

Rail Accident Report



**Trains passed over washed out track at Baildon,
West Yorkshire
7 June 2016**

Report 03/2017
February 2017

This investigation was carried out in accordance with:

- the Railway Safety Directive 2004/49/EC;
- the Railways and Transport Safety Act 2003; and
- the Railways (Accident Investigation and Reporting) Regulations 2005.

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This report is published by the Rail Accident Investigation Branch, Department for Transport.

Preface

The purpose of a Rail Accident Investigation Branch (RAIB) investigation is to improve railway safety by preventing future railway accidents or by mitigating their consequences. It is not the purpose of such an investigation to establish blame or liability. Accordingly, it is inappropriate that RAIB reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The RAIB's findings are based on its own evaluation of the evidence that was available at the time of the investigation and are intended to explain what happened, and why, in a fair and unbiased manner.

Where the RAIB has described a factor as being linked to cause and the term is unqualified, this means that the RAIB has satisfied itself that the evidence supports both the presence of the factor and its direct relevance to the causation of the accident. However, where the RAIB is less confident about the existence of a factor, or its role in the causation of the accident, the RAIB will qualify its findings by use of the words 'probable' or 'possible', as appropriate. Where there is more than one potential explanation the RAIB may describe one factor as being 'more' or 'less' likely than the other.

In some cases factors are described as 'underlying'. Such factors are also relevant to the causation of the accident but are associated with the underlying management arrangements or organisational issues (such as working culture). Where necessary, the words 'probable' or 'possible' can also be used to qualify 'underlying factor'.

Use of the word 'probable' means that, although it is considered highly likely that the factor applied, some small element of uncertainty remains. Use of the word 'possible' means that, although there is some evidence that supports this factor, there remains a more significant degree of uncertainty.

An 'observation' is a safety issue discovered as part of the investigation that is not considered to be causal or underlying to the event being investigated, but does deserve scrutiny because of a perceived potential for safety learning.

The above terms are intended to assist readers' interpretation of the report, and to provide suitable explanations where uncertainty remains. The report should therefore be interpreted as the view of the RAIB, expressed with the sole purpose of improving railway safety.

The RAIB's investigation (including its scope, methods, conclusions and recommendations) is independent of any inquest or fatal accident inquiry, and all other investigations, including those carried out by the safety authority, police or railway industry.

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Summary

Between 16:29 and 17:58 hrs on 7 June 2016, three passenger trains passed over a section of the single line at Baildon, where part of the supporting embankment had been washed away by flood water. This left one of the rails unsupported over a length of between 3 and 4 metres. None of the trains derailed and no one was injured.

The washout occurred following a period of intense rainfall between around 15:30 and 16:00 hrs that afternoon. A member of the public had noticed the washed out track and had reported it to the local Fire and Rescue Service who had then informed Network Rail shortly before 16:30 hrs. Around the same time, the driver of a train on that line reported there was flooding in the area, with the water being above the level of the rails. Network Rail stopped train movements and sent staff to inspect the track at the location reported by the train driver. The inspection found that the flood water had receded significantly, but did not identify the washout because it was at a different location. At 17:30 hrs, the line was reopened for use at its normal maximum speed of 50 mph (80 km/h).

At 17:45 hrs, a second train passed over the damaged section of track. The driver did not report any fault, but a call from a member of the public was received by the local police stating they had witnessed this train passing over the unsupported section. The message was passed to Network Rail, but before the line was again blocked to traffic, a third train passed over it. This train also had not been stopped from running over the washout. The driver of this train saw the washout, but was unable to stop his train, passing over it at a speed of 38 mph (62 km/h). He subsequently stopped the train and made an emergency call to the signaller.

These near miss incidents occurred because the reports of the damaged track from members of the public, via the emergency services, were not dealt with appropriately by railway controllers. The track damage was similar to a previous washout at the same location that occurred in August 2012. Since that incident, no action had been taken on the recommendations considered by Network Rail to prevent a recurrence.

As a result of its investigation, the RAIB has made three recommendations to Network Rail, relating to:

- measures to minimise the risk of further washouts at Baildon;
- improving the emergency response to incidents on the track by providing Network Rail responders with accurate location information; and
- improving the effectiveness of communicating safety critical information between incident controllers, signallers and drivers.

The RAIB has also identified three learning points. Two are for control office staff about the importance of listening carefully to safety critical messages, and the need to continuously monitor and maintain standards in safety critical communication. The third is for duty holders, regarding the requirement to inform the RAIB of incidents which, in slightly different circumstances, could have resulted in a more serious outcome.

Introduction

Key definitions

- 1 Metric units are used in this report, except when it is normal railway practice to give speeds and locations in imperial units. Where appropriate the equivalent metric value is also given.
- 2 The report contains abbreviations and technical terms (shown in *italics* the first time they appear in the report). These are explained in appendices A and B. Sources of evidence used in the investigation are listed in appendix C.

The incident

Summary of the incident

- 3 At around 16:30 hrs on Tuesday 7 June 2016, Network Rail received a message from a member of the public, via the emergency services, that a section of track near Baildon, West Yorkshire (figure 1) was damaged following a flood which had washed out part of the track. Shortly afterwards a train passed over this damaged track. The line was then closed following that train driver's report that the track had flooded.
- 4 Network Rail then received another call from the emergency services relating to a further 999 call from the member of the public. This call also contained information regarding the unsafe condition of the track. However, the way in which the call was handled subsequently led to Network Rail incident responders being sent to the area solely to look for flooding, and not for track damage (figure 2).
- 5 A member of Network Rail staff inspected the area that had been reported as flooded and concluded that it was safe to reopen the line. The washed out track, which was at a location 280 yards (250 metres) south of the inspected area, was not identified and the line was reopened. Another two passenger trains then passed over the washed out track. The driver of the second of these trains saw the damage as he approached it, applied the train's brakes and then reported that he had passed over it. The train was not derailed and nobody was injured, but the driver was badly shaken. The line was repaired and reopened to trains on 9 June 2016.

