

# Appendix B

2023 Modelling review

## **B.1 Executive Summary**

This modelling review has been undertaken as part of the wider Strategic Flood Risk Assessment (SFRA) review. It sets out the need for flood risk modelling in relation to the requirements of the SFRA and looks at how changes since the last review may have impacted the outputs of that modelling. It particularly focuses on the previous surface water and sewer flooding model, originally undertaken in 2012. The review concludes that while changes have occurred, they would not significantly impact the model outputs and that these remain valid. Therefore no further or new modelling is required as part of the wider review.

## **B.2 Introduction**

The City of London Corporation has committed to reviewing its Strategic Flood Risk Assessment (SFRA) at least every five years. The current SFRA was completed in 2017 as a Level 2 SFRA and included new modelling of hazard and risk from a number of flooding sources. This SFRA has not been allowed to lapse and remains valid.

During that time, while there have been changes to the flooding and climate change policy framework, there have been limited changes that could be considered to have a significant impact to the hazard and likelihood of flooding in the Square Mile. This document sets out the rationale for the approach for the modelling review and justifies the decision to not refresh the existing modelling nor undertake further modelling at this stage.

It will first set out the expectations for SFRA modelling, discuss the existing models and then look at the changes that have occurred since that modelling was completed. It will then analyse the significance of these changes on the models before discussing further the consequences and impact of not producing further modelling at this time.

This paper will be part of the supporting documentation that will form part of the third-party review.

## **B.3 SFRA modelling requirement**

SFRAs are produced to fulfil and bring together objectives from a number of sources and have diverse intended user groups. These objectives and intended uses influence the specification of modelling that needs to be undertaken to provide the basis of the SFRA. There are two primary drivers for producing an SFRA: the National Planning Policy Framework (NPPF) and the Flood Risk Regulations 2009. In summary, these documents tend to specify required model outputs (mechanisms and mapping) rather than processes to attain the information required. The requirements set out by these are further refined by local policy, guidance, and the local context. These have the following consequences for the current SFRA review:

### **National Planning Policy Framework:**

The NPPF requires local planning authorities to produce SFRA and use them as evidence to inform local development plans and policies. It sets out the role of spatial flooding data in planning decision making, specifically looking at identifying sites at risk of flooding for use in the sequential and exception tests as well as for use in determining safe egress routes. To fulfil these requirements, it is necessary to have information of the risk and consequence of flooding for given areas. In the City of London, development will be proposed in areas of flood risk, as such a Level 2 SFRA is required. This needs to identify the impact of flooding at a site level.

### **Flood Risk Regulations 2009:**

The Flood Risk Regulations established Lead Local Flood Authorities (LLFAs) and created statutory duties on the LLFAs to produce risk and hazard mapping for their areas. Where areas of flood risk are identified, the LLFA is required to prepare a flood risk management plan. The Regulations set expectations for flooding probability and scope for flood hazard including extent, depth and direction and speed of flow but otherwise do not specify in detail the requirements of modelling to inform the mapping or why flooding occurs. The maps produced to fulfil the statutory duties within the regulations have previously been used as the basis of the SFRA.

### **Local Flood Risk Management Strategy (LFRMS):**

The City Corporation adopted its current LFRMS in February 2021, which includes a measure (Measure 3) that commits the organisation to reviewing the SFRA ahead of Q4 of 2022-23. This includes identifying infrastructure at risk of flooding, flooding from burst water mains, guidance on safe egress and analysis of flooding events. This will be considered as part of the SFRA update but is dependent on the provision of sound information on flood risk, which is the focus of this modelling review. To fulfil the commitment within the LFRMS, it will be necessary to determine if the current modelling is sufficient to meet the considerations identified within the measure. This therefore means that the mapping outputs still need to be sufficient to identify flood hazard at a site level.

