GeoSmart Information

Technical Review

Assessment of the Environment Agency's Response to Recommendations from a Review (September 2024) of Horncastle Reservoir Asset Performance during Storm Babet, and the Associated Flooding at Horncastle, Lincolnshire.

Grid Reference

526159,369469

Date

06/02/2025

Report Prepared for

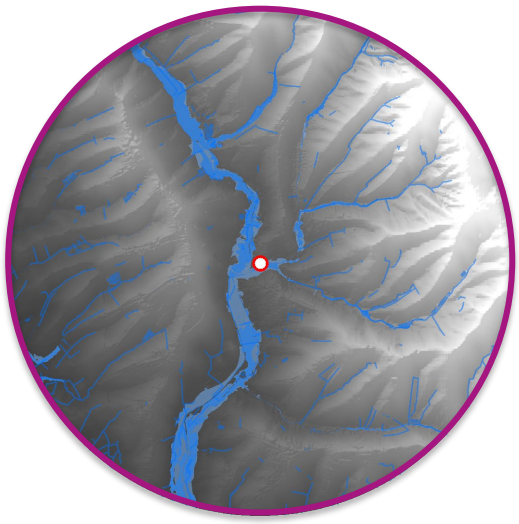
Lincolnshire County Council
County Offices,
Newland,
Lincoln,
LN1 1YL

Report Status

FINAL

Report Reference

80863.03R2



Report Author

Dr Paul Ellis
BSc, PhD

Report Reviewer

Bob Sargent
CSci, CENV BA (Hons), MBA

GeoSmart Information Ltd
Suite 9-11, 1st Floor, Old Bank Buildings,
Bellstone, Shrewsbury, SY1 1HU
+44(0)1743 298 100
info@geosmartinfo.co.uk
www.geosmartinfo.co.uk

GeoSmart Information

Contents Page

1 Introduction

1.1 Scope

Geosmart Information Ltd was commissioned by Lincolnshire County Council (LCC) to undertake a Peer Review of the findings of the Environment Agency (EA)'s Horncastle Reservoir Asset Performance Review (February 2024), following the impact of Storm Babet in October 2023 on the village of Horncastle, Lincolnshire. The findings of our assessment were presented in our report reference 80863.03R1_Final dated 04/09/2024. Whilst on the balance of probabilities, from the information available, the EA's findings appeared reasonable. However, we provided ten recommendations that, in our opinion, would make the assessment by the EA more robust and reduce the uncertainty within our findings.

The EA have provided a response to our recommendations '2024-11 LCC Review Recommendations - Response v2' (Appendix 1) and LCC have requested that we evaluate and comment upon the EA's responses. For each response we have identified whether sufficient information has been provided to advance our assessment beyond what has already been presented in our original report dated 04/09/24.

The EA provided a large amount of additional supporting information including hydrometric data and modelling reports. We have included a brief commentary on what has been provided by the EA and what additional information is recommended.

1.2 Background

Storm Babet brought very heavy rainfall over the various catchments upstream of Horncastle on 19th and 20th October 2023 resulting in significant flooding within the town, alongside the River Bain, River Waring and Thunker Drain. Intense rainfall was observed, and the Bain catchment had up to two months of rain in one day. The town benefits from the Horncastle Flood Storage Reservoir (HFSR) situated upstream on the River Bain. A potential malfunction of the HFSR resulted in the delayed closure of a sluice gate which allowed additional water to contribute to flow downstream to Horncastle.

The EA have undertaken a review of the operational events, and a flood modelling investigation aimed at establishing whether the malfunction contributed to flooding in Horncastle. The study modelled discharge from the HFSR and concluded that the by-pass flow from the HFSR did not significantly increase the flooding in Horncastle. Rather the EA considered the flooding in Horncastle was primarily the result of extremely high run-off from the catchments downstream of the HFSR.

2 Review

2.1 Recommendation 1

Provision of a risk analysis and uncertainty assessment of the modelling results and discussion of how these affect the outcome of the impact assessment.

The EA have provided multiple reports and supporting data from the Bain Catchment Model 2020 project including the results of the model sensitivity analyses. This is useful background information; however, we recommend the EA summarise what they consider to be the level of uncertainty within the assessment of Storm Babet and how the outcomes of the impact assessment could change as a result, including the future flood management implications.

The EA's response indicates that there was adequate sensitivity assessment done at the time and published in the calibration and sensitivity reports for the 2020 Bain model. However, the 2020 model and calibration did not effectively simulate Storm Babet and several parameters were changed to support the Babet impact assessment. There is no assessment of the impact on the flood study outcomes of alternative explanations for the flooding in Horncastle, other than the unusually high runoff modelled below HFSR.

