Queensbury Tunnel

Emergency infilling of No.2 Shaft

OCTOBER 2019

Queensbury
TUNNEL SOCIETY

Background

On 21st October 2019, Highways England announced that it would use emergency planning powers to infill a ventilation shaft forming part of the disused railway tunnel under Queensbury, West Yorkshire, following an inundation of floodwater three weeks earlier.

Since October 2018, contractor AMCO-Giffen has been undertaking preparatory works for the tunnel's abandonment due to perceived safety concerns. However the project has been hampered by flooding after a pumping station at the Holmfield/south end of the tunnel was switched off - a consequence of Highways England twice failing to pay the £50 annual rent for the land on which it is sited. Ingressing water flows towards the Holmfield end due to the tunnel's 1:100 gradient.

A significant flooding event occurred over six days in late September/early October, causing the water level in the tunnel to rise by a reported 6.5 metres. As a result, the contractor has been unable to undertake activities at its next worksite - No.2 shaft, 365 metres (400 yards) from the Holmfield end - and the programme has been put back by at least five weeks.

Highways England's media statement reads:

Emergency planning powers have been brought in to ensure urgent safety work can be carried out at Queensbury Tunnel in West Yorkshire.

Tunnel owners, the Department for Transport, are using the powers for work to infill one of the air shafts because of the increasingly deteriorating condition of a section of the structure and fears it could collapse.

The work will be delivered by Highways England who manage the tunnel on the department's behalf.

Highways England Yorkshire and North East Regional Director, Richard Marshall said: "Today's emergency measures to stabilise one of the air shafts in the tunnel follows an influx of water over the last weekend of September. The volume of water entering the tunnel from the southern opening not only endangered the safety of our workforce but also caused the first phase of our safety work to be halted.

"We had been clear that the first phase of the safety work wouldn't prevent the tunnel's future reopening. However, the infilling of the shaft in this manner means that any reopening is now going to be more challenging.

"We are aware that this news will be a disappointment to those seeking the reopening of the tunnel, however we have no option other than to complete this work immediately to ensure both the safety of those communities living close by and the workforce who need to maintain it."

Queensbury Tunnel was constructed in the 1870s as part of the railway from Halifax to Keighley, and the line closed in the 1950s. In 2013 ownership of the Historical Railway Estate (HRE) was transferred to the Secretary of State for Transport from the former British Railways Board (Residuary) Ltd which was abolished that year. The Highways Agency inherited maintenance responsibility and associated liabilities for the HRE at this time as it was seen as having the necessary expertise. Responsibility for maintaining the HRE then transferred to Highways England in 2015.

For the first time in more than two years contractors took the opportunity to carry out a close inspection of the base of shaft two at the end of last month, at which point water began to enter the tunnel at an unprecedented volume and speed. They had to abandon equipment and move to a safe area and, within 48 hours, water levels were close to the highest ever recorded.

Engineers determined the affected area, which is close to an access road used by people accessing nearby properties, needed immediate attention.

Water levels in the southern section of the tunnel means further inspections of the base and planned strengthening work can't be carried out.

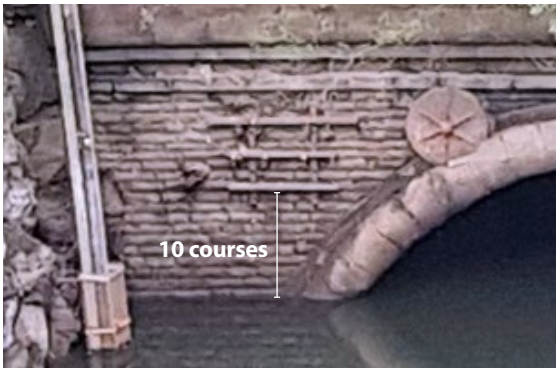
The emergency work involves infilling the shaft from above with natural material. This will stabilise the shaft, reducing the risk of collapse.

Before having to stop work, Highways England contractors were close to completing the first phase of safety work, with water levels close to their lowest since October 2018. This was providing partial and short-term strengthening to the most vulnerable sections of the tunnel.

