Appendix G - Modelling Technical Notes

JBA Project Code	2022s1632
Contract	Newham SFRA
Client	London Borough of Newham Council
Day, Date and Time	26 October 2023
Author	Georgie Troy & Freya Nation BSc
Reviewer / Sign-off	David Kearney BSc MSc MCIWEM C.WEM
Subject	Updated Modelling

1 Introduction

1.1 Updating the SFRA Modelling

The London Borough of Newham (LBN) Level 1 SFRA provides a comprehensive and robust evidence base on flood risk issues to support the review and update of the LBN Local Plan and associated Planning Policy documents, using the best available information. The Environment Agency's 'Flood Map for Planning' is used to represent the flood zones and levels of flood risk and incorporates updated modelled data where available.

The Planning Practice Guidance on Flood Risk and Coastal Change was updated on the 25 August 2022 which resulted in the need to update the SFRA. These updates include the requirement for:

- Updated climate change modelling for all sources of flood risk
- Definition of the functional floodplain (Flood Zone 3b) based around the 3.3% AEP event, rather than the 5% AEP event under previous guidance.

2 Lower Roding

The Lower Roding modelling was developed as part of the Shonks Mill Flood Storage Area (FSA) study under Lot 3 of the Water and Environmental Management (WEM) framework to deliver an Outline Business Case (OBC) in 2018. The hydraulic model consists of a 1D-2D linked ESTRY-TUFLOW model, run with TUFLOW build 2016-03-AD-iSP-w64.

The hydraulic modelling of the Lower Roding has been updated to simulate the Central, Higher Central and Upper End climate change allowances for the 3.3%, 1% and 0.5% AEP events as well as the Present Day 0.1% AEP event. These climate change allowances for the Roding, Beam and Ingrebourne Management Catchment are quoted in Table 2-1.

The Lower Roding flows along the eastern boundary of the LBN from Little Ilford in the north-east to Beckton in the south-east, where it flows into the River Thames, as shown in Figure 2-1.

Figure 2-2 shows the Lower Roding 1D-2D model extent.

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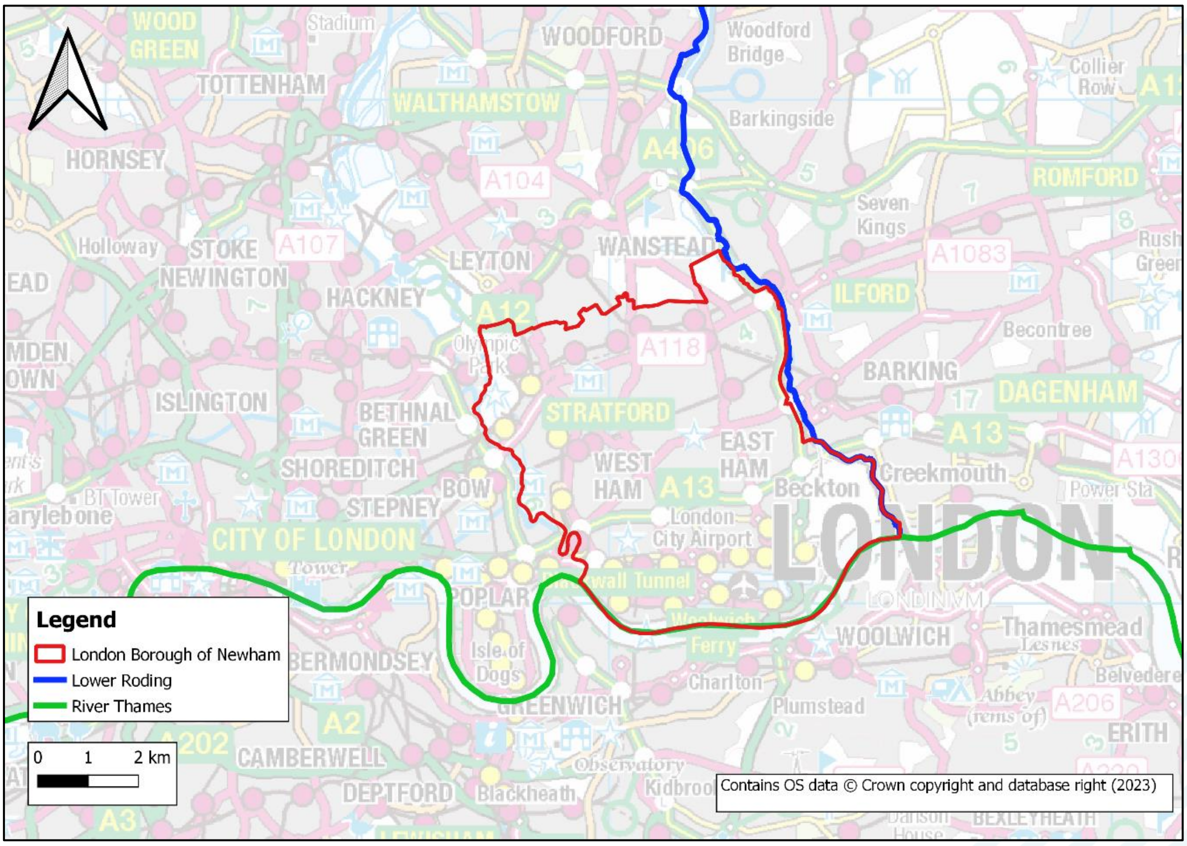