The EA referred to similar events occurring in this downstream catchment, and suggest there is something innate about the catchment and its position that causes occasional high runoff events. This was not included in the sensitivity assessment, although it has apparently occurred before. The EA provided information on a potentially similar event relating to a severe flash flood on 7th October 1960.

The implied runoff from these downstream catchments is very large, and has a return period greater than elsewhere in the catchment. The EA agree that the flow from the intervening catchments between the FSR and Horncastle is towards the upper bound of probable runoff contribution. Unfortunately, there is little supporting data available to confirm that this actually occurred, as the catchments are ungauged, only comparison with the model outputs.

One issue that may warrant further consideration is the relative timing of the peak flows in the catchments which focus on Horncastle. Potentially flooding in the town is sensitive to whether the peaks from the different catchments coincide in ways which were not modelled.

Another issue is the antecedent conditions. Along with the higher rainfall, these are now assumed to have been the cause of the very high runoff proportion from the eastern catchments downstream of the HFSR. Sensitivity analysis on antecedent conditions was done in the initial modelling, principally by adjusting the Cini file in the runoff modelling so that simulations matched the observed in the calibration results. In the computer flood model, TUFLOW, used for the simulations, Cini refers to the Initial Conditions (CINI) file, which is used to set up the starting conditions of a flood model. This file defines initial water depths, velocities, and other parameters before the simulation begins. According to the report, Cini had to be varied considerably on an ad-hoc basis to match the observed flows.

The outcome of the impact assessment remains with some significant uncertainties which are difficult to resolve. Storm Babet was an extreme event that caused exceptional flooding

in Horncastle. Yet the data suggests a fairly minor rainfall event on the River Bain, within the design limits of the HFSR which did not fill to capacity.

A moderate 24 hour rainfall event (1in 25 to 1 in 50 year return period) has caused significant flooding in Horncastle apparently as a result of unusually high run-off from the Hemingby and West Ashton catchment areas. Detailed rainfall analysis may reveal very intense rainfall cells passing over the eastern tributaries that are not seen in the 24 rainfall hour map or the rain gauge data. Given the potential impacts of climate change, further investigation is recommended to support mitigation of the potential future flood impacts.

2.2 Recommendation 2

Verification of the modelled discharge from the HFSR, including comparison with modelled run-off, previous calibrations, flow monitoring and check calculations based on the control structure geometry.

The two discharges from the HFSR reservoir (hydroflow and sluice gate) have been modelled and are fundamental to the assessment. Assuming the discharge calculation from the HFSR is correct then flows coming in downstream of the HFSR may be estimated by subtracting the HFSR discharges from the flow monitored at Victoria Mill gauging station (GS), leading to high estimates of inflow from the lower catchments, which supports the EA's findings. If discharge from the HFSR was higher than modelled, then the impact of the late closure of the sluice would have been more significant.

The EA are relying on the manufacturer's rating for the Hydroslide but have indicated that a flow gauge has now been installed downstream of the reservoir. It is recommended that information is provided from the check gauging, over a range of flows which is not reliant on the manufacturer's rating.

According to section 5.4.1.2 of the Model User Guide, Bain catchment Model 2020 provided by the EA a failure scenario for the HFSR was considered as follows *'Scenario 2 - In this scenario, it is assumed that the FSR hydroslide continues to operate as normal, but that the adjacent sluice gate fails to close. The baseline 'defended' hydraulic model does not include representation of the adjacent sluice gate, as this is assumed to close during an event. Therefore, to model the failure scenario described above, a (rectangular) Orifice unit has been added with dimensions 1400mm x 1400mm'.* It is assumed that these are the dimensions used in the EA's later modelling for Storm Babet. The original model report does not include any details on the calibration or performance of the sluice beyond the above.

Malfunction of the Hydroslide and the failure of the sluice gate to close were simulated in the 2020 modelling. Scenario 2, in which the sluice gate is not closed, produces the greatest increase in flooding in Horncastle (LNA modelling programme 2020-21 River Bain Model Update, section 4.2.8).

The EA's response does not provide any confirmation for the sluice of the previous calibrations, check flow monitoring or check calculations based on the control structure geometry. The EA continue to rely on the model outcomes for the sluice and it is recommended that further data is provided to confirm the accuracy of these predictions.