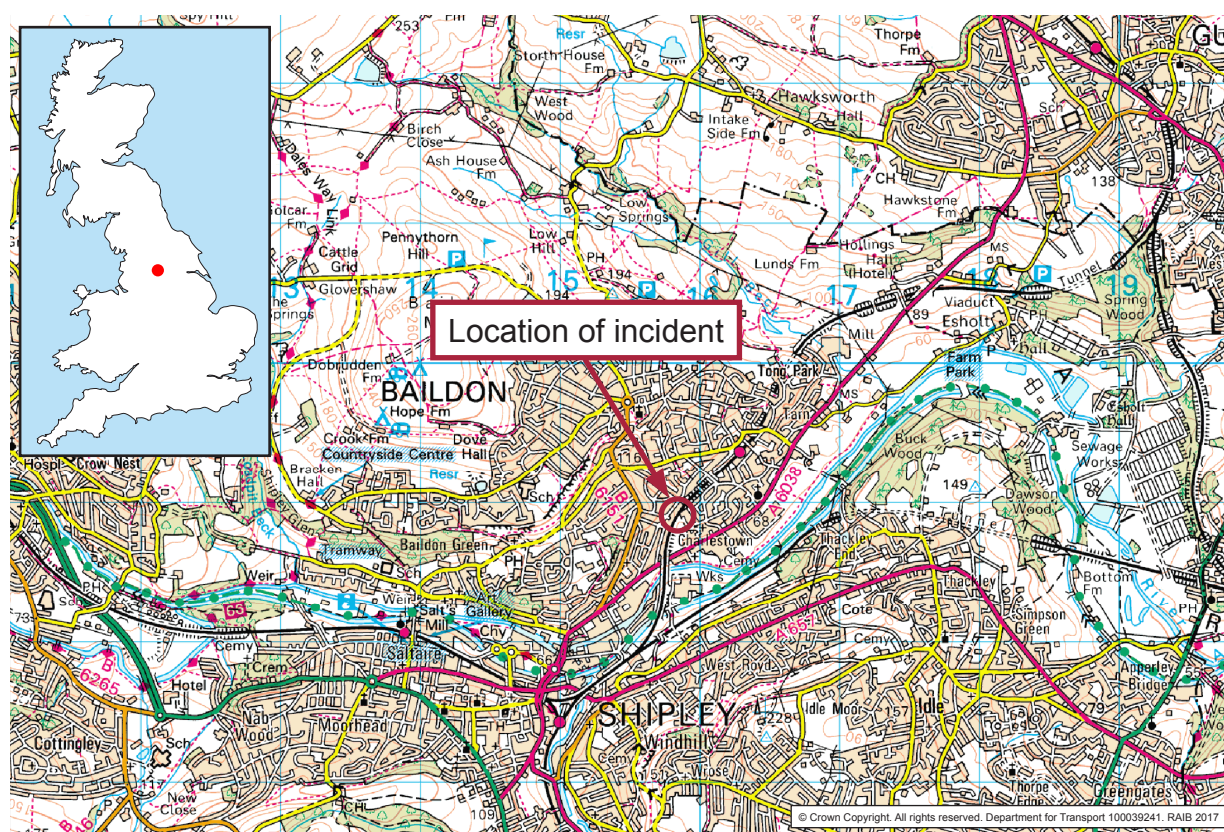


Figure 1: Extract from Ordnance Survey map showing location of incident



Figure 2: The washed out track and the embankment

Context

Location

- 6 Baildon railway station is situated on the 4.7 mile (7.6 km) long single track line running in a south-west to north-east direction between Shipley and Guiseley. The maximum permissible speed of the line is 50 mph (80 km/h). Northern Rail operates a regular passenger service over this section between Bradford Forster Square and Ilkley. The operations and signalling control are part of the London North Eastern (LNE) route.
- 7 The track washout was located approximately 630 metres to the south-west of Baildon railway station (figure 3).

Organisations involved

- 8 Network Rail is the owner and maintainer of the railway infrastructure at Baildon. It is also the employer of the controllers, signallers and incident responders involved in this incident.
- 9 Northern Rail is the operator of the trains which travelled over the line and the employer of the drivers involved.
- 10 Both organisations freely co-operated with the investigation.



Figure 3: Location of the washed out track¹

Trains involved

- 11 Three trains were involved in the incident. The following times, given in brackets, are those at which the trains passed over the incident site. Train 2D68 (at 16:29 hrs) was travelling in the down direction between Shipley and Baildon with an estimated 106 passengers on board. Train 2D72 (at 17:45 hrs) was also travelling in the down direction with an estimated 95 passengers on board. Train 2D73 (at 17:59 hrs) was travelling in the up direction between Baildon and Shipley with an estimated 55 passengers on board. The estimated passenger numbers were provided to the RAIB by Northern Rail who was the operator of the three Class 333 *electric multiple units* involved in the incident.
- 12 The condition of the trains did not contribute to the incident.

Rail equipment/systems involved

- 13 The section of affected track was constructed from rails mounted on concrete sleepers. These were supported by ballast on top of clay soil. This particular section is where a shallow cutting (running from Baildon station approximately 600 metres towards Shipley) ends and a single sided embankment begins (figure 4). The gradient of the line in the area of the washout was approximately 1 in 100 sloping down towards Shipley.
- 14 The signalling system on the single line is *track circuit block* with entry and exit signals at Dockfield Junction near Shipley and Esholt Junction near Guiseley. This is visible on the signaller's workstation as a single section 3.5 miles (5.6 km) long.

¹ One chain is approximately equal to 20 metres.

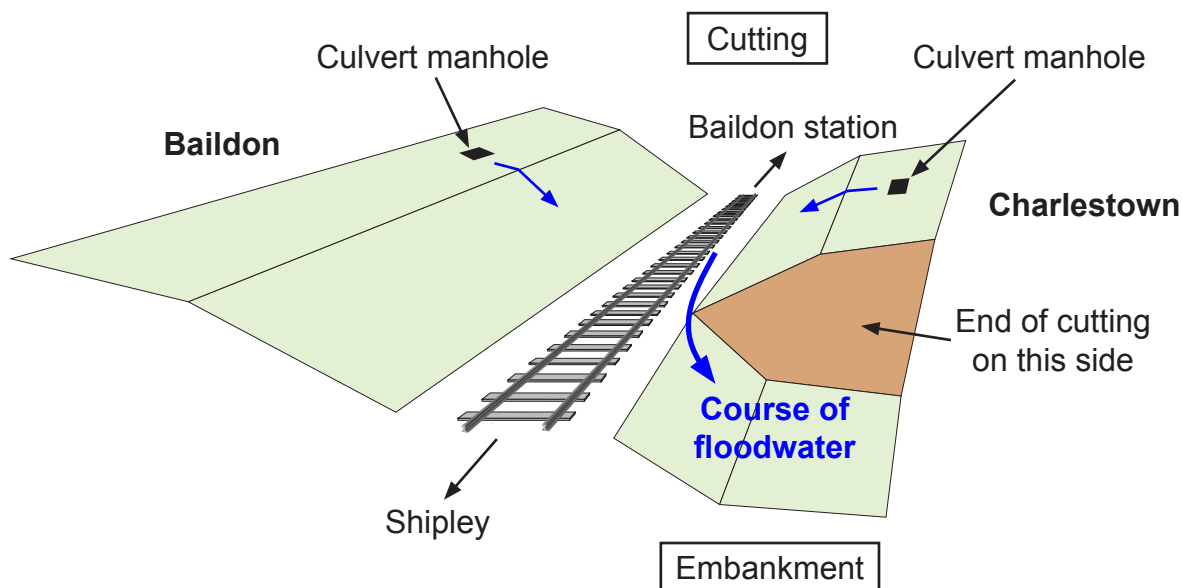


Figure 4: The cutting and the single sided embankment

Staff involved

- 15 The three Network Rail LNE incident controllers involved in this incident were based in route control within the Rail Operating Centre (ROC) in York. All three were deemed to be competent in safety critical communications by Network Rail. Although they work on dedicated desks for a particular area, there is an emergency phone line that can be answered by any controller in the room depending upon their availability.
- 16 On the day of the incident, a controller (controller 1) was the incident controller responsible for the LNE Central area and had been employed by Network Rail as a controller since 2008.
- 17 A second controller (controller 2) was working on the LNE West Yorkshire control desk which includes the Baildon area. Controller 2 had been employed by Network Rail as a controller since 2010.
- 18 A third controller (controller 3) was working on the LNE East Coast North desk and had been employed by Network Rail as a controller since July 2014.
- 19 The control of the signalling system in the Baildon area was the responsibility of the LNE Leeds North West signaller (the signaller) based at York signalling control centre. Also in this control centre was a shift signalling manager responsible for the supervision of the signallers.
- 20 A track technician, who was sent to investigate a reported problem on the line, was based at Keighley and had been in this role for 14 years.
- 21 The mobile operations manager (MOM), also sent to investigate a reported problem on the line, was based at Shipley and had worked in the area since 2014.

