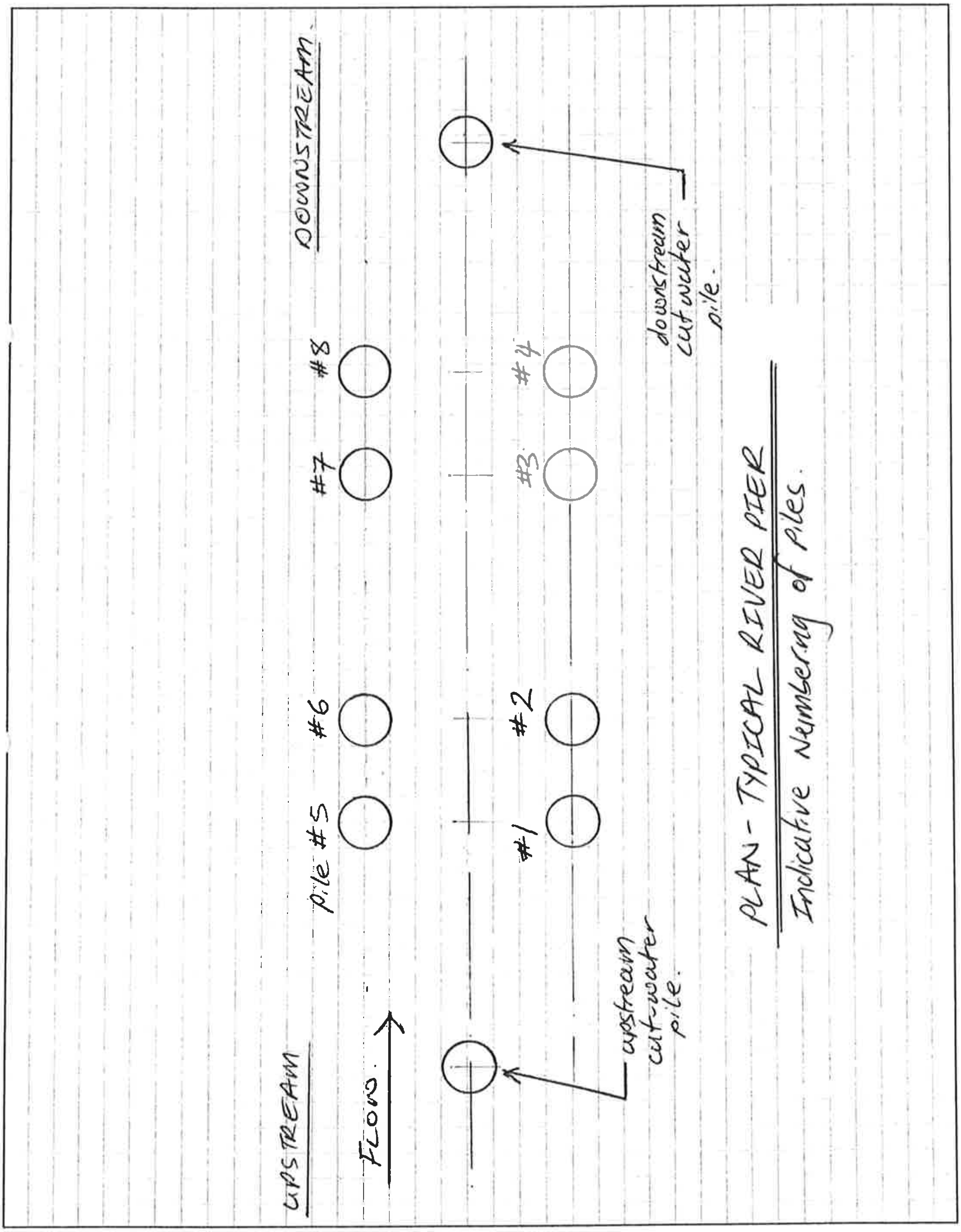
PROJECT: WDC Totara River Bridge PROJECT NO.: Z1845400

DESCRIPTION: PLAN - RIVER PIER (Numbering Convention

PREPARED BY: JKD DATE:

CHECKED BY: DATE:

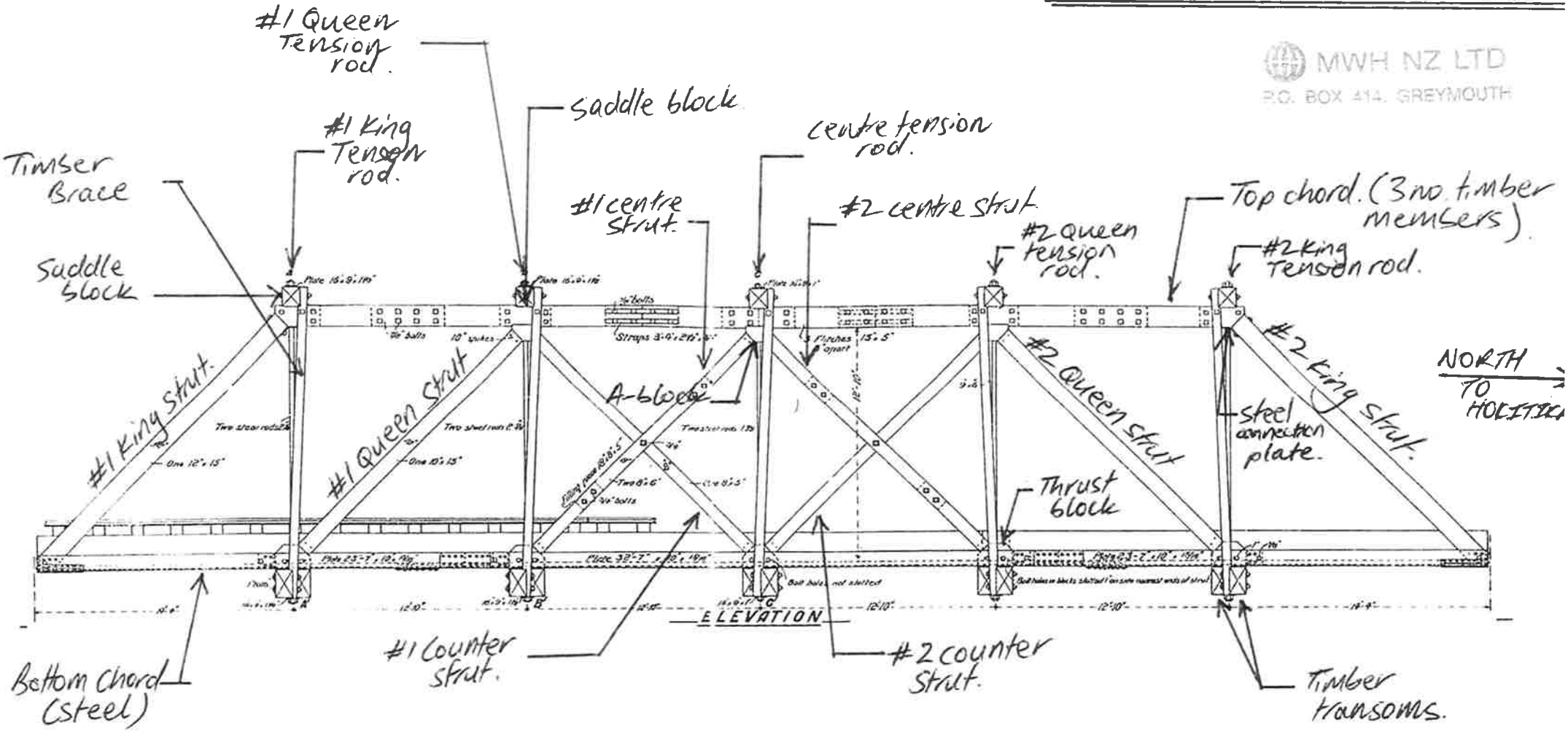
REF/DWGS: SHEET 1 OF 1



Z1845700.

NDC TOTAKA RIVER BRIDGE.

MWH NZ LTD
P.O. BOX 414, GREYMOUTH



ELEVATION – Downstream Truss (viewed from inside)

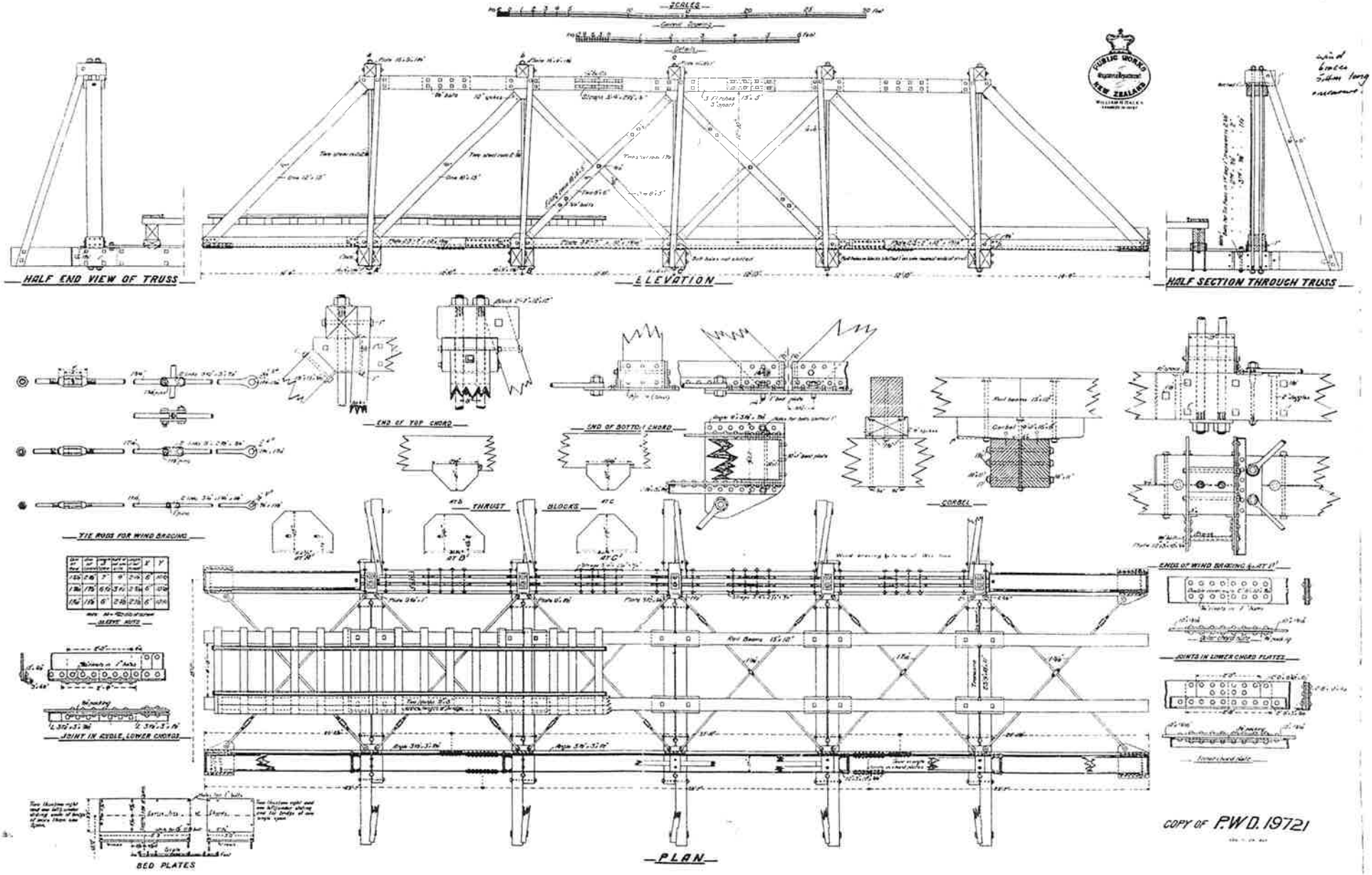
Typical Naming conventions for members of Howe Truss

Not to scale
Indicative only.

Appendix B:

- **Typical Construction Drawing – 80ft Howe Truss**
  (1 page)

TRUSS 80 Ft. SPAN – STEEL LOWER CHORD



GR. 1968

Appendix C: Inspection Results – Trusses (10 pages)

Definition of terminology used

- "PDK" – Pocket Decay
- "EDK" – End Decay
- "CDK" – Centre Decay

TOTARA RIVER BRIDGE - TRUSSES

Span	Side	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
			Sound / Treatment only	Investigate Further	Replace		
3	LH	**Timber Struts**					
		#1 - King Strut		•		50%	Significant weathering and deep cracking top surface; bottom half section sound; large PDK at base
		#1 - Queen Strut		•		50%	Heavy weathering and deep cracking top surface; bottom half section sound;
		#1 - Counter Strut		•			Large split through centre; large PDK at base
		#1 - Centre Strut - Inside		•			Bottom sounds drummy; PDK inside face; splitting
		- Outside		•			Large PDK at base; top surface weathering and splitting
		#2 - Centre Strut - Inside		•			Sounds drummy,
		- Outside		•			PDK inside face; sounds drummy at top
		#2 - Counter Strut		•			Vertical splitting at top; sounds drummy
		#2 - Queen Strut		•		50%	PDK top face; weathering and splitting top face
		#2 - King Strut	•			50%	Large horizontal split inside face; significant weathering / splitting on top surface
		Vertical Steel Tension Rods					
		#1 - King Rods - Inside	•			80%	Heavily corroded
		- Outside	•			70%	Heavily corroded
		#1 - Queen Rods - Inside	•			70%	Heavily corroded
		- Outside	•			70%	Heavily corroded
		#1 - Centre Rods - Inside	•			50%	Heavily corroded
		- Outside	•			50%	Heavily corroded
		#2 - Queen Rods - Inside	•			80%	Heavily corroded
		- Outside	•			60%	Heavily corroded
		#2 - King Rods - Inside	•			90%	Heavily corroded
		- Outside	•			70%	Heavily corroded
		Timber Thrust Blocks					
		#1 - King Timber Thrust Block	•				
		#1 - Queen Timber Thrust Block		•			Large PDK at outside rod
		Centre Timber Thrust Block	•				
		#2 - Queen Timber Thrust Block	•				
		#2 - King Timber Thrust Block	•				
		Timber A-Blocks					
		#1 - Queen A-Block	•				
		Centre A-Block	•				
		#2 - Queen A-Block	•				
		Timber Saddle Blocks					
		#1 - King Saddle Block			•		Large CDK; sounds hollow
		#1 - Queen Saddle Block		•			Weathered with large splits on top; sounds drummy
		Centre Saddle Block		•			Large CDK inside end
		#2 - Queen Saddle Block		•			CDK inside end; otherwise appears sound
		#2 - King Saddle Block	•				Typical EDK and weathering; otherwise sound
		Top Chord					
		#1 King - #1 Queen - Inside			•		Large PDK; significant weathering
		- Middle		•			
		- Outside		•			
		#1 Queen - Centre - Inside	•				
		- Middle	•				Significant weathering
		- Outside	•				Significant weathering
		Centre - #2 Queen - Inside	•				Surface weathering
		- Middle	•				
		- Outside		•			Sounds drummy
		#2 Queen - #2 King - Inside	•				
		- Middle		•			EDK at king strut; large PDK near #2 queen
		- Outside		•			Sounds Drummy
		Bottom Chord					
		Steel Bottom Chord	•			80%	Heavy corrosion, King strut seatings at piers sound
		Steel Connection Plates					
		#1 King Strut to top chord	•			70%	Heavily corroded; bolts gone
		#2 King Strut to top chord	•			80%	Heavily corroded; bolts gone
		Timber Braces					
		#1 - King Timber Brace			•		EDK top end
		#1 - Queen Timber Brace			•		EDK top end
		Centre Timber Brace	•				EDK top end; connection to saddle block OK, bolt / nuts corroded
		#2 - Queen Timber Brace			•		EDK top end
		#2 - King Timber Brace			•		EDK top end

TOTARA RIVER BRIDGE - TRUSSES

Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
3	RH	**Timber Struts**						
		#1 - King Strut			•			Sounds Drummy
		#1 - Queen Strut			•			Replaced 1966; Sounds drummy lower portion
		#1 - Counter Strut		•				Vertical splitting through top surface full length
		#1 - Centre Strut	- Inside		•			PDK at thrust block; Splitting and Pad top surface
			- Outside	•				PDK outside face around bolts
		#2 - Centre Strut	- Inside		•			
			- Outside	•				
		#2 - Counter Strut		•				PDK outside face; vertical splitting
		#2 - Queen Strut			•			Surface weathering; dull sound at base
		#2 - King Strut			•			Surface weathering; insect holes noted near top
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			70%	
			- Outside	•			70%	
		#1 - Queen Rods	- Inside	•			80%	
			- Outside	•			90%	
		#1 - Centre Rods	- Inside	•			80%	
			- Outside	•			80%	
		#2 - Queen Rods	- Inside	•			70%	
			- Outside	•			70%	
		#2 - King Rods	- Inside		•		30%	
			- Outside		•		30%	
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block				•		Significant decay top surface; large PDK between rods and on outside of rods
		#1 - Queen Timber Thrust Block		•				
		Centre Timber Thrust Block		•				
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				
		Timber A-Blocks						
		#1 - Queen A-Block		•				
		Centre A-Block		•				
		#2 - Queen A-Block		•				
		Timber Saddle Blocks						
		#1 - King Saddle Block			•			Large CDK inside end
		#1 - Queen Saddle Block		•				Typical EDK and weathering
		Centre Saddle Block		•				CDK inside end; significant decay / weathering on top surface
		#2 - Queen Saddle Block		•				
		#2 - King Saddle Block			•			Small CDK inside end; several PDK's on northern face
		Top Chord						
		#1 King - #1 Queen	- Inside		•			Remove vegetation at end and investigate further
			- Middle		•			Replaced 1950; remove vegetation at end and investigate further
			- Outside		•			Remove vegetation at end and investigate further
		#1 Queen - Centre	- Inside	•				Significant surface decay top surface
			- Middle	•				
			- Outside	•				
		Centre - #2 Queen	- Inside	•				Surface decay inside face
			- Middle	•				Weathered
			- Outside	•				Weathered
		#2 Queen - #2 King	- Inside		•			Replaced 1933 (second hand); large PDK inside face at bolt group
			- Middle	•				Weathered
			- Outside	•				Weathered
		Bottom Chord						
		Steel Bottom Chord		•			60 - 80%	Heavy corrosion, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•			60%	Heavy corrosion; bolts gone
		#2 King Strut to top chord		•			90%	Heavy corrosion; bolts gone
		Timber Braces						
		#1 - King Timber Brace				•		EDK top end
		#1 - Queen Timber Brace				•		EDK top end
		Centre Timber Brace				•		EDK top end; large PDK (approx. half section gone)
		#2 - Queen Timber Brace				•		EDK top end; extensive splitting throughout
		#2 - King Timber Brace		•				PDK at connection to transom

TOTARA RIVER BRIDGE - TRUSSES

Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
4	LH	**Timber Struts**						
		#1 - King Strut		•			50%	Significant weathering / cracking top surface; small PDK at base; top half of section sounds dull
		#1 - Queen Strut		•			50%	Significant weathering / cracking top surface; small PDK at base; top half of section sounds dull
		#1 - Counter Strut		•				Small PDK inside face at base; splitting in top surface
		#1 - Centre Strut	- Inside	•				Some splitting along inside face
			- Outside	•				Some surface splitting
		#2 - Centre Strut	- Inside	•				PDK on top surface
			- Outside	•				Some splitting top surface
		#2 - Counter Strut		•				Split in top surface full length of member
		#2 - Queen Strut			•			Deep splitting / weathering in top surface
		#2 - King Strut		•				Replaced 1944
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			80%	Heavy corroded
			- Outside	•			80%	Heavy corroded
		#1 - Queen Rods	- Inside	•			60%	Heavy corroded
			- Outside	•			80%	Heavy corroded
		#1 - Centre Rods	- Inside	•			90%	Heavy corroded
			- Outside	•			60%	Heavy corroded
		#2 - Queen Rods	- Inside	•			70%	Heavy corroded
			- Outside	•			70%	Heavy corroded
		#2 - King Rods	- Inside	•			60%	Heavy corroded
			- Outside	•			60%	Heavy corroded
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block		•				
		#1 - Queen Timber Thrust Block		•				
		Centre Timber Thrust Block		•				
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				
		Timber A-Blocks						
		#1 - Queen A-Block		•				Small CDK
		Centre A-Block		•				
		#2 - Queen A-Block			•			CDK approx. 120mm diameter
		Timber Saddle Blocks						
		#1 - King Saddle Block		•				CDK inside end approx. 50mm diameter
		#1 - Queen Saddle Block		•				Surface decay on top extending down into saddle block
		Centre Saddle Block		•				CDK inside end approx. 40mm diameter
		#2 - Queen Saddle Block		•				
		#2 - King Saddle Block		•				CDK inside end approx. 20mm diameter; Pad at drill holes on northern face.
		Top Chord						
		#1 King - #1 Queen	- Inside	•				Weathered
			- Middle	•				Replaced 1933 (second hand); weathered
			- Outside	•				Weathered
		#1 Queen - Centre	- Inside	•				Weathered
			- Middle	•				Weathered
			- Outside		•			Large PDK at end or flitch (approx. half section missing)
		Centre - #2 Queen	- Inside	•				
			- Middle	•				PDK top surface and inside face; weathered
			- Outside	•				PDK top surface; weathered
		#2 Queen - #2 King	- Inside	•				Weathered
			- Middle	•				Significant weathering and Isolated PDK
			- Outside		•			Significant weathering and Isolated PDK; dozy near #2 king Timber brace connection.
		Bottom Chord						
		Steel Bottom Chord		•			80%	Typically heavily corroded, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•			90%	Heavily corroded; bolts gone
		#2 King Strut to top chord		•			80%	Heavily corroded; bolts gone
		Timber Braces						
		#1 - King Timber Brace		•				
		#1 - Queen Timber Brace		•				Nuts missing from bolts
		Centre Timber Brace		•				
		#2 - Queen Timber Brace			•			Large PDK at base; bolts fully corroded
		#2 - King Timber Brace		•				Split at bolt otherwise sound

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Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
4	RH	**Timber Struts**						
		#1 - King Strut		•				Significant surface weathering top surface; several PDK top surface.
		#1 - Queen Strut		•				Weathered top surface
		#1 - Counter Strut			•			Split and PDK top surface
		#1 - Centre Strut	- Inside	•				Some vertical cracking noted
			- Outside	•				Some vertical cracking noted
		#2 - Centre Strut	- Inside		•			Some surface decay and splitting at base
			- Outside		•			Large vertical split full length; surface decay
		#2 - Counter Strut		•				Splitting in top surface full length
		#2 - Queen Strut			•			Cracking in top surface; sounds hollow from 1m below A-block
		#2 - King Strut		•				Weathered top surface; isolated PDK inside surface
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			50%	Heavily corroded
			- Outside	•			40%	Heavily corroded
		#1 - Queen Rods	- Inside	•			30%	Heavily corroded
			- Outside	•			30%	Heavily corroded
		#1 - Centre Rods	- Inside	•			40%	Heavily corroded
			- Outside	•			40%	Heavily corroded
		#2 - Queen Rods	- Inside	•			70%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		#2 - King Rods	- Inside	•			70%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block		•				
		#1 - Queen Timber Thrust Block		•				
		Centre Timber Thrust Block		•				
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				
		Timber A-Blocks						
		#1 - Queen A-Block		•				
		Centre A-Block		•				
		#2 - Queen A-Block		•				Small CDK inside end
		Timber Saddle Blocks						
		#1 - King Saddle Block		•				Small CDK and splitting inside end; significant EDK outside end to beyond brace connection
		#1 - Queen Saddle Block		•				EDK outside end
		Centre Saddle Block		•				Advanced CDK
		#2 - Queen Saddle Block			•			Small CDK inside end; significant EDK outside end to beyond Timber brace connection; sounds hollow
		#2 - King Saddle Block			•			Large CDK inside end up to 150mm diameter; surface decay; sounds hollow; investigate and treat / replace
		Top Chord						
		#1 King - #1 Queen	- Inside		•			Weathered; sounds hollow
			- Middle		•			Large PDK inside face approx. 50mm deep; weathered
			- Outside		•			Large PDK, approx half cross section missing
		#1 Queen - Centre	- Inside	•				
			- Middle	•				
			- Outside	•				EDK at splice connection
		Centre - #2 Queen	- Inside	•				Weathered
			- Middle	•				Weathered
			- Outside	•				Weathered; small PDK top surface
		#2 Queen - #2 King	- Inside		•			Weathered; split; PDK inside flitch below saddle; sounds hollow
			- Middle	•				Weathered; split
			- Outside	•				Weathered; split
		Bottom Chord						
		Steel Bottom Chord		•			70%	Moderate to heavy corrosion, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•				
		#2 King Strut to top chord		•			70%	Heavily corroded
		Timber Braces						
		#1 - King Timber Brace		•				PDK at base; weathered and splitting
		#1 - Queen Timber Brace		•				Large split from top end through bolted connection; install split bolt
		Centre Timber Brace		•				
		#2 - Queen Timber Brace			•			Significant cracking; hollow sound
		#2 - King Timber Brace		•				Split in end; large PDK at connection to transom

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Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
5	LH	**Timber Struts**						
		#1 - King Strut			•			Significant weathering / cracking top surface; small PDK at base; top half of section sounds dull
		#1 - Queen Strut		•			50%	Weathered top surface with large splits down centre; PDK and split on underside
		#1 - Counter Strut			•			PDK top surface
		#1 - Centre Strut	- Inside	•				Vertical splitting full length; some horizontal splitting on sides
			- Outside		•			Significant vertical splitting and decay of top surface; horizontal splitting inside face
		#2 - Centre Strut	- Inside			•		Large horizontal crack full length; significant surface decay and PDK
			- Outside			•		Significant splitting and PDK at base; large split at top
		#2 - Counter Strut			•			PDK at thrust block; splitting at base; sounds dull
		#2 - Queen Strut					70%	PDK at base; significant weathering and cracking top surface approx 1/4 depth
		#2 - King Strut		•				Surface weathering on top surface
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			90%	Heavily corroded
			- Outside	•			90%	Heavily corroded
		#1 - Queen Rods	- Inside	•			90%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		#1 - Centre Rods	- Inside	•			80%	Heavily corroded
			- Outside	•			60%	Heavily corroded
		#2 - Queen Rods	- Inside	•			60%	Heavily corroded
			- Outside	•			60%	Heavily corroded
		#2 - King Rods	- Inside	•			80%	Heavily corroded
			- Outside	•			90%	Heavily corroded
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block		•				
		#1 - Queen Timber Thrust Block		•				
		Centre Timber Thrust Block			•			Some splitting and compression occurring
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				
		Timber A-Blocks						
		#1 - Queen A-Block		•				Small CDK inside end
		Centre A-Block		•				Small CDK inside end; small PDK at strut
		#2 - Queen A-Block		•				Large CDK inside end approx. 100mm diameter
		Timber Saddle Blocks						
		#1 - King Saddle Block		•				Small CDK; large vertical split; treat and provide horizontal split bolts
		#1 - Queen Saddle Block		•				CDK approx. 80mm diameter inside end
		Centre Saddle Block		•				CDK inside end; PDK on south side
		#2 - Queen Saddle Block				•		Large CDK extending to top chord of truss (approx. 150mm diameter), extends to vertical tie rod
		#2 - King Saddle Block			•			Soft end; sounds dull
		Top Chord						
		#1 King - #1 Queen	- Inside	•				
			- Middle	•				
			- Outside	•				Replaced 1940
		#1 Queen - Centre	- Inside		•			Large PDK, approx. half section missing
			- Middle		•			Large PDK and split through side; sounds drummy
			- Outside	•				
		Centre - #2 Queen	- Inside	•				Large vertical split approx. 50mm deep
			- Middle	•				
			- Outside	•				
		#2 Queen - #2 King	- Inside		•			CDK at south end; large vertical split
			- Middle		•			Significant weathering; PDK inside face
			- Outside		•			Large PDK inside face, approx. half section gone;
		Bottom Chord						
		Steel Bottom Chord		•			70%	Heavily corroded, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•			60%	Heavily corroded; bolts gone
		#2 King Strut to top chord		•			50%	Heavily corroded; bolts gone
		Timber Braces						
		#1 - King Timber Brace				•		EDK to beyond fixing bolt to saddle block
		#1 - Queen Timber Brace		•				
		Centre Timber Brace		•				Some end splitting
		#2 - Queen Timber Brace			•			CDK approx. 60mm diameter at top
		#2 - King Timber Brace			•			Large PDK south face; large split

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Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
5	RH	**Timber Struts**						
		#1 - King Strut			•			Weathered top surface; decay to approximately half depth of member
		#1 - Queen Strut		•				Minor splitting in top surface
		#1 - Counter Strut		•				
		#1 - Centre Strut	- Inside	•				Vertical splitting in lower half
			- Outside	•				Vertical splitting in lower half
		#2 - Centre Strut	- Inside	•				
			- Outside	•				
		#2 - Counter Strut		•				
		#2 - Queen Strut			•			Surface decay at top; dull sound in lower portion, possible CDK
		#2 - King Strut		•				
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			90%	Heavily corroded
			- Outside	•			90%	Heavily corroded
		#1 - Queen Rods	- Inside	•			70%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		#1 - Centre Rods	- Inside	•			70%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		#2 - Queen Rods	- Inside	•			50%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		#2 - King Rods	- Inside	•			60%	Heavily corroded
			- Outside	•			60%	Heavily corroded
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block		•				
		#1 - Queen Timber Thrust Block		•				
		Centre Timber Thrust Block		•				PDK top surface and inside contact area for #2 Counter Strut
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				
		Timber A-Blocks						
		#1 - Queen A-Block		•				
		Centre A-Block		•				
		#2 - Queen A-Block		•				Small CDK inside end
		Timber Saddle Blocks						
		#1 - King Saddle Block		•				CDK inside end approx 50mm diameter; EDK outside end
		#1 - Queen Saddle Block		•				EDK outside end
		Centre Saddle Block		•				Small CDK and vertical split inside end; EDK outside end
		#2 - Queen Saddle Block		•				CDK inside end; EDK outside end
		#2 - King Saddle Block			•			CDK inside end approx. 70mm diameter; EDK outside end; PDK northern face
		Top Chord						
		#1 King - #1 Queen	- Inside	•				
			- Middle	•				
			- Outside		•			PDK top surface approx 300mm long; PDK on underside
		#1 Queen - Centre	- Inside	•				
			- Middle	•				Replaced 1976
			- Outside		•			PDK to half section depth
		Centre - #2 Queen	- Inside	•				
			- Middle	•				
			- Outside	•				
		#2 Queen - #2 King	- Inside	•				Replaced 1933 (second hand)
			- Middle	•				
			- Outside	•				
		Bottom Chord						
		Steel Bottom Chord		•			60-80%	Heavily corroded, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•			60%	Heavily corroded; steel delaminating at edges
		#2 King Strut to top chord		•			60%	Heavily corroded; steel delaminating at edges
		Timber Braces						
		#1 - King Timber Brace		•				EDK at top connection; nut missing from bolted connection; extensive splitting
		#1 - Queen Timber Brace		•				Nut missing from bolt connecting to transom
		Centre Timber Brace		•				EDK and vertical split at top
		#2 - Queen Timber Brace		•				
		#2 - King Timber Brace		•				

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Span	Side	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
			Sound / Treatment only	Investigate Further	Replace		
6	LH	**Timber Struts**					
		#1 - King Strut	•			70%	Significant surface weathering and PDK in top surface; top 1/4 section no longer contributing to strength
		#1 - Queen Strut		•			Advanced surface decay top surface; splitting in top surface approx. 100mm deep
		#1 - Counter Strut	•			60%	Significant splitting on top surface and inside face, full length; PDK top surface; top 1/3 section no longer contributing to strength
		#1 - Centre Strut - Inside	•				Splitting in top surface; PDK near top
		- Outside		•			Splitting in top surface; PDK top surface and outside face
		#2 - Centre Strut - Inside		•			PDK at base; weathering of top surface
		- Outside	•				Weathering of top surface
		#2 - Counter Strut	•				Weathering and splitting of top surface; PDK top surface; some splitting in side at top
		#2 - Queen Strut	•				PDK and thrust block; weathered top surface
		#2 - King Strut		•			Replaced 1928; advance surface decay on top surface; PDK on sides and top surface; horizontal split bolts at top
		Vertical Steel Tension Rods					
		#1 - King Rods - Inside	•			70%	Heavily corroded
		- Outside	•			80%	Heavily corroded
		#1 - Queen Rods - Inside	•			60%	Heavily corroded
		- Outside	•			60%	Heavily corroded
		#1 - Centre Rods - Inside	•			70%	Heavily corroded
		- Outside	•			50%	Heavily corroded
		#2 - Queen Rods - Inside	•			70%	Heavily corroded
		- Outside	•			70%	Heavily corroded
		#2 - King Rods - Inside	•			95%	Light surface corrosion only
		- Outside	•			60%	Heavily corroded
		Timber Thrust Blocks					
		#1 - King Timber Thrust Block	•				
		#1 - Queen Timber Thrust Block		•			Significant splitting and decay
		Centre Timber Thrust Block	•				
		#2 - Queen Timber Thrust Block	•				
		#2 - King Timber Thrust Block		•			Significant decay across top in line of tension rods.
		Timber A-Blocks					
		#1 - Queen A-Block	•				Small CDK inside end
		Centre A-Block	•				Small CDK inside end
		#2 - Queen A-Block	•				
		Timber Saddle Blocks					
		#1 - King Saddle Block		•			Significant EDK (approx 1/3 of end) extending to top surface; dull sound at top
		#1 - Queen Saddle Block	•				Replaced 1967; small CDK inside end; soft
		Centre Saddle Block		•			CDK inside end approx. 80mm diameter extending to base of saddle block
		#2 - Queen Saddle Block		•			CDK inside end extending up to top surface
		#2 - King Saddle Block		•			EDK inside end (approx. 1/3 of end); dull sound on northern face
		Top Chord					
		#1 King - #1 Queen - Inside	•				
		- Middle	•				Weathered
		- Outside	•				Weathered
		#1 Queen - Centre - Inside	•				
		- Middle	•				Weathered
		- Outside	•				Weathered
		Centre - #2 Queen - Inside	•				Horizontal splitting inside face
		- Middle	•				Isolated PDK
		- Outside		•			PDK inside face, approx. 50% loss of section
		#2 Queen - #2 King - Inside	•				Weathered
		- Middle	•				
		- Outside	•				Weathered; PDK
		Bottom Chord					
		Steel Bottom Chord	•			70%	Heavily corroded, King strut seatings at piers sound
		Steel Connection Plates					
		#1 King Strut to top chord	•			70%	Heavily corroded; bolts gone
		#2 King Strut to top chord	•			80%	Heavily corroded; bolts gone
		Timber Braces					
		#1 - King Timber Brace	•				Splitting and surface decay at base; nut missing from bolt connecting to saddle
		#1 - Queen Timber Brace	•				Large split through centre; PDK outside edge near base; nut missing from bolt connecting to saddle
		Centre Timber Brace			•		Top end completed decayed
		#2 - Queen Timber Brace	•				
		#2 - King Timber Brace	•				

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Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
6	RH	**Timber Struts**						
		#1 - King Strut		•				Replaced 1977
		#1 - Queen Strut		•				Replaced 1965
		#1 - Counter Strut		•				
		#1 - Centre Strut	- Inside	•				Surface weathering
			- Outside	•				Surface weathering
		#2 - Centre Strut	- Inside	•				Surface weathering
			- Outside	•				Surface weathering
		#2 - Counter Strut		•				
		#2 - Queen Strut			•			Some hollowing in bottom end; PDK top surface
		#2 - King Strut		•				
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			60%	Heavily corroded
			- Outside	•			80%	Heavily corroded
		#1 - Queen Rods	- Inside	•			70%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		#1 - Centre Rods	- Inside	•			80%	Heavily corroded
			- Outside	•			80%	Heavily corroded
		#2 - Queen Rods	- Inside	•			95%	Very light surface corrosion
			- Outside	•			80%	Heavily corroded
		#2 - King Rods	- Inside	•			90%	Light corrosion only
			- Outside	•			70%	Heavily corroded
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block		•				
		#1 - Queen Timber Thrust Block		•				Small section missing from top outside of outside tie rod
		Centre Timber Thrust Block		•				
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				CDK started on outside face
		Timber A-Blocks						
		#1 - Queen A-Block		•				
		Centre A-Block		•				CDK inside end approx. 80mm diameter
		#2 - Queen A-Block		•				
		Timber Saddle Blocks						
		#1 - King Saddle Block		•				EDK at Timber brace connection
		#1 - Queen Saddle Block		•				Vertical split through inside face
		Centre Saddle Block				•		PDK; outside tension rod loose due to saddle block crushing
		#2 - Queen Saddle Block		•				EDK at Timber brace connection
		#2 - King Saddle Block		•				Significant EDK at outside end; up to 20% CDK inside end
		Top Chord						
		#1 King - #1 Queen	- Inside	•				Splitting and PDK top surface; EDK and southern end
			- Middle	•				
			- Outside	•				
		#1 Queen - Centre	- Inside	•				Splitting in top surface
			- Middle	•				
			- Outside	•				PDK
		Centre - #2 Queen	- Inside	•				
			- Middle	•				
			- Outside	•				
		#2 Queen - #2 King	- Inside	•				
			- Middle	•				
			- Outside	•				
		Bottom Chord						
		Steel Bottom Chord		•			80-90%	Light to moderate corrosion, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•			70%	Heavily corroded; bolts gone
		#2 King Strut to top chord		•			70%	Heavily corroded; bolts gone
		Timber Braces						
		#1 - King Timber Brace		•				Significant splitting and PDK
		#1 - Queen Timber Brace		•				Split through centre at top end
		Centre Timber Brace				•		EDK top end
		#2 - Queen Timber Brace				•		EDK top end; large split through centre
		#2 - King Timber Brace		•				

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Span	Side	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
			Sound / Treatment only	Investigate Further	Replace		
7	LH	**Timber Struts**					
		#1 - King Strut	•			70%	Extensive surface weathering and splitting
		#1 - Queen Strut	•				
		#1 - Counter Strut	•				
		#1 - Centre Strut - Inside			•		Large PDK inside face; splitting
		- Outside	•				Splitting and associated PDK; ropey top surface
		#2 - Centre Strut - Inside	•				Vertical splitting top surface; small PDK at base
		- Outside	•				Vertical splitting top surface
		#2 - Counter Strut	•				PDK both ends; some horizontal splitting; weathering and surface decay on top surface
		#2 - Queen Strut	•				Replaced 1960; Splitting and PDK top surface
		#2 - King Strut	•			70%	Vertical splitting and PDK top surface up to 50mm deep
		Vertical Steel Tension Rods					
		#1 - King Rods - Inside	•			95%	Light surface corrosion
		- Outside	•			60%	Heavily corroded
		#1 - Queen Rods - Inside	•			20%	Heavily corroded
		- Outside	•			40%	Heavily corroded
		#1 - Centre Rods - Inside	•			20%	Heavily corroded
		- Outside	•			40%	Heavily corroded
		#2 - Queen Rods - Inside	•			70%	Heavily corroded
		- Outside	•			95%	Light surface corrosion
		#2 - King Rods - Inside	•			80%	Heavily corroded
		- Outside	•			90%	Heavily corroded
		Timber Thrust Blocks					
		#1 - King Timber Thrust Block	•				
		#1 - Queen Timber Thrust Block	•				Second hand (replaced); PDK top surface; small PDK inside of inside rod
		Centre Timber Thrust Block	•				
		#2 - Queen Timber Thrust Block	•				
		#2 - King Timber Thrust Block	•				Second hand (replaced); Some decay along top through centre
		Timber A-Blocks					
		#1 - Queen A-Block	•				Split with some decay south edge
		Centre A-Block	•				Small CDK inside end; small PDK behind strut
		#2 - Queen A-Block	•				Small CDK and some splitting through end
		Timber Saddle Blocks					
		#1 - King Saddle Block		•			Large split inside end from top to centre; Significant EDK outside end; sounds hollow
		#1 - Queen Saddle Block		•			Large EDK extending full depth; sounds hollow underneath bolts
		Centre Saddle Block			•		Large CDK inside end full depth of saddle
		#2 - Queen Saddle Block	•				CDK starting at inside end with vertical crack
		#2 - King Saddle Block			•		Large CDK inside end through centre extending to top surface; outside end similar; sounds very hollow
		Top Chord					
		#1 King - #1 Queen - Inside	•				Replaced 1960; some splitting and PDK inside face
		- Middle	•				
		- Outside	•				Significant weathering and PDK inside face
		#1 Queen - Centre - Inside	•				Large PDK inside face
		- Middle	•				
		- Outside	•				Small PDK on top; splitting on inside face
		Centre - #2 Queen - Inside	•				Replaced 1960; Large split on inside face
		- Middle	•				Replaced 1960
		- Outside	•				
		#2 Queen - #2 King - Inside	•				Replaced 1960; PDK and splitting inside face
		- Middle	•				Replaced 1960
		- Outside	•				Weathered top surface
		Bottom Chord					
		Steel Bottom Chord	•			70-80%	Heavily corroded; Up to 50% loss in section between #2 King Rods and pier, King strut seatings at piers sound
		Steel Connection Plates					
		#1 King Strut to top chord	•			70%	Heavily corroded; bolts gone
		#2 King Strut to top chord	•			60%	Heavily corroded; bolts gone
		Timber Braces					
		#1 - King Timber Brace			•		Large cracks; Large PDK below saddle block
		#1 - Queen Timber Brace	•				Large CDK at top (splice in short section at top?)
		Centre Timber Brace			•		EDK at top to beyond fixing bolt to saddle block
		#2 - Queen Timber Brace			•		EDK at top to beyond fixing bolt to saddle block
		#2 - King Timber Brace			•		Large PDK at base and mid height