### **Environment Agency (EA) Guidance on How to Prepare a SFRA:**

The EA publishes its guidance on producing SFRA on the gov.uk website (available [here](#)). This outlines the fundamental considerations when producing an SFRA, including scoping, governance, and consultation. It provides guidance on when an SFRA should be reviewed and identifies when there are changes to the following:

- the predicted impacts of climate change on flood risk\*
- detailed flood modelling from the Environment Agency or your lead local flood authority

- your local plan, spatial development strategy or relevant local development documents
- local flood management schemes
- flood risk management plans
- shoreline management plans
- local flood risk management strategies\*
- national planning policy or guidance

The items marked with an asterisk are potential triggers for the current review. Where these have changed the significance of their impact on the modelling will be considered as part of this modelling review.

The guidance also goes into detail on what to cover in a Level 1 and Level 2 SFRA, including what attributes of flooding need to be modelled. This guidance has not been significantly amended since the previous SFRA review.

#### **SFRA - A good practice guide:**

This is a new guidance document written by the EA and partners and published in November 2021. It looks at the process for undertaking a SFRA and provides detailed best practice guidance. This included providing more detail on the requirement needed within a Level 2 SFRA to apply the sequential and exceptions test and assessing the safety of new development. It does not go into detail of specifying models, rather reiterating the level of information needed to make decisions from the EA Guidance.

#### **B.4 SFRA 2017 Modelling Outputs**

The current SFRA utilises a number of models to provided information for different flood risks. These are summarised in Table 1.

In the Square Mile, the primary reasons for undertaking a review of the SFRA and its supporting model is to better understand surface water and sewer flooding. This has previously been the focus on bespoke modelling undertaken by consultants on behalf of the City Corporation, with other flooding risks covered by modelling from other parties.

Fluvial and tidal flooding from main rivers such as the Thames are the domain of the EA. As such flood modelling information is primarily produced by them and it is not expected that the City Corporation as LLFA would model this independently. As such, no additional modelling was undertaken for these sources of flooding in previous iterations of the SFRA. The EA's update to these models will be discussed in section 4.

Table 1 Summary of Models used for SFRA 2017

| Flood type              | Mechanism                                     | Model Used  | Year undertaken |
|-------------------------|---|---|-----------------|
| Fluvial and Tidal       | Undefended flooding                           | NPPF Flood zones/ EA Flood Map for Planning (Rivers and Seas) | 2017            |
|                         | Residual Risk/ Defence failure                | Thames Tidal Upriver Breach Inundation Assessment             | 2017            |
| Groundwater             | Perched water table in River Terrace Deposits | Drain London SWMP   | 2012            |
| Surface Water and Sewer | Drained surface water and sewer surcharge     | City of London Model  | 2012            |
|                         | Drained surface water and sewer surcharge     | Westminster City Council Model (calibrated)                   | 2015            |

The impact of groundwater flooding within the Square Mile focuses on the river terrace deposits above the London Clay rather than in the deep level chalk aquifer. This is because groundwater flooding is only likely to cause significant local impact within this shallow depth. The deep level chalk aquifer is managed on a regional basis. There is limited data available on water levels within the shallow geology and the current model only identifies areas with a potential for elevated groundwater. This is based on assumed geology and topography which due to its nature have seen minimal changes. There are a number of ways in which groundwater flooding risk can be locally changed but it is not possible to realistically model these in any more detail than the current potential for elevated groundwater mapping. As such, no improved modelling for groundwater flooding is reasonably possible.

The current mapping for surface water flooding hazard and risk model is still primarily based on the modelling undertaken in 2012 specifically for the City of London. The 2017 review considered a number of alternative models that had been developed including updates, which are discussed in detailed in Appendix C of the SFRA 2017. However, it was felt that the 2012 model was the more conservative and therefore continued to be used, with the outputs updated to use a higher climate change allowance at 40%. This review established that the mechanism (or why flooding happened in given areas) remained the same even if the extent (or area covered by flooding) slightly changed.

As the risk management authority responsible for surface water flooding, modelling of surface water and sewer flooding offers the most scope for further investigation by the City Corporation. It is therefore the primary focus of this review. Further modelling would only be beneficial if there have been significant changes to the assumptions of the existing model and if these give materially different outputs (mechanisms, extents, risks and hazard).