External circumstances

- 22 The incident occurred in daylight. On the afternoon of 7 June 2016 there had been heavy rainfall in the Baildon area (paragraph 47). However, just prior to, and during the course of the incident, it was not raining.

The sequence of events

Events preceding the incident

- 23 Between 16:00 and 16:30 hrs, several members of the public who lived close to the railway, about 600 metres south-west of Baildon railway station (in an area known as Charlestown), were observing flood water flowing down a railway embankment. It had been raining there between approximately 15:30 and 16:00 hrs, but at the time they were watching the flood water, and for the rest of the day, it remained dry. One of them captured video footage of the flood water on his mobile phone (figure 5).



Figure 5: Still image of the flood water and the washed out embankment taken from the video recorded by a member of the public

Events during the incident

- 24 At 16:26 hrs on Tuesday 7 June 2016, one of the members of the public called the West Yorkshire Fire and Rescue Service (WYFRS) to report that a section of track had been 'ripped up with a flood'. He was at Dewhurst Road in Charlestown, from where he could see the damaged railway line (figure 3). He passed his location, including a street name and a postcode, to the WYFRS operator.
- 25 At 16:29 hrs the WYFRS operator contacted Network Rail LNE route control via an emergency line to pass on the message, which included the phrase 'ripped up lines', and the member of the public's location (both the street name and the postcode). Controller 1 answered the emergency call and verbally passed on these details to controller 2, as they emerged during the course of this phone call. Controller 2 was responsible for the Baildon area.

- 26 At 16:31 hrs controller 2 phoned the shift signalling manager at York signalling control centre and asked whether there had been any trains in the Baildon area. At the same time as talking to controller 2, the shift signalling manager could overhear a call from the driver of train 2D68 to the signaller. The driver was reporting that he had passed over a flooded section of track on the approach to Baildon station (at 16:29 hrs). The driver stated that the flood water was flowing and that it was above the rails. He reported the location of the flooding as the Shipley side of bridge 7 (figure 3).
- 27 At 16:32 hrs the signaller blocked the line to trains in accordance with the requirements in the Rule Book (GE/RT/8000- M3) regarding moving flood water. This rule is designed to address the risk of washed away ballast which can affect the support of the track.
- 28 At 16:33 hrs, having seen train 2D68 pass over the washed out track, the same member of the public called West Yorkshire Police. This message, recorded on the police control room log, included the phrases 'line currently flooded', 'ballast has come away from the tracks' and 'dangerous for passing trains'.
- 29 At 16:35 hrs, the police control room operator called Network Rail LNE route control via the emergency line. This call was answered by controller 1. The police operator began the message by saying that a call had been received from a person who lived close to the track near Dewhurst Road in Charlestown. Controller 1 interrupted by asking whether that was near Baildon; the police operator answered that it was. Controller 1 then responded by stating that Network Rail were aware that there was flooding on the track and the line was blocked to trains. The call then ended without controller 1 listening to the message relating to the condition of the track that the police had received from the member of the public.
- 30 Between 16:36 and 16:44 hrs, controller 2 made a series of phone calls which resulted in a MOM and a track technician being deployed to look for flooding in the area. The location given to them was the Shipley side of bridge 7, as reported by the driver of train 2D68. Neither were told of the reports of damaged track, or the street and postcode of the location adjacent to the railway given by the member of the public who had twice reported the track damage.
- 31 Controller 2 was aware that the MOM was unable to go on the track unaccompanied as he was on medication, so the controller asked him to go to the area around bridge 7. He was given the name of the road that passed over the railway at this bridge and he confirmed to controller 2 that he knew where this was and that it was close to Baildon station.
- 32 At 16:53 hrs the MOM called controller 2 to say that he was near the track at an access point but could not see any flooding. It was not until he spoke to controller 2 again, at 17:23 hrs, that the MOM realised he was at bridge 2, which was 0.45 miles (0.7 km) south of the washout site and 0.8 miles (1.3 km) south of Baildon station, instead of at bridge 7 to which he had been directed.

- 33 By 17:20 hrs the local track technician was on the track close to bridge 7 having accessed it via the access point near Baildon station. He reported to controller 2 that there was some water on the track but it was slow moving and below rail level. At 17:28 hrs, having walked 60 to 80 metres along the track beyond bridge 7 in a south-westerly direction (figure 6), he reported to controller 2 and the signaller that there was some water in both cesses and some in the *four foot*. He also reported that there was no sign of ballast disturbance and it was safe to reopen to trains at the maximum permissible speed of the line.



Figure 6: The location of the track that was inspected for flooding by the track technician²

- 34 At 17:30 hrs the signaller reopened the line to traffic. The next train over the single line was train 2D72 which passed over the section of damaged track at 17:45 hrs. This train was travelling from Shipley towards Baildon in a north-easterly direction. Images taken from the forward facing closed-circuit television (FFCCTV) on this train clearly show that ballast was missing from the right-hand side of the track in the direction of travel (figure 7). However, the driver, who had been made aware of the previous flooding report by the signaller, did not see the washed out track. This was probably because, relative to the FFCCTV camera, he was further back and to the left-hand side of the cab. There was a structural pillar in the centre of the cab windscreen and foliage in front of the washed out section on the approach to the site along a right-hand curve, making visibility of the embankment difficult for drivers of trains travelling in the down direction³. Also the driver has stated that as he came around the curve he was concentrating on his approach to Baildon station which was his next station stop.

² One chain is approximately equal to 20 metres.

³ Trains are not driven by line-of-sight, so there is no requirement or expectation that a driver travelling at line speed will sight, or should be able to sight, such a feature.



Figure 7: Still image of the track damage taken from the forward facing CCTV footage from train 2D72 (image courtesy of Northern Rail)

- 35 At 17:49 hrs the member of the public who had recorded the flood water coming from the track on his mobile phone (paragraph 23), called West Yorkshire Police. The police control room log records that he had reported that there had been a heavy downpour which had washed away land from under the rails and that a section of rail was 'floating in the air'. It also records that he had seen a train had just passed over this section of the line and reported that the rails were 'visibly bent'. The police log also recorded the caller's location including a street name and a postcode.
- 36 At 17:52 hrs West Yorkshire Police again contacted Network Rail route control on the emergency line. This call was answered by controller 3, who noted the message, including the person's street name and the postcode. Controller 3 also confirmed with the police that the member of the public's report had included seeing a train passing over the section since the line had been reopened. Controller 3 then verbally passed this information to controller 2.
- 37 At 17:53 hrs, train 2D73 from Guiseley had entered the single line and was heading towards Baildon 2.3 miles (3.7 km) to the south-west.