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Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
7	RH	**Timber Struts**						
		#1 - King Strut		•				
		#1 - Queen Strut		•				Significant surface cracking top surface
		#1 - Counter Strut		•				
		#1 - Centre Strut	- Inside	•				Some cracking and isolated PDK
			- Outside	•				Some cracking and isolated PDK
		#2 - Centre Strut	- Inside	•				Split at top
			- Outside	•				Split with PDK at top
		#2 - Counter Strut				•		Significant loss of section at bottom end through decay otherwise sound; splice in a short length?
		#2 - Queen Strut		•				
		#2 - King Strut		•				Replaced 1933 (second hand); surface decay inside face
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			95%	Light surface corrosion only
			- Outside	•			95%	Light surface corrosion only
		#1 - Queen Rods	- Inside	•			50%	Heavily corroded
			- Outside	•			50%	Heavily corroded
		#1 - Centre Rods	- Inside	•			95%	Light surface corrosion only
			- Outside	•			50%	Heavily corroded
		#2 - Queen Rods	- Inside	•			40%	Heavily corroded
			- Outside	•			40%	Heavily corroded
		#2 - King Rods	- Inside	•			90%	Light corrosion only
			- Outside	•			90%	Light corrosion only
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block		•				
		#1 - Queen Timber Thrust Block		•				
		Centre Timber Thrust Block		•				
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				
		Timber A-Blocks						
		#1 - Queen A-Block				•		CDK; PDK and splitting on counter strut side; signs of compression; replace within 5yrs
		Centre A-Block		•				Small PDK around strut
		#2 - Queen A-Block		•				
		Timber Saddle Blocks						
		#1 - King Saddle Block				•		CDK; PDK top at top
		#1 - Queen Saddle Block				•		Large CDK inside end; replace within 5 years
		Centre Saddle Block		•				EDK outside end
		#2 - Queen Saddle Block		•				Some surface decay and weathering
		#2 - King Saddle Block		•				EDK outside end
		Top Chord						
		#1 King - #1 Queen	- Inside			•		PDK inside and outside faces at #1 Queen A-block
			- Middle	•				
			- Outside			•		Large PDK around bolts; completely gone near #1 Queen A-block
		#1 Queen - Centre	- Inside			•		PDK inside and outside faces at #1 Queen A-block
			- Middle	•				
			- Outside			•		Large PDK around bolts; completely gone near #1 Queen A-block
		Centre - #2 Queen	- Inside	•				
			- Middle	•				
			- Outside	•				PDK around bolts
		#2 Queen - #2 King	- Inside	•				
			- Middle	•				Replaced 1974 (second hand)
			- Outside	•				
		Bottom Chord						
		Steel Bottom Chord				•	60%	Heavily corroded, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•			70%	Heavily corroded; bolts gone
		#2 King Strut to top chord		•			70%	Heavily corroded; bolts gone
		Timber Braces						
		#1 - King Timber Brace				•		Large PDK at end
		#1 - Queen Timber Brace		•				
		Centre Timber Brace		•				Crack through centre (top half)
		#2 - Queen Timber Brace		•				Spilt through lower half of brace
		#2 - King Timber Brace		•				EDK top end

Appendix D: Inspection Results – Transoms (2 pages)

Definition of terminology used

- "PDK" – Pocket Decay
- "EDK" – End Decay
- "CDK" – Centre Decay

TOTARA RIVER BRIDGE - TRANSOMS

Span	Side	Structural Element	Structural Assessment / Recommendation			Estimated % Original Capacity	Comments
			Sound / Treatment only	Further Investigation	Replace		
3	LH	#1 King Transom	•				Bolts heavily corroded
	RH	#1 King Transom	•				Replaced 1960
	LH	#1 Queen Transom	•				Condition of bolts is mixed
	RH	#1 Queen Transom	•				Replaced 1944; PDK downstream end
	LH	Centre Transom	•				Weathered
	RH	Centre Transom	•				Replaced 1977 (second hand); PDK top surface between road beams
	LH	#2 Queen Transom	•				Replaced 1977
	RH	#2 Queen Transom	•				Replaced 1960
	LH	#2 King Transom	•				Replaced 1977; small surface defect top surface between RH truss and RH road beam
	RH	#2 King Transom	•				Replaced 1967 (second hand)
4	LH	#1 King Transom		•			large CDK; Sounds hollow under road beams
	RH	#1 King Transom		•			Significant EDK upstream end; sounds hollow under truss
	LH	#1 Queen Transom		•			Sounds hollow under LH road beam
	RH	#1 Queen Transom	•				Honey combing and surface decay downstream end; large split between RH road beam and RH truss; small CDK upstream end
	LH	Centre Transom		•			Sounds hollow under LH road beam
	RH	Centre Transom	•				Isolated PDK south face; surface weathering and decay
	LH	#2 Queen Transom		•			Replaced 1960; large CDK downstream end extending back to thrust block; EDK upstream end; large PDK northern face between RH road beam and RH truss
	RH	#2 Queen Transom		•			Replaced 1960; EDK upstream end; condition of bolts is mixed
	LH	#2 King Transom	•				Condition of bolts is mixed
	RH	#2 King Transom	•				
5	LH	#1 King Transom	•				Replaced 1975
	RH	#1 King Transom	•				Some horizontal splitting downstream end; condition of bolts is mixed
	LH	#1 Queen Transom	•				Replaced 1977
	RH	#1 Queen Transom	•				Split through top at upstream end
	LH	Centre Transom	•				Replaced 1944
	RH	Centre Transom	•				Split through top at upstream end
	LH	#2 Queen Transom					
	RH	#2 Queen Transom		•			Significant EDK upstream end extending up to 1.5m from end; extensive surface decay on top surface; member collapsing inward; (likely replacement required)
	LH	#2 King Transom	•				Condition of bolts is mixed; 5 splice bolts between transoms are missing
	RH	#2 King Transom	•				

TOTARA RIVER BRIDGE - TRANSOMS

Span	Side	Structural Element	Structural Assessment / Recommendation			Estimated % Original Capacity	Comments
			Sound / Treatment only	Further Investigation	Replace		
6	LH	#1 King Transom	•				PDK top surface; EDK upstream end; condition of bolts mixed
	RH	#1 King Transom	•				End splitting upstream end
	LH	#1 Queen Transom	•				Replaced 1944; condition of bolts is mixed
	RH	#1 Queen Transom	•				
	LH	Centre Transom	•				large CDK / EDK upstream end; surface decay / weathering on top surface
	RH	Centre Transom	•				Weathered; large horizontal split through side at upstream end - install vertical split bolts
	LH	#2 Queen Transom	•				Splitting downstream end; significant horizontal splitting upstream end - install vertical split bolts
	RH	#2 Queen Transom	•				Weathered
	LH	#2 King Transom		•			CDK downstream end; large PDK south face; PDK upstream face; hollow sound from LH truss to end
	RH	#2 King Transom	•				Weathered; splitting on north and south face with associated decay
7	LH	#1 King Transom		•			Small EDK upstream end; splitting; sounds drummy
	RH	#1 King Transom	•				
	LH	#1 Queen Transom	•				Large CDK downstream end; significant weathering; PDK
	RH	#1 Queen Transom	•				large CDK upstream end; splitting both ends; horizontal split and downstream end requires vertical split bolts
	LH	Centre Transom		•			Significant weathering; large PDK upstream end; sounds drummy
	RH	Centre Transom	•				Horizontal split through centre at downstream end; install vertical split bolts
	LH	#2 Queen Transom	•				Replaced 1977
	RH	#2 Queen Transom		•			Significant EDK upstream end in horizontal plane, extending back under truss; large PDK south face; significant weathering; soft
	LH	#2 King Transom	•				Surface weathering
	RH	#2 King Transom	•				PDK upstream end; significant weathering

Appendix E: Inspection Results – Road Beams, Corbels and Deck Bracing (9 pages)

Definition of terminology used

- "PDK" – Pocket Decay
- "EDK" – End Decay
- "CDK" – Centre Decay

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
Road Beams	LH1		•			Significant weathering and splitting; large PDK outside face; PDK top surface and outside face near pier #2; vegetation growing on top
	LH2		•			Significant weathering and splitting; PDK inside and outside face at northern end; PDK top surface; *- bottom half of section appears sound*
	LH3	•				Numerous PDK top surface and both sides; significant horizontal splitting through sides over top 1/2 to 2/3 section depth
	LH4	•				Weathering and splitting top surface; minor horizontal cracking in sides; numerous PDK top surface
	LH5	•				Replaced 1974; diagonal splitting on side and PDK both sides of beam at #2 Queen corbel ; PDK at northern end; drummy sound at pier #4 end
	LH6		•			Large PDK at north end extending from top to within 150mm of base (2/3 section gone); significant weathering and splitting; numerous PDK top surface; large PDK between #1 King and #1 Queen transoms approx. 40mm deep; dull sound at southern end
	LH7	•				Weathering , splitting and surface decay on top and both sides; numerous PDK on top surface and on sides
	LH8		•			Significant weathering; significant splitting both sides; PDK inside and outside faces; evidence of insect attack; hollow sound at north end *- estimate top half of beam not contributing structurally*
	LH9			•		Significant weathering and surface decay all faces; evidence of insect attack; large PDK top surface at north end; PDK sides and underside
	LH10	•				Replaced 1960; large PDK inside face at south end; isolated PDK top and outside face; weathering and splitting on outside face; vertical splitting on top; evidence of insect attack;
	LH11		•			Replaced 1933 (second hand); top surface weathering and splitting; large PDK inside face and significant vertical splitting at south end; significant weathering south end *- Investigate south end*
	LH12	•				Typical surface weathering
	LH13	•				Typical surface weathering and splitting; isolated PDK top surface; evidence of insect attack
	LH14		•			Weathering and isolated PDK to top surface and sides; horizontal splitting to sides; top 1/4 depth sounds drummy to end of corbel at south end; large horizontal split to end of corbel at north end
	LH15	•				Replaced 1966; weathering, splitting and isolated PDK top surface; significant weathering and surface decay, outside face; PDK both ends; sounds drummy at ends *- Assume top 1/4 section does not contribute structurally*
	LH16		•			Weathering and PDK, top surface; split and associated PDK, and large split in side with associated decay at south end; *- Investigate south end*

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
	LH17		•			Vertical and horizontal cracking with associated decay at north end; hollow sound at north end; numerous PDK top surface; splitting and PDK to sides *- Investigate further (likely replacement)*
	LH18	•				Replaced 1966
	LH19		•			Replaced 1940; advanced surface decay and weathering on top and sides; soft sound at south end
	CN1		•			Significant weathering and splitting; PDK on downstream face at cross member; vegetation growing on top; hollow sound at pier #2 end
	CN2	•				Significant weathering and splitting; PDK top surface and inside face; horizontal split and CDK at pier #3
	CN3		•			Significant weathering, splitting and associated decay top and downstream face; isolated PDK upstream face; probable end decay at pier #9 *- Investigation end south end and PDK at mid span (upstream face)*
	CN4		•			Surface weathering; general decay; PDK on sides; horizontal split at north end *- Likely redundant*
	RH1		•			Significant weathering and splitting; splitting and associated PDK on inside face; *- bottom half of beam appears sound*
	RH2	•				Weathering and vertical splitting top surface; minor horizontal splitting and weathering to sides
	RH3	•				
	RH4	•				Weathering and splitting top surface; minor horizontal cracking in sides; numerous PDK top surface
	RH5		•			Significant splitting and associated PDK in top and both sides; evidence of insect attack; large PDK / EDK at pier #4 end
	RH6		•			Advanced surface decay and weathering; numerous PDK top surface; horizontal splitting through top half of section; estimate top 1/4 of section not contributing structurally; soft surface and dull sound at south end;
	RH7	•				
	RH8	•				Replaced (est. 1950 - 1965, barrier post covering date); isolated PDK top surface; weathering and horizontal splitting on sides
	RH9	•				Replaced 1950; numerous small PDK top surface; weathering and PDK outside face; large PDK approx. 600 long x 40 deep and approx. 1/3 section depth on outside face
	RH10	•				
	RH11		•			Weathering and decay both sides; large split and PDK at south end extending full width of section; horizontal split inside face at north end
	RH12			•		Several large PDK along member *- Parts of beam may be reused elsewhere*
	RH13		•			Weathering and splitting; large PDK on outside face at north end extending to end of corbel; large vertical split from north end to first bolt; sounds hollow at north end.

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
	RH14		•			Significant weathering and splitting and associated PDK on top and both sides; large horizontal split at south end with PDK; large vertical split at north end; PDK over #2 King corbel (both sides of beam); sounds drummy both ends
	RH15		•			Weathering and associated decay to top surface; PDK south end and sounds hollow; top half sounds drummy at north end; dull sound inside face between #1 King and #1 Queen transoms *- Assume top 1/4 of member does not contribute structurally*
	RH16	•				Weathering and associated PDK top surface; weathered sides; splitting resulting in loose segments at top corners of beam.
	RH17	•				Replaced 1963
	RH18	•				Replaced 1940; extensive weathering and decay on outside face; weathering and PDK top surface; worm holes outside face
	RH19		•			Significant weathering and splitting and associated PDK on top surface; large PDK to half width of member over #1 King transom; significant splitting at south end, sounds drummy out to end of corbel
	RH20	•				Splitting and decay on top surface and sides; PDK and horizontal split outside face at south end.
	RH21	•				Replaced 1968; minor weathering
	RH22		•			Large PDK / EDK at both ends; Large PDK top surface at #2 King transom; significant weathering outside face; horizontal splitting north end
	RH23	•				EDK south end; weathering, splitting and associated decay to top surface; large horizontal split at north end (approx. 600 long, near centre); hollow sound at north end
	RH24	•				General weathering only

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
Corbels						
Pier # 2	LH Corbel	•				
	Centre Corbel	•				
	RH Corbel		•			CDK southern end; large PDK outside face
Pier # 3	LH Corbel	•				Cracking at end and small CDK starting; surface weathering and cracking on outside face
	Centre Corbel		•			EDK southern end; PDK both sides; honeycombing of upstream and downstream sides; evidence of possible insect attack
	RH Corbel	•				Splitting at ends; CDK southern end
#1 King	LH Corbel	•				PDK at sides; surface decay
	RH Corbel			•		PDK inside and outside extending in under beams; EDK - *Replace within 5yrs*
#1 Queen	LH Corbel		•			PDK at sides of corbel extending in under beams
	RH Corbel	•				CDK starting at southern end
Centre	LH Corbel	•				PDK at fixing to transom
	RH Corbel	•				PDK at fixing to transom
#2 Queen	LH Corbel	•				Replaced 1966
	RH Corbel	•				PDK at sides
#2 King	LH Corbel	•				Replaced 1977 (second Hand); large vertical split at northern end - *Replace corroded splitter bolts*
	RH Corbel	•				Splitting at ends; PDK at fixings to transom
Pier #4	LH Corbel	•				CDK southern end; significant splitting and PDK outside face
	RH Corbel	•				Replaced 1944
#1 King	LH Corbel	•				Replaced 1966
	RH Corbel					Replaced 1965
#1 Queen	LH Corbel	•				PDK inside face near centre
	RH Corbel	•				PDK top surface and inside and outside faces
Centre	LH Corbel	•				PDK both sides
	RH Corbel	•				PDK inside vertical face; surface decay and soft on sides
#2 Queen	LH Corbel	•				PDK outside face at base
	RH Corbel	•				PDK outside face; large area of decay on inside top and side.
#2 King	LH Corbel	•				PDK both side above transom; PDK top surface inside face
	RH Corbel	•				Weathering and splitting; PDK both sides above transom

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
Pier #5	LH Corbel	•				Replaced 1960; split at north end near centre; weathering and softening on outside surface; horizontal split inside face
	RH Corbel		•			Replaced 1977 (second hand); weathered
#1 King	LH Corbel	•				PDK outside face overtop of transoms; decay at base of corbel over LH transom extending approx. 150mm over transom (20mm deep); split along inside top edge; large PDK inside face
	RH Corbel		•			Significant weathering and decay inside face; large diagonal crack and associated decay extending from top surface down under beam *- Investigate further when beam is replaced*
#1 Queen	LH Corbel	•				Small EDK north end; PDK both sides overtop of transoms
	RH Corbel	•				Weathering on outside face; PDK inside and outside faces
Centre	LH Corbel	•				PDK inside and outside face; weathering and softening to outside surface
	RH Corbel	•				Typical weathering; PDK outside face; split and PDK linking spike holes on inside face
#2 Queen	LH Corbel	•				Typical weathering and splitting; PDK over LH transom
	RH Corbel	•				Split on inside face; weathered outside face
#2 King	LH Corbel	•				
	RH Corbel	•				Typical weathering and splitting
Pier #6	LH Corbel	•				CDK / EDK at south end; weathered outside face; horizontal split and associated PDK outside face; significant splitting and decay to inside face; splitting at north end
	RH Corbel	•				CDK both ends; significant weathering and splitting both sides
#1 King	LH Corbel		•			Surface decay to top surface extending in under beams (both sides); vertical split through centre at north end; *- Install horizontal split bolt at north end*
	RH Corbel	•				
#1 Queen	LH Corbel		•			Significant amount of decay at top extending in under beam (both sides of corbel)
	RH Corbel	•				Surface decay at top (inside face)
Centre	LH Corbel		•			Decay at top surface extending in under beam (both sides of corbel); extensive PDK both sides
	RH Corbel		•			Decay at top surface extending in under beam (both sides of corbel); *- Likely replace*

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
#2 Queen	LH Corbel		•			Advanced decay at top on outside *- Likely replace*
	RH Corbel	•				
#2 King	LH Corbel	•				
	RH Corbel	•				Decay to contract surface with transoms on inside face
Pier #7	LH Corbel	•				Decay along bottom edge in contact with packers (inside face)
	RH Corbel	•				Weathered
#1 King	LH Corbel	•				Weathering; isolated PDK
	RH Corbel	•				Weathering; splitting and PDK on outside
#1 Queen	LH Corbel			•		Large CDK at both ends (full depth); large crack and associated decay under beam
	RH Corbel	•				PDK inside face around spikes; splitting and PDK outside face; *- Vegetation in the way on inside at transom*
Centre	LH Corbel	•				Top surface decay on outside; some isolated PDK
	RH Corbel	•				Top surface cracking and associated decay; some isolated PDK
#2 Queen	LH Corbel	•				Top decay on outside extending under beam; some PDK
	RH Corbel	•				Replaced 1960; weathered
#2 King	LH Corbel	•				End splitting and weathering; split bolts both ends
	RH Corbel	•				Large vertical split separating two halves with split bolt at north end; sounds drummy but likely due to split *- Install split bolt at south end*
Pier #8	LH Corbel		•			Manmade vertical cut on south side near outside edge of pier, still approx. 600mm seating for beam; decay
	Centre Corbel	•				Replaced 1967 (second hand); surface decay upstream face
	RH Corbel		•			Isolated PDK inside face; large horizontal split and PDK under beam RH22 *- Investigate PDK under beam (otherwise sound)*
Pier #9	LH Corbel		•			Splitting and EDK both ends; numerous PDK on sides
	Centre Corbel	•				Surface decay and splitting both ends
	RH Corbel		•			CDK / PDK and splitting both ends

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
Cross Bracing, Solid Blocking and Tie Rods						
Span #1	Solid Blocking			•		4 no. at 1/3 points; various states of decay; blocks falling out *- Replace / reinstate*
	Tie Rods	•				Rods generally ok; some nuts missing *- Replace nuts*
Span #2	Solid Blocking			•		4 no. at 1/3 points; various states of decay; blocks falling out *- Replace / reinstate*
	Tie Rods	•				Rods generally ok; some nuts missing *- Replace nuts*
Span #3	**Cross Bracing**					
Pier #3 to #1K	LH			•	30%	
	RH	•				Sound
#1K to #1Q	LH	•				Sound
	RH	•			50%	
#1Q to Centre	LH	•				Sound
	RH			•	0%	1/2 rod missing from centre to #1Q transom
Centre to #2Q	LH	•			80%	
	RH	•			80%	
#2Q to #2K	LH	•			50%	Sound through centre
	RH			•	30%	Ends sound
#2K to Pier #4	LH			•	20%	Sound through centre
	RH			•	40%	Heavily corroded at pier end; otherwise sound

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
Span #4	**Cross Bracing**					
Pier #4 to #1K	LH			•	40%	
	RH			•	40%	40% at pier end; 70% under LH beam; otherwise sound
#1K to #1Q	LH			•	25%	25% under LH beam; otherwise sound
	RH			•	10%	10% at #1K transom; 50% under RH beam; otherwise sound
#1Q to Centre	LH	•			70%	
	RH	•			70%	
Centre to #2Q	LH	•			50%	
	RH	•			70%	
#2Q to #2K	LH	•			50%	
	RH	•			50%	
#2K to Pier #5	LH	•			60%	
	RH			•	5%	5% and 25% at ends, otherwise sound
Span #5	**Cross Bracing**					
Pier #5 to #1K	LH			•	0%	Almost gone at King Transom; 30% at pier end
	RH	•			70%	
#1K to #1Q	LH			•	0%	Eyes at end sound; rest of rod completely gone
	RH	•			50%	
#1Q to Centre	LH	•			60%	
	RH			•	10%	10% at centre transom end; 50% along rod; sound at #1Q transom
Centre to #2Q	LH	•			60%	Sound at ends
	RH	•			50%	50% at coupler under LH beam; 60% under RH beam; otherwise sound
#2Q to #2K	LH	•			70%	
	RH	•			50%	Railway iron replacement; heavily corroded along full length
#2K to Pier #6	LH			•	20%	20% and 40% at ends; 70% along rod
	RH			•	40%	40% at #2K end; 80% along rod

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
Span #6	**Cross Bracing**					
Pier #6 to #1K	LH	•				Sound
	RH			•	0%	Completely gone at #1K end; 80% along rod
#1K to #1Q	LH	•			70%	
	RH			•	20%	20% both ends; 40% along rod
#1Q to Centre	LH	•			60%	60% at coupler under LH beam; 80% under RH beam; otherwise sound
	RH	•			60%	60% under beams; otherwise sound
Centre to #2Q	LH	•			70%	Sound at ends
	RH	•			60%	60% under beams; otherwise sound
#2Q to #2K	LH			•	<10%	<10% at #2K transom; 30% at coupler under LH beam; otherwise sound
	RH			•		Almost completely gone at #2K end; otherwise sound *- Replace from centre to #2K end*
#2K to Pier #7	LH	•			60%	
	RH	•			50%	
Span #7	**Cross Bracing**					
Pier #7 to #1K	LH			•	<10%	<10% at #1K transom; remaining rod >60%
	RH	•			80%	
#1K to #1Q	LH			•	30%	30% and 40% at ends; 60% along rod
	RH			•	30%	30% at #1Q end; remaining rod >80%
#1Q to Centre	LH	•			80%	Railway iron replacement
	RH	•			70%	
Centre to #2Q	LH			•	0%	Rod completely gone at centre transom end; 50% along rod; sound at #2Q end
	RH			•	40%	sound at eyes
#2Q to #2K	LH	•			60%	
	RH			•	30%	30% under RH beam; 50% under LH beam; sound at ends
#2K to Pier #8	LH			•	30%	30% at pier end; 70% under LH beam
	RH	•				Sound
Span #8	Solid Blocking	•				4 no. at 1/3 points; various states of decay; blocks falling out; one block missing *- Replace / reinstate*
	Tie Rods	•				Rods generally ok; some nuts missing *- Replace nuts*
Span #9	Solid Blocking	•				4 no. at 1/3 points; various states of decay; blocks falling out *- Replace / reinstate*
	Tie Rods	•				Rods generally ok; some nuts missing *- Replace nuts*

Appendix F: Inspection Results – Piers (8 pages)

Definition of terminology used

- "PDK" – Pocket Decay
- "EDK" – End Decay
- "CDK" – Centre Decay

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
1	**Piles**					
	Upstream Pile	•				PDK at top where previously drilled; general splitting and weathering
	Centre Pile	•				Surface soft but sound underneath; general weathering
	Downstream Pile	•				Surface splitting; EDK at top where previously drilled; excavation around pile showed pile sound below ground
	Pile Cap	•				CDK both ends; significant weathering and splitting; appears sound over piles
	Abutment Walls - Timber facing			•		Top part collapsing; ends gone; otherwise appears ok; top part needs replacing
	Abutment Walls - Vertical Railway Irons	•			60%	Extensive corrosion
2	**Piles**					
	Upstream Pile	•				Surface splitting and weathering; PDK under pile cap, at top of pile, and several small isolated PDK along pile
	Centre Pile	•				Vertical splitting and weathering; small loss of outer section at ground level; excavation around pile showed pile sound below ground
	Downstream Pile	•				Large vertical splits in top 1/3 pile; hollow sound at top likely due to splitting; large PDK at top; excavation around pile showed pile sound below ground
	Upstream Cut Water Pile	•				EDK and splitting at top
	Downstream Cut Water Pile	•				Large CDK / EDK at top
	Raker Studs					
	Upstream Raker Stud	•				Significant weathering; top surface has honeycomb effect and worm holes
	Downstream Raker Stud		•			Surface decay and weathering to downstream face; PDK / EDK at base
	Diagonal Bracing					
	Cross bracing	•			70%	Steel railway iron; varying amounts of corrosion
	Whaling's					
	Whaling's	•			50%	Steel railway irons; heavily corroded
	Pile Cap	•				Replaced 1975

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
3	**Piles**					
	Pile #1	•				Vertical splitting above whalers
	Pile #2	•				Vertical splitting above whalers
	Pile #3	•				Deep splits / pockets on north face from spikes
	Pile #4	•				Vertical splitting above whalers
	Pile #5	•				Replaced 1961
	Pile #6	•				Splitting; weathering; block bolted to outside face at top to support pile cap
	Pile #7		•			Large CDK just above whaler; sound at ground and cap - *Consider splicing in section of pile or redundant*
	Pile #8		•			Large CDK just above whaler; sound at ground and cap - *Consider splicing in section of pile or redundant*
	Upstream cut-water pile		•			Has sunk approx 600mm; significant splitting and decay at top
	Downstream cut-water pile	•				Splitting and small EDK at top
	Raker Studs					
	Upstream Raker Stud			•		Has come free of fixing at top due to sinking cut-water pile; large split and EDK at top; large split upstream face; weathered
	Downstream Raker Stud			•		Splitting, surface weathering and significant decay downstream face; large CDK / EDK at base - *Probable replacement*
	Diagonal Bracing					
	Cross Bracing	•			70%	Railway iron cross bracing; varying amounts of corrosion
	Whaling's					
	Whaling's	•				All present; individual assessment of each whaler not carried out
	Pile Caps					
	Pile Cap #1	•				Replaced 1975; EDK downstream end
	Pile Cap #2	•				Splitting and associated CDK downstream end; EDK and splitting upstream end
	Pile Cap #3	•				Splitting and EDK starting downstream end; EDK upstream end
	Pile Cap #4			•		Large end section gone downstream end; large PDK along length and extensive decay upstream end - *Replace or consider redundant*
	Corbels					
	LH Truss Corbel - Inside	•				Replaced 1975 second hand; vertical split north end
	- Outside	•				PDK outside face; weathered
	RH Truss Corbel - Inside	•				Replaced 1975 second hand; minor end splitting
	- Outside	•				EDK and splitting both ends
	Packers Between Pile Cap and Beam Corbel					
	Perpendicular to corbel	•				4 no. total; weathered
	Parallel to corbel	•	•			Weathered but generally sound except for packer under LH corbel which has significant decay - *Consider packing or replacement*

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
4	**Piles**					
	Pile #1		•			Extensive CDK at top; vertical splitting above whalers at spike locations
	Pile #2		•			Major splitting and decay on outside face and other areas; sound at base and top
	Pile #3	•				Vertical splitting above whalers
	Pile #4	•				Advanced EDK at top; vertical splitting above whalers
	Pile #5		•			Splitting and associated decay on outside face due to spikes; sounds drummy above whaler; possible CDK
	Pile #6		•			Splitting and associated decay on outside face going into centre due to spikes; possible CDK
	Pile #7		•			Splitting and associated decay outside face but appears sounds; sounds drummy at top - *Investigate top further*
	Pile #8	•				EDK at top; splitting and associated decay due to spike holes
	Upstream cut-water pile		•			Significant CDK / EDK
	Downstream cut-water pile	•				
	Raker Studs					
	Upstream Raker Stud		•			Packer missing at top; significant splitting and decay on north face; large split and CDK at base - *Possible replacement*
	Downstream Raker Stud	•				Weathering and splitting on sides and downstream face
	Diagonal Bracing					
	Cross bracing	•			50%	Heavily corroded railway irons
	Whaling's					
	Whaling's	•				All present; individual assessment of each whaler not carried out
	Pile Caps					
	Pile Cap #1	•				Small EDK downstream end
	Pile Cap #2	•				Small EDK downstream end
	Pile Cap #3	•				Replaced 1960
	Pile Cap #4	•				Replaced 1967 second hand
	Corbels					
	LH Truss Corbel - Inside	•				
	- Outside	•				
	RH Truss Corbel - Inside	•				Splitting at south end
	- Outside	•				EDK both ends
	Packers Between Pile Cap and Beam Corbel					
	LH Beam	•				
	RH Beam	•				

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
5	**Piles**					
	Pile #1		•			EDK at top; typical splitting and decay on outside face - *worst pile of group therefore recommend investigating*
	Pile #2	•				Typical splitting and decay on outside face
	Pile #3	•				Typical splitting and decay on outside face
	Pile #4		•			Large split and associated decay on outside face due to spike holes; CDK; excavation around pile showed pile sound below ground - *Investigate or may be redundant*
	Pile #5		•			EDK at top; deep splitting and associated decay all around pile; numerous drill holes from previous investigations
	Pile #6	•				Minor splitting and associated decay
	Pile #7	•				Typical splitting and decay on outside face; excavation around pile showed pile sound below ground
	Pile #8	•				EDK at top; evidence of insect attack; significant splitting and associated decay
	Upstream cut-water pile	•				Splitting and EDK at top
	Downstream cut-water pile	•				Significant EDK at top, full of soil
	Raker Studs					
	Upstream Raker Stud	•				Splitting and EDK at top
	Downstream Raker Stud		•			Significant weathering / splitting and associated decay; EDK at base; possible CDK at connection to cut-water pile
	Diagonal Bracing					
	Brace #1	•			50%	Heavily corroded railway irons
	Brace #2	•			50%	Heavily corroded railway irons
	Whaling's					
	Whaling's	•				Whalers all there; soil + vegetation on top of whalers; individual assessment of each whaler not carried out
	Pile Caps					
	Pile Cap #1	•				Replaced 1977; minor splitting downstream end only
	Pile Cap #2	•				
	Pile Cap #3	•				Replaced 1977; minor splitting downstream end only
	Pile Cap #4	•				EDK downstream end
	Corbels					
	LH Truss Corbel - Inside	•				
	- Outside	•				
	RH Truss Corbel - Inside	•				
	- Outside	•				Small EDK and splitting south end
	Packers Between Pile Cap and Beam Corbel					
	LH Beam	•				Typical sound; packer directly under and parallel to corbel is sound but packer on outside is not
	RH Beam	•				Small amount of decay on downstream packer // to corbel - not supporting corbel; otherwise typically sound

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
6	**Piles**					
	Pile #1	•				Vertical split at top; timber on outside covering spike lines; isolated honeycombing
	Pile #2	•				EDK at top; typical splitting outside face; multiple drill holes; small amount of decay at each seating; excavation around pile showed pile sound below ground
	Pile #3	•				Decay below whaler at seating on inside of pile
	Pile #4	•				Typical splitting outside face
	Pile #5	•				Significant EDK at top; vertical splitting on outside face; minor splitting elsewhere
	Pile #6	•				Minor honeycombing through midsection; minor splitting
	Pile #7	•				Minor splitting and decay; excavation around pile showed pile sound below ground
	Pile #8	•				Minor splitting on outside face; excavation around pile showed pile sound below ground
	Upstream cut-water pile					
	Downstream cut-water pile	•				EDK at top; appears sound at attachment to raking stud
	Raker Studs					
	Upstream Raker Stud	•				Minor splitting along lines of spikes Fenders in good condition, SH61 (inside), SH77 (outside / upstream)
	Downstream Raker Stud			•	30%	Significant CDK; decay on downstream face to 1/2 depth *- Replace or consider redundant*
	Diagonal Bracing					
	Cross bracing	•			50%	Steel railway irons; varying amounts of corrosion
	Whaling's					
	Whaling's	•				All present; vegetation on top; generally appear sound
	Pile Caps					
	Pile Cap #1	•				Replaced 1944
	Pile Cap #2	•				Replaced 1977
	Pile Cap #3	•				Replaced 1977
	Pile Cap #4	•				
	Corbels					
	LH Truss Corbel - Inside	•				EDK both ends
	- Outside	•				Replaced 1967
	RH Truss Corbel - Inside		•			Vertical split north end; large CDK south end
	- Outside	•				Replaced 1960; vertical split north end
	Packers Between Pile Cap and Beam Corbel					
	LH Beam	•				Typically 2 no. parallel to corbel and 4 no. perpendicular; packer #1 perpendicular to corbel dozy; others typically sound
	RH Beam	•				

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
7	**Piles**					
	Pile #1	•				Isolated weathering and honeycombing; timber covering spike holes
	Pile #2	•				Typical splitting on outside face from spikes up to 100mm deep; surface decay and weathering; packer missing at top to cap *- Reinstate packer at top to pile cap*
	Pile #3	•				Typical splitting on outside face from spikes; lower 2/3 of pile has advanced surface decay and splitting; advanced decay at top below cap *- Further assess decay at top when treating*
	Pile #4	•				Minor splitting at top; typical splitting and decay
	Pile #5	•			70%	Split running approx. 1m down pile from backside of seating at top; typical splitting due to spikes *- Replace split bolt at top*
	Pile #6	•				Vertical split extending down from cap seat; split bolt corroded; typical vertical splitting on outside face extending into core *- Replace split bolt at top*
	Pile #7	•				Large split and EDK at top; outside face covered in timber; large vertical split extends down approx. 600mm from cap seating; split bolt corroded *- Replace split bolt at top*
	Pile #8	•				Large split and EDK at top; vertical split and Pad behind brace connection at top; typical splitting on outside face
	Upstream cut-water pile	•				
	Downstream cut-water pile	•				Minor splitting and weathering; some EDK
	Raker Studs					
	Upstream Raker Stud	•				EDK / CDK at base; weathering and splitting on sides and upstream face
	Downstream Raker Stud	•				Splitting in side due to spikes; weathering, splitting and decay on downstream face; packer at top about to fall out
	Diagonal Bracing					
	Cross bracing	•			50%	Timber; PDK behind pile connections
	Whaling's					
	Whaling's	•				All present; sound condition
	Pile Caps					
	Pile Cap #1	•				
	Pile Cap #2	•				Replaced 1933 second hand
	Pile Cap #3	•				Replaced 1975
	Pile Cap #4	•				Replaced 1975
	Corbels					
	LH Truss Corbel - Inside	•				Replaced 1967 second hand; minor end splitting
	- Outside	•				Replaced 1967 second hand; minor end splitting
	RH Truss Corbel - Inside	•				
	- Outside	•				Vertical split at south end
	Packers Between Pile Cap and Beam Corbel					
	LH Beam	•				General weathering only
	RH Beam	•				

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
8	**Piles**					
	Pile #1	•			70%	Typical vertical splitting on outside face
	Pile #2	•			70%	Typical vertical splitting on outside face
	Pile #3	•			70%	Typical vertical splitting on outside face; significant split on downstream face starting above whaler
	Pile #4	•			50%	Top filled with pitch; vertical splitting on outside face through mid section through to CDK *- Estimate only 50% of pile contributing due to splitting*
	Pile #5	•			70%	EDK at top; splitting through mid section due to spikes; vertical splitting on backside approx. 30mm deep
	Pile #6	•			70%	Full length splits on backside approx. 70mm deep; large vertical splits on outside extending into pile centre; excavation around pile showed pile sound below ground
	Pile #7	•			70%	Minor splitting only
	Pile #8	•			50%	Top filled with pitch; vertical splitting on outside face through mid section through to CDK *- Estimate only 50% of pile contributing due to splitting*
	Upstream cut-water pile			•		Splitting and hollow at top; heavily decayed *- Replace or consider redundant*
	Downstream cut-water pile			•		Splitting and hollow at top; heavily decayed *- Replace or consider redundant*
	Raker Studs					
	Upstream Raker Stud	•				Splitting along lines of spikes; decayed over lower section where previously buried in vegetation
	Downstream Raker Stud	•				Splitting along lines of spikes; decayed over lower section where previously buried in vegetation
	Diagonal Bracing					
	Cross bracing	•			70%	Varying amounts of corrosion; railway iron braces
	Whaling's					
	Whaling's		•			Buried in soil - not assessed, may be redundant
	Pile Caps					
	Pile Cap #1			•		Advanced EDK upstream end; extensive PDK and splitting back to RH truss corbel at downstream end
	Pile Cap #2	•				Splitting at upstream end; general weathering and splitting and EDK at downstream end
	Pile Cap #3	•				Splitting at upstream end; general weathering and splitting and EDK at downstream end
	Pile Cap #4	•				Replaced 1978; EDK downstream end
	Corbels					
	LH Truss Corbel - Inside	•				Vertical splits at both ends
	- Outside	•				Replaced 1967 second hand
	RH Truss Corbel - Inside		•			Large CDK / EDK north end; significant decay all way along *- Investigate further, likely replace*
	- Outside	•				Replaced 1967 second hand
	Packers Between Pile Cap and Beam Corbel					
	Perpendicular to corbel	•				#1 packer rotten at downstream end in under corbel *- Rotten packer likely redundant*
	Parallel to corbel	•				Sound under beams; downstream packer completely rotten *- Rotten packer likely redundant*

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
9	**Piles**					
	Upstream Pile	•				Splitting and EDK at top; vertical splitting and associated decay further down; sounds drummy
	Centre Pile	•				Significant splitting full length; sounds drummy but likely due to splitting; small EDK at top; excavation around pile showed pile sound below ground
	Downstream Pile	•				Minor splitting and decay; small EDK at top
	Upstream Cut Water Pile					
	Downstream Cut Water Pile	•				Large CDK / EDK at top; significant weathering, splitting and decay; appears reasonably sound at connection to raking stud
	Raker Studs					
	Upstream Raker Stud			•		Splitting and decay at top; highly decayed at base
	Downstream Raker Stud	•				Large vertical split and decay at top; significant weathering and decay on sides and downstream face
	Diagonal Bracing					
	Cross bracing	•			80%	Light to moderate corrosion; railway iron braces
	Whaling's					
	Whaling's			•		Timber splitting and decayed through centre; south side buried under soil; effectively not doing anything *- Replace or may be redundant as pier is on river bank not subject to any water flow*
	Pile Cap			•		Heavily decayed
10	**Piles**					
	Upstream Pile	•				Spliced at ground level 1966; splice split at top; top of splice section sounds hollow; EDK at top of original pile; original pile - pile surface soft and wet below ground level, otherwise sound
	Centre Pile	•				Replaced 1966; some splitting
	Downstream Pile	•				Splitting down to ground level; excavation around pile showed pile sound below ground
	Pile Cap	•				Replaced 1944; splitting and EDK both ends; typical weathering
	Abutment Walls - Timber facing			•		Various states of decay; collapsing at upstream end
	Abutment Walls - Vertical Railway Irons	•		•		4 no. railway irons; various states of decay / corrosion

Appendix B
WSP Structural Assessment Report

25 July 2023

Rem Markland
WSP
23 High Street
Greymouth 7805

Totara Rail Bridge Load Assessment

6-WWES3.98

Dear Rem,

This letter report outlines the results of our load assessment on Totara Rail Bridge located near Ross.