The EA indicate in response to recommendation 3 regarding flow from the sluice that *'The key variables in this are upstream water level, orifice size and downstream water level. As the upstream water level is measured and the orifice size is known the only parameter which could be altered is the downstream water level. The model results did indicate that the sluice operated in drowned mode which means that the flow is affected by the level in the downstream channel.'*

As information on the water levels and sluice parameters were not provided with supporting analytical check calculations, it is not possible to verify these. We also note that the sluice gate is drowned and, as the EA indicate, the flow rate depends on both upstream and downstream values. The use of "standard hydraulic theory" using only the observed upstream level is therefore flawed. It is recommended that the EA provide the potential range in flows that could come from the sluice, alongside the supporting details. If there is confidence in the flow from the HFSR then the focus of further assessment can be the implications of the extremely high flows from the downstream catchment.

2.3 Recommendation 3

Review alternative model options that do not result in such a large increase in flow downstream of the HFSR in the adjusted model compared to the original calibrated model. Indicate the outcome for the impact assessment of the alternative results.

The EA indicate in their response that they are satisfied that flow from the HFSR has been modelled adequately (see our response to recommendation 2) and therefore higher flows must originate from the downstream catchments. The EA have not provided an assessment of the uncertainty in their conclusions or a list of alternative explanations beyond the original model assessment. We have discussed in response to recommendation 1 what we consider to be the uncertainties in the EA's assumptions about the flow from the catchment below HFSR.

The EA consider that the HFSR worked, but Horncastle still suffered serious flooding. The exact reasons why remain uncertain. Some further work, including installation of flow gauges, on the downstream catchments would seem to be justified in order to find out if the assumed cause of the Horncastle floods really does come from these small catchments. And if so, perhaps another FSR is justified.

2.4 Recommendation 4

Undertake a sensitivity analysis on the impact assessment findings including the following parameters: change in bank heights, travel times and attenuation of peak flow from the HFSR sluice.

The EA has checked the change in the model bank heights and have confirmed that 14m^3/s is an accurate representation of when flooding in Horncastle commences. Apart from timing of the peak flows in the ungauged tributaries, travel times seem well established. If it is accepted that the late closure of the FSR was not a contributary cause of the flooding then further work on this is not considered necessary at this stage.

2.5 Recommendation 5

Further supporting information on modelled versus actual observed flows and levels.

The EA provided a detailed spreadsheet containing observed levels and flows, including the intermediate gauging station at Shearmans Wath between HFSR and Victoria Mill GS. No further information is required unless further modelling is to be undertaken.

