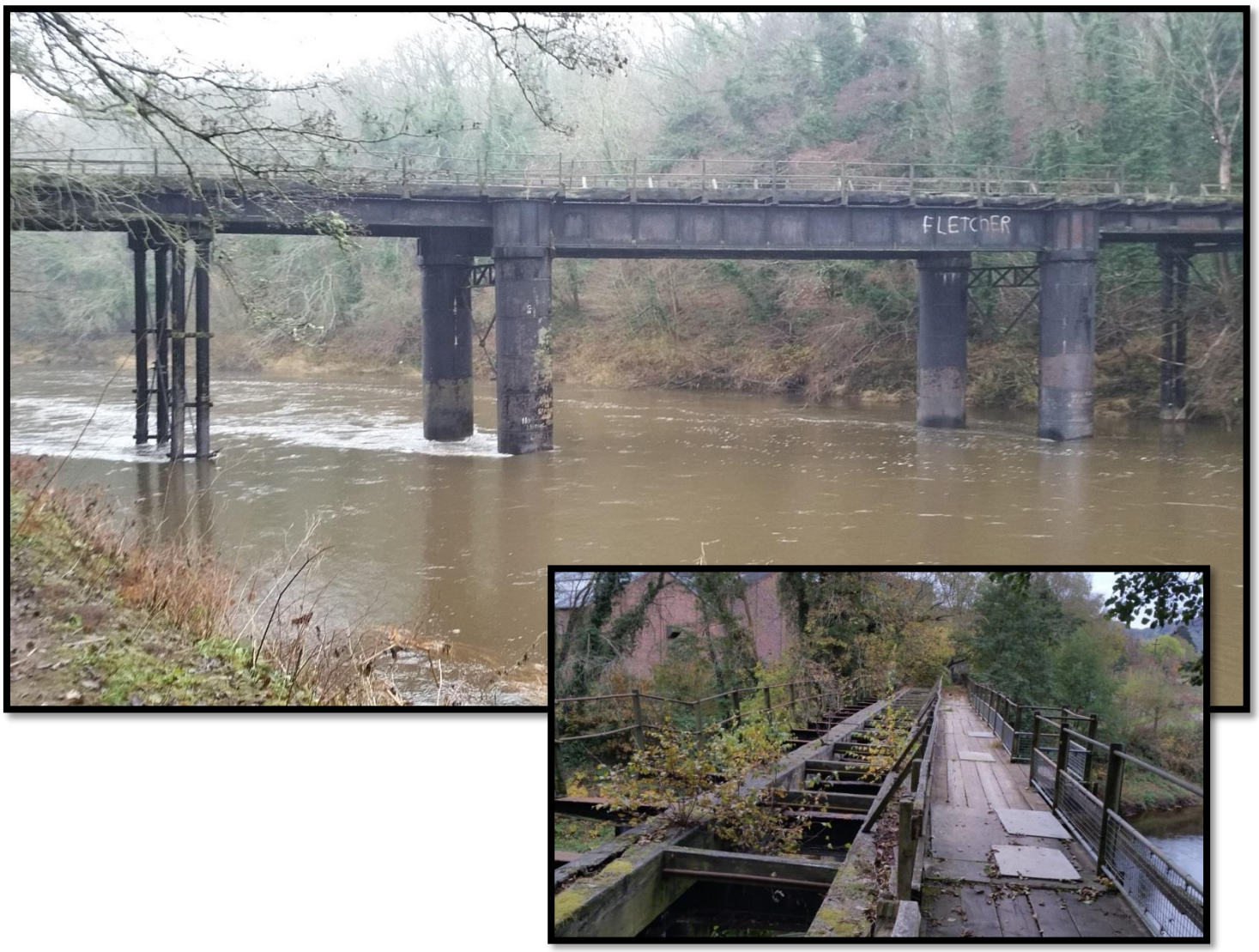
amey consulting



B976 LYDBROOK RAILWAY BRIDGE

RISK ASSESSMENT

B976 Revision A

January 2018

Document Control Sheet

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1 EXECUTIVE SUMMARY

On November 2016, Amey was appointed by Gloucestershire County Council (GCC) to carry out a feasibility study at Lydbrook Railway Bridge to identify the necessary works to refurbish and repair the bridge.