The emergency work is expected to take around two weeks, after which Highways England can determine next steps for resuming the safety work that was halted.

As a result of AMCO-Giffen's pumping operation, the level of floodwater in Queensbury Tunnel is thought to have reached its low point on 26 September, with photographs taken on 27th September showing the water to be approximately 350mm higher than on 25th September. Witness evidence suggests the water level reached its peak on 2nd October and was therefore rising for about 140 hours.

The south portal's headwall at 15:50hrs on 25 September, showing 12 courses of stonework below the timber frame.



The south portal's headwall at 15:10hrs on 27 September, showing 10 courses of stonework below the timber frame.

AMCO-Giffen suspended its pumping operation in the early hours of 29th September, so floodwater was being discharged from the tunnel for the first 60 hours of this period at a presumed rate of 30 litres per second - the maximum allowed under the contractor's environmental permit.

By 2nd October, the volume of water in the tunnel was around 30,000m^3 greater than when the influx started, with an additional 6,500m^3 having been pumped out. The contractor reported that the leading edge of the water was 650 metres further into the tunnel.

Over 140 hours, this represents an average ingress rate of 72 litres per second. For context, during construction, the average rate at which water was pumped from four of the seven shafts was 80 litres per second. On 18th January 2016, a severe weather event resulted in the floodwater level in the tunnel rising by about 1 metre overnight, at an estimated rate of 76 litres per second.

In its press statement, Highways England asserts that:

> *"For the first time in more than two years contractors took the opportunity to carry out a close inspection of the base of shaft two at the end of last month, at which point water began to enter the tunnel at an unprecedented volume and speed. They had to abandon equipment and move to a safe area and, within 48 hours, water levels were close to the highest ever recorded."*

However, the average rate at which the water level rose between 26th September and 2nd October was 0.013mm per second or 4.6cm per hour. Clearly, the suggestion that this represented any threat to the workforce or that equipment had to be abandoned is therefore risible.

In January 2016, flooding in the approach cutting was at the same level as 2nd October 2019.
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The water level recorded in the tunnel following the influx was no higher than the level it typically attained during periods of peak flooding from 2006-2012 and 2013-2016.

No.2 Shaft is 99 metres (324 feet) deep and 2.75 metres (9 feet) in diameter. It is located alongside a farm access road which joins Roper Lane 180 metres from the shaft. The nearest property to the east is 150 metres away; to the west there is a farm building 230 metres away.

The shaft lining was constructed in two sections, with the upper part reaching a depth of 39 metres (128 feet) from the surface where it is supported on a rock ledge. Below is a 4-metre (12 feet) unlined section of competent rock. The lower part of the lining is 56 metres (184 feet) deep and is likely to weigh in the region of 218 tons.

At the bottom of the shaft, a kerb of stone blocks transfers much of the load from the shaft lining around the arch, through the sidewalls and into the foundations; the remainder dissipates into the rock surrounding the shaft through friction.

