www.jbaconsulting.com

# Three Rivers Level 2 Strategic Flood Risk Assessment

## Draft

**Prepared for**

Three Rivers District Council

**Date**

16 January 2026

# Document Status

| | |
|---|---|
| Issue date | 16 January 2026 |
| Issued to | Marko Kalik |
| BIM reference | NMH-JBAU-XX-XX-RP-Z-0002-S0-P01.04-Three_Rivers_L2_SFRA_Report |
| Revision | S0-P01 |
| Prepared by | Jasmine Mukkath BSc (Hons)<br>Analyst |
| Reviewed by | Alistair Clark BSc MSc<br>Senior Analyst |
| Authorised by | Alistair Clark BSc MSc<br>Senior Analyst |

# Carbon Footprint

The format of this report is optimised for reading digitally in pdf format. Paper consumption produces substantial carbon emissions and other environmental impacts through the extraction, production and transportation of paper. Printing also generates emissions and impacts from the manufacture of printers and inks and from the energy used to power a printer. Please consider the environment before printing.

# Accessibility

JBA aims to align with governmental guidelines on accessible documents and WGAG 2.2 AA standards, so that most people can read this document without having to employ special adaptation measures. This document is also optimised for use with assistive technology, such as screen reading software.

# Contract

| | |
|---|---|
| JBA Project Manager | Jasmin Mukkath |
| Address | Pipe House, Lupton Road, Wallingford, Oxfordshire, OX10 9BS |
| JBA Project Code | 2024s1000 |

This report describes work commissioned by Three Rivers District Council, by an instruction dated 29 October 2025. The Client's representative for the contract was Marko Kalik of the Three Rivers District Council. Jasmine Mukkath of JBA Consulting carried out this work.

## Purpose and Disclaimer

Jeremy Benn Associates Limited ("JBA") has prepared this Report for the sole use of Three Rivers District Council and its appointed agents in accordance with the Agreement under which our services were performed.

JBA has no liability for any use that is made of this Report except to Three Rivers District Council for the purposes for which it was originally commissioned and prepared.

JBA disclaims any undertaking or obligation to advise any person of any change in any matter affecting the Report, which may come or be brought to JBA's attention after the date of the Report.

The methodology adopted and the sources of information used by JBA in providing its services are outlined in this Report. The work described in this Report was undertaken between (October and January 2026) and is based on the information available during the said period. The scope of this Report and the services are accordingly factually limited by these circumstances.

The conclusions and recommendations contained in this Report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by JBA has not been independently verified by JBA, unless otherwise stated in the Report.


## Acknowledgements

We would like to acknowledge the assistance of Three Rivers District Council and Hertfordshire County Council.

# Contents

## List of Tables

## Abbreviations

| | |
|---|---|
| AEP | Annual Exceedance Probability |
| AIMS | Asset Information Management System |
| BGS | British Geological Survey |
| CC | Climate Change |
| CCTV | Closed Circuit Television |
| EA | Environment Agency |
| FAA | Flood Alert Area |
| FMfP | Flood Map For Planning |
| FRA | Flood Risk Assessment |
| FWA | Flood Warning Area |
| GIS | Geographical Information System |
| JBA | Jeremy Benn Associates |
| LiDAR | Light Detection And Ranging |
| LLFA | Lead Local Flood Authority |
| LPA | Local Planning Authority |
| mAOD | metres Above Ordnance Datum |
| NaFRA2 | National Flood Risk Assessment 2 |
| NPPF | National Planning Policy Framework |
| OS | Ordnance Survey |
| PPG | Planning Practice Guidance |
| RBD | River Basin District |
| RMA | Risk Management Authority |
| RoFSW | Risk of Flooding from Surface Water |
| SFRA | Strategic Flood Risk Assessment |
| SuDS | Sustainable Drainage Systems |
| TRDC | Three Rivers District Council |
| TW | Thames Water |

## Definitions

**1D model:** One-dimensional hydraulic model, typically representing a watercourse and structures within the channel (for example bridges and culverts).

**2D model: Two-dimensional hydraulic model, typically representing the floodplain flows.**

**Annual Exceedance Probability**: The probability (expressed as a percentage) of a flood event occurring in any given year.

**Brownfield**: A previously developed parcel of land.

**Climate change**: Long term variations in global temperature and weather patterns caused by natural and human actions.

**Design flood:** A flood event of a given annual flood probability, which is generally taken as: fluvial (river) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), or surface water flooding likely to occur with a 1% annual probability (a 1 in 100 change each year), plus an appropriate allowance for climate change, against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed.

**Dry island**: Land which may not be at risk of flooding itself but is surrounded by flood risk and therefore may become cut off during a flood event.

**Flood defence**: Infrastructure used to protect an area against floods such as floodwalls and embankments; they are designed to a specific standard of protection (design standard).

**Green infrastructure**: A network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs, and urban fringe.

**Greenfield**: An undeveloped parcel of land.

**Lead Local Flood Authority**: The unitary authority for the area or if there is no unitary authority, the county council for the area.

**Local Planning Authority (LPA)**: The local government body which is responsible by law to exercise planning functions for a particular area.

**Main River**: A watercourse shown as such on the statutory Main River map held by the Environment Agency. They are usually the larger rivers and streams. The Environment Agency has permissive powers (not duties) to carry out maintenance and improvement works on Main Rivers.

**Major development**: Defined in the National Planning Policy Framework as a housing development where 10 or more homes will be provided, or the site has an area of 0.5 hectares or more, or as a non-residential development with additional floorspace of 1,000m² or more, or a site of 1 hectare or more, or as otherwise provide in the Town and Country Planning (Development Management Procedure) (England) Order 2015 (gov.uk).

**Natural Flood Management:** Techniques that work with nature to reduce the risk of flooding for communities.

**Ordinary watercourse**: Any river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and passage through which water flows but which does not form part of a main river. The local authority or internal drainage board has permissive powers (not duties) on ordinary watercourses.

**Permissive powers:** Authorities have the power to undertake flood risk management activities, but not a duty to do so. This will depend on priorities in flood risk management.

**Return period**: An estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.

**Riparian owner:** A riparian landowner, in a water context, owns land or property, next to a river, stream or ditch.

**Risk**: In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.

**Risk Management Authority**: The Environment Agency, Lead Local Flood Authorities, District and Borough Councils in an area where there is no unitary authority, Coast Protection Authorities in coastal areas, Water and sewerage companies, Internal Drainage Boards, and Highways authorities.

**Standard of Protection (SoP):** Defences are provided to reduce the risk of flooding (typically from a river, sea or surface water). A Standard of Protection is usually described in terms of an AEP flood event. For example, a flood embankment could be described as providing a 1% AEP Standard of Protection

**Stakeholder:** A person or organisation affected by the problem or solution or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.

**Sustainable Drainage Systems**: Sustainable Drainage Systems are methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques, such as grates, gullies, and channels.

**Windfall site**: A site which becomes available for development unexpectedly and therefore not included as allocated land in a planning authority's local plan.

# Executive Summary

### Introduction and context

This Level 2 Strategic Flood Risk Assessment (SFRA) document was created with the purpose of supporting the New Local Plan for Three Rivers District Council, to cover the Local Plan period until 2041. This document supersedes the Level 2 SFRA published for the district in 2019. The Level 2 SFRA document should be read in conjunction with Three Rivers District Level 1 SFRA (2025).

The primary purpose of the Level 2 SFRA is to provide an appropriate understanding of the level of actual risk affecting development included in the Local Plan Review. The assessment considers all sources of flooding and considers other factors affecting flood risk such as residual risk. The information provided as part of the Level 2 SFRA enables Three Rivers District Council to apply the Sequential and Exception Test to sites in accordance with the National Planning Policy Framework.

### SFRA objectives

The Government's Planning Practice Guidance (PPG) on Flood Risk and Coastal Change advocates a tiered approach to risk assessment involving Level 1 and Level 2 SFRAs.

The Level 2 assessment aims to build on identified risks from the Level 1 SFRA to provide a greater understanding of fluvial, surface water, groundwater, sewer, and reservoir related flooding risks to these shortlisted sites. From this, Three Rivers District Council and developers can make more informed decisions regarding future development. The Level 2 assessment also identifies sites requiring further risk analysis at the site-specific Flood Risk Assessment (FRA) stage.

### Level 2 SFRA Outputs

The Level 2 assessment includes detailed assessments of the proposed site options. These include:

- An assessment of all sources of flooding including fluvial flooding, surface water flooding, groundwater flooding, and the potential increase in fluvial and surface water flood risk due to climate change.
- Reporting on conditions of flood defence infrastructure, where applicable.
- An assessment of existing flood warning and emergency planning procedures, including an assessment of safe access and escape during an extreme event.
- Advice and recommendations on the likely applicability of sustainable drainage systems for managing surface water runoff.
- Advice on whether the sites are likely to pass the second part of the Exception Test with regards to flood risk and on the requirements for a site-specific FRA

### Summary of Level 2 SFRA

Three Rivers District Council provided 368 sites for screening as part of this Level 2 SFRA. Sites were identified from a range of sources, including sites put forward during the 'Call for Sites' process, sites on the Council's Brownfield Register and previously considered sites.

Three Rivers District Council only identified 72 of the 368 sites as having potential for development. Of these 72 sites, 33 were identified as at risk of flooding from one or more sources. Of these 33 sites at risk of flooding, four sites were removed due to being at low risk that would not pose any constraints to development. The remaining 29 sites were taken forward for a site-specific Level 2 assessment.

These sites were screened against flood risk datasets to assess the potential viability and provide flood risk recommendations. Summary tables were prepared for all 29 sites and multiple sources of flood risk were assessed and can be found in Appendix A. Maps of the depth and velocity of flooding as well as hazard mapping have been produced where modelled outputs were available. The flood datasets used are outlined in Appendix B.

The following points summarise the Level 2 assessment:

- **Fluvial flooding** - Some areas of the district are at greater risk than others. Fluvial flood risk in Three Rivers is concentrated along the Rivers Colne, at Batchworth and Rickmansworth, where the river forms a confluence with the incoming Rivers Gade and Chess and interacts with the Grand Union Canal. Flood risk is also present along the River Gade where significant surface water flow paths are present that drain towards the river. To a lesser degree, smaller watercourses such as the Hartsbourne Stream are also a source of risk, affecting one of the proposed development sites. Eleven sites in total are affected by fluvial flood risk within the study area are ACFS8b, CFS32, CFS39b, CFS55, CFS61, CFS70 CFS72, H22a, NCFS35 and NSS10. Two of these sites are identified as being at low risk (CFS39b and CFS61). Due to their flood risk and the vulnerability of the proposed development, the remaining eight sites require the Exception Test.
- **Flood Warning Areas (FWAs)** - All 10 sites affected by fluvial flooding are located within existing EA FWAs. For proposed development within existing Environment Agency (EA) FWAs, developers should consult the EA to ensure that adequate flood warning procedures and evacuation processes are in place and that Risk Management Authorities (RMAs) are not put under any additional burden.
- **Surface water flooding** - Surface water flow routes tend to follow the topography of a site, for example, along watercourses or isolated pockets of ponding where there are topographic depressions. This includes residential areas of Eastbury, South Oxhey, Carpenders Park and Rickmansworth, which naturally drain towards the River Colne, and Croxley Green where overland flows drain eastwards into the River Gade. Ponding occurs where the topography flattens on the floodplain of the River Colne. 26 sites out of the 29 sites assessed in this Level 2 SFRA are at risk of surface water flooding. Sites ACFS8b, CFS70 and CFS72 are at very low risk of surface water flooding.
- **Access and escape routes** - Sites AB31, ACFS10, CFS36, CFS55, CFS60, CFS61, H22a, NCFS15, NCFS34 and NCFS35 have potential access and escape route issues as a result of fluvial and/or surface water flooding of the

surrounding roads. At these sites, consideration should be made as to how safe access and escape routes can be provided during flood events, both for people and emergency vehicles. Consideration should also be given to the nature of the risk, for example whether the flooding forms a flow path or bisects the site, meaning access across the site from one side to another may be compromised.