- 38 At 17:55 hrs, in response to the message from controller 3, controller 2 made an emergency call to the shift signalling manager requesting that the line be blocked to traffic because of a report from a member of the public that there was landslip under the track. The signaller then blocked the line at 17:55 hrs, preventing any further trains from entering into it. At this time, train 2D73 was on the single line approaching Baildon station, where, at 17:58 hrs, it made a scheduled stop for approximately 40 seconds. The reason why train 2D73 was not stopped is discussed in paragraph 81.
- 39 At 17:59 hrs, having departed Baildon station, the driver of train 2D73 saw the damaged track as he came around the left-hand curve of the track (figure 8). The train was travelling at approximately 38 mph (62 km/h) when it passed over the washed out section and the driver applied the brakes on the train and stopped at the next signal. He then contacted the signaller to report that he had just passed over a section of washed out track.



Figure 8: Still image of the track damage taken from the forward facing CCTV footage from train 2D73 (image courtesy of Northern Rail)

Events following the incident

- 40 The signaller blocked the line a second time. The track technician and a track section manager (TSM) attended the site and noted that there were six unsupported sleepers with their ends hanging up to 1.25 metres above the washed out ground.

- 41 Following repairs to the embankment, the line was reopened to trains with a 20 mph (32 km/h) speed restriction at 23:45 hrs the following day. This included adding large boulders, weighing approximately 1 tonne each, to re-establish the embankment (figure 9). This section of track was opened at its maximum permissible speed at 07:07 hrs on 12 June 2016.



Figure 9: The rebuilt embankment following its repair

- 42 Although the RAIB was aware of the washout soon afterwards, it was not aware that passenger trains had passed over it until 24 June 2016. Neither Network Rail nor Northern Rail notified the RAIB. Network Rail did not recognise the incident was reportable to the RAIB as one which in slightly different circumstances could have led to a serious accident. Northern Rail has stated that it assumed that Network Rail would have notified the RAIB and therefore did not need to. The RAIB was informed of the incident by another source and, having made preliminary enquiries, decided to undertake its own investigation.

Key facts and analysis

Identification of the immediate cause

- 43 The line was open to traffic after the track support had been washed out by floodwater.**

Identification of causal factors

- 44 The incident occurred due to a combination of the following causal factors:
- the ballast under one rail of the track had been washed out for a distance of 3 - 4 metres (paragraph 45); and
 - Network Rail did not deal with the reports of the damaged track appropriately (paragraph 61).

Each of these factors is now considered in turn.

The washed out track

- 45 The ballast under one rail of the track had been washed out for a distance of 3 - 4 metres.**

- 46 This causal factor arose due to a combination of the following:
- a drainage system running under the track could not cope with the quantity of water following the flash flood;
 - the flood water on the railway was directed to the single sided embankment; and
 - a repair to the embankment following a previous flood could not withstand the flow of water.

Each of these factors is now considered in turn.

The source of the flood water and the drainage system

- 47 There had been a heavy localised shower in the Baildon area on 7 June 2016. A weather station approximately one mile west of Baildon railway station recorded a rainfall of 17 mm between 15:30 and 16:00 hrs. However, records from two other weather stations, within a mile of the railway to the south, together with a third weather station 3 miles to the west, recorded no rainfall for the entire day. This indicates the intense and localised nature of the rainfall at Baildon that afternoon.
- 48 Figure 10 shows the Baildon rainfall catchment areas. A natural watercourse, known as the Barnsley Beck, is shown in blue. It runs from a former reservoir to the north-west of Baildon, under the town and to the south-east where it crosses under the railway line through a culvert known to the railway as structure GUE2/5. The difference in height between the land on the north-western edges of the catchment area and the culvert is around 180 metres.

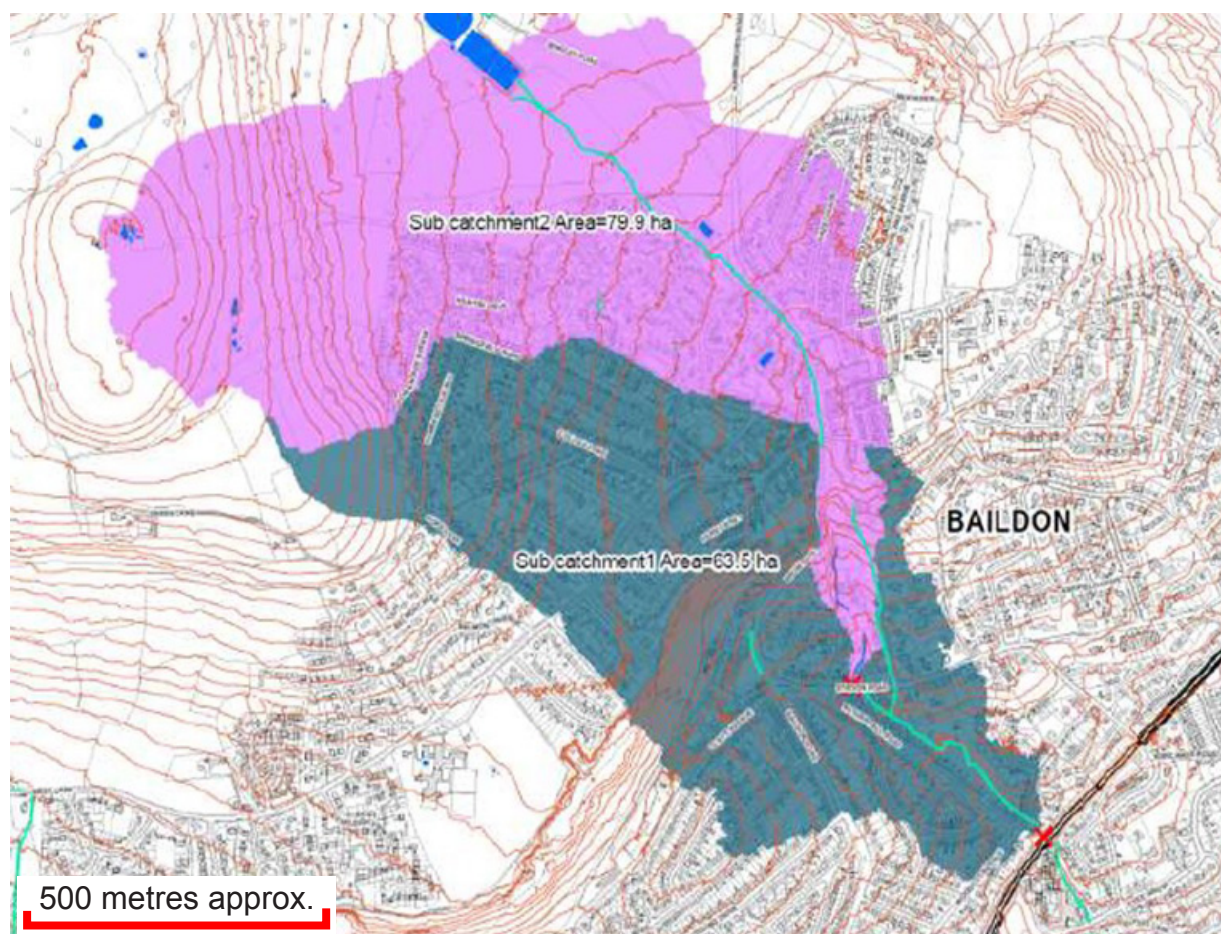


Figure 10: The Baildon rainfall catchment areas (courtesy of Bradford Metropolitan District Council)

- 49 The culvert, which allows the railway to pass over the beck, was built when the railway was constructed in the 1870s. It consists of a brick barrel arch, which is approximately 1.1 metres high by 1.8 metres wide and passes under the railway approximately 100 metres north of the washed out embankment. Old maps of Baildon indicate that until the mid-1960s, sections of the beck were open and visible on both sides of the railway.
- 50 In 1966 an agreement was made between the British Railways Board and the then Baildon Urban District Council to connect drain pipes to the culvert. Inspection chambers were added at both ends of the culvert and then connected to it at its *headwalls* (figure 11). Records indicate that both the inlet and outlet, to and from the chambers, consist of circular concrete pipes with internal diameters of 36 inches (915 mm). The bore of these pipes reduced the overall cross sectional area of the drainage system, which affects the quantity of water that can be carried, to approximately one-third of that of the original culvert. It is also known that there is a change in direction of the downstream outlet which would tend to further restrict the flow.