The report indicates that although the structural elements of the bridge have deteriorated due to a lack of maintenance, it does not compromise the capacity of the structure as a footbridge. The report concludes that it is feasible to refurbish the bridge as a footbridge.

However, given the severe deterioration of the elements that form the deck of the bridge, especially the timber walkway and the top flanges of the transverse beams that support it, the report states that it is not safe to keep the bridge open to the public until remedial works were completed. In addition, the report indicates that there is a significant risk of elements of the bridge falling into the river Wye and onto the track underneath the bridge (Public Right of Way) compromising the safety of the members of the public. The report concludes that if it not possible to refurbish the bridge within a short period of time, then it is necessary to remove those elements that represent a hazard to the members of the public using the river Wye and Public Right of Way.

In January 2018, Gloucestershire County Council (GCC) appointed Amey to complete a risk assessment on the bridge to identify the elements that represent a risk to the members of the public.

2 INTRODUCTION

Lydbrook Bridge was closed to the public in 2016 after finding significant defects on the bridge during a principal inspection. After that, a feasibility report has been completed to determine the best approach to enable the bridge to be re-opened. The feasibility report identifies a risk of some elements fallings into the river Wye and the track (Public Right of Way) underneath of the bridge.

The aim of this document is to identify those elements that represent a risk to the public and the action required to make the bridge safe. The reader should refer to the document entitled "B976, Lydbrook Railway Bridge. Feasibility Report" for a more detailed description of the structural elements of the bridge.

To determine the risk of each element, a risk assessment is completed on each of the elements identified as a risk in the feasibility report completed by Amey in 2016.

Although each element is assessed individually, a general recommendation is given to make the bridge safe based on the existing environmental and working constraints of the bridge.

3 RISK ASSESSMENT OF ELEMENTS IDENTIFIED AS AN HAZARD

3.1 INTRODUCTION

The feasibility report completed by Amey in 2017 identified the following elements of the bridge as a potential hazard to members of the public due to their poor condition:

- Downstream steel parapets
- Upstream steel parapets
- Inner timber parapets
- Walkway (timber planks and top flanges of transverse beams)
- Rail track sleepers

Each of the above listed elements will be assessed individually in the following sections.

3.2 RISK ASSESSMENT METHODOLOGY

To determine the risk that each of the elements represents to the public two attributes must be established, namely severity and likelihood. Hazard is a source of potential harm which poses a threat to third parties. For the purpose of this document, the severity is the harm that the falling of an element (or a part of it) may have on the members of the public. The extent of the risk is a combination of the likelihood and the severity of the hazard being realised, that is, the likelihood of a potential harm from a hazard being realised. Therefore, for each hazard an assessment of the potential severity and the probability of the accident has been calculated. A risk matrix has been used to assess the risk associated with each hazard.

The probability has beenclassified as follows:

Extremely unlikely	Highly improbable
Unlikely	Within 10 years
Likely	Within 5 years
Extremely likely	Within 1 year
Almost certain	Within 6 months

The harm that can be caused by a determine hazard has been clasified as follows:

Major harm	Fatal injury, major damage or loss
Serious harm	Serious injury, substantial damage or loss
Moderate harm	Slightly injury, moderate damage or loss
Minor harm	Minor damage or loss no injury

To combine the likelihood with the harm the next matrix has been used to obtain the risk (R):

Probability (P)		Severity (S)			
		1	2	3	4
		Minor	Moderate	Serious	Major
1	Extremely unlikely	1	2	3	4
2	Unlikely	2	4	6	8
3	Likely	3	6	9	12
4	Extremely Likely	4	8	12	16
5	Almost Certain	5	10	15	20

Attending to the score obtained in the matrix above the risk has been classified as:

Low (1-5). Action not needed. The current inspection regime is enough to detect any further deterioration of the element before they become a risk to members of the public.

Medium (6-12). If no works are completed to stop/reduce the deterioration of the element, the element will become a high risk to members of the public within one to two years so that it will not be possible to manage the risk with the current regime of inspections.

High (12-20). Risk not permitted. Actions must be taken to avoid the risk.

3.3 UPSTREAM PARAPETS

The upstream parapet is made of two tubular rails supported by steel posts spaced 2400 mm. The posts are connected to the bridge with a gusset plate. The gusset plate is the only element that keeps the parapets attached to the bridge and its failure will result in the parapet falling into the river or track. The gusset plates have suffered a severe corrosion which have produced a significant loss of their section. In 2006 a section of the parapet located next to the northern bank fell into the river resulting in emergency works to remove another section of parapet that remained attached to the bridge.