WSP Greymouth requested on behalf of Westland District Council (WDC) that we carry out an assessment of the truss components to determine the permanent and live load demand on the structure. The assessment had to provide the undeteriorated capacity of members to determine the tolerance against section loss/decay. The intention is for these results to be used as an estimated intervention threshold for deteriorated members.

The assessment was restricted to the original truss structure and only pedestrian/cyclist live load was considered.

Bridge Description

The Totara Rail Bridge is located on the West Coast Wilderness Cycle Trail approximately 3 km from Ross, in the Westland Region. It comprises nine spans with the first two spans at each end constructed using simply supported timber beams. The central five spans are Howe Trusses with a span length of 24.4 m (80 ft). The assessment only considers the truss spans.

A general location plan and elevation of the bridge is shown in Figures 1 to 3.

The truss of this bridge appears to be of the same arrangement as a typical Howe Truss designed by the New Zealand Public Works Department (refer Figure 4).

Assessment Criteria

Our assessment was completed in accordance with the following documents:

- Section 7 of the Waka Kotahi NZ Transport Agency Bridge Manual, 3rd Edition, including Amendments 1, 2, 3 and 4 (Bridge Manual)
- NZS 3404: Part 1: 1997 (including Amendments 1, and 2)
- AS 1720: Part 1: 2010

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150 YEARS IN AOTEAROA

Figure 1: General location of Totara Bridge.

Figure 2: Elevation of Totara Bridge.

Figure 3: Deck Approach of Totara Bridge.

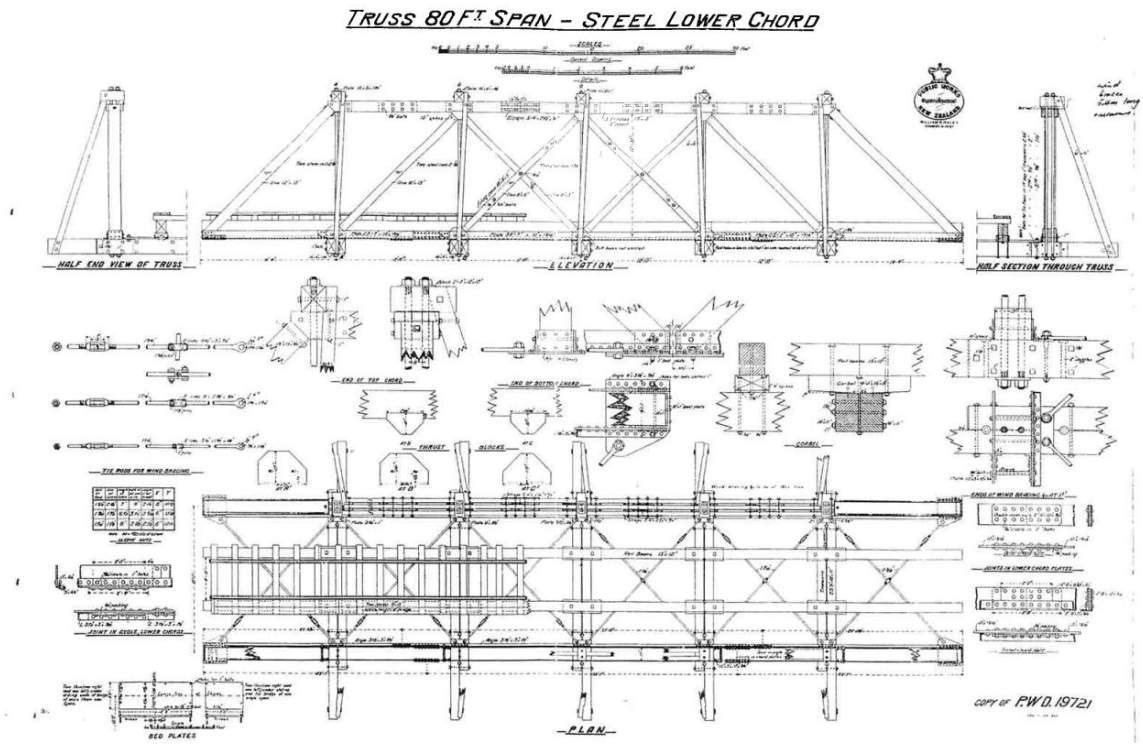


Figure 4: Typical Howe Truss Layout

Material Properties

Material strengths and factors

The material strengths assumed in our assessment were taken from the previous John Greenfields analysis of the truss (date of assessment unknown). Ironbark was adopted as the applicable timber with a calculated allowable compression strength of 7.4 MPa. The nominal strength was back calculated, as based on a load factor of 1.35 and a strength factor of 0.7 and found to be 14.3 MPa. The nearest comparable timber stress grade from AS 1720: Part 1 was found to be MGP 10 and was subsequently adopted for the assessment (refer to Table H3 of AS 1720.1). See Table 1 for the assumed timber strengths.

Wrought iron was adopted for the steel members as based on John Greenfields analysis (see Table 1 for assumed yield strength).

Other material factors applicable to the timber and steel capacity calculations were based on the requirements of AS 1720.1 and NZS 3404, respectively and are listed in Table 2.

Table 1: Material strengths adopted for the assessment.

Material	Characteristic Action	Strength (MPa)
Timber MGP 10	Compression parallel to grain	16
	Bending	14
	Tension parallel to grain	6.1
Wrought Iron	Yield strength	205

Table 2: Material factors adopted for the assessment.

Material	Factor	Value
Wrought Iron	Strength reduction	0.8
Timber	Strength reduction	0.7
	k_1 – load duration factor	1.0
	k_4 – moisture condition (seasoned)	1.0
	k_6 - temperature	1.0
	k_9 – strength sharing factor (varies as based on slenderness)	varies
	k_{12} – stability factor (varies as based on slenderness)	varies
	p_b – material constant bending	0.75
	p_c – material constant compression	0.96

Structural Condition

The assessment was based on the undeteriorated capacity of the members, with the intention to establish the tolerance against section loss/decay.

Structural Convention

The same naming convention as previously used in the assessment by John Greenfields was also adopted for this exercise, see Figure 5 for the convention.

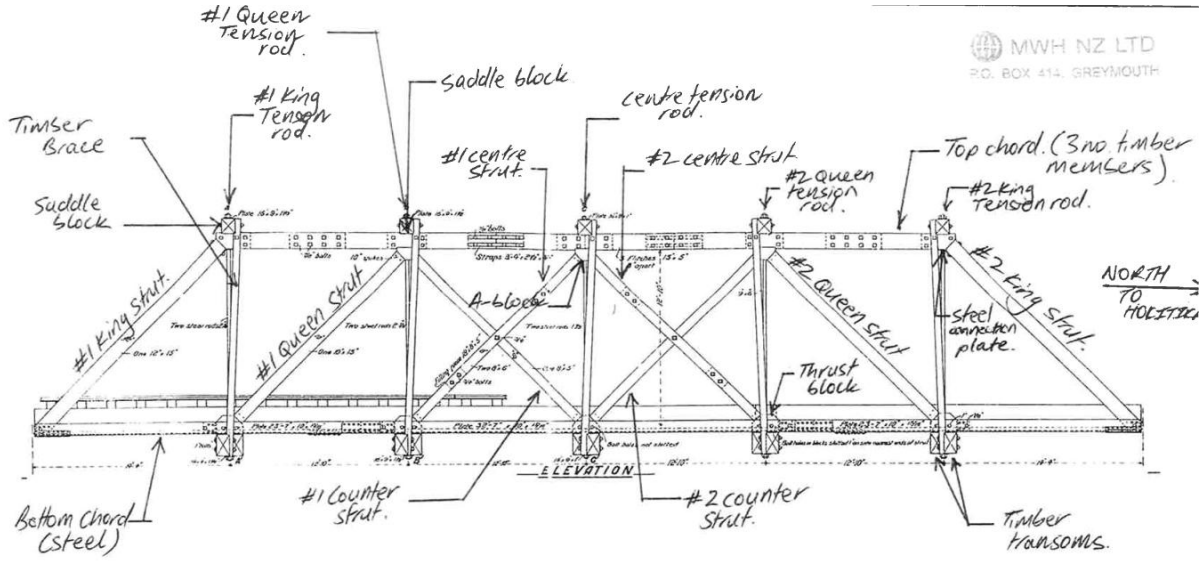


Figure 5: Structural convention

Typical Member Sizes

The truss member sizes were based on the typical section dimensions measured as part of the condition inspection. These are listed in Table 3.

Table 3: Composition of truss elements

Member	Material	Typical Dimensions (mm)
Top Chord	Timber	360 x 300
Bottom Chord	Wrought Iron	280 x 22 plate 82 x 82 x 22 angle
King Strut	Timber	360 x 300
Queen Strut	Timber	320 x 250
Centre Strut	Timber	200 x 140
Counter Strut	Timber	210 x 115
Hanger	Wrought Iron	2 no. 80 ø
Transom	Timber	2 no. 440 x 310
Cross Bracing	Wrought Iron	28 ø
Timber Brace	Timber	250 x 150

It is to be noted that the assessment was based on the main truss members only, and that verification of the connections did not form part of the scope.

Load Demands

The dead load of the truss and walkway were based on the following material unit weights:

- Timber truss members (Ironbark) = 1200 kg/m^3
- Wrought Iron members = 7850 kg/m^3

- Timber walkway = 650 kg/m^3

The pedestrian live loading was based on 5 kN/m^2 as per section 3.4.14 of the Bridge Manual.

The following load factors were used:

- Dead load, Υ_D = 1.2
- Pedestrian live load, Υ_L = 1.5

Assessment Results

Table 4 provides a summary of the assessment results that relate to the truss members. It shows the undeteriorated member capacities against the calculated load demands. The factor of safety percentages have been capped at 200%. The table also shows the threshold sectional condition factor that will trigger further action (this includes additional investigations such as drilling of timber members, repair or replacement). It is to be noted that this condition factor does not relate to the overall condition of a member but to the most deteriorated specific section/location along a member. This means for example that if the overall condition of a top chord member is rated at say 90% but the end bearing is showing severe decay to a condition rating of 50%, further action may be required. The same goes for any connections, splices, packers, and thrust blocks associated with a specific truss member. Further action will be required if any of these components have a condition rating less than the listed value for the associated truss member.

Table 4: Summary of truss member results

Member	Capacity (kN) [1]	Load Demand (kN) [1]	Factor of Safety (%)	Threshold Sectional Condition Factor
Top Chord	1040	418	> 200%	55%
Bottom Chord	-1240	-420	> 200%	50%
King Strut	720	346	> 200%	70%
Queen Strut	380	200	190%	75%
Centre Strut	170	53	> 200%	55%
Counter Strut	-103	-17	> 200%	50%
Hanger	-1657	-214	> 200%	50%
Transom	177	95	186%	55%
Cross Bracing	-101	-25	> 200%	50%
Timber Brace	112	10	> 200%	50%

[1] A negative sign indicates a tension force.

Conclusions and Recommendations

This assessment report forms part of the investigation into the current condition of Totara Rail Bridge. The main aim of the investigation is to inform the structural investigations, improvements, repairs, or replacement management plan for the bridge.

The member conditions recorded as part of the visual inspection programme can subsequently be compared against the sectional condition listed in Table 4, which provides an estimated intervention threshold for deteriorated members. An indicative investigation, repair or replacement schedule/forward works programme can subsequently be developed on the basis of the recorded assessment results.

It is important to note that the threshold condition factors listed in Table 4 do not relate to the general condition rating of a member but to the rating of specific member defects. Investigations, repairs or replacements should therefore be managed on a weakest point basis and not on the overall/general condition of a member.

The assessment showed that the undeteriorated strength of the truss members carry substantial reserve capacity given that it was originally built as a rail bridge and now only utilised as a pedestrian / cycle bridge. However, severe deterioration of the truss members/components has been recorded and it is recommended that the results of Table 4 are utilised to identify these elements as part of the development of the forward works programme.

We trust that the above meets your requirements. If we can be of any further assistance, then please do not hesitate to contact us.

Regards.

Prepared by:

Tiaan Kramer
Senior Bridge and Civil Structures Engineer

Approved by:

Anthony Rooke
Team Leader | Technical Principal
Bridges & Civil Structures Asset Management

Appendix C
Site Inspection Notes

Truss SPAN C - D (Upstream)					
Span	Side	Structural Element		Estimated %	Comments
		CD UPSTREAM		Original Capacity	#1 North (Hoki) #2 South (Ross)
CD	**US**	**Timber Struts**			
		#1 - King Strut		50%	Significant weathering and deep cracking top surface; bottom half section sound; large PDK at base; splitting inside face
		#1 - Queen Strut		50%	Heavy weathering and deep cracking top surface; bottom half section sound;
		#1 - Counter Strut		75%	Large split through centre; large PDK at base
		#1 - Centre Strut	- Inside	80%	Bottom sounds drumy; PDK inside face; splitting
			- Outside	50-75%	Large PDK at base; top surface weathering and splitting
		#2 - Centre Strut	- Inside	50-75%	Sounds drummy
			- Outside	70%	PDK inside face; sounds drummy at top
		#2 - Counter Strut		50-75%	Vertical splitting throughout; sounds drummy
		#2 - Queen Strut		50%	PDK top face; weathering and splitting top face
		#2 - King Strut		50%	Large horizontal split inside face; significant weathering / splitting on top surface
CD	**US**	**Vertical Steel Tension Rods**			
		#1 - King Rods	- Inside	80%	Heavily corroded
			- Outside	60%	Heavily corroded
		#1 - Queen Rods	- Inside	70%	Heavily corroded
			- Outside	60%	Heavily corroded
		#1 - Centre Rods	- Inside	>90%	New
			- Outside	>90%	New
		#2 - Queen Rods	- Inside	80%	Heavily corroded
			- Outside	50%	Heavily corroded
		#2 - King Rods	- Inside	90%	Heavily corroded
			- Outside	70%	Heavily corroded
CD	**US**	**Timber Thrust Blocks**			
		#1 - King Thrust Block		75-90%	
		#1 - Queen Thrust Block		50-75%	Large PDK at outside rod
		Centre Thrust Block		75-90%	
		#2 - Queen Thrust Block		75-90%	
		#2 - King Thrust Block		75-90%	PDK at outside rod
CD	**US**	**Timber A-Blocks**			
		#1 - Queen A-Block		75-90%	
		Centre A-Block		75-90%	
		#2 - Queen A-Block		75-90%	
CD	**US**	**Timber Saddle Blocks**			
		#1 - King Saddle Block		<50%	Large CDK; sounds hollow
		#1 - Queen Saddle Block		50-75%	Weathered with large splits on top; sounds drummy; end PDK
		Centre Saddle Block		50-75%	Large CDK inside end
		#2 - Queen Saddle Block		50-75%	CDK inside end; otherwise appears sound
		#2 - King Saddle Block		75-90%	Typical EDK and weathering; otherwise sound

Truss SPAN C - D (Upstream)					
CD	**US**	**Top Chord**			
		#1 King - #1 Queen	- Inside	<50%	Large PDK; significant weathering
			- Middle	50-75%	
			- Outside	50-75%	
		#1 Queen - Centre	- Inside	75-90%	Replaced 1960
			- Middle	75-90%	Significant weathering
			- Outside	75-90%	Significant weathering
		Centre - #2 Queen	- Inside	75-90%	
			- Middle	75-90%	
			- Outside	50-75%	Sounds drummy
		#2 Queen - #2 King	- Inside	75-90%	
			- Middle	50-75%	EDK at king strut; large PDK near #2 queen; PDK throughout
			- Outside	50-75%	Sounds Drummy
CD	**US**	**Steel Connection Plates**			
		#1 King Strut to top chord		70%	Heavily corroded; bolts gone
		#2 King Strut to top chord		80%	Heavily corroded; bolts gone
CD	**US**	**Timber Braces**			
		#1 - King Timber Brace		>90%	New
		#1 - Queen Timber Brace		>90%	New
		Centre Timber Brace		<50%	EDK top end; connection to saddle block OK, bolt / nuts corroded - Section loss at bottom connection; split
		#2 - Queen Timber Brace		>90%	New
		#2 - King Timber Brace		>90%	New
CD	**US**	**Bottom Cord (Steel)**			
		Pier - #1 King	- Inside	50-75%	Bottom flange ineffective
			- Outside	50-75%	Web Strengthened
		#1 King - #1 Queen	- Inside	50-75%	Splice plate corrosion
			- Outside	50-75%	Mostly strengthened (Up to splice plate)
		#1 Queen - Centre	- Inside	50-75%	Minor pockets of corrosion
			- Outside	50-75%	Heavy web corrosion
		Centre - #2 Queen	- Inside	50-75%	Moderate corrosion
			- Outside	50-75%	Heavy corrosion
		#2 Queen - #2 King	- Inside	50-75%	Moderate to heavy corrosion
			- Outside	50-75%	Heavy corrosion
		#2 King - Pier	- Inside	50-75%	Moderate to heavy corrosion
			- Outside	50-75%	Heavy corrosion

Truss SPAN C - D (Downstream)					
Span	Side	Structural Element		Estimated %	Comments
		CD DOWNSTREAM		Original Capacity	#1 North (Hoki) #2 South (Ross)
CD	**DS**	**Timber Struts**			
		#1 - King Strut		50-75%	Sounds Drummy - PDK Throughout
		#1 - Queen Strut		50-75%	Replaced 1966; Sounds drummy lower portion
		#1 - Counter Strut		75-90%	Vertical splitting through top surface full length
		#1 - Centre Strut	- Inside	50-75%	PDK at thrust block; Splitting and PDK top surface
			- Outside	75-90%	PDK outside face around bolts
		#2 - Centre Strut	- Inside	<50%	PDK Throughout
			- Outside	75-90%	
		#2 - Counter Strut		75-90%	PDK outside face; vertical splitting
		#2 - Queen Strut		50-75%	Surface weathering; dull sound at base
		#2 - King Strut		50-75%	Surface weathering; insect holes noted near top
CD	**DS**	**Vertical Steel Tension Rods**			
		#1 - King Rods	- Inside	70%	
			- Outside	60%	
		#1 - Queen Rods	- Inside	60%	
			- Outside	>90%	New
		#1 - Centre Rods	- Inside	80%	
			- Outside	90%	
		#2 - Queen Rods	- Inside	>90%	New
			- Outside	90%	
		#2 - King Rods	- Inside	30%	
			- Outside	30%	
CD	**DS**	**Timber Thrust Blocks**			
		#1 - King Thrust Block		75-90%	
		#1 - Queen Thrust Block		75-90%	
		Centre Thrust Block		75-90%	
		#2 - Queen Thrust Block		75-90%	
		#2 - KingThrust Block		<50%	Significant decay top surface; large PDK between rods and on outside of rods; heavy top section loss
CD	**DS**	**Timber A-Blocks**			
		#1 - Queen A-Block		75-90%	
		Centre A-Block		75-90%	
		#2 - Queen A-Block		75-90%	
CD	**DS**	**Timber Saddle Blocks**			
		#1 - King Saddle Block		50-75%	Small CDK inside end; several PDK's on northern face
		#1 - Queen Saddle Block		75-90%	PDK on Top
		Centre Saddle Block		75-90%	CDK inside end; significant decay / weathering on top surface
		#2 - Queen Saddle Block		75-90%	Typical EDK and weathering
		#2 - King Saddle Block		50-75%	Large CDK inside end

Truss SPAN C - D (Downstream)					
CD	**DS**	**Top Chord**			
		#1 King - #1 Queen	- Inside	50-75%	Replaced 1933 (second hand); large PDK inside face at bolt group
			- Middle	75-90%	Weathered
			- Outside	75-90%	Weathered
		#1 Queen - Center	- Inside	75-90%	Surface decay inside face - Loss of section
			- Middle	75-90%	Weathered
			- Outside	75-90%	Weathered
		Centre - #2 Queen	- Inside	75-90%	Significant surface decay top surface - Loss of section
			- Middle	75-90%	PDK Decay
			- Outside	75-90%	Splitting
		#2 Queen - #2 King	- Inside	50-75%	Remove vegetation at end and investigate further - EDK around bolts
			- Middle	50-75%	Replaced 1950; remove vegetation at end and investigate further
			- Outside	50-75%	Remove vegetation at end and investigate further
CD	**DS**	**Steel Connection Plates**			
		#1 King Strut to top chord		90%	Heavy corrosion; bolts gone
		#2 King Strut to top chord		60%	Heavy corrosion; bolts gone
CD	**DS**	**Timber Braces**			
		#1 - King Timber Brace		75-90%	PDK at connection to transom
		#1 - Queen Timber Brace		>90%	New
		Centre Timber Brace		>90%	New
		#2 - Queen Timber Brace		>90%	New
		#2 - King Timber Brace		>90%	New
CD	**DS**	**Bottom Chord**			
		Pier - #1 King	- Inside	50-75%	Heavy Corrosion
			- Outside	50-75%	Heavy
		#1 King - #1 Queen	- Inside	50-75%	Heavy
			- Outside	50-75%	Heavy
		#1 Queen - Centre	- Inside	50-75%	Moderate
			- Outside	50-75%	Moderate
		Centre - #2 Queen	- Inside	50-75%	Moderate
			- Outside	50-75%	Moderate
		#2 Queen - #2 King	- Inside	50-75%	Heavy
			- Outside	50-75%	Heavy but Strengthened
		#2 King - Pier	- Inside	50-75%	Heavy
			- Outside	50-75%	Heavy but Strengthened

Truss SPAN D - E (Upstream)					
Span	Side	Structural Element		Estimated %	Comments
		DE UPSTREAM		Original Capacity	#1 North (Hoki) #2 South (Ross)
DE	**US**	**Timber Struts**			
		#1 - King Strut		50%	Significant weathering / cracking top surface; small PDK at base; top half of section sounds dull
		#1 - Queen Strut		50%	Significant weathering / cracking top surface; small PDK at base; top half of section sounds dull
		#1 - Counter Strut		75-90%	Small PDK inside face at base; splitting in top surface; PDK inside face at top by bolt
		#1 - Centre Strut	- Inside	75-90%	Some splitting along inside face; splitting and PDK throughout
			- Outside	75-90%	Some surface splitting; splitting and PDK throughout
		#2 - Centre Strut	- Inside	75-90%	PDK on top surface; splitting and PDK throughout
			- Outside	75-90%	Some splitting top surface; splitting and PDK throughout
		#2 - Counter Strut		75-90%	Split in top surface full length of member; EDK at top
		#2 - Queen Strut		50-75%	Deep splitting / weathering in top surface
		#2 - King Strut		75-90%	Replaced 1944; weathered
DE	**US**	**Vertical Steel Tension Rods**			
		#1 - King Rods	- Inside	70%	Heavy corroded
			- Outside	60%	Heavy corroded
		#1 - Queen Rods	- Inside	60%	Heavy corroded
			- Outside	80%	Heavy corroded
		#1 - Centre Rods	- Inside	80%	Heavy corroded
			- Outside	50%	Heavy corroded
		#2 - Queen Rods	- Inside	70%	Heavy corroded
			- Outside	70%	Heavy corroded
		#2 - King Rods	- Inside	60%	Heavy corroded
			- Outside	60%	Heavy corroded
DE	**US**	**Timber Thrust Blocks**			
		#1 - King Thrust Block		75-90%	
		#1 - Queen Thrust Block		75-90%	
		Centre Thrust Block		75-90%	
		#2 - Queen Thrust Block		75-90%	
		#2 - King Thrust Block		75-90%	
DE	**US**	**Timber A-Blocks**			
		#1 - Queen A-Block		75-90%	Small CDK
		Centre A-Block		75-90%	
		#2 - Queen A-Block		50-75%	CDK approx. 120mm diameter
DE	**US**	**Timber Saddle Blocks**			
		#1 - King Saddle Block		75-90%	CDK inside end approx. 50mm diameter
		#1 - Queen Saddle Block		75-90%	Surface decay on top extending down into saddle block
		Centre Saddle Block		75-90%	CDK inside end approx. 40mm diameter
		#2 - Queen Saddle Block		75-90%	Weathered on top
		#2 - King Saddle Block		75-90%	CDK inside end approx. 20mm diameter; PDk at drill holes on northern face.

Truss SPAN D - E (Upstream)					
DE	**US**	**Top Chord**			
		#1 King - #1 Queen	- Inside	75-90%	Weathered
			- Middle	75-90%	Replaced 1933 (second hand); weathered
				75-90%	Weathered
		#1 Queen - Centre	- Inside	75-90%	Weathered; PDK
			- Middle	75-90%	Weathered
			- Outside	50-75%	Large PDK at end or flitch (approx. half section missing) - Check UAV?
		Centre - #2 Queen	- Inside	75-90%	
				75-90%	PDK top surface and inside face; weathered
			- Outside	75-90%	PDK top surface; weathered
		#2 Queen - #2 King	- Inside	75-90%	Weathered
			- Middle	75-90%	Significant weathering and Isolated PDK
			- Outside	50-75%	Significant weathering and Isolated PDK; dozy near #2 king windbrace connection.
DE	**US**	**Steel Connection Plates**			
		#1 King Strut to top chord		90%	Heavily corroded; bolts gone
		#2 King Strut to top chord		80%	Heavily corroded; bolts gone
DE	**US**	**Timber Braces**			
		#1 - King Timber Brace		75-90%	Organic growth from splits centre; heavy decay at bottom
		#1 - Queen Timber Brace		75-90%	Nuts missing from bolts
		Centre Timber Brace		75-90%	Section loss at bottom; decay lower section
		#2 - Queen Timber Brace		50-75%	Large PDK at base; bolts fully corroded; surface splitting at centre
		#2 - King Timber Brace		75-90%	Split at bolt otherwise sound; mid-splice
DE	**US**	**Bottom Chord**			
		Pier - #1 King	- Inside	50-75%	Heavy corrosion
			- Outside	50-75%	Heavy corrosion
		#1 King - #1 Queen	- Inside	50-75%	Heavy corrosion
			- Outside	50-75%	Heavy corrosion
		#1 Queen - Centre	- Inside	50-75%	Moderate corrosion
			- Outside	50-75%	Moderate corrosion
		Centre - #2 Queen	- Inside	50-75%	Moderate corrosion
			- Outside	50-75%	Moderate corrosion
		#2 Queen - #2 King	- Inside	50-75%	Heavy corrosion including splice plate
			- Outside	50-75%	Heavy corrosion including splice plate; bolts cracked and corroded
		#2 King - Pier	- Inside	50-75%	Moderate corrosion
			- Outside	50-75%	Heavy corrosion

Truss SPAN D - E (Downstream)					
Span	Side	Structural Element		Estimated % Original Capacity	Comments #1 North (Hoki) #2 South (Ross)
DE	**DS**	**Timber Struts**			
		#1 - King Strut		75-90%	Significant surface weathering top surface; several PDK top surface.
		#1 - Queen Strut		75-90%	Weathered top surface
		#1 - Counter Strut		50-75%	Split and PDK top surface; bottom edge splitting; bottom decaying inside face
		#1 - Centre Strut	- Inside	75-90%	Some vertical cracking noted
			- Outside	75-90%	Some vertical cracking noted; PDK inside face
		#2 - Centre Strut	- Inside	50-75%	Some surface decay and splitting at base
			- Outside	50-75%	Large vertical split full length; surface decay
		#2 - Counter Strut		75-90%	Splitting in top surface full length; edge decay inside face
		#2 - Queen Strut		50-75%	Cracking in top surface; sounds hollow from 1m below A-block; PDK inside face; likely CDK
		#2 - King Strut		75-90%	Weathered top surface; isolated PDK inside surface
DE	**DS**	**Vertical Steel Tension Rods**			
		#1 - King Rods	- Inside	>90%	New
			- Outside	40%	Heavily corroded
		#1 - Queen Rods	- Inside	30%	Heavily corroded
			- Outside	30%	Heavily corroded
		#1 - Centre Rods	- Inside	>90%	New
			- Outside	>90%	New
		#2 - Queen Rods	- Inside	60%	Heavily corroded
			- Outside	60%	Heavily corroded
		#2 - King Rods	- Inside	70%	Heavily corroded
			- Outside	70%	Heavily corroded
DE	**DS**	**Timber Thrust Blocks**			
		#1 - King Portal Thrust Block		75-90%	
		#1 - King Thrust Block		75-90%	
		#1 - Queen Thrust Block		75-90%	
		Centre Thrust Block		75-90%	
		#2 - Queen Thrust Block		75-90%	
		#2 - KingThrust Block		75-90%	
		#2 - King Portal Thrust Block		75-90%	
DE	**DS**	**Timber A-Blocks**			
		#1 - Queen A-Block		75-90%	CDK
		Centre A-Block		75-90%	
		#2 - Queen A-Block		75-90%	
DE	**DS**	**Timber Saddle Blocks**			
		#1 - King Saddle Block		75-90%	Small CDK and splitting inside end; significant EDK outside end to beyond brace connection; top decay
		#1 - Queen Saddle Block		75-90%	EDK outside end
		Centre Saddle Block		75-90%	Advanced decay all round
		#2 - Queen Saddle Block		50-75%	Small CDK inside end; significant EDK outside end to beyond windbrace connection; sounds hollow
		#2 - King Saddle Block		<50%	Large CDK inside end up to 150mm diameter; surface decay; sounds hollow; investigate and treat / replace; decay advanced inside face

Truss SPAN D - E (Downstream)					
DE	**DS**	**Top Chord**			
		#1 King - #1 Queen	- Inside	50-75%	Weathered; sounds hollow
			- Middle	50-75%	Large PDK inside face approx. 50mm deep; weathered
			- Outside	50-75%	Large PDK, approx half cross section missing
		#1 Queen - Centre	- Inside	75-90%	
			- Middle	75-90%	Bottom surface decay
			- Outside	75-90%	EDK at splice connection; vegetation growing from splice connection
		Centre - #2 Queen	- Inside	75-90%	Weathered
			- Middle	75-90%	Weathered
			- Outside	75-90%	Weathered; small PDK top surface; advancing surface decay
		#2 Queen - #2 King	- Inside	50-75%	Weathered; split; PDK inside flitch below saddle; sounds hollow
			- Middle	75-90%	Weathered; split
			- Outside	75-90%	Weathered; split
DE	**DS**	**Steel Connection Plates**			
		#1 King Strut to top chord			Heavily corroded
		#2 King Strut to top chord		70%	Heavily corroded
DE	**DS**	**Timber Braces**			
		#1 - King Timber Brace		75-90%	PDK at base; weathered and splitting
		#1 - Queen Timber Brace		75-90%	Large split from top end through bolted connection; install split bolt; loose bottom bolt; some organice growth
		Centre Timber Brace		75-90%	Surface decay and splitting
		#2 - Queen Timber Brace		50-75%	Significant cracking; hollow sound
		#2 - King Timber Brace		<50%	Split in end; large PDK at connection to transom; one bolt at bottom ineffective
DE	**DS**	**Bottom chord (Steel)**			
		Pier - #1 King	- Inside	70%	Heavy isolated corrosion
			- Outside	50%	Heavy corrosion
		#1 King - #1 Queen	- Inside	50%	Heavy corrosion
			- Outside	80%	Heavy corrosion
		#1 Queen - Centre	- Inside	50-75%	Moderate corrosion
			- Outside	50-75%	Moderate corrosion
		Centre - #2 Queen	- Inside	50-75%	Moderate isolated heavy
			- Outside	50-75%	Heavy corrosion at centre thrust bock
		#2 Queen - #2 King	- Inside	50-75%	Heavy Corrosion
			- Outside	50-75%	Heavy Corrosion
		#2 King - Pier	- Inside	50-75%	Heavy Corrosion
			- Outside	50-75%	Heavy Corrosion

Truss SPAN E - F (Upstream)					
Span	Side	Structural Element		Estimated %	Comments
				Original Capacity	#1 North (Hoki) #2 South (Ross)
EF	**US**	**Timber Struts**			
		#1 - King Strut		50-75%	Significant weathering / cracking top surface; small PDK at base; top half of section sounds dull; large decay at top
		#1 - Queen Strut		50%	Weathered top surface with large splits down centre; PDK and split on underside
		#1 - Counter Strut		~0%	PDK top surface; minimal contact at bottom (Decay)
		#1 - Centre Strut	- Inside	75-90%	Vertical splitting full length; some horizontal splitting on sides
			- Outside	<50%	Significant vertical splitting and dacay of top surface; horizontal splitting inside face; condition likely deteriorated
		#2 - Centre Strut	- Inside	<50%	Large horizontal crack full length; significant surface decay and PDK; base decay
			- Outside	<50%	Significant splitting and PDK at base; large split at top
		#2 - Counter Strut		50-75%	PDK at thrust block; splitting at base; sounds dull
		#2 - Queen Strut		70%	PDK at base; significant weathering and cracking top surface approx 1/4 depth
		#2 - King Strut		75-90%	Surface weathering on top surface
EF	**US**	**Vertical Steel Tension Rods**			
		#1 - King Rods	- Inside	90%	Heavily corroded
			- Outside	80%	Heavily corroded
		#1 - Queen Rods	- Inside	90%	Heavily corroded
			- Outside	60%	Heavily corroded
		#1 - Centre Rods	- Inside	70%	Heavily corroded
			- Outside	>90%	New
		#2 - Queen Rods	- Inside	50%	Heavily corroded
			- Outside	60%	Heavily corroded
		#2 - King Rods	- Inside	70%	Heavily corroded
			- Outside	90%	Heavily corroded
EF	**US**	**Timber Thrust Blocks**			
		#1 - King Thrust Block		75-90%	
		#1 - Queen Thrust Block		75-90%	
		Centre Thrust Block		50-75%	Some splitting and compression occuring
		#2 - Queen Thrust Block		75-90%	
		#2 - KingThrust Block		75-90%	
EF	**US**	**Timber A-Blocks**			
		#1 - Queen A-Block		75-90%	Small CDK inside end
		Centre A-Block		75-90%	Small CDK inside end; small PDK at strut
		#2 - Queen A-Block		75-90%	Large CDK inside end approx. 100mm diameter

Truss SPAN E - F (Upstream)					
EF	**US**	**Timber Saddle Blocks**			
		#1 - King Saddle Block		75-90%	Small CDK; large vertical split; treat and provice horizontal split bolts; full depth split
		#1 - Queen Saddle Block		75-90%	CDK approx. 80mm diameter inside end
		Centre Saddle Block		75-90%	CDK inside end; PDK on south side
		#2 - Queen Saddle Block		<50%	Large CDK extending to top chord of truss (approx. 200mm diameter), extends to vertical tie rod
		#2 - King Saddle Block		<50%	Soft end; sounds dull; deteriorated overall
EF	**US**	**Top Chord**			
		#1 King - #1 Queen	- Inside	75-90%	Weathering
			- Middle	75-90%	
			- Outside	75-90%	Replaced 1940
		#1 Queen - Centre	- Inside	50-75%	Large PDK, approx. half section missing
			- Middle	50-75%	Large PDK and split through side; sounds drummy
			- Outside	75-90%	
		Centre - #2 Queen	- Inside	75-90%	Large vertical split approx. 50mm deep
			- Middle	75-90%	
			- Outside	75-90%	
		#2 Queen - #2 King	- Inside	50-75%	CDK at south end; large vertical spilt; one corroeded splice bolt
			- Middle	50-75%	Significant weathering; PDK inside face; blocking ineffective
			- Outside	50-75%	Large PDK inside face, approx. half section gone;
EF	**US**	**Steel Connection Plates**			
		#1 King Strut to top chord		60%	Heavily corroded; bolts gone
		#2 King Strut to top chord		50%	Heavily corroded; bolts gone
EF	**US**	**Timber Braces**			
		#1 - King Timber Brace		>90%	New
		#1 - Queen Timber Brace		50-75%	PDK throughout
		Centre Timber Brace		<50%	Some end splitting and section loss
		#2 - Queen Timber Brace		>90%	New
		#2 - King Timber Brace		<50%	Large PDK south face; large split through; PDK both sides
EF	**US**	**Bottom chord (Steel)**			
		Pier - #1 King	- Inside	50-75%	Heavy corrosion
			- Outside	30%	Heavy corrosion
		#1 King - #1 Queen	- Inside	50-75%	Heavy corrosion
			- Outside	50-75%	Heavy corrosion
		#1 Queen - Centre	- Inside	50-75%	Heavy corrosion
			- Outside	50-75%	Heavy corrosion
		Centre - #2 Queen	- Inside	50-75%	Heavy corrosion
			- Outside	50-75%	Heavy corrosion
		#2 Queen - #2 King	- Inside	<50%	Severe corrosion
			- Outside	<50%	Severe corrosion
		#2 King - Pier	- Inside	<50%	Severe corrosion
			- Outside	<50%	Severe corrosion

Truss SPAN E - F (Downstream)					
Span	Side	Structural Element		Estimated %	Comments
				Original Capacity	#1 North (Hoki) #2 South (Ross)
EF	**DS**	**Timber Struts**			
		#1 - King Strut		50-75%	Weathered top surface; decay to approximately half depth of member; water ponding at base
		#1 - Queen Strut		75-90%	Minor splitting in top surface
		#1 - Counter Strut		75-90%	
		#1 - Centre Strut	- Inside	<50%	Vertical splitting in lower half; some PDK at centre inside fall
			- Outside	75-90%	Vertical splitting in lower half
		#2 - Centre Strut	- Inside	75-90%	
			- Outside	75-90%	Splitting at bottom
		#2 - Counter Strut		75-90%	Top splitting
		#2 - Queen Strut		50-75%	Surface decay at top; dull sound in lower portion, possible CDK; section necking
		#2 - King Strut		75-90%	Weathered
EF	**DS**	**Vertical Steel Tension Rods**			
		#1 - King Rods	- Inside	85%	Heavily corroded
			- Outside	90%	Heavily corroded
		#1 - Queen Rods	- Inside	60%	Heavily corroded
			- Outside	40%	Heavily corroded
		#1 - Centre Rods	- Inside	>90%	New
			- Outside	50%	Heavily corroded
		#2 - Queen Rods	- Inside	50%	Heavily corroded
			- Outside	50%	Heavily corroded
		#2 - King Rods	- Inside	50%	Heavily corroded
			- Outside	60%	Heavily corroded
EF	**DS**	**Timber Thrust Blocks**			
		#1 - King Thrust Block		75-90%	
		#1 - Queen Thrust Block		75-90%	
		Centre Thrust Block		75-90%	PDK top surface and inside contact area for #2 Counter Strut
		#2 - Queen Thrust Block		75-90%	
		#2 - KingThrust Block		75-90%	Centre spilt; EDK outside face
EF	**DS**	**Timber A-Blocks**			
		#1 - Queen A-Block		75-90%	
		Centre A-Block		75-90%	
		#2 - Queen A-Block		75-90%	Small CDK inside end
EF	**DS**	**Timber Saddle Blocks**			
		#1 - King Saddle Block		75-90%	CDK inside end approx 50mm diameter; EDK outside end
		#1 - Queen Saddle Block		75-90%	EDK outside end
		Centre Saddle Block		75-90%	Small CDK and vertical split inside end; EDK outside end; significant top decay north face
		#2 - Queen Saddle Block		75-90%	CDK inside end; EDK outside end
		#2 - King Saddle Block		50-75%	CDK inside end approx. 70mm diameter; EDK outside end; PDK northern face

