NOTE

Date 24-08-2023

Casenr. 2022-364

**English translation of report summary, conclusion and recommendations.**

Railway embankment under rapid deterioration while a regional train was passing (26-08-2022).

1. Summary.

Shortly before train 5362, which was on its way from Skjern towards Herning, passed an embankment in line 35's km 88.65, the two locomotive drivers (driver teacher and student) observed that there were missing ballast under the track. The train was unable to stop and the area was passed at 87 km/h. During the passage, the train set bounced violently, and several passengers suffered knocks and bruises. No one was seriously injured, but the damage to rolling stock and infrastructure was extensive.

In the hours leading up to the incident, it had rained heavily over the area by the embankment, and large amounts of rainwater had flown to the embankment. The water caused the embankment to collapse around an aqueduct bridge, and once a hole had been breached, large parts of the embankment below the track were washed away. A few minutes after train 5362 had passed, approx. 10 meters of the embankment below the track had disappeared.

Regular inspection and maintenance were not sufficient barriers to safeguard against the line becoming impassable as a result of heavy rain. Furthermore, operational rules regarding the handling of warnings about local cloudbursts were not followed.

The AIB's investigation has been made difficult by the fact that parts of the documentation regarding repairs and risk management around the embankment and the aqueduct bridge in km 88.65 could not be obtained.

AIB has made two recommendations

5. Conclusion.

The embankment and aqueduct bridge at km 88.65 on line 35 between Troldhede and Kibæk were broken down by large amounts of water, which flowed in after an unusual rain event over the hydrological catchment area.

It is likely that the water volumes caused the embankment to fail by one or more of three possible degradation mechanisms:

* The water found its way through the embankment along any weaknesses. Possibly at the outer sides of the aqueduct bridge, its bottom, or at an unprotected ditch side, and took material with it.
* The water ran through the ballast on top of the embankment, whereby the sand in the embankment began to be washed away.
* The water gushing out of the outlet side of the aqueduct bridge washed material with it, collapsing the embankment from behind.

The annual inspections of the aqueduct bridge in relation to drainage gave no indication of functional impairment, and an ongoing erosion of the ditch side near the entrance to the aqueduct bridge had not been registered and dealt with.

Risk mapping in 2008 with checking of problematic embankment and checking of the capacity of aqueduct bridges, in relation to extreme rain events, probably led to the repair of the outlet side of the aqueduct bridge, but no comments regarding possible capacity issues. Documentation for risk assessment in relation to capacity regarding embankment and aqueduct bridge at km 88.65 have not been available for the investigation. The documentation for repairs regarding embankment and aqueduct bridge at km 88.65 have not been available for the investigation.

Banedanmark (the IM) did not initiate rain preparedness prior to the incident, because warnings of cloudbursts were considered imprecise, which is why it was uncertain where (and whether) rain preparedness would be needed. Stbst (the signaler) therefore received no information about rain preparedness, and was thus not particularly aware that cloudbursts could cause problems on the routes that he managed.

With the repeal of TC[[1]](#footnote-1) 2023-18, a warning system is no longer established.

Signalers and locomotive drivers, who had to jointly assess whether train operations should be limited or suspended on sections through areas with a lot of water, had no prerequisites to know when the amount of water could be critical for the infrastructure.

None of the reports to Stbst about water on and along the track included km 88.65, where the aqueduct bridge was located. It must therefore be assumed that the locomotive drivers who passed the site were not able to identify the imminent danger to the infrastructure at this particular site. Thus, Stbst's incomplete perception and relaying of the registered areas is assessed not to have had an influence on the course of events.

The track inspector, who was called to assess the condition of the track, did not arrive until the incident had occurred.

Imprecise communication of order to drive with “enhanced lookout” led to the perception that the area had been passed before it had been reached.

Driving under the rules of “enhanced lookout” would probably not be sufficient to prevent trains from passing dangerous sections of line that were impassable, because the distance need to stop could be greater than the distance at which critical damage to the infrastructure could be observed.

Thus, TC 2022-22 is not seen as sufficient barriers for the risks associated with train operation on sections which became impassable due to sudden inflows of water in connection with heavy cloudburst.

5.1. Additional Information.

TC 2022-22 (continued as TC 2023-18 and later TC 2023-26) was also applicable to CBTC and ECTS lines. The rule sets for these sections (ORS/ORF) did not support driving with “enhanced lookout”.

TC 2022-27 introduced after the incident, and continued as TC 2023-13 and later TC 2023-26, is also applicable to both SR, CBTC and ECTS lines. Here, however, a maximum speed of 40 km/h has been introduced when driving on CBTC and ECTS lines, which are at risk of being affected by water, displacements of the track, missing ballast or landslides on embankments. On SR lines, driving continues with “enhanced lookout”, with up to 60 km/h. It is noted that only on CBTC lines, the speed must be adjusted so that vehicles can stop short of an obstacle.

Banedanmark has during hearing informed that they considers the theme regarding inspection of ditch sides to be included in the contract for maintenance by the wording:

During the inspection, the Supplier inspects the entire facility and reports faults, deficiencies and breakdowns per line to Banedanmark.

7. Recommendations.

Repairs and risk assessment regarding the embankment and the aqueduct bridge in km 88.65 are not documented, which is why it has been difficult to assess the condition of this part of the infrastructure prior to the rain event on 26-08-2022, as well as to determine the extent of the risk assessment in relation to the capacity of the aqueduct bridge.

DK-2023 R 2 of 22-08-2023.

AIB recommends that the Danish Transport Agency ensures that Banedanmark documents and archives safety-relevant information regarding repairs and risk assessments on the railway's drainage elements, and ensures traceability between the drainage elements and the archived safety-relevant information.

In the incident on 26-08-2022, it was not possible to stop the train within the distance that was available after the situation around the embankment/aqueduct bridge was observed. Driving with “enhanced lookout” as described in the rulebook (SR §2, section 5.3) as well as looking out while driving at a maximum of 40 km/h (Rulebook for ERTMS) does not require the train to be able to stop short of an obstacle.

DK-2023 R 3 of 22-08-2023.

AIB recommends that the Danish Transport Agency ensures that Banedanmark investigates whether the rules regarding driving with “enhanced lookout” (SR), as well as “lookout while driving” at a maximum of 40 km/h (Rulebook for ERTMS), on sections that are at risk of being affected by water, displacements of the track, missing ballast or landslides on embankments, provide sufficient protection against the dangers associated with trains traveling on parts of the infrastructure that have become impassable due to these conditions.

1. TC is short for TrafikCirkulære, which is publications of rules and/or procedures. [↑](#footnote-ref-1)