Therefore, it is considered that in their current condition, the gusset plate cannot hold the weight of the post and could fail at any time. Each post weighs thirty kilograms without including the tubular rails, this makes them a high risk to members of the public.

Probability (P)		Severity (S)			
		1	2	3	4
		Minor	Moderate	Serious	Major
1	Extremely unlikely	1	2	3	4
2	Unlikely	2	4	6	8
3	Likely	3	6	9	12
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5	Almost Certain	5	10	15	20

Given the high risk that the upstream parapets represent to members of the public, action must be taken to avoid the risk as the current risk is not acceptable.

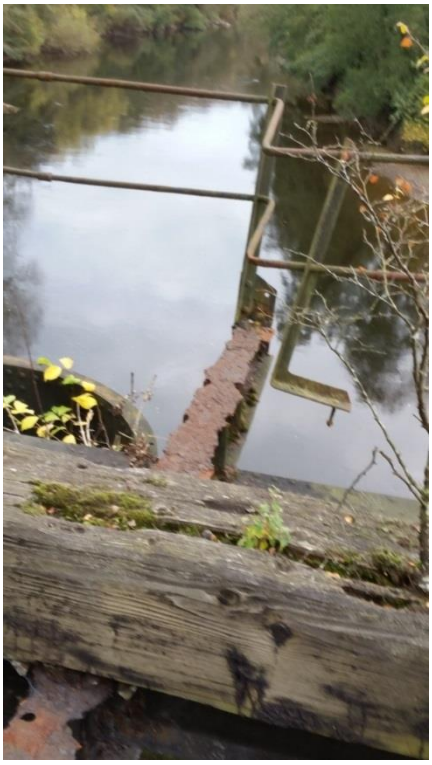

photo 1- Post loose

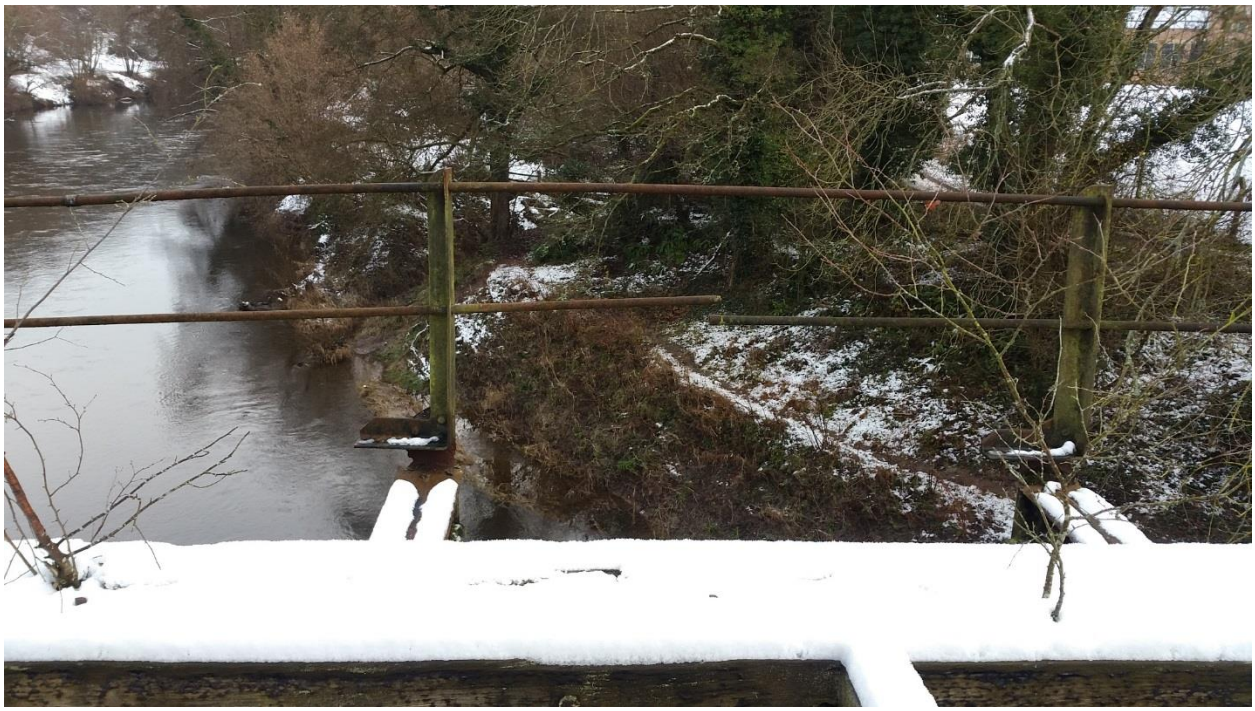

photo 2- Upstream parapet

3.4 DOWNSTREAM PARAPETS

Originally the downstream parapet has the same configuration that the upstream parapets. However, works have been previously completed on this parapet. In 1992, the old gusset plate that connect the parapet to the bridge were strengthened using a