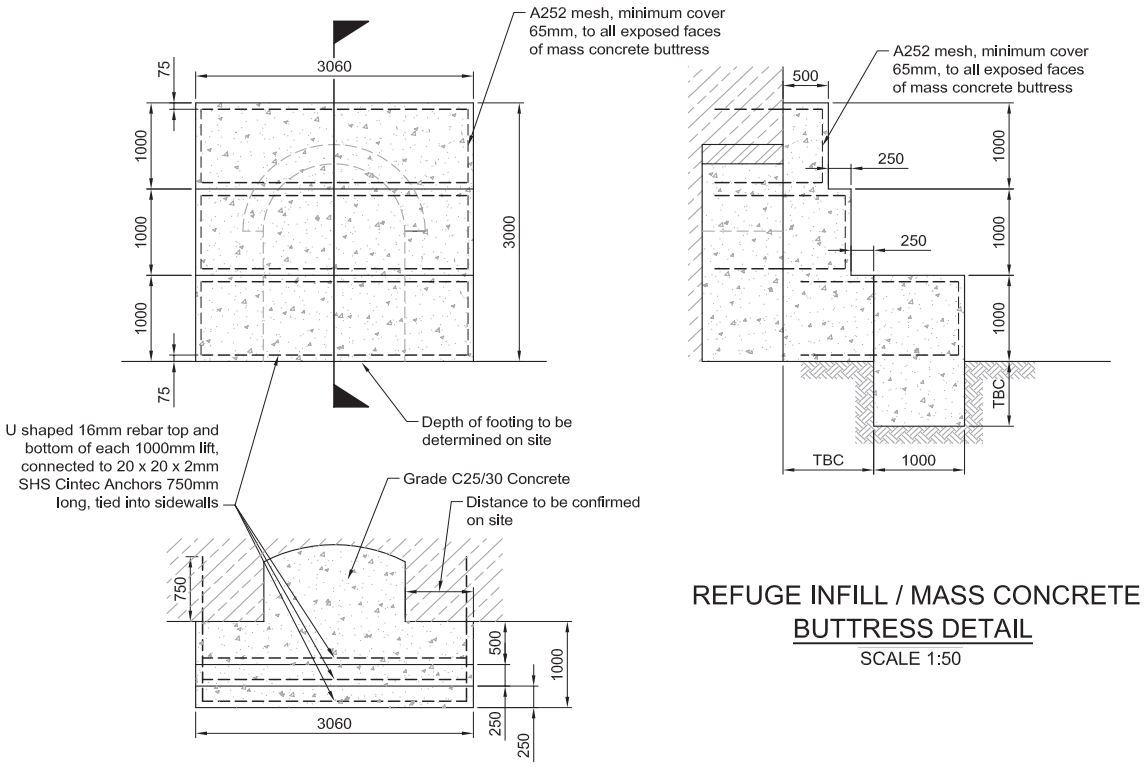
(Top) A general view of No.2 Shaft taken in March 2016.
(Above left) Approximately 19.5m from the bottom of the shaft is an adit from which a signficiant volume of water is discharged.
(Above right) The shaft eye.

Source: Highways England inspection report (February 2016), licensed under the Open Government Licence v3.0

No.2 Shaft is one of the greatest sources of water ingress into the tunnel. Around 19.5 metres (64 feet) from the bottom is an adit from which floodwater is thought to discharge from adjacent fireclay workings. Infilling the shaft in the manner proposed by Highways England raises future issues around drainage and flood risk, and concerns have already been raised by Bradford Council.

The tunnel lining below and adjacent to the shaft was constructed in stone. However a 1-metre high section of the Up/West sidewall has been repaired in brick, extending for 6 metres towards the south. This is indicative of a longstanding defect at this location.

During an inspection in 2012, it was observed that a trackworker refuge 5 metres south of No.2 Shaft had started to fail. Jacobs, Highways England's consulting engineers, developed a repair to resist any further movement, comprising a mass concrete buttress. However the work was never undertaken.



A mass concrete buttress designed by Jacobs, Highways England's consulting engineers, in 2012 as proposed remediation at the failing refuge. The work was never undertaken.

Source: Queensbury Tunnel Options Report (February 2016), licensed under the Open Government Licence v3.0

Some of the adjacent masonry facework has since collapsed and a bulge has formed on the north side of the refuge, extending diagonally upwards to a height of approximately 2 metres. However there is currently nothing to suggest that this is affecting the stability of the shaft. There are no other signs of distress and the tunnel's profile has not significantly changed since construction, as evidenced by the Geoterra 3D point cloud laser scan undertaken in August 2018 as part of a broader study by AECOM into the tunnel's condition.