Truss SPAN E - F (Downstream)					
EF	**DS**	**Top Chord**			
		#1 King - #1 Queen	- Inside	75-90%	Splitting inside face
			- Middle	75-90%	
			- Outside	50-75%	PDK top surface approx 300mm long; PDK on underside; splitting inside face
		#1 Queen - Centre	- Inside	75-90%	Weathered
			- Middle	75-90%	Replaced 1976
			- Outside	50-75%	PDK to half section depth
		Centre - #2 Queen	- Inside	75-90%	Bottom decay
			- Middle	75-90%	Splitting
			- Outside	75-90%	
		#2 Queen - #2 King	- Inside	75-90%	Replaced 1933 (second hand)
			- Middle	75-90%	PDK
			- Outside	75-90%	
EF	**DS**	**Steel Connection Plates**			
		#1 King Strut to top chord		60%	Heavily corroded; steel delamination at edges
		#2 King Strut to top chord		60%	Heavily corroded; steel delamination at edges
EF	**DS**	**Timber Braces**			
		#1 - King Timber Brace		>90%	New
		#1 - Queen Timber Brace		75-90%	Nut missing from bolt connecting to transom
		Centre Timber Brace		75-90%	EDK and vertical split at top
		#2 - Queen Timber Brace		75-90%	Split and PDK
		#2 - King Timber Brace		75-90%	PDK
EF	**DS**	**Bottom chord (Steel)**			
		Pier - #1 King	- Inside	75-90%	Strengthened
			- Outside	60%	Heavy Corrosion
		#1 King - #1 Queen	- Inside	75-90%	Strengthened
			- Outside	50-75%	Heavy Corrosion
		#1 Queen - Centre	- Inside	50-75%	Moderate corrosion
			- Outside	50-75%	Moderate corrosion
		Centre - #2 Queen	- Inside	50-75%	Moderate corrosion
			- Outside	50-75%	Moderate corrosion
		#2 Queen - #2 King	- Inside	50-75%	Isolated heavy corrosion
			- Outside	75-90%	Strengthened
		#2 King - Pier	- Inside	50-75%	Heavy Corrosion
			- Outside	75-90%	Strengthened

Truss SPAN F - G (Upstream)					
Span	Side	Structural Element		Estimated % Original Capacity	Comments #1 North (Hoki) #2 South (Ross)
FG	**US**	**Timber Struts**			
		#1 - King Strut		70%	Significant surface weathering and PDK in top surface; top 1/4 section no longer contributing to strength
		#1 - Queen Strut		50-75%	Advanced surface decay top surface; splitting in top surface approx. 100mm deep
		#1 - Counter Strut		60%	Significant splitting on top surface and inside face, full length; PDK top surface; top 1/3 section no longer contributing to strength
		#1 - Centre Strut	- Inside	75-90%	Splitting in top surface; PDK near top
			- Outside	50-75%	Splitting in top surface; PDK top surface and outside face
		#2 - Centre Strut	- Inside	50-75%	PDK at base; weathering of top surface; bottom and top decay at base
			- Outside	75-90%	Weathering of top surface
		#2 - Counter Strut		75-90%	Weathering and splitting of top surface; PDK top surface; some splitting in side at top
		#2 - Queen Strut		75-90%	PDK throughout
		#2 - King Strut		50-75%	Replaced 1928; advance surface decay on top surface; PDK on sides, top and bottom surface; horizontal split bolts at top; advancing decay
FG	**US**	**Vertical Steel Tension Rods**			
		#1 - King Rods	- Inside	60%	Heavily corroded
			- Outside	80%	Heavily corroded
		#1 - Queen Rods	- Inside	60%	Heavily corroded
			- Outside	60%	Heavily corroded
		#1 - Centre Rods	- Inside	90-100%	New
			- Outside	90-100%	New
		#2 - Queen Rods	- Inside	50%	Heavily corroded
			- Outside	50%	Heavily corroded
		#2 - King Rods	- Inside	90%	Pitting
			- Outside	60%	Heavily corroded
FG	**US**	**Timber Thrust Blocks**			
		#1 - King Thrust Block		75-90%	Split in centre
		#1 - Queen Thrust Block		<50%	Significant splitting and decay
		Centre Thrust Block		75-90%	
		#2 - Queen Thrust Block		75-90%	
		#2 - KingThrust Block		<50%	Significant decay across top in line of tension rods.
FG	**US**	**Timber A-Blocks**			
		#1 - Queen A-Block		75-90%	Small CDK inside end
		Centre A-Block		75-90%	Small CDK inside end
		#2 - Queen A-Block		75-90%	
FG	**US**	**Timber Saddle Blocks**			
		#1 - King Saddle Block		50-75%	Significant EDK (approx 1/3 of end approaching 1/2) extending to top surfce; dull sound at top
		#1 - Queen Saddle Block		75-90%	Replaced 1967; small CDK inside end; soft
		Centre Saddle Block		50-75%	CDK inside end approx. 80mm diameter extending to base of saddle block
		#2 - Queen Saddle Block		50-75%	CDK inside end extending up to top surface
		#2 - King Saddle Block		50-75%	EDK inside end (approx. 1/3 of end approaching 1/2); dull sound on northern face

Truss SPAN F - G (Upstream)					
FG	**US**	**Top Chord**			
		#1 King - #1 Queen	- Inside	75-90%	Inside face splits
			- Middle	75-90%	Weathered
			- Outside	75-90%	Weathered
		#1 Queen - Centre	- Inside	75-90%	Inside face splits
			- Middle	75-90%	Weathered; moss growing
			- Outside	75-90%	Weathered; moss growing
		Centre - #2 Queen	- Inside	75-90%	Horizontal splitting inside face
			- Middle	75-90%	Isolated PDK
			- Outside	50-75%	PDK inside face, approx. 50% loss of section
		#2 Queen - #2 King	- Inside	75-90%	Weathered
			- Middle	75-90%	
			- Outside	75-90%	Weathered; PDK
FG	**US**	**Steel Connection Plates**			
		#1 King Strut to top chord		30%	Heavily corroded; bolts gone
		#2 King Strut to top chord		70%	Heavily corroded; bolts gone
FG	**US**	**Timber Braces**			
		#1 - King Timber Brace		75-90%	Splitting and surface decay at base; nut missing from bolt connecting to saddle
		#1 - Queen Timber Brace		75-90%	Large split through centre; PDK outside edge near base; nut missing from bolt connecting to saddle; bolt missing at base
		Centre Timber Brace		<50%	Top end completed decayed; organic matter growing
		#2 - Queen Timber Brace		75-90%	Nut missing at bottom; replace bottom bolt
		#2 - King Timber Brace		75-90%	PDK at bottom around bolts
FG	**US**	**Bottom chord (Steel)**			
		Pier - #1 King	- Inside	50-75%	Heavy corrosion
			- Outside	<50%	Approaching severe corrosion
		#1 King - #1 Queen	- Inside	50-75%	Heavy corrosion
			- Outside	50-75%	Heavy corrosion
		#1 Queen - Centre	- Inside	50-75%	Moderate corrosion
			- Outside	50-75%	Moderate corrosion
		Centre - #2 Queen	- Inside	50-75%	Moderate corrosion
			- Outside	50-75%	Moderate corrosion
		#2 Queen - #2 King	- Inside	50-75%	Heavy corrosion
			- Outside	<50%	Severe corrosion
		#2 King - Pier	- Inside	50-75%	Heavy corrosion
			- Outside	<50%	Severe corrosion

Truss SPAN F - G (Downstream)					
Span	Side	Structural Element		Estimated % Original Capacity	Comments #1 North (Hoki) #2 South (Ross)
FG	**DS**	**Timber Struts**			
		#1 - King Strut		75-90%	Replaced 1977
		#1 - Queen Strut		75-90%	Replaced 1965; splitting top surface
		#1 - Counter Strut		75-90%	
		#1 - Centre Strut	- Inside	75-90%	Surface weathering; splitting
			- Outside	75-90%	Surface weathering
		#2 - Centre Strut	- Inside	75-90%	Surface weathering; splitting top surface
			- Outside	75-90%	Surface weathering; bottom face splitting at top
		#2 - Counter Strut		75-90%	Weathering and splitting
		#2 - Queen Strut		50-75%	Some hollowing in bottom end; PDK top surface; weathered throughout
		#2 - King Strut		75-90%	
FG	**DS**	**Vertical Steel Tension Rods**			
		#1 - King Rods	- Inside	50%	Heavily corroded
			- Outside	80%	Heavily corroded
		#1 - Queen Rods	- Inside	60%	Heavily corroded
			- Outside	60%	Heavily corroded
		#1 - Centre Rods	- Inside	60%	Heavily corroded
			- Outside	80%	Heavily corroded
		#2 - Queen Rods	- Inside	85%	Light corrosion
			- Outside	70%	Heavily corroded
		#2 - King Rods	- Inside	70%	Heavily corroded
			- Outside	60%	Heavily corroded
FG	**DS**	**Timber Thrust Blocks**			
		#1 - King Thrust Block		75-90%	
		#1 - Queen Thrust Block		75-90%	Small section missing from top outside of outside tie rod
		Centre Thrust Block		75-90%	Centre split
		#2 - Queen Thrust Block		75-90%	
		#2 - King Thrust Block		75-90%	CDK started on outside face; small section missing from top outside of outside tie rod
FG	**DS**	**Timber A-Blocks**			
		#1 - Queen A-Block		75-90%	
		Centre A-Block		75-90%	CDK inside end approx. 100mm+ diameter
		#2 - Queen A-Block		75-90%	
FG	**DS**	**Timber Saddle Blocks**			
		#1 - King Saddle Block		75-90%	EDK at windbrace connection
		#1 - Queen Saddle Block		75-90%	Vertical split through inside face
		Centre Saddle Block		<50%	PDK; outside tension rod loose due to saddle block crushing; 30% section gone by crushing
		#2 - Queen Saddle Block		75-90%	EDK at windbrace connection; CDK inside approx 70mm diameter
		#2 - King Saddle Block		75-90%	Significant EDK at outside end; up to 20% CDK inside end

Truss SPAN F - G (Downstream)					
FG	**DS**	**Top Chord**			
		#1 King - #1 Queen	- Inside	75-90%	Splitting and PDK top surface; EDK and southern end
			- Middle	75-90%	
			- Outside	75-90%	
		#1 Queen - Centre	- Inside	<50%	Splitting in top surface; heavy bottom decay
			- Middle	75-90%	
			- Outside	75-90%	PDK
		Centre - #2 Queen	- Inside	75-90%	Weathered
			- Middle	75-90%	Weathering
			- Outside	75-90%	Weathering
		#2 Queen - #2 King	- Inside	75-90%	
			- Middle	75-90%	
			- Outside	75-90%	
FG	**DS**	**Steel Connection Plates**			
		#1 King Strut to top chord		70%	Heavily corroded, bolts gone
		#2 King Strut to top chord		60%	Heavily corroded, bolts gone
FG	**DS**	**Timber Braces**			
		#1 - King Timber Brace		75-90%	
		#1 - Queen Timber Brace		75-90%	Split through centre at top end
		Centre Timber Brace		>90%	New
		#2 - Queen Timber Brace		>90%	New
		#2 - King Timber Brace		75-90%	
FG	**DS**	**Bottom chord (Steel)**			
		Pier - #1 King	- Inside	50-75%	Heavy corrosion
			- Outside	<50%	Severe corrosion
		#1 King - #1 Queen	- Inside	<50%	Severe corrosion
			- Outside	50-75%	Heavy corrosion
		#1 Queen - Centre	- Inside	50-75%	Moderate corrosion
			- Outside	50-75%	Moderate corrosion
		Centre - #2 Queen	- Inside	50-75%	Moderate corrosion
			- Outside	50-75%	Moderate corrosion
		#2 Queen - #2 King	- Inside	<50%	Severe corrosion
			- Outside	<50%	Isolated severe corrosion
		#2 King - Pier	- Inside	<50%	Severe corrosion
			- Outside	50-75%	Heavy corrosion

Truss SPAN G - H (Upstream)					
Span	Side	Structural Element		Estimated % Original Capacity	Comments #1 North (Hoki) #2 South (Ross)
GH	**US**	**Timber Struts**			
		#1 - King Strut		70%	Extensive surface weathering and splitting
		#1 - Queen Strut		75-90%	
		#1 - Counter Strut		75-90%	
		#1 - Centre Strut	- Inside	<50%	Large PDK inside face; splitting
			- Outside	<50%	Splitting and associated PDK; ropey top surface
		#2 - Centre Strut	- Inside	75-90%	Vertical splitting top surface; small PDK at base
			- Outside	75-90%	Vertical splitting top surface
		#2 - Counter Strut		75-90%	PDK both ends; some horizontal splitting; weathering and surface decay on top surface
		#2 - Queen Strut		75-90%	Repaced 1960; Splitting and PDK top surface
		#2 - King Strut		70%	Vertical splitting and PDK top surface up to 60mm deep
GH	**US**	**Vertical Steel Tension Rods**			
		#1 - King Rods	- Inside	85%	Surface corrosion
			- Outside	60%	Heavily corroded
		#1 - Queen Rods	- Inside	80%	Heavily corroded
			- Outside	60%	Heavily corroded
		#1 - Centre Rods	- Inside	80%	Heavily corroded
			- Outside	50%	Heavily corroded
		#2 - Queen Rods	- Inside	70%	Heavily corroded
			- Outside	95%	Light surface corrosion
		#2 - King Rods	- Inside	80%	Heavily corroded
			- Outside	90%	Heavily corroded
GH	**US**	**Timber Thrust Blocks**			
		#1 - King Thrust Block		75-90%	
		#1 - Queen Thrust Block		75-90%	Second hand (replaced); PDK top surface; small PDK inside of inside rod
		Centre Thrust Block		75-90%	
		#2 - Queen Thrust Block		75-90%	
		#2 - King Thrust Block		75-90%	Second hand (replaced); Some decay along top through centre; cement repair outside north corner
GH	**US**	**Timber A-Blocks**			
		#1 - Queen A-Block		75-90%	Split with some decay south edge
		Centre A-Block		75-90%	Small CDK inside end; small PDK behind strut
		#2 - Queen A-Block		75-90%	Small CDK and some splitting through end
GH	**US**	**Timber Saddle Blocks**			
		#1 - King Saddle Block		50-75%	Large split inside end from top to centre; Significant EDK outside end; sounds hollow; ply over inside end
		#1 - Queen Saddle Block		50-75%	Large EDK extending full depth; souds hollow underneath bolts
		Centre Saddle Block		<50%	Large CDK inside end full depth of saddle; ply covered inside end
		#2 - Queen Saddle Block		75-90%	CDK starting at inside end with vertical crack
		#2 - King Saddle Block		75-90%	Large CDK inside end through centre extending to top surface; outside end similar; sounds very hollow; cement patched

Truss SPAN G - H (Upstream)					
GH	**US**	**Top Chord**			
		#1 King - #1 Queen	- Inside	75-90%	Replaced 1960; some splitting and PDK inside face
			- Middle	75-90%	
			- Outside	75-90%	Significant weathering and PDK inside face
		#1 Queen - Centre	- Inside	75-90%	Large PDK inside face
			- Middle	75-90%	
			- Outside	75-90%	Small PDK on top; splitting on inside face; significantly weathered
		Centre - #2 Queen	- Inside	75-90%	Replaced 1960; Large split on inside face
			- Middle	75-90%	Replaced 1960
			- Outside	75-90%	Significantly weathered
		#2 Queen - #2 King	- Inside	75-90%	Replaced 1960; PDK and splitting inside face
			- Middle	75-90%	Replaced 1960
			- Outside	75-90%	Weathered top surface
GH	**US**	**Steel Connection Plates**			
		#1 King Strut to top chord		30%	Heavily corroded; bolts gone
		#2 King Strut to top chord		40%	Heavily corroded; bolts gone
GH	**US**	**Timber Braces**			
		#1 - King Timber Brace		>90%	New
		#1 - Queen Timber Brace		>90%	New
		Centre Timber Brace		>90%	New
		#2 - Queen Timber Brace		>90%	New; dark staining south face
		#2 - King Timber Brace		>90%	New
GH	**US**	**Bottom chord**			
		Pier - #1 King	- Inside	50-75%	Moderate corrosion
			- Outside	<50%	Severe corrosion
		#1 King - #1 Queen	- Inside	50-75%	Heavy corrosion
			- Outside	50-75%	Heavy corrosion
		#1 Queen - Centre	- Inside	50-75%	Moderate corrosion
			- Outside	50-75%	Heavy corrosion
		Centre - #2 Queen	- Inside	50-75%	Heavy corrosion
			- Outside	50-75%	Heavy corrosion
		#2 Queen - #2 King	- Inside	50-75%	Heavy corrosion
			- Outside	75-90%	Strengthened
		#2 King - Pier	- Inside	50-75%	Heavy corrosion
			- Outside	75-90%	Strengthened

Truss SPAN G - H (Downstream)					
Span	Side	Structural Element		Estimated % Original Capacity	Comments #1 North (Hoki) #2 South (Ross)
GH	**DS**	**Timber Struts**			
		#1 - King Strut		75-90%	Weathering; PDK on top face
		#1 - Queen Strut		75-90%	Significant surface cracking top surface and inside face
		#1 - Counter Strut		75-90%	Weathering; splitting on top
		#1 - Centre Strut	- Inside	75-90%	Some cracking and isolated PDK
			- Outside	75-90%	Some cracking and isolated PDK
		#2 - Centre Strut	- Inside	75-90%	Split at top; splits and PDK throughout
			- Outside	75-90%	Split with PDK at top
		#2 - Counter Strut		<50%	Significant loss of section at bottom end through decay
		#2 - Queen Strut		75-90%	Top surface weathering
		#2 - King Strut		75-90%	Replaced 1933 (second hand); surface decay inside face
GH	**DS**	**Vertical Steel Tension Rods**			
		#1 - King Rods	- Inside	85%	Corrosion
			- Outside	70%	Corrosion
		#1 - Queen Rods	- Inside	50%	Heavily corroded
			- Outside	50%	Heavily corroded
		#1 - Centre Rods	- Inside	95%	Light surface corrosion only
			- Outside	>90%	New
		#2 - Queen Rods	- Inside	60%	Heavily corroded
			- Outside	60%	Heavily corroded
		#2 - King Rods	- Inside	90%	Corrosion
			- Outside	80%	Corrosion
GH	**DS**	**Timber Thrust Blocks**			
		#1 - King Thrust Block		50-75%	Top section loss
		#1 - Queen Thrust Block		75-90%	
		Centre Thrust Block		75-90%	Centre split
		#2 - Queen Thrust Block		75-90%	
		#2 - King Thrust Block		75-90%	Weathering
GH	**DS**	**Timber A-Blocks**			
		#1 - Queen A-Block		<50%	CDK; PDK and splitting on counter strut side; signs of compression; replace within 5yrs
		Centre A-Block		75-90%	Small PDK around strut
		#2 - Queen A-Block		75-90%	

Truss SPAN G - H (Downstream)					
GH	**DS**	**Timber Saddle Blocks**			
		#1 - King Saddle Block		50-75%	CDK; PDK top at top; ply covered
		#1 - Queen Saddle Block		<50%	Large CDK inside end; replace within 5 years
		Centre Saddle Block		75-90%	EDK outside end and inside end
		#2 - Queen Saddle Block		75-90%	Some surface decay and weathering
		#2 - King Saddle Block		75-90%	EDK; all round vegetation growing
GH	**DS**	**Top Chord**			
		#1 King - #1 Queen	- Inside	75-90%	Splice plate over A-block
			- Middle	75-90%	
			- Outside	75-90%	Large PDK around bolts; completely gone near #1 Queen A-block
		#1 Queen - Centre	- Inside	<50%	PDK around splice; plate strengthened
			- Middle	75-90%	
			- Outside	75-90%	Plate strengthened
		Centre - #2 Queen	- Inside	75-90%	
			- Middle	75-90%	
			- Outside	75-90%	PDK around bolts
		#2 Queen - #2 King	- Inside	75-90%	Weathered
			- Middle	75-90%	Replaced 1974 (second hand)
			- Outside	75-90%	Moss growth
GH	**DS**	**Steel Connection Plates**			
		#1 King Strut to top chord		50%	Heavily corroded; bolts gone
		#2 King Strut to top chord		70%	Heavily corroded, bolts gone
GH	**DS**	**Timber Braces**			
		#1 - King Timber Brace		>90%	New; splintered at top
		#1 - Queen Timber Brace		>90%	New
		Centre Timber Brace		>90%	New
		#2 - Queen Timber Brace		50-75%	Spilt through lower half of brace
		#2 - King Timber Brace		>90%	New
GH	**DS**	**Bottom chord**			
		Pier - #1 King	- Inside	<50%	Severe corrosion
			- Outside	<50%	Severe corrosion
		#1 King - #1 Queen	- Inside	<50%	Severe corrosion
			- Outside	<50%	Severe corrosion
		#1 Queen - Centre	- Inside	50-75%	Heavy corrosion
			- Outside	50-75%	Heavy corrosion
		Centre - #2 Queen	- Inside	50-75%	Heavy corrosion
			- Outside	50-75%	Heavy corrosion
		#2 Queen - #2 King	- Inside	50-75%	Heavy corrosion
			- Outside	50-75%	Heavy corrosion
		#2 King - Pier	- Inside	50-75%	Heavy corrosion
			- Outside	50-75%	Heavy corrosion

TRANSOMS (per span)				
Span	Side	Structural Element	Estimated % Original Capacity	Comments #1 North (Hoki) #2 South (Ross)
CD	US	#1 King Transom	75-90%	Bolts heavily corroded; horizontal split US; EDK DS
	DS	#1 King Transom	75-90%	Replaced 1960
	US	#1 Queen Transom	75-90%	Condition of bolts is mixed; EDK upstream
	DS	#1 Queen Transom	<50%	Replaced 1944; PDK downstream end; EDK severe
	US	Centre Transom	75-90%	Weathered; EDK; cement reapir; bolts corroded and missing
	DS	Centre Transom	75-90%	Replaced 1977 (second hand); PDK top surface between road beams; bolts corroded and missing; horizontal split DS
	US	#2 Queen Transom	75-90%	Replaced 1977; nuts missing
	DS	#2 Queen Transom	75-90%	Replaced 1960; weathered; horizontel crack and EDK both ends
	US	#2 King Transom	75-90%	Replaced 1977; small surface defect top surface between RH truss and RH road beam
	DS	#2 King Transom	75-90%	Replaced 1967 (second hand); organic growth; horizontal splitting
DE	US	#1 King Transom	<50%	large CDK; Sounds hollow under road beams; EDK and splititng both ends
	DS	#1 King Transom	<50%	Significant EDK upstream end; sounds hollow under truss; EDK downstream and fixings corroded
	US	#1 Queen Transom	50-75%	Sounds hollow under US road beam; top decay and weathering, splitting, CDK, EDK
	DS	#1 Queen Transom	75-90%	Honey combing and surface decay downstream end; large split between DS road beam and DS truss; small CDK upstream end; plate repair DS end with cement
	US	Centre Transom	50-75%	Sounds hollow under US road beam; weathering; splitting; EDK US
	DS	Centre Transom	75-90%	Isolated PDK south face; surface weathering and decay; weathering; splitting, EDK DS
	US	#2 Queen Transom	50-75%	Replaced 1960; large CDK downstream end extending back to thrust block; EDK upstream end; large PDK northern face between DS road beam and DS truss; bolts/fixings corroded
	DS	#2 Queen Transom	50-75%	Replaced 1960; EDK upstream end; condition of bolts is mixed - Splitting DS end
	US	#2 King Transom	75-90%	Condition of bolts is mixed; EDK upstream and downstream
	DS	#2 King Transom	75-90%	PDK
EF	US	#1 King Transom	75-90%	Replaced 1975; weathered EDK DS; US end split
	DS	#1 King Transom	75-90%	Some horizontal splitting downstream end; condition of bolts is mixed; nuts misisng
	US	#1 Queen Transom	75-90%	Replaced 1977; splitting DS end
	DS	#1 Queen Transom	75-90%	Split through top at upstream end
	US	Centre Transom	75-90%	Replaced 1944; weathered; splitting at ends
	DS	Centre Transom	75-90%	Split through top at upstream end; EDK; PDK throughout
	US	#2 Queen Transom	75-90%	Replaced 1960; splitting DS end
	DS	#2 Queen Transom	50-75%	Significant EDK upstream end extending up to 1.5m from end; extensive surface decay on top surface; member collapsing inward; (likely replacement required); EDK DS; end plate strengthend
	US	#2 King Transom	75-90%	Condition of bolts is mixed; 5 splice bolts between transoms are missing; EDK both ends, PDK; Replaced 1933
	DS	#2 King Transom	75-90%	Horizontal split DS end
FG	US	#1 King Transom	75-90%	PDK top surface; EDK upstream end; condition of bolts mixed
	DS	#1 King Transom	75-90%	End splitting upstream end; CDK DS end 200m diameter
	US	#1 Queen Transom	75-90%	Replaced 1944; condition of bolts is mixed; splits at both ends
	DS	#1 Queen Transom	75-90%	
	US	Centre Transom	75-90%	large horizontal split through side at upstream end - install vertical split bolts
	DS	Centre Transom	75-90%	large CDK / EDK upstream end; surface decay / weathering on top surface; EDK DS
	US	#2 Queen Transom	75-90%	Weathered; EDK US
	DS	#2 Queen Transom	75-90%	Splitting downstream end; install vertical split bolts
	US	#2 King Transom	50-75%	CDK downstream end; large PDK south face; PDK upstream face; hollow sound from LH truss to end; cement repair south face and plate repair US
	DS	#2 King Transom	75-90%	Weathered; splitting on north and south face with associated decay
GH	US	#1 King Transom	50-75%	Small EDK upstream end; splitting; sounds drummy
	DS	#1 King Transom	75-90%	EDK US
	US	#1 Queen Transom	75-90%	Large CDK downstream end; significant weathering; PDK
	DS	#1 Queen Transom	75-90%	large CDK upstream end; splitting both ends; horizontal split and downstream end; plate reapir DS
	US	Centre Transom	50-75%	Significant weathering; large PDK upstream end; sounds drummy
	DS	Centre Transom	75-90%	Horizontal split through centre at downstream end; install vertical split bolts; replaced 1961
	US	#2 Queen Transom	75-90%	Replaced 1977; PDK
	DS	#2 Queen Transom	50-75%	Significant EDK upstream end in horizontal plane, extending back under truss; large PDK south face; significant weathering; soft; plate repair effectiveness questionable due to significant DS end decay
	US	#2 King Transom	75-90%	Surface weathering EDK and splitting US
	DS	#2 King Transom	75-90%	PDK upstream end; significant weathering; DS plate repaired effectiveness questionable due to significant DS end decay

PIERS (Abutment A - Abutment J)						
Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated	Comments
		Sound / Treatment only	Investigate Further	Replace	% of Original Capacity	#1 North (Hoki) #2 South (Ross)
Abut. A	**Piles**					
Abut. A	Upstream Pile	•				PDK at top where previously drilled; general splitting and weathering
Abut. A	Centre Pile	•				Surface soft but sound underneath; general weathering
Abut. A	Downstream Pile	•				Surface splitting; EDK at top where previously drilled; excavation around pile showed pile sound below ground (2010?)
Abut. A	Pile Cap	•				CDK both ends; significant weathering and splitting; appears sound over piles
Abut. A	Abutment Walls - Timber facing	•				Top part collapsing; ends gone; otherwise appears ok
Abut. A	Abutment Walls - Vertical Railway Irons	•			60%	Extensive corrosion
Pier B	**Piles**					
Pier B	Upstream Pile	•				Surface splitting and weathering; PDK under pile cap, at top of pile, and several small isolated PDK along pile
Pier B	Centre Pile	•				Small outer section missing top and US end; vertical splitting and weathering; small loss of outer section at ground level; excavation around pile showed pile sound below ground
Pier B	Downstream Pile	•				Large vertical splits in top 1/3 pile; hollow sound at top likely due to splitting; large PDK at top;
Pier B	Upstream Cut Water Pile	•				EDK and splitting at top; vegetation growth all around
Pier B	Downstream Cut Water Pile	•				Not inspected due to vegetation
Pier B	**Raker Studs**					
Pier B	Upstream Raker Stud	•				Significant decay at bottom; significant weathering; top surface has honeycomb effect and worm holes
Pier B	Downstream Raker Stud		•			Not inspected to due vegetation
Pier B	**Diagonal Bracing**					
Pier B	Cross bracing	•			70%	Steel railway iron; varying amounts of corrosion
Pier B	**Whaling's**					
Pier B	Whaling's	•			50%	Steel railway irons; heavily corroded
Pier B	Pile Cap	•				Replaced 1975; surface decay North Face
Pier C	**Piles**					
Pier C	Pile #1	•				Vertical splitting above whalers
Pier C	Pile #2	•				Vertical splitting above whalers
Pier C	Pile #3	•				Deep splits / pockets on north face from spikes >1/2 depth over 2m length
Pier C	Pile #4	•				Vertical splitting above whalers; surface loss US stream
Pier C	Pile #5	•				Replaced 1961
Pier C	Pile #6	•				Splitting; weathering; block bolted to outside face at top to support pile cap
Pier C	Pile #7		•			Large CDK just above whaler; sound at ground and cap - *Consider splicing in section of pile or redundant; h* ollow sounding
Pier C	Pile #8		•			Large CDK just above whaler; sound at ground and cap - *Consider splicing in section of pile or redundant*
Pier C	Upstream cut-water pile		•			Has sunk approx 600mm; significant splitting and decay at top
Pier C	Downstream cut-water pile	•				Splitting and small EDK at top
Pier C	**Raker Studs**					
Pier C	Upstream Raker Stud			•		Has come free of fixing at top due to sinking cut-water pile; large split and EDK at top; large split upstream face; weathered
Pier C	Downstream Raker Stud			•		Splitting, surface weathering and significant decay downstream face; large CDK / EDK at base - *Probable replacement*
Pier C	**Diagonal Bracing**					
Pier C	Cross Bracing	•			70%	Railway iron cross bracing; varying amounts of corrosion
Pier C	**Whaling's**					
Pier C	Whaling's	•				All present; individual assessment of each whaler not carried out
						All whalings significantly deteriorated

PIERS (Abutment A - Abutment J)						
Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated	Comments
		Sound / Treatment only	Investigate Further	Replace	% of Original Capacity	#1 North (Hoki) #2 South (Ross)
Pier C	**Pile Caps**					
Pier C	Pile Cap #1	•				Replaced 1975; EDK downstream end; PDK upstream
Pier C	Pile Cap #2	•				Splitting and associated CDK downstream end; EDK and splitting upstream end
Pier C	Pile Cap #3	•				Splitting and EDK starting downstream end; EDK upstream end; PDK centre
Pier C	Pile Cap #4			•		Large end section gone downstream end; large PDK along length and extensive decay upstream end and ineffective - *Replace or consider redundant*
Pier C	**Corbels**					
Pier C	LH Truss Corbel - Inside	•				Replaced 1975 second hand; vertical split north end
Pier C	- Outside	•				PDK outside face; weathered
Pier C	RH Truss Corbel - Inside	•				Replaced 1975 second hand; minor end splitting
Pier C	- Outside	•				EDK and splitting both ends
Pier C	**Packers Between Pile Cap and Beam Corbel**					
Pier C	Perpendicular to corbel	•				4 no. total; weathered
Pier C	Parallel to corbel	•	•			Weathered but generally sound except for packer under LH corbel which has significant decay; all deteriorated - *Consider packing or replacement*
Pier D	**Piles**					
Pier D	Pile #1		•			Extensive CDK at top; vertical splitting above whalers at spike locations
Pier D	Pile #2		•			Major splitting and decay on outside face and other areas; sound at base and top
Pier D	Pile #3	•				Vertical splitting above whalers
Pier D	Pile #4	•				Advanced EDK at top; vertical splitting above whalers
Pier D	Pile #5		•			Splitting and associated decay on outside face due to spikes; sounds drummy above whaler; possible CDK
Pier D	Pile #6		•			Splitting and associated decay on outside face going into centre due to spikes; possible CDK; deep split >1/2 depth
Pier D	Pile #7		•			Splitting and associated decay outside face but appears sounds; sounds drummy at top - *Investigate top further*
Pier D	Pile #8	•				EDK at top; splitting and associated decay due to spike holes
Pier D	Upstream cut-water pile		•			Significant CDK / EDK
Pier D	Downstream cut-water pile	•				
Pier D	**Raker Studs**					
Pier D	Upstream Raker Stud		•			Packer missing at top; significant splitting and decay on north face; large split and CDK at base - *Possible replacement*
Pier D	Downstream Raker Stud	•				Weathering and splitting on sides and downstream face
Pier D	**Diagonal Bracing**					
Pier D	Cross bracing	•			50%	Heavily corroded railway irons
Pier D	**Whaling's**					
Pier D	Whaling's	•				All present; individual assessment of each whaler not carried out; US North end missing between pile 1 and raker stud
Pier D	**Pile Caps**					
Pier D	Pile Cap #1	•				Typically split and EDK
Pier D	Pile Cap #2	•				Typically split and EDK
Pier D	Pile Cap #3	•				Replaced 1960; typically split and EDK
Pier D	Pile Cap #4	•				Replaced 1967 second hand; typically split and EDK
Pier D	**Corbels**					
Pier D	US Truss Corbel - Inside	•				
Pier D	- Outside	•				End Splitting
Pier D	DS Truss Corbel - Inside	•				Splitting at south end
Pier D	- Outside	•				EDK both ends
Pier D	**Packers Between Pile Cap and Beam Corbel**					
Pier D	US Beam	•				Weathered and deteriorated
Pier D	DS Beam	•				Weathered and deteriorated

PIERS (Abutment A - Abutment J)						
Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated	Comments
		Sound / Treatment only	Investigate Further	Replace	% of Original Capacity	#1 North (Hoki) #2 South (Ross)
Pier E	**Piles**					
Pier E	Pile #1		•			EDK at top; typical splitting and decay on outside face; deep split *- worst pile of group therefore recommend investigating*
Pier E	Pile #2	•				Typical splitting and decay on outside face
Pier E	Pile #3	•				Typical splitting and decay on outside face
Pier E	Pile #4			•		Large split and associated decay on outside face due to spike holes; CDK; excavation around pile showed pile sound below ground; only shell remaining above whaler *- Investigate or may be redundant*
Pier E	Pile #5		•			EDK at top; deep splitting and associated decay all around pile; numerous drill holes from previous investigations
Pier E	Pile #6	•				Minor splitting and associated decay
Pier E	Pile #7	•				Typical splitting and decay on outside face; excavation around pile showed pile sound below ground
Pier E	Pile #8	•				EDK at top; evidence of insect attack; significant splitting and associated decay
Pier E	Upstream cut-water pile	•				Splitting and EDK at top
Pier E	Downstream cut-water pile	•				Significant EDK at top, full of soil
Pier E	**Raker Studs**					
Pier E	Upstream Raker Stud	•				Splitting and EDK at top; some debris
Pier E	Downstream Raker Stud		•			Significant weathering / splitting and associated decay; EDK at base; possible CDK at connection to cut-water pile
Pier E	**Diagonal Bracing**					
Pier E	Brace #1	•			50%	Heavily corroded railway irons
Pier E	Brace #2	•			50%	Heavily corroded railway irons
Pier E	**Whaling's**					
Pier E	Whaling's	•				Whalers all there; soil + vegetation on top of whalers; individual assessment of each whaler not carried out; weathered; deteriation around fixings
Pier E	**Pile Caps**					
Pier E	Pile Cap #1	•				Replaced 1977; typical splitting and EDK
Pier E	Pile Cap #2	•				Typical splitting and EDK
Pier E	Pile Cap #3	•				Replaced 1977; minor splitting downstream end only; typical splitting and EDK
Pier E	Pile Cap #4	•				Typical splitting and EDK
Pier E	**Corbels**					
Pier E	US Truss Corbel - Inside	•				
Pier E	- Outside	•				
Pier E	DS Truss Corbel - Inside	•				
Pier E	- Outside	•				Small EDK and splitting south end
Pier E	**Packers Between Pile Cap and Beam Corbel**					
Pier E	US Beam	•				Typical sound; packer directly under and parallel to corbel is sound but packer on outside is not
Pier E	DS Beam	•				Small amount of decay on downstream packer // to corbel - not supporting corbel; otherwise typically sound
Pier F	**Piles**					
Pier F	Pile #1	•				Vertical split at top; timber on outside covering spike lines; isolated honeycombing
Pier F	Pile #2	•				EDK at top; typical splitting outside face; multiple drill holes; small amount of decay at each seating; excavation around pile showed pile sound below ground; deep pockets
Pier F	Pile #3	•				Decay below whaler at seating on inside of pile; 2023 debris below whaler
Pier F	Pile #4	•				Typical splitting outside face
Pier F	Pile #5	•				Significant EDK at top; vertical splitting on outside face; minor splitting elsewhere
Pier F	Pile #6	•				Minor honeycombing through midsection; minor splitting
Pier F	Pile #7	•				Minor splitting and decay; excavation around pile showed pile sound below ground
Pier F	Pile #8	•				Minor splitting on outside face; excavation around pile showed pile sound below ground; splits and surface decay
Pier F	Upstream cut-water pile					
Pier F	Downstream cut-water pile	•				EDK at top; appears sound at attachment to raking stud

PIERS (Abutment A - Abutment J)						
Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated	Comments
		Sound / Treatment only	Investigate Further	Replace	% of Original Capacity	#1 North (Hoki) #2 South (Ross)
Pier F	**Raker Studs**					
Pier F	Upstream Raker Stud	•				Minor splitting along lines of spikes Fenders in good condition, SH61 (inside), SH77 (outside / upstream)
Pier F	Downstream Raker Stud			•	30%	Significant CDK; decay on downstream face to 1/2 depth; vegetation *- Replace or consider redundant*
Pier F	**Diagonal Bracing**					
Pier F	Cross bracing	•			50%	Steel railway irons; varying amounts of corrosion
Pier F	**Whaling's**					
Pier F	Whaling's	•				All present; vegetation on top; weathered and deteriorated
Pier F	**Pile Caps**					
Pier F	Pile Cap #1	•				Replaced 1944; end splitting typical
Pier F	Pile Cap #2	•				Replaced 1977; end splitting typical
Pier F	Pile Cap #3	•				Replaced 1977; end splitting typical
Pier F	Pile Cap #4	•				End splitting typical
Pier F	**Corbels**					
Pier F	US Truss Corbel - Inside	•				
Pier F	- Outside	•				Replaced 1967; EDK both ends
Pier F	DS Truss Corbel - Inside		•			Vertical split north end; large CDK south end
Pier F	- Outside	•				Replaced 1960; vertical split north end; EDK South
Pier F	**Packers Between Pile Cap and Beam Corbel**					
Pier F	US Beam	•				Typically 2 no. parallel to corbel and 4 no. perpendicular; packer #1 perpendicular to corbel dozy; others typically sound; perpendicular ones generally deteriorated
Pier F	DS Beam	•				Generally deteriorated
Pier G	**Piles**					
Pier G	Pile #1	•				Isolated weathering and honeycombing; timber covering spike holes
Pier G	Pile #2	•				Typical splitting on outside face from spikes up to 100mm deep; surface decay and weathering; packer missing at top to cap *- Reinstate packer at top to pile cap*
Pier G	Pile #3	•				Typical splitting on outside face from spikes; lower 2/3 of pile has advanced surface decay and splitting; advanced decay at top below cap *- Further assess decay at top when treating*
Pier G	Pile #4	•				Minor splitting at top; typical splitting and decay
Pier G	Pile #5	•			70%	Split running approx. 1m down pile from backside of seating at top; typical splitting due to spikes *- Replace split bolt at top*
Pier G	Pile #6	•				Vertical split extending down from cap seat; split bolt corroded; typical vertical splitting on outside face extending into core *- Replace split bolt at top*
Pier G	Pile #7	•				Large split and EDK at top; outside face covered in timber; large vertical split extends down approx. 600mm from cap seating; split bolt corroded *- Replace split bolt at top*
Pier G	Pile #8	•				Large split and EDK at top; vertical split and PDK behind brace connection at top; typical splitting on outside face
Pier G	Upstream cut-water pile	•				Debris build up against
Pier G	Downstream cut-water pile	•				Minor splitting and weathering; some EDK
Pier G	**Raker Studs**					
Pier G	Upstream Raker Stud	•				EDK / CDK at base; weathering and splitting on sides and upstream face; vegetated
Pier G	Downstream Raker Stud	•				Splitting in side due to spikes; weathering, splitting and decay on downstream face; packer at top fallen out
Pier G	**Diagonal Bracing**					
Pier G	Cross bracing	•			50%	Timber; PDK behind pile connections