steel gusset plate. A third horizontal tubular rail was incorporated to reduce the vertical space between them, and kee-klamp panels were installed. However, an appraisal of the handrails in 2002 determined that the handrails do not comply with BS 7818:1995 "Specification for pedestrian restraint system in metal". This appraisal found that the parapet is structurally understrength in relation to the horizontal rails, the angle posts and the strength of the gusset plates.

Like the upstream parapets, the collapse of the downstream parapet could produce a fatal injury to members of the public using the river Wye or track. However, **the failure of this parapet in its current condition is extremely unlikely, this means that they only represent a low risk to members of the public.**

Probability (P)		Severity (S)			
		1	2	3	4
		Minor	Moderate	Serious	Major
1	Extremely unlikely	1	2	3	4
2	Unlikely	2	4	6	8
3	Likely	3	6	9	12
4	Extremely Likely	4	8	12	16
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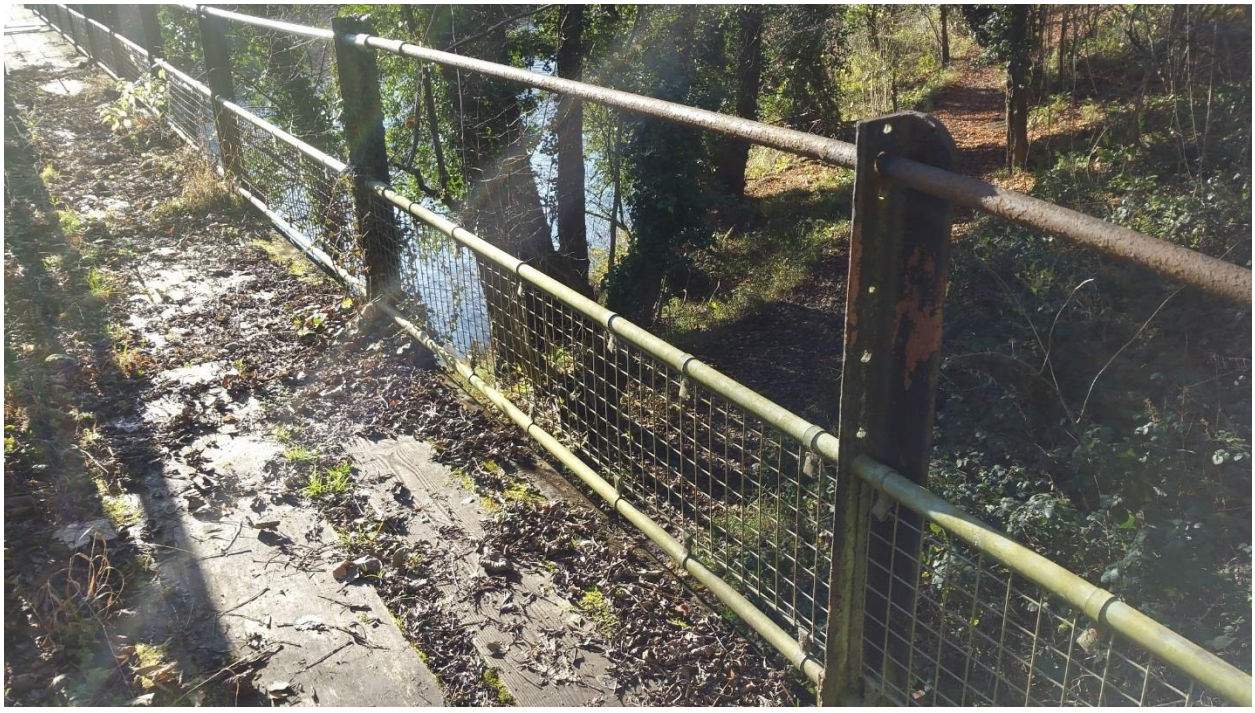

