ResilienTogether | INNOVATION

Case study #12

January 2025

ResilienTogether is a Defra-funded project that aims to build a Smart Catchment to enhance flood resilience.
Our Innovation Case Studies showcase new and creative approaches to building a smarter, more resilient catchment.

Flood Forecasting

Use of council owned river sensing data for probability based flood forecasting during flood events in Autumn 2024.

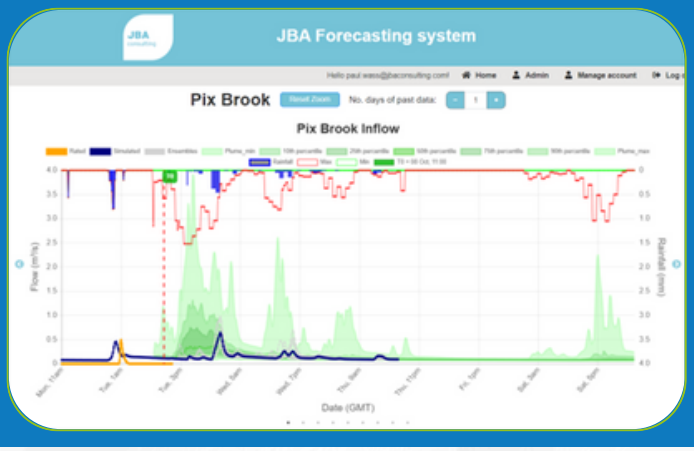

Figure 1. Probability based forecasts and rainfall, as presented in the JBA Forecasting System

ResilienTogether

ResilienTogether is creating a Smart Catchment, through use of innovative technologies and techniques, to reduce flood risk to people and places, enhance the water environment in the Pix Brook catchment and improve community resilience in the face of climate change.

The project is achieving this through a close-knit partnership that collaborate to deliver six inter-related work packages. This case study relates to the Flow Telemetry and Live Modelling Platform Work Packages and outlines the innovative role of council-led forecasting during a flood event in Autumn 2024.

Challenge

On the 22nd September 2024, Bedfordshire experienced a significant flood event. Shortly after this event, on the 27th September and the 1st October 2024, more heavy downpours further increased water levels across the Pix Brook River Catchment. Numerous properties were flooded, and roads and schools were forced to close.

Innovative Solution

The JBA Forecasting System (Figure 1) is licensed to ResilienTogether to provide forecasting for the Pix Brook Catchment. It runs a rainfall-runoff catchment model of the Pix Brook using multiple rainfall forecasts to create a probability based projection of river levels. There was therefore an opportunity to assess the previous flooding event using the forecasting system. This data was then also compared to gauge data within the catchment, which provides real-time flood monitoring, assisting with forecasting/flood response within the catchment.

Each forecasting event simulation uses observed rainfall data. There are two categories of forecast:
Deterministic where outcomes are precisely determined by initial conditions, with no randomness
Probabilistic where outcomes involve elements of chance or randomness.

Deterministic

- A radar-based forecast that accurately forecasts up to six hours into the future.
- Predicts a single, specific river level that does not convey any uncertainties in forecast calculations.

Probabilistic

- Thirty-six five-day forecasts (known as an ensemble forecast) are simulated for each river level gauge.
- Each forecast has slightly different starting conditions, creating a range of possible future weather scenarios. This accounts for the uncertainty in the rainfall forecast.
- The forecasting system then conveys the chance of a given river level occurring as a percentage.
- For example, if half the forecast scenarios show a river flow of 1.5m3/s, that river response is estimated to have a 50% chance of occurring.

Benefits

1. Prediction

Flood events can be reasonably well forecasted 24 hours in advance.

2. Awareness

Patterns can be identified to locate where flooding is usually considered most significant to help awareness and preparation.

3. Assessment

The underlying JBA Forecasting System retains forecasts from the last seven days to allow post-event analysis.