- **Climate change** - Fluvial and surface water climate change mapping indicates that flood extents are predicted to increase. As a result, the depths, velocities, and hazard of flooding may also increase. The significance of the increase will depend on the topography of the site and the climate change percentage allowance used. Site-specific FRAs should confirm the impact of climate change using latest guidance. The sites most at risk from increased risk due to climate change are CFS55, CFS61, CFS70 and H22a. It is recommended that Three River District Council works with other RMAs to review the long-term sustainability of existing and new development in these areas when developing climate change plans and strategies for the district.
- **Historic flooding** - Historic data provided by the EA and Hertfordshire County Council (HCC) show that 11 sites are close to locations with recorded flood incidents. These are ACFS10, CFS20, CFS32, CFS55, CFS60, CFS61, CG47, H22a, NCFS26, NCFS35 and RW31.
- **Sewer flooding** - Thames Water provides sewerage services across the district and has provided details of historic sewer flooding for the period between 2015 and 2025. Settlements with the greatest historic risk of sewer flooding include Oxhey, Carpenders Park, Rickmansworth, Chorleywood and Croxley Green. Up to nine sites were located in the postcode sector with the highest incidence of sewer flooding (between 60-75 incidents). These are AB26, AB31, ACFS1, CFS20, CFS36, CFS61, CG47, CW9 and NCFS15.
- **Groundwater flooding** - High groundwater flood risk within the district is concentrated in the floodplains of the Rivers Colne, Chess and Gade, where the chalk geology and gravel surface deposits can result in heightened groundwater levels at, or just below, the ground surface. Nine sites are predicted to have groundwater levels within 0.025m of the ground surface in a 1% AEP groundwater event (ACFS8B, CFS32, CFS39B, CFS40a, CFS55, CFS60, CFS70, NCFS35 and NSS10). The settlements identified as at highest risk of groundwater flooding are Rickmansworth, Croxley Green, Loudwater, Carpenders Park and Oxhey. There is no national risk-based groundwater flood dataset of a suitable resolution to inform the areas at risk from groundwater flooding. However, emergence mapping, when considered in conjunction with topography and surface water flow paths, can indicate areas where groundwater is likely to emerge, and the flow paths it may take once above the ground. An appropriate assessment of the groundwater regime for a site should be carried out at the site-specific FRA stage.
- **Reservoir flooding** - There are six sites (ACFS10, CFS32, CFS60, CFS72, H22a and NCFS35) assessed within the detailed site assessments that are

shown to be at risk of reservoir flooding. The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from reservoirs is very low. However, there is a residual risk of a reservoir breach, and this risk should be considered in any site-specific FRA.

- **Canal flooding** - There is a risk of flooding from the Grand Union Canal, where it interacts with the River Colne at Rickmansworth and further downstream. Data received from the Canal and River Trust indicates that there has been one recorded incident of canal overtopping in 2014 between Rickmansworth and West Hyde (in the vicinity of site H22a), in response to overtopping of the River Colne. While the flooding from the Grand Union Canal is largely a residual risk in the district, the actual and residual risk of canal flooding needs to be assessed on a site-by-site basis for any proposed allocation or future development sites.
- **SuDS** - A strategic assessment of SuDS suitability was conducted using regional datasets. A detailed site-specific assessment of suitable SuDS techniques would need to be undertaken at site-specific level to understand which SuDS options are feasible and most effective.

**Recommendations**

Section 8 sets out the recommendations based on the findings of this Level 2 SFRA. This includes recommendations for applying the Exception Test, where required, requirements for developers in developing the Local Plan allocations, and guidance for windfall sites and development of sites not included within the Local Plan

# 1 Introduction

## 1.1 Purpose of the Strategic Flood Risk Assessment

Paragraph 171 of the National Planning Policy Framework (NPPF) (2024) (gov.uk) states that *'Strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards*.'

## 1.2 Levels of SFRA

The Planning Practice Guidance (PPG) Flood risk and coastal change (gov.uk) advocates a staged approach to risk assessment and identifies two levels of a Strategic Flood Risk Assessment (SFRA):

- A Level 1 assessment, which all Local Planning Authorities (LPAs) are required to undertake. Where potential site allocations are at low flood risk and where development pressures are low a Level 1 assessment is likely to be sufficient, without the LPA progressing to a more detailed Level 2 assessment. The Level 1 assessment should be of sufficient detail to enable application of the Sequential Test, to inform the allocation of development to areas of lower flood risk.
- A Level 2 assessment is required where land outside flood risk areas cannot appropriately accommodate all necessary development, creating the need to apply the NPPF's Exception Test, or if an LPA believe they may receive high numbers of applications in flood risk areas on sites not identified in the Local Plan. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of all sources of flooding.

This SFRA report fulfils the requirements for a Level 2 assessment of development sites identified for potential allocation within Three Rivers District and has been prepared in accordance with the NPPF (2024) and PPG (2022).

This report should be read alongside the 'Three Rivers Level 1 SFRA (2025) and builds upon information presented within the Level 1 SFRA.

## 1.3 SFRA objectives

The objectives of this Level 2 SFRA are to:

1. Provide individual flood risk analysis for site options using the latest available flood risk data, thereby assisting the Council in applying the Exception Test, where required, to their proposed site options in preparation of their Local Plan.
2. Using the available data, provide information and comprehensive mapping presenting flood risk from all sources for the site.

3. Provide recommendations for making sites safe throughout their lifetime.
4. Take into account most recent policy and legislation in the NPPF, PPG, EA SFRA Guidance, and LLFA SuDS guidance.

## 1.4 Consultation

SFRAs should be prepared in consultation with other RMAs.

- Environment Agency
- Hertfordshire County Council as LLFA
- Canal and River Trust
- Thames Water

## 1.5 How to use this report

Table 1-1 below outlines the contents of this report and details how different users can apply this information.

Table 1-1: Outline of the contents of each section of this report.

| Section | Contents | How to use |
|---|---|---|
| 1. Introduction | Outlines the purpose and objectives of the Level 2 SFRA. | For general information and context. |
| 2. Policy and strategy for flood risk management | Includes information on the implications of recent changes to planning and flood risk policies and legislation and signposts to relevant sections of the Level 1 SFRA. | Users should refer to this section and the relevant sections of the Level 1 SFRA for any relevant policy which may underpin strategic or site-specific assessments. |
| 3. Sequential and Exception Tests | Signposts to relevant sections of the Level 1 SFRA for information on the Sequential and Exception Tests. | Users should refer to this section and the relevant sections of the Level 1 SFRA to understand and follow the steps required for applying the Sequential and Exception Tests. |
| 3. Information used in the Level 2 SFRA | Summarises the data used in the Level 2 detailed site assessments and mapping. | Users should refer to this section in conjunction with the detailed site assessments (Appendix A) and mapping (Appendix 0) to understand the data presented. |
| 4. Level 2 Assessment Methodology | Summarises the sites taken forward to a Level 2 assessment and the outputs produced for each of these sites. | Users should refer to this section in conjunction with the detailed site assessments (Appendix A) and mapping (Appendix 0) to understand the data presented. |

| Section | Contents | How to use |
|---|---|---|
| 6. Flood risk management requirements for developers | Identifies the scope of the assessments that must be submitted in Flood Risk Assessments (FRAs) supporting applications for new development. Refers to relevant sections in the Level 1 SFRA for mitigation guidance. | Developers should use this section alongside the relevant sections of the Level 1 SFRA to understand requirements for FRAs, which conditions/guidance documents should be followed, and information on flood mitigation options. |
| 7. Surface water management and SuDS | Signposts to relevant sections of the Level 1 SFRA for information on the management of surface water including types of SuDS, SuDS policy and guidance, and SuDS constraints. | Developers should use this section alongside the relevant sections of the Level 1 SFRA to understand what national, regional, and local SuDS standards are applicable. |
| 8. Summary of Level 2 assessment and recommendations | Summarises the results and conclusions of the Level 2 assessment, and signposts to the Level 1 SFRA for planning policy recommendations. | Developers and planners should use this section to see a summary of the Level 2 assessment and understand the key messages from the detailed site assessments.<br>Developers should refer to the Level 1 SFRA recommendations when considering requirements for site-specific assessments. |
| Appendix A: Detailed site assessments | Provides a detailed summary of flood risk for sites requiring a more detailed assessment, which considers flood risk, emergency planning, climate change, broadscale assessment of possible SuDS, Exception Test requirements, and requirements for site-specific FRAs. | Planners should use this appendix to inform the application of the Sequential and Exception Tests, as relevant.<br>Developers should use these assessments to understand flood risk, access and escape route requirements, climate change, SuDS, and FRA requirements for site-specific assessments. |
| Appendix B: Static Mapping | Provides mapping of the flood risk at each of the sites afforded a detailed site assessment. Includes depth, velocity and hazard information for fluvial and surface water flood risk where available, alongside climate change risk. | Planners should use this appendix to inform the application of the Sequential and Exception Tests, as relevant.<br>Developers should use these assessments to understand flood risk, access and escape route requirements, climate change, SuDS, and FRA requirements for site-specific assessments. |

| Section | Contents | How to use |
|---|---|---|
| Appendix C: Data sources used in this SFRA | Summarises the data used in the Level 2 detailed site assessments and mapping. | Users should refer to this section to understand the data used and where this data can be obtained. |

## 1.6 SFRA study area

Three Rivers District in southwest Hertfordshire covers an area of approximately 89km$^2$ and has a population of approximately 95,807 (according to the 2024 census). Rickmansworth is the largest town with a population of approximately 26,291 (as per the 2021 Census). Other notable settlements include South Oxhey, Croxley Green, Abbots Langley, Chorleywood, Leavesden and Mill End. Outside the settlements, the M25 runs along the central band of the district amongst large areas of agricultural arable land and rural settlements. The authorities that neighbour the Three Rivers District are:

- Hertsmere Borough Council
- Watford Borough Council
- St Albans and City District Council
- Dacorum Borough Council
- Buckinghamshire Council
- London Boroughs of Hillingdon and Harrow

The Main Rivers that flow through the district are the River Colne (flowing east to south), River Gade (flowing southwards along the easter border), River Chess (flowing north-west to south-east) and the Grand Union Canal (running north-east to south-west). There are also several smaller tributary watercourses of the River Colne, including Oxhey Brook, Moor Park Stream and Hartsbourne Stream.

# 2 Policy and strategy for flood risk management

The flood risk management roles and responsibilities for different organisations and relevant legislation, policy and strategy are detailed within Section 2 of the Three Rivers Level 1 SFRA (2025).

This contains details on:

- Key legislation for flood and water management.
- Key national, regional, and local policy documents and strategies.
- Roles and responsibilities for flood risk management in Three Rivers District.

The following section summarises any changes to flood risk legislation, policy, and strategy since publication of the previous Level 1 SFRA (South West Hertfordshire Level 1 SFRA, 2018).

## 2.1 National Planning Policy Framework

The NPPF (December 2024) (gov.uk) sets out Government's planning policies for England and how these are expected to be applied. The NPPF is based on core principles of sustainability and forms the national policy framework in England, also accompanied by a number of PPG. It must be taken into account in the preparation of local plans and is a material consideration in planning decisions.

At the time of the Level 1 SFRA, the latest version of the NPPF was the December 2023 update. The NPPF has since been updated in December 2024. Overall, the changes in relation to flood risk (Paragraphs 170 to 182) are considered to be relatively minor and strengthen ambiguity within the previous framework rather than materially changing anything and therefore no changes to the Level 1 SFRA are considered necessary.

The following points summarise the changes in the December 2024 NPPF:

- **Paragraph 173**: A new paragraph has been added with the purpose of specifying that the Sequential Test should apply to individual applications as well as plans. This was already included within the PPG and as such has been included in the NPPF for completeness.
- **Paragraph 174 (previously Paragraph 168)**: Reference to the sequential approach ('the sequential approach should be used in areas known to be at risk now or in the future from any form of flooding') has been deleted from this paragraph.
- **Paragraph 175**: A new paragraph has been added which brings across changes which were made in the EA standing advice in August. This addition clarifies under what circumstances the Sequential Test would not need to be applied; where a site-specific FRA demonstrates that no built development within the site boundary, including access or escape routes, land raising or other potentially vulnerable elements, would be located on an area that would be at risk of

flooding from any source, now and in the future (having regard to potential changes in flood risk).

- **Paragraph 176**: This paragraph is largely the same as paragraph 174 in the previous version of the NPPF, but it has been moved further up the document to a more appropriate location.
- **Paragraph 177 (previously Paragraph 169)**: The start of this paragraph has been updated to include 'Having applied the sequential test' – providing more clarification that the Sequential Test needs to be applied before the Exception Test.
- **Paragraph 182 (previously Paragraph 175)**: The reference to 'Major developments' has been removed, thus applying the need for SuDS to all development. A statement on proportionality has also been included in place of 'unless there is clear evidence that this would be inappropriate'. Greater emphasis has also been placed on the multifunctional benefits.

# 3 Sequential and Exception Tests

Information on planning policy for flood risk management is detailed in Section 3 of the Three Rivers Level 1 SFRA (2025). Users should consider this section within the Level 1 SFRA to understand national planning policy guidance and how to evidence that a proposed development will pass the Sequential Test, and if necessary, the Exception Tests.

