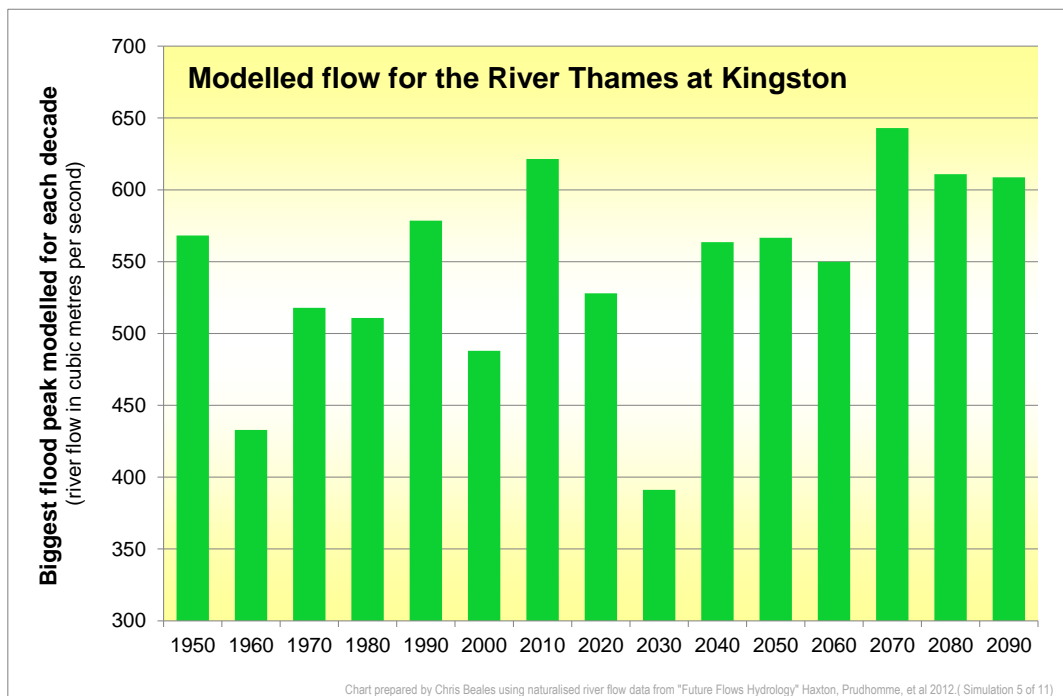


Flooding and climate change

This supporting document is to accompany the **Thames Valley flooding and climate change**, video, which you can find here: <https://youtu.be/WuLZaBPSwRc>



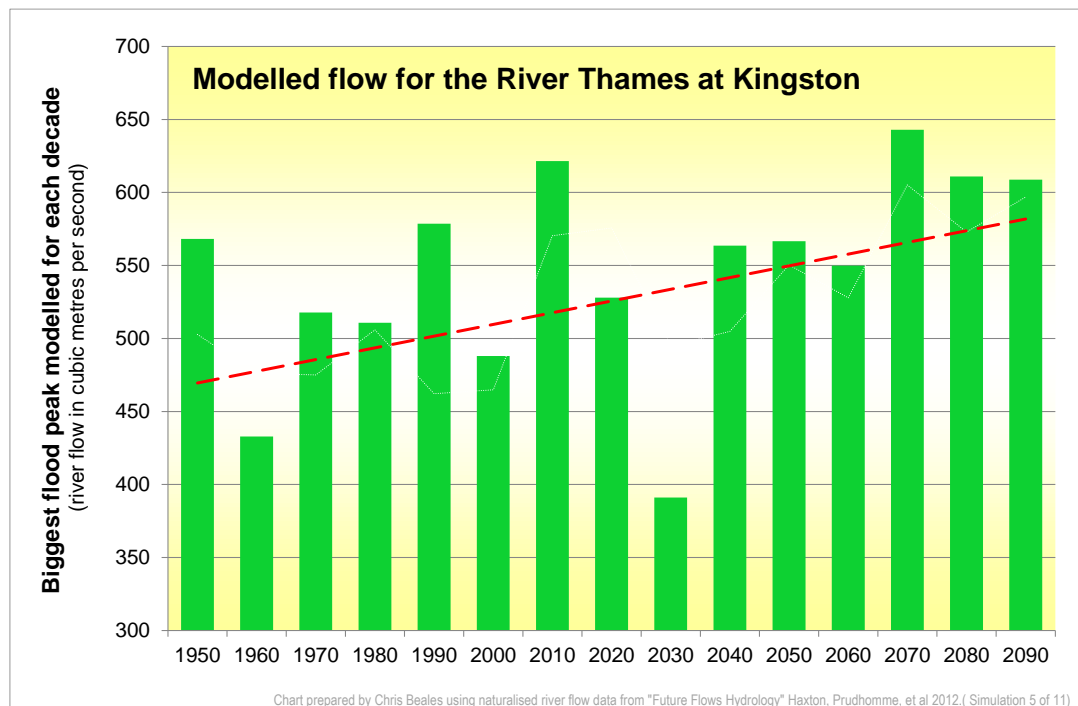
The video uses animation to help us picture what the following bar chart of **biggest flood peak modelled for each decade**, might look like on a map and for a cross-section of the river. Hopefully it goes some way to explain what climate scientists and flood hydrologists have taken years to understand.