photo 3- Downstream parapet

3.5 WALKWAY. TIMBER PLANKS AND TRANSVERSE BEAMS.

The walkway is made of timber planks which span between the transverse beams that span between the two main longitudinal beams. The timber planks are placed on and bolted to the top flange of the transverse beams with a bolt at each end. The planks are severely rotten and some have fallen into the river since the bridge was closed to the public. The planks are 2.4 m long with a section of 250x100 mm and weight approximately 20 kilograms each.

The top flanges of the transverse girders (where the timber planks are bolted) are badly corroded with severe delamination and knife edging. The failure of one of these flanges will result in the collapse of a section of 2.4m walkway which will result in 5 timber planks and pieces of steel falling into the river. This is a significant hazard to the public.

The collapse of the walkway (including timber planks and/or top flanges of transverse beams) represent a high risk for members of the public using the river Wye or the track and action must be taken to eliminate the risk.

Probability (P)		Severity (S)			
		1	2	3	4
		Minor	Moderate	Serious	Major
1	Extremely unlikely	1	2	3	4
2	Unlikely	2	4	6	8
3	Likely	3	6	9	12
4	Extremely Likely	4	8	12	16
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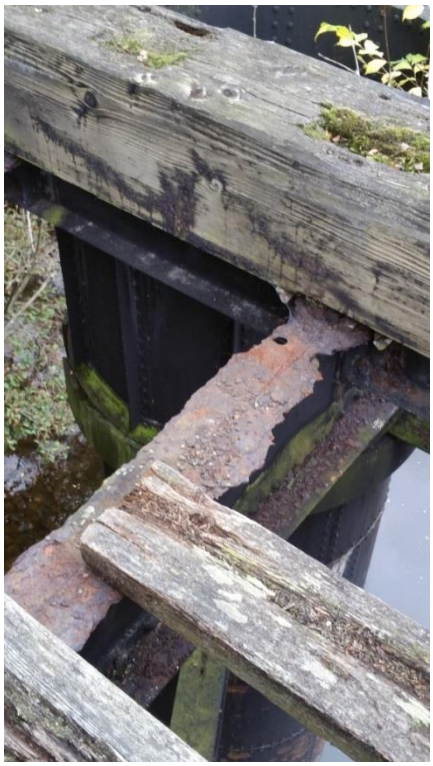

photo 4-Transverse beam

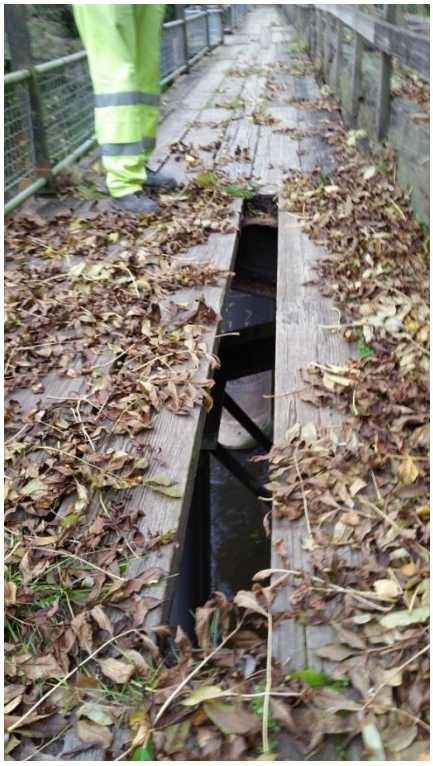

photo 5- Timber planks

3.6 TIMBER SLEEPERS

Next to the walkway there are two timber sleepers connected with a steel tie rod. The sleepers are supported by secondary longitudinal beams which span between the transverse beams. The sleepers have a section of 450x450mm while the flanges of the beams that support them are 200mm wide which leave part of the sleepers in the air. The timber of the sleeper is rotten which could cause pieces of timber fall into the river and onto the track.