Section 3 contains detail on:

- the NPPF and PPG;
- the risk-based approach; and
- the Sequential and Exception Tests.

# 4 Information used in the Level 2 SFRA

This section outlines the datasets used in assessing the Local Plan proposed development sites in the Level 2 SFRA Appendix A.

It should be noted that datasets used to inform this SFRA may be updated following the publication of this SFRA and new information on flood risk may be produced by RMAs. This new information (such as updated mapping and modelling) may supersede the information included in this SFRA. Guidance should be sought from the LPA, LLFA, and the EA as appropriate to check the most up to date source of information is used for future flood risk assessment.

Appendix C provides an overview of the supplied data used to inform the appraisal of flood risk for Three Rivers District, including when the data was provided, the source of the data, and how the data can be obtained by a developer if applicable.

## 4.1 Historic flooding

The EA's 'Historic Flood Map' and 'Recorded Flood Outlines' datasets have been used to understand whether historic fluvial flooding has been recorded at the sites. These datasets consider the presence of defences, structures, and other infrastructure where they existed at the time of flooding.

HCC's Flood Incident Database has also been reviewed, with floods up to the end of 2025 included. As specified in the Level 1 SFRA, there is a history of documented flood events within the district, with properties impacted by fluvial, surface water and sewer flooding.

It is important to note that the absence of historic flood records does not mean that an area has never flooded, only that records are not held. For previously undeveloped sites, it is likely that historic flooding incidents may have gone unreported due to a lack of site use or interest. In addition, it is also possible that flooding mechanisms have changed since the date of a recorded flooding incident, making it more or less likely for flooding to occur on site.

## 4.2 River networks

Main Rivers are represented by the EA's Statutory Main River layer. There are three watercourses that have been classified by the Environment Agency as Main Rivers that flow through Three Rivers District. The River Gade which runs along the north-eastern boundary of the district and flows in a south to south easterly direction through the Chilterns. The geology of the Gade catchment is dominated by chalk which results in groundwater fed chalk “bournes” which are dry in the upper reaches in the summer. The River Colne flows from northeast to southwest from near Hatfield, through Watford, to Rickmansworth. The main tributaries along the reach are the Ver, the Mimmshall Brook and the Ellen Brook which both flow to the east of the Upper Colne. The River Chess is a

groundwater chalk stream in the west of the district. The Rivers Chess, Gade and Colne meet in Rickmansworth and flow southwards to form a confluence with the River Thames.

Ordinary Watercourse data was obtained from HCC. Caution should be taken when using these layers to identify culverted watercourses which may appear as straight lines but the course of the watercourse below ground is likely to be different in reality.

### 4.3 Fluvial flooding

The EA's Flood Map for Planning (FMfP) was updated (on 25 March 2025 and 28 November 2025) as part of the new National Flood Risk Assessment (NaFRA2). This incorporated the latest modelling data available and is updated on a bi-annual basis. An updated model for the Upper Colne was made available in November 2025 and is yet to be included in the FMfP. In addition to the Colne, the Upper Colne 2025 model also represents flooding from the River Gade, River Ches and the Grand Union Canal in Rickmansworth and its downstream reaches (up to the A40). At Watford (downstream of the M1 to the Watford), the Hartsbourne Stream and Flood Storage Area are also included. In contrast to the superseded 2010 model, the Oxhey Brook and Moor Park Brook is not included in this model.

This modelling has been used for the Level 2 SFRA as the most up to date data, at the time of writing. However, over time the online FMfP is likely to be updated more often than the SFRA, therefore the latest available version of the FMfP should be used within future assessments. Further details on the definition of Flood Zones can also be found within the Level 1 SFRA and in Appendix C.

Fluvial flood risk is most significant along the low-lying valley of the River Colne, affecting Rickmansworth and Batchworth. Elsewhere in the district, flood risk is largely constrained to the floodplains of the steep river valleys. The detailed model data included within the Level 2 SFRA is outlined in Table 4-2. These outputs include depth, velocity and hazard information.

Table 4-1 Detailed modelling used for fluvial flood risk in Three Rivers Level 2 SFRA

| Source of risk | Fluvial model - defended | Fluvial model - undefended |
|---|---|---|
| Fluvial risk | Upper Colne (2025) - 3.3%, 1%, 0.1% AEP defended<br>Gade and Bulbourne (2019) - 2%, 1%, 0.1% defended | Upper Colne (2025) - 1%, 0.1% AEP undefended<br>Gade and Bulbourne (2019) - 1%, 0.1% undefended |

A number of smaller watercourses and field drains located within the district also have the potential to pose flood risk to development. The FMfP does not represent the floodplain for watercourses with smaller catchments as well in topographically flat areas where the flow routes are not as well defined. In the absence of detailed modelling, the Risk of Flooding from Surface Water (RoFSW) map provides an indication of the floodplain of small watercourses and ditches.

## 4.4 Flood defences

Current flood defence information has been taken from the EA's Asset Information Management System (AIMS) Spatial Defences dataset. These datasets include all flood defences currently owned, managed or inspected by the EA and include information pertaining to their current condition and standard of protection.

The main flood defences in the study area are located along the main water courses. These are mostly comprised of natural/engineered high ground, embankments, three maintained flood walls and one flood storage area. These defences are located near Brookdene Avenue on Hartsbourne Brook, North of Batchworth on the River Chess, and on the River Colne at Rickmansworth (which is part of the Lower Colne Improvement Scheme). The condition of these defences varies from poor to good, with the Standard of Protection varying between the defences.

## 4.5 Surface water flooding

Mapping of surface water flood risk in Three Rivers District has been taken from the Environment Agency's Risk of Flooding from Surface Water (RoFSW) mapping. Surface water flood risk is subdivided into the following four categories:

- **High**: An area has a chance of flooding greater than 3.3% AEP (1 in 30-yr) each year.
- **Medium**: An area has a chance of flooding between 1% AEP (1 in 100-yr) and 3.3% AEP (1 in 30-yr) each year.
- **Low**: An area has a chance of flooding between 0.1% AEP (1 in 1,000-yr) and 1% AEP (1 in 100-yr) each year.
- **Very Low:** An area has a chance of flooding of less than 0.1% AEP (1 in 1,000-yr) each year.

In March 2025, revised RoFSW data was released as part of NaFRA2 data. Further datasets including depth, velocity and hazard were published in September 2025. This mapping incorporates updated topographical data, local modelling and new modelling techniques. However, there are limitations associated with this dataset such as the use of a default loss rate to represent drainage. The RoFSW mapping is intended to be used as a high-level assessment. If a particular site is indicated in the EA mapping to be at risk from surface water flooding, a more detailed assessment should be required to illustrate the flood risk more accurately at a site-specific scale. Such an assessment should use the RoFSW in partnership with other sources of local flooding information to confirm the presence of a surface water risk at that location.

Detailed modelling, based on site-specific topographic survey to inform ground levels, is likely to be necessary where there is a significant risk of surface water flooding. It is not anticipated that that further modelling will fundamentally change the locations identified to be at risk from surface water flooding, but the improved analysis techniques will reduce some of the uncertainties associated with the assessment.

## 4.6 Climate change

Climate change mapping is shown in the mapping in Appendix 0 for fluvial, tidal and surface water flooding using modelled outputs with the latest climate change uplifts where available.

### 4.6.1 Climate change allowances for peak flows

Climate change is expected to increase the peak flows of rivers, meaning that flows which were previously thought to be extreme will now be considered far more possible. Areas benefiting from flood defences will find the standard of protection changes over time with overtopping of defences more likely unless they are upgraded.

Peak river flow climate change allowances developed by the EA are divided into a series of Management Catchments, where Three Rivers District falls under the Colne Management Catchment (Table 4-2). This information provides a strategic assessment of climate change risk; developers should undertake detailed modelling of climate change allowances as part of a site-specific FRA, following the latest Climate Change Guidance set out by the EA.

Table 4-2: Peak river flow allowances for the Colne Management Catchment.

| Allowance category | Total potential change (%) anticipated for '2020s' (2015 to 2039) | Total potential change (%) anticipated for '2050s' (2040 to 2069) | Total potential change (%) anticipated for '2080s' (2070 to 2125) |
|---|---|---|---|
| Upper | 30% | 38% | 72% |
| Higher | 16% | 16% | 35% |
| Central | 10% | 8% | 21% |

The FMfP released as part of NAFRA2 also includes a 'Rivers and Sea undefended flood risk extents - climate change' dataset, which applies the central uplift for the 2080s epoch. Climate change flood extents are provided for the 1% AEP and 0.1% AEP events, which are suitable for considering future flood risk to all development types other than essential infrastructure. However, the dataset does not include depth, velocity and hazard information.

Climate change modelling was available for the Upper Colne (2025) and the Gade and Bulbourne (2019) defended models. The following model outputs were used to represent climate change in this SFRA:

- Upper Colne model (2025) - 1% AEP defended scenario (+35%, +72%)
- River Gade and Bulbourne (2019) - 3.3% and 1% AEP defended scenario (+25%, +35%, +70%)

Where detailed modelling was not available to accurately map the impact of climate change, Flood Zone 2 (0.1% AEP) was used as a conservative proxy.

### 4.6.2 Climate change allowances for peak rainfall

Climate change is predicted to result in wetter winters and increased summer storm intensity in the future. This increased rainfall intensity will affect land and urban drainage systems, resulting in surface water flooding, due to the increased volume of water entering the systems.

Peak rainfall climate change allowances developed by the EA are divided into the same Management Catchments as peak river flows and are detailed in 0.1% AEP surface water extent has therefore been used as a conservative indication of the impact of climate change on surface water flood risk for the 2070s epoch.

Table 4-3. The Environment Agency's Risk of Flooding from Surface Water (RoFSW) with Climate Change dataset has been used to assess the impacts of climate change on surface water flood risk. This data includes depth, hazard and velocity information. However, this dataset only provides the central allowance up to the 2050s epoch. The 0.1% AEP surface water extent has therefore been used as a conservative indication of the impact of climate change on surface water flood risk for the 2070s epoch.

Table 4-3: Peak rainfall intensity allowances for small and urban catchments for the Colne Management Catchment.

| Allowance category | Total potential change (%) anticipated for '2050s' (2022 to 2060) for 3.3% AEP | Total potential change (%) anticipated for '2050s' (2022 to 2060) for 1% AEP | Total potential change (%) anticipated for '2070s' (2061 to 2125) for 3.3% AEP | Total potential change (%) anticipated for '2070s' (2061 to 2125) for 1% AEP |
|---|---|---|---|---|
| Upper end | 35% | 40% | 35% | 40% |
| Central | 20% | 20% | 25% | 25% |

## 4.7 Groundwater flooding

The JBA Groundwater Emergence map has been used to assess potential areas that are likely to be at higher risk of groundwater flooding. The JBA Groundwater Emergence map, shows the likelihood of groundwater emergence posing a risk to both surface and subsurface assets, based on predicted groundwater levels during a 1% AEP event. Surface water mapping and topographic data have been used to gain an understanding of the overland flow routes which may be impacted by this emergence.

The JBA Groundwater Emergence mapping is categorised into five different classes; a detailed description of the classes is in Table 4-4 below.

Table 4-4: JBA Groundwater Emergence Map category descriptions.

| Category | Potential risk |
|---|---|
| Groundwater levels are either at or very near (within 0.025m of) the ground surface. | Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity |

| Category | Potential risk |
|---|---|
| | to flow overland and/or pond within any topographic low spots. |
| Groundwater levels are between 0.025m and 0.5m below the ground surface. | Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally. |
| Groundwater levels are between 0.5m and 5m below the ground surface. | There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely. |
| Groundwater levels are at least 5m below the ground surface. | Flooding from groundwater is not likely. |
| No risk. | This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits. |

It should be noted that this data cannot form part of the Sequential Test as it is not directly comparable to other datasets (e.g. Flood Zones), and therefore cannot categorise an area as high, medium or low risk on its own. The map should be interpreted as an initial indicative tool to assess groundwater flood risk at preliminary stages of planning/site allocation. Where mapping indicates a risk of groundwater flooding a detailed assessment should be undertaken to confirm the risk to the site as part of any planning application, which may require ground investigations.

For development sites that are indicated to be at high risk from groundwater emergence (groundwater levels are within 0.025m of the ground surface), it is advised that on site investigations are conducted to determine the risk to the site. Groundwater flood risk within Three Rivers is concentrated in the floodplains of the Rivers Colne, Chess and Gade. Here, the chalk geology and permeable surface deposits can result in heightened groundwater levels at or just below the ground surface. This is the case for sites which are near watercourses. The settlements identified as at highest risk of groundwater flooding are Rickmansworth, eastern Croxley Green, western Loudwater and Oxhey.