Watching the video animation you see

- the natural variability in flooding
- that the model projections are showing bigger floods towards the end of the 21st century

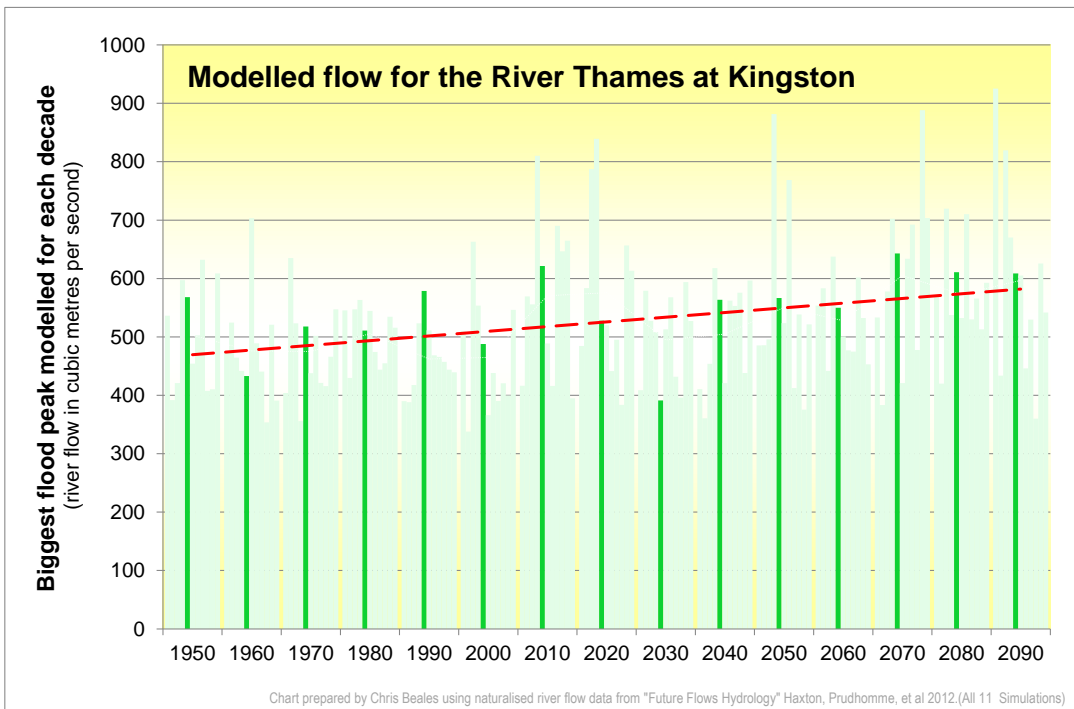
In the following chart, a simple trend line has been added. This helps to show the impact of climate change on the flood peaks.