View of the failing refuge 5m south of No.2 Shaft.
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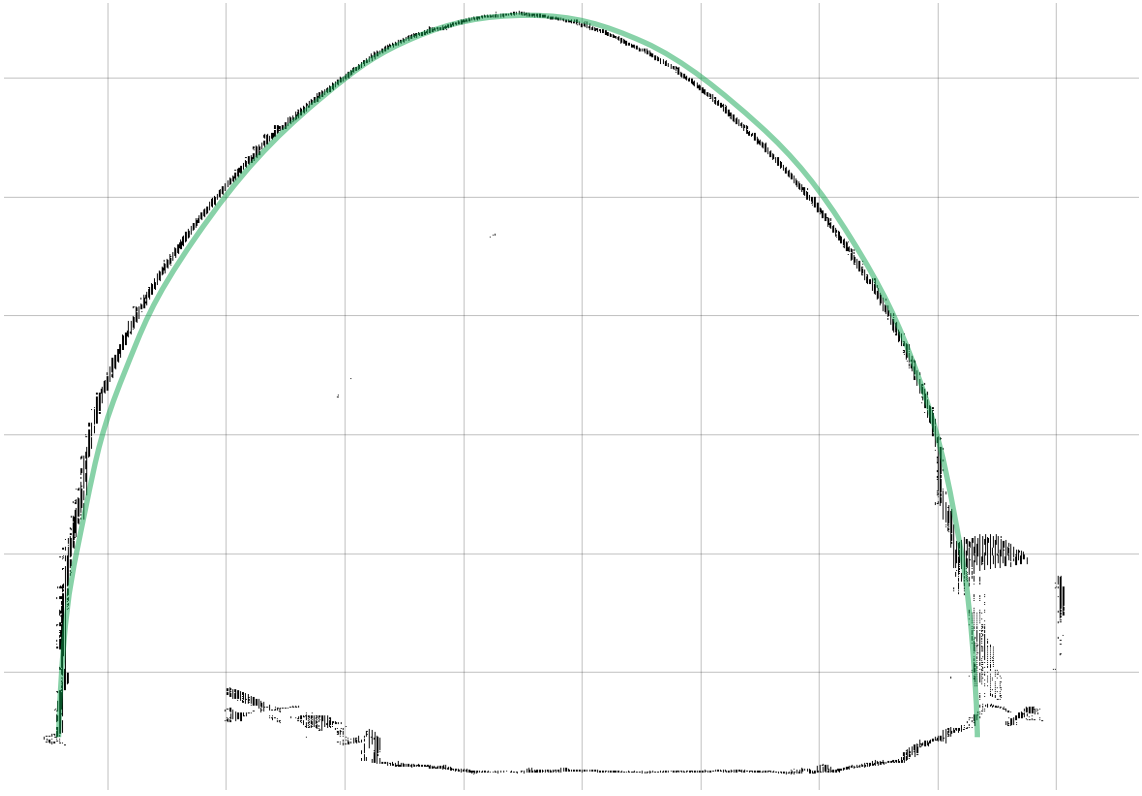

A laser scan of the tunnel profile (looking south) immediately north of the refuge, suggesting a deflection at the haunches of ~150mm. The original/unchanged profile is overlayed in green.
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Infilling the shaft

In its handbook, *The Treatment of Disused Mine Shafts and Adits*, the National Coal Board's Mining Department recommends materials and methologies for infilling shafts. It states that "most stable granular materials" are acceptable for this purpose, so the use of 6N aggregate - the material chosen by Jacobs for No.2 Shaft - is appropriate.

The handbook considers the marginal stability at the base of the infill where slight changes in the disposition of loads and stresses may cause failure, the possibility of a silo-like discharge which turns into a major outflow, and the development of horizontal and vertical hydrostatic pressures if water accumulates in the shaft and saturates the fill. We must assume that these risks have been recognised and assessed by Highways England's team.

Where there are doubts about the stability of a shaft - as is clearly the case here through the use of emergency powers - the handbook states that a potential collapse zone should be determined and clearly delineated on site by an appropriate means, such as a fence. No-one should enter the collapse zone unless they are wearing a safety harness anchored at least 5 metres outside it. In all cases when filling from the surface, the conveyor carrying material to the shaft should be loaded at a point at least 10 metres outside the collapse zone. The absence of such safeguards at No.2 Shaft (see photo below) add to doubts as to whether the attendant risks constitute a genuine emergency.

With regards to the potential impact of the infilling works on the tunnel's proposed reuse, advice obtained by the Queensbury Tunnel Society indicates that the 6N aggregate could be carefully and progressively removed from the base of the shaft using a long-reach excavator, encouraging material from above to drop down. It could then be redistributed within the tunnel.

The estimated volume of 6N aggregate required for the infilling is 900m^3 which could reasonably provide half the sub-base material for a 4-metre wide cycle track through the length of the tunnel.