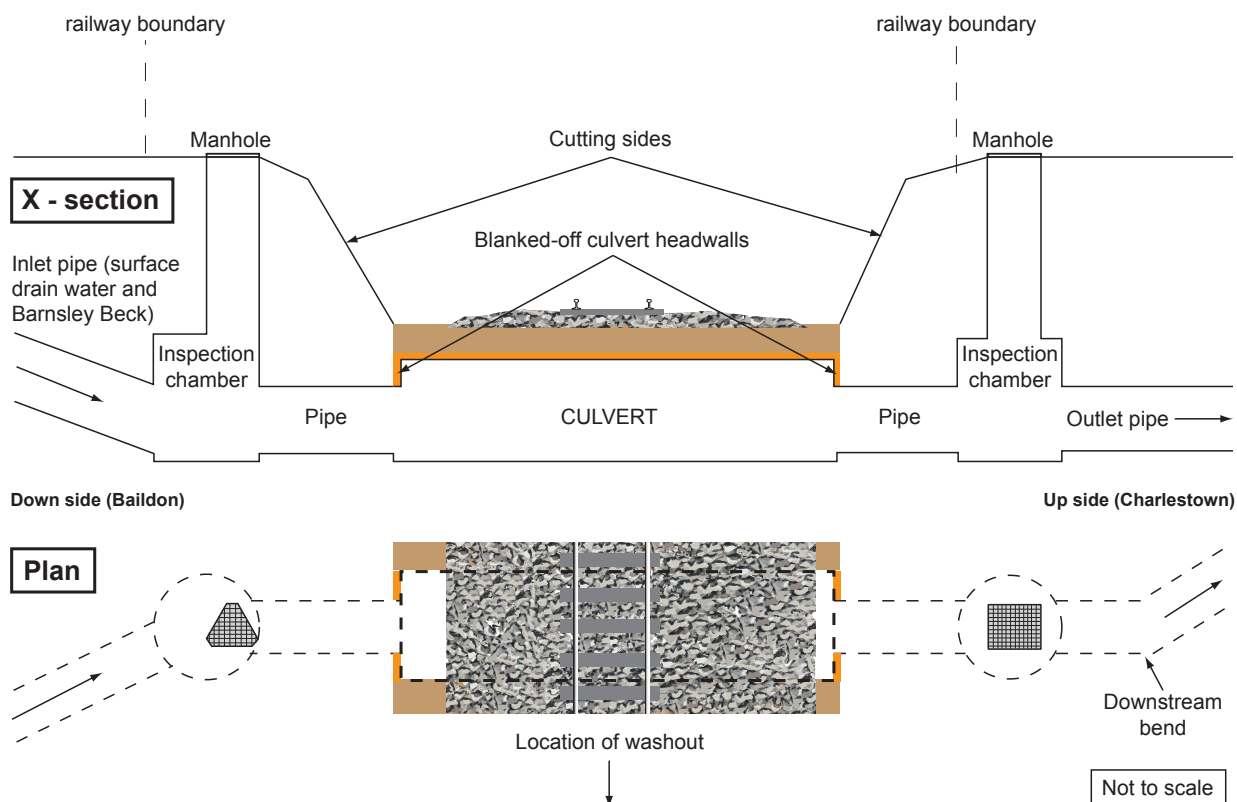


Figure 11: The culvert and its connections to the drainage system

- 51 Since the piped system was constructed, the land either side of the railway has been elevated and built upon so that the beck, which is now carried by the pipe, and the culvert are no longer visible above ground level. As is common, land developments in Baildon have resulted in an increase in housing and roads which has reduced the amount of land available for rain water to soak away. This will have tended to increase the rate at which surface water drains into the beck and the drainage system.
- 52 The track flooding in this incident was caused by water overflowing from the inspection chambers either side of the railway at each end of the culvert. This is supported by the evidence of the lifted manhole covers (figure 12). The water then flowed down the sides of the cutting and onto the track. This occurred because the drain system was unable to cope with the quantity of water that entered it during this flash flooding event.
- 53 This is exactly the same mechanism as described in a Network Rail investigation report into a previous flooding and washout event at the same location in August 2012 (paragraph 59). No trains were reported to have passed over the damaged section during that earlier incident.
- 54 One of the recommendations from that investigation was to ask Bradford Metropolitan District Council, which is responsible for the inlet and outlet pipes connecting to the culvert, to undertake a survey and clear any blockages found. Network Rail contacted the council who supplied it with a map of the route of the piped system, but Network Rail did not pursue its request to undertake a survey of the whole drainage system. The council has informed the RAIB that it was unaware of the 2012 flooding event.