### 4.7.1 Groundwater flooding and climate change

The impact of climate change is more uncertain for groundwater flooding associated with rivers and land catchments and those watercourses where groundwater has a large influence on winter flood flows. There is no technical modelling data available to assess climate change impacts on groundwater. Changes in frequency and intensity of groundwater flooding due to climate change would depend on the flooding mechanism and geological characteristics. Flood risk could increase when groundwater is already high or emerged, causing additional overland flow paths or areas of still ponding.

Milder wetter winters may increase the frequency of groundwater flooding incidents in areas that are already susceptible, but warmer drier summers may counteract this effect by drawing down groundwater levels to a greater extent during the summer months.

## 4.8 Reservoir flooding

The risk of inundation as a result of a breach or failure of a number of reservoirs within the area has been identified from the EA's Reservoir Flood Extents dataset (gov.uk). Although it is predicted that there is a risk to life if these reservoirs were to fail, the risk of such an event occurring is very low.

This dataset consists of flood extents for two scenarios including 'Wet Day' and 'Dry Day', for all large, raised reservoirs. The 'Dry Day' scenario shows flood extents in the event that reservoirs were to fail and release the water they hold when local rivers are at normal levels. The 'Wet Day' scenario shows flood extents in the event that reservoirs were to fail and release the water they hold when local rivers are in flood.

Flood extents are not included for smaller reservoirs or for reservoirs commissioned after the reservoir modelling programme began in October 2016. Furthermore, only those reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975.

A considerable area of Three Rivers District is identified as having a residual risk of reservoir flooding. There are no designated reservoirs within the district. However, the flood risk originates from Aldenham and Hillfield Park Reservoirs to the east, and is conveyed by the Rivers Chess and Colne, as well as the Hartsmere Brook. Mapping suggests that, due to the steep topography and well-defined river channels within the district, flood waters would be conveyed and confined within the floodplains of the main watercourses, rather than causing extensive flooding to additional low-lying areas of settlements. The extents should be taken into consideration as part of the site-specific Flood Risk Assessment.

## 4.9 Sewer flooding

Thames Water is the water and sewerage company responsible for the management of the sewerage networks across the Three Rivers District

Thames Water provided their sewer flooding register for the district from 2015 to the present day. Due to licencing and confidentiality restrictions, sewer data has not been represented on the mapping, but incidents within the same postcode location as a site were referred to within the detailed site assessments. The largest number of incidents within a single postcode area is recorded in WD3 (146 recorded incidents), which includes the settlements of Rickmansworth, Chorleywood and Croxley Green. A further area with many incidents is WD19 (100 incidents), which covers the areas of Oxhey and Carpenders Park. Section 4.6 of the Level 1 SFRA provides a more complete summary of sewer flood incidents recorded in the district. In the Level 2 site assessments, the density of incidents in the postcode area of a site has been considered as indication of likely risk from sewer flooding.

Information provided within the Thames Water Drainage and Wastewater Management Plan (DWMP) has also been evaluated for pertinent information that can be used in site assessments. In Section 2.3 of the Three Rivers Level 1 SFRA (2025)., further discussion is provided on why the information is not suitable for use at a catchment or more refined

scale. While there is an emphasis on future planning, the DWMP only evaluates flood risk for 3.3.% and 2% Annual Exceedance Probability (AEP) events. By comparison, fluvial, tidal and surface water modelling already used within the Sequential Test is for the 3.3%, 1% and 0.1% AEP events. Additionally, the future epochs considered in the DWMP are 2035 and 2050. The fluvial, tidal and surface water mapping used in the Sequential Test consider events up to 2080. On this basis, DWMP information and mapping cannot meaningfully be used to assess sewer flooding and as such, has not been used in this Level 2 SFRA.

Developers should contact Thames Water for further information on the risk of sewer flooding to the sites

### 4.10 Residual risk

Several sites assessed within the district are near culverted sections of watercourses which flow beneath roads, railway lines, and footpaths, and present a residual flood risk should they become blocked or collapse. Potential culvert blockages that may affect a site were identified on OS Mapping and the OS Open Rivers layer to determine where watercourses flow into culverts or through structures (i.e. bridges) in the vicinity of the sites. Any potential locations were flagged in the detailed site assessments.

Four sites within the district are located within proximity of raised flood defences which present a residual risk should they breach or be overtopped. These are:

- CFS32
- CFS60
- H22a
- NCFS35

Raised flood defences were identified using the EA AIMS Dataset or LLFA Asset Database.

### 4.11 Canal flooding

There is a risk of flooding from the Grand Union Canal, where it interacts with the River Colne at Rickmansworth and further downstream. Data received from the Canal and River Trust indicates that there have been two incidents of canal overtopping between Rickmansworth and West Hyde, in response to heavy rainfall and raised levels or overtopping of the River Colne. The incidents occurred in April 2013 and February 2014, largely affecting the canal towpath between Coppermill Lane and Coppermill Lock, with no damage to property reported. Unlike fluvial flood risk however, canal water levels can be controlled and contained within individual reaches through the use of locks, and therefore the risk can be contained. To evaluate flood risk from canals. a buffer zone of 100m was created around the canal embankments, and each potential development site in the study area was assessed against its proximity to the embankment.

## 4.12 Depth, velocity, and hazard to people

The Level 2 assessment seeks to map the probable depth and velocity of flooding as well as the hazard to people. The following depth mapping was included in the SFRA:

- Defended fluvial 3.33%, 1%, 1% plus climate change and 0.1% AEP
- Undefended fluvial 1% and 0.1% AEP
- Risk of Flooding from Surface Water 3.33%, 1% and 0.1% AEP
- Risk of Flooding from Surface Water 3.33%, 1% and 0.1% AEP plus Climate Change

Hazard to people has been calculated using the below formula as suggested in Defra's Supplementary note on flood hazard ratings and thresholds for development planning and control purpose (gov.uk). The different hazard categories are shown in Table 4-5. Developers should also test the impact of climate change depths, velocities, and hazard on the site, as part of the site-specific FRA.

Table 4-5: Defra's 'Flood Risks to People' classifications

| Description of Flood Hazard Rating | Flood Hazard Rating | Classification Explanation |
|---|---|---|
| Very Low Hazard/ Caution | <0.75 | 'Flood zone with shallow flowing water or deep standing water' |
| Danger For Some (i.e. children) | 0.75 - 1.25 | 'Danger: flood zone with deep or fast flowing water' |
| Danger For Most | 1.25 - 2.00 | 'Danger: flood zone with deep fast flowing water' |
| Danger For All | >2.00 | 'Extreme danger: flood zone with deep fast flowing water' |

## 4.13 SuDS suitability

The hydraulic and geological characteristics of each site have been assessed to determine the factors that potentially constrain schemes for surface water management. This assessment is designed to inform the early-stage site planning process and is not intended to replace site-specific detailed drainage assessments. A high-level assessment of suitability of SuDS is included in the site assessments in Appendix A.

The assessment is based on catchment characteristics using the following data:

- EA 1m LiDAR
- The British Geological Survey website (bgs.ac.uk) geology and soils mapping
- JBA Groundwater Emergence Mapping (see Section 4.7 for further details)
- Historic landfill sites
- Groundwater Source Protection Zones
- Nitrate Vulnerable Zones
- OS Open Watercourse
- RoFSW mapping

- Flood Zones derived as part of this Level 2 SFRA (see Section 4.3 for further details)

This data was then collated to provide an indication of particular groups of SuDS systems which might be suitable at a site. SuDS techniques were categorised into five main groups, as shown in Table 4-6.

Table 4-6: Summary of SuDS categories

| SuDS Type | Technique |
|---|---|
| Source Controls | Green Roof, Rainwater Harvesting, Rain Gardens |
| Infiltration | Infiltration Trench, Infiltration Basin, Soakaway, Pervious Pavements |
| Detention | Pond, Wetland, Subsurface Storage, Shallow Wetland, Extended Detention Wetland, Pocket Wetland, Submerged Gravel Wetland, Wetland Channel, Detention Basin |
| Filtration | Surface Sand Filter, Sub-Surface Sand Filter, Perimeter Sand Filter, Bioretention, Filter Strip, Filter Trench |
| Conveyance | Dry Swale, Under-drained Swale, Wet Swale |

The suitability of each SuDS type for the development sites has been described in the detailed site assessments, where applicable. The assessment of suitability is broadscale and indicative only; more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS.

## 4.14 Emergency Planning

Flood Warning Areas (FWAs) and Flood Alert Areas (FAAs) are detailed in the EA's GIS datasets and can be used to inform emergency planning. FAAs inform the EA when there is flooding first in the catchment, irrespective of properties, hence this coverage tends to apply to whole watercourses or stretch of coastline. FWAs are derived from the extreme flood outline (0.1% AEP event), focussed on communities, properties, and/or infrastructure. Modelled depth, velocity and hazard data can be used to understand safe access and escape routes for each site.

# 5 Level 2 Assessment Methodology

This section outlines how sites were screened against flood risk datasets to determine which sites required a Level 2 detailed site assessment. It also identifies other sites, referred to in this SFRA as 'amber sites', at lower risk with general recommendations for developers.

## 5.1 Site screening

Three Rivers District Council provided 368 sites for assessment. These sites were screened using an 'overlap analysis' tool in GIS. This analysed various flood risk datasets against the site allocations layer and calculated the percentage cover for each flood risk dataset against each site. This was used to provide a summary of risk to each site, including:

- the proportion of the site in each Flood Zone derived from the EA's NaFRA2 FMfP and detailed hydraulic model outputs (see Section 4.2 for a summary of how the Flood Zones were derived for this SFRA).
- the proportion of the site affected by climate change within the EA's NaFRA2 FMfP plus Climate Change dataset.
- whether the site is shown to be at risk from surface water flooding in the RoFSW mapping for the 3.3%, 1%, and 0.1% AEP events, and the RoFSW plus Climate Change dataset for the 3.33% and 1% AEP events.
- whether the site is within, or partially within, the reservoir 'Dry Day' or 'Wet Day' flood extents.
- whether the site is within, or partially within, the EA Historic Flood Map dataset.
- whether the site contains a watercourse shown within the ordinary watercourses layer provided by HCC.
- whether the site is within 100m of a canal.
- whether the site is >10% within highest risk category in JBA Groundwater map (where groundwater is <0.025m below the surface in the 1% AEP event).

The results of the screening provide a quick and efficient way of identifying sites that are likely to require a Level 2 assessment, assisting Three Rivers District Council with Sequential Test decision-making so that flood risk is taken into account when considering allocation options. A spreadsheet was prepared for the 368 sites assessing them against the criteria detailed above. The site screening spreadsheet is included in Appendix D of this report.

The screening also provides an opportunity to identify sites which may show to be 100% in Flood Zone 1, but upon visual inspection in GIS, have an ordinary watercourse flowing through or adjacent to them. Although there are no Flood Zone maps available for these watercourses, it does not mean the watercourse does not pose a risk, it just means no modelling has yet been undertaken to identify the risk.

Flood Zones are not provided for specific sites or land where the catchment of the watercourse falls below 3km². For this reason, the Flood Zones are not of a resolution to be used as application evidence to provide the details of possible flooding for individual properties or sites and for any sites with watercourses on, or adjacent to the site. The RoFSW has been used to assess flood risk in these cases because it is comparable to fluvial flooding from smaller watercourses and is therefore a reasonable representation of the floodplain of such watercourses to use for a strategic assessment.

## 5.2 Sites taken forward to a Level 2 assessment

Only 72 of the 368 sites which were identified by Three River District Council as having potential for development. Of these 72 sites, 33 were identified as being at some level of flood risk using the criteria above.

Further analysis was undertaken for these sites, assessing flood risk from fluvial, groundwater and surface water flooding  sources . Sites were taken forwards for assessment if greater than 10% of the site area was within the following flood extents:

- Fluvial 1% Annual Exceedance Probability (AEP) plus climate change (using the Environment Agency Flood Zone plus Climate Change dataset)
- Surface water 0.1% AEP flood event.

The historical flood risk, residual flood risk and groundwater flood risk was also considered for each site, along with location within Flood Warnings/Alert areas, as well as the presence of flood risk management structures and defences. Access and escape were then also assessed for each site, identifying areas of the surrounding road network with flood depths greater than 300mm for both fluvial and surface water flooding.