The 2012 model improved on previous modelling output by reducing the dependency on a number of assumptions. This was done by including the interaction with the sewer network, local topography and the density of the built environment. To do this, the Thames Water Beckton Model was utilised in a 1D – 2D format. Due a lack of historic flooding in the area of interest, it was not possible to calibrate this model.

The 2012 Model considered the following return periods: 1 in 5, 30, 75 and 200 year and 1 in 100 year plus climate change (updated in 2017 to 40%). These still represent the most useful return periods and allow for sensitivity to particularly large storm events.

The 2015 Westminster City Council model made two further improvements. It utilised a calibrated version of the Beckton Model and modelled roads to provide dynamic attenuation storage. The comparison in 2017 however showed that the flood mechanisms remained the same and the area of flooding was also generally similar. Using a calibrated version of the Beckton Model gives increased confidence in the validity of the model and in confirming the outcomes of the 2012 model, this confidence extends to that model also. Including dynamic on-road attenuation rather than direct to sewer rainfall gives a less conservative approach, but depending on the efficiency of road drainage systems this could lead to an underestimation of the flood extent. The arguments for continuing to use the 2012 model rather than the 2017 model remain valid. Since the 2015 modelling, Thames Water now only provide the results from the model rather than the Beckton Model itself.

The results of the 2012 modelling continue to be used by a wide audience including internally for determining planning applications, by developers in supporting applications and by the LLFA for its flood risk management duties. The results include hazard mapping at a site level which can be used for identifying unflooded routes for egress and access. The major improvements for these user groups concern the way the data is presented rather than the data itself, which will be considered by the wider SFRA review.

The specification of the 2012 Model was acceptable at the time and remains sufficient to provide the information and mapping required by the NPPF and Flood Risk Regulations 2009. Where base assumptions have changed since, these will be discussed in detail in section 4 and 5.

## **B.5 Physical and policy framework changes**

### **Physical changes:**

While there have been localised changes to the built environment, there have been limited wide scale changes to the Square Mile's topography and built environment since 2012 and this extends to much of central London. Due to its already intense level of development there is only limited potential for urban creep.

The increased use of SuDS should eventually have an impact. However, as of June 2022, of the SuDS schemes considered by planning, only 1 out of 285 hectares in the Square Mile have completed SuDS schemes. The current pipeline of development will see 7.2% of the Square Mile covered by SuDS on completion of these schemes. This coverage should continue to increase in the future and may become significant for the next review in 2027.

The Thames Water sewer network has also undergone minimal changes within central London. The Thames Tideway Sewer is expected to come online in 2025, approximately two years before the SFRA is next to be reviewed. The Thames Tideway is a project to control pollution and only anticipated to have minor ancillary benefits for managing flood risk. The next review in 2027 will be better placed to assess the impact of the project on flood risk in the Square Mile.

### **Climate change allowances:**

The EA issues guidance on the allowances to be used to take account of climate change in flood risk assessments. This guidance was updated in May 2022. This update included two main changes. Firstly, it now gives regional values for peak rainfall allowance. The City of London is now covered by the London Management Catchment. Secondly, it now specifies different allowances for the 1:30 year storm and the 1:100-year storm.

The upper end allowance for the 1 in 100-year storm remains 40% as was previously used in the 2017 modelling output update.

### **Further modelling:**

Since 2017, the City Corporation has undertaken no further modelling on flood risk. Thames Water have undertaken more modelling of their network as part of the Drainage and Wastewater Management Plan preparation process. For the Beckton Catchment, this considers the Thames Tideway scheme to be online.

The EA have started their National Flood Risk Assessment 2 which includes the creation of a New National Model that includes river and surface water flood

risk. While the LLFA is currently involved with the development of the New National Model, it is not expected to be completed until 2024, after the SFRA needs to be updated.

#### **Local Plan:**

Since 2017 the City of London Local Plan has not been updated. The update to the SFRA will form part of the evidence base of a new local plan, but at present there are no policy changes within the Local Plan since the last review.

#### **London Plan:**

A new London Plan was adopted in 2021, which tightened a number of flood risk and sustainable drainage policies. This included changing the drainage hierarchy and withdrawing the Sustainable Design and Construction Supplementary Planning Guidance.