PIERS (Abutment A - Abutment J)						
Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated	Comments
		Sound / Treatment only	Investigate Further	Replace	% of Original Capacity	#1 North (Hoki) #2 South (Ross)
Pier G	**Whaling's**					
Pier G	Whaling's	•				All present; sound condition; not fully inspected
Pier G	**Pile Caps**					
Pier G	Pile Cap #1	•				
Pier G	Pile Cap #2	•				Replaced 1933 second hand; end splitting and EDK
Pier G	Pile Cap #3	•				Replaced 1975; end splitting and EDK
Pier G	Pile Cap #4	•				Replaced 1975; end splitting and EDK
Pier G	**Corbels**					
Pier G	US Truss Corbel - Inside	•				Replaced 1967 second hand; minor end splitting
Pier G	- Outside	•				Replaced 1967 second hand; minor end splitting
Pier G	DS Truss Corbel - Inside	•				
Pier G	- Outside	•				Vertical split at south end
Pier G	**Packers Between Pile Cap and Beam Corbel**					
Pier G	US Beam	•				General weathering only
Pier G	DS Beam		•			Deteriorated
Pier H	**Piles**					
Pier H	Pile #1	•			70%	Typical vertical splitting on outside face
Pier H	Pile #2	•			70%	Typical vertical splitting on outside face; top decay
Pier H	Pile #3	•			70%	Typical vertical splitting on outside face; significant split on downstream face starting above whaler
Pier H	Pile #4	•			50%	Top filled with pitch; vertical splitting on outside face through mid section through to CDK; top splitting and decay *- Estimate only 50% of pile contributing due to splitting*
Pier H	Pile #5	•			70%	EDK at top; splitting through mid section due to spikes; vertical splitting on backside approx. 30mm deep
Pier H	Pile #6	•			70%	Full length splits on backside approx. 70mm deep; large vertical splits on outside extending into pile centre; excavation around pile showed pile sound below ground; CDK
Pier H	Pile #7	•			70%	Minor splitting only
Pier H	Pile #8	•			50%	Top filled with pitch; vertical splitting on outside face through mid section through to CDK *- Estimate only 50% of pile contributing due to splitting*
Pier H	Upstream cut-water pile			•		Splitting and hollow at top; heavily decayed *- Replace or consider redundant*
Pier H	Downstream cut-water pile			•		Splitting and hollow at top; heavily decayed *- Replace or consider redundant*
Pier H	**Raker Studs**					
Pier H	Upstream Raker Stud	•				Splitting along lines of spikes; decayed over lower section where previously buried in vegetation; vegetation growth
Pier H	Downstream Raker Stud	•				Splitting along lines of spikes; decayed over lower section where previously buried in vegetation
Pier H	**Diagonal Bracing**					
Pier H	Cross bracing	•			70%	Varying amounts of corrosion; railway iron braces
Pier H	**Whaling's**					
Pier H	Whaling's		•			Buried in soil - not assessed, may be redundant
Pier H	**Pile Caps**					
Pier H	Pile Cap #1			•		Advanced EDK upstream end; extensive PDK and splitting back to RH truss corbel at downstream end
Pier H	Pile Cap #2	•				Splitting at upstream end; general weathering and splitting and EDK at downstream end
Pier H	Pile Cap #3	•				Splitting at upstream end; general weathering and splitting and EDK at downstream end
Pier H	Pile Cap #4	•				Replaced 1978; EDK downstream end

PIERS (Abutment A - Abutment J)						
Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated	Comments
		Sound / Treatment only	Investigate Further	Replace	% of Original Capacity	#1 North (Hoki) #2 South (Ross)
Pier H	**Corbels**					
Pier H	US Truss Corbel - Inside	•				Vertical splits at both ends; decay top surface
Pier H	- Outside	•				Replaced 1967 second hand
Pier H	DS Truss Corbel - Inside			•		Large CDK / EDK north end; significant decay all way along; EDK Severe *- Investigate further, likely replace*
Pier H	- Outside			•		Replaced 1967 second hand; EDK severe
Pier H	**Packers Between Pile Cap and Beam Corbel**					
Pier H	Perpendicular to corbel	•				#1 packer rotten at downstream end in under corbel; all packers likely decayed due to moisture *- Rotten packer likely redundant*
Pier H	**Parallel to corbel**	•				Sound under beams; downstream packer completely rotten *- Rotten packer likely redundant* due to moisture
Pier I	**Piles**					
Pier I	Upstream Pile	•				Splitting and EDK at top; vertical splitting and associated decay further down; sounds drummy
Pier I	Centre Pile	•				Significant splitting full length; sounds drummy but likely due to splitting; small EDK at top; excavation around pile showed pile sound below ground
Pier I	Downstream Pile	•				Minor splitting and decay; small EDK at top
Pier I	Upstream Cut Water Pile					
Pier I	Downstream Cut Water Pile	•				Large CDK / EDK at top; significant weathering, splitting and decay; appears reasonably sound at connection to raking stud; not inspected due to vegetation
Pier I	**Raker Studs**					
Pier I	Upstream Raker Stud			•		Splitting and decay at top; highly decayed at base; decay throughout
Pier I	Downstream Raker Stud	•				Large vertical split and decay at top; significant weathering and decay on sides and downstream face
Pier I	**Diagonal Bracing**					
Pier I	Cross bracing	•			80%	Light to moderate corrosion; railway iron braces
Pier I	**Whaling's**					
Pier I	Whaling's			•		Timber splitting and decayed through centre; south side buried under soil; effectively not doing anything *- Replace or may be redundant as pier is on river bank not subject to any water flow*
Pier I	**Pile Cap**			•		Heavily decayed; moist likely internally too
Abut. J	**Piles**					
Abut. J	Upstream Pile	•				Spliced at ground level 1966; splice split at top; top of splice section sounds hollow; EDK at top of original pile; original pile - pile surface soft and wet below ground level, otherwise sound
Abut. J	Centre Pile	•				Replaced 1966; some splitting
Abut. J	Downstream Pile	•				Splitting down to ground level; excavation around pile showed pile sound below ground
Abut. J	Pile Cap	•				Replaced 1944; splitting and EDK both ends; typical weathering
Abut. J	Abutment Walls - Timber facing			•		Various states of decay; collapsing at upstream end
Abut. J	Abutment Walls - Vertical Railway Irons	•		•		4 no. railway irons; various states of decay / corrosion

ROAD BEAMS, CORBELS & BRACING						
Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		Road beams Only inspected from beneath
Road Beams	US1		•			Significant weathering and splitting; large PDK outside face; PDK top surface and outside face near pier B; vegetation growing on top
Road Beams	US2		•			Significant weathering and splitting; PDK inside and outside face at northern end; PDK top surface; *- bottom half of section appears sound*
Road Beams	US3	•				Numerous PDK top surface and both sides; significant horizontal splitting through sides over top 1/2 to 2/3 section depth
Road Beams	US4	•				Weathering and splitting top surface; minor horizontal cracking in sides; numerous PDK top surface
Road Beams	US5	•				Replaced 1974; diagonal splitting on side and PDK both sides of beam at #2 Queen corbel ; PDK at northern end; drummy sound at pier D end
Road Beams	US6		•			Large PDK at north end extending from top to within 150mm of base (2/3 section gone); significant weathering and splitting; numerous PDK top surface; large PDK between #1 King and #1 Queen transoms approx. 40mm deep; dull sound at southern end; horizontal splitting
Road Beams	US7	•				Weathering , splitting and surface decay on top and both sides; numerous PDK on top surface and on sides; PDK US end between Center-#2 Queen
Road Beams	US8		•			Significant weathering; significant splitting both sides; PDK inside and outside faces; evidence of insect attack; hollow sound at north end; significant horizontal splitting PDK US between #2 King - Pier *- estimate top half of beam not contributing structurally*
Road Beams	US9			•		Significant weathering and surface decay all faces; evidence of insect attack; large PDK top surface at north end; PDK sides and underside; evidence of cement repair top; PDK under repair US
Road Beams	US10		•			Replaced 1960; large PDK inside face at south end; isolated PDK top and outside face; weathering and splitting on outside face; vertical splitting on top; evidence of insect attack; horizontal splitting DS
Road Beams	US11		•			Replaced 1933 (second hand); top surface weathering and splitting; large PDK inside face and significant vertical splitting at south end; significant weathering south end; cement repair at pier *- Investigate south end*
Road Beams	US12	•				Typical surface weathering; PDK south end US; PDK north end DS
Road Beams	US13	•				Typical surface weathering and splitting; isolated PDK top surface; evidence of insect attack; PDK bottom north end
Road Beams	US14		•			Weathering and isolated PDK to top surface and sides; horizontal splitting to sides; top 1/4 depth sounds drummy to end of corbel at south end; large horizontal split to end of corbel at north end
Road Beams	US15	•				Replaced 1966; weathering, splitting and isolated PDK top surface; significant weathering and surface decay, outside face; PDK both ends; sounds drummy at ends *- Assume top 1/4 section does not contribute structurally*
Road Beams	US16		•			Weathering and PDK, top surface; split and associated PDK, and large split in side with associated decay at south end; *- Investigate south end*
Road Beams	US17		•			Vertical and horizontal cracking with associated decay at north end; hollow sound at north end; numerous PDK top surface; splitting and PDK to sides *- Investigate further (likely replacement)*
Road Beams	US18	•				Replaced 1966; EDK
Road Beams	US19		•			Replaced 1940; advanced surface decay and weathering on top and sides; soft sound at south end
Road Beams	CN1		•			Significant weathering and splitting; PDK on downstream face at cross member; vegetation growing on top; hollow sound at pier B end
Road Beams	CN2	•				Significant weathering and splitting; PDK top surface and inside face; horizontal split and CDK at pier C
Road Beams	CN3		•			Significant weathering, splitting and associated decay top and downstream face; isolated PDK upstream face; probable end decay at pier I - Investigation end south end and PDK at mid span (upstream face)
Road Beams	CN4		•			Surface weathering; general decay; PDK on sides; horizontal split at north end *- Likely redundant*
Road Beams	DS1		•			Significant weathering and splitting; splitting and associated PDK on inside face; *- bottom half of beam appears sound*
Road Beams	DS2	•				Weathering and vertical splitting top surface; minor horizontal splitting and weathering to sides; replaced 1941; splitting and decay US; spliting US south end
Road Beams	DS3	•				Weathered north end; minor splitting

ROAD BEAMS, CORBELS & BRACING						
Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		Road beams Only inspected from beneath
Road Beams	DS4	•				Weathering and splitting top surface; minor horizontal cracking in sides; numerous PDK top surface
Road Beams	DS5		•			Significant splitting and associated PDK in top and both sides; evidence of insect attack; large PDK / EDK at both ends
Road Beams	DS6		•			Advanced surface decay and weathering; numerous PDK top surface; horizontal splitting through top half of section; estimate top 1/4 of section not contributing structurally; soft surface and dull sound at south end; PDK DS end
Road Beams	DS7	•				Replaced 1965, PDK north end splitting throughout
Road Beams	DS8	•				Replaced (est. 1950 - 1965, barrier post covering date); isolated PDK top surface; weathering and horizontal splitting on sides
Road Beams	DS9	•				Replaced 1950; numerous small PDK top surface; weathering and PDK outside face; large PDK approx. 600 long x 40 deep and approx. 1/3 section depth on outside face
Road Beams	DS10	•				Horizontal splitting US face
Road Beams	DS11		•			Weathering and decay both sides; large split and PDK at south end extending full width of section; horizontal split inside face at north end
Road Beams	DS12			•		Several large PDK along member; ply repair work both sides *- Parts of beam may be reused elsewhere*
Road Beams	DS13		•			Weathering and splitting; large PDK on outside face at north end extending to end of corbel; large vertical split from north end to first bolt; sounds hollow at north end; horizontal splitting US side
Road Beams	DS14		•			Significant weathering and splitting and associated PDK on top and both sides; large horizontal split at south end with PDK; large vertical split at north end; PDK over #2 King corbel (both sides of beam); sounds drummy both ends
Road Beams	DS15		•			Weathering and associated decay to top surface; PDK south end and sounds hollow; top half sounds drummy at north end; dull sound inside face between #1 King and #1 Queen transoms; horizontal splitting US face *- Assume top 1/4 of member does not contribute structurally*
Road Beams	DS16	•				Weathering and associated PDK top surface; weathered sides; splitting resulting in loose segments at top corners of beam; PDK DS side
Road Beams	DS17	•				Replaced 1963; splitting US face
Road Beams	DS18	•				Replaced 1940; extensive weathering and decay on outside face; weathering and PDK top surface; worm holes outside face
Road Beams	DS19		•			Significant weathering and splitting and associated PDK on top surface; large PDK to half width of member over #1 King transom; significant splitting at south end, sounds drummy out to end of corbel
Road Beams	DS20	•				Splitting and decay on top surface and sides; PDK and horizontal split outside face at south end.
Road Beams	DS21	•				Replaced 1968; minor weathering
Road Beams	DS22		•			Large PDK / EDK at both ends; Large PDK top surface at #2 King transom; significant weathering outside face; horizontal splitting north end
Road Beams	DS23	•				EDK south end; weathering, splitting and associated decay to top surface; large horizontal split at north end (approx. 600 long, near centre); hollow sound at north end
Road Beams	DS24	•				General weathering only

ROAD BEAMS, CORBELS & BRACING						
Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		Road beams Only inspected from beneath
Corbels						
Pier B	US Corbel	•				Surface decay
	Centre Corbel	•				
	DS Corbel		•			CDK southern end; large PDK outside face
Pier C	US Corbel	•				Cracking at end and small CDK starting; surface weathering and cracking on outside face
	Centre Corbel		•			EDK southern end; PDK both sides; honeycombing of upstream and downstream sides; evidence of possible insect attack
	DS Corbel	•				Splitting at ends; CDK southern end
#1 King	US Corbel	•				PDK at sides; surface decay
	DS Corbel			•	40%	PDK inside and outside extending in under beams; EDK *- Replace within 5yrs*
#1 Queen	US Corbel		•			PDK at sides of corbel extending in under beams
	DS Corbel	•				CDK starting at southern end
Centre	US Corbel	•				PDK at fixing to transom
	DS Corbel	•				PDK at fixing to transom
#2 Queen	US Corbel	•				Replaced 1966
	DS Corbel	•				PDK at sides; bolt corroded
#2 King	US Corbel	•				Replaced 1977 (second Hand); large vertical split at northern end *- Replace corroded splitter nuts*
	DS Corbel	•				Splitting at ends; PDK at fixings to transom
Pier D	US Corbel	•				CDK southern end; significant splitting and PDK outside face
	DS Corbel	•				Replaced 1944
#1 King	US Corbel	•				Replaced 1966
	DS Corbel					Replaced 1965
#1 Queen	US Corbel	•				PDK inside face near centre
	DS Corbel	•				PDK top surface and inside and outside faces
Centre	US Corbel	•				PDK both sides
	DS Corbel	•				PDK inside vertical face; surface decay and soft on sides
#2 Queen	US Corbel	•				PDK outside face at base
	DS Corbel	•				PDK outside face; large area of decay on inside top and side; PDK around bolts
#2 King	US Corbel	•				PDK both side above transom; PDK top surface inside face
	DS Corbel	•				Weathering and splitting; PDK both sides above transom; corbel is bowed

ROAD BEAMS, CORBELS & BRACING						
Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		Road beams Only inspected from beneath
Corbels						
Pier E	US Corbel	•				Replaced 1960; split at north end near centre; weathering and softening on outside surface; horizontal split inside face; end split south
	DS Corbel		•			Replaced 1977 (second hand); weathered; end split south
#1 King	US Corbel	•				PDK outside face overtop of transoms; decay at base of corbel over US transom extending approx. 150mm over transom (20mm deep); split along inside top edge; large PDK inside face
	DS Corbel		•			Significant weathering and decay inside face; large diagonal crack and associated decay extending from top surface down under beam *- Investigate further when beam is replaced*
#1 Queen	US Corbel	•				Small EDK north end; PDK both sides overtop of transoms
	DS Corbel	•				Weathering on outside face; PDK inside and outside faces
Centre	US Corbel	•				PDK inside and outside face; weathering and softening to outside surface
	DS Corbel	•				Typical weathering; PDK outside face; split and PDK linking spike holes on inside face
#2 Queen	US Corbel	•				Typical weathering and splitting; PDK over US transom
	DS Corbel	•				Split on inside face; weathered outside face
#2 King	US Corbel	•				Vertical Split
	DS Corbel	•				Typical weathering and splitting
Pier F	US Corbel	•				CDK / EDK at south end; weathered outside face; horizontal split and associated PDK outside face; significant splitting and decay to inside face; splitting at north end
	DS Corbel	•				CDK both ends; significant weathering and splitting both sides
#1 King	US Corbel		•			Surface decay to top surface extending in under beams (both sides); vertical split through centre at north end; *- Install horizontal split bolt at north end*
	DS Corbel	•				PDK
#1 Queen	US Corbel		•			Significant amount of decay at top extending in under beam (both sides of corbel)
	DS Corbel	•				Surface decay at top (inside face)
Centre	US Corbel		•			Decay at top surface extending in under beam (both sides of corbel); extensive PDK both sides
	DS Corbel		•			Decay at top surface extending in under beam (both sides of corbel); *- Likely replace*
#2 Queen	US Corbel		•			Advanced decay at top on outside *- Likely replace*
	DS Corbel	•				PDK
#2 King	US Corbel	•				
	DS Corbel	•				Decay to contract surface with transoms on inside face

ROAD BEAMS, CORBELS & BRACING						
Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		Road beams Only inspected from beneath
Corbels						
Pier G	US Corbel	•				Decay along bottom edge in contact with packers (inside face)
	DS Corbel	•				Weathered
#1 King	US Corbel	•				Weathering; isolated PDK
	DS Corbel	•				Weathering; splitting and PDK on outside
#1 Queen	US Corbel			•		Large CDK at both ends (full depth); large crack and associated decay under beam
	DS Corbel	•				PDK inside face around spikes; splitting and PDK outside face; *- Vegetation in the way on inside at transom*
Centre	US Corbel	•				Top surface decay on outside; some isolated PDK
	DS Corbel	•				Top surface cracking and associated decay; some isolated PDK
#2 Queen	US Corbel	•				Top decay on outside extending under beam; some PDK
	DS Corbel	•				Replaced 1960; weathered
#2 King	US Corbel	•				End splitting and weathering; split bolts both ends
	DS Corbel	•				Large vertical split separating two halves with split bolt at north end; sounds drummy but likely due to split *- Install split bolt at south end*
Pier H	US Corbel		•			Manmade vertical cut on south side near outside edge of pier, still approx. 600mm seating for beam; decay
	Centre Corbel	•				Replaced 1967 (second hand); surface decay upstream face
	DS Corbel		•			Isolated PDK inside face; large horizontal split and PDK under beam DS22 - Investigate PDK under beam (otherwise sound)
Pier I	US Corbel		•			Splitting and EDK both ends; numerous PDK on sides; end splitting; weathering and decay
	Centre Corbel	•				Surface decay and splitting both ends; end splitting; weathering and decay
	DS Corbel		•			CDK / PDK and splitting both ends; end splitting; weathering and decay

ROAD BEAMS, CORBELS & BRACING						
Structural Element		Structural Assessment / Recommendation			Estimated	Comments
		Sound / Treatment only	Investigate Further	Replace	% of Original Capacity	Road beams Only inspected from beneath
Cross Bracing, Solid Blocking and Tie Rods						
Span AB	Solid Blocking			•		4 no. at 1/3 points; various states of decay; blocks falling out - *Replace / reinstate*
	Tie Rods	•				Rods generally ok; some nuts missing - *Replace nuts*
Span BC	Solid Blocking			•		4 no. at 1/3 points; various states of decay; blocks falling out - *Replace / reinstate*
	Tie Rods	•				Rods generally ok; some nuts missing - *Replace nuts*
Span CD	**Cross Bracing**					
Pier C to #1K	US				20%	
	DS				75-90%	Sound
#1K to #1Q	US				20%	
	DS				30%	
#1Q to Centre	US				70%	Sound
	DS				60%	
Centre to #2Q	US				70%	
	DS				80%	
#2Q to #2K	US				0%	Broken detached at 2K end
	DS				0%	Broken
#2K to Pier D	US				5%	Pitch point at pier end
	DS				30%	Heavily corroded at pier end; otherwise sound
Span DE	**Cross Bracing**					
Pier D to #1K	US				40%	Heavy corrosion at pier end
	DS				30%	40% at pier end; 70% under US beam; otherwise sound
#1K to #1Q	US				0%	25% at both ends, broken centre rod
	DS				10%	Ineffective at K1 end
#1Q to Centre	US				40%	
	DS				50%	Bent
Centre to #2Q	US				50%	
	DS				0%	Broken at 2Q end
#2Q to #2K	US				5%	Rail iron heavily corroded along lenth
	DS				50%	Rail iron heavily corroded along lenth
#2K to Pier E	US				40%	
	DS				0%	Broken at piers end
Span EF	**Cross Bracing**					
Pier E to #1K	US				0%	gone at King Transom; 30% at pier end; gone at 1K
	DS				70%	
#1K to #1Q	US				0%	Broken/gone
	DS				20%	
#1Q to Centre	US				40%	
	DS				0%	0% at centre transom end; 50% along rod; sound at #1Q transom; nut missing 1Q end
Centre to #2Q	US				50%	Sound at ends
	DS				50%	50% at coupler under US beam; 60% under DS beam; otherwise sound
#2Q to #2K	US				70%	
	DS				50%	Railway iron replacement; heavily corroded along full length
#2K to Pier F	US				0%	0% and 0% at ends; 70% along rod
	DS				30%	30% at #2K end; 80% along rod

ROAD BEAMS, CORBELS & BRACING						
Structural Element		Structural Assessment / Recommendation			Estimated	Comments
		Sound / Treatment only	Investigate Further	Replace	% of Original Capacity	Road beams Only inspected from beneath
Cross Bracing, Solid Blocking and Tie Rods						
Span FG	**Cross Bracing**					
Pier F to #1K	US				90%	Sound
	DS				0%	Completely gone at #1K end; 80% along rod; broken at 1K
#1K to #1Q	US				70%	
	DS				0%	0% both ends; 40% along rod
#1Q to Centre	US				0%	60% at coupler under US beam; 80% under DS beam; otherwise sound; broken at coupler
	DS				30%	60% under beams; otherwise sound
Centre to #2Q	US				0%	Sound at ends; broken at coupler
	DS				50%	60% under beams; otherwise sound
#2Q to #2K	US				0%	0% at #2K transom; 30% at coupler under US beam; otherwise sound
	DS				0%	gone at #2K end; otherwise sound *- Replace from centre to #2K end*
#2K to Pier G	US				40%	Pier G end
	DS				30%	Pier G end
Span GH	**Cross Bracing**					
Pier G to #1K	US				0%	Broken at #1K transom; remaining rod >60%
	DS				60%	Pier G end
#1K to #1Q	US				10%	10% and 30% at ends; 60% along rod
	DS				20%	20% at #1Q end; remaining rod >80%
#1Q to Centre	US				80%	Railway iron replacement; corroded significantly
	DS				70%	
Centre to #2Q	US				0%	Rod completely gone at centre transom end; 50% along rod; sound at #2Q end
	DS				40%	sound at eyes
#2Q to #2K	US				60%	
	DS				30%	30% under DS beam; 50% under US beam; sound at ends
#2K to Pier H	US				20%	20% at pier end; 70% under US beam
	DS				40%	Pier H end
Span HI	Solid Blocking	•				4 no. at 1/3 points; various states of decay; blocks falling out; one block missing *- Replace / reinstate*
	Tie Rods	•				Rods generally ok; some nuts missing *- Replace nuts*
Span IJ	Solid Blocking	•				4 no. at 1/3 points; various states of decay; blocks falling out *- Replace / reinstate*
	Tie Rods	•				Rods generally ok; some nuts missing *- Replace nuts*

Appendix D
Typical Defect Photos

Moderate to Heavy Bottom Chord Corrosion.

Critical Bottom Chord Corrosion.

Typical Timber Splitting – Top Chord Shown.

Typical Timber Splitting – King Strut Shown.

Typical Weathered Timber and Ponding Moisture.

Typical Weathered Timber.

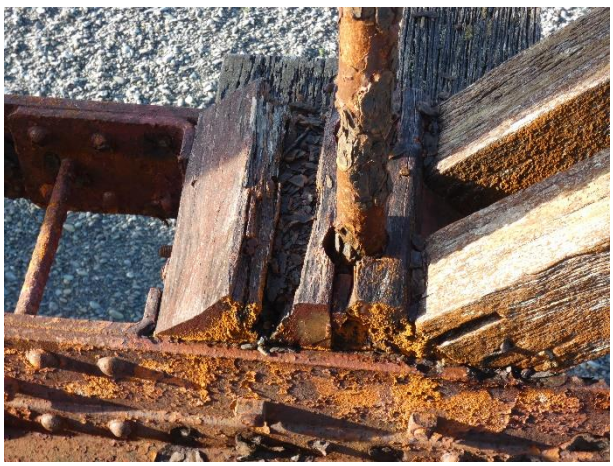
Typical Corroded (Pack Rusting) Hanger Rods – Heavy to Critical Corrosion Shown.

Timber Decay – Heavy to Critical Decay Shown.

Typical Decay and Loss of Timber Section at Connections – Top of Wind Brace Shown.

Typical Decay and Loss of Timber Section at Connections – Bottom of Wind Brace Shown.

Typical Decay of Top Blocks.



Typical Splitting and Section Loss of Thrust Blocks.

Typical Moderate Decay of ‘A’ Block.

Typical Heavy to Critical Decay of ‘A’ Block.

Corrosion of Truss Connection Plates.

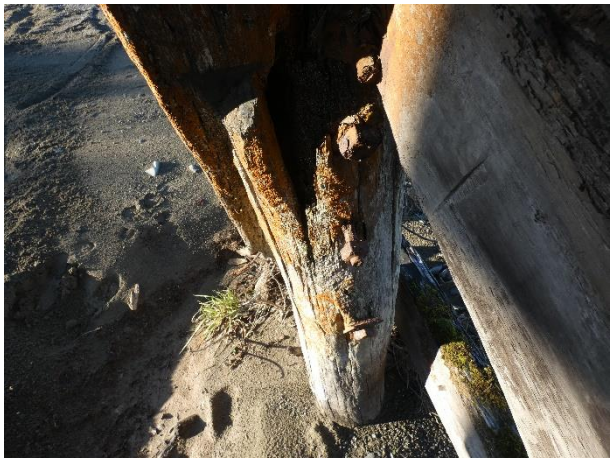
Corrosion and Loss of Fixing Components. Missing Nut and Necked Bolt Shown.

Typical Loose Fixings. Corroded Steel Components.

Widespread Loss of Deck Bracing Due to Corrosion.

Missing Pier Waling Timbers

Typical Decay of Pier Cap Timbers



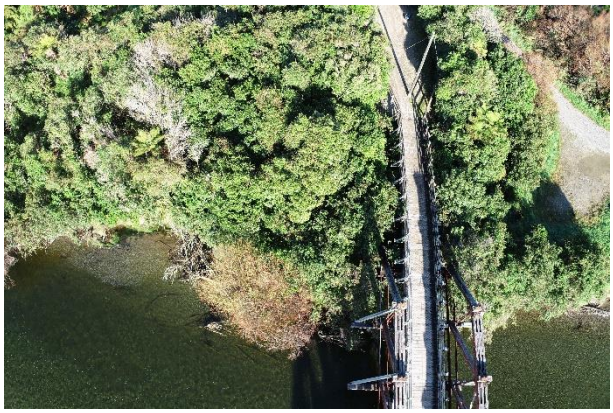
Typical Decay of Pier Piles

Typical Splitting and Decay of Pier Piles

Vegetation Growth From Timber Decay Pockets

Debris Caught on Piers Causing Local Scour.

Approach Spans Shrouded in Dense Vegetation. Northern Approach.



Approach Spans Shrouded in Dense Vegetation. Southern Approach.

Moisture in Timber Components. Reduced Air Flow for Drying due to Vegetation.

Dislodged and Missing Timber Bracing Blocks Typical.

Observation – Flow Favours True Left of River as this is the Outside of the Curved Alignment. Significant Gravel Deposition.

Pier G and Underside of Span G-H not inspected due to Channel Location. Main Channel is Deep. Pile Embedment Depth Unknown.

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REPORT

Totara River Bridge
Structural Condition Assessment - Preliminary

Prepared for Westland District Council

AUGUST 2010

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1	Dec 09	Draft for Client Comment	JD	JS	J Strange
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WESTLAND DISTRICT COUNCIL

Totara River Bridge
Structural Condition Assessment – Preliminary

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LIST OF FIGURES

1 Executive Summary

This report was prepared for the Westland District Council to assess the structural condition of the Totara River Bridge.

The on-site visual condition assessment showed that there are considerable variations in the condition of the various structural members. A large portion of the structural members are in sound condition and require only treatment to treat decay and weathering that has occurred and to prolong the life of the members. A small portion of the members have undergone significant decay and corrosion and now require replacement. The remaining members require further investigation to determine if treatment or replacement is required.

Intrusive investigations and detailed structural analysis were not carried out as part of this assessment.

We recommend the following processes be carried out to determine the extent and cost of renewal and maintenance works on the bridge:

1. Carry out a structural assessment
2. Carry out intrusive investigation
3. Prepare recommendations for remedial and maintenance works to the bridge
4. Prepare rough order cost estimates for the renewal and maintenance works

2 Introduction

As requested by Westland District Council, MWH New Zealand Ltd carried out a visual baseline inspection of the Totara River Bridge.

The Totara River Bridge formed part of the Hokitika to Ross Railway Line which was closed in 1980. Westland District Council are proposing to use this bridge as a pedestrian / cycle bridge as part of a proposed cycle way between Hokitika and Ross.

3 Inspection

A visual baseline inspection was carried out over eight days on 19, 20, 21, 23, and 27 October and 03, 25, and 26 November. The inspection was carried out by John Strange and Jason Davidson. Assistance for inspection was provided by the following:

- Dean Arthur (Due West Ltd) - assistance with safety ropes and lines for all work at heights.
- Dave Hawes (Department of Conservation) - assisted with the inspection on 19 October to provide input into inspection and recording techniques, based on his previous experience with similar structures whilst working for NZ Rail and the Department of Conservation.

4 Bridge Description

The Totara River Bridge is the southernmost rail bridge on the old Hokitika to Ross Railway. The Railway was opened on 01 April 1909 following completion of the Totara River Bridge and closed 71 years later in November 1980[1]. Some time following the closure of the railway from Hokitika to Ross, the railway lines and decking on the Totara River Bridge were removed.

1. Mahinapua Creek Railway Bridge – Conservation Plan prepared by Chris Cochran, 30 July 1999

Following removal of the decking (sleepers) only the main longitudinal beams were left remaining. The bridge currently has a timber barrier / balustrade fixed to the downstream beam (refer Figure 4-4). We understand that the Westland District Council had this installed to enable walking access to be maintained across the bridge as the bridge is regularly used by a local farmer to access his land and livestock on the northern side of the Totara River.

The Totara River Bridge is a nine span timber bridge constructed predominantly of what we understand to be Australian Hardwood timbers, and "steel" bracing and tension members. There was a transition from the use of black iron to steel during the period from 1880 to 1910 and during this period it was common for both materials to be used in construction.

The bridge is made up of nine spans with the first two spans constructed using simply supported timber beams and the central five spans, being much longer are Howe Trusses. Figure 4-1 on the following page shows a typical Howe Truss and Table 4-1 below shows the construction of each span.

Table 4-1 : Bridge Spans

Span Number	Structure Description
Span #1	Simply supported timber beams
Span #2	Simply supported timber beams
Span #3	Howe Truss (Standard Railway 80ft truss)
Span #4	Howe Truss (Standard Railway 80ft truss)
Span #5	Howe Truss (Standard Railway 80ft truss)
Span #6	Howe Truss (Standard Railway 80ft truss)
Span #7	Howe Truss (Standard Railway 80ft truss)
Span #8	Simply supported timber beams
Span #9	Simply supported timber beams

The bridge superstructure is supported on timber piers. The timber piers supporting the longer Howe truss spans (river spans) consist of ten piles and the piers supporting the shorter simply supported spans (land spans) and forming the abutment walls consist of five and three piles respectively. Figures 4-2 and 4-3 on the following pages show typical piers supporting both river and land spans.

The hardwood piles forming the piers appear to have been driven and all piles generally have markings to enable the depth of pile below ground level to be determined.

A plan of the bridge which outlines the numbering system for the piers and spans etc is included in Appendix A of this report and Appendix B includes a typical drawing of an 80ft span Howe Truss.

Figure 4-1 : Typical Howe Truss Span (Span 6 – Downstream)

Figure 4-2 : Typical End Span (Spans 8 and 9 – Southern End)

Figure 4-3 : Typical River Pier (Pier No. 7)

Figure 4-4 : Typical View North Along Bridge

5 Bridge Inspection

5.1 Inspection Methodology

The structural inspection of the bridge involved visually inspecting all members / elements. In addition to the visual inspections, timber members were "hammer tested" to check for signs of internal decay. This involved striking the timber members with a hammer and listening to the pitch of the sound which alters with changes in timber density. Intrusive investigations were not carried out as part of these inspections.

In addition to this, excavations were carried out by Westroads Ltd with an excavator down alongside a number of piles to check the condition of these piles at and below existing ground level.

This inspection methodology was used to classify members into the following three categories:

1. ***Member sound, treatment only required***: Members in this category are typically sound and may or may not exhibit one or more of the following signs of decay:
    - No, or limited, signs of centre decay
    - No, or limited, sign of end decay
    - Minor isolated pocket decays
    - Minor surface weathering / decay
    - Minor splitting and associated decay
    - Corrosion of steel members

    In some instances, an assumption has been made during the inspection as to the required member capacity for the intended future use of the structure. Taking this into account some members with greater decay / corrosion have been classed as "sound – treatment only" if they appear to have a sufficient amount of redundancy. For example a steel member with corrosion that has reduced the cross section considerably but which is likely to have sufficient redundancy for the intended future use of the structure.
2. ***Further investigation required***: Members in this category are suspect and exhibit one or more of the following signs of decay:
    - Signs of centre decay where the extent of the decay is unknown (i.e. dull sound)
    - Significant end decay extending into / along member where the extent is unknown
    - Significant pocket decays where the depth / extent is unknown
    - Significant splitting and / or decay where the depth / extent is unknown
    - Heavy corrosion of steel members

    Further investigation is likely to involve core drilling of timbers to assess the extent of any decay and in a number of cases will also include a structural load assessment to determine the required size of members.
3. ***Member requires replacement***: Members in this category are typically heavily decayed or corroded. The following criteria has been used to classify members into this category and further investigation (i.e. structural calculations) may be required to confirm assumptions that have been made:
    - Steel members with >50% loss of cross section
    - Timber members that are decayed to an extent where treatment is no longer an option, i.e. large centre decays reducing cross section

The above classifications do take into account the intended future use of the structure, being a pedestrian / cycle bridge. These classifications therefore take account of the significant redundancies in some members and some assumptions have been made on site as to the required capacity / size of some members for the intended future use of this structure.

Figures 5-1 to 5-4 below and on the following pages show the classification of some structural members.

Figure 5-1 : Top Chord of Timber Trusses – Minor Weathering / Splitting Only, "Sound"

Figure 5-2 : Saddle Block – Large Centre Decay Back Beyond Tension Rod, "Requires Replacement"; A-Block (Top Thrust Block), "Sound"

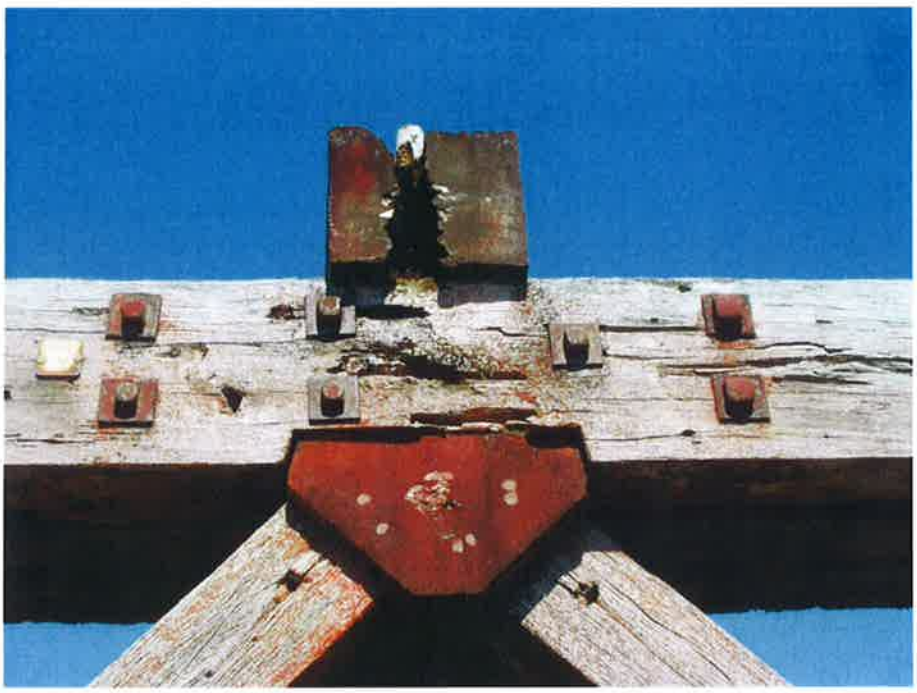


Figure 5-3 : Lateral Braces – Members Completely Decayed at Ends, "Requires Replacement"

Figure 5-4 : King Strut – Significant Surface Decay, Pocket Decay and Splitting, "Investigate Further"

The structural inspections were carried out by John Strange (Senior Engineer) and Jason Davidson (Structural Engineer). Dave Hawes (Department of Conservation) also spent one day (19 October 2009) on site assisting with the structural inspections.

5.2 Inspection Results

The structural inspection of the bridge showed that there is considerable variation in the condition of the various structural elements. When this structure was in service it was subject to regular checks and maintenance by Railways. When timber members were replaced by Railways, the date was chiselled into the surface of the new timber to indicate its age. There are a large number of timber members that have been replaced with dates ranging from 1928 for the earliest replacements to 1978 for the last members replaced before closure of the railway line. A number of those members replaced have been replaced with second hand members, denoted by an "SH" chiselled into the face of the member with the date of replacement. Many of these timber members that have been replaced, and particularly those replaced toward the end of the bridges service period, are in noticeably better condition than those older timber members.

As a result of the exposed location of the bridge in close proximity to the sea, some elements have undergone significant weathering, particularly where they face the prevailing westerly winds. Steel elements including cross bracing, tension rods, bottom truss chord and bolts are typically heavily corroded. Timber members show various signs of decay including surface decay and weathering (particularly on faces exposed to the prevailing weather), small isolated pocket decays typically where there are penetrations in the wood surface allowing moisture into the timber, end decays where the ends of the timber members are exposed to the weather and centre decays where the softer centre of the hardwood timber members have started to decay.

Detailed inspection results are included in Appendices C, D, E and F of this report.

6 Recommendations

We recommend that to more accurately quantify the extent and cost of remedial and maintenance works required to bring this structure up to a standard suitable for a pedestrian / cycle bridge, the following works be carried out:

1. ***Structural Assessment:***

Carry out a desktop structural assessment to determine required sizes of members (steel and timber) for the future intended purpose of the structure.

This would include modelling the bridge to assess loads through individual members and connections and enable treatment or replacement of members to be more accurately quantified.

2. ***Intrusive Investigation:***

Following determination of member and connection requirements by structural assessment, those members currently classified as "investigate further" could be investigated by intrusive methods to confirm whether or not they meet structural requirements. If so they would be reclassified as "treatment required" and if not would be reclassified as "require replacement".

Investigation would involve carrying out core drilling of timber members.

