

Horncastle Reservoir Review Summary

February 2024

Summary

This is a summary of the Horncastle reservoir review findings. The investigation consists of a technical and modelling report. These reports conclude that the flooding was caused by heavy rainfall downstream of the reservoir and to the east of Horncastle in excess of the flood storage reservoir scheme design. It was not caused by the delayed closure of the reservoir sluice gate.

Reservoir background

The Horncastle Flood Storage Reservoir was completed in 2017 to reduce flood risk along the River Bain in Horncastle and villages downstream. It only became possible thanks to funding contributions from Lincolnshire County Council, East Lindsey District Council and Horncastle Town Council. It is located at Hemingby, upstream of Horncastle, which was the most suitable location to maximise the reduction of flood risk based on topography, cost-effectiveness and funding. It was designed to reduce the flood risk along the River Bain in Horncastle to a 1 in 100 chance in any year and can store 1.5 million cubic metres of water.

A control structure, known as a hydroslide (see photo on page 6), at the reservoir limits the flow of water from the Upper Bain catchment by temporarily storing water. This hydroslide operates using a float system and limits the flow of water in the River Bain downstream of the reservoir. A separate sluice gate is in place to drain the agricultural land within the lowest part of the reservoir when it is not in use.

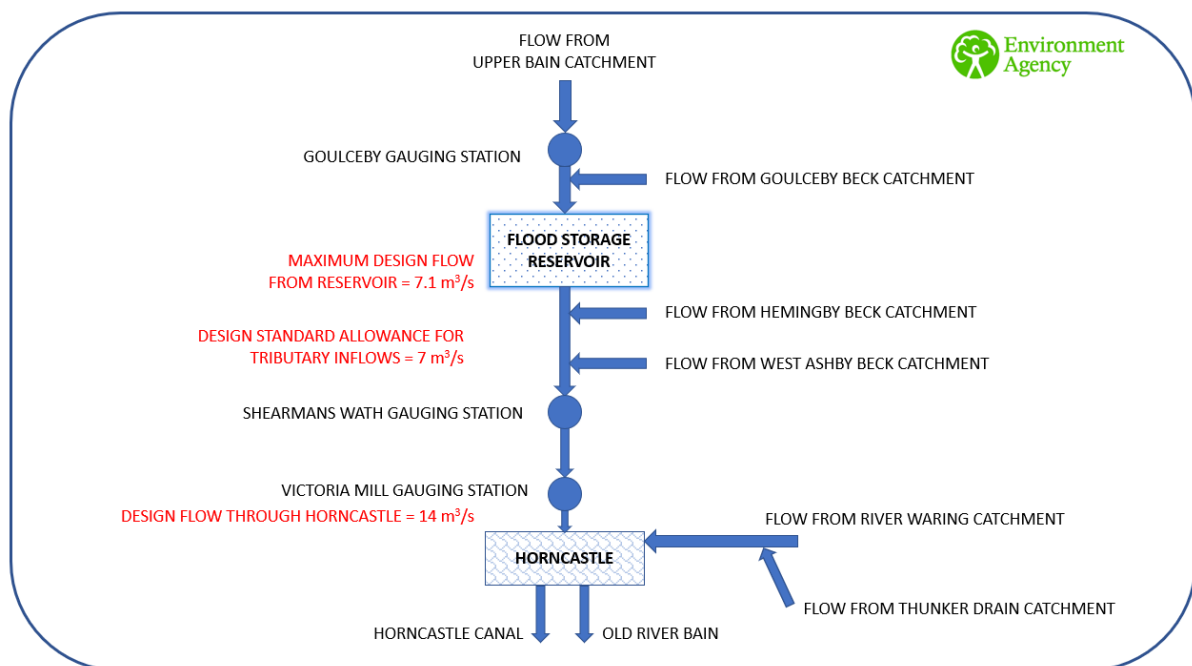


Figure 1: Upper Bain catchment schematic showing reservoir scheme design flows

What happened

Storm Babet caused extreme flooding. It brought significant heavy rainfall overnight on the 19 and 20 October 2023 across the county – the River Bain catchment had up to two months of rain in a day. Some locations across the East Midlands saw the highest recorded river levels, including on the River Waring.

The Environment Agency has a duty team in place 24/7 to monitor the river levels and forecast and to respond to any issues. With the forecast changing significantly on the morning of Thursday 19 October, action was taken to get staff in place to open the incident room at the earliest opportunity. Staff worked around the clock, with emergency services partners in the Lincolnshire Resilience Forum, responding to multiple issues across the county.

Sluice gate

The sluice gate has regular mechanical and electrical tests. The trigger level for the sluice gate is set so that it automatically closes several hours before it is needed. This allows time for it to be closed manually, if required. This, in conjunction with the hydroslide, ensures the downstream flow is limited. There was a delay in closing the sluice gate on 20 October of around 2.5 hours after it was required to be closed.