Figure 2-1: Lower Roding watercourse

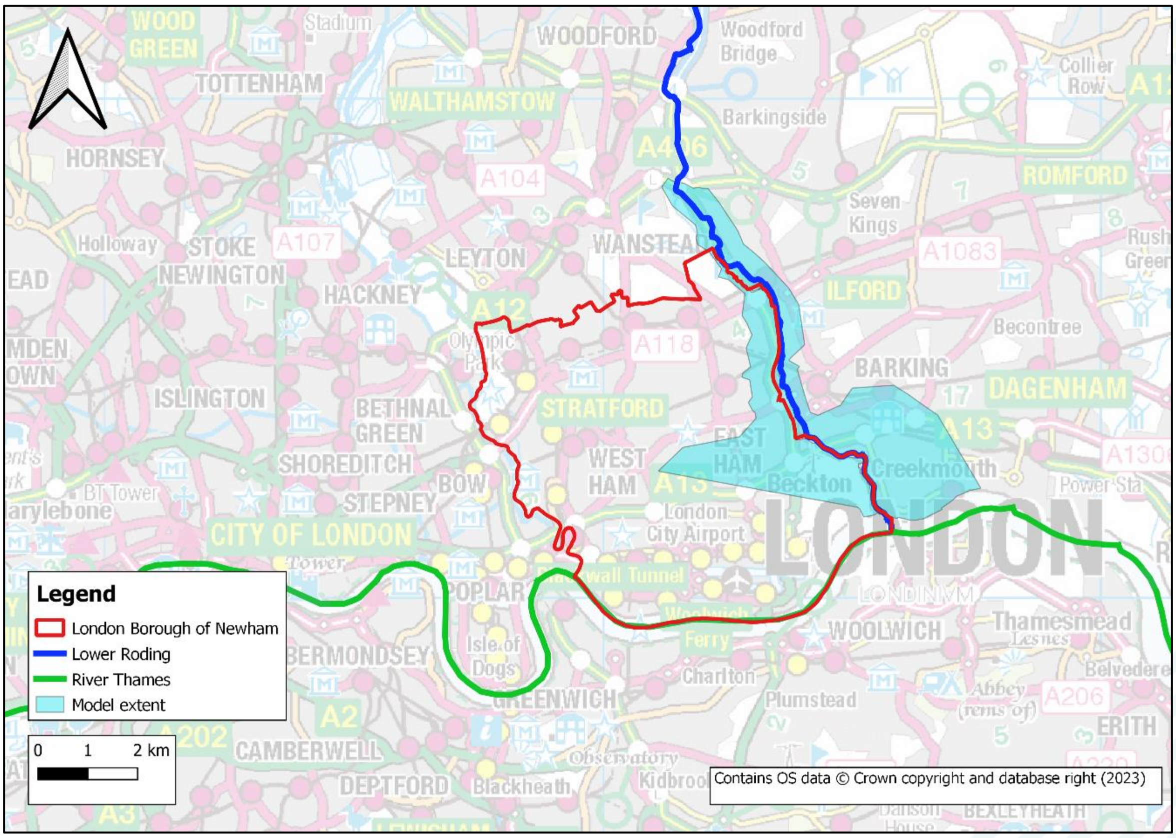

Figure 2-2: Extent of 1D-2D linked model

2.1 Method

2.1.1 Estimating the climate change flows

There have been no significant changes to the Environment Agency's Shonks Mill Lower Roding model. Flows for the specific climate change AEP events listed in the previous section were not available with the existing model files. A .csv file was created for each AEP event. The existing hydrological study contained flows for the present day 3.3%, 1% and 0.5% AEP events so these flows were multiplied by factors of 26%, 36% and 64% to represent the respective climate change allowances. These new flows were then entered into the aforementioned new csv files to be read into the bc_dbase.