3. ***Recommendations for Renewal / Maintenance Works***

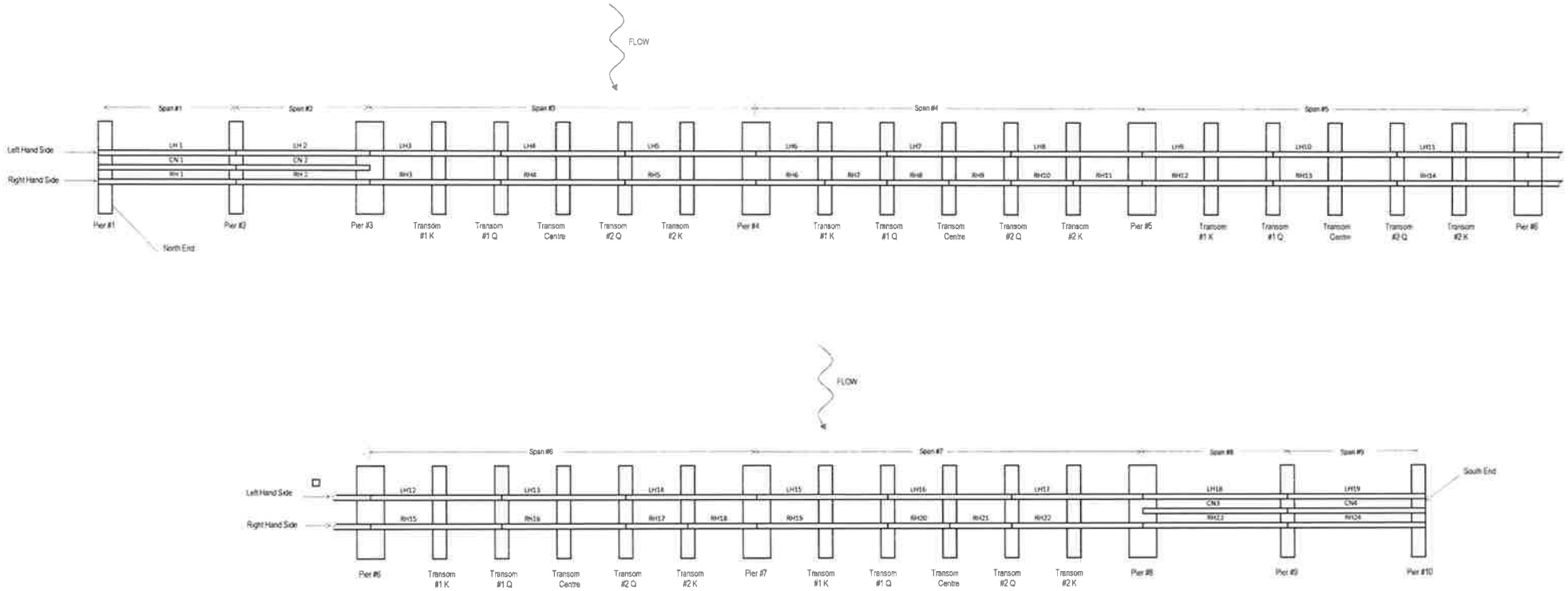
Prepare recommendations for renewal and maintenance works. These recommendations would be classified as immediate, short term and long term

4. ***Rough Order Cost Estimates***

Prepare rough order cost estimates for renewal and maintenance works.

Appendix A:

- **Indicative Plan of Totara River Bridge**
- **Pier Pile Plan**
- **Truss Elevation**
  (3 pages total)



PLAN - TOTARA RIVER BRIDGE

MWH

BUILDING A BETTER WORLD

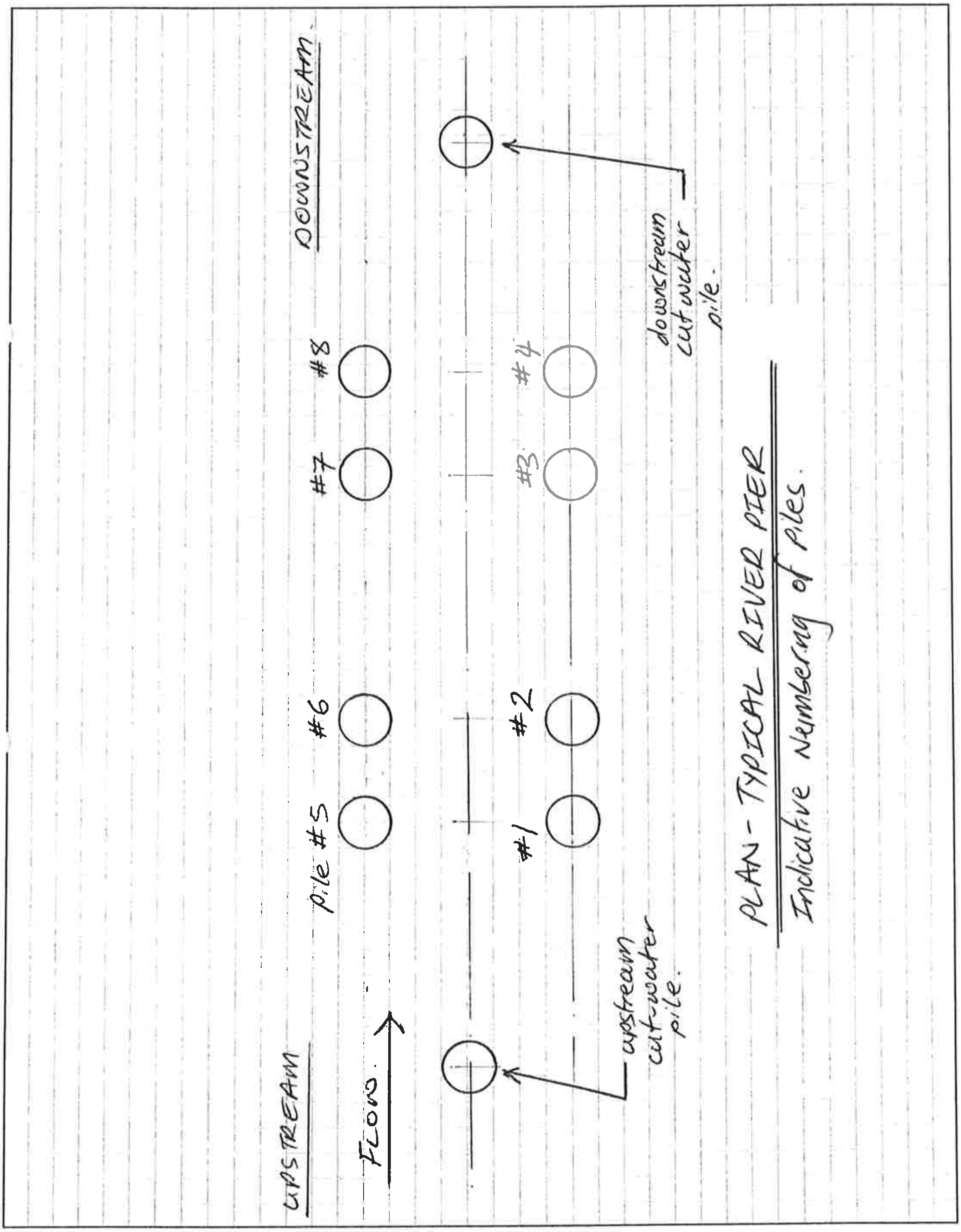
PROJECT WDC Totara River Bridge PROJECT NO. Z1845700

DESCRIPTION PLAN - RIVER PIER (Numbering Convention

PREPARED BY JKD DATE

CHECKED BY DATE

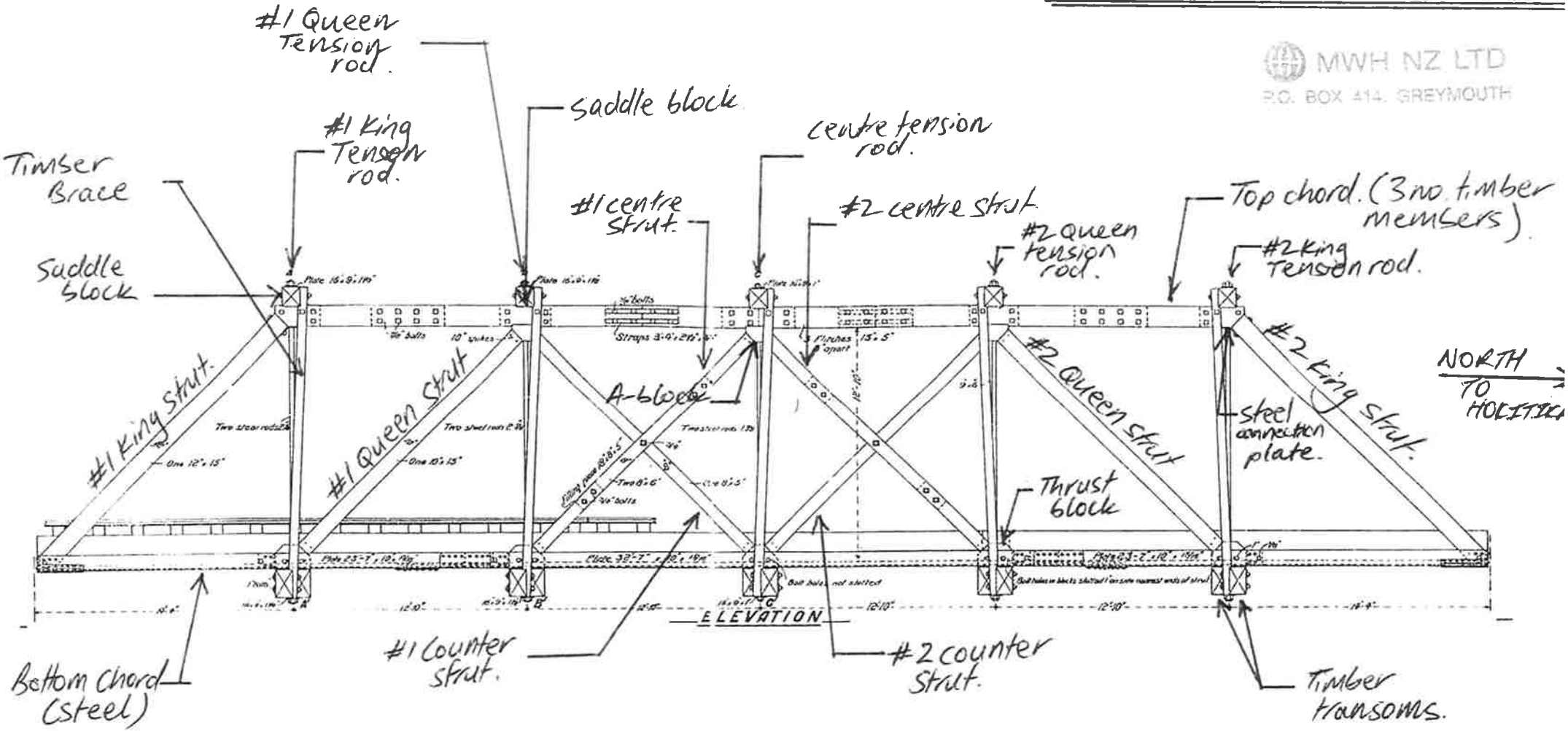
REF/DWGS SHEET 1 OF 1



Z1845700.

NDC TOTAKA RIVER BRIDGE.

MWH NZ LTD
P.O. BOX 414, GREYMOUTH



ELEVATION – Downstream Truss (viewed from inside)

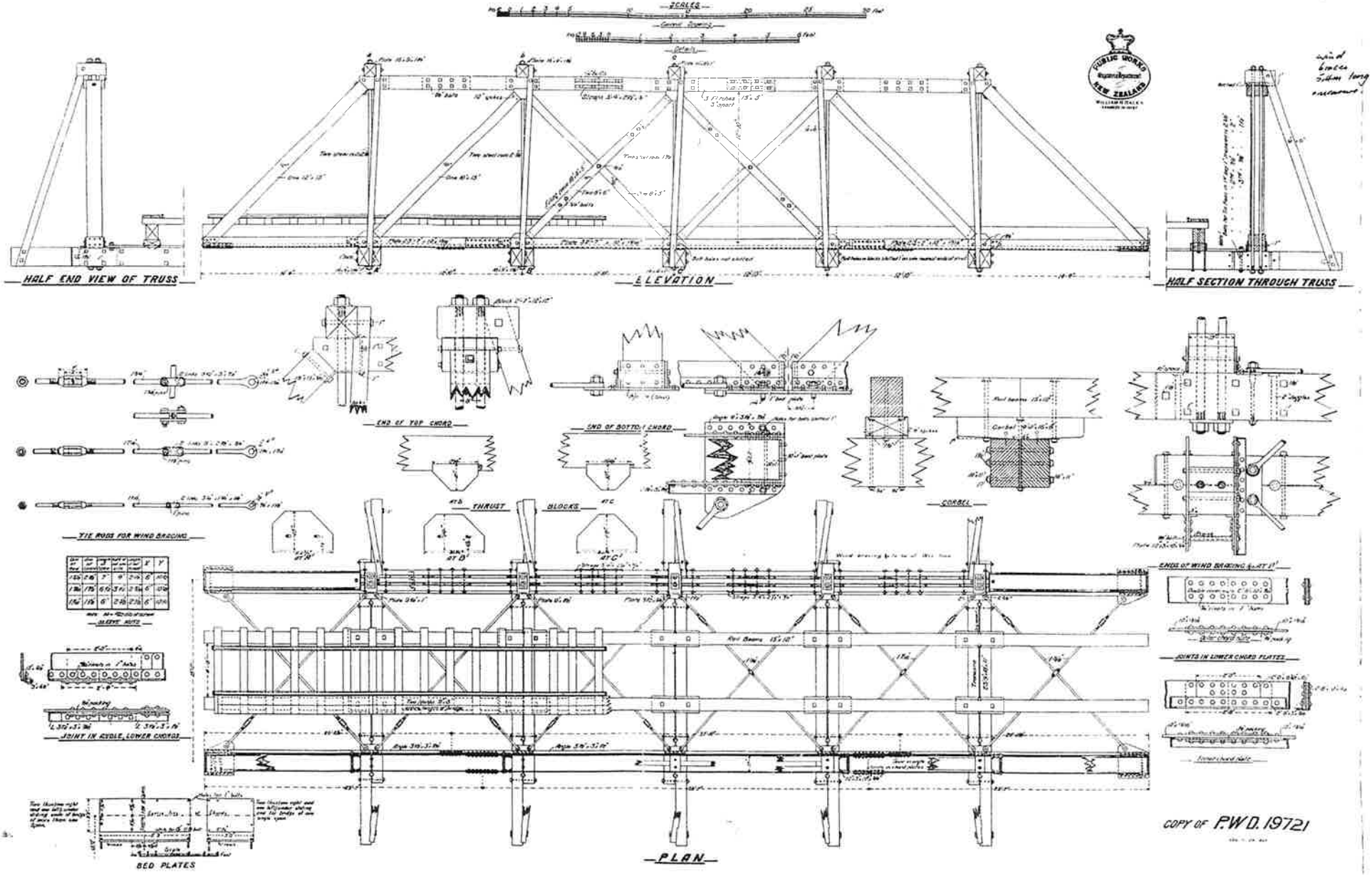
Typical Naming conventions for members of Howe Truss

Not to scale
Indicative only.

Appendix B:

- **Typical Construction Drawing – 80ft Howe Truss**
  (1 page)

TRUSS 80 Ft. SPAN – STEEL LOWER CHORD



GR. 1968

Appendix C: Inspection Results – Trusses (10 pages)

Definition of terminology used

- "PDK" – Pocket Decay
- "EDK" – End Decay
- "CDK" – Centre Decay

TOTARA RIVER BRIDGE - TRUSSES

Span	Side	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
			Sound / Treatment only	Investigate Further	Replace		
3	LH	**Timber Struts**					
		#1 - King Strut		•		50%	Significant weathering and deep cracking top surface; bottom half section sound; large PDK at base
		#1 - Queen Strut		•		50%	Heavy weathering and deep cracking top surface; bottom half section sound;
		#1 - Counter Strut		•			Large split through centre; large PDK at base
		#1 - Centre Strut - Inside		•			Bottom sounds drummy; PDK inside face; splitting
		- Outside		•			Large PDK at base; top surface weathering and splitting
		#2 - Centre Strut - Inside		•			Sounds drummy,
		- Outside		•			PDK inside face; sounds drummy at top
		#2 - Counter Strut		•			Vertical splitting at top; sounds drummy
		#2 - Queen Strut		•		50%	PDK top face; weathering and splitting top face
		#2 - King Strut	•			50%	Large horizontal split inside face; significant weathering / splitting on top surface
		Vertical Steel Tension Rods					
		#1 - King Rods - Inside	•			80%	Heavily corroded
		- Outside	•			70%	Heavily corroded
		#1 - Queen Rods - Inside	•			70%	Heavily corroded
		- Outside	•			70%	Heavily corroded
		#1 - Centre Rods - Inside	•			50%	Heavily corroded
		- Outside	•			50%	Heavily corroded
		#2 - Queen Rods - Inside	•			80%	Heavily corroded
		- Outside	•			60%	Heavily corroded
		#2 - King Rods - Inside	•			90%	Heavily corroded
		- Outside	•			70%	Heavily corroded
		Timber Thrust Blocks					
		#1 - King Timber Thrust Block	•				
		#1 - Queen Timber Thrust Block		•			Large PDK at outside rod
		Centre Timber Thrust Block	•				
		#2 - Queen Timber Thrust Block	•				
		#2 - King Timber Thrust Block	•				
		Timber A-Blocks					
		#1 - Queen A-Block	•				
		Centre A-Block	•				
		#2 - Queen A-Block	•				
		Timber Saddle Blocks					
		#1 - King Saddle Block			•		Large CDK; sounds hollow
		#1 - Queen Saddle Block		•			Weathered with large splits on top; sounds drummy
		Centre Saddle Block		•			Large CDK inside end
		#2 - Queen Saddle Block		•			CDK inside end; otherwise appears sound
		#2 - King Saddle Block	•				Typical EDK and weathering; otherwise sound
		Top Chord					
		#1 King - #1 Queen - Inside			•		Large PDK; significant weathering
		- Middle		•			
		- Outside		•			
		#1 Queen - Centre - Inside	•				
		- Middle	•				Significant weathering
		- Outside	•				Significant weathering
		Centre - #2 Queen - Inside	•				Surface weathering
		- Middle	•				
		- Outside		•			Sounds drummy
		#2 Queen - #2 King - Inside	•				
		- Middle		•			EDK at king strut; large PDK near #2 queen
		- Outside		•			Sounds Drummy
		Bottom Chord					
		Steel Bottom Chord	•			80%	Heavy corrosion, King strut seatings at piers sound
		Steel Connection Plates					
		#1 King Strut to top chord	•			70%	Heavily corroded; bolts gone
		#2 King Strut to top chord	•			80%	Heavily corroded; bolts gone
		Timber Braces					
		#1 - King Timber Brace			•		EDK top end
		#1 - Queen Timber Brace			•		EDK top end
		Centre Timber Brace	•				EDK top end; connection to saddle block OK, bolt / nuts corroded
		#2 - Queen Timber Brace			•		EDK top end
		#2 - King Timber Brace			•		EDK top end

TOTARA RIVER BRIDGE - TRUSSES

Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
3	RH	**Timber Struts**						
		#1 - King Strut			•			Sounds Drummy
		#1 - Queen Strut			•			Replaced 1966; Sounds drummy lower portion
		#1 - Counter Strut		•				Vertical splitting through top surface full length
		#1 - Centre Strut	- Inside		•			PDK at thrust block; Splitting and Pad top surface
			- Outside	•				PDK outside face around bolts
		#2 - Centre Strut	- Inside		•			
			- Outside	•				
		#2 - Counter Strut		•				PDK outside face; vertical splitting
		#2 - Queen Strut			•			Surface weathering; dull sound at base
		#2 - King Strut			•			Surface weathering; insect holes noted near top
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			70%	
			- Outside	•			70%	
		#1 - Queen Rods	- Inside	•			80%	
			- Outside	•			90%	
		#1 - Centre Rods	- Inside	•			80%	
			- Outside	•			80%	
		#2 - Queen Rods	- Inside	•			70%	
			- Outside	•			70%	
		#2 - King Rods	- Inside		•		30%	
			- Outside		•		30%	
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block				•		Significant decay top surface; large PDK between rods and on outside of rods
		#1 - Queen Timber Thrust Block		•				
		Centre Timber Thrust Block		•				
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				
		Timber A-Blocks						
		#1 - Queen A-Block		•				
		Centre A-Block		•				
		#2 - Queen A-Block		•				
		Timber Saddle Blocks						
		#1 - King Saddle Block			•			Large CDK inside end
		#1 - Queen Saddle Block		•				Typical EDK and weathering
		Centre Saddle Block		•				CDK inside end; significant decay / weathering on top surface
		#2 - Queen Saddle Block		•				
		#2 - King Saddle Block			•			Small CDK inside end; several PDK's on northern face
		Top Chord						
		#1 King - #1 Queen	- Inside		•			Remove vegetation at end and investigate further
			- Middle		•			Replaced 1950; remove vegetation at end and investigate further
			- Outside		•			Remove vegetation at end and investigate further
		#1 Queen - Centre	- Inside	•				Significant surface decay top surface
			- Middle	•				
			- Outside	•				
		Centre - #2 Queen	- Inside	•				Surface decay inside face
			- Middle	•				Weathered
			- Outside	•				Weathered
		#2 Queen - #2 King	- Inside		•			Replaced 1933 (second hand); large PDK inside face at bolt group
			- Middle	•				Weathered
			- Outside	•				Weathered
		Bottom Chord						
		Steel Bottom Chord		•			60 - 80%	Heavy corrosion, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•			60%	Heavy corrosion; bolts gone
		#2 King Strut to top chord		•			90%	Heavy corrosion; bolts gone
		Timber Braces						
		#1 - King Timber Brace				•		EDK top end
		#1 - Queen Timber Brace				•		EDK top end
		Centre Timber Brace				•		EDK top end; large PDK (approx. half section gone)
		#2 - Queen Timber Brace				•		EDK top end; extensive splitting throughout
		#2 - King Timber Brace		•				PDK at connection to transom

TOTARA RIVER BRIDGE - TRUSSES

Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
4	LH	**Timber Struts**						
		#1 - King Strut		•			50%	Significant weathering / cracking top surface; small PDK at base; top half of section sounds dull
		#1 - Queen Strut		•			50%	Significant weathering / cracking top surface; small PDK at base; top half of section sounds dull
		#1 - Counter Strut		•				Small PDK inside face at base; splitting in top surface
		#1 - Centre Strut	- Inside	•				Some splitting along inside face
			- Outside	•				Some surface splitting
		#2 - Centre Strut	- Inside	•				PDK on top surface
			- Outside	•				Some splitting top surface
		#2 - Counter Strut		•				Split in top surface full length of member
		#2 - Queen Strut			•			Deep splitting / weathering in top surface
		#2 - King Strut		•				Replaced 1944
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			80%	Heavy corroded
			- Outside	•			80%	Heavy corroded
		#1 - Queen Rods	- Inside	•			60%	Heavy corroded
			- Outside	•			80%	Heavy corroded
		#1 - Centre Rods	- Inside	•			90%	Heavy corroded
			- Outside	•			60%	Heavy corroded
		#2 - Queen Rods	- Inside	•			70%	Heavy corroded
			- Outside	•			70%	Heavy corroded
		#2 - King Rods	- Inside	•			60%	Heavy corroded
			- Outside	•			60%	Heavy corroded
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block		•				
		#1 - Queen Timber Thrust Block		•				
		Centre Timber Thrust Block		•				
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				
		Timber A-Blocks						
		#1 - Queen A-Block		•				Small CDK
		Centre A-Block		•				
		#2 - Queen A-Block			•			CDK approx. 120mm diameter
		Timber Saddle Blocks						
		#1 - King Saddle Block		•				CDK inside end approx. 50mm diameter
		#1 - Queen Saddle Block		•				Surface decay on top extending down into saddle block
		Centre Saddle Block		•				CDK inside end approx. 40mm diameter
		#2 - Queen Saddle Block		•				
		#2 - King Saddle Block		•				CDK inside end approx. 20mm diameter; Pad at drill holes on northern face.
		Top Chord						
		#1 King - #1 Queen	- Inside	•				Weathered
			- Middle	•				Replaced 1933 (second hand); weathered
			- Outside	•				Weathered
		#1 Queen - Centre	- Inside	•				Weathered
			- Middle	•				Weathered
			- Outside		•			Large PDK at end or flitch (approx. half section missing)
		Centre - #2 Queen	- Inside	•				
			- Middle	•				PDK top surface and inside face; weathered
			- Outside	•				PDK top surface; weathered
		#2 Queen - #2 King	- Inside	•				Weathered
			- Middle	•				Significant weathering and Isolated PDK
			- Outside		•			Significant weathering and Isolated PDK; dozy near #2 king Timber brace connection.
		Bottom Chord						
		Steel Bottom Chord		•			80%	Typically heavily corroded, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•			90%	Heavily corroded; bolts gone
		#2 King Strut to top chord		•			80%	Heavily corroded; bolts gone
		Timber Braces						
		#1 - King Timber Brace		•				
		#1 - Queen Timber Brace		•				Nuts missing from bolts
		Centre Timber Brace		•				
		#2 - Queen Timber Brace			•			Large PDK at base; bolts fully corroded
		#2 - King Timber Brace		•				Split at bolt otherwise sound

TOTARA RIVER BRIDGE - TRUSSES

Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
4	RH	**Timber Struts**						
		#1 - King Strut		•				Significant surface weathering top surface; several PDK top surface.
		#1 - Queen Strut		•				Weathered top surface
		#1 - Counter Strut			•			Split and PDK top surface
		#1 - Centre Strut	- Inside	•				Some vertical cracking noted
			- Outside	•				Some vertical cracking noted
		#2 - Centre Strut	- Inside		•			Some surface decay and splitting at base
			- Outside		•			Large vertical split full length; surface decay
		#2 - Counter Strut		•				Splitting in top surface full length
		#2 - Queen Strut			•			Cracking in top surface; sounds hollow from 1m below A-block
		#2 - King Strut		•				Weathered top surface; isolated PDK inside surface
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			50%	Heavily corroded
			- Outside	•			40%	Heavily corroded
		#1 - Queen Rods	- Inside	•			30%	Heavily corroded
			- Outside	•			30%	Heavily corroded
		#1 - Centre Rods	- Inside	•			40%	Heavily corroded
			- Outside	•			40%	Heavily corroded
		#2 - Queen Rods	- Inside	•			70%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		#2 - King Rods	- Inside	•			70%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block		•				
		#1 - Queen Timber Thrust Block		•				
		Centre Timber Thrust Block		•				
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				
		Timber A-Blocks						
		#1 - Queen A-Block		•				
		Centre A-Block		•				
		#2 - Queen A-Block		•				Small CDK inside end
		Timber Saddle Blocks						
		#1 - King Saddle Block		•				Small CDK and splitting inside end; significant EDK outside end to beyond brace connection
		#1 - Queen Saddle Block		•				EDK outside end
		Centre Saddle Block		•				Advanced CDK
		#2 - Queen Saddle Block			•			Small CDK inside end; significant EDK outside end to beyond Timber brace connection; sounds hollow
		#2 - King Saddle Block			•			Large CDK inside end up to 150mm diameter; surface decay; sounds hollow; investigate and treat / replace
		Top Chord						
		#1 King - #1 Queen	- Inside		•			Weathered; sounds hollow
			- Middle		•			Large PDK inside face approx. 50mm deep; weathered
			- Outside		•			Large PDK, approx half cross section missing
		#1 Queen - Centre	- Inside	•				
			- Middle	•				
			- Outside	•				EDK at splice connection
		Centre - #2 Queen	- Inside	•				Weathered
			- Middle	•				Weathered
			- Outside	•				Weathered; small PDK top surface
		#2 Queen - #2 King	- Inside		•			Weathered; split; PDK inside flitch below saddle; sounds hollow
			- Middle	•				Weathered; split
			- Outside	•				Weathered; split
		Bottom Chord						
		Steel Bottom Chord		•			70%	Moderate to heavy corrosion, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•				
		#2 King Strut to top chord		•			70%	Heavily corroded
		Timber Braces						
		#1 - King Timber Brace		•				PDK at base; weathered and splitting
		#1 - Queen Timber Brace		•				Large split from top end through bolted connection; install split bolt
		Centre Timber Brace		•				
		#2 - Queen Timber Brace			•			Significant cracking; hollow sound
		#2 - King Timber Brace		•				Split in end; large PDK at connection to transom

TOTARA RIVER BRIDGE - TRUSSES

Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
5	LH	**Timber Struts**						
		#1 - King Strut			•			Significant weathering / cracking top surface; small PDK at base; top half of section sounds dull
		#1 - Queen Strut		•			50%	Weathered top surface with large splits down centre; PDK and split on underside
		#1 - Counter Strut			•			PDK top surface
		#1 - Centre Strut	- Inside	•				Vertical splitting full length; some horizontal splitting on sides
			- Outside		•			Significant vertical splitting and decay of top surface; horizontal splitting inside face
		#2 - Centre Strut	- Inside			•		Large horizontal crack full length; significant surface decay and PDK
			- Outside			•		Significant splitting and PDK at base; large split at top
		#2 - Counter Strut			•			PDK at thrust block; splitting at base; sounds dull
		#2 - Queen Strut					70%	PDK at base; significant weathering and cracking top surface approx 1/4 depth
		#2 - King Strut		•				Surface weathering on top surface
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			90%	Heavily corroded
			- Outside	•			90%	Heavily corroded
		#1 - Queen Rods	- Inside	•			90%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		#1 - Centre Rods	- Inside	•			80%	Heavily corroded
			- Outside	•			60%	Heavily corroded
		#2 - Queen Rods	- Inside	•			60%	Heavily corroded
			- Outside	•			60%	Heavily corroded
		#2 - King Rods	- Inside	•			80%	Heavily corroded
			- Outside	•			90%	Heavily corroded
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block		•				
		#1 - Queen Timber Thrust Block		•				
		Centre Timber Thrust Block			•			Some splitting and compression occurring
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				
		Timber A-Blocks						
		#1 - Queen A-Block		•				Small CDK inside end
		Centre A-Block		•				Small CDK inside end; small PDK at strut
		#2 - Queen A-Block		•				Large CDK inside end approx. 100mm diameter
		Timber Saddle Blocks						
		#1 - King Saddle Block		•				Small CDK; large vertical split; treat and provide horizontal split bolts
		#1 - Queen Saddle Block		•				CDK approx. 80mm diameter inside end
		Centre Saddle Block		•				CDK inside end; PDK on south side
		#2 - Queen Saddle Block				•		Large CDK extending to top chord of truss (approx. 150mm diameter), extends to vertical tie rod
		#2 - King Saddle Block			•			Soft end; sounds dull
		Top Chord						
		#1 King - #1 Queen	- Inside	•				
			- Middle	•				
			- Outside	•				Replaced 1940
		#1 Queen - Centre	- Inside		•			Large PDK, approx. half section missing
			- Middle		•			Large PDK and split through side; sounds drummy
			- Outside	•				
		Centre - #2 Queen	- Inside	•				Large vertical split approx. 50mm deep
			- Middle	•				
			- Outside	•				
		#2 Queen - #2 King	- Inside		•			CDK at south end; large vertical split
			- Middle		•			Significant weathering; PDK inside face
			- Outside		•			Large PDK inside face, approx. half section gone;
		Bottom Chord						
		Steel Bottom Chord		•			70%	Heavily corroded, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•			60%	Heavily corroded; bolts gone
		#2 King Strut to top chord		•			50%	Heavily corroded; bolts gone
		Timber Braces						
		#1 - King Timber Brace				•		EDK to beyond fixing bolt to saddle block
		#1 - Queen Timber Brace		•				
		Centre Timber Brace		•				Some end splitting
		#2 - Queen Timber Brace			•			CDK approx. 60mm diameter at top
		#2 - King Timber Brace			•			Large PDK south face; large split

TOTARA RIVER BRIDGE - TRUSSES

Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
5	RH	**Timber Struts**						
		#1 - King Strut			•			Weathered top surface; decay to approximately half depth of member
		#1 - Queen Strut		•				Minor splitting in top surface
		#1 - Counter Strut		•				
		#1 - Centre Strut	- Inside	•				Vertical splitting in lower half
			- Outside	•				Vertical splitting in lower half
		#2 - Centre Strut	- Inside	•				
			- Outside	•				
		#2 - Counter Strut		•				
		#2 - Queen Strut			•			Surface decay at top; dull sound in lower portion, possible CDK
		#2 - King Strut		•				
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			90%	Heavily corroded
			- Outside	•			90%	Heavily corroded
		#1 - Queen Rods	- Inside	•			70%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		#1 - Centre Rods	- Inside	•			70%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		#2 - Queen Rods	- Inside	•			50%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		#2 - King Rods	- Inside	•			60%	Heavily corroded
			- Outside	•			60%	Heavily corroded
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block		•				
		#1 - Queen Timber Thrust Block		•				
		Centre Timber Thrust Block		•				PDK top surface and inside contact area for #2 Counter Strut
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				
		Timber A-Blocks						
		#1 - Queen A-Block		•				
		Centre A-Block		•				
		#2 - Queen A-Block		•				Small CDK inside end
		Timber Saddle Blocks						
		#1 - King Saddle Block		•				CDK inside end approx 50mm diameter; EDK outside end
		#1 - Queen Saddle Block		•				EDK outside end
		Centre Saddle Block		•				Small CDK and vertical split inside end; EDK outside end
		#2 - Queen Saddle Block		•				CDK inside end; EDK outside end
		#2 - King Saddle Block			•			CDK inside end approx. 70mm diameter; EDK outside end; PDK northern face
		Top Chord						
		#1 King - #1 Queen	- Inside	•				
			- Middle	•				
			- Outside		•			PDK top surface approx 300mm long; PDK on underside
		#1 Queen - Centre	- Inside	•				
			- Middle	•				Replaced 1976
			- Outside		•			PDK to half section depth
		Centre - #2 Queen	- Inside	•				
			- Middle	•				
			- Outside	•				
		#2 Queen - #2 King	- Inside	•				Replaced 1933 (second hand)
			- Middle	•				
			- Outside	•				
		Bottom Chord						
		Steel Bottom Chord		•			60-80%	Heavily corroded, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•			60%	Heavily corroded; steel delaminating at edges
		#2 King Strut to top chord		•			60%	Heavily corroded; steel delaminating at edges
		Timber Braces						
		#1 - King Timber Brace		•				EDK at top connection; nut missing from bolted connection; extensive splitting
		#1 - Queen Timber Brace		•				Nut missing from bolt connecting to transom
		Centre Timber Brace		•				EDK and vertical split at top
		#2 - Queen Timber Brace		•				
		#2 - King Timber Brace		•				

TOTARA RIVER BRIDGE - TRUSSES

Span	Side	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
			Sound / Treatment only	Investigate Further	Replace		
6	LH	**Timber Struts**					
		#1 - King Strut	•			70%	Significant surface weathering and PDK in top surface; top 1/4 section no longer contributing to strength
		#1 - Queen Strut		•			Advanced surface decay top surface; splitting in top surface approx. 100mm deep
		#1 - Counter Strut	•			60%	Significant splitting on top surface and inside face, full length; PDK top surface; top 1/3 section no longer contributing to strength
		#1 - Centre Strut - Inside	•				Splitting in top surface; PDK near top
		- Outside		•			Splitting in top surface; PDK top surface and outside face
		#2 - Centre Strut - Inside		•			PDK at base; weathering of top surface
		- Outside	•				Weathering of top surface
		#2 - Counter Strut	•				Weathering and splitting of top surface; PDK top surface; some splitting in side at top
		#2 - Queen Strut	•				PDK and thrust block; weathered top surface
		#2 - King Strut		•			Replaced 1928; advance surface decay on top surface; PDK on sides and top surface; horizontal split bolts at top
		Vertical Steel Tension Rods					
		#1 - King Rods - Inside	•			70%	Heavily corroded
		- Outside	•			80%	Heavily corroded
		#1 - Queen Rods - Inside	•			60%	Heavily corroded
		- Outside	•			60%	Heavily corroded
		#1 - Centre Rods - Inside	•			70%	Heavily corroded
		- Outside	•			50%	Heavily corroded
		#2 - Queen Rods - Inside	•			70%	Heavily corroded
		- Outside	•			70%	Heavily corroded
		#2 - King Rods - Inside	•			95%	Light surface corrosion only
		- Outside	•			60%	Heavily corroded
		Timber Thrust Blocks					
		#1 - King Timber Thrust Block	•				
		#1 - Queen Timber Thrust Block		•			Significant splitting and decay
		Centre Timber Thrust Block	•				
		#2 - Queen Timber Thrust Block	•				
		#2 - King Timber Thrust Block		•			Significant decay across top in line of tension rods.
		Timber A-Blocks					
		#1 - Queen A-Block	•				Small CDK inside end
		Centre A-Block	•				Small CDK inside end
		#2 - Queen A-Block	•				
		Timber Saddle Blocks					
		#1 - King Saddle Block		•			Significant EDK (approx 1/3 of end) extending to top surface; dull sound at top
		#1 - Queen Saddle Block	•				Replaced 1967; small CDK inside end; soft
		Centre Saddle Block		•			CDK inside end approx. 80mm diameter extending to base of saddle block
		#2 - Queen Saddle Block		•			CDK inside end extending up to top surface
		#2 - King Saddle Block		•			EDK inside end (approx. 1/3 of end); dull sound on northern face
		Top Chord					
		#1 King - #1 Queen - Inside	•				
		- Middle	•				Weathered
		- Outside	•				Weathered
		#1 Queen - Centre - Inside	•				
		- Middle	•				Weathered
		- Outside	•				Weathered
		Centre - #2 Queen - Inside	•				Horizontal splitting inside face
		- Middle	•				Isolated PDK
		- Outside		•			PDK inside face, approx. 50% loss of section
		#2 Queen - #2 King - Inside	•				Weathered
		- Middle	•				
		- Outside	•				Weathered; PDK
		Bottom Chord					
		Steel Bottom Chord	•			70%	Heavily corroded, King strut seatings at piers sound
		Steel Connection Plates					
		#1 King Strut to top chord	•			70%	Heavily corroded; bolts gone
		#2 King Strut to top chord	•			80%	Heavily corroded; bolts gone
		Timber Braces					
		#1 - King Timber Brace	•				Splitting and surface decay at base; nut missing from bolt connecting to saddle
		#1 - Queen Timber Brace	•				Large split through centre; PDK outside edge near base; nut missing from bolt connecting to saddle
		Centre Timber Brace			•		Top end completed decayed
		#2 - Queen Timber Brace	•				
		#2 - King Timber Brace	•				

TOTARA RIVER BRIDGE - TRUSSES

Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
6	RH	**Timber Struts**						
		#1 - King Strut		•				Replaced 1977
		#1 - Queen Strut		•				Replaced 1965
		#1 - Counter Strut		•				
		#1 - Centre Strut	- Inside	•				Surface weathering
			- Outside	•				Surface weathering
		#2 - Centre Strut	- Inside	•				Surface weathering
			- Outside	•				Surface weathering
		#2 - Counter Strut		•				
		#2 - Queen Strut			•			Some hollowing in bottom end; PDK top surface
		#2 - King Strut		•				
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			60%	Heavily corroded
			- Outside	•			80%	Heavily corroded
		#1 - Queen Rods	- Inside	•			70%	Heavily corroded
			- Outside	•			70%	Heavily corroded
		#1 - Centre Rods	- Inside	•			80%	Heavily corroded
			- Outside	•			80%	Heavily corroded
		#2 - Queen Rods	- Inside	•			95%	Very light surface corrosion
			- Outside	•			80%	Heavily corroded
		#2 - King Rods	- Inside	•			90%	Light corrosion only
			- Outside	•			70%	Heavily corroded
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block		•				
		#1 - Queen Timber Thrust Block		•				Small section missing from top outside of outside tie rod
		Centre Timber Thrust Block		•				
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				CDK started on outside face
		Timber A-Blocks						
		#1 - Queen A-Block		•				
		Centre A-Block		•				CDK inside end approx. 80mm diameter
		#2 - Queen A-Block		•				
		Timber Saddle Blocks						
		#1 - King Saddle Block		•				EDK at Timber brace connection
		#1 - Queen Saddle Block		•				Vertical split through inside face
		Centre Saddle Block				•		PDK; outside tension rod loose due to saddle block crushing
		#2 - Queen Saddle Block		•				EDK at Timber brace connection
		#2 - King Saddle Block		•				Significant EDK at outside end; up to 20% CDK inside end
		Top Chord						
		#1 King - #1 Queen	- Inside	•				Splitting and PDK top surface; EDK and southern end
			- Middle	•				
			- Outside	•				
		#1 Queen - Centre	- Inside	•				Splitting in top surface
			- Middle	•				
			- Outside	•				PDK
		Centre - #2 Queen	- Inside	•				
			- Middle	•				
			- Outside	•				
		#2 Queen - #2 King	- Inside	•				
			- Middle	•				
			- Outside	•				
		Bottom Chord						
		Steel Bottom Chord		•			80-90%	Light to moderate corrosion, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•			70%	Heavily corroded; bolts gone
		#2 King Strut to top chord		•			70%	Heavily corroded; bolts gone
		Timber Braces						
		#1 - King Timber Brace		•				Significant splitting and PDK
		#1 - Queen Timber Brace		•				Split through centre at top end
		Centre Timber Brace				•		EDK top end
		#2 - Queen Timber Brace				•		EDK top end; large split through centre
		#2 - King Timber Brace		•				