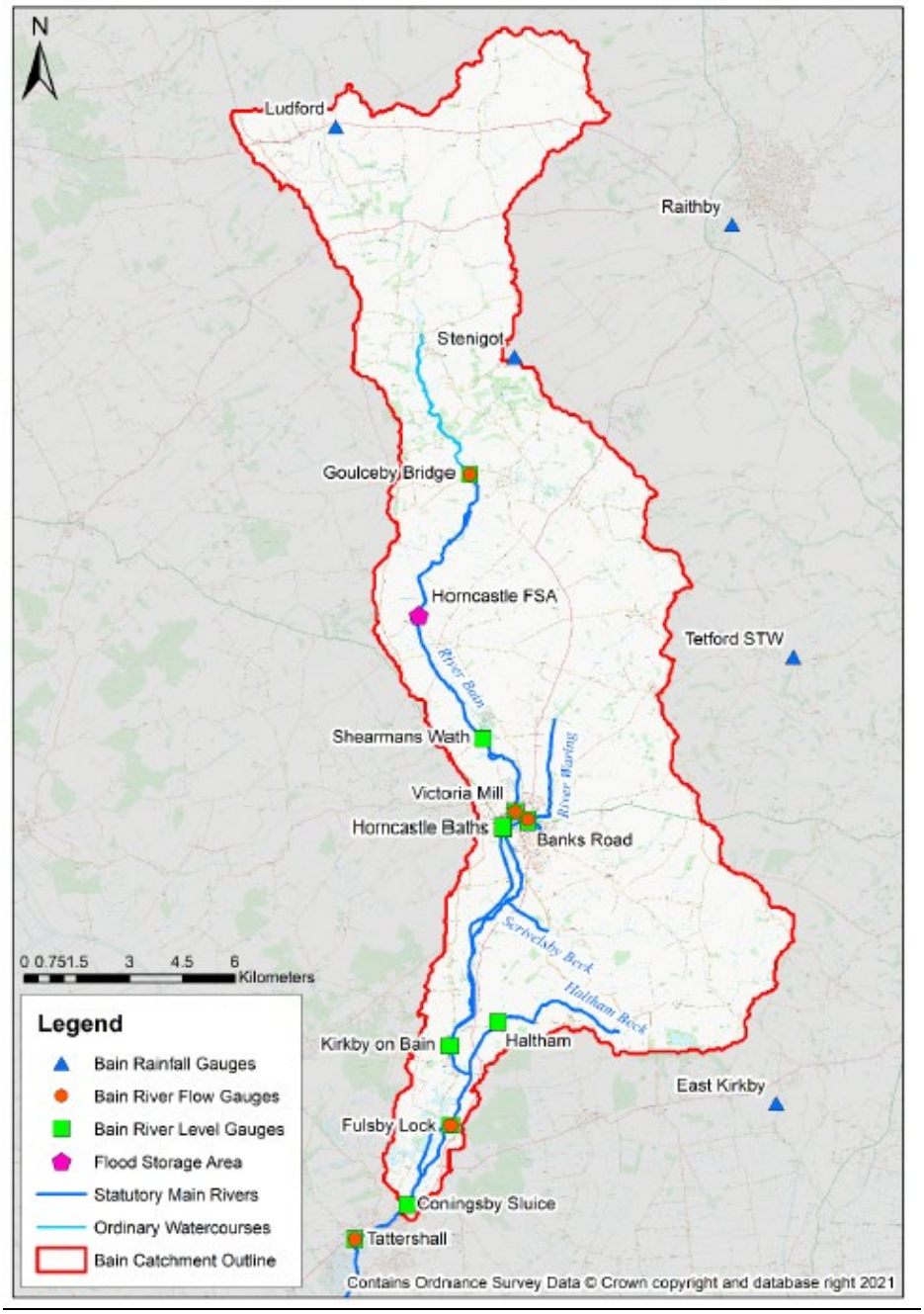


Figure showing location of hydrometric gauges within the Bain catchment
Source: AECOM Model Report (Appendix 4, EA*4, 2024)

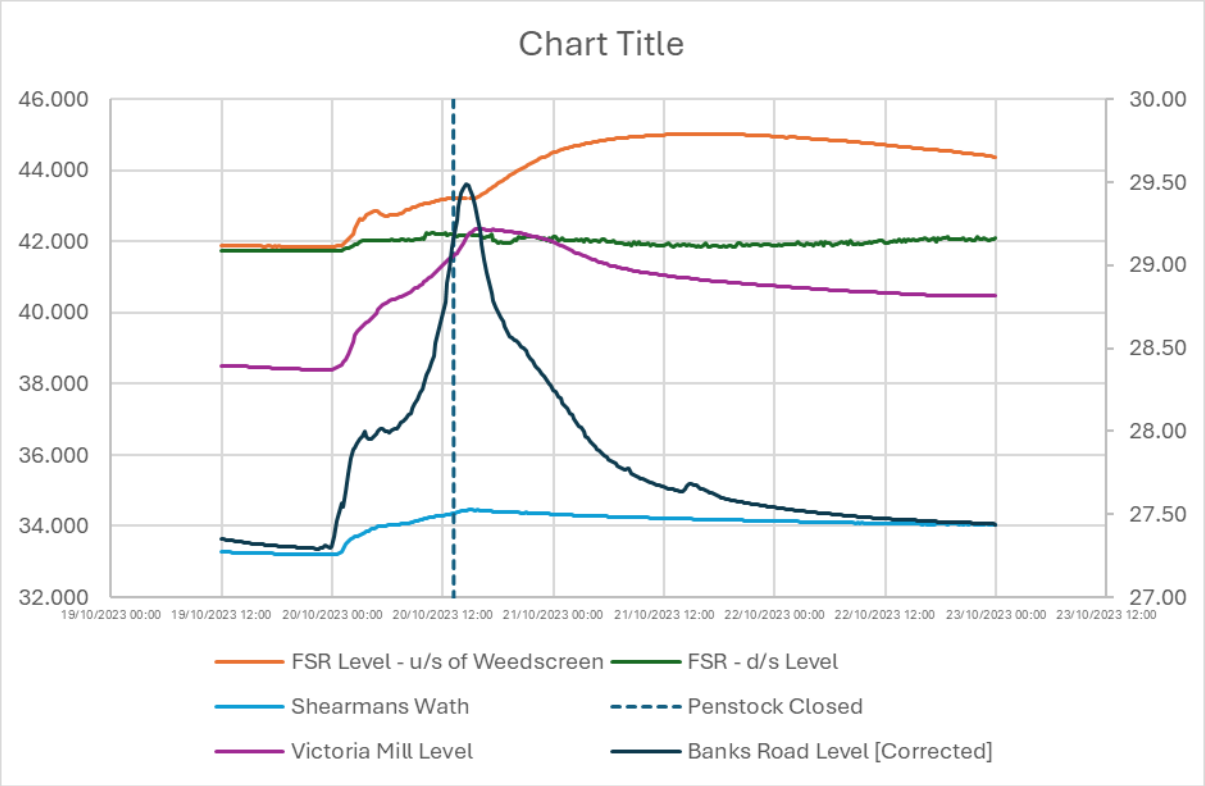


Figure taken from EA spreadsheet showing river levels from gauging stations

2.6 Recommendation 6

Verification of the Victoria Mill GS level and flow measurements for peak flows.