Conclusions

Although the refuge adjacent to No.2 Shaft probably began to fail within the past ten years, there is no evidence from pre-2019 inspections to suggest any meaningful deterioration in the condition of the shaft or that of the support structure immediately below it. The proximity to the shaft of this failure and the adjacent bulging clearly heightens the level of risk, but evidence that the recent flooding introduces additional unacceptable risk has not yet been provided.

The southern half of Queensbury Tunnel has been affected by flooding to a greater or lesser extent since the 1970s; the section around No.2 Shaft has been fully submerged for substantial periods since 2006. There is nothing unique about the current circumstances.

According to Highways England's media statement, it was staff from AMCO-Giffen, their contractor, who "took the opportunity to carry out a close inspection of the base of shaft two at the end of [September]". However, by the time AMCO-Giffen arrived on site in October 2018, the southern end of the tunnel was flooded so they would not have previously seen the failing refuge or the section of tunnel lining below the shaft. Without this knowledge, it would be difficult to make an informed judgement as to whether its condition had deteriorated so significantly that it "needed immediate attention".

There is no evidence of the shaft suffering from historic instability and "fears it could collapse" could only arise if a significant change has been observed since the time of the laser scan survey. The shaft is remote from any property although an access track to two farms runs past it.

For public safety to be threatened, a series of major failures would have to occur, resulting in ground settlement:

- the refuge/sidewall below the shaft fails
- there is insufficient remaining lining on either side of the tunnel for the load paths to successfully redistribute
- the entire lower section of the shaft lining overcomes the effect of friction and collapses
- the collapse causes a 4-metre section of competent rock above to fail, undermining the support for the upper section of shaft lining
- the entire upper section of the shaft lining overcomes the effect of friction and collapses
- the collapse causes a sink hole to develop which extends 3 metres to the NW side of the shaft
- members of the public are passing at the time.

Highways England's shaft inspection report from February 2016 records the lining to be in mostly Fair but locally Poor condition; the kerb, pointing, cap and protection wall are all Fair.

On this basis, it is difficult to understand how any reasonable and proportionate judgement of the prevailing circumstances could judge them to constitute an emergency.

Commentary

Over the past four years, the campaign to secure Queensbury Tunnel for future use as part of a greenway connecting Bradford and Halifax has been persistently set back by failures on the part of Highways England and its Historical Railways Estate team.

They neglected to formally review an error-strewn draft Options Report before acting on it, did not recognise that a £35.4M costing therein for the tunnel's repair was "simply too high to be credible" (as subsequently determined by engineering advisors to the DfT) and misrepresented this costing to a Government minister.

These deficiencies led to Bradford Council making clear that it would never accept ownership of Queensbury Tunnel and abandonment became the only option on the table.

In 2016, around £400K of legal action brought the installation of a pumping station to keep the tunnel dewatered. However Highways England contrived to lose this facility by never paying the £50 annual rent stipulated in the associated lease, claiming that doing so was not its responsibility despite clear official evidence to the contrary. It compounded this loss by attempting to overcome the resulting logistical difficulties by implementing a costly and challenging strategy which required work to be undertaken in a section of the tunnel that had previously been designated as too dangerous to enter.

When the project floundered and costs went through the roof, Highways England joined forces with AMCO-Giffen to make unfounded allegations against members of the public whose only offence was to seek a positive future for the tunnel. It did so in a determined attempt to deflect attention from its own failings.

There is no emergency situation at No.2 Shaft; in fact there is no meaningful situation of any kind there. This is purely an attempt to circumvent statutory planning processes. Public officials - shamed by tenacious campaigners who have shone spotlights on Highways England's ignorance, hysteria and unhelpful outbreaks of incompetence - have decided to wreak vengeance by crashing a wrecking ball through the repurposing of Queensbury Tunnel as a beneficial strategic asset.

They will not succeed and must be held accountable for their actions. This is far from over.

Furthermore, the use of emergency powers to help extricate Highways England from a hole they keep digging themselves into is clearly unwarranted and must therefore be unlawful.

Queensbury Tunnel: Emergency infilling of No.2 Shaft (October 2019)

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