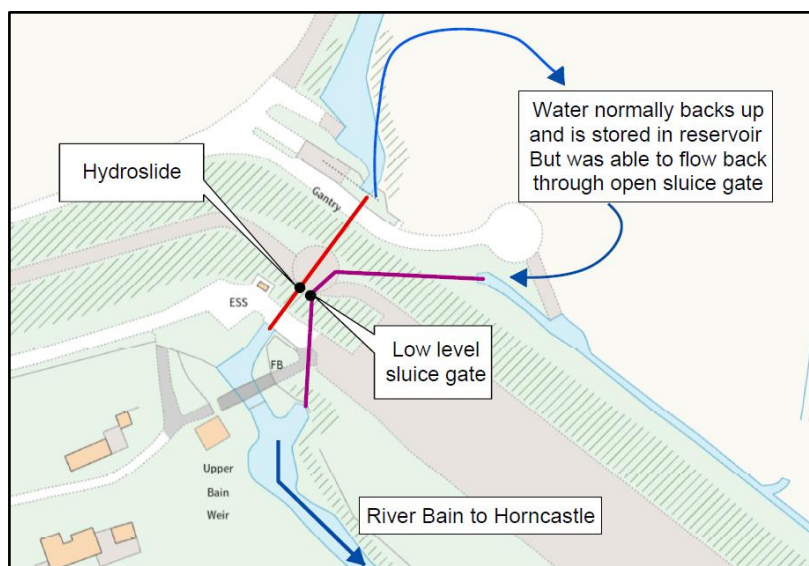


Figure 2: Diagram of hydroslide and sluice gate locations and how water backs up in the reservoir

Flooding in Horncastle and downstream

A total of 197 properties are known to have been affected by Storm Babet across Horncastle plus 31 properties affected in Kirkby-on-Bain downstream of the town.

Scope of Review

The Environment Agency's Chief Executive commissioned a review of the delayed closure of the sluice gate to determine:

1. What happened.
2. Whether the reservoir operated as expected or not.
3. What was the impact on flood levels in normal operation and in this incident.

In answering these questions, the review, which has been overseen by the Environment Agency's Chief Engineer, has considered the root cause of the issues and made recommendations to reduce the likelihood of it happening again. It has also assessed any impact on flooding due to the delayed closure.

Investigation

- **Reservoir**

After prolonged heavy rainfall, the levels on the River Bain began to rise. A message was sent by the telemetry system at 3.23am BST to say the river had reached a level where the sluice gate should close. It is designed to close automatically several hours before needed to allow time for it to be closed manually if required. On this occasion it was 11.45am when the flow reached the threshold where the sluice gate needed to be fully closed. It was understood the sluice gate was in automatic mode and therefore would have closed. Given the scale of the incident, with staff responding to multiple issues across the county, this was not verified. At 7.17am, the duty team were contacted to check the gate but due to the pace at which the incident was escalating, this was not actioned. Staff were diverted to the reservoir after a landowner called at 12.41pm to advise the sluice gate was still open. Flooded roads delayed the arrival on site. The sluice gate was closed at 2.15pm.

The investigation discovered an issue with the controls of the sluice gate that meant, despite the sluice gate being switched to automatic on the control panel, a system setting could override the gate to manual mode. This was the case on 20 October, which prevented automatic operation. This issue has now been resolved so it cannot happen again.

- **Impact**

Additional computer modelling of the catchment was carried out to understand whether there was any impact from the sluice gate not being closed sooner, given the significant heavy rainfall over the River Bain and its tributaries. This involved simulating the run off response from the rainfall for each of the tributaries, as well as the River Bain. It took into account the distribution and timing of rainfall, soil conditions and how the flow passes along the river systems. The modelling has taken a number of weeks to complete due to the complexity of the tasks required.

The modelling showed that until the sluice gate was closed fully, the maximum flow downstream from the reservoir was above the scheme design for approximately 2.5 hours. This resulted in additional volume of approximately 7,800m³ passing downstream from the reservoir. This was not sufficient to make a difference to peak water levels further downstream.

Earlier closure of the sluice gate may have delayed the river reaching this peak by just over an hour. It would also have delayed when the flood warning threshold was reached. This would not have provided any additional advanced notice of the flooding. In effect the whole sequence would have been delayed by just over an hour.

Met Office records indicate that the rainfall was more intense downstream of the reservoir and across the tributaries on the eastern side of the catchment. Figure 3 shows the rainfall totals from 9pm Thursday 19 to 9pm Friday 20 October. This rainfall resulted in river flows in the tributaries downstream of the reservoir in excess of that allowed for in the design. This additional flow of approximately 312,000m³ ultimately caused the flooding from the River Bain.