Out of the 33 sites, 29 sites were identified as potentially requiring a Level 2 assessment. The following four sites were removed, the justification for this is provided in Table 5-1.

Table 5-1 Sites removed from Level 2 assessment

| Site reference | Site name | Justification |
|---|---|---|
| CFS18 | Hill Farm, Stag Lane, Chorleywood | This site is not at risk of fluvial flooding or groundwater flooding.<br>The RoFSW mapping shows that 0.3% of the site is within the 1% AEP surface water event. This increases to 0.5% in the 0.1% AEP event. This is shown only as ponding at topographic low points in the site and is not associated with external flow paths. There is no flooding present outside of the site boundary along access roads.<br>There are no flood defences or assets identified as being in proximity to the site. The records show that are no significant historic flooding events have occurred near the site. |

| Site reference | Site name | Justification |
|---|---|---|
| CFS40a | Land at Park Road | The Upper Colne (2025) model shows that 0.3% of the site is in Flood Zone 2.<br>The RoFSW mapping shows that there is surface water flood risk up to the 3.33% AEP event, which affects up to 3% at the site. This increases to 4.7% in the 0.1% AEP event. The surface water flood extents are largely coincident with fluvial flood extents. However, flooding only affects the periphery of the site in the 0.1% AEP fluvial and surface water events.<br>While flooding is present around the site, flood depths remain shallow on surrounding roads and access and escape is possible for both the fluvial and surface water events. |
| EOS7.0 | Land to the south of Shepherds Lane and west of the M25 | This site is not at risk of fluvial flooding or groundwater flooding.<br>The RoFSW mapping shows that 0.5% of the site is within the 1% AEP surface water event. This increases to 0.6% in the 0.1% AEP event. Flooding occurs at a topographic low point in the site and is not associated with external flow paths.<br>Up to the 0.1% AEP surface water event, only shallow flooding is predicted at the site boundary and on access roads (less than 0.2m). |
| NSS1 | 1 Denham Way, Maple Cross | This site is not at risk of fluvial flooding.<br>The RoFSW mapping shows that 2.1% of the site is within the 0.1% AEP surface water event. There are no external flow paths affecting the site. Only ponding occurs at a low point within the site.<br>Access roads are unaffected by flooding. |

The key points for the 29 sites taken forward are listed in Table 5-2 below, full details are provided in Appendix A.

Table 5-2 Site summary table key points

| Site reference | Site name | Key points |
|---|---|---|
| AB26 | Garages Tibbs Hill Road | The site has been identified to be at low risk of fluvial flooding due to its location within Flood Zone 1.<br>Up to 20% of the site is at risk of surface water flooding in the 0.1% AEP event, affecting the central part of the site. |

| Site reference | Site name | Key points |
|---|---|---|
| | | Maximum flood depths and velocities are predicted to reach 0.30-0.60m and 0.5-1m/s respectively. These high depths and velocities are found in the north-eastern part of the site, resulting in a maximum hazard classification of 'Moderate'. With the application of the central allowance (20%) to the 0.1% AEP event, the surface water extent is predicted to increase to 30.5% of the site. The predicted peak depth, hazard and velocity do not significantly increase. Safe access is available to the west of the site to Tibbs Hill Road in all events.<br>The site is low risk of groundwater flooding; the mapping suggests that groundwater levels are more than 5m below the ground surface during a 1% AEP groundwater flood event. |
| AB31 | Garages Jacketts Field | The site has been identified to be at low risk of fluvial flooding due to its location within Flood Zone 1.<br>Approximately 12.5% of the site is affected by flooding in the 3.33% AEP event. There is a single surface water flow path originating outside the site boundary which enters the site from the southeast.<br>Access to the site is likely to be affected during a 1% AEP and greater surface water event. Developers will need to demonstrate that safe access can be achieved in the 1% AEP event, including an allowance for climate change.<br>The site is at low risk of groundwater flooding; the mapping suggests that groundwater levels are more than 5m below the ground surface during a 1% AEP groundwater flood event. |
| ACFS1 | Heath House, Rickmansworth Road | The site has been identified to be at low risk of fluvial flooding due to its location within Flood Zone 1.<br>Up to 16% of the site is predicted to flood during the 1% AEP event and approximately 34% in the 0.1% AEP event. Surface water ponding during these events affects a central part of the site. Access to the site through the A404 is unaffected up to the 0.1% AEP, as flood depths are predicted to remain below 0.3m.<br>The site is at low risk of groundwater flooding; the mapping suggests that groundwater levels are more than 5m below the ground surface during a 1% AEP groundwater flood event. |

| Site reference | Site name | Key points |
|---|---|---|
| ACFS10 | Andrews Ley Farm, Harefield Rd | The site has been identified to be at very low risk of fluvial flooding due to its location within Flood Zone 1.<br>The site is at high risk of surface water flooding. It is predicted that up to 54% of the site is at risk during the 3.33% AEP event, this increases to 56% and 60% in the 1% AEP and 0.1% AEP events respectively. The flow path affecting the site originates from an unnamed watercourse southwest of the site boundary, bisecting Harefield Road, adjacent to the site. A deep area of flooding is predicted to form within the central part of the site.<br>While flood depths along Harefield Road remain shallow (less than 0.2m) up to the 1% AEP event, significant hazard is predicted. Access to the site is affected in the 1% AEP event due to depth of flooding predicted (up to 0.6m) and the flood hazard class of 'Extreme'. |
| ACFS8b | Flower House 2-3 Station Road | The site is identified to be at risk of fluvial flooding. The Mill Stream (Main River) flows adjacent to the western site boundary.<br>The site is situated 5.8% in Flood Zone 3b, and 8.2% in Flood Zone 2 and 3a. While the site is in proximity to the watercourse, the modelling predicts that floodwaters largely remain in channel and do not inundate access roads. However, the watercourse is culverted to the north-west of the site, therefore there is residual risk of flooding from blockages. A site-specific Flood Risk Assessment should assess the impact of a blockage on flood risk.<br>Surface water flooding is not predicted to affect this site or the access and escape for the site. Shallow groundwater is predicted across much of the site, with up to 32% of the site shown to have groundwater levels less than 0.025m below the ground surface during a 1% AEP groundwater flood event. The areas of highest risk are coincident with the fluvial floodplain. A site-specific Flood Risk Assessment should confirm the risk to the site. |

| Site reference | Site name | Key points |
|---|---|---|
| BR20 | Northwick Day Centre | The site has been identified to be at very low risk of fluvial flooding due to its location within Flood Zone 1.<br>The mapping shows that up to 4.5% of the site is predicted to be at risk during the 3.33% AEP surface water event, increasing to 6% and 12% in the 1% AEP and 0.1% AEP events respectively. There is also a minor flow path within the site, where there is an accumulation of surface water at a topographic low spot. Additionally, a westward flow path is shown to affect Northwick Road which is the primary access for the site. However, flood depths are predicted to remain shallow until the 0.1% AEP event. |
| CFS14 | Land North of Oxhey Lane | The site is identified as being in Flood Zone 1. Oxhey Brook flows along the southern border of the site. Fluvial flood risk from Oxhey Brook is not represented in the Flood Map for Planning or in the hydraulic models at this location.<br>The RoFSW mapping represents the flood extents associated with Oxhey Brook. This site remains outside the 0.1% AEP extents associated with flooding from Oxhey Brook. There is some isolated ponding in the northwest of the site. Approximately 4% of the site is at surface water risk in the 3.33% AEP, which increases to 5% in the 1% AEP event and up to 10% in the 0.1% AEP event. The predicted extents do not affect the access road for the site.<br>A significant proportion of the site is within an area designated as a historic landfill site (Auburn Mere). |

| Site reference | Site name | Key points |
|---|---|---|
| CFS20 | Land at Croxley Station, Watford Road | The site has been identified to be at low risk of fluvial flooding due to its location within Flood Zone 1. The River Gade and the Grand Union Canal are located approximately 250m east of Croxley Station.<br>Surface water flood risk to the site is predicted in the 3.33% AEP event. However, this is mostly accumulation of surface water along the railway line. About 5% of the site is predicted to be at risk in 3.33% AEP, this increases to approximately 12% in the 1% AEP and 20% in the 0.1% AEP. Away from the railway line, the site is unaffected, Flood depths are predicted to remain below 0.3m until the 0.1% AEP event.<br>Watford Road, which is the access road for the site, is unaffected by surface water flooding up to the 0.1% AEP event. |
| CFS32 | Land at Lynsters Farm, Maple Cross | This is site is identified as being at risk of fluvial flooding from an unnamed tributary of the Colne that flows 100m from the boundary of the site.<br>The Upper Colne 2025 model shows that 44% of the site is situated in Flood Zone 3a, and 60% in Flood Zone 2.<br>Surface water flood risk is predicted within the 3.33% AEP event. Less than 3% of the site is affected in the 3.33% AEP event, this extends to 11% in the 1% AEP event and 34% in the 0.1% AEP event.<br>The greatest flood depths in the fluvial and surface water events occur primarily in the southwest part of the site. Flooding is not predicted to affect access roads to the site up to the 0.1% AEP surface water and fluvial flood events.<br>The entire site is at high risk of groundwater flooding. Groundwater mapping indicates that across the entire site groundwater levels are estimated to be either at or within 0.025m of the ground surface during a 1% AEP groundwater event.<br>The site is also identified to be at risk of flooding from Hilfield Park Reservoir, in the unlikely event of a breach. |

| Site reference | Site name | Key points |
|---|---|---|
| CFS36 | Land at Junction 17 of M25 | The site has been identified to be at very low risk of fluvial flooding due to its location within Flood Zone 1.<br>The RoFSW map predicts a low risk of surface water flooding. Less than 1% of the site is at risk from surface water events up to the 1% AEP event. This only increases to 1% in the 0.1% AEP event. Surface water flows past the eastern border of the site, flowing southwards. Access to the site is possible in the 1% AEP event, but 'significant' hazard is predicted for a small region of the A412 roundabout. In the 0.1% AEP event, this increases to high hazard due to an increase in flood depths up to 0.6m.<br>The mapping suggests that this flow path enters a culvert adjacent to the site, under the A412 road. Blockage modelling should be carried out as part of a site-specific Flood Risk Assessment to understand the residual risk to the site. |
| CFS39B | Land to the east of Merchant Taylors School | The site is located approximately 30m west of the River Colne. A very small proportion of the site is within Flood Zone 2 (0.4%). Outside of this area, fluvial risk to the site from the River Colne is very low. There is a unnamed watercourse present immediately east of the site. The RoFSW mapping was used to assess risk from the watercourse.<br>Surface water flooding is predicted to affect the site during the 3.33% AEP and greater events. There are two main flow paths that are the source of risk to the site. These are surface water runoff from the northwest, which is associated with a large area of ponding, and from the southeast, where flows are conveyed by Hampermill Lane. The southeastern flow path follows the watercourse north towards the River Colne. The north eastern flow path only affects the site in the 1% AEP. Up to the 1% AEP, flooding within the site boundary is limited to a topographic low point in the northeast and minor flooding in the northwest. Flood depths along Hampermill Road only become significant in the 0.1% AEP, but access and escape are possible south of the site via Sandy Lodge, which remains at very low risk of flooding.<br>Very shallow groundwater levels (<0.025m) are predicted across approximately 34% of the site, |

| Site reference | Site name | Key points |
|---|---|---|
| | | primarily in the lower lying region in the northern part of the site.<br>A small proportion of the site (1%) is at risk of reservoir flooding from the Hilfield Park, in the unlikely event of a breach. |
| CFS55 | Land at Station Road, Kings Langley | A significant proportion of the site (30%) is located within Flood Zones 2 and 3 due to fluvial risk from the Mill Stream (a Main River) that flows through the site and an unnamed watercourse in the southwest of the site. However, flood waters remain in-channel in flood events up to and including the 0.1% AEP event, therefore the majority of the site is within Flood Zone 1. The highest flood depths and hazard are located in the river channel. Elsewhere the predicted flood depths (<0.25m) and velocities (<0.25m/s) and hazard class ('Low - caution') are low.<br>The site is at surface water flood risk during the 3.3%, 1% and 0.1% present day AEP events. Significant flood depths are not predicted within the site boundary in areas away from the watercourse. However, flow paths are shown to affect access roads to the site in the 3.33% AEP and greater event.<br>Mapping suggests that most of the site (79%) is at very high risk of groundwater emergence, with groundwater levels estimated to be within 0.025m of the ground surface during a 1% AEP groundwater event. |
| CFS60 | Affinity Water Depot, Church Street | The River Colne flows through the centre of the site. As such, most of the site is at high risk of fluvial flooding, with 86% of the site located within Flood Zone 3b. Significant flood depths and hazard are predicted within the site boundary and along access roads for the site. The Grand Union Canal is also located at the northern boundary of the site. Through this reach, the Grand Union Canal and the River Colne merge and share the same channel.<br>A small percentage of the site (up to 10%) is at surface water flood risk up to the 0.1% AEP event. Flood depths and hazard remain low within the site boundary. However, significant flood depths and hazard are predicted along the access routes to the site during the 1% AEP surface water event. |