2.1.2 Estimating the climate change downstream boundary

Due to the Lower Roding flowing into the tidally influenced River Thames, it was necessary to derive the downstream boundary from the Barking Barrier levels, rather than the Thames Barrier due to the former being downstream of the Lower Roding. The Barking Barrier is operated at 4.6m AOD. The downstream boundary for the 0.1% AEP event was calculated by identifying the cross section node on the network line that was closest to the Barking Barrier. This node's flows were then copied over from the 1D results to a new csv file in the bc_dbase. For the climate change downstream boundary, the previously mentioned flows for the node closest to the Barking Barrier were entered into a 'fit to peak' hydrograph .csv where these flows were uplifted by 4.6m AOD. These results were then entered into a .csv file in the bc_dbase. The climate change downstream boundary flows are the same for all climate change AEP events.

2.1.3 Rectifying the model

In order to complete the model simulations for the Lower Roding, several model files had to be updated. This involved creating new bc_dbase and .tcf files for the climate change events as well as the 0.1% AEP event. Once run, the model did not produce ASCII files which show the flood extent in GIS. To rectify this, a batch file was run to produce ASCII grids from the XMDF file which was generated for each AEP event following the model runs. Finally, the file paths stated in the .tcf and .tgc files for the Lower Roding model were corrected due to these being previously directed to a separate computer drive.

2.1.4 Applying the climate change guidance

In 2018, the government published new UK Climate Projections (UKCP18). The Environment Agency used these projections to update their climate change guidance for new developments with regards to updated fluvial and rainfall allowances which were released in July 2021.

Table 2-1 shows the updated peak river flow allowances that apply in the LBN for fluvial flood risk for the Roding, Beam and Ingrebourne Management Catchment (last updated in July 2021). These allowances supersede the previous allowances by River Basin District. The Lower Roding model was updated with the Central, Higher Central and Upper End estimates for the 2080s for the 3.3%, 1% and 0.5% AEP events.

Table 2-1: Peak river flow allowances for the Management Catchment in the LBN

Management Catchment	Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Roding, Beam and Ingrebourne	Upper End	31%	38%	64%
	Higher Central	20%	21%	36%
	Central	15%	14%	26%

The following events were simulated for this model:

- 3.3% AEP CC - Central, Higher Central and Upper End allowances
- 1.0% AEP CC - Central, Higher Central and Upper End allowances
- 0.5% AEP CC - Central, Higher Central and Upper End allowances
- 0.1% AEP

Modelling results were then mapped in GIS to obtain flood extents, depth, velocity and hazard grids, and are presented in the mapping accompanying the L2 SFRA report and as digital deliverables to the LBN Council.

3 River Lee

The River Lee 2D Modelling Study was commissioned by the Environment Agency and developed by Halcrow in 2014. The hydraulic modelling consists of 14 cascading 1D-2D linked Flood Modeller-TUFLOW models. Four main stem models cover the River Lee from Water Hall to the Thames. Another ten models cover selected tributaries. The M03 and M04 models cover the two most downstream reaches of the River Lee from the M25 to the Thames confluence. All 2D models were initially developed using TUFLOW build 2009-07-AF and sent for review. Subsequent changes to the M03 model were ran using TUFLOW build 2012-05-AE-iSP-w64. Changes made to the M04 model were ran using TUFLOW build 2013-12-AA-iSP-w64. Both models were ran using Flood Modeller (ISIS) version 6.6.2.91.

For this study it was not possible to run the complete sequence of 14 cascading models to simulate climate change on the entire River Lee as this is beyond the scope of the SFRA, the lowest reaches of the river were run (M03 and M04) which cover the area of LBN and areas upstream.

The M03 model was simulated with the updated London Management Catchment climate change allowances first. The results from the M03 model were used as inflows for the M04 model which covers the London Borough of Newham.