The EA provided the Hydrology Report for 2020 Model which contained information on Victoria Mill GS as follows. The Victoria Mill gauge is a standard flat-v weir located approximately 200m to the north of Horncastle town centre, adjacent to the Tesco superstore (NGR TF 2585 6985). The current structure was installed in 1998. The gauging station was surveyed for the EA in April 2020 in advance of the modelling study. The rating is fitted to 33 spot flows and extrapolated to high flows. The gauging datum is 28 mAOD. The hydrology report stated that the highest flow gaugings are only around 50% of QMED and hence the gauge should be used with caution for flood estimation purposes. However, previous modelling work by AECOM (Witham Flood Forecasting Phase 2, 2009) concluded that no bypassing or drowning of the structure would occur for flows up to around 20 m^3/s and the rating is likely to be relatively accurate within this limit.

The maximum recorded level during storm Babet from the data provided by the EA was approximately 29.2 mAOD. The previous maximum level recorded was 29.007 mAOD and bankful height is 29.64 mAOD. To undertake check gauging would require assessment when the river is in flood. The weir geometry was reviewed as part of the 2020 Model study. The gauge rating is classed as Good by the EA.

The EA have provided further information although not given a direct response to this recommendation. Based on the information provided, no further work is recommended at this stage.

2.7 Recommendation 7

Confirmation that Flooding at Victoria Mill GS does not commence when flows are below 14 m^3/s, as a result of the lower bank heights identified in the additional survey data or due to other downstream modifications to the river channel and control structures.

The EA have confirmed this, based on the modelling of Storm Babet (with no increase in flows downstream of the FSR). Subject to the Victoria Mill GS rating being correct, this seems reasonable.

2.8 Recommendation 8

Subject to the outcome of the recommendations set out above, the EA conclusion that the operation of HFSR was not related to flooding in the River Waring and Thunker Drain should be confirmed, potentially in combination with further investigation of the local influences on flooding in the Thunker Drain and River Waring.

The EA have confirmed this and no further work is recommended at this stage.

2.9 Recommendation 9

Present the return period analyses for rainfall and river flow, for the various catchments, including the sub catchments immediately upstream of HFSR. This will confirm the flooding in Horncastle can be classified as an exceedance incident rather than due to an operational failure.

The EA provide some information related to return periods for Storm Babet in relation to rainfall, river levels and flow. However, the supporting analysis is not provided for review.

Rainfall is in the order of 1 in 25 to 1 in 50 Annual Exceedance. Both River flow and stage at Victoria Mill are between a 1:100 and 1:200 Annual Exceedance. The EA refer to the Waring being a 1:1000 event, but the runoff from the Hemingby and West Ashton tributaries seems to have been even greater, even though the rainfall over these catchments seems not to have been much more than that over the Bain upstream of the FSR (see below, from Storm Babet October 2023. Horncastle Asset Operation Failure Impact Assessment).

It is recommended that the model outcome for the Babet storm is compared with the 2020 model results for the 1% storm, which *"generally reported a good fit to observed data as all sites on the River Bain between the FSR and Horncastle"* according to the Bain 2020 model report.

Although it may be the case that significant variance can occur between rainfall and river flow annual exceedance probability, it is the central puzzle of the Babet flood in Horncastle and it warrants further assessment in any future work on assessing the flood risk to Horncastle.