| Site reference | Site name | Key points |
|---|---|---|
| | | The site is at moderate to high risk of groundwater flooding. Across most of the site, groundwater levels are predicted to reach between 0.5 – 5m below the ground surface during a 1% AEP groundwater flood event.<br>The site is at risk of reservoir flooding in the unlikely event of a breach on Aldenham Reservoir and Hilfield Park Reservoir. |
| CFS61 | Cinnamond House | The site is located 50m west of the River Gade and Grand Union Canal. There is also a railway line 50m to the north. A very small proportion of the site is within Flood Zone 2 (0.4%). Elsewhere the site is at very low fluvial risk.<br>The site is at significant risk from surface water flooding during the 1% and 0.1% present day AEP events. Up to 65% of the site is affected in the 0.1% AEP event. Flooding occurs in the north-west corner against the railway embankment and near the existing buildings in the 3.33% AEP event, but flood depths only exceed 0.2m in the 1% AEP event. Peak flood depths up to 0.6m and velocities up to 0.5m/s are predicted in the 0.1% AEP event. Access to the site is likely to be via A412 Rickmansworth Road or Baldwins Lane. Baldwins Lane has the greatest risk of flooding from surface water, and access on this route from the north is likely to be restricted during the 3.3% AEP and greater surface water events. These issues pose significant obstacles for development.<br>Groundwater levels are predicted to be between 0.25m and 0.5m below the ground surface during a 1% AEP groundwater flood event. The site is outside of the highest groundwater flood risk category, but risk is substantial and there is a likely risk to surface and subsurface assets during a groundwater flood event. |
| CFS70 | Croxley Business Park | The River Gade forms the boundary of both parcels of land that constitute the site. The site is predominantly located within Flood Zone 1, with small areas along the southern and eastern boundaries falling within Flood Zones 2, 3a, and 3b. Maximum flood depths reach up to 1.93 m (in the river channel), and hazard classifications range from 'Moderate' to 'Significant'. Climate change modelling indicates a slight increase in fluvial flood extent, confirming the site's sensitivity to future river flow increases.<br>Surface water flood risk is limited to the 0.1% |

| Site reference | Site name | Key points |
|---|---|---|
| | | AEP event, with shallow depths (0.2-0.3 m), low velocities (≤0.025 m/s), and a 'Low' hazard rating. Climate change scenarios show a minor expansion of ponded areas. Access routes to the site via Hatters Lane and Woodshots Meadow are unaffected up to the 0.1% AEP event.<br>Groundwater emergence is a key consideration, particularly in the northern parcel where levels are predicted to be very near the surface (<0.025m). |

| Site reference | Site name | Key points |
|---|---|---|
| CFS72 | Land off Solesbridge Lane | An ordinary unnamed watercourse forms the eastern border of the site. The site is located within Flood Zones 2 and 3 in the present-day fluvial flood model. This site is sensitive to climate change, with the Central (21%) allowance climate change expanding Flood Zone 2 to 15.9% of the site and Flood Zone 3a to 8.4%, primarily affecting the northeastern boundary.<br>The site is located outside of the extents of available detailed modelling. As such, modelling should be undertaken as part of a site-specific Flood Risk Assessment.<br>Surface water flood risk is minor, affecting only 0.2% of the site at the northeastern boundary during the low-risk (0.1% AEP) event, with shallow depths (0.2m), no velocity, and a 'Low' hazard classification. No risk is present in medium (1% AEP) or high (3.3% AEP) events.<br>Groundwater flood risk is potentially significant in the eastern boundary, where groundwater levels are predicted to be at or near the surface (within 0.025 m) during a 1% AEP groundwater flood event, with ponding predicted to form in the northeastern corner due to low elevations.<br>Access to the site is likely via Solesbridge Lane. It is located within Flood Zone 1, but a small, localised area of surface water flooding is predicted in the 0.1% AEP event, near the southern boundary of the site. However, the maximum depth of flooding is 0.2m, which is unlikely to prevent safe access.<br>The northeastern boundary of the site is at risk from the Latimer Lakes reservoir (in the unlikely event of a reservoir breach).<br>There is also residual risk in the event of blockage to a culvert below the M25, located near the site. Blockage modelling should be carried out as part of a site-specific Flood Risk Assessment to understand the residual risk to the site. |
| CG47 | Garages off Grove Crescent | The site is at very low fluvial flood risk and is located in Flood Zone 1.<br>Surface water flooding is present on site from the 3.33% AEP event, where 14% of the site is at risk due to ponding within the site. The RoFSW plus climate change mapping indicates only a slight increase in surface water flooding compared to present-day conditions, with overall patterns |

| Site reference | Site name | Key points |
|---|---|---|
| | | remaining consistent. In the 0.1% AEP event, depths are mostly below 0.2m. Hazard remains at low for all events up the 0.1% AEP event.<br>Historic records show flood incidents in the vicinity of the site, mainly pertaining to blocked or insufficient drainage.<br>Access to the site will be available from Grove Cresent and Baldwins Lane. Both routes are unaffected up by fluvial flooding up to the 0.1% AEP (Flood Zone 2) plus central climate change event. Grove Cresent is flood free in the 0.1% AEP surface water event. Baldwins Lane shows a small, localised area of flooding in this event, but the predicted flood depths are all below 0.2m, thus safe access is likely to be possible.<br>The site is low risk of groundwater flooding; the mapping suggests that groundwater levels are predicted to lie more than 5m below the ground surface during a 1% AEP groundwater flood event.<br>Due to the change in use from its current use (garages) to residential development, there is an increase in vulnerability classification from 'Less Vulnerable' to 'More Vulnerable'. |
| CW9 | Garages at Copmans Wick | The site is in Flood Zone 1 and is at very low risk of fluvial flooding.<br>The southern and eastern areas of the site are at risk of surface water flooding from a surface water flow path originating to the south-west during the 0.1% AEP event. The site shows a mild sensitivity to climate change, the 0.1% AEP extent increases and extends into the site when the central climate change allowance is applied.<br>The site is at low risk of groundwater flooding; the mapping suggests that groundwater levels are predicted to lie more than 5m below the ground surface during a 1% AEP groundwater flood event.<br>The entire site is at risk from the Heronsgate Reservoir No.3 reservoir (in the unlikely event of a reservoir breach). |
| H15 | Garages rear of Drillyard, West Way | The site is located entirely in Flood Zone 1, and is therefore at very low risk of fluvial flooding.<br>The site contains an area of predicted surface water pooling between two rows of garages on site. Under the present-day scenario in the RoFSW mapping, the site is predicted to flood in |

| Site reference | Site name | Key points |
|---|---|---|
| | | the low risk 0.1% AEP event, with floodwater depths keeping below 0.2m with no velocity or hazard classification There is low sensitivity to climate change at this site, as there is no increase in extent predicted<br>Groundwater levels are indicated to lie between 0.5 and 5m below the ground surface during a 1% AEP groundwater flood event therefore the site is moderately susceptible to flooding. |
| H22a | Depot, Stockers Farm Rd | The north-east section of the site is shown to be at significant risk of fluvial flooding as it is in Flood Zones 2 and 3. Approximately 26% is identified as being location in Flood Zone 2, with up to 12.7% in Flood Zone 3b. However, fluvial risk to the site is exacerbated in the defended scenarios due to the inclusion of the Grand Union Canal downstream of Stockers Lock. As such, defended modelling should be used as the 1% AEP plus climate change design fluvial events. The 1% AEP plus 35% climate change event predicts that 26% of the site is at risk.<br>Most of the site is at significant surface water flood risk during the 3.3%, 1% and 0.1% present day AEP events. 55% of the site is affected by flooding from the 3.33% AEP event. Two flow paths primarily affect the site, from the northeast and the south.<br>The access roads for the site, Stocker Farm Road and Harefield Road are at risk of flooding from the 3.33% AEP fluvial and surface water events.<br>Groundwater levels are estimated to be between 0.5 and 5m below the ground surface during a 1% AEP groundwater flood event. Therefore, there is a risk of flooding to subsurface assets and below ground development such as basements.<br>Reservoir flooding mapping shows that the entire site is at risk from reservoir flooding if there was a breach from the Harefield No.3 reservoir.<br>There are significant constrains to the development of this site. |
| NCFS15 | Chorleywood Library | The FMfP shows that the site is located entirely within Flood Zone 1, therefore it is not identified to be at fluvial flood risk in the present or for the 0.1% AEP plus climate change event (Flood Zone 2 plus central climate change allowance).<br>Up to 17.1% of the site is affected by surface |

| Site reference | Site name | Key points |
|---|---|---|
| | | water flooding during the 0.1% AEP event, with depths between 0.3 m and 0.6 m and a hazard classification of Significant.<br>Under climate change scenarios, the extent of surface water flooding increases slightly to 13.3% for the 1% AEP plus 20% uplift, with depths remaining between 0.3 m to 0.6 m and hazard remaining Moderate.<br>Lower Road, which is the access road for the site, is shown to be at risk of surface water flooding during the 1% AEP plus climate change event, with most depths below 0.2 m but some areas reaching 0.3 m to 0.6 m.<br>Groundwater flood risk is low, with groundwater levels predicted to lie more than 5m below the ground surface during a 1% AEP groundwater flood event. However, pooling could occur along the western boundary in the site's topographical low point if groundwater emergence occurred. |
| NCFS26 | Meresworth | The FMfP shows that the site is located entirely in Flood Zone 1 and is not identified to be at fluvial risk up to the 0.1% AEP plus climate change event (Flood Zone 2 plus central allowance).<br>Up to 12% of the site is affected by a surface water flow path from the southwest of the site during the 0.1% AEP event, with depths below 0.2m, peak velocities up to 0.25m/s and a maximum hazard classification of 'Low'.<br>Along Uxbridge Road, which is the main access road for site, shallow flood depths (<0.2m) are predicted. Peak velocity reaches 0.5m/s but hazard remains 'Low'.<br>The site is at moderate risk of groundwater flooding during a 1% AEP event, with ground water predicted to be within 0.5m and 5m of the ground surface during a 1% AEP groundwater flood event. Emerging groundwater is likely to follow the south-north gradient of the site. |
| NCFS34 | Pinewood Lodge | The FMfP shows that the site is located entirely in Flood Zone 1 and is not identified to be at fluvial risk up to the 0.1% AEP plus climate change event (Flood Zone 2 plus central allowance).<br>The site is at risk of surface water flooding in the 3.33%, 1% and 0.1% AEP events. During the 3.33% AEP event, ponding occurs in the southern part of the site, covering 11% of the site. The area of ponding extends slightly during the 1% |

| Site reference | Site name | Key points |
|---|---|---|
| | | but there is a significant increase in extent in the 0.1% AEP event to 50% of the site. Peak flood maximum flood depths are between at 0.3-0.6m, with small areas of deeper ponding (up to 0.9m) along the southeast corner of the existing building. Additionally, a surface water flow path originating from the eastern boundary affects the site in the 0.1% AEP event. The convergence of these two pathways in the 0.1% AEP events results in flood depths of up to 0.6m across most of the site. |
| NCFS35 | Land south of Chalfont Lane | The site is bisected laterally by Tilehouse Lane. The southern section of site is shown to be at high risk of fluvial flooding as it is in Flood Zone 3b. Flood flows enter the site from the east, conveyed from Pynesfield Lake, which provides flood storage for the Colne at this location. An ordinary watercourse flows along the eastern border of the site.<br>The northern section of the site is at significant surface water flood risk during the 3.3%, 1% and 0.1% present day AEP events. About 5% of the site is affected in the 3.33%, this increases up to 17% in the 0.1% AEP. Surface water risk at this site is largely characterised by deep areas of ponding (up to 0.6m), which also affects Watford Road which is likely the main access for this site.<br>Very shallow groundwater levels (less than 0.025m below the ground surface) are predicted for 28% of the site during a 1% AEP groundwater flood event. There is a variation in groundwater levels across the site, therefore there is potential for groundwater to emerge at the topographic lows in the east of the site. |
| NSS10 | Land at Mill Place | A small proportion of the site is located within Flood Zone 3b. Only 1% of the site is at risk of fluvial flooding in the 0.1% AEP event (Flood Zone 2). In this area, the River Gade and Grand Union Canal merge, so flows and water levels in the channel are controlled.<br>The site is at moderate risk of surface water flooding; flooding is predicted from the 3.33% AEP where 5% of the site is affected. Up to 8% and 17% of the site is shown to be at surface water risk in the 1% and 0.1% AEP surface water events. The highest areas of risk are associated with ponding in the northern and northwestern |

