

North Yorkshire County Council

Beck Hole Bridge Maintenance 2021

Engineering Statement

Structure Reference Number: 392



Rev A

July 2021

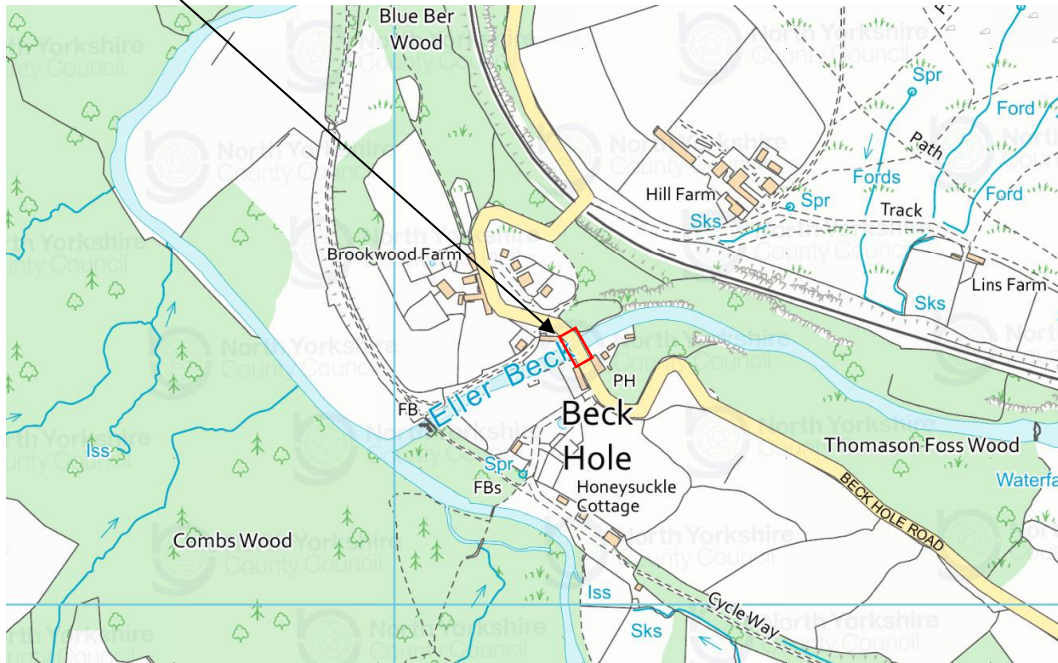
Introduction

This report has been prepared by Ben Savage, Assistant Engineer North Yorkshire County Council in support of the application for Listed Building Consent to North Yorkshire County Council for the scheme to “Dismantle and rebuild south-east spandrel wall using existing stone”. This statement has been prepared in accordance with the current guidance regarding the conservation and enhancement of the historic environment. All drawings are to be read in conjunction with all relevant documents for the proposed works.

It is submitted as part of a package of information intended to outline and highlight the reasons why this bridge is in need of repair to protect and preserve the historical listed building. It will also show how the proposed repairs will not materialistically change any external appearance of the structure from its original intended appearance.

The Site

The application site is across Eller Beck, as shown on the location plans below.



Beck Hole Bridge



OS GRID REF 394031, 450932

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Photographs



Downstream Elevation (SW Spandrel) – 1997



Downstream Elevation (SW Spandrel) - 2011



Downstream Elevation (SW Spandrel) - 2015



Downstream Elevation (SW Spandrel) – 2021

Engineers Report

Beck Hole Bridge is a two span masonry arch structure which carries 'Beck Hole Road' over Eller Beck through the village of Beck Hole, North Yorkshire. Each arch spans approximately 6.3m with a rise of 3.5m.

The bridge is a Grade II listed structure. It has a unique listing entry (No. 1174143), which details the following:

'GOATHLAND BECK HOLE NZ8202-8302 19/86 Bridge over the Eller Beck GV II Bridge. C19. Rusticated sandstone. Two semi-circular arches of voussoirs with cutwaters on both sides of centre pier. Pilaster piers at each end rising through plain parapet over moulded band. Parapet slightly raked with cambered coping. Flat caps to piers. Included for group value.'

The National Planning Portal Framework (NPPF) states that "Any harm to, or loss of, the significance of a designated heritage asset (from its alteration or destruction, or from development within its setting), should require clear and convincing justification. Substantial harm to or loss of: grade II listed buildings, or grade II registered parks or gardens, should be exceptional."

Beck Hole Bridge has undergone routine inspections since 1997 with all identifying movement in the south west spandrel wall for the southern span of the structure. The movement is clearly not typical of the original build and is classed as a defect. The movement has been monitored and has since continued to move and now requires remedial work to prevent further structural instability.

From a Principal Inspection and assessment report (1997)

"Beck Hole Bridge is in good condition. No defects were found that would seriously affect the capacity of the bridge. The South West wing wall and spandrel wall should be monitored at regular intervals to assess if any further movement is taking place."

Movement has taken place on the South West side of the structure which is affecting the spandrel wall, wing wall and parapet. The spandrel wall and wing wall are bulging outward. This has caused the spandrel to separate from the edge voussoirs of the South arch by up to 25mm. No cracking or other defects have taken place."

The structure has received routine inspections with BCI scoring from 2005. In 2017 further movement was identified with the crack appearing to increase from 30mm to 50mm.

From an BCI inspection report (2017)

"The SW spandrel to the south-arch appears to have displaced outwards further since the last inspection. This should be pointed to enable any future movement to be detected more easily. Bulge appears to be increasing SW (30mm to 50mm)."