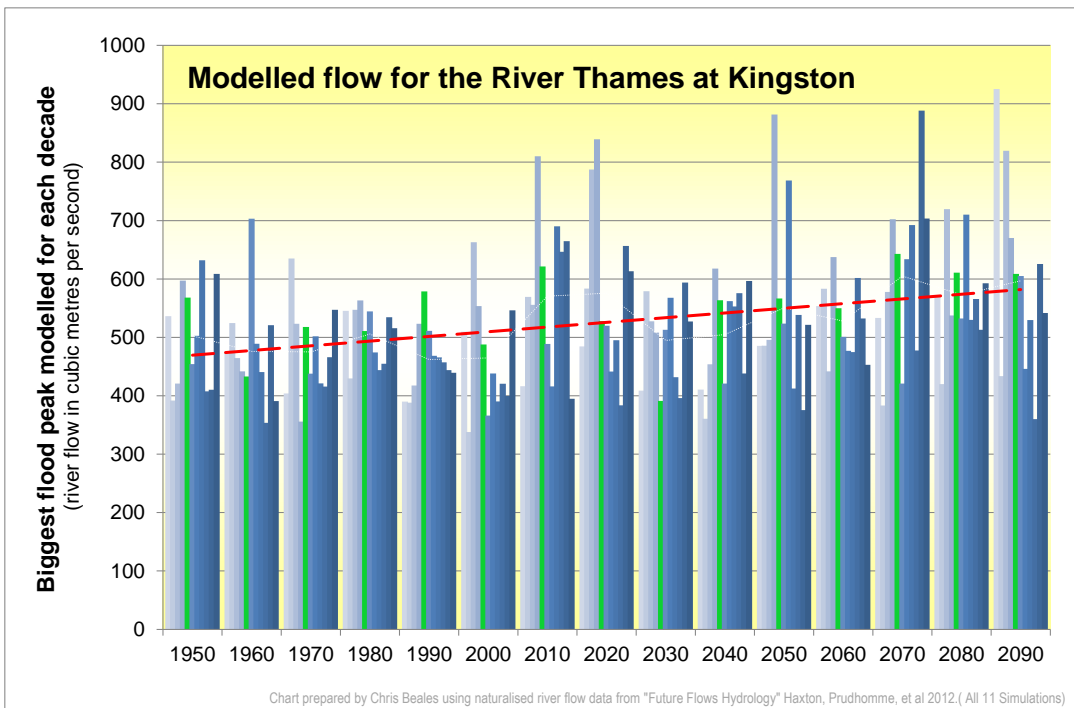
In the video it was noted that the chart is based on one of 11 model simulations. These were created using data from the Future Flows and Groundwater Levels project (Haxton, Prudhomme, et al 2012)ⁱ. Each simulation is based on the same climate change scenario but, in effect, the model dice are rerolled each time. Looking at all 11 model simulations together we can then get a better sense of the range of extreme floods that we can expect in the future.

- The following 2 charts show how our chosen simulation (code named 'afixi') compares to the other 10.
- Notice that the y-axis is extended to capture the wider range of results from the full set of simulations.
- Our video simulation is quite conservative compared to others but it was chosen because it fits the general climate trend best of the set.
- Any of these simulations are realistic given the climate scenario and it is notable that there is the risk of some extremely big flood peaks, particularly as the influence of climate change takes effect.





Simulation afixi highlighted against the full set of Future Flows data



Full set of Future Flows data showing the range of decadal flood peaks for all 11 model simulations



About the climate models

The Future Flows project used projections of rainfall, temperature, and other weather parameters, from the UK Climate Projections 2009 (UKCP09)ⁱⁱ. It is important to note that one of the biggest uncertainties in climate change modelling is the impacts of our behaviour as the human race. Whilst most people are aware that burning coal, oil and gas is heating the atmosphere, we still do not have robust international agreements to cut our emissions as rapidly as is needed. For this reason, climate scientists use different 'emission scenarios' in their climate models. The Future Flows modelling was based on a medium emission scenario (code named 'A1B')ⁱⁱⁱ, which represents a world where global mean temperatures are over 3 degrees Celsius warmer than the pre industrial climate.

- If we can meet the goals framed in the international Paris climate change agreement (1.5 to 2 degrees Celsius limit), there will be a smaller change in our climate, and less increase in risk of flooding in the Thames Valley. However, there would still be an increase, and the natural variability does include the risk of some very big floods, which is something we know from our historic records (e.g. 1947 and 1894 floods).
- We could end up in a worse "High emissions" future than the one that was used in the Future Flows modelling. In this scenario, the climate will warm even further by the end of the century. Model projections for the UK show that an increase in warming is likely to increase winter rainfall, and hence we expect further increases in flood peaks.

More recent climate modelling

In 2018 an updated set of UK Climate Projections (UKCP18)^{iv} was released. These use more advanced modelling to give us an even better understanding of the likely impacts of climate change. It is worth looking at the BBC visualisation tool: <https://www.bbc.co.uk/news/resources/idt-d6338d9f-8789-4bc2-b6d7-3691c0e7d138>

There is work ongoing to create an updated set of Future Flows data. This should be coming soon but was not available at the time of production for this Thames Valley Flood Scheme climate change and flooding video. The new climate projections do not change the overall picture for the UK, and the headline messages note that the results are 'broadly consistent with UKCP09'. This supporting document and the accompanying video is an illustration to help people understand why we are concerned about the increasing flood risk. Finally, it is important to note that the work on the Thames Valley Flood Scheme itself will use the latest UKCP18 science.

Frequently Asked Questions

1. Are the past flows modelled or are they real?

I mention this in the video but it is important make it clear that all of the data in the charts are from models. The UKCP09 project created 11 simulations of daily rainfall, temperature and other weather parameters, which the hydrologists fed into a river flow model, to create the 'Future Flows' data for the River Thames at Kingston. The modelled data for 1950 to 2010 were important to calibrate the results, and make sure that the models outputs were matching the frequencies of high, medium and low flows that we see in the real, measured flows at Kingston.