| Site reference | Site name | Key points |
|---|---|---|
| | | parts of the site. Access via Watford Road is possible up to the 0.1% AEP event.<br>Mapping show that very shallow groundwater levels (within 0.025m of the ground surface) are predicted across approximately 22% of the site during a 1% AEP groundwater flood event, primarily in the northeast of the site. |
| OSPF6 | Land west of Leavesden Aerodrome, Hunton Bridge | The River Gade flows in close proximity to the eastern border of the site, but the site remains in Flood Zone 1 up to the 0.1% AEP plus climate change event (Flood Zone 2 plus central allowance).<br>Old Mill Road and Watford Road are likely to be the primary access for the site. Both routes remain mostly at very low risk of flooding until the 0.1% AEP plus central climate change event (Flood Zone 2), where the roads are predicted to flood extensively. As<br>Mapping show that shallow groundwater levels (between 0.025m and 0.5m of the ground surface) are predicted to occur across approximately 22% of the site during a 1% AEP groundwater flood event, primarily in the northeast of the site. |
| PCS2 | East Carpenders Park | The FMfP shows that the site is located entirely within Flood Zone 1, therefore it is not identified to be at fluvial flood risk under present or for the 0.1% AEP plus climate change event (Flood Zone 2 plus central allowance).<br>A prominent westward surface water flow path is predicted to affect the site from the 3.33% AEP event, primarily in the southeast of the site. Flood extents within the site are constrained to the southeast of the site, with 6% of the site in the 3.33% event, this increases to 7.5% and 10% in the 1% AEP and 0.1% AEP. Maximum flood depths of up to 0.6m are predicted within the site boundary in the 1% AEP, this increases to 0.9m in the 0.1% AEP. However, the highest flood depths are only predicted near the eastern border, elsewhere in the site areas of ponding are predicted to be limited to 0.6m.<br>Due to the proximity of the Hartsbourne Flood Storage Area and its embankments, there is a localised increase in fluvial flood risk to the Oxhey Lane predicted during the 0.1% AEP undefended and 1% AEP plus central climate change |

| Site reference | Site name | Key points |
|---|---|---|
| | | defended fluvial extents. Surface water mapping used in this assessment, also suggests that access is severely impeded from the 3.33% AEP and higher surface water events.<br>There is residual risk of flooding from the Hartsbourne Stream culvert at Oxhey Lane and from the Hartsbourne Flood Storage Area in the highly unlikely event of a reservoir breach. Blockage modelling should be carried out as part of a site-specific Flood Risk Assessment to understand the residual risk to the site. |
| PCS47 | South of Little Oxhey Lane | The site is located entirely in Flood Zone 1 in the Flood Map for Planning. However, there are two unmapped watercourses within the site boundary. The risk of flooding from these watercourses should be determined within a site-specific FRA.<br>Surface water flooding is predicted for the site from the 3.33% AEP event, affecting 6% of the site. This increases to 7.5% and 10% in the 1% AEP and 0.1% AEP respectively. Flood extents are predicted to be concentrated along watercourses and land drains, with the largest extent at the eastern watercourse.<br>Access to the site is available from B4542 Little Oxhey Lane, the A4008 Oxhey Lane, that is adjacent to the eastern boundary of the site. Both routes are unaffected by fluvial flooding up to the 0.1% AEP event. Both roads are at risk of flooding from surface water during the 0.1% AEP event, but flooding is localised and depths do not exceed 0.3m so access is likely still possible.<br>The eastern watercourse is culverted on Oxhey Lane, therefore there is residual risk of flooding. A site-specific Flood Risk Assessment should assess the impact of a blockage on flood risk. |

| Site reference | Site name | Key points |
|---|---|---|
| RW31 | Garden land off Uxbridge Road | The site is in Flood Zone 1, so it is not identified to be at fluvial risk.<br>The site is at low risk of surface water flooding. Under the present-day scenario, the site is predicted to flood in the low risk 0.1% AEP event, with floodwater reaching a maximum depth of 0.3m and a velocity of 2m/s, resulting in a significant hazard classification. No flooding is predicted during the 3.3% or 1% AEP events.<br>The modelled climate change scenarios show an increase in surface water flood risk. In the 1% AEP plus climate change event, the site experiences flooding covering approximately 5.7% of the site within an area of low topography. Maximum flood depths are very shallow 0.2m with no velocity (0 m/s), meaning most of the area is classified as Low hazard, except for a small Moderate hazard zone at the centre of the site.<br>The site is likely to be accessed from the southern boundary via the A412 and Uxbridge Road. Access routes are unaffected up to the 1% AEP fluvial and surface water events.<br>The site is at moderate risk of groundwater flooding; the mapping suggests that groundwater levels are expected to be between 0.5 and 5m below the ground surface during the 1% AEP groundwater flood event. |

## 5.3 Detailed site assessments

As part of the Level 2 SFRA, detailed site assessments have been produced for the 29 sites identified in Section 5.2. The site assessments can be found in Appendix A with the mapping shown in Appendix 0. Table 5-3 sets out the information contained within each section of the site assessment.

Table 5-3: Summary of the information within each section of the detailed site assessments.

| Section | Information |
|---|---|
| 1. Background | • Location of the site<br>• Area, current land use (greenfield/brownfield), proposed site use<br>• Topography of the site<br>• Geology and soil characteristics |

| Section | Information |
|---|---|
| 2. Sources of flood risk | • Location of the site within the catchment<br>• Existing drainage features<br>• Fluvial – proportion of site at risk including description from mapping/modelling, utilising depth, hazard, and velocity information from detailed hydraulic models where available<br>• Surface Water – proportion of site at risk including description from RoFSW mapping using available depth, hazard, and velocity information<br>• Reservoir flood risk in both the 'Dry Day' and 'Wet Day' scenarios<br>• Groundwater emergence risk<br>• Sewer flood risk - reported incidences within the site and any additional known risks identified by Thames Water<br>• Flood history - historic incidents on or surrounding the site from the EA Recorded Flood Outline and Historic Flood Map datasets |
| 3. Climate Change | • Fluvial climate change - summary of available climate change allowances and increase in flood extent compared to the 1% AEP event<br>• Surface water climate change - summary of available climate change allowances and increase in flood extent compared to the 1% AEP event |
| 4. Flood risk management infrastructure | • Flood risk management infrastructure<br>• Description of residual risk |
| 5. Emergency planning | • Flood warnings and alerts<br>• Access and escape routes |
| 6. Requirements for drainage control and impact mitigation | • Broadscale assessment of possible SuDS to provide indicative surface water drainage advice for each site assessed for the Level 2 SFRA.<br>• Identification of potential SuDS constraints including Groundwater Source Protection Zones, Nitrate Vulnerable Zones and historic landfill sites |
| 7. NPPF and planning implications | • Exception Test requirements<br>• Requirements and guidance for site-specific Flood Risk Assessment<br>• Guidance for site design and making development safe |
| 8. Conclusions | • Summary of key risks to the site<br>• Summarising considerations if development proceeds |

## 5.4 Sites not taken forward to a Level 2 assessment

Sites that were identified as not requiring a Level 2 assessment may still have some constraints. It is therefore critical that the flood risk at each development site including access and escape is considered to prepare the necessary documentation (for example a Flood Response Plan) and gain the appropriate advice.

Sites can still be allocated but should be assessed as part of an individual site-specific assessment and should have a Flood Response Plan produced to further consider access and escape on a site-specific basis. Residents should sign up to Flood Warnings and Alerts where these are available. Please refer to Paragraph: 047 of the Flood and Coastal Change section of the PPG for further details on access and escape.

# 6 Flood risk management requirements for developers

The flood risk management requirements and guidance for developers are detailed within the **Section 7 and 8 of the Level 1 SFRA**. Users should refer to these sections for guidance on site-specific FRAs and principles for managing flood risk in new development.

This contains details on:

- early consultation with statutory and non-statutory consultees;
- requirements for site-specific FRAs, including signposting to specific guidance; and
- emergency planning.

The sections below contain further information on emergency planning and the requirements for developer contributions.

## 6.1 Emergency planning

Safe access and escape routes from the site should be provided. The developer should seek to incorporate an emergency plan and a safe refuge point if the development site has been identified to be at risk of flooding. The local authority and Emergency Services should be consulted when designing an emergency plan.

This Level 2 assessment has identified 11 proposed sites located within existing EA FWAs and/or FAAs:

- ACFS8b
- CFS32
- CFS39B
- CFS55
- CFS60
- CFS61
- CFS70
- CFS72
- H22a
- NCFS35
- NSS10

For proposed development within existing EA FWAs, developers should consult the EA to ensure that adequate flood warning procedures and evacuation processes are in place and that RMAs are not put under any additional burden.

Section 9.2 of the Level 1 SFRA report discusses NPPF requirements and what an emergency plan will need to consider and other relevant information on emergency planning. The Hertfordshire Local Resilience Forum provides Emergency Planning

information about risks to the community, warn of hazardous conditions, such as flooding, snow, and drought, and provide information on preparing for emergency situations.

The duration and onset of flooding affecting a site depends on several factors:

- Location of the site within the catchment: flooding is likely to be rapid and flashy in the upper catchment (e.g. small tributaries) and slower responding and longer in duration in the lower catchment.
- Upstream storage: floodplains, reservoirs, and other storage areas upstream of a site may provide some online flood storage that reduces the flood risk downstream and delays the onset of flooding.
- Timing of peak flow: at the confluence of the larger watercourses and smaller tributaries, there may be different timings of peak flows, for example smaller tributaries would peak much earlier than the larger catchments.
- The principal source of flooding: where this is surface water, depending on the intensity and location of the rainfall, flooding could be experienced within 30 minutes of the heavy rainfall event e.g., a thunderstorm. Typically, the duration of flooding for areas at risk of surface water flooding, or from flash flooding from small watercourses, is short (hours rather than days).
- The preceding weather conditions prior to the flooding: wet weather lasting several weeks will lead to saturated ground. Rivers respond much quicker to rainfall in these conditions.
- Whether a site is defended, noting that if the defences were to fail, a site could be affected by very fast flowing and hazardous water within 15 minutes of a breach developing (depending on the size of the breach and the location of the site in relation to the breach), causing danger to life.
- Catchment geology: the permeability of a catchment affects its response time, for example chalk catchments take longer to respond than clay catchments.

## 6.2 Developer contributions

In some cases, and following the application of the Sequential Test, it may be appropriate for the developer to contribute to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions should include the following:

- Developers should check the online Flood Map for Planning (gov.uk) in the first instance to identify any major changes to the Flood Zones and the long-term flood risk mapping portal (gov.uk) for any changes to flood risk from surface water or inundation from reservoirs.
- Developer contributions can be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS).
- Developers should also confirm that a development will not impact upon the ability of a floodplain to store or convey and seek opportunities to provide floodplain betterment, should the footprint of a development change.

- Where necessary, compensatory flood storage should be provided up to the 1% AEP plus climate change flood level and adjacent to the floodplain so that the flood storage can hydraulically fill and drain.
- Developers must be aware that that information within the Level 1 and Level 2 SFRAs will be a useful starting point for development considerations, however they must request the most recent data and update hydraulic modelling where required. The EA are due to publish a new national risk information for flooding and coastal erosion, this will include future scenarios accounting for climate change. Once this information is available, it should be used as the main source of flood risk information, unless site-specific modelling / information is available.

The council should only use planning obligations to secure contributions where it is satisfied that the contribution will fund works / measures which are:

- Necessary to make the development acceptable in planning terms;
- Directly related to the development; and
- Fairly and reasonably related in scale and kind to the development (Paragraph 57, NPPF).

# 7 Surface water management and SuDS

The Surface Water Management roles and responsibilities for different organisations and relevant legislation, policy and strategy are detailed within the Section 8 in the Level 1 SFRA. Users should refer to this section when considering the different sources of flood risk to the site and how this can be mitigated in a sustainable way.

This contains detail on:

- role of the LLFA and LPA in surface water management;
- types of SuDS;
- sources of SuDS guidance; and,
- other surface water considerations including Groundwater Vulnerability Zones (GVZs), Groundwater Source Protection Zones (GSPZs), and Nitrate Vulnerability Zones (NVZs).