#### **Major incidents of flooding:**

The best practise guide suggests that a SFRA should be reviewed following major flooding incidents. While London more widely has experienced flooding since 2017, notably in July 2021 including within the Beckton Sewer catchment, this had limited impact within the Square Mile.

### **B.6 Impact on 2017 SFRA outputs**

The previous section identified factors which could change the base assumptions of the surface water and sewer model or changes to the output requirements. This section will now consider in turn the impact of these changes on the model and the likely consequences.

#### **Physical changes:**

As no large-scale physical changes have been made this should not have impacted the topography used in the original model or the drainage assets considered. The physical changes in the environment would have a negligible impact on the flooding mechanisms identified and a minimal impact the area of flooding extent and hazard mapping.



### **Climate change allowances:**

While the guidance has changed, the headline allowance figure used has remained the same. The changes to the climate change allowances would have a negligible impact on the model outputs.

### **Further Modelling:**

All the modelling undertaken either considers a future condition or will not be available until after the updated SFRA is needed. The changes to the further modelling will have no impact on the model outputs for the present condition.

### **Local Plan:**

The City of London's Local Plan policies have not changed since the last review. The outcomes of the application of these policies, particularly on sustainable drainage, have yet to come to meaningful fruition due to the long-term scale of development in the City. The Local Plan will have negligible impact on the flooding mechanisms identified and a minimal impact on the area of flooding extent and hazard mapping.

### **London Plan:**

The London Plan has been updated since the last review, but this was so recent that the new policies will not yet have had significant impact. Similarly to the Local Plan, the new policies have yet to come to meaningful fruition. The London Plan will have negligible impact on the flooding mechanisms identified and a minimal impact the area of flooding extent and hazard mapping.

### **Major incidents of flooding:**

There have been no major incidents of flooding directly affecting the Square Mile. This therefore presents no opportunity to validate the existing model used or further the calibrated model undertaken by Westminster City Council. Beyond validation, major incidents of flooding will have no impact on the model outputs.

## **B.7 Rationale on not undertaking further modelling**

The purpose of the review has been to establish if the current modelling used in the previous SFRA is sufficient and if the outputs produced remain valid. There are three ways for which any model can be updated: the base assumptions or the information put into the model can be changed; the

processes used within the model can be amended to better reflect the assumptions; or observed data can be used to validate the model. In terms of outputs for flooding elements, there are three elements that can be impacted by changes to the model: the flooding mechanism; the extent of flooding; and the hazard of flooding.

Of the factors identified as having a potential to result in a change to the outputs of the surface water and sewer model, none could impact the mechanism of flooding previously identified. When considered individually, there is possible that a minimal change would be seen to the flood extents and hazard mapping from physical changes and from policy changes. However, the major contributor to the physical changes would be the inclusion of SuDS in new developments, which itself is also the major potential contributor of the policy changes. Even then, this is limited to schemes that cover just 0.35% of the Square Mile. These two changes while considered here separately result in the same impact and therefore would have no cumulative effect when considered together. In total, the changes that have occurred to the model are minimal and likely to be within the same order of change of the previously rejected difference between the 2012 model and the Westminster City Council model. As such, there is no need to update the model due to changes in its base assumptions and parameters at this time.

An alternative reason for new modelling would be to derive further outputs. The review of guidance suggests that the existing mapping is sufficient for these requirements, including to ascertain access and egress routes. Other further useful outputs have not been identified. Improving the user experience, including updating the mapping into more friendly formats, is a further aim, but it should be possible to do so without changes to the model.

In conclusion, the only flooding models which would be reasonable to review relate to surface water and sewer flooding risk. Despite the changes that have been identified since the last review, it appears that the existing model used for this type of flood risk remains valid and that the output in the form of mapping remains sufficient for the purposes for which it is required. It should be noted that between now and the next planned SFRA review in 2027, further modelling will have been produced by the EA, the impact of planning policy should have a larger impact and the Thames Tideway sewer will be in operation. These changes will be of more significance than those which have occurred in the preceding five years and the need to undertake new modelling will need to be considered again.