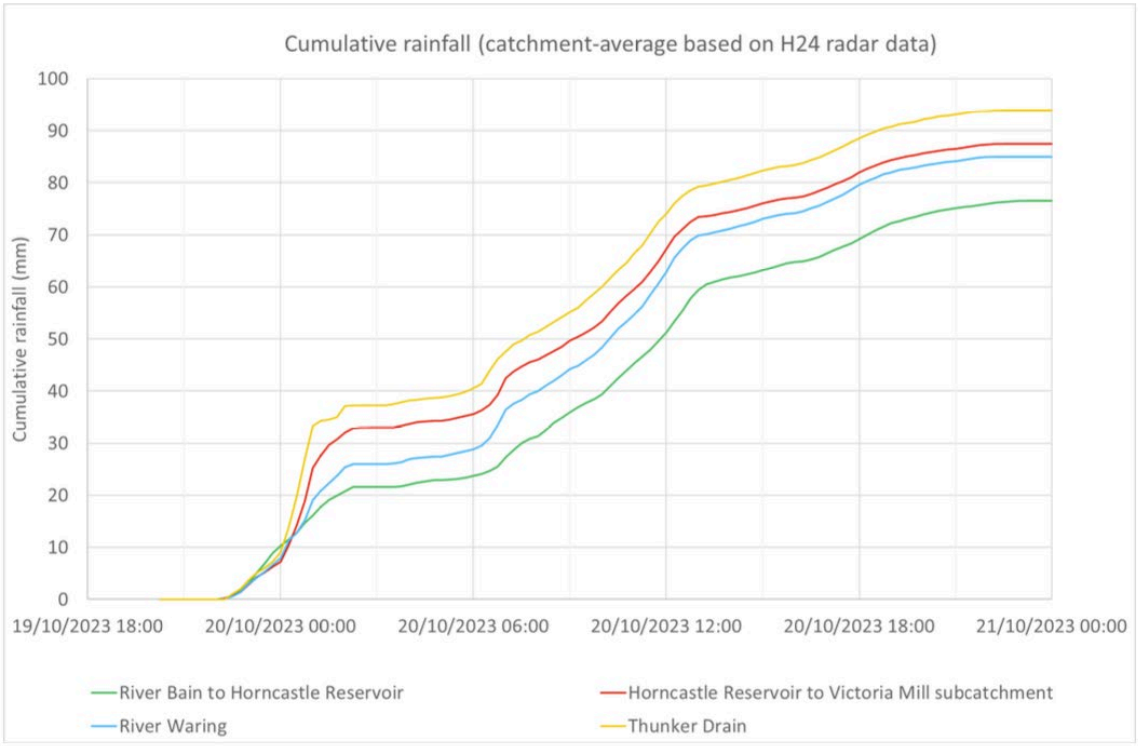


Figure showing cumulative rainfall totals for selected catchments

2.10 Recommendation 10

*Confirmation that the changes to the design and operation of the HFSR proposed in the Chief Engineers Report (EA*3, 2024) have been implemented.*

The EA have provided a progress report on the recommendations from the Asset Failure Review, updated on 18th July 2024. At this time two of the ten items identified in the Chief Engineers report had been completed or substantially completed. It is assumed further progress has been made since this time and it is recommended that confirmation is provided that each of the numbered recommendations in the Chief Engineers report has been implemented.

3 Summary

Recommendation	Status
1	Given the potential impacts of climate change, further investigation of the causes and likelihood of a similar flood event occurring is recommended to support mitigation of the potential future flood impacts on Horncastle.
2	Verification of the two discharges from the HFSR reservoir (hydroflow and sluice gate) are fundamental to the assessment. The EA's response does not provide any confirmation for the sluice of the previous calibrations, check flow monitoring or check calculations based on the control structure geometry. The EA continue to rely on the model outcomes for the sluice and it is recommended that further data is provided to confirm the accuracy of these predictions.
3	The EA consider that the HFSR worked, but Horncastle still suffered serious flooding. The exact reasons why remain uncertain. Some further work, including installation of flow gauges, on the downstream catchments would be justified in order to confirm if the cause of the Horncastle floods results from the downstream catchments. If so, perhaps another flood alleviation scheme should be considered.
4	No further information is required.
5	No further information is required.
6	No further information is required.
7	No further information is required.
8	No further information is required.
9	A moderate 24-hour rainfall event (1 in 25 to 1 in 50 year return period) has caused significant flooding in Horncastle, apparently as a result of conjectured unusually high run-off from the ungauged Hemingby and West Ashton catchment areas. The EA have provided information related to return periods for Babet in relation to rainfall, river levels and flow. However, the supporting analyses is not available. Further information would be required to undertake a review.
10	Further information is required to confirm that each of the numbered recommendations in the Chief Engineers report has been implemented since the last progress update provided by the EA from 18th July 2024.