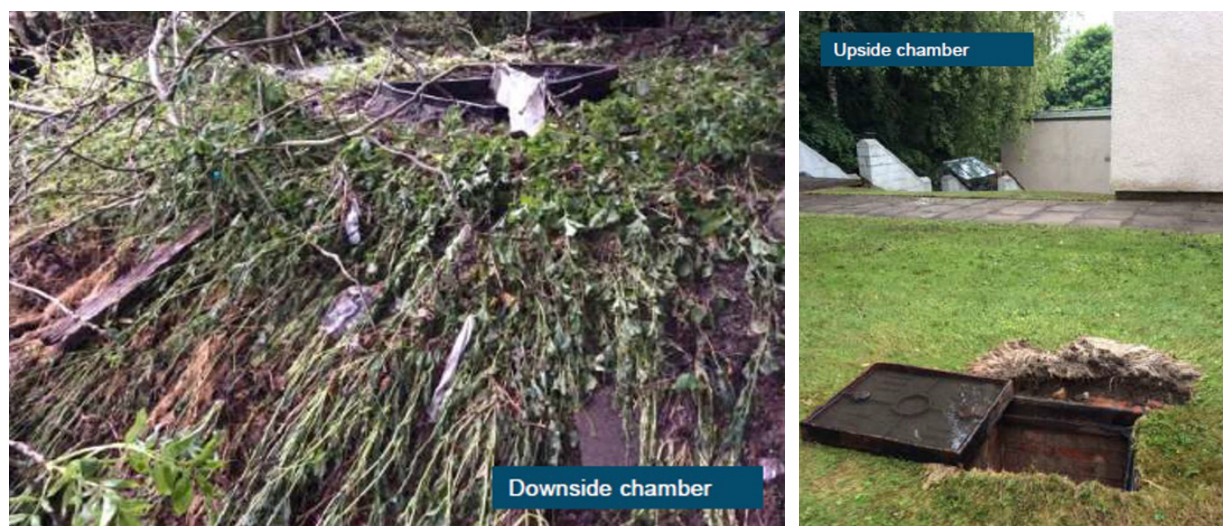


Figure 12: The lifted manhole covers of the drain's inspection chambers

The flow of the flood water towards the single-sided embankment

- 55 The land on both sides of the railway around the manholes slopes towards the railway as the track is within a shallow cutting. The track does not have any subsurface drainage of its own, so the water flowed onto, and over, the track.
- 56 The water then flowed around 100 metres down the gradient towards Shipley, contained by the sloping sides of the cutting, until it reached the end of the cutting on the Charlestown side where the embankment began (figure 4). The land at the foot of the embankment falls away to a small valley in which there are allotments and through which the flood water flowed.
- 57 The flow of the water caused the ballast, which both formed the side of the embankment and provided support to the track, to be washed away. This also happened in the 2012 event.
- 58 Network Rail's report into the 2012 incident contained a further recommendation for it to consider a piped drainage system to capture any flood water overflowing from the inspection chambers and directing it to a soak away ditch beyond the embankment without flooding neighbouring land. Network Rail has informed the RAIB that this drainage improvement was not progressed (paragraph 89).

Repairs to the embankment following the previous flooding event

- 59 Following the washout of the track at the same location in 2012, the line was closed for about a day while repairs were made to the embankment (figure 13). The repairs following the washout in 2012 consisted of digging out the clay around the embankment and reinstating it with ballast. Network Rail has stated that it considered the repair to be a temporary solution to reinstate railway services, until a more permanent solution was found.
- 60 In addition to the two recommendations (paragraphs 54 and 58) Network Rail has stated that it was considering reconstructing the embankment at the site of the washout so that it could withstand the flow of flood water. This too was not progressed (paragraph 89).



Figure 13: The unsupported track section following the washout in 2012

Trains were allowed to run over the washed out track

61 Network Rail did not deal with the reports of the damaged track appropriately.

62 Images from the CCTV footage from the two trains which travelled over the damaged section at 17:45 hrs and 17:59 hrs following the reopening of the line (paragraph 34), show that the track had been washed out.

63 The times of the two initial phone calls to the emergency services, and the state of the embankment recorded on the member of the public's video, indicate that the track was in a washed out condition as train 2D68, whose driver reported running water over the rails at 16:29 hrs, passed over it. This was 90 minutes before the washout was identified by the driver of the third train, train 2D73.

64 This causal factor arose due to a combination of the following:

- a. controllers did not listen carefully to the safety messages within the emergency phone calls they received;
- b. controllers did not direct the incident responders to the correct location;
- c. incident responders were not aware of the vulnerability of the embankment to flooding; and
- d. the third train to go over the washout was not stopped from doing so, despite the line having already been blocked to traffic.

Each of these factors is now considered in turn.

Controllers did not listen carefully to the safety messages in the emergency phone calls they received

65 The key safety related message within the first emergency phone call from WYFRS included the words 'ripped up the lines' (paragraph 25). The phrase 'ripped up some of the track' was spoken across the desk by controller 1 to controller 2, whose area included Baildon, as the call from WYFRS continued.

- 66 Controller 2 attempted to get more information by contacting the shift signalling manager. During this phone call there is no mention of the possible damaged state of track. This phone call was disjointed because the shift signalling manager was listening to another conversation at the same time. This was the call between the signaller and the driver of 2D68 reporting the flooding, with the shift signalling manager relaying it to controller 2.
- 67 Although the signaller blocked the line to trains because of its flooded condition, the greater risk to trains at the time was the washed out track, and this was not communicated to those who were sent to the site.
- 68 The message within the second emergency phone call from West Yorkshire police was not listened to fully (paragraph 29). Controller 1 asked the police control room operator whether the report he had received was from someone near Baildon and, following affirmation, then assumed that the message was to inform Network Rail that the track was flooded. The manner in which the call was handled was abrupt and the safety related message which contained the member of the public's phrases including 'ballast has come away from the tracks' and 'dangerous for passing trains' was not communicated. Controller 1 has stated that, knowing that the incident was being handled by controller 2 and there were Network Rail responders being sent to site, assumed that any damage would be seen and there was no need for further details. The possible underlying factor behind these communication issues is discussed at paragraph 92.

Controllers did not direct the incident responders to the correct location

- 69 Neither the track technician nor the MOM were instructed to go to the location of the track washout which was visible to the members of the public. Due to the way in which the calls from the emergency services were handled, both these responders were only instructed to look for flooding.
- 70 The driver had reported that there was flooding on the Shipley side of bridge 7 (paragraph 26). Evidence from the FFCCTV of train 2D72 at 17:45 hrs and the track technician indicates that there had been flood water on the track at least as far north as bridge 7. This water had likely flowed from land on either side of the cutting closer to Baildon station following the heavy rainfall. The location given by the train driver was likely identified by the 'Bridge 7' sign on the approach to it. This was the first identifiable feature on the flooded section of the line which he reached some 20 seconds after passing over the damaged embankment.
- 71 The track technician was told that the flooding was the Shipley side of bridge 7 (paragraph 30). Although he walked to the south of bridge 7 and reported that there was water to the sides of the track (paragraph 33), the examination ended 280 yards (250 metres) north of the washed out embankment, so the damage was not identified.
- 72 The MOM did not go to the location he had been directed to (paragraph 32). However, even if he had gone to the correct access point closer to Baildon station he would not have seen the washed out embankment as he had a medical restriction preventing him from accessing the railway line unaccompanied.

- 73 Controller 1 was aware of the street name and the postcode of the member of the public who had called the emergency services. These details were mentioned by controller 1 to controller 2 in the same conversation as the phrase 'ripped up some of the track' (paragraph 65). However, these details were neither used to direct the responders to a more accurate location on the railway, nor to direct them to a location off the railway from where the member of the public had seen the damage to the track.
- 74 The track technician could have been directed more precisely to the section of washed out track if the controllers had better identified its mileage from the adjacent street location given to them. Controller 2, who was aware of the track access restriction of the MOM, could have directed him to the street from where the member of the public could see the track damage.
- 75 The RAIB also found that these details were not recorded on the Network Rail's Control Centre Incident Log (CCIL) for this incident at 16:33 hrs when the log was created. This system allows others in Network Rail to view and respond to information received on railway incidents.

The incident responders were not aware of the vulnerability of the embankment to flooding

- 76 Although some in Network Rail were aware of the previous washout in August 2012 (paragraph 53), those who were involved in the response to this latest flooding incident were not aware of the susceptibility of the embankment to washout.
- 77 The LNE route geotechnics team, comprising its earthworks and drainage asset engineers, was aware of the previous washout in 2012. Since 2015, the drainage asset engineer had been identifying sites within the LNE route which had a history of flooding. These sites were included within a prototype extreme weather warning system known as 'Meteolert'. The system creates an alert when it receives a prediction of an extreme weather event for a localised area in which a vulnerable asset exists. The intention is that local on-call staff can then be sent to the site to inspect or monitor the asset to ensure that it is safe for trains. At the time of the incident, all the sites on the system, including the embankment at Baildon, were for trial purposes only.
- 78 At 15:00 hrs on 7 June 2016, the system predicted heavy rainfall in the Baildon area. However, this information was only available to the geotechnics team and not to the control room because the system was at a trial stage. It was not fully active because the value of the rainfall rate at which an alert was triggered was only an estimate, as there was insufficient data on the actual rate that preceded the 2012 flooding event. Also, for the system to work correctly, it required the actions of any responders to an alert to be defined and briefed. This had not been done at the time of the incident because there was concern about having an unproven system that gave false alarms leading to people ignoring them.