Figure 4 shows the calculated flows passing downstream from the reservoir and those from the Hemingby Beck and West Ashby Beck tributaries.

The modelling has confirmed that even if the sluice gate had been closed earlier, properties alongside the River Bain would still have flooded because the heaviest rain fell downstream of the reservoir.

The modelling has also confirmed the initial findings that flooding along Thunker Drain and the River Waring was not related to the sluice gate at the reservoir. This flooding was solely down to the quantity of rainfall in such a short period of time, resulting in the highest levels for over 30 years.

The modelling shows Storm Babet produced flows from the Hemingby Beck and West Ashby Beck tributaries with a 1 in 1,000 chance of happening in any year.

- **Conclusion**

The investigation has identified several improvements that could be made to the sluice gate operating system to improve its reliability.

The investigation has concluded the delay in closing the sluice gate did not cause the flooding in Horncastle. This was caused by heavy rainfall over catchments downstream of the reservoir which was in excess of the scheme design.

The scheme was designed to reduce the risk for a 1 in 100 chance in any year flood. The modelling has shown Storm Babet over the tributaries was a far greater flood event with a 1 in 1,000 chance in any year. It was an extreme flood.

What next

Although the sluice gate operation did not cause any property flooding, it did highlight issues with the sluice gate operating system. Since Storm Babet, the Environment Agency has:

1. Resolved the sluice gate operating system issue by removing the system setting that can override the control panel setting.
2. Made the telemetry alarm messages clearer for staff to follow and receive an action to check gate closure, rather than receive an alarm 'for information'.
3. Decided to leave the sluice gate partially closed at all times to reduce the risk of impacts should gate operation fail in the future.
4. Clarified and updated the procedures used by duty teams on the operation of the sluice gate.

The Environment Agency will continue its ongoing dialogue with the community to see if there is anything additional that can help reduce flood risk through the town, including raising awareness of flood risk and how people can be prepared.

The learning from this incident will be shared and implemented across the Environment Agency for all assets.

Additional documents

The technical report about the operation of the sluice gate at the reservoir and the modelling report about the impact contain more detail. These can be viewed online

www.horncastletowncouncil.co.uk/services/flooding

Figures:

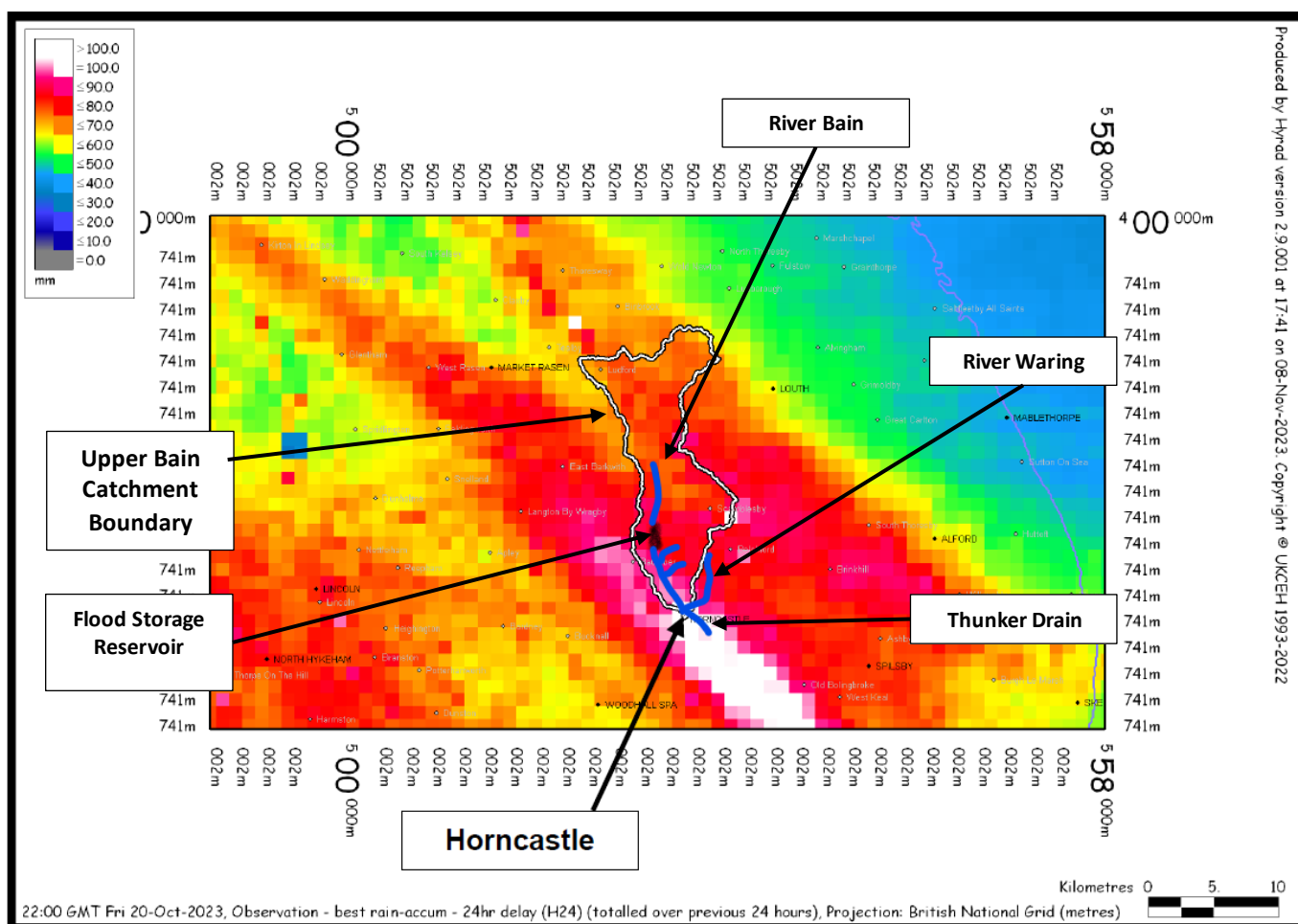


Figure 3: Rainfall totals from 9pm Thursday 19 October to 9pm Friday 20 October

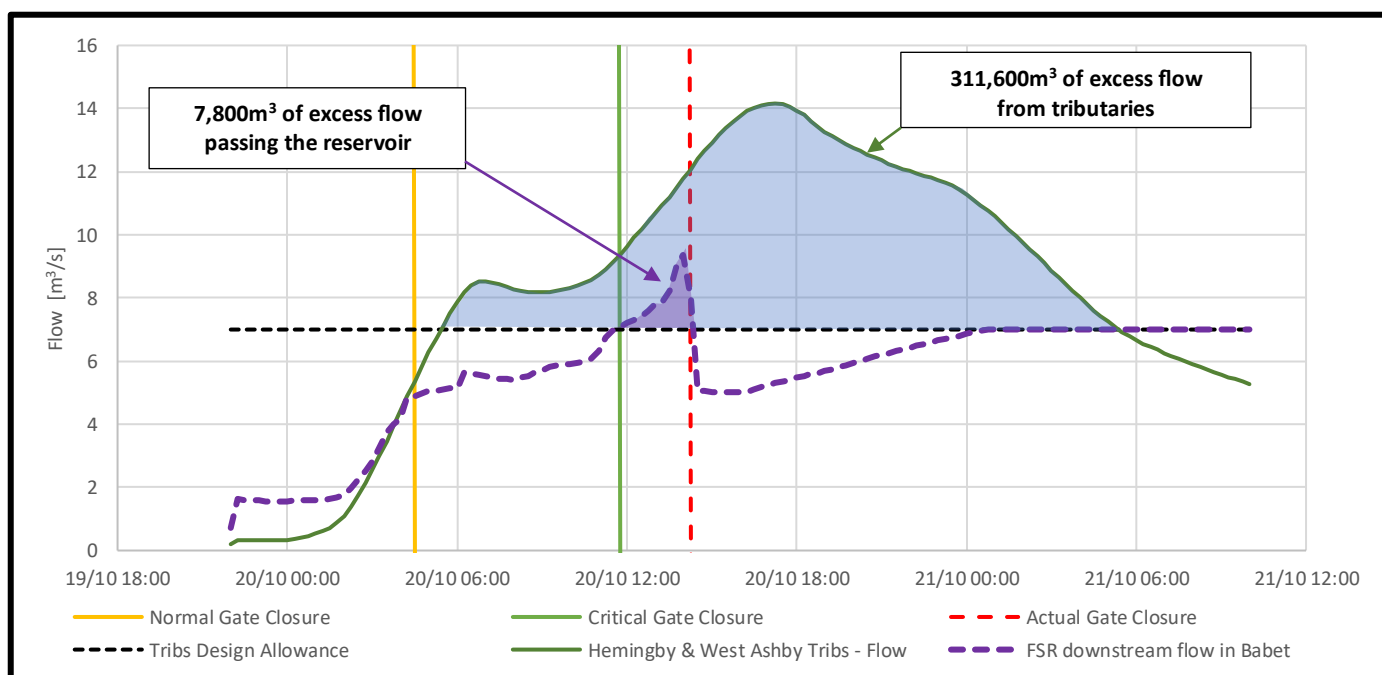


Figure 4: Calculated flows passing downstream from the reservoir and that from the Hemingby Beck and West Ashby Beck tributaries



Photo 1: Hydroslide – rotates as water levels rise to restrict flows passing downstream