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Learning from the Event

This section explores how accurately the 1st October 2024 flooding event was forecast compared to the observed flows and rainfall:

- 24 hours before the flood event, the JBA Forecasting System ensemble forecast identified a rainfall event with likely high impacts on the brook at Standalone Farm. The forecast comprised of three peaks at approximately 1am, 6am and midday (Figure 2).
- Within 12 hours - forecasts began to concentrate together to predict a slightly larger flooding event at approximately midday.
- Within five hours - deterministic radar-based forecast could be used. This predicted the peak discharge to be within a two-hour period between 2pm and 4pm, whilst the ensemble forecast predicted a four-hour period between 2pm and 6pm.
- Within two hours - the deterministic forecast predicted a spike at approximately 4pm. This prediction coincided with the actual event.
- The forecast accurately determined flooding would occur two hours in advance and gave notice of the probability of flooding at the location 24 hours in advance.
- After the event - the system analysed the observed rainfall and calculated observed flow. Figure 3 shows that the forecast predicted the peak flow time reasonably accurately but under-predicted the extent of the spike in flow. This suggests that the rainfall event was very localised and could not be fully represented by the rainfall radar. This resulted in higher peak flows than forecast.

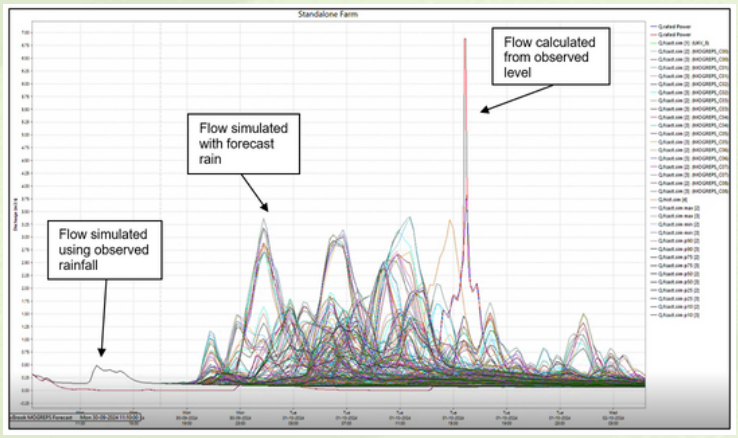

Figure 2. 24-hour ensemble forecast for high flows on 30th September 2024 .

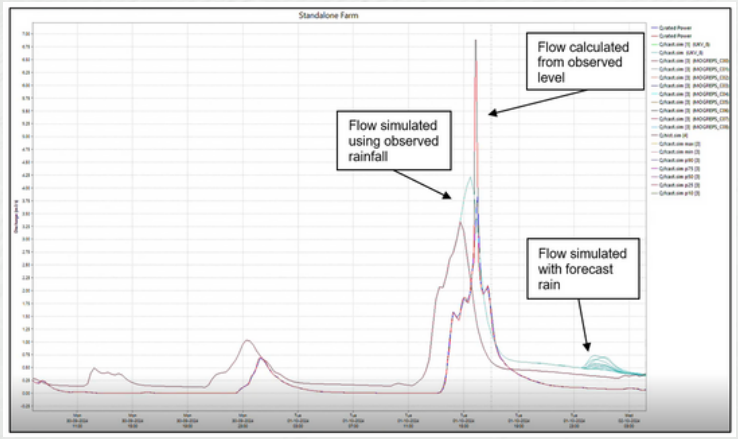

Figure 3. Observed flow vs forecast flow for 1st October 2024 flood event.

Event Conclusions

- The forecasting system predicted that discharge rates would be significantly higher than normal 24 hours ahead.
- Forecast accuracy improved closer to the event (especially the deterministic which is refreshed more often), with the peak flow accurately predicted two hours prior to the event.
- The maximum flow peak were under-predicted but overall the forecast flow agreed reasonably well with the observed flow. Similarly, the forecast rain matched the observed rain at Letchworth but under-predicted the observed peak.
- The event highlights the challenges of forecasting for small, rapid responding catchments. To be successful, rainfall must be predicted at the right intensity in exactly the right location. These conditions are often only realised using the radar-based forecast at short notice.

Matthew Cowdell

Principal Flood Forecasting Analyst - JBA Consulting

"The Pix Brook forecasting system allows crucial early warning and risk mitigation in this fast-responding catchment. It supports communities and stakeholders to take informed decisions using the latest in forecasting technology."

Use Our Learning

We encourage and offer our learning to be adapted and used by Lead Local Flood Authorities (LLFAs) across the country who are seeking to better understand flood forecasting and its uses in providing awareness for flooding events.

If you want to hear more, please contact ResilienTogether.project@Centralbedfordshire.gov.uk or visit our website https://resilientogether.org.uk/