The movement can be attributed to an increase in traffic loadings from its original build. When it was built circa C19, there would have been a lot less traffic using the bridge, and of different type mainly horse and cart. The bridge is now subject to modern day to day use of public and agricultural vehicles, which can weigh up to 44t without any restriction. The increased usage can and has caused spandrel movement, which can be clearly seen

on Beck Hole Bridge. It is commonly found on masonry arch bridges particularly with a reduced road width and no verge protection. A typical repair is to take down the defected stonework to sound material and rebuild back up using the existing stone and a durable mortar, matching the existing colour. The stonework rebuild will be carried out by competent stonemasons.

Although the structure is a grade II listed structure, its current 'day to day' use should not be ignored and should not be assessed as a typical listed building, it should be ensured that the structure is fit and safe for its intended purpose. The bridge carries over 'Beck Hole Road' which forms part of the council's highway network, it is classed as a 'highway maintainable at public expense' and the council has a duty to maintain the highway and its assets. A pragmatic approach should be taken to protect public interest when carrying out maintenance repairs to structures, the listed status has been taken into account and the proposed works are to prevent further deterioration of the structure, preventing any harm to, or loss of, the significance of a designated heritage asset. By not carrying out the works, the structure would continue to deteriorate further and therefore have a potential to collapse causing significant loss of historical material.

A Cement: Hydrated Lime: Sand (1:1:6) mortar mix has been proposed over Lime: Sand mortar for a variety of reasons. The bridge is located on an actively used route in the middle of a village, with any works requiring as minimal impact on local residents and businesses as possible. A traditional cement based mortar will have a quick setting time, allowing for the works to be completed within a 3-5 week period. A traditional lime mortar does not have a quick setting time and needs to be carefully worked. 'Historic Scotland (TAN1): Preparation and Use of Lime Mortars' report states *"For work on ruined structures in exposed locations it may be necessary to provide a weatherproof envelope some time in advance to encourage drying out of saturated masonry fabric. The water content of the masonry should be reduced to a level at which lime mortar can dry and carbonate, which may take up to a year in some situations. Potential future sources of water ingress into the masonry fabric must also be eliminated."* According to BS8104:1992, Beck Hole Bridge is located in a 'severe' weather exposure location, resulting in an unacceptable environment for a lime based mortar to be used. It would also be impossible to keep the lime mortar dry, as water will be present in the ground it is retaining, even with concrete backing there will still be water and salt penetration. If a lime mortar was to be considered it would involve an extended amount of time repairing the bridge, potentially up to a year. This would close an important highways route, resulting in a significant impact on local residents and businesses as well as increasing the cost on public spending.

A review of 'The Smeaton Project: Factors affecting the properties of Lime-Based mortars' report, which analysed 'traditional' lime based mortars and slightly less than 'traditional' cement based mortars, using OPC and WOPC showed that a typical cement mixture performed well compared to a 'traditional' lime mortar which performed poorly on the one year and five year exposure tests. The report states *"All of the lime: cement mixtures performed poorly until at least ½ part of cement had been added to the standard 1:3 mix."*, the report shows that it is only when a Pozzolan is added to the lime mortar, such as brick dust, ash or cement, the lime mortar becomes durable and increases in strength.

It is clear that Beck Hole Bridge is located in a highly exposed environment with either previous repairs or the original build using a cement based mortar, which can be seen on pictures provided so therefore a like for like cement mortar should be used, with the colour and texture matching.

The council has extensive use and evidence of a 1:1:6 mortar mix being used on masonry bridge structures. This is due to its compressive strength, quick setting times and in some cases has shown to be more permeable than some limed mortars. As indicated by multiple reports that have tested the use of lime mortars (The Smeaton project and Historic Scotland TAN1), they show that any use of a lime mortar used in an exposed environment is not suitable and usually results in failure, let alone on a structure such as a bridge.

Ecology report

A bat and ecology survey was carried out in June/July 2021 on the structure. The survey found that although bats were recorded in the area, none were found to be seen emerging from any part of the structure. It was recommended that works should proceed with care and must stop if bats are encountered.

A check of a stretch of the Eller Beck was carried out to search for evidence of Otters and Water Voles. Although there is some potential for both of these species in the vicinity (especially Otters) no evidence of their presence was found. This stretch of watercourse is generally quite disturbed due to its location in the village, proximity to the pub and ready accessibility to the public.

A check was also made for evidence of invasive non-native plant species. There have been past records of Japanese Knotweed and Rhododendron within 2km of the bridge, but these records do not relate to the 1km square in which the bridge is located. No evidence of either of these species was found during the field survey, but there was a small amount of Buddleia upstream of the pub and cultivated Rose species in a garden on the north bank close to the bridge. Neither of these locations will be disturbed as a result of the proposed works which are very localised in extent.

It is concluded that the proposed works are unlikely to adversely impact on protected species or result in the spread of invasive non-native species. The works are restricted to the south-west corner of the bridge and to parts of the structure on land. There is some potential for the crevice that is to be repaired to support roosting bats on a casual basis, so care must be taken during works and must stop if bats are encountered.

As there is no bat roosts in the structure there is no legal requirement to install bat boxes or other similar roosting opportunities. The works are defined as maintenance works, and not a development, to a highways structure maintainable at the public expense. The works are carried out under the Highways Act 1980. It is not common practice at NYCC to install bat boxes or similar on bridges where there are currently no bats present, as this impacts future maintenance of the structures and carry's a higher cost to the public to do so.

Any correspondence should be given in writing to:-

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