## 7.1 Updated SuDS guidance

Since publication of the Level 1 SFRA, the Defra National standards for sustainable drainage systems (SuDS) (gov.uk) were published in June 2025.

Previously SuDS guidance was developed to sit alongside the PPG and provide non-statutory standards as to the expected design and performance for SuDS. The new national remain as a non-statutory specification but form a material consideration for LPAs when assessing planning applications. These standards aim to reflect and reinforce good practice and use of SuDS, reflecting the four pillars of SuDS design.

The national standards contain two sets of standards. The first type (Standard 1) is known as the hierarchy standard and gives criteria for the prioritisation of final runoff destinations. The other standards (Standards 2-7) detail the minimum requirements of design criteria that surface water drainage systems should satisfy alongside how they are to be appropriately built, maintained, and operated.

# 8 Recommendations

## 8.1 Considering the Exception Test for the proposed development sites

When required, to pass the Exception Test it must be shown that the development will provide wider sustainability benefits that outweigh the risk, and that the development will be safe throughout its lifetime without increasing risk elsewhere. The former is a planning-related consideration and the Level 2 SFRA helps to answer the latter part of the Test.

Some of the sites assessed in this Level 2 SFRA are at greater risk and will require careful consideration and significant mitigation to pass the flood risk element of the Exception Test, these are shown in

Table 8-1. For the majority of the sites assessed, more than 70% of the development is located within Flood Zone 1. Therefore, it is expected that it will be possible to preserve Flood Zones 2 and 3 (subject to a detailed flood risk assessment) as public green space or other open land category, with built development restricted to Flood Zone 1. For these sites, the Exception Test will only be required if built development is proposed in Flood Zone 2 or 3 and will be dependent upon their vulnerability.

Table 8-1 Sites which require the Exception Test

| Site | Proposed use | Vulnerability classification* | Highest risk category | % of the site in Flood Zone 1 |
|---|---|---|---|---|
| ACFS8b | Residential | More vulnerable | Flood Zone 3b | 91.8 |
| CFS55 | Employment | Less vulnerable | Flood Zone 3b | 69.2 |
| CFS60 | Residential | More vulnerable | Flood Zone 3b | 10.1 |
| CFS70 | Employment | Less vulnerable | Flood Zone 3b | 90.7 |
| CFS72 | Residential | More vulnerable | Flood Zone 3b | 88.3 |
| H22a | Residential | More vulnerable | Flood Zone 3b | 81.0 |
| NCFS35 | Employment | Less vulnerable | Flood Zone 3b | 72.6 |
| NSS10 | Residential | More vulnerable | Flood Zone 3b | 98.8 |

The other sites are likely to pass the flood risk element of the Exception Test by:

- Undertaking a sequential approach to site planning so development is steered away from areas within the site at the highest risk.
- Considering safe access/escape routes in the event of a flood (from all parts of the site, if say the site is severed by a flood flow path). If access and escape are affected, a Flood Response Plan may be required.

* National Planning Policy Framework - Annex 3: Flood risk vulnerability classification - Guidance - GOV.UK

- Designing buildings with finished floor levels above the estimated flood level (fluvial 1% AEP event with an allowance for climate change), including an allowance for freeboard.
- Using areas in Flood Zone 2 for the least vulnerable parts of the development in accordance with Table 2 in the PPG. No development should be permitted in Flood Zone 3b (aside from Essential Infrastructure).
- Testing flood mitigation measures if these are to be implemented, to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
- Considering space for green infrastructure in the areas of highest flood risk.

Although not explicitly required within the PPG, consideration should be given to surface water risk where this is high, with regards to the Exception Test. This includes sites such as ACFS10, CG47, and NCFS34.

If a site is split in future into smaller land parcels for development, and some of those parcels are in areas of flood risk, the Exception Test may need to be re-applied by the developer at the planning application stage.

## 8.2 Recommendations from the Level 1 SFRA

Recommendations from this report should be considered in addition to recommendations from the Level 1 SFRA, which still stand for the site allocations and any windfall development that comes forward. The recommendations for the Level 1 SFRA are set out in Section 11 of the Three Rivers Level 1 SFRA (2025)..

## 8.3 Requirements for developers

The sections below set out requirements for developers to consider both for developing sites assessed within this Level 2 SFRA and for developing windfall sites.

### 8.3.1 Watercourses

Any sites located where there is a Main River (including culverted reaches of a Main River) will require an easement of 8m either side of the watercourse from the top of the bank. This may introduce constraints regarding what development will be possible and consideration will also need to be given for access and maintenance at locations where there are culverts. Developers will be required to apply for appropriate permits so the activity being carried out over easements does not increase flood risk. Further information relating to this can be viewed on the government website Flood risk activities: environmental permits (gov.uk).

Where no recent detailed hydraulic modelling is present, it is recommended that developers construct new, or update existing, detailed hydraulic models at these sites as part of a site-specific FRA using channel, structure, and topographic survey to confirm flood risk. Site-specific flood modelling will likely need to be developed in locations where it is necessary to

understand the effects of proposed development schemes on the existing flood flow paths and flood volume storage, in the present day and in the future.

At the planning application stage, developers may need to undertake more detailed hydrological and hydraulic assessments of unmodelled watercourses and surface water interactions so that the potential effects of proposals can be evaluated at site level and ensure that there is no increase in risk off-site as a result of development. The modelling should evidence flood extents, depths, velocities and hazard (including latest climate change allowances), inform development zoning within the site and prove, if required, whether the Exception Test can be passed.

If an ordinary watercourse is within or immediately adjacent to the site area, consultation with the Hertfordshire County Council as the LLFA should be undertaken. If alterations or discharges are proposed to the watercourse, a land drainage consent will be required.

Developers should be aware of the need to identify the route of, and flood risk associated with, any culverts within a site. CCTV condition survey will be required to establish the current condition of the culvert and hydraulic assessments will be necessary to establish culvert capacity of both culverts on site and those immediately offsite that could pose a risk to the site. The risk of flooding should be established using site survey, including the residual risk of culvert blockage.

### 8.3.2 Flood risk management infrastructure and residual risk

For sites where existing flood defences provide a reduction in the flood risk to the site, it is important to understand the standard of protection these structures and measures provide. It is also necessary to understand how this level of protection changes over time, considering the implications of climate change.

If flood defences are required to protect a development site, evidence will be required to show that the new development does not adversely impact and increase flood risk to other areas, for example that there is no net loss in floodplain storage in circumstances where this is a material consideration. It will need to be established that these defences can be appropriately managed and maintained during the lifetime of the development. In some cases, it will be a requirement to demonstrate that there is an appropriate level of commitment to the maintenance of the standard of protection afforded by existing defences, where reliance is placed on the standard they provide.

Any development proposed adjacent to a canal should include a detailed assessment of how a canal breach would impact the site, as part of a site-specific FRA. The Canal and River Trust (canalrivertrust.org.uk) provide guidance on development near canals.

### 8.3.3 Access and escape routes

Access and escape routes should be considered at the site, but also in the vicinity of the site, for example, a site may have low surface water risk, but in the immediate locality, access/escape routes to and from the site could be restricted for vehicles and/or people. For sites assessed within this Level 2 SFRA, an initial overview of potential access and

escape options is provided within the detailed site assessments and potential constraints identified.

### 8.3.4 Surface water flood risk and SuDS

Surface water risk should be considered in terms of the proportion of the site at risk in the 3.3%, 1% and 0.1% AEP events (with an appropriate allowance for climate change), whether the risk is due to isolated minor ponding or deeper pooling of water, or whether the risk is due to a wider overland flow route.

A strategic assessment of SuDS options has been undertaken using regional datasets for sites assessed within this Level 2 SFRA. A detailed site-specific assessment of suitable SuDS techniques should be undertaken at site-specific level to understand which SuDS options are most appropriate. This may need to include infiltration testing to determine the suitability of infiltration methods.

Surface water risk and mitigation should be considered as part of a detailed site-specific FRA and surface water drainage strategy.

## 8.4 Use of SFRA data and future updates

It is important to recognise that the SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from all sources and the potential impacts of future climate change.

The SFRA should be a 'living document', and as a result should be updated when new information on flood risk, flood warning, or new planning guidance or legislation becomes available. New information may be provided by the Hertfordshire County Council as LLFA, the EA, and Thames Water Such information may be in the form of:

- New hydraulic modelling results.
- Flood event information following a future flood event.
- Policy or legislation updates.
- Updates to the EA flood mapping.
- New flood defence schemes or flood alleviation schemes.

The EA regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated information is available prior to commencing a detailed FRA.

It is recommended that the SFRA is reviewed in line with the EA's Flood Zone map updates to ensure latest data is still represented in the SFRA, allowing a cycle of review and a review of any updated data by checking with the above bodies for any new information.

# Appendices

# A Detailed site assessments

# B Static mapping

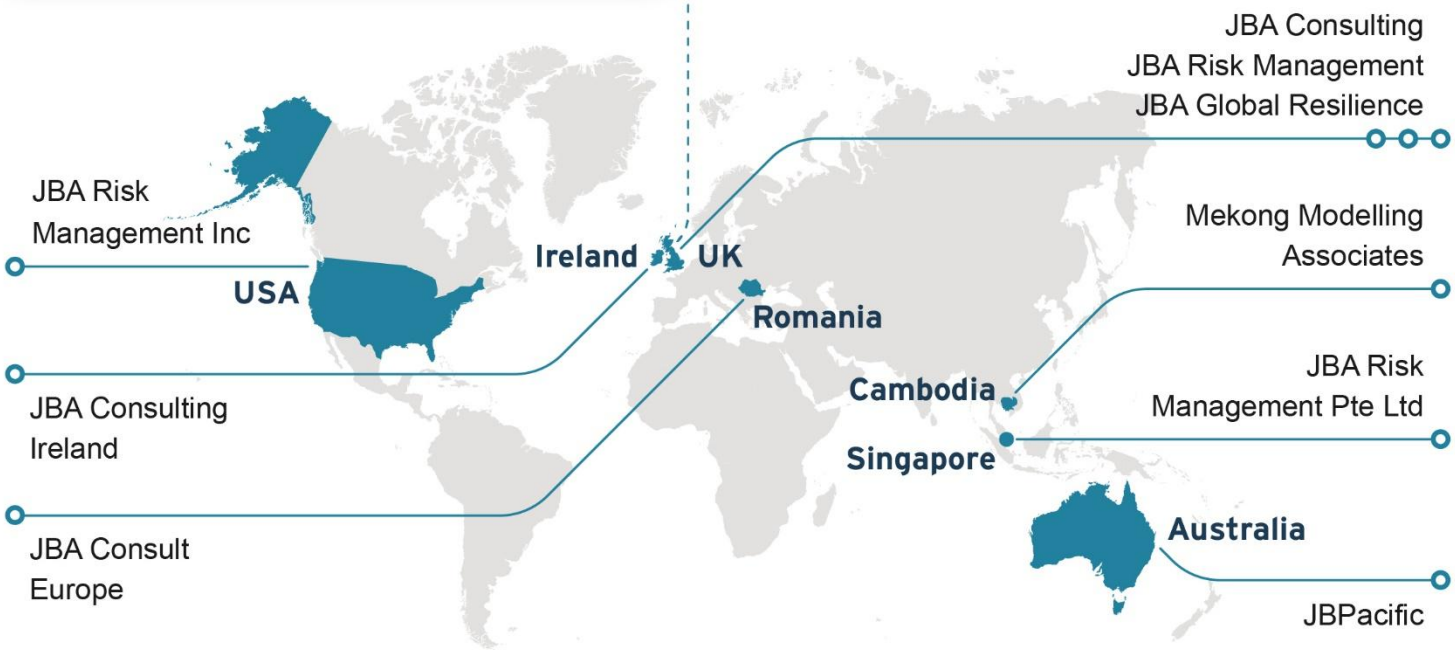
# C Data sources used in this SFRA

# D Site Screening Spreadsheet

www.jbaconsulting.com

## Our Offices

Bristol
Coleshill
Cork
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Leeds
Limerick
Newcastle
Newport
Peterborough
Portsmouth
Saltaire
Skipton
Tadcaster
Thirsk
Wallingford
Warrington




**Registered Office**
1 Broughton Park
Old Lane North
Broughton
SKIPTON
North Yorkshire
BD23 3FD
United Kingdom

+44(0) 1756 799919
info@jbaconsulting.com
www.jbaconsulting.com

Follow us on

Jeremy Benn
Associates Limited
Registered in
England
3246693

JBA Group Ltd is
certified to
ISO 9001:2015
ISO 14001:2015
ISO 27001:2022
ISO 45001:2018