The hydraulic modelling of the Lee has been updated to simulate the following events:

- 3.3% AEP present day event
- 3.3% AEP + Central climate change allowance event
- 3.3% AEP + Higher Central climate change allowance event
- 1% AEP + Central climate change allowance event
- 1% AEP + Upper End climate change allowance event
- 0.5% AEP + Central climate change allowance event
- 0.5% AEP + Higher Central climate change allowance event

These climate change allowances for the London Management Catchment are quoted in Table 3-2.

Three events did not run. This was due to instability in the model caused by larger flows. There is an ongoing EA study updating the complete extent of the River Lee. This will produce flood extents on climate change scenarios by completing cascading events through the whole sequence of models, any development located in the River Lee modelled flood extents, should refer to this.

In order to represent the flood risk during these events throughout the SFRA, proxy events have been used. The proxy events are quoted in Table 3-1.

Table 3-1: Proxy events used in SFRA

Event which did not run	Proxy event used
3.3% AEP + Upper End (54%) climate change	1% AEP baseline

Event which did not run	Proxy event used
1% AEP + Higher Central (27%) climate change	0.5% AEP + Central (17%) climate change
0.5% AEP + Higher Central (54%) climate change	1% AEP + Upper End (54%) climate change. The model became unstable when running the 0.5% AEP + Upper End (54%) event. Developers may need to refer to this event to inform site planning. It is recommended that developers contact the Environment Agency in order to use the newly updated River Lee model outputs once they become available.

The Lee flows along the western boundary of the LBN from Queen Elizabeth Olympic Park in the north-west to the Docklands in the south-west, where it flows into the River Thames, as shown in Figure 3-1. Figure 3-2 shows the Lee 1D-2D model extent.