TOTARA RIVER BRIDGE - TRUSSES

Span	Side	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
			Sound / Treatment only	Investigate Further	Replace		
7	LH	**Timber Struts**					
		#1 - King Strut	•			70%	Extensive surface weathering and splitting
		#1 - Queen Strut	•				
		#1 - Counter Strut	•				
		#1 - Centre Strut - Inside			•		Large PDK inside face; splitting
		- Outside	•				Splitting and associated PDK; ropey top surface
		#2 - Centre Strut - Inside	•				Vertical splitting top surface; small PDK at base
		- Outside	•				Vertical splitting top surface
		#2 - Counter Strut	•				PDK both ends; some horizontal splitting; weathering and surface decay on top surface
		#2 - Queen Strut	•				Replaced 1960; Splitting and PDK top surface
		#2 - King Strut	•			70%	Vertical splitting and PDK top surface up to 50mm deep
		Vertical Steel Tension Rods					
		#1 - King Rods - Inside	•			95%	Light surface corrosion
		- Outside	•			60%	Heavily corroded
		#1 - Queen Rods - Inside	•			20%	Heavily corroded
		- Outside	•			40%	Heavily corroded
		#1 - Centre Rods - Inside	•			20%	Heavily corroded
		- Outside	•			40%	Heavily corroded
		#2 - Queen Rods - Inside	•			70%	Heavily corroded
		- Outside	•			95%	Light surface corrosion
		#2 - King Rods - Inside	•			80%	Heavily corroded
		- Outside	•			90%	Heavily corroded
		Timber Thrust Blocks					
		#1 - King Timber Thrust Block	•				
		#1 - Queen Timber Thrust Block	•				Second hand (replaced); PDK top surface; small PDK inside of inside rod
		Centre Timber Thrust Block	•				
		#2 - Queen Timber Thrust Block	•				
		#2 - King Timber Thrust Block	•				Second hand (replaced); Some decay along top through centre
		Timber A-Blocks					
		#1 - Queen A-Block	•				Split with some decay south edge
		Centre A-Block	•				Small CDK inside end; small PDK behind strut
		#2 - Queen A-Block	•				Small CDK and some splitting through end
		Timber Saddle Blocks					
		#1 - King Saddle Block		•			Large split inside end from top to centre; Significant EDK outside end; sounds hollow
		#1 - Queen Saddle Block		•			Large EDK extending full depth; sounds hollow underneath bolts
		Centre Saddle Block			•		Large CDK inside end full depth of saddle
		#2 - Queen Saddle Block	•				CDK starting at inside end with vertical crack
		#2 - King Saddle Block			•		Large CDK inside end through centre extending to top surface; outside end similar; sounds very hollow
		Top Chord					
		#1 King - #1 Queen - Inside	•				Replaced 1960; some splitting and PDK inside face
		- Middle	•				
		- Outside	•				Significant weathering and PDK inside face
		#1 Queen - Centre - Inside	•				Large PDK inside face
		- Middle	•				
		- Outside	•				Small PDK on top; splitting on inside face
		Centre - #2 Queen - Inside	•				Replaced 1960; Large split on inside face
		- Middle	•				Replaced 1960
		- Outside	•				
		#2 Queen - #2 King - Inside	•				Replaced 1960; PDK and splitting inside face
		- Middle	•				Replaced 1960
		- Outside	•				Weathered top surface
		Bottom Chord					
		Steel Bottom Chord	•			70-80%	Heavily corroded; Up to 50% loss in section between #2 King Rods and pier, King strut seatings at piers sound
		Steel Connection Plates					
		#1 King Strut to top chord	•			70%	Heavily corroded; bolts gone
		#2 King Strut to top chord	•			60%	Heavily corroded; bolts gone
		Timber Braces					
		#1 - King Timber Brace			•		Large cracks; Large PDK below saddle block
		#1 - Queen Timber Brace	•				Large CDK at top (splice in short section at top?)
		Centre Timber Brace			•		EDK at top to beyond fixing bolt to saddle block
		#2 - Queen Timber Brace			•		EDK at top to beyond fixing bolt to saddle block
		#2 - King Timber Brace			•		Large PDK at base and mid height

TOTARA RIVER BRIDGE - TRUSSES

Span	Side	Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
				Sound / Treatment only	Investigate Further	Replace		
7	RH	**Timber Struts**						
		#1 - King Strut		•				
		#1 - Queen Strut		•				Significant surface cracking top surface
		#1 - Counter Strut		•				
		#1 - Centre Strut	- Inside	•				Some cracking and isolated PDK
			- Outside	•				Some cracking and isolated PDK
		#2 - Centre Strut	- Inside	•				Split at top
			- Outside	•				Split with PDK at top
		#2 - Counter Strut				•		Significant loss of section at bottom end through decay otherwise sound; splice in a short length?
		#2 - Queen Strut		•				
		#2 - King Strut		•				Replaced 1933 (second hand); surface decay inside face
		Vertical Steel Tension Rods						
		#1 - King Rods	- Inside	•			95%	Light surface corrosion only
			- Outside	•			95%	Light surface corrosion only
		#1 - Queen Rods	- Inside	•			50%	Heavily corroded
			- Outside	•			50%	Heavily corroded
		#1 - Centre Rods	- Inside	•			95%	Light surface corrosion only
			- Outside	•			50%	Heavily corroded
		#2 - Queen Rods	- Inside	•			40%	Heavily corroded
			- Outside	•			40%	Heavily corroded
		#2 - King Rods	- Inside	•			90%	Light corrosion only
			- Outside	•			90%	Light corrosion only
		Timber Thrust Blocks						
		#1 - King Timber Thrust Block		•				
		#1 - Queen Timber Thrust Block		•				
		Centre Timber Thrust Block		•				
		#2 - Queen Timber Thrust Block		•				
		#2 - King Timber Thrust Block		•				
		Timber A-Blocks						
		#1 - Queen A-Block				•		CDK; PDK and splitting on counter strut side; signs of compression; replace within 5yrs
		Centre A-Block		•				Small PDK around strut
		#2 - Queen A-Block		•				
		Timber Saddle Blocks						
		#1 - King Saddle Block				•		CDK; PDK top at top
		#1 - Queen Saddle Block				•		Large CDK inside end; replace within 5 years
		Centre Saddle Block		•				EDK outside end
		#2 - Queen Saddle Block		•				Some surface decay and weathering
		#2 - King Saddle Block		•				EDK outside end
		Top Chord						
		#1 King - #1 Queen	- Inside			•		PDK inside and outside faces at #1 Queen A-block
			- Middle	•				
			- Outside			•		Large PDK around bolts; completely gone near #1 Queen A-block
		#1 Queen - Centre	- Inside			•		PDK inside and outside faces at #1 Queen A-block
			- Middle	•				
			- Outside			•		Large PDK around bolts; completely gone near #1 Queen A-block
		Centre - #2 Queen	- Inside	•				
			- Middle	•				
			- Outside	•				PDK around bolts
		#2 Queen - #2 King	- Inside	•				
			- Middle	•				Replaced 1974 (second hand)
			- Outside	•				
		Bottom Chord						
		Steel Bottom Chord				•	60%	Heavily corroded, King strut seatings at piers sound
		Steel Connection Plates						
		#1 King Strut to top chord		•			70%	Heavily corroded; bolts gone
		#2 King Strut to top chord		•			70%	Heavily corroded; bolts gone
		Timber Braces						
		#1 - King Timber Brace				•		Large PDK at end
		#1 - Queen Timber Brace		•				
		Centre Timber Brace		•				Crack through centre (top half)
		#2 - Queen Timber Brace		•				Spilt through lower half of brace
		#2 - King Timber Brace		•				EDK top end

Appendix D: Inspection Results – Transoms (2 pages)

Definition of terminology used

- "PDK" – Pocket Decay
- "EDK" – End Decay
- "CDK" – Centre Decay

TOTARA RIVER BRIDGE - TRANSOMS

Span	Side	Structural Element	Structural Assessment / Recommendation			Estimated % Original Capacity	Comments
			Sound / Treatment only	Further Investigation	Replace		
3	LH	#1 King Transom	•				Bolts heavily corroded
	RH	#1 King Transom	•				Replaced 1960
	LH	#1 Queen Transom	•				Condition of bolts is mixed
	RH	#1 Queen Transom	•				Replaced 1944; PDK downstream end
	LH	Centre Transom	•				Weathered
	RH	Centre Transom	•				Replaced 1977 (second hand); PDK top surface between road beams
	LH	#2 Queen Transom	•				Replaced 1977
	RH	#2 Queen Transom	•				Replaced 1960
	LH	#2 King Transom	•				Replaced 1977; small surface defect top surface between RH truss and RH road beam
	RH	#2 King Transom	•				Replaced 1967 (second hand)
4	LH	#1 King Transom		•			large CDK; Sounds hollow under road beams
	RH	#1 King Transom		•			Significant EDK upstream end; sounds hollow under truss
	LH	#1 Queen Transom		•			Sounds hollow under LH road beam
	RH	#1 Queen Transom	•				Honey combing and surface decay downstream end; large split between RH road beam and RH truss; small CDK upstream end
	LH	Centre Transom		•			Sounds hollow under LH road beam
	RH	Centre Transom	•				Isolated PDK south face; surface weathering and decay
	LH	#2 Queen Transom		•			Replaced 1960; large CDK downstream end extending back to thrust block; EDK upstream end; large PDK northern face between RH road beam and RH truss
	RH	#2 Queen Transom		•			Replaced 1960; EDK upstream end; condition of bolts is mixed
	LH	#2 King Transom	•				Condition of bolts is mixed
	RH	#2 King Transom	•				
5	LH	#1 King Transom	•				Replaced 1975
	RH	#1 King Transom	•				Some horizontal splitting downstream end; condition of bolts is mixed
	LH	#1 Queen Transom	•				Replaced 1977
	RH	#1 Queen Transom	•				Split through top at upstream end
	LH	Centre Transom	•				Replaced 1944
	RH	Centre Transom	•				Split through top at upstream end
	LH	#2 Queen Transom					
	RH	#2 Queen Transom		•			Significant EDK upstream end extending up to 1.5m from end; extensive surface decay on top surface; member collapsing inward; (likely replacement required)
	LH	#2 King Transom	•				Condition of bolts is mixed; 5 splice bolts between transoms are missing
	RH	#2 King Transom	•				

TOTARA RIVER BRIDGE - TRANSOMS

Span	Side	Structural Element	Structural Assessment / Recommendation			Estimated % Original Capacity	Comments
			Sound / Treatment only	Further Investigation	Replace		
6	LH	#1 King Transom	•				PDK top surface; EDK upstream end; condition of bolts mixed
	RH	#1 King Transom	•				End splitting upstream end
	LH	#1 Queen Transom	•				Replaced 1944; condition of bolts is mixed
	RH	#1 Queen Transom	•				
	LH	Centre Transom	•				large CDK / EDK upstream end; surface decay / weathering on top surface
	RH	Centre Transom	•				Weathered; large horizontal split through side at upstream end - install vertical split bolts
	LH	#2 Queen Transom	•				Splitting downstream end; significant horizontal splitting upstream end - install vertical split bolts
	RH	#2 Queen Transom	•				Weathered
	LH	#2 King Transom		•			CDK downstream end; large PDK south face; PDK upstream face; hollow sound from LH truss to end
	RH	#2 King Transom	•				Weathered; splitting on north and south face with associated decay
7	LH	#1 King Transom		•			Small EDK upstream end; splitting; sounds drummy
	RH	#1 King Transom	•				
	LH	#1 Queen Transom	•				Large CDK downstream end; significant weathering; PDK
	RH	#1 Queen Transom	•				large CDK upstream end; splitting both ends; horizontal split and downstream end requires vertical split bolts
	LH	Centre Transom		•			Significant weathering; large PDK upstream end; sounds drummy
	RH	Centre Transom	•				Horizontal split through centre at downstream end; install vertical split bolts
	LH	#2 Queen Transom	•				Replaced 1977
	RH	#2 Queen Transom		•			Significant EDK upstream end in horizontal plane, extending back under truss; large PDK south face; significant weathering; soft
	LH	#2 King Transom	•				Surface weathering
	RH	#2 King Transom	•				PDK upstream end; significant weathering

Appendix E: Inspection Results – Road Beams, Corbels and Deck Bracing (9 pages)

Definition of terminology used

- "PDK" – Pocket Decay
- "EDK" – End Decay
- "CDK" – Centre Decay

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
Road Beams	LH1		•			Significant weathering and splitting; large PDK outside face; PDK top surface and outside face near pier #2; vegetation growing on top
	LH2		•			Significant weathering and splitting; PDK inside and outside face at northern end; PDK top surface; *- bottom half of section appears sound*
	LH3	•				Numerous PDK top surface and both sides; significant horizontal splitting through sides over top 1/2 to 2/3 section depth
	LH4	•				Weathering and splitting top surface; minor horizontal cracking in sides; numerous PDK top surface
	LH5	•				Replaced 1974; diagonal splitting on side and PDK both sides of beam at #2 Queen corbel ; PDK at northern end; drummy sound at pier #4 end
	LH6		•			Large PDK at north end extending from top to within 150mm of base (2/3 section gone); significant weathering and splitting; numerous PDK top surface; large PDK between #1 King and #1 Queen transoms approx. 40mm deep; dull sound at southern end
	LH7	•				Weathering , splitting and surface decay on top and both sides; numerous PDK on top surface and on sides
	LH8		•			Significant weathering; significant splitting both sides; PDK inside and outside faces; evidence of insect attack; hollow sound at north end *- estimate top half of beam not contributing structurally*
	LH9			•		Significant weathering and surface decay all faces; evidence of insect attack; large PDK top surface at north end; PDK sides and underside
	LH10	•				Replaced 1960; large PDK inside face at south end; isolated PDK top and outside face; weathering and splitting on outside face; vertical splitting on top; evidence of insect attack;
	LH11		•			Replaced 1933 (second hand); top surface weathering and splitting; large PDK inside face and significant vertical splitting at south end; significant weathering south end *- Investigate south end*
	LH12	•				Typical surface weathering
	LH13	•				Typical surface weathering and splitting; isolated PDK top surface; evidence of insect attack
	LH14		•			Weathering and isolated PDK to top surface and sides; horizontal splitting to sides; top 1/4 depth sounds drummy to end of corbel at south end; large horizontal split to end of corbel at north end
	LH15	•				Replaced 1966; weathering, splitting and isolated PDK top surface; significant weathering and surface decay, outside face; PDK both ends; sounds drummy at ends *- Assume top 1/4 section does not contribute structurally*
	LH16		•			Weathering and PDK, top surface; split and associated PDK, and large split in side with associated decay at south end; *- Investigate south end*

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
	LH17		•			Vertical and horizontal cracking with associated decay at north end; hollow sound at north end; numerous PDK top surface; splitting and PDK to sides *- Investigate further (likely replacement)*
	LH18	•				Replaced 1966
	LH19		•			Replaced 1940; advanced surface decay and weathering on top and sides; soft sound at south end
	CN1		•			Significant weathering and splitting; PDK on downstream face at cross member; vegetation growing on top; hollow sound at pier #2 end
	CN2	•				Significant weathering and splitting; PDK top surface and inside face; horizontal split and CDK at pier #3
	CN3		•			Significant weathering, splitting and associated decay top and downstream face; isolated PDK upstream face; probable end decay at pier #9 *- Investigation end south end and PDK at mid span (upstream face)*
	CN4		•			Surface weathering; general decay; PDK on sides; horizontal split at north end *- Likely redundant*
	RH1		•			Significant weathering and splitting; splitting and associated PDK on inside face; *- bottom half of beam appears sound*
	RH2	•				Weathering and vertical splitting top surface; minor horizontal splitting and weathering to sides
	RH3	•				
	RH4	•				Weathering and splitting top surface; minor horizontal cracking in sides; numerous PDK top surface
	RH5		•			Significant splitting and associated PDK in top and both sides; evidence of insect attack; large PDK / EDK at pier #4 end
	RH6		•			Advanced surface decay and weathering; numerous PDK top surface; horizontal splitting through top half of section; estimate top 1/4 of section not contributing structurally; soft surface and dull sound at south end;
	RH7	•				
	RH8	•				Replaced (est. 1950 - 1965, barrier post covering date); isolated PDK top surface; weathering and horizontal splitting on sides
	RH9	•				Replaced 1950; numerous small PDK top surface; weathering and PDK outside face; large PDK approx. 600 long x 40 deep and approx. 1/3 section depth on outside face
	RH10	•				
	RH11		•			Weathering and decay both sides; large split and PDK at south end extending full width of section; horizontal split inside face at north end
	RH12			•		Several large PDK along member *- Parts of beam may be reused elsewhere*
	RH13		•			Weathering and splitting; large PDK on outside face at north end extending to end of corbel; large vertical split from north end to first bolt; sounds hollow at north end.

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
	RH14		•			Significant weathering and splitting and associated PDK on top and both sides; large horizontal split at south end with PDK; large vertical split at north end; PDK over #2 King corbel (both sides of beam); sounds drummy both ends
	RH15		•			Weathering and associated decay to top surface; PDK south end and sounds hollow; top half sounds drummy at north end; dull sound inside face between #1 King and #1 Queen transoms *- Assume top 1/4 of member does not contribute structurally*
	RH16	•				Weathering and associated PDK top surface; weathered sides; splitting resulting in loose segments at top corners of beam.
	RH17	•				Replaced 1963
	RH18	•				Replaced 1940; extensive weathering and decay on outside face; weathering and PDK top surface; worm holes outside face
	RH19		•			Significant weathering and splitting and associated PDK on top surface; large PDK to half width of member over #1 King transom; significant splitting at south end, sounds drummy out to end of corbel
	RH20	•				Splitting and decay on top surface and sides; PDK and horizontal split outside face at south end.
	RH21	•				Replaced 1968; minor weathering
	RH22		•			Large PDK / EDK at both ends; Large PDK top surface at #2 King transom; significant weathering outside face; horizontal splitting north end
	RH23	•				EDK south end; weathering, splitting and associated decay to top surface; large horizontal split at north end (approx. 600 long, near centre); hollow sound at north end
	RH24	•				General weathering only

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
Corbels						
Pier # 2	LH Corbel	•				
	Centre Corbel	•				
	RH Corbel		•			CDK southern end; large PDK outside face
Pier # 3	LH Corbel	•				Cracking at end and small CDK starting; surface weathering and cracking on outside face
	Centre Corbel		•			EDK southern end; PDK both sides; honeycombing of upstream and downstream sides; evidence of possible insect attack
	RH Corbel	•				Splitting at ends; CDK southern end
#1 King	LH Corbel	•				PDK at sides; surface decay
	RH Corbel			•		PDK inside and outside extending in under beams; EDK - *Replace within 5yrs*
#1 Queen	LH Corbel		•			PDK at sides of corbel extending in under beams
	RH Corbel	•				CDK starting at southern end
Centre	LH Corbel	•				PDK at fixing to transom
	RH Corbel	•				PDK at fixing to transom
#2 Queen	LH Corbel	•				Replaced 1966
	RH Corbel	•				PDK at sides
#2 King	LH Corbel	•				Replaced 1977 (second Hand); large vertical split at northern end - *Replace corroded splitter bolts*
	RH Corbel	•				Splitting at ends; PDK at fixings to transom
Pier #4	LH Corbel	•				CDK southern end; significant splitting and PDK outside face
	RH Corbel	•				Replaced 1944
#1 King	LH Corbel	•				Replaced 1966
	RH Corbel					Replaced 1965
#1 Queen	LH Corbel	•				PDK inside face near centre
	RH Corbel	•				PDK top surface and inside and outside faces
Centre	LH Corbel	•				PDK both sides
	RH Corbel	•				PDK inside vertical face; surface decay and soft on sides
#2 Queen	LH Corbel	•				PDK outside face at base
	RH Corbel	•				PDK outside face; large area of decay on inside top and side.
#2 King	LH Corbel	•				PDK both side above transom; PDK top surface inside face
	RH Corbel	•				Weathering and splitting; PDK both sides above transom

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
Pier #5	LH Corbel	•				Replaced 1960; split at north end near centre; weathering and softening on outside surface; horizontal split inside face
	RH Corbel		•			Replaced 1977 (second hand); weathered
#1 King	LH Corbel	•				PDK outside face overtop of transoms; decay at base of corbel over LH transom extending approx. 150mm over transom (20mm deep); split along inside top edge; large PDK inside face
	RH Corbel		•			Significant weathering and decay inside face; large diagonal crack and associated decay extending from top surface down under beam *- Investigate further when beam is replaced*
#1 Queen	LH Corbel	•				Small EDK north end; PDK both sides overtop of transoms
	RH Corbel	•				Weathering on outside face; PDK inside and outside faces
Centre	LH Corbel	•				PDK inside and outside face; weathering and softening to outside surface
	RH Corbel	•				Typical weathering; PDK outside face; split and PDK linking spike holes on inside face
#2 Queen	LH Corbel	•				Typical weathering and splitting; PDK over LH transom
	RH Corbel	•				Split on inside face; weathered outside face
#2 King	LH Corbel	•				
	RH Corbel	•				Typical weathering and splitting
Pier #6	LH Corbel	•				CDK / EDK at south end; weathered outside face; horizontal split and associated PDK outside face; significant splitting and decay to inside face; splitting at north end
	RH Corbel	•				CDK both ends; significant weathering and splitting both sides
#1 King	LH Corbel		•			Surface decay to top surface extending in under beams (both sides); vertical split through centre at north end; *- Install horizontal split bolt at north end*
	RH Corbel	•				
#1 Queen	LH Corbel		•			Significant amount of decay at top extending in under beam (both sides of corbel)
	RH Corbel	•				Surface decay at top (inside face)
Centre	LH Corbel		•			Decay at top surface extending in under beam (both sides of corbel); extensive PDK both sides
	RH Corbel		•			Decay at top surface extending in under beam (both sides of corbel); *- Likely replace*

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
#2 Queen	LH Corbel		•			Advanced decay at top on outside *- Likely replace*
	RH Corbel	•				
#2 King	LH Corbel	•				
	RH Corbel	•				Decay to contract surface with transoms on inside face
Pier #7	LH Corbel	•				Decay along bottom edge in contact with packers (inside face)
	RH Corbel	•				Weathered
#1 King	LH Corbel	•				Weathering; isolated PDK
	RH Corbel	•				Weathering; splitting and PDK on outside
#1 Queen	LH Corbel			•		Large CDK at both ends (full depth); large crack and associated decay under beam
	RH Corbel	•				PDK inside face around spikes; splitting and PDK outside face; *- Vegetation in the way on inside at transom*
Centre	LH Corbel	•				Top surface decay on outside; some isolated PDK
	RH Corbel	•				Top surface cracking and associated decay; some isolated PDK
#2 Queen	LH Corbel	•				Top decay on outside extending under beam; some PDK
	RH Corbel	•				Replaced 1960; weathered
#2 King	LH Corbel	•				End splitting and weathering; split bolts both ends
	RH Corbel	•				Large vertical split separating two halves with split bolt at north end; sounds drummy but likely due to split *- Install split bolt at south end*
Pier #8	LH Corbel		•			Manmade vertical cut on south side near outside edge of pier, still approx. 600mm seating for beam; decay
	Centre Corbel	•				Replaced 1967 (second hand); surface decay upstream face
	RH Corbel		•			Isolated PDK inside face; large horizontal split and PDK under beam RH22 *- Investigate PDK under beam (otherwise sound)*
Pier #9	LH Corbel		•			Splitting and EDK both ends; numerous PDK on sides
	Centre Corbel	•				Surface decay and splitting both ends
	RH Corbel		•			CDK / PDK and splitting both ends

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
Cross Bracing, Solid Blocking and Tie Rods						
Span #1	Solid Blocking			•		4 no. at 1/3 points; various states of decay; blocks falling out *- Replace / reinstate*
	Tie Rods	•				Rods generally ok; some nuts missing *- Replace nuts*
Span #2	Solid Blocking			•		4 no. at 1/3 points; various states of decay; blocks falling out *- Replace / reinstate*
	Tie Rods	•				Rods generally ok; some nuts missing *- Replace nuts*
Span #3	**Cross Bracing**					
Pier #3 to #1K	LH			•	30%	
	RH	•				Sound
#1K to #1Q	LH	•				Sound
	RH	•			50%	
#1Q to Centre	LH	•				Sound
	RH			•	0%	1/2 rod missing from centre to #1Q transom
Centre to #2Q	LH	•			80%	
	RH	•			80%	
#2Q to #2K	LH	•			50%	Sound through centre
	RH			•	30%	Ends sound
#2K to Pier #4	LH			•	20%	Sound through centre
	RH			•	40%	Heavily corroded at pier end; otherwise sound

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
Span #4	**Cross Bracing**					
Pier #4 to #1K	LH			•	40%	
	RH			•	40%	40% at pier end; 70% under LH beam; otherwise sound
#1K to #1Q	LH			•	25%	25% under LH beam; otherwise sound
	RH			•	10%	10% at #1K transom; 50% under RH beam; otherwise sound
#1Q to Centre	LH	•			70%	
	RH	•			70%	
Centre to #2Q	LH	•			50%	
	RH	•			70%	
#2Q to #2K	LH	•			50%	
	RH	•			50%	
#2K to Pier #5	LH	•			60%	
	RH			•	5%	5% and 25% at ends, otherwise sound
Span #5	**Cross Bracing**					
Pier #5 to #1K	LH			•	0%	Almost gone at King Transom; 30% at pier end
	RH	•			70%	
#1K to #1Q	LH			•	0%	Eyes at end sound; rest of rod completely gone
	RH	•			50%	
#1Q to Centre	LH	•			60%	
	RH			•	10%	10% at centre transom end; 50% along rod; sound at #1Q transom
Centre to #2Q	LH	•			60%	Sound at ends
	RH	•			50%	50% at coupler under LH beam; 60% under RH beam; otherwise sound
#2Q to #2K	LH	•			70%	
	RH	•			50%	Railway iron replacement; heavily corroded along full length
#2K to Pier #6	LH			•	20%	20% and 40% at ends; 70% along rod
	RH			•	40%	40% at #2K end; 80% along rod

TOTARA RIVER BRIDGE - ROAD BEAMS, CORBELS and DECK BRACING

Structural Element		Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
Span #6	**Cross Bracing**					
Pier #6 to #1K	LH	•				Sound
	RH			•	0%	Completely gone at #1K end; 80% along rod
#1K to #1Q	LH	•			70%	
	RH			•	20%	20% both ends; 40% along rod
#1Q to Centre	LH	•			60%	60% at coupler under LH beam; 80% under RH beam; otherwise sound
	RH	•			60%	60% under beams; otherwise sound
Centre to #2Q	LH	•			70%	Sound at ends
	RH	•			60%	60% under beams; otherwise sound
#2Q to #2K	LH			•	<10%	<10% at #2K transom; 30% at coupler under LH beam; otherwise sound
	RH			•		Almost completely gone at #2K end; otherwise sound *- Replace from centre to #2K end*
#2K to Pier #7	LH	•			60%	
	RH	•			50%	
Span #7	**Cross Bracing**					
Pier #7 to #1K	LH			•	<10%	<10% at #1K transom; remaining rod >60%
	RH	•			80%	
#1K to #1Q	LH			•	30%	30% and 40% at ends; 60% along rod
	RH			•	30%	30% at #1Q end; remaining rod >80%
#1Q to Centre	LH	•			80%	Railway iron replacement
	RH	•			70%	
Centre to #2Q	LH			•	0%	Rod completely gone at centre transom end; 50% along rod; sound at #2Q end
	RH			•	40%	sound at eyes
#2Q to #2K	LH	•			60%	
	RH			•	30%	30% under RH beam; 50% under LH beam; sound at ends
#2K to Pier #8	LH			•	30%	30% at pier end; 70% under LH beam
	RH	•				Sound
Span #8	Solid Blocking	•				4 no. at 1/3 points; various states of decay; blocks falling out; one block missing *- Replace / reinstate*
	Tie Rods	•				Rods generally ok; some nuts missing *- Replace nuts*
Span #9	Solid Blocking	•				4 no. at 1/3 points; various states of decay; blocks falling out *- Replace / reinstate*
	Tie Rods	•				Rods generally ok; some nuts missing *- Replace nuts*

Appendix F: Inspection Results – Piers (8 pages)

Definition of terminology used

- "PDK" – Pocket Decay
- "EDK" – End Decay
- "CDK" – Centre Decay

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
1	**Piles**					
	Upstream Pile	•				PDK at top where previously drilled; general splitting and weathering
	Centre Pile	•				Surface soft but sound underneath; general weathering
	Downstream Pile	•				Surface splitting; EDK at top where previously drilled; excavation around pile showed pile sound below ground
	Pile Cap	•				CDK both ends; significant weathering and splitting; appears sound over piles
	Abutment Walls - Timber facing			•		Top part collapsing; ends gone; otherwise appears ok; top part needs replacing
	Abutment Walls - Vertical Railway Irons	•			60%	Extensive corrosion
2	**Piles**					
	Upstream Pile	•				Surface splitting and weathering; PDK under pile cap, at top of pile, and several small isolated PDK along pile
	Centre Pile	•				Vertical splitting and weathering; small loss of outer section at ground level; excavation around pile showed pile sound below ground
	Downstream Pile	•				Large vertical splits in top 1/3 pile; hollow sound at top likely due to splitting; large PDK at top; excavation around pile showed pile sound below ground
	Upstream Cut Water Pile	•				EDK and splitting at top
	Downstream Cut Water Pile	•				Large CDK / EDK at top
	Raker Studs					
	Upstream Raker Stud	•				Significant weathering; top surface has honeycomb effect and worm holes
	Downstream Raker Stud		•			Surface decay and weathering to downstream face; PDK / EDK at base
	Diagonal Bracing					
	Cross bracing	•			70%	Steel railway iron; varying amounts of corrosion
	Whaling's					
	Whaling's	•			50%	Steel railway irons; heavily corroded
	Pile Cap	•				Replaced 1975

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
3	**Piles**					
	Pile #1	•				Vertical splitting above whalers
	Pile #2	•				Vertical splitting above whalers
	Pile #3	•				Deep splits / pockets on north face from spikes
	Pile #4	•				Vertical splitting above whalers
	Pile #5	•				Replaced 1961
	Pile #6	•				Splitting; weathering; block bolted to outside face at top to support pile cap
	Pile #7		•			Large CDK just above whaler; sound at ground and cap - *Consider splicing in section of pile or redundant*
	Pile #8		•			Large CDK just above whaler; sound at ground and cap - *Consider splicing in section of pile or redundant*
	Upstream cut-water pile		•			Has sunk approx 600mm; significant splitting and decay at top
	Downstream cut-water pile	•				Splitting and small EDK at top
	Raker Studs					
	Upstream Raker Stud			•		Has come free of fixing at top due to sinking cut-water pile; large split and EDK at top; large split upstream face; weathered
	Downstream Raker Stud			•		Splitting, surface weathering and significant decay downstream face; large CDK / EDK at base - *Probable replacement*
	Diagonal Bracing					
	Cross Bracing	•			70%	Railway iron cross bracing; varying amounts of corrosion
	Whaling's					
	Whaling's	•				All present; individual assessment of each whaler not carried out
	Pile Caps					
	Pile Cap #1	•				Replaced 1975; EDK downstream end
	Pile Cap #2	•				Splitting and associated CDK downstream end; EDK and splitting upstream end
	Pile Cap #3	•				Splitting and EDK starting downstream end; EDK upstream end
	Pile Cap #4			•		Large end section gone downstream end; large PDK along length and extensive decay upstream end - *Replace or consider redundant*
	Corbels					
	LH Truss Corbel - Inside	•				Replaced 1975 second hand; vertical split north end
	- Outside	•				PDK outside face; weathered
	RH Truss Corbel - Inside	•				Replaced 1975 second hand; minor end splitting
	- Outside	•				EDK and splitting both ends
	Packers Between Pile Cap and Beam Corbel					
	Perpendicular to corbel	•				4 no. total; weathered
	Parallel to corbel	•	•			Weathered but generally sound except for packer under LH corbel which has significant decay - *Consider packing or replacement*

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
4	**Piles**					
	Pile #1		•			Extensive CDK at top; vertical splitting above whalers at spike locations
	Pile #2		•			Major splitting and decay on outside face and other areas; sound at base and top
	Pile #3	•				Vertical splitting above whalers
	Pile #4	•				Advanced EDK at top; vertical splitting above whalers
	Pile #5		•			Splitting and associated decay on outside face due to spikes; sounds drummy above whaler; possible CDK
	Pile #6		•			Splitting and associated decay on outside face going into centre due to spikes; possible CDK
	Pile #7		•			Splitting and associated decay outside face but appears sounds; sounds drummy at top - *Investigate top further*
	Pile #8	•				EDK at top; splitting and associated decay due to spike holes
	Upstream cut-water pile		•			Significant CDK / EDK
	Downstream cut-water pile	•				
	Raker Studs					
	Upstream Raker Stud		•			Packer missing at top; significant splitting and decay on north face; large split and CDK at base - *Possible replacement*
	Downstream Raker Stud	•				Weathering and splitting on sides and downstream face
	Diagonal Bracing					
	Cross bracing	•			50%	Heavily corroded railway irons
	Whaling's					
	Whaling's	•				All present; individual assessment of each whaler not carried out
	Pile Caps					
	Pile Cap #1	•				Small EDK downstream end
	Pile Cap #2	•				Small EDK downstream end
	Pile Cap #3	•				Replaced 1960
	Pile Cap #4	•				Replaced 1967 second hand
	Corbels					
	LH Truss Corbel - Inside	•				
	- Outside	•				
	RH Truss Corbel - Inside	•				Splitting at south end
	- Outside	•				EDK both ends
	Packers Between Pile Cap and Beam Corbel					
	LH Beam	•				
	RH Beam	•				

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
5	**Piles**					
	Pile #1		•			EDK at top; typical splitting and decay on outside face - *worst pile of group therefore recommend investigating*
	Pile #2	•				Typical splitting and decay on outside face
	Pile #3	•				Typical splitting and decay on outside face
	Pile #4		•			Large split and associated decay on outside face due to spike holes; CDK; excavation around pile showed pile sound below ground - *Investigate or may be redundant*
	Pile #5		•			EDK at top; deep splitting and associated decay all around pile; numerous drill holes from previous investigations
	Pile #6	•				Minor splitting and associated decay
	Pile #7	•				Typical splitting and decay on outside face; excavation around pile showed pile sound below ground
	Pile #8	•				EDK at top; evidence of insect attack; significant splitting and associated decay
	Upstream cut-water pile	•				Splitting and EDK at top
	Downstream cut-water pile	•				Significant EDK at top, full of soil
	Raker Studs					
	Upstream Raker Stud	•				Splitting and EDK at top
	Downstream Raker Stud		•			Significant weathering / splitting and associated decay; EDK at base; possible CDK at connection to cut-water pile
	Diagonal Bracing					
	Brace #1	•			50%	Heavily corroded railway irons
	Brace #2	•			50%	Heavily corroded railway irons
	Whaling's					
	Whaling's	•				Whalers all there; soil + vegetation on top of whalers; individual assessment of each whaler not carried out
	Pile Caps					
	Pile Cap #1	•				Replaced 1977; minor splitting downstream end only
	Pile Cap #2	•				
	Pile Cap #3	•				Replaced 1977; minor splitting downstream end only
	Pile Cap #4	•				EDK downstream end
	Corbels					
	LH Truss Corbel - Inside	•				
	- Outside	•				
	RH Truss Corbel - Inside	•				
	- Outside	•				Small EDK and splitting south end
	Packers Between Pile Cap and Beam Corbel					
	LH Beam	•				Typical sound; packer directly under and parallel to corbel is sound but packer on outside is not
	RH Beam	•				Small amount of decay on downstream packer // to corbel - not supporting corbel; otherwise typically sound

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
6	**Piles**					
	Pile #1	•				Vertical split at top; timber on outside covering spike lines; isolated honeycombing
	Pile #2	•				EDK at top; typical splitting outside face; multiple drill holes; small amount of decay at each seating; excavation around pile showed pile sound below ground
	Pile #3	•				Decay below whaler at seating on inside of pile
	Pile #4	•				Typical splitting outside face
	Pile #5	•				Significant EDK at top; vertical splitting on outside face; minor splitting elsewhere
	Pile #6	•				Minor honeycombing through midsection; minor splitting
	Pile #7	•				Minor splitting and decay; excavation around pile showed pile sound below ground
	Pile #8	•				Minor splitting on outside face; excavation around pile showed pile sound below ground
	Upstream cut-water pile					
	Downstream cut-water pile	•				EDK at top; appears sound at attachment to raking stud
	Raker Studs					
	Upstream Raker Stud	•				Minor splitting along lines of spikes Fenders in good condition, SH61 (inside), SH77 (outside / upstream)
	Downstream Raker Stud			•	30%	Significant CDK; decay on downstream face to 1/2 depth *- Replace or consider redundant*
	Diagonal Bracing					
	Cross bracing	•			50%	Steel railway irons; varying amounts of corrosion
	Whaling's					
	Whaling's	•				All present; vegetation on top; generally appear sound
	Pile Caps					
	Pile Cap #1	•				Replaced 1944
	Pile Cap #2	•				Replaced 1977
	Pile Cap #3	•				Replaced 1977
	Pile Cap #4	•				
	Corbels					
	LH Truss Corbel - Inside	•				EDK both ends
	- Outside	•				Replaced 1967
	RH Truss Corbel - Inside		•			Vertical split north end; large CDK south end
	- Outside	•				Replaced 1960; vertical split north end
	Packers Between Pile Cap and Beam Corbel					
	LH Beam	•				Typically 2 no. parallel to corbel and 4 no. perpendicular; packer #1 perpendicular to corbel dozy; others typically sound
	RH Beam	•				

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
7	**Piles**					
	Pile #1	•				Isolated weathering and honeycombing; timber covering spike holes
	Pile #2	•				Typical splitting on outside face from spikes up to 100mm deep; surface decay and weathering; packer missing at top to cap *- Reinstate packer at top to pile cap*
	Pile #3	•				Typical splitting on outside face from spikes; lower 2/3 of pile has advanced surface decay and splitting; advanced decay at top below cap *- Further assess decay at top when treating*
	Pile #4	•				Minor splitting at top; typical splitting and decay
	Pile #5	•			70%	Split running approx. 1m down pile from backside of seating at top; typical splitting due to spikes *- Replace split bolt at top*
	Pile #6	•				Vertical split extending down from cap seat; split bolt corroded; typical vertical splitting on outside face extending into core *- Replace split bolt at top*
	Pile #7	•				Large split and EDK at top; outside face covered in timber; large vertical split extends down approx. 600mm from cap seating; split bolt corroded *- Replace split bolt at top*
	Pile #8	•				Large split and EDK at top; vertical split and Pad behind brace connection at top; typical splitting on outside face
	Upstream cut-water pile	•				
	Downstream cut-water pile	•				Minor splitting and weathering; some EDK
	Raker Studs					
	Upstream Raker Stud	•				EDK / CDK at base; weathering and splitting on sides and upstream face
	Downstream Raker Stud	•				Splitting in side due to spikes; weathering, splitting and decay on downstream face; packer at top about to fall out
	Diagonal Bracing					
	Cross bracing	•			50%	Timber; PDK behind pile connections
	Whaling's					
	Whaling's	•				All present; sound condition
	Pile Caps					
	Pile Cap #1	•				
	Pile Cap #2	•				Replaced 1933 second hand
	Pile Cap #3	•				Replaced 1975
	Pile Cap #4	•				Replaced 1975
	Corbels					
	LH Truss Corbel - Inside	•				Replaced 1967 second hand; minor end splitting
	- Outside	•				Replaced 1967 second hand; minor end splitting
	RH Truss Corbel - Inside	•				
	- Outside	•				Vertical split at south end
	Packers Between Pile Cap and Beam Corbel					
	LH Beam	•				General weathering only
	RH Beam	•				