- 79 Network Rail has a register of its assets which are considered to be at risk of damage from extreme weather events. This is available to the local track maintenance engineers (TMEs) in each area. At the time of this incident, the embankment south of Baildon station was not on the asset risk register for this area. The local TME had only been in post since late 2015 and was not aware of the 2012 event. Neither the TSM, nor the MOM who was sent to look for flooding, were aware of the previous washout. A TME from another area, who was the on-call TME at the time, was made aware of this flooding event by Network Rail control. However, he was neither familiar with the Baildon area, nor the previous 2012 washout.
- 80 The track technician, who was instructed to inspect the track for flooding at the location given to him by the controller, via the TSM, later recalled that he assisted in restoring the geometry of the track after the embankment had been repaired following the 2012 incident. However, he has stated that he had forgotten this at the time of the track examination and did not have access to any asset risk register.

The third train to go over the washout was not stopped from doing so, despite the line having already been blocked to traffic

- 81 The signaller has stated that he was about to make an emergency call to train 2D73 when the driver made an emergency call to him (paragraph 39). This call was made at 18:01 hrs, two minutes after train 2D73 had passed over the damaged section at 17:59 hrs, and six minutes after the shift signalling manager had received the emergency call from controller 2 and the signaller had taken action to block the line.
- 82 The shift signalling manager has stated that he thought it was train 2D73 that the member of the public had reported as having already passed over the washed out track, rather than train 2D72. This assumption arose because of the time between the member of the public making the call at 17:49 hrs and the message reaching the shift signalling manager six minutes later, via the emergency services and two incident controllers.
- 83 At 17:55 hrs, train 2D73 was approaching Baildon station. The information available to the shift signalling manager and the signaller did not provide them with sufficient detail to know the actual location of a train on the single line track (paragraph 14). However, had an emergency call been made to the driver of train 2D73, the train would not have passed over the washed out track.
- 84 The railway system for communication between signallers and controllers to a train driver is known as GSM-R (*Global System for Mobile Communications – Railways*). It allows an authorised user to initiate a railway emergency group call by activating a red button which also sends an 'all trains stop' message to any train within a particular operational area within the relevant route. It can also be used to initiate a 'stop' message to an individual train in the area.
- 85 At the time of the incident, GSM-R terminals were available to all the signallers individually within the York signalling control centre. In the route control office, there was only one terminal located on the duty route control manager's (RCM) desk. Controller 2 could have requested the RCM to send a 'stop' message. However, Network Rail has stated that although controllers had received initial training on the system, on-going competency had not been maintained. Competency assessments were resumed in September 2016.

- 86 Alternatively, controller 2 could have telephoned the signaller directly with the emergency message, rather than relaying the message via the shift signalling manager. It is likely that this would have resulted in the signaller making a GSM-R emergency call to the driver of train 2D73 and preventing it from passing over the washout.
- 87 Evidence provided to the RAIB indicates that some LNE controllers believe that contacting the signaller directly is the quickest method of stopping a train, rather than making a GSM-R emergency call from the control room, because signallers can usually identify more quickly than controllers which particular operational area or individual train needs to receive a 'stop' message.

Identification of underlying factors

88 **Network Rail did not take any substantive remedial actions following the previous track washout at the same location in 2012.**

- 89 Following the washout in August 2012, Network Rail conducted an examination of the culvert which showed it to be free from debris preventing the flow of water. The investigation report indicated that either the pipe downstream of the culvert was restricted, or that the piped system as a whole, even if totally unblocked was unable to handle the quantity of water following the flooding event. For this reason it made two recommendations (paragraphs 54 and 58). At the time of the 7 June 2016 washout, Network Rail had undertaken neither. Additionally, Network Rail had not pursued suggested modifications to the embankment to withstand further flooding (paragraph 60).
- 90 Network Rail has informed the RAIB that these recommendations were not acted upon because of other significant flooding and earthworks failures that had occurred on the LNE route between May and December 2012. The modifications to prevent another washout at Baildon were considered to be of a lower priority and were not pursued.

91 **The competence of controllers in safety critical communications was not being adequately managed. This was a possible underlying factor.**

- 92 The way in which the first emergency calls were handled (paragraph 65) affected the incident response and the subsequent consequence of two trains passing over the section of washed out track. Controllers 1 and 2 did not correctly identify that the reason for the emergency calls from the members of the public was not just because there was flood water flowing off the embankment, but because they could see that the track had been significantly damaged. The controllers were therefore not fully aware of the state of the track and the risk to trains.
- 93 Controllers are included among those undertaking safety critical activities in Network Rail's Operations Manual (NR/L3/OPS/041). This manual also defines the required quality levels of communications expected and the requirements for monitoring and assessing them. Procedure 3-08 of the operations manual defines the frequency of monitoring controllers' phone calls as every six months. Each monitoring session requires a controller's manager, usually a route control manager (RCM), to listen to a minimum of three randomly selected voice recordings and assess their quality.

- 94 The assessment involves rating the phone call quality between grades A to E, where grades A and B are described as good, and grade D and E are poor. The grading criteria includes checking that both parties know who they are talking with, the correct use of the phonetic alphabet and ensuring that messages between the parties are fully understood.
- 95 Controller 1 had been assessed on the quality of communications in April 2016, by monitoring only one phone call and not the three specified by the procedure. This was rated as a grade C as there were shortcomings in not sufficiently identifying the other party, and not confirming that the message was understood by repeating back the key details. Network Rail were unable to provide the RAIB with any evidence that there had been any preceding monitoring assessments of controller 1 since October 2013.
- 96 Controller 2 had been assessed on three phone calls in May 2016; the quality of communication rated as a grade C on all three calls. The monitoring assessment prior to this had been in November 2015 where four phone calls were all rated as grade B.
- 97 Although Network Rail assessed controller 3 in March 2016 (with grades A and B given on three phone calls), it was unable to provide the RAIB with evidence that there had been any other monitoring assessments since February 2014.
- 98 The Network Rail procedure states that where an assessment is rated as a grade C, D or E, a development plan is to be created to improve the quality. Network Rail has provided no evidence to the RAIB that development plans had been created to improve the quality of communications, following the grade C ratings for controllers 1 and 2, by the time of this incident.

Summary of conclusions

Immediate cause

- 99 The line was open to traffic after the track's support had been washed out by flood water (paragraph 43).