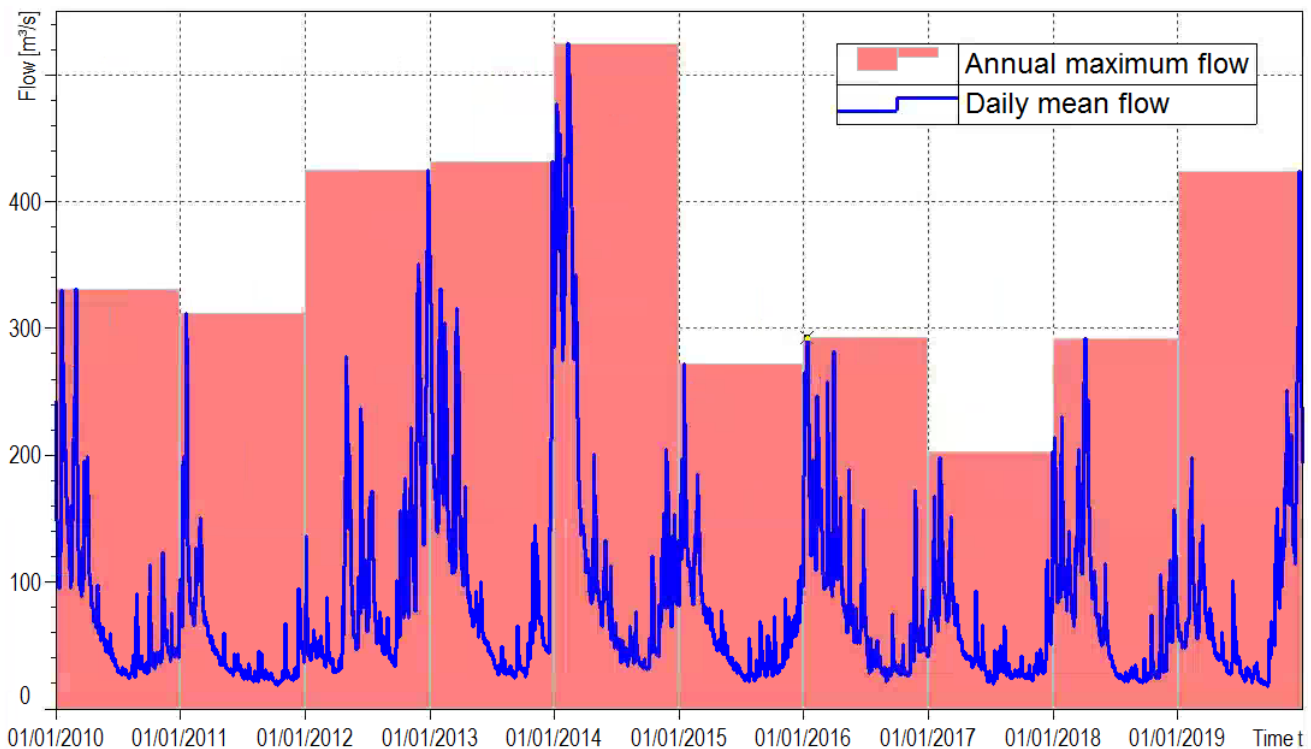


Is there a drought in the model for the 2030s?

Looking at the first chart in this document (and the one we used in the video) you would be forgiven for thinking that the 2030s was showing a low flow event or drought. It is important to remember that each green bar is actually the ten-year **maximum** flow: in this case 390 cubic metres of water per second (cumecs). This is still a high flow, certainly compared to the full range of flows that we get in a typical year in the River Thames at Kingston.

The following chart shows some real river flow data for our flow gauge at Kingston.

- Note the blue line is daily average flow, which ranges from approximately 20 cumecs (in a dry summer) to 525 cumecs in our biggest flood of the decade (winter of 2013/14).
- The pink bars show the maximum flow for each year.
- To compare against our model data (in the charts above), this whole decade would be shown as just the 525 cumecs maximum.



Real (measured) river flow data for the River Thames at Kingston (from 2010 to 2019)

Chris Beales

25 May 2021

i "Future Flows and Groundwater Levels" project (Haxton, Prudhomme, et al 2012)
<https://www.ceh.ac.uk/our-science/projects/future-flows-and-groundwater-levels>



ii See <https://webarchive.nationalarchives.gov.uk/20181204111018/http://ukclimateprojections-ukcp09.metoffice.gov.uk/>

iii See https://static.chrisbeales.net/environment/consequences_emission%20scenarios.html

iv See <https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index>