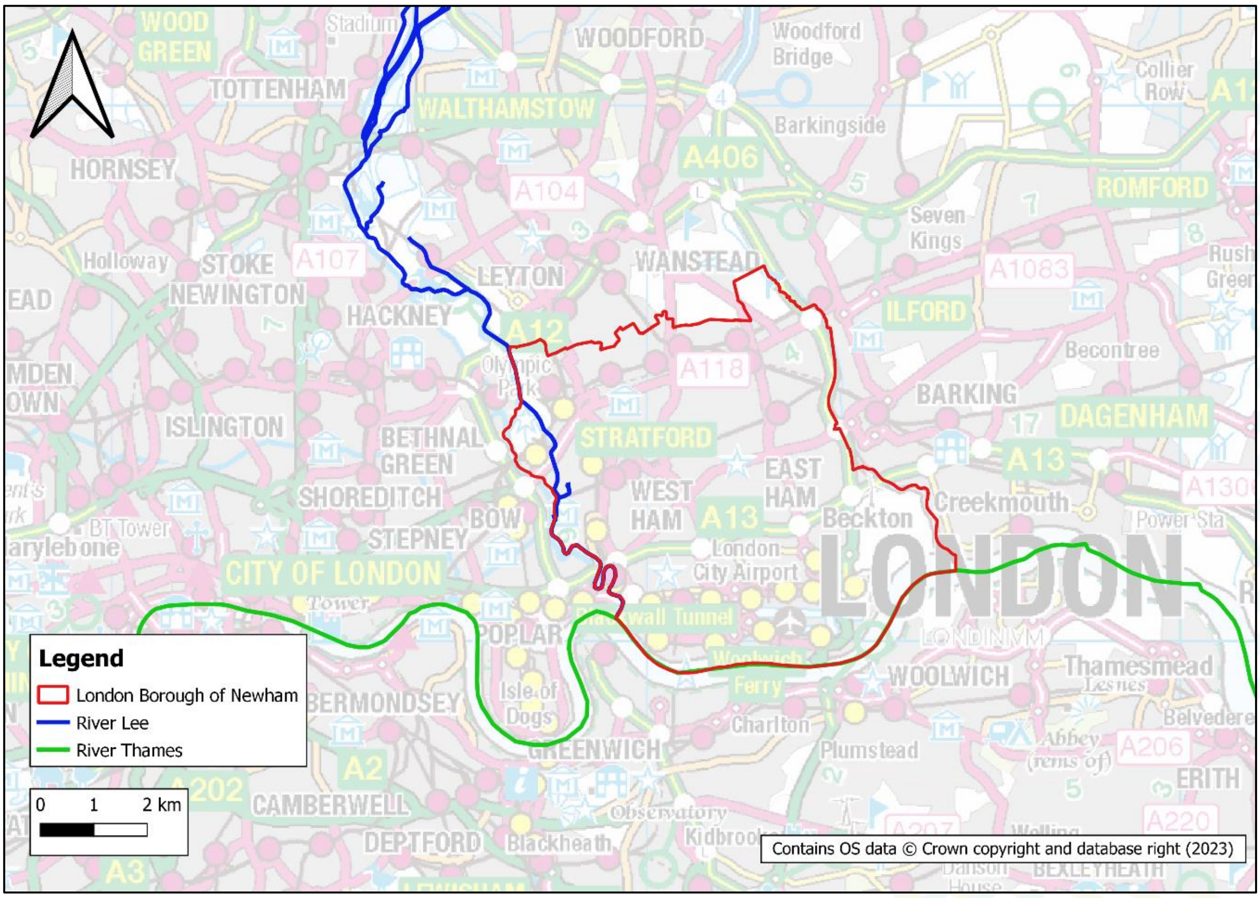

Figure 3-1: Lee watercourse

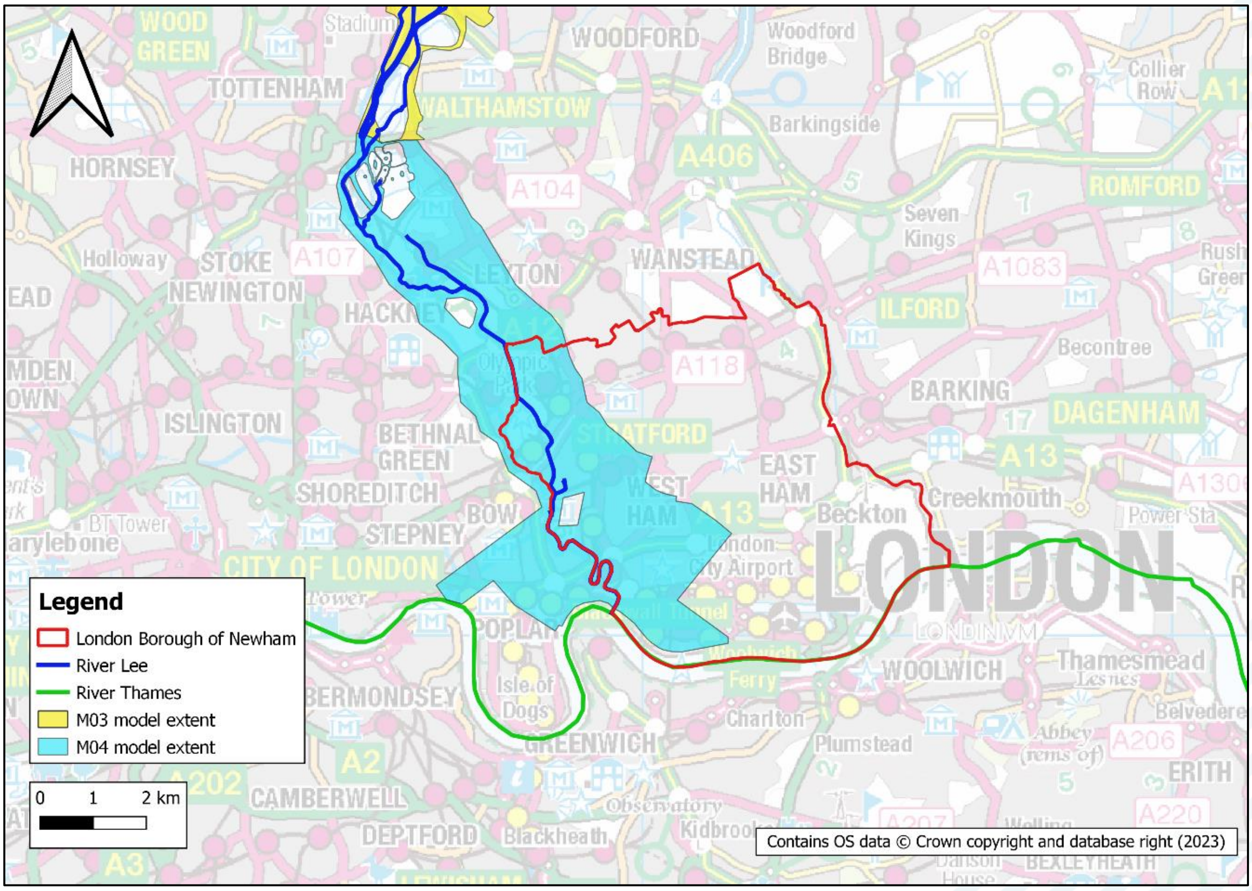

Figure 3-2: Extent of 1D-2D linked model

3.1 Method

3.1.1 Estimating the climate change flows

There have been no significant changes to the Environment Agency's River Lee model. Flows for the specific climate change AEP events listed in the previous section were not available with the existing model files. One new Flood Modeller event (ied) file was created for each new AEP event. These ied files contained QT hydrographs. The existing hydrological study contained flows for the present day 1% and 0.5% AEP events, so these flows were multiplied by factors of 17%, 27% and 54% using a stretch to new peak spreadsheet to represent the respective climate change allowances.

A 3.3% AEP event was also estimated by subtracting the peak flow during the 5% AEP event from the peak flow during the 2% AEP event and dividing it by three. This value was then added to the 5% AEP event peak to find the new peak for the 3.3% AEP event and therefore scale up the 5% AEP hydrograph to create the 3.3% AEP hydrograph and ied file.

These new flows were then used in new Flood Modeller simulation (ief) files.

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3.1.2 Estimating the climate change downstream boundary

The Lee flows into the tidally influenced River Thames. The Thames downstream boundary ied file within the M04 model has the peak water level set to the maximum level of water the Thames Barrier will allow (4.79m), so this downstream boundary has been used for all M04 events.

3.1.3 Rectifying the model

In order to complete the model simulations for the Lee, several model files had to be updated. This involved creating new Flood Modeller ied and ief files as well as TUFLOW tcf files for the climate change events as well as the 3.3% AEP event.

Originally the inflow hydrographs within the QT ied files for the M04 model were scaled up to represent the climate change allowances during each event. This approach produced results which were too conservative due to the high flows calculated and the lack of representation of the storage lakes upstream of the London Borough of Newham.

As a result, a different approach of updating the M04 model was taken. This involved running the upstream M03 model with the climate change allowances applied to its inflow ied files and taking the model outflows at specific nodes and using those QT hydrographs as the inflows for the M04 model.