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
8	**Piles**					
	Pile #1	•			70%	Typical vertical splitting on outside face
	Pile #2	•			70%	Typical vertical splitting on outside face
	Pile #3	•			70%	Typical vertical splitting on outside face; significant split on downstream face starting above whaler
	Pile #4	•			50%	Top filled with pitch; vertical splitting on outside face through mid section through to CDK *- Estimate only 50% of pile contributing due to splitting*
	Pile #5	•			70%	EDK at top; splitting through mid section due to spikes; vertical splitting on backside approx. 30mm deep
	Pile #6	•			70%	Full length splits on backside approx. 70mm deep; large vertical splits on outside extending into pile centre; excavation around pile showed pile sound below ground
	Pile #7	•			70%	Minor splitting only
	Pile #8	•			50%	Top filled with pitch; vertical splitting on outside face through mid section through to CDK *- Estimate only 50% of pile contributing due to splitting*
	Upstream cut-water pile			•		Splitting and hollow at top; heavily decayed *- Replace or consider redundant*
	Downstream cut-water pile			•		Splitting and hollow at top; heavily decayed *- Replace or consider redundant*
	Raker Studs					
	Upstream Raker Stud	•				Splitting along lines of spikes; decayed over lower section where previously buried in vegetation
	Downstream Raker Stud	•				Splitting along lines of spikes; decayed over lower section where previously buried in vegetation
	Diagonal Bracing					
	Cross bracing	•			70%	Varying amounts of corrosion; railway iron braces
	Whaling's					
	Whaling's		•			Buried in soil - not assessed, may be redundant
	Pile Caps					
	Pile Cap #1			•		Advanced EDK upstream end; extensive PDK and splitting back to RH truss corbel at downstream end
	Pile Cap #2	•				Splitting at upstream end; general weathering and splitting and EDK at downstream end
	Pile Cap #3	•				Splitting at upstream end; general weathering and splitting and EDK at downstream end
	Pile Cap #4	•				Replaced 1978; EDK downstream end
	Corbels					
	LH Truss Corbel - Inside	•				Vertical splits at both ends
	- Outside	•				Replaced 1967 second hand
	RH Truss Corbel - Inside		•			Large CDK / EDK north end; significant decay all way along *- Investigate further, likely replace*
	- Outside	•				Replaced 1967 second hand
	Packers Between Pile Cap and Beam Corbel					
	Perpendicular to corbel	•				#1 packer rotten at downstream end in under corbel *- Rotten packer likely redundant*
	Parallel to corbel	•				Sound under beams; downstream packer completely rotten *- Rotten packer likely redundant*

TOTARA RIVER BRIDGE - PIERS

Pier Number	Structural Element	Structural Assessment / Recommendation			Estimated % of Original Capacity	Comments
		Sound / Treatment only	Investigate Further	Replace		
9	**Piles**					
	Upstream Pile	•				Splitting and EDK at top; vertical splitting and associated decay further down; sounds drummy
	Centre Pile	•				Significant splitting full length; sounds drummy but likely due to splitting; small EDK at top; excavation around pile showed pile sound below ground
	Downstream Pile	•				Minor splitting and decay; small EDK at top
	Upstream Cut Water Pile					
	Downstream Cut Water Pile	•				Large CDK / EDK at top; significant weathering, splitting and decay; appears reasonably sound at connection to raking stud
	Raker Studs					
	Upstream Raker Stud			•		Splitting and decay at top; highly decayed at base
	Downstream Raker Stud	•				Large vertical split and decay at top; significant weathering and decay on sides and downstream face
	Diagonal Bracing					
	Cross bracing	•			80%	Light to moderate corrosion; railway iron braces
	Whaling's					
	Whaling's			•		Timber splitting and decayed through centre; south side buried under soil; effectively not doing anything *- Replace or may be redundant as pier is on river bank not subject to any water flow*
	Pile Cap			•		Heavily decayed
10	**Piles**					
	Upstream Pile	•				Spliced at ground level 1966; splice split at top; top of splice section sounds hollow; EDK at top of original pile; original pile - pile surface soft and wet below ground level, otherwise sound
	Centre Pile	•				Replaced 1966; some splitting
	Downstream Pile	•				Splitting down to ground level; excavation around pile showed pile sound below ground
	Pile Cap	•				Replaced 1944; splitting and EDK both ends; typical weathering
	Abutment Walls - Timber facing			•		Various states of decay; collapsing at upstream end
	Abutment Walls - Vertical Railway Irons	•		•		4 no. railway irons; various states of decay / corrosion

Span 3 - LH

TOTARA RIVER BRIDGE - ROSS

Key:
Pipe - interal Pocket
PDK - Powder Decay
HDK - Heart Decay
WS - White Spot/Yellow Spot
Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Side	Structural Element	PIPE	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
LH	**Timber Struts**									
	#1-King Strut (Dia 330x300x5.3m)	X		X		X		X		Bottom -100x90 Middle- Sound Top-120x70.
	#1-Queen Strut (Dia 250x300x5.3)	X	X	X		X		X		50x70 Pipe - 90x120 PDK-Sound.
	#1 Counter Strut					X				Sound
	#1- Centre Strut-Inside					X				Sound
	Outside	X								Bottom 40x70 Remainder sound
	#2- Centre Strut- Inside	X				X				Bottom 35x70 remainder sound
	Outside									Sound
	#2-Counter Strut					X		X		Sound
	#2-Queen Strut	X		X	X			X		40x30 HDK-110x150 Pipe &WS-135x80 Pipe&WS
	#2-King Strut					X				
	Vertical Steel Tension Rods									
	#1-King Rods -Inside									
	Outside									
	#1-Queen Rods -Inside									
	Outside									
	#1-Centre Rods- Inside									
	Outside									
	#2-Queen Rods -Inside									
	Outside							X		
	#2- King Rods -Inside									
	Outside									
	Timber Thrust Blocks									
	#1 King Timber Thrust Block									
	#1 Queen Timber Thrust Block	X						X		100x55 pipe
	Centre Timber Thrust Blocks									
	#2 Queen Timber Thrust Blocks									
	#2 King Timber Thrust Blocks									
	Timber A-Blocks									
	#1-Queen A-Blocks									
	Centre A-Block									
	#2-Queen A-Blocks									
	Timber Saddle Blocks									
	#1 King saddle Block							X		AS Per WSP Report
	#1 Queen saddle block	X							X	30x90 pipe has open pipe both ends Grout Repair
	Centre Saddle Block	X				X		X		45x130 Pipe Has major spilting bothends
	#2- Queen Saddle Block	X						X		90x135 Pipe
	Top Chord									
	#1-King-#1Queen -Inside							X		As per WSP report
	Middle									Sound
	Outside									Sound
	#1 Queen- Centre Inside									
	Middle									
	Outside									
	Centre- #2 Queen Inside									
	Middle									
	Outside									
	#2 Queen # 2 King Inside									Sound
	Middle							X		Minor Pipe- 40x90 Pipe-60x120 Pipe
	Outside							X		
	Steel Plate Connections									
	#1-King Strut to Top Cord							X	X	Bolt replacement/Plate Replacement
	#2-King Strut to Top Cord							X	X	
	Timber Braces									
	#1-King Timber Brace									
	#1-Queen Timber Brace									
	Centre Timber Brace							X		
	#2-Queen Timber Brace									
	#2-King Timber Brace									

Span 3 - RH

TOTARA RIVER BRIDGE - ROSS

Key:
Pipe - interal Pocket
PDK - Powder Decay
HDK - Heart Decay
WS - White Spot/Yellow Spot
Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Side	Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
RH	**Timber Struts**									
	#1-King Strut (Dia 330x300x5.3m)	X		X		X		X		Bottom -Sound Middle- Sound Top-85x135 Pipe
	#1-Queen Strut (Dia 250x300x5.3)									
	#1 Counter Strut									
	#1- Centre Strut-Inside					X				Sound
	Outside									Bottom 40x70 Remainder sound
	#2- Centre Strut- Inside							X		Sound
	Outside									
	#2-Counter Strut					X				Sound
	#2-Queen Strut									Sound
	#2-King Strut					X				Sound
	Vertical Steel Tension Rods									
	#1-King Rods -Inside									
	Outside									
	#1-Queen Rods -Inside									
	Outside									
	#1-Centre Rods- Inside									
	Outside									
	#2-Queen Rods -Inside									
	Outside									
	# 2 King Rods -Inside						X	X		
	-Outside						X	X		
	Timber Thrust Blocks									
	#1 King Timber Thrust Block							X		
	#2 Queen Timber Thrust block									
	Centre Timber Thrust Blocks									
	#2 Queen Timber Thrust Blocks									
	#2 King Timber Thrust Blocks							X		
	Timber Saddle Blocks									
	#1 King saddle Block							X		
	#2 Queen saddle block									
	Centre Saddle Block									
	#2 Queen Saddle Block									
	#2 King saddle block	X						X		
	Top Chord									
	#1-King-#1Queen -Inside									
	Middle									
	Outside									
	#1 Queen-Centre - Inside									
	Middle									
	Outside									
	Centre-#2 Queen- Inside									
	Middle									
	Outside									
	#2 Queen-#2 King - Inside							X		Replace High amount of Surface Decay
	Middle							X		Replace High amount of Surface Decay
	Outside							X		Replace High amount of Surface Decay
	Steel Connection Plate									
	#1-King Strut to Top Cord								X	Bolt Replacement
	#2-King Strut to Top Cord								X	Bolt Replacement
	Timber Braces									
	#1-King Timber Brace									
	#1-Queen Timber Brace									
	Centre Timber Brace									
	#2-Queen Timber Brace									
	#2-King Timber Brace									

Span 4 - LH

TOTARA RIVER BRIDGE - ROSS

Key:
Pipe - interal Pocket
PDK - Powder Decay
HDK - Heart Decay
WS - White Spot/Yellow Spot
Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Side	Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
LH	**Timber Struts**									
	#1-King Strut (Dia 330x300x5.3m)							X		Need to re visit
	#1-Queen Strut (Dia 250x300x5.3)							X		Need to re visit
	#1 Counter Strut									
	#1- Centre Strut-Inside									
	Outside									
	#2- Centre Strut- Inside									
	Outside									
	#2-Counter Strut									
	#2-Queen Strut	X						X		95x60-120x70-Top Sound
	#2-King Strut									
	Vertical Steel Tension Rods									
	# 1 King Rods -Inside									
	-Outside							X		
	#1 Queen Rods -Inside							X		
	-Outside									
	#1-Centre Rods -Inside									
	-Outside							X		
	#2 Queen Rods-Inside									
	Outside									
	#2 King Rods -Inside							X		
	Outside							X		
	Timber A-Blocks									
	#1- Queen A-Blocks									Open Pipe at End-Grout Repair
	Centre Saddle Block									
	#2-Queen A- Block								X	Grout Repair Hole in middle of block Bores minor Decay
	Timber Thrust Blocks									
	#1 King Timber Thrust Block									
	#2 Queen Timber Thrust block									
	Centre Timber Thrust Blocks									
	#2 Queen Timber Thrust Blocks									
	#2 King Timber Thrust Blocks									
	Timber Saddle Blocks									
	#1 King saddle Block									
	#1-Queen saddle block									
	Center Saddle Block									
	#2- Queen Saddle Block									
	#2-King Saddle Block									
	Top Chord									
	#1-King-#1Queen - Inside									
	Middle									
	Outside									
	#1-Queen -Centre Inside									
	Middle									
	Outside	X						X		70x90-60x120-Sound
	#2 Queen-#2 King - Inside									
	Middle									
	Outside	X						X		Sound-60x100-75x125
	Steel Connection Plate									
	#1-King Strut To Top Chord								X	Replace bolts
	#2 King Strut To Top Chord								X	Replace bolts
	Timber Braces									
	#1-King Timber Brace									
	#1-Queen Timber Brace									
	Centre Timber Brace									
	#2-Queen Timber Brace									
	#2-King Timber Brace	X						X		Sound-80x135.Bad surface Decay

Span 4 - RH

TOTARA RIVER BRIDGE - ROSS

Key:
Pipe - interal Pocket
PDK - Powder Decay
HDK - Heart Decay
WS - White Spot/Yellow Spot
Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Side	Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
RH	**Timber Struts**									
	#1-King Strut (Dia 330x300x5.3m)									
	#1-Queen Strut (Dia 250x300x5.3)									
	#1 Counter Strut									Sound
	#1- Centre Strut-Inside									Sound
	Outside	X						X		70x80-Sound
	#2- Centre Strut- Inside									Sound
	Outside	X						X		70x80- large full length spilt and surface decay
	#2-Counter Strut									
	#2-Queen Strut	X			X			X		50x40-60x120-65x75 Pipe/WS
	#2-King Strut									
	Vertical Steel Tension Rods									
	# 1 King Rods -Inside									
	-Outside							X		
	#1 Queen Rods -Inside							X		
	-Outside							X		
	#1-Centre Rods -Inside									
	-Outside									
	#2 Queen Rods-Inside									
	Outside									
	#2 King Rods -Inside									
	Outside									
	Timber A-Blocks									
	#1- Queen A-Blocks									
	Centre A-Blocks									
	#2-Queen A-Blocks									
	Timber Thrust Blocks									
	#1 King Timber Thrust Block									
	#1-Queen Timber Thrust Block									
	Centre Timber thrust Block									
	#2- Queen Timber Thrust Block									
	#2-King Timber Thrust Block									
	Timber Saddle Blocks									
	#1 King saddle Block									
	#2 Queen saddle block									
	Centre Saddle Block									
	#2 Queen saddle Block	X						X		80x100
	#2 King saddle Block	X							X	50x40 Grout Repair open pipe ends
	Top Chord									
	#1-King-#1Queen - Inside	X						X		45x50-50-40-Sound. High amount of decay inside face
	Middle									Sound
	Outside	x								60x40-Sound
	#1-Queen-Centre- Inside									
	Middle									Sound
	Outside									
	Centre-#2Queen - Inside									
	Middle									
	Outside									
	#2 Queen-#2 King -Inside									Minor decay otherwise sound
	Middle									
	Outside									
	Steel Connection Plate									
	#1 King Strut To Top Cord									
	#2 King Strut To Top Cord									
	Timber Braces									
	#1-King Timber Brace									
	#1 Queen Timber Brace									
	Centre Timber Brace									
	#2 Queen Timber Brace							X		
	#2 King Timber Brace							X		

Span 5 - LH

TOTARA RIVER BRIDGE - ROSS

Key:
Pipe - interal Pocket
PDK - Powder Decay
HDK - Heart Decay
WS - White Spot/Yellow Spot
Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Side	Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
LH	**Timber Struts**									
	#1-King Strut (Dia 330x300x5.3m)	X							X	40x25-30x80. Big split through top. Split clamp or split bolt repair
	#1-Queen Strut (Dia 250x300x5.3)							X		
	#1 Counter Strut							X		Bores sound. Split at bottom. Split clamp or split bolt repair
	#1- Centre Strut-Inside									
	Outside							X		Sound
	#2- Centre Strut- Inside							X		
	Outside							X		
	#2-Counter Strut									Sound
	#2-Queen Strut									
	#2-King Strut									
	Vertical Steel Tension Rods									
	# 1 King Rods -Inside									
	-Outside									
	#1 Queen Rods -Inside									
	-Outside							X		
	#1-Centre Rods -Inside									
	-Outside									
	#2 Queen Rods-Inside							X		
	Outside									
	#2 King Rods -Inside									
	Outside									
	Timber A-Blocks									
	#1- Queen A-Blocks									
	Centre A-Blocks									
	#2-Queen A-Blocks									
	Timber Thrust Blocks									
	#1 King Timber Thrust Block									
	#1-Queen Timber Thrust Block									
	Centre Timber thrust Block	X						X		100x130
	#2- Queen Timber Thrust Block									
	#2-King Timber Thrust Block									Sound
	Timber Saddle Blocks									
	#1 King saddle Block									
	#2 Queen saddle block									
	Centre Saddle Block									
	#2 Queen saddle Block							X		
	#2 King saddle Block							X		
	Top Chord									
	#1-King-#1Queen -Inside									
	Middle									
	Outside									
	#1 King- #1 Queen Inside									
	Middle									
	Outside									
	#1-Queen To Centre Inside									
	Middle							X		End Sound however centre has major decay unable to drill
	Outside									Sound
	Centre-#2 Queen Inside									
	Middle									
	Outside	X								
	#2 Queen-#2 King - Inside			X				X		Sound-Soft to drill through out
	Middle									Sound-Sound-60x65
	Outside									Sound
	Steel Connection Plate									
	#1 King Strut To Top Cord							X		
	#2 King Strut To Top Cord							X		
	Timber Braces									
	#1-King Timber Brace									
	#1 Queen Timber Brace									
	Centre Timber Brace							X		
	#2 Queen Timber Brace									Has been replace
	#2 King Timber Brace							X		Major decay to soft to drill

Span 5 - RH

TOTARA RIVER BRIDGE - ROSS

Key:
Pipe - interal Pocket
PDK - Powder Decay
HDK - Heart Decay
WS - White Spot/Yellow Spot
Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Side	Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
RH	**Timber Struts**									
	#1-King Strut (Dia 330x300x5.3m)	X		X				X	X	Minor decay and Pipe through out 150mm deep split Weathered at top grout repair top
	#1-Queen Strut (Dia 250x300x5.3)									
	#1 Counter Strut									
	#1- Centre Strut-Inside									
	Outside									
	#2- Centre Strut- Inside									
	Outside									
	#2-Counter Strut									
	#2-Queen Strut									Sound
	#2-King Strut									
	Vertical Steel Tension Rods									
	# 1 King Rods -Inside									
	-Outside									
	#1 Queen Rods -Inside									
	-Outside							X		
	#1-Centre Rods -Inside									
	-Outside							X		
	#2 Queen Rods- Inside							X		
	Outside							X		
	#2 King Rods -Inside							X		
	Outside							X		
	Timber A-Blocks									
	#1- Queen A-Blocks									
	Centre A-Blocks									
	#2-Queen A-Blocks									
	Timber Thrust Blocks									
	#1 King Timber Thrust Block									
	#1-Queen Timber Thrust Block									
	Centre Timber Thrust Block									
	#2- Queen Timber Thrust Block									
	#2-King Timber Thrust Block									
	Timber Saddle Blocks									
	#1 King saddle Block	X							X	
	#2 Queen saddle block									
	Centre Saddle Block									
	#2 Queen saddle Block									
	#2 King saddle Block	X							X	60x90. Open Pipe at ends grout repair
	Top Chord									
	#1-King-#1Queen - Inside									
	Middle									
	Outside									Sound
	#1-Queen-Centre -Inside									
	Middle									
	Outside									Sound
	Centre-#2 Queen - Inside									
	Middle									
	Outside									
	#2 Queen-#2 King - Inside									
	Middle									
	Outside									
	Steel Connection Plate									
	#1 King Strut To Top Cord							X		
	#2 King Strut To Top Cord							X		
	Timber Braces									
	#1-King Timber Brace									
	#1 Queen Timber Brace									
	Centre Timber Brace									
	#2 Queen Timber Brace									
	#2 King Timber Brace									

Span 6 - LH

TOTARA RIVER BRIDGE - ROSS

Key:
Pipe - interal Pocket
PDK - Powder Decay
HDK - Heart Decay
WS - White Spot/Yellow Spot
Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Side	Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
LH	**Timber Struts**									
	#1-King Strut (Dia 330x300x5.3m)									
	#1-Queen Strut (Dia 250x300x5.3)	X				X		X		170x 120 Through split-60x60-Sound. Major surface decay top face
	#1 Counter Strut									
	#1- Centre Strut-Inside									
	Outside									Sound
	#2- Centre Strut- Inside									Sound
	Outside									
	#2-Counter Strut									
	#2-Queen Strut									
	#2-King Strut						x	X	X	Top of strut has top face decay grout repair
	Vertical Steel Tension Rods									
	# 1 King Rods -Inside							X		
	-Outside									
	#1 Queen Rods -Inside							X		
	-Outside							X		
	#1-Centre Rods -Inside									
	-Outside									
	#2 Queen Rods- Inside							X		
	Outside							X		
	#2 King Rods -Inside									
	Outside									
	Timber A-Blocks									
	#1- Queen A-Blocks									
	Centre A-Blocks									
	#2-Queen A-Blocks									
	Timber Thrust Blocks									
	#1 King Timber Thrust Block									
	#1-Queen Timber Thrust Block					X		X		Major splits and decay
	Centre Timber Thrust Block									
	#2- Queen Timber Thrust Block									
	#2-King Timber Thrust Block							X		Sound
	Timber Saddle Blocks									
	#1 King saddle Block	X								90x65
	#2 Queen saddle block									Sound
	Centre Saddle Block	X			X			X		120 x110
	#2 Queen saddle Block									
	#2 King saddle Block	X						X		115x90
	Top Chord									
	#1-King-#1Queen - Inside									
	Middle									
	Outside									
	#1-Queen-Centre -Inside									
	Middle									
	Outside	X								60x70
	Centre-#2 Queen - Inside									
	Middle									
	Outside							X		
	#2 Queen-#2 King -Inside									
	Middle									
	Outside									
	Steel Connection Plate									
	#1 King Strut To Top Cord							X		
	#2 King Strut To Top Cord								X	Replace Bolts
	Timber Braces									
	#1-King Timber Brace									
	#1 Queen Timber Brace									
	Centre Timber Brace							X		As per WSP Report
	#2 Queen Timber Brace									
	#2 King Timber Brace									

Span 6 - RH

TOTARA RIVER BRIDGE - ROSS

Key:
Pipe - interal Pocket
PDK - Powder Decay
HDK - Heart Decay
WS - White Spot/Yellow Spot
Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Side	Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
RH	**Timber Struts**									
	#1-King Strut (Dia 330x300x5.3m)									
	#1-Queen Strut (Dia 250x300x5.3)									Sound
	#1 Counter Strut									
	#1- Centre Strut-Inside									
	Outside									
	#2- Centre Strut- Inside									
	Outside									
	#2-Counter Strut									
	#2-Queen Strut									
	#2-King Strut									
	Vertical Steel Tension Rods									
	# 1 King Rods -Inside							X		
	-Outside									
	#1 Queen Rods -Inside							X		
	-Outside							X		
	#1-Centre Rods -Inside							X		
	-Outside									
	#2 Queen Rods- Inside									
	Outside									
	#2 King Rods -Inside									
	Outside							X		
	Timber A-Blocks									
	#1- Queen A-Blocks									
	Centre A-Blocks									
	#2-Queen A-Blocks									
	Timber Thrust Blocks									
	#1 King Timber Thrust Block									
	#1-Queen Timber Thrust Block									
	Centre Timber Thrust Block									
	#2- Queen Timber Thrust Block									
	#2-King Timber Thrust Block									
	Timber Saddle Blocks									
	#1 King saddle Block									
	#2 Queen saddle block									
	Centre Saddle Block							X		As Per WSP Report
	#2 Queen saddle Block									
	#2 King saddle Block									
	Top Chord									
	#1-King-#1Queen - Inside									
	Middle									
	Outside									
	#1-Queen-Centre -Inside							X		Not bore. However signs of failure
	Middle									
	Outside									
	Centre-#2 Queen - Inside									
	Middle									
	Outside									
	#2 Queen-#2 King -Inside									
	Middle									
	Outside									
	Steel Connection Plate									
	#1 King Strut To Top Cord									
	#2 King Strut To Top Cord							X		
	Timber Braces									
	#1-King Timber Brace									
	#1 Queen Timber Brace									
	Centre Timber Brace							X		As per WSP Report
	#2 Queen Timber Brace							X		As per WSP Report
	#2 King Timber Brace									

Span 7 - LH

TOTARA RIVER BRIDGE - ROSS

Key:
Pipe - interal Pocket
PDK - Powder Decay
HDK - Heart Decay
WS - White Spot/Yellow Spot
Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Side	Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
LH	**Timber Struts**									
	#1-King Strut (Dia 330x300x5.3m)									
	#1-Queen Strut (Dia 250x300x5.3)									
	#1 Counter Strut									
	#1- Centre Strut-Inside							X		AS Per WSP report
	Outside							X		
	#2- Centre Strut- Inside									
	Outside									
	#2-Counter Strut									
	#2-Queen Strut									
	#2-King Strut									
	Vertical Steel Tension Rods									
	# 1 King Rods -Inside									
	-Outside							X		
	#1 Queen Rods -Inside									
	-Outside									
	#1-Centre Rods -Inside									
	-Outside							X		
	#2 Queen Rods- Inside									
	Outside									
	#2 King Rods -Inside									
	Outside									
	Timber A-Blocks									
	#1- Queen A-Blocks									
	Centre A-Blocks									
	#2-Queen A-Blocks									
	Timber Thrust Blocks									
	#1 King Timber Thrust Block									
	#1-Queen Timber Thrust Block									
	Centre Timber Thrust Block									
	#2- Queen Timber Thrust Block									
	#2-King Timber Thrust Block									
	Timber Saddle Blocks									
	#1 King saddle Block							X		Sound
	#2 Queen saddle block							X		Sound
	Centre Saddle Block							X		As Per WSP
	#2 Queen saddle Block									
	#2 King saddle Block							X		As Per WSP
	Top Chord									
	#1-King-#1Queen - Inside									
	Middle									
	Outside									
	#1-Queen-Centre -Inside									
	Middle									
	Outside									
	Centre-#2 Queen - Inside									
	Middle									
	Outside									
	#2 Queen-#2 King - Inside									
	Middle									
	Outside									
	Steel Connection Plate									
	#1 King Strut To Top Cord							X		
	#2 King Strut To Top Cord							X		
	Timber Braces									
	#1-King Timber Brace							X		As Per WSP report
	#1 Queen Timber Brace									
	Centre Timber Brace							X		AS Per WSP Report
	#2 Queen Timber Brace							X		AS Per WSP Report
	#2 King Timber Brace							X		AS Per WSP Report

Span 7 - RH

TOTARA RIVER BRIDGE - ROSS

Key:
Pipe - interal Pocket
PDK - Powder Decay
HDK - Heart Decay
WS - White Spot/Yellow Spot
Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Side	Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
RH	**Timber Struts**									
	#1-King Strut (Dia 330x300x5.3m)									
	#1-Queen Strut (Dia 250x300x5.3)									
	#1 Counter Strut									
	#1- Centre Strut- Inside									
	Outside									
	#2- Centre Strut- Inside									
	Outside									
	#2-Counter Strut							X		As per WSP report
	#2-Queen Strut									
	#2-King Strut									
	Vertical Steel Tension Rods									
	# 1 King Rods - Inside									
	- Outside									
	#1 Queen Rods -Inside							X		
	-Outside							X		
	#1-Centre Rods -Inside									
	-Outside									
	#2 Queen Rods- Inside							X		
	Outside							X		
	#2 King Rods - Inside									
	Outside									
	Timber A-Blocks									
	#1- Queen A-Blocks							X		As per WSP report
	Centre A-Blocks									
	#2-Queen A-Blocks									
	Timber Thrust Blocks									
	#1 King Timber Thrust Block									
	#1-Queen Timber Thrust Block									
	Centre Timber Thrust Block									
	#2- Queen Timber Thrust Block									
	#2-King Timber Thrust Block									
	Timber Saddle Blocks									
	#1 King saddle Block							X		
	#2 Queen saddle block							X		
	Centre Saddle Block									
	#2 Queen saddle Block									
	#2 King saddle Block									
	Top Chord									
	#1-King-#1Queen - Inside							X		
	Middle									
	Outside							X		
	#1-Queen-Centre -Inside									
	Middle									
	Outside							X		
	Centre-#2 Queen -Inside									
	Middle									
	Outside									
	#2 Queen-#2 King - Inside									
	Middle									
	Outside									
	Steel Connection Plate									
	#1 King Strut To Top Cord							X		
	#2 King Strut To Top Cord								X	Bolts gone
	Timber Braces									
	#1-King Timber Brace							X		
	#1 Queen Timber Brace									
	Centre Timber Brace									
	#2 Queen Timber Brace									
	#2 King Timber Brace									

Transoms

TOTARA RIVER BRIDGE - ROSS

Key:
Pipe - interal Pocket
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Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Span	Side	Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
3											All from upstream to downstream
	LH	#1-King Transom									
	RH	#1-King Transom									
	LH	#1 Queen Transom									
	RH	#1-Queen Transm							X		
	LH	Centre Transom									
	RH	Centre Transom									
	LH	#2 Queen Transom									
	RH	#2 Queen Transom									
	LH	#2 King Transom									
	RH	#2-King Transom									
4	LH	#1-King Transom	X							X	Sound from upstream to downstream end 85x85 Open pipe grout Repair
	RH	#1-King Transom	X							X	Sound from upstream to downstream end 130x200 Open pipe grout Repair bothends
	LH	#1 Queen Transom	X							X	100x80 Pipe Upstream end remainder sound
	RH	#1-Queen Transm									
	LH	Centre Transom									Sound
	RH	Centre Transom									
	LH	#2 Queen Transom	X							X	Upstream 150x140. Remainder sound. Grout repair
	RH	#2 Queen Transom	X							X	Sound -120x150-80x125-Sound-Repair steel PFC bothsides
	LH	#2 King Transom									
	RH	#2 King Transom									
5	LH	#1-King Transom									
	RH	#1-King Transom									
	LH	#1 Queen Transom									
	RH	#1 Queen Transom									
	LH	Centre Transom									
	RH	Centre Transom									
	LH	#2 Queen Transom									
	RH	#2 Queen Transom					X		X		Sound. Split Downstream side
	LH	#2 King Transom									
	RH	#2 King Transom								X	Grout repair
6	LH	#1-King Transom									
	RH	#1-King Transom									
	LH	#1 Queen Transom									
	RH	#1 Queen Transom									
	LH	Centre Transom									
	RH	Centre Transom									
	LH	#2 Queen Transom									Sound
	RH	#2 Queen Transom									
	LH	#2 King Transom									
	RH	#2 King Transom									
7	LH	#1-King Transom									
	RH	#1-King Transom									
	LH	#1 Queen Transom									
	RH	#1 Queen Transom									
	LH	Centre Transom									
	RH	Centre Transom									
	LH	#2 Queen Transom									
	RH	#2 Queen Transom									
	LH	#2 King Transom									
	RH	#2 King Transom									

Road Beams

TOTARA RIVER BRIDGE - ROSS

Key:
Pipe - interal Pocket
PDK - Powder Decay
HDK - Heart Decay
WS - White Spot/Yellow Spot
Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
									Bores are from Hoki to Ross
LH1					X			X	Split clamp repair Grout repair to Face Decay
LH2	X								80x125- sound
LH3									
LH4									
LH5									
LH6	X				X		X		125x195-130x195-60x110-sound. Steel PFC repair
LH7									
LH8					X		X		Sound.Major Surface decay and spliting
LH9							X		As per WSP report
LH10									
LH11					X				Sound
LH12									
LH13									
LH14					X				Sound
LH15									
LH16					X				Sound
LH17									
LH18									
LH19									
CN1					X				Sound
CN2									
CN3									
CN4									
									Sound
RH1									
RH2									
RH3									
RH4									
RH5	X				X		X		Sound-110x75-100x140-150x150
RH6	X				X				Sound-80x90-Sound -Sound
RH7									
RH8									
RH9									
RH10									
RH11	X				X				Sound-85x80-Sound-Sound
RH12							X		As per WSP report
RH13					X				Sound
RH14	X				X				Bores sound however major surface decay and spliting
RH15					X				Sound
RH16									
RH17									
RH18									
RH19					X				Sound
RH20									
RH21									
RH22					X				Sound
RH23									
RH24									

Corbels

TOTARA RIVER BRIDGE - ROSS

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PDK - Powder Decay
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Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Pier	Side	Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
		Corbels									
2		LH Corbel									
		Centre Corbel									
		RH Corbel	X								120x90
3		LH Corbel									
		Centre Corbel									Sound
		RH Corbel									
	1#King	LH Corbel									
		RH Corbel							X		AS Per WSP Report
	1#Queen	LH Corbel									Sound
		RH Corbel									
	Centre	LH Corbel									
		RH Corbel									
	#2Queen	LH Corbel									
		RH Corbel									
	#2King	LH Corbel									
		RH Corbel									
4		LH Corbel									
		Centre Corbel									
		RH Corbel									
	1#King	LH Corbel									
		RH Corbel									
	1#Queen	LH Corbel									
		RH Corbel									
	Centre	LH Corbel									
		RH Corbel									
	#2Queen	LH Corbel									
		RH Corbel									
	#2King	LH Corbel									
		RH Corbel									
5		LH Corbel									
		Centre Corbel									
		RH Corbel					X		X		Sound, Dia spilts. Replace when beam is replaced
	1#King	LH Corbel									
		RH Corbel	X						X		200x200
	1#Queen	LH Corbel									
		RH Corbel									
	Centre	LH Corbel									
		RH Corbel									
	#2Queen	LH Corbel									
		RH Corbel									
	#2King	LH Corbel									
		RH Corbel									
6		LH Corbel									
		Centre Corbel									
		RH Corbel									
	1#King	LH Corbel								X	Sound, Split clamp
		RH Corbel									
	1#Queen	LH Corbel									Sound
		RH Corbel									
	Centre	LH Corbel	X						X		250x250
		RH Corbel									Sound
	#2Queen	LH Corbel	X						X		150x230
		RH Corbel									
	#2King	LH Corbel									
		RH Corbel									
7		LH Corbel							X		As per WSP report
		Centre Corbel									
		RH Corbel									
	1#King	LH Corbel									
		RH Corbel									
	1#Queen	LH Corbel									
		RH Corbel									
	Centre	LH Corbel									
		RH Corbel									
	#2Queen	LH Corbel									
		RH Corbel									
	#2King	LH Corbel									
		RH Corbel									
8		LH Corbel	X						X		sound-140x140-105x120
		Centre Corbel									
		RH Corbel	X								90x130-Sound
9		LH Corbel	X				X				70x140
		Centre Corbel									
		RH Corbel									Sound

Cross Bracing, Solid Blocking & Tie Rods

TOTARA RIVER BRIDGE - ROSS

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WS - White Spot/Yellow Spot
Spilt - Major Spilts in Timber
Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Pier/Span	Side	Structural Element	PIPE	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
		Cross Bracing,Soild Blocking & Tie Rods									
Span # 1		Soild Blocking							X		As per WSP report
		Tie Rods								X	Nuts missing, WSP Report
Span #2		Soild Blocking							X		As Per WSP report
		Tie Rods								X	Nuts missing, WSP Report
Span #3		**Cross Bracing**									
Pier #3 To #1K	LH								X		
	RH										
#1K to #1Q	LH										
	RH										
#1Q to Centre	LH										
	RH								X		
#2Q to#2K	LH										
	RH								X		
#2K to Pier #4	LH								X		
	RH								X		
Span # 4											
Pier #4 To #1K	LH								X		
	RH								X		
#1K to #1Q	LH								X		
	RH								X		
#1Q to Centre	LH										
	RH										
#2Q to#2K	LH										
	RH										
#2K to Pier #5	LH										
	RH								X		
Span #5											
Pier #5 To #1K	LH								X		
	RH										
#1K to #1Q	LH								X		
	RH										
#1Q to Centre	LH										
	RH								X		
#2Q to#2K	LH										
	RH										
#2K to Pier #6	LH								X		
	RH								X		
Span #6											
Pier #6 To #1K	LH										
	RH								X		
#1K to #1Q	LH										
	RH								X		
#1Q to Centre	LH										
	RH										
#2Q to#2K	LH								X		
	RH								X		
#2K to Pier #7	LH										
	RH										
Span #7											
Pier #7 To #1K	LH								X		
	RH										
#1K to #1Q	LH								X		
	RH								X		
#1Q to Centre	LH										
	RH										
centre to #2Q	LH								X		
	RH								X		
#2Q to#2K	LH										
	RH								X		
#2K to Pier #8	LH								X		
	RH										
Span #8	Soild Blocking								X		As per WSP report
	Tie Rods									X	Nuts missing
Span #9	Soild Blocking								X		As per WSP report
	Tie Rods									X	Nuts Missing

Piles

TOTARA RIVER BRIDGE - ROSS

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Other - Corroision, Missing bolts, Damaged, loose
RED - From WSP Report

Pier	Side	Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
3		**Piles**									Bores = Bottom to top
		Pile #1									
		Pile #2									
		Pile #3									
		Pile #4									
		Pile #5									
		Pile #6									
		Pile #7	X				X		X		Sound- 105x140-Sound
		Pile #8	X				X		X		Sound- 130x140-Sound
		Upstream cut water pile	X				X		X		Sound-265x155-Sound
		Downstream cut water pile									
		Raker Studs									
		Upstream raker Stud					X		X		Major decay and splits
		Downstream Raker Stud					X		X		Major decay and splits
		Diagonal Bracing									
		Cross Bracing									
		Whalings									
		Whalings									
		Pile Cap									
		Cap #1									
		Cap #2									
		Cap #3									
		Cap #4							X		Poor condition
4		**Piles**									
		Pile #1	X				X				95x70-remainder sound
		Pile #2	X				X		X		Sound-105x40-sound.Major spilting
		Pile #3									
		Pile #4									
		Pile #5	X						X		145x155-90x85-Sound
		Pile #6	X				X		X		130x125-210x165-sound-sound
		Pile #7									Sound
		Pile #8									
		Upstream cut water pile									Sound
		Downstream cut water pile									
		Raker Studs									
		Upstream raker Stud	X				X		X		Major Decay
		Downstream Raker Stud									
		Diagonal Bracing									
		Cross Bracing									
		Whalings									
		Whalings									
		Pile Cap									
		Cap #1									
		Cap #2									
		Cap #3									
		Cap #4									

Piles

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Pier	Side	Structural Element	Pipe	PDK	HDK	WS	Split	Other	Replace	Repair	Comments-
5		**Piles**									
		Pile #1	X				X		X		50x110-80x90-120x200
		Pile #2									
		Pile #3									
		Pile #4	x				X				Sound-Sound-150x90
		Pile #5	X				X		X		Sound-260x235-200x190-230x195
		Pile #6									
		Pile #7									
		Pile #8									
		Upstream cut water pile									
		Downstream cut water pile									
		Raker Studs									
		Upstream raker Stud									
		Downstream Raker Stud	X				X		X		Major Decay
		Diagonal Bracing									
		Cross Bracing									
		Whalings									
		Whalings									
		Pile Cap									
		Cap #1									
		Cap #2									
		Cap #3									
		Cap #4									
6		**Piles**									
		Pile #1									
		Pile #2									
		Pile #3									
		Pile #4									
		Pile #5									
		Pile #6									
		Pile #7									
		Pile #8									
		Upstream cut water pile									
		Downstream cut water pile									
		Raker Studs									
		Upstream raker Stud									
		Downstream Raker Stud							X		
		Diagonal Bracing									
		Cross Bracing									
		Whalings									
		Whalings									
		Pile Cap									
		Cap #1									
		Cap #2									
		Cap #3									
		Cap #4									
7		**Piles**									
		Pile #1									
		Pile #2									
		Pile #3									
		Pile #4									
		Pile #5									
		Pile #6									
		Pile #7									
		Pile #8									
		Upstream cut water pile									
		Downstream cut water pile									
		Raker Studs									
		Upstream raker Stud									
		Downstream Raker Stud									
		Diagonal Bracing									
		Cross Bracing									
		Whalings									
		Whalings									
		Pile Cap									
		Cap #1									
		Cap #2									
		Cap #3									
		Cap #4									