Causal factors

100 The causal factors were:

- a. The ballast under one rail of the track had been washed out for a distance of 3 - 4 metres (paragraph 45). This causal factor arose due to a combination of the following:
 - i. the drainage system running under the track could not cope with the quantity of water following the flash flood (paragraph 47);
 - ii. the flood water on the railway was directed to the single sided embankment (paragraph 55); and
 - iii. a repair to the embankment following a previous flood could not withstand the flow of water (paragraph 59).
- b. Network Rail did not deal with the reports of the damaged track appropriately (paragraph 61). This causal factor arose due to a combination of the following:
 - i. the controllers did not carefully listen to the safety messages within the emergency phone calls (paragraph 65);
 - ii. the controllers did not direct its incident responders to the correct location (paragraph 69);
 - iii. incident responders were not aware of the vulnerability of the embankment to flooding (paragraph 76); and
 - iv. the third train to go over the washout was not stopped from doing so, despite the line having been blocked to traffic (paragraph 81).

Underlying factors

101 The underlying factors were:

- a. Network Rail did not take any substantive remedial actions following the previous track washout at the same location in August 2012 (paragraph 89, **Recommendation 1**), and
- b. The competence of controllers in safety critical communications was not being adequately managed; this was a possible underlying factor (paragraph 92, **Learning point 1**).

Actions reported that address factors which otherwise would have resulted in a RAIB recommendation

- 102 In July 2016 Bradford Metropolitan District Council undertook a CCTV survey of the drainage system downstream of the culvert and has reported that no debris or blockage was found. Network Rail has reported that a full survey of the culvert and extensive lengths of the upstream and downstream pipes was completed in November 2016.
- 103 The Baildon site is on the Network Rail Weather Service list and a procedure on the necessary actions to take in the event of an extreme weather alert is being prepared. Additionally, Network Rail reports that it has assessed the capability of the 2016 repair as being adequate to withstand the water flows seen in 2012 and 2016.
- 104 Since the incident Network Rail has reported to the RAIB that it has reviewed and discussed with the incident controllers the way in which the calls were handled and has put the necessary development plans in place. The quality of communications of incident controllers in York ROC are now being monitored and assessed in accordance with the requirements of the operations manual (paragraph 93).

Recommendations and learning points

Recommendations

105 The following recommendations are made⁴:

- 1 *The intent of this recommendation is to minimise the risk of recurrence of another track washout at Baildon endangering trains.*

Network Rail should put measures in place to reduce the risk of a track washout at Baildon. Measures to be considered should include, but not be limited to, the following:

- a) following the inspection of the drain system that leads from culvert GUE/5, an assessment of whether there is any blockage that needs clearing, or a permanent restriction in the drain system (paragraph 100a.i);
- b) installation of a line-side flood water capture system to carry flood water away safely from the site to prevent further washouts (paragraph 100a.ii); and
- c) completion of the work already begun on providing alerts to trigger actions of incident responders following heavy rainfall events detected in the Baildon area by the Network Rail Weather Service system (paragraph 100b.iii).

- 2 *The intent of this recommendation is to improve Network Rail's emergency response to incidents on the track particularly in situations where emergencies are first identified by members of the public.*

Network Rail should develop and implement a system to enable its controllers to be able to rapidly translate geographic or post code information provided by others on locations adjacent to the railway, into track location information so enabling the effective direction of responders (paragraph 100b.ii).

⁴ Those identified in the recommendations have a general and ongoing obligation to comply with health and safety legislation, and need to take these recommendations into account in ensuring the safety of their employees and others.

Additionally, for the purposes of regulation 12(1) of the Railways (Accident Investigation and Reporting) Regulations 2005, these recommendations are addressed to the Office of Rail and Road (ORR) to enable it to carry out its duties under regulation 12(2) to:

- (a) ensure that recommendations are duly considered and where appropriate acted upon; and
- (b) report back to RAIB details of any implementation measures, or the reasons why no implementation measures are being taken.

Copies of both the regulations and the accompanying guidance notes (paragraphs 200 to 203) can be found on RAIB's website www.gov.uk/raib.

- 3 *The intent of this recommendation is to improve the effectiveness of communicating safety critical information between incident controllers and signallers and drivers, in order to reduce the time taken to alert trains in emergency situations.*

Network Rail should review how its controllers respond to emergency phone calls about the safety of the line, to make sure that important information is captured and accurately transmitted to relevant railway responders, and implement any identified improvements. The scope of the review should include consideration of the following:

- a) controllers making direct contact with the initiator of the emergency call to clarify the nature of the emergency situation and its location (paragraph 69), and
- b) the most appropriate way for GSM-R emergency calls to be made to train drivers, whether from the control room directly, via the shift signalling manager, or via the signaller (paragraph 79).

Learning points

106 The RAIB has identified the following key learning points⁵:

- 1 Controllers and signallers are reminded to manage operational communications with great care. In particular it is important to:
 - identify and capture key descriptions and safety critical information.
 - not interrupt the caller even if they think they know what the message is about (it is possible that a new message about an incident that is already known about may provide further important information about the nature of the incident which may require a modification to the railway's response) (paragraph 100b.i).
 - avoid passing on messages to others in an informal manner while also listening to an emergency call.
- 2 Control room managers are reminded of the need to continuously monitor and maintain a good standard of safety critical communications within their control offices as required by the Network Rail operations manual (paragraph 101b).

⁵ 'Learning points' are intended to disseminate safety learning that is not covered by a recommendation. They are included in a report when the RAIB wishes to reinforce the importance of compliance with existing safety arrangements (where the RAIB has not identified management issues that justify a recommendation) and the consequences of failing to do so. They also record good practice and actions already taken by industry bodies that may have a wider application.

- 3 Duty holders should not assume others have reported incidents to the RAIB (paragraph 42). The Railways (Accident Investigation and Reporting) regulations requires all duty holders to report in accordance with the schedules.

Appendices

Appendix A - Glossary of abbreviations and acronyms

CCIL	Control Centre Incident Log
FFCCTV	Forward facing closed circuit television
GSM-R	Global System for Mobile Communications – Railways
LNE	London North Eastern
MOM	Mobile Operations Manager
RCM	Route Control Manager
ROC	Rail Operating Centre
TME	Track Maintenance Engineer
TSM	Track Section Manager
WYFRS	West Yorkshire Fire and Rescue Service

Appendix B - Glossary of terms

All definitions marked with an asterisk, thus (*), have been taken from Ellis's British Railway Engineering Encyclopaedia © Iain Ellis. www.iainellis.com.

Cess	The spaces to the side of a railway track
Electric multiple unit	A multiple unit that can be driven and controlled as a single unit from the driving cab at the leading end and whose motive power is electricity supplied externally from Overhead Line Equipment (OLE) or conductor rails.*
Four foot	The space between the two rails of a railway track.
Global System for Mobile Communications – Railways	A radio system for data transmission to and from trains.
Headwalls	The wall forming the ends of a tunnel or culvert.
Track circuit block	A signalling system where the signals are controlled by the use of track circuits.

Appendix C - Investigation details

The RAIB used the following sources of evidence in this investigation:

- information provided by witnesses;
- Network Rail control room voice recordings;
- information taken from the on-train data recorder (OTDR) of train 2D73;
- closed circuit television (CCTV) recordings taken from trains 2D72 and 2D73;
- the member of the public's video recording;
- signalling records;
- emergency services control room logs;
- site photographs and measurements;
- weather reports and observations at the site;
- Network Rail's report following a previous washout at the same location in 2012;
- Network Rail's and Northern Rail's investigation reports; and
- a review of previous RAIB investigations that had relevance to this incident.

This report is published by the Rail Accident Investigation Branch,
Department for Transport.

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