The nodes where the M03 outflows were used as inflows for the M04 model are listed below:

- PY.004c
- WC08
- CC02D
- BBW4
- LL45D
- DG.048dD

Once run, the model did not produce ASCII files which show the flood extent in GIS. To rectify this, a batch file was run to produce ASCII grids from the XMDF file which was generated for each AEP event following the model runs. Finally, the file paths stated in the tcf and tgc files for the Lee model were corrected due to these being previously directed to a separate computer drive.

3.1.4 Applying the climate change guidance

In 2018, the government published new UK Climate Projections (UKCP18). The Environment Agency used these projections to update their climate change guidance for new developments with regards to updated fluvial and rainfall allowances which were released in July 2021.

Table 2-1 shows the updated peak river flow allowances that apply in the LBN for fluvial flood risk for the London Management Catchment (last updated in July 2021). These allowances supersede the previous allowances by River Basin District. The Lee model was updated with the Central, Higher Central and Upper End estimates for the 2080s for the 3.3%, 1% and 0.5% AEP events.

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Table 3-2: Peak river flow allowances for the Management Catchment in the LBN

Management Catchment	Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
London	Upper End	26%	30%	54%
	Higher Central	14%	14%	27%
	Central	10%	7%	17%

The following events were simulated for this model:

- 3.3% AEP present day
- 3.3% AEP CC - Central and Higher Central
- 1.0% AEP CC - Central and Upper End allowances
- 0.5% AEP CC - Central and Higher Central allowances

Table 3-1 shows the proxy events used for the three scenarios which did not run.

Modelling results were then mapped in GIS to obtain flood extents, depth, velocity and hazard grids, and are presented in the mapping accompanying the L2 SFRA report and as digital deliverables to the LBN Council.

It should be noted that both the River Lee and River Roding models are in the process of being updated by the EA, and developers should contact the EA to see if these are available when assessing flood risk for the site.