Probability (P)		Severity (S)			
		1	2	3	4
		Minor	Moderate	Serious	Major
1	Extremely unlikely	1	2	3	4
2	Unlikely	2	4	6	8
3	Likely	3	6	9	12
4	Extremely Likely	4	8	12	16
5	Almost Certain	5	10	15	20

In their current condition, the sleepers represent a medium risk to members of the public. However, if no action is taken to reduce their deterioration they will become a high risk within 1-2 years.

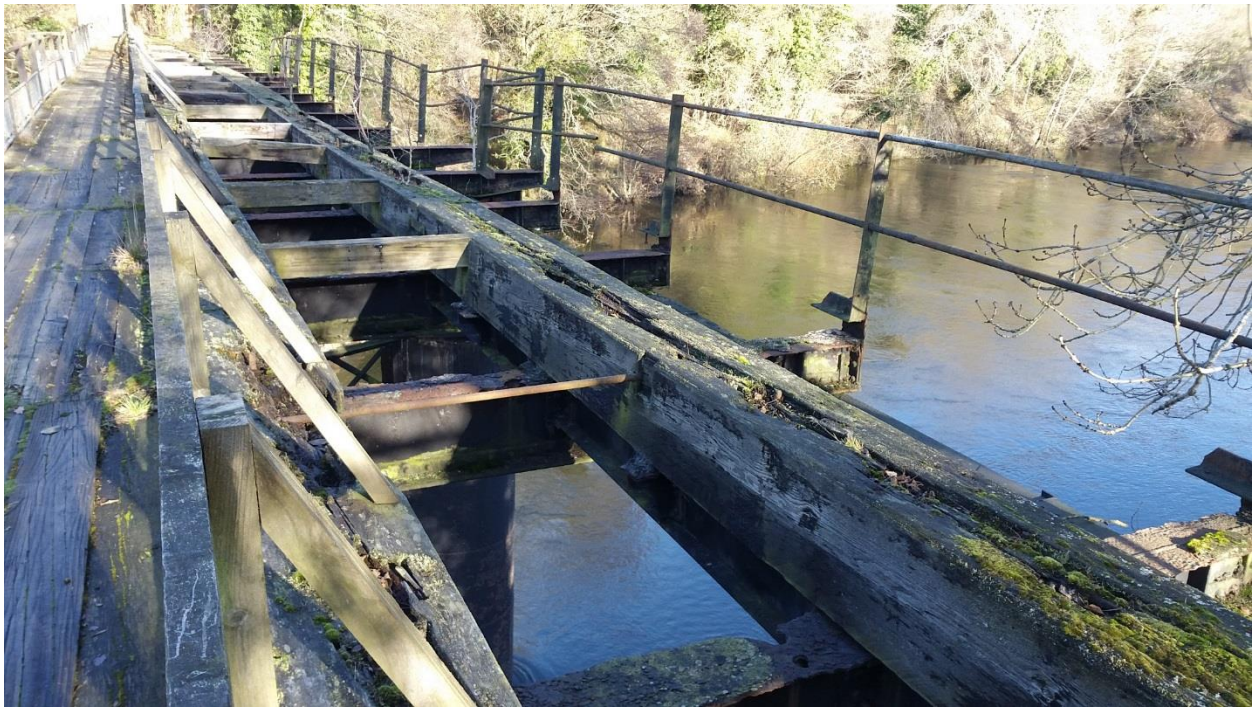

photo 6-Timber sleeper

3.7 INNER TIMBER PARAPETS

The inner edge of the footway is protected with a timber parapet fixed to the timber sleepers. This parapet is made of timber beams with a section of 100x50mm. The parapet is loose and do not comply with current standards. However, **they do not represent a significant risk to the members of the public in their current condition.**