4 Appendix 1

LCC Review of EA Horncastle Investigation - GeoSmart Recommendations

EA Response – v2 December 2024

No.	Recommendation	Response
1	Provision of a risk analysis and uncertainty assessment of the modelling results and discussion of how these affect the outcome of the impact assessment.	Sensitivity analysis has previously been carried out on the original 2020 Bain Catchment Model to assess sensitivity to flow, Manning's n and downstream boundary conditions. This analysis was undertaken for the 1% AEP design event and is reported on in Section 6 of the Model User Report produced for the Bain Catchment Model 2020 project. This work showed the results, in terms of flood levels / extents in Horncastle, were not significantly sensitive to Mannings n or downstream boundary conditions. Not surprisingly flooding in the town is sensitive to an increase in flow. When compared to the modelled climate change scenarios the observed flood extent was somewhere between the +20% and +32% increase to model inflow scenarios. Beyond this we would point to the calibration of the original 2020 Bain Catchment Model, as set out in Section 4 of the Model User Report, which generally reported a good fit to observed data as all sites on the River Bain between the FSR and Horncastle. No further work on this is proposed by the Environment Agency.
2	Verification of the modelled discharge from the HFSR, including comparison with modelled run-off, previous calibrations, flow monitoring and check calculations based on the control structure geometry.	The stage-flow rating curve for the hydroslide is well known, having been provided by the manufacturer, and is included in the model. The flow from the side sluice gate is not measured but standard hydraulic theory is applied within the model to calculate flow through the opening based on the observed upstream level. The model results do indicate that the sluice operates in drowned mode, which means that the flow is affected by the level in the downstream channel. Calibration plots for previous events are included in the 2020 Bain Model User report. For information, we have also just installed a flow gauge immediately downstream of the hydroslide outlet. No further work on this is proposed by the Environment Agency.
3	Review alternative model options that do not result in such a large increase in flow downstream of the HFSR in the adjusted model compared to the original calibrated model. Indicate the outcome for the impact assessment of the alternative results.	This has been interpreted as a recommendation to consider whether the observed flooding in Horncastle could be reproduced with a lower flow from the intervening catchment downstream of the FSR if different assumptions were made in the hydraulic model, and whether this would change the conclusion that the delayed closing of the sluice did not significantly affect the flooding in Horncastle. We would agree that the flow from the intervening catchments between the FSR and Horncastle is towards the upper bound of probable runoff contribution. However, as has been demonstrated, anything lower than this with the current representation of the FSR outflows and downstream hydraulic model parameterisation does not replicate the observed flooding in the town.

		We have considered what alternative model setup would allow for flow from the intervening catchments not to be adjusted and yet still reflect the observed flows, levels and flood extent in Horncastle. As stated above, standard hydraulic theory is applied within the model to calculate flow through the sluice gate. The key variables in this are upstream water level, orifice size and downstream water level. As the upstream water level is measured and the orifice size is known the only parameter which could be altered is the downstream water level. The model results did indicate that the sluice operated in drowned mode which means that the flow is affected by the level in the downstream channel, though downstream levels had only risen by circa 0.4m. We have considered whether it may be appropriate to change to Mannings n values, specifically reducing them in the channel immediately downstream of the FSR, to see if this increases flow through the sluice. However considering the sensitivity testing carried out on the original 2020 Bain model demonstrated the river was not sensitive to a 20% reduction in Mannings n and taking into account the annual weed cut in the channel had taken place in September, we do not feel further reduction in Mannings n is justified. The sensitivity testing indicated a reduction in flood level immediately downstream of the sluice gate by around 0.2m. This is not considered sufficient to make a large difference to the outflow. After consideration we do not believe additional modelling is required or justified and no other work on this is proposed by the Environment Agency.
4	Undertake a sensitivity analysis on the impact assessment findings including the following parameters: change in bank heights, travel times and attenuation of peak flow from the HFSR sluice.	We do not feel this is necessary. Simulating the event in the model takes account of the travel time and attenuation in the system. The change in bank heights referred to in the model report affect the spill over the right bank some 350m upstream of Victoria Mill. This only comes into play for events greater than the 1:100 AEP [see response to recommendation 7 below]. It is worth remembering the model is not a full calibration and is for comparison between scenarios, so it is the relative difference not absolute figures. No further work on this is proposed by the Environment Agency.
5	Further supporting information on modelled versus actual observed flows and levels.	In September 2024 we provided GeoSmart with a spreadsheet containing observed levels and flows, plus levels and flow outputs from model runs. This was the 'working out' spreadsheet used in our analysis. No further work on this is proposed by the Environment Agency.
6	Verification of the Victoria Mill GS level and flow measurements for peak flows.	In September 2024 we provided GeoSmart with the Hydrology Report for 2020 Model which contains ratings review for flow gauging sites. No further work on this is proposed by the Environment Agency.