Probability (P)		Severity (S)			
		1	2	3	4
		Minor	Moderate	Serious	Major
1	Extremely unlikely	1	2	3	4
2	Unlikely	2	4	6	8
3	Likely	3	6	9	12
4	Extremely Likely	4	8	12	16
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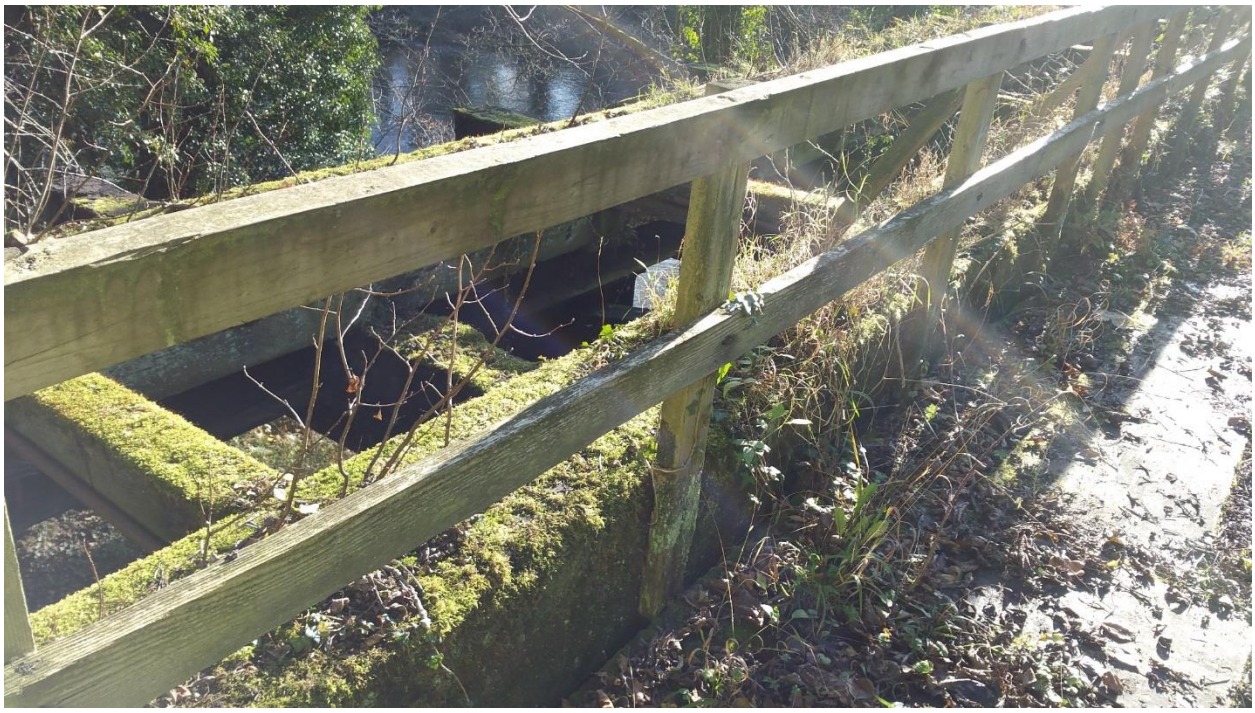

photo 7-Timber parapet

4 CONCLUSION

A risk assessment has been completed on the elements identified in the Amey feasibility report as potential risk for members of the public using the river Wye and the track (Public Right of Way) underneath the bridge.

The risk assessment has been completed based on the current condition of the elements.

The risk has been classified as low, medium and high. A high risk is not permitted and action must be taken to eliminate the risk. If no actions are undertaken on medium risk elements, they will become a high-risk element within one to two years. The low risk can be managed with the current inspection regime and no action are required within the next one to two years.

The table below summaries the results:

Element	Risk
Upstream parapet	High
Downstream parapet	Low
Walkway (timber planks and transverse beams' top flanges)	High
Timber sleepers	Medium
Inner timber parapet	Low

The upstream parapets and walkway represent a high risk. Given the impracticality of repairing them in future refurbishment works to the bridge, it is recommended to remove them within a period of six months to eliminate the risk.

The timber sleepers are elements that formed part of the rail track but will need to be removed if the bridge is to be refurbished as a footbridge. Additional inspections would be needed to establish the moment they become a high risk as a consequence of their deterioration. Given the ambient conditions in the Wye Valley, it is considered that they will become a high risk within one to two years.

At present, the downstream parapet represents a low risk. However, it will deteriorate if no maintenance works are completed. In addition, they do not comply with current standards which makes them unsuitable.

The inner timber parapet represents a low risk. However, it does not comply with current standards and will need to be replaced in the future if the bridge is re-opened.

Due to environmental constraints (the river Wye is a Site of Special Scientific Interest and Special Area of Conservation), to remove the elements that represent a high risk (upstream parapets, timber planks and top flanges of transverse beams), a crash deck must be erected underneath of the bridge. The cost of installing the crash deck needed to complete any dismantling works is significant. Therefore, it is advisable to remove all the elements that represent or may represent a risk in future at the same time in order to save the cost of two mobilisations.