7	Confirmation that Flooding at Victoria Mill GS does not commence when flows are below 14 m3/s, as a result of the lower bank heights identified in the additional survey data or due to other downstream modifications to the river channel and control structures.	The Bain Catchment Model 2020 used for simulation of the Storm Babet event was as per the calibrated model, but with additional bank level data inserted upstream of Victoria Mill to better represent overtopping into North Ings Drain. In the version of the Storm Babet simulation where inflow from the catchment downstream of the flood storage reservoir was not adjusted (i.e. inflow was not increased), a modelled flow of 14.3 cumecs passed the Victoria Mill gauging station. This did not cause overtopping at the location of the lowered bank upstream of Victoria Mill, and only minor out-of-bank flooding of Tesco car park immediately downstream of Victoria Mill (see Figure 3.5 of the AECOM report). This confirms that property flooding in Horncastle does not occur when flows at Victoria Mill are at or below 14 cumecs. No further work on this is proposed by the Environment Agency.
8	Subject to the outcome of the recommendations set out above, the EA conclusion that the operation of HFSR was not related to flooding in the River Waring and Thunker Drain should be confirmed, potentially in combination with further investigation of the local influences on flooding in the Thunker Drain and River Waring.	We are satisfied the flooding along Thunker Drain and the Waring is not connected to the reservoir issue. Flooding first began at around 0230hrs and was due to surface water / overland flow caused by the heavy rainfall. The main flooding along these watercourses was later in the day, though was still before Victoria Mill peaked and receded quickly, as they have done in previous events. Both the modelling done for Storm Babet and previous modelling have demonstrated the backwater effect from the confluence of the Waring and Bain does not exceed far up the Waring. No further work on this is proposed by the Environment Agency.
9	Present the return period analyses for rainfall and river flow, for the various catchments, including the sub catchment immediately upstream of HFSR. This will confirm the flooding in Horncastle can be classified as an exceedance incident rather than due to an operational failure.	We carried out initial rainfall analysis shortly after the incident and this is presented in Appendix 3 of the Horncastle Asset Operation Failure Impact Assessment Report published in February. This reported: "*the catchment average rainfall totals are considered to be in the order of 1 in 25 to 1 in 50 Annual Exceedance Probability (AEP). However, river flow return periods may be more extreme due to the impacts of wet antecedent conditions.*" Analysis of recorded flows / levels against design flows / levels from the 2020 Bain Model indicate: **Goulceby** [u/s of FSR] – peak flow of 10.88m^3/s, noting this was recorded around 8pm, several hours after the sluice gate was closed and after flooding had occurred. This equates to between a 1:30 and 1:50 AEP. **Shearmans Wath** [first available gauge d/s of FSR] – peak level of 34.46mAOD. This equates to between 1:200 [34.34mAOD] and 1:1000 [34.53mAOD] AEP.

		Victoria Mill – peak level of 29.22mAOD. This equates to between a 1:100 [29.14mAOD] and 1:200 [29.47mAOD] AEP. The peak flow at Victoria Mill flow was rated at Flow = 17.36 m^3/s This equates to between a 1:100 [13.15m^3/s] and 1:200 [20.58m^3/s] AEP. It can be seen the AEP of the recorded peak levels significantly increased downstream of the FSR. Given the flow from the FSR has been calculated using standard hydraulic calculations within the model and the flow recorded at Goulceby was a lower AEP, then logically the intervening catchments must be the source of the additional flow causing the high flows entering Horncastle. This correlates geographically with where we know the most intense rainfall fell. As with the catchments downstream of the FSR the heavy rainfall also impacted the River Waring and Thunker Drain. At Banks Road gauge the Waring recorded a peak level of 29.49mAOD. This equates to between a 1:200 [28.95mAOD] and 1:1000 [29.65mAOD] AEP. The peak flow at Banks Road was rated at = 13.43m^3/s which equates to approximately a 1:200 [13.48m^3/s] AEP. There is no gauge on the Thunker Drain, though the modelled peak flow was 4m^3/s which, compared to the original design model, is in excess of a 1:1000 AEP. Whilst we acknowledge the less than ideal performance of our model for Thunker Drain in replicating the observed flooding, it is clear from photographic and video evidence the observed flows were excessive. We acknowledge there are uncertainties with gauging station rating curves at higher flows, though peak levels are considered to be recorded accurately. No further work on this is proposed by the Environment Agency.
10	Confirmation that the changes to the design and operation of the HFSR proposed in the Chief Engineers Report (EA*3, 2024) have been implemented.	Specific actions to reduce the risk of the same issue occurring again are substantially complete. All other actions are ongoing.

5 Terms and conditions, CDM regulations and date limitations

5.1 Disclaimer

This report has been prepared by GeoSmart in its professional capacity as soil, groundwater, flood risk and drainage specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client and is provided by GeoSmart for the use of its client according to the terms and conditions agreed with LCC reference, GS-LincsCCTerms Conditions 13-05-2024 .

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to GeoSmart at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, GeoSmart may, by prior written agreement, agree to such release, provided that it is acknowledged that GeoSmart accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. GeoSmart accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against GeoSmart except as expressly agreed with GeoSmart in writing.

5.2 Further information

Information on confidence levels and ways to improve this report can be provided for any location on written request to info@geosmart.co.uk or via our website. Please contact us if you would like to join our User Group and help with feedback on infiltration SuDS and flood mapping suggestions.

CDM regulations can be found on our website:

http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/

Data use and limitations can be found on our website: