Wokingham Borough Council
Level 1 Strategic Flood Risk Assessment

Final Report

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Prepared for:
Wokingham Borough Council

WOKINGHAM
BOROUGH COUNCIL

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Contract

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This report describes work commissioned by Wokingham Borough Council by an instruction dated 16th December 2022). The Client's representative for the contract was James McCabe of Wokingham Borough Council. Rebecca Lee, Sarah Hambling and Thomasin Sayers of JBA Consulting carried out this work.

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Acknowledgements

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Abbreviations

AEP ..... Annual Exceedance Probability
AStGWf ..... Areas Susceptible to Groundwater flooding
CC ..... Climate Change
CFMP ..... Catchment Flood Management Plan
CIRIA..... Construction Industry Research and Information Association
Defra ..... Department for Environment, Food and Rural Affairs
EA ..... Environment Agency
EU ..... European Union
FAA ..... Flood Alert Area
FCERM ..... Flood and Coastal Erosion Risk Management
FRA ..... Flood Risk Assessment
FRMP ..... Flood Risk Management Plan
FWA ..... Flood Warning Area
FWMA ..... Flood and Water Management Act
FWS ..... Flood Warning System
GSPZ ..... Groundwater Source Protection Zone
IDB ..... Internal Drainage Board
JBA..... Jeremy Benn Associates
LFRMS ..... Local Flood Risk Management Strategy
LiDAR..... Light Detection and Ranging
LLFA..... Lead Local Flood Authority
LPA ..... Local Planning Authority
LPU ..... Local Plan Update
mAOD ..... metres Above Ordnance Datum
NFM ..... Natural Flood Management
NPPF..... National Planning Policy Framework
NRD ..... National Receptor Database
NVZs ..... Nitrate Vulnerable Zones
PFRA..... Preliminary Flood Risk Assessment
PPG..... Planning Practice Guidance
RBD..... River Basin District
RBMP ..... River Basin Management Plan
RMAs ..... Risk Management Authorities

RoFSW..... Risk of Flooding from Surface Water
SFRA..... Strategic Flood Risk Assessment
SoP ..... Standard of Protection
SSSI..... Site of Special Scientific Interest
SuDS..... Sustainable Drainage Systems
SWMP..... Surface Water Management Plan
WBC..... Wokingham Borough Council
WFD..... Water Framework Directive

Definitions

1D model: one-dimensional hydraulic model

2D model: two-dimensional hydraulic model

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

Brownfield: previously developed parcel of land

Climate Change: long term variations in global temperature and weather patterns caused by natural and human actions.

Catchment Flood Management Plan: a high-level planning strategy through which the EA works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.

Cumecs: the cumec is a measure of flow rate. One cumec is shorthand for cubic metre per second (m^3/s).

Design flood: This is 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 tidal flooding with a 0.5% annual probability (1 in 200 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.

Exception test: Set out in the NPPF, the exception test is a method used to demonstrate that flood risk to people and property will be managed appropriately, where alternative sites at a lower flood risk are not available. The exception test is applied following the sequential test.

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).

Flood Map for Planning: The EA Flood Map for Planning (Rivers and Sea) is an online mapping portal which shows the Flood Zones in England. The Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences and do not account for the possible impacts of climate change.

Flood Risk Area: An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).

Flood Risk Regulations: Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically

address flood risk by prescribing a common framework for its measurement and management.

Floods and Water Management Act: Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.

Fluvial Flooding: Flooding resulting from water levels exceeding the bank level of a river (main river or ordinary watercourse).

Flood Risk Assessment: a site-specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.

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

Greenfield: undeveloped parcel of land

Indicative Flood Risk Area: nationally identified flood risk areas based on the definition of 'significant' flood risk described by Defra and WAG.

Lead Local Flood Authority: the unitary authority for the area or if there is no unitary authority, the county council for the 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 (NPPF) 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 available here.

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.

Pitt Review: Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.

Pluvial flooding: see surface water flooding.

Resilience measures: Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.

Resistance measures: Measures designed to keep flood water out of properties and businesses; could include flood guards for example.

Return period: Is 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; a lead local flood authority; a district council in an area where there is no unitary authority; an internal drainage board; a water company and a highway authority.

Sequential test: Set out in the NPPF, the sequential test is a method used to steer new development to areas with the lowest probability of flooding.

Sewer flooding: Flooding caused by a blockage or overflowing in a sewer or urban drainage system.

Standard of Protection: Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1% AEP (1 in 100 year) 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.

Surface water flooding: Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity.

Sustainable Drainage Systems: SuDS 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.

Surface Water Management Plan: The SWMP plan should outline the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner. It is the principal output from the SWMP study. There are three key partners who must be involved and engaged in the SWMP study process: the Local Authority, the Environment Agency and the relevant Water and Sewerage Companies.

Water Framework Directive: Under the WFD, all waterbodies have a target to achieve Good Ecological Status (GES) or Good Ecological Potential (GEP) by a set

deadline. River Basin Management Plans (RBMPs) set out the ecological objectives for each water body and give deadlines by when objectives need to be met.

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

This report provides a comprehensive and robust evidence base on flood risk issues to support the review and update of the Wokingham Borough Council's planning policies. The review process is known as the Local Plan Update (LPU). This report uses the best available information, including input from key stakeholders. This Level 1 Strategic Flood Risk Assessment (SFRA) for Wokingham Borough Council (WBC) was prepared to replace and update the previous Level 1 SFRA produced by WSP and published in 2020. The SFRA assesses additional land promoted to WBC for potential development, changes to the proposed development sites within the borough, and changes in national planning policy and guidance, including the update to the National Planning Policy Framework (NPPF) in July 2021, the update to the Planning Practice Guidance (PPG) in August 2022, and the updates to the EA climate change guidance in July 2021 and May 2022.

Introduction

To support the review and update of the Local Plan for WBC, the key objectives of the assessment are:

- To collate and analyse the latest available information and data for current and future (i.e. climate change) flood risk from all sources, and how these may be mitigated for development.
- To inform decisions in the emerging LPU, including the selection of development sites and planning policies.
- To provide evidence to support the application of the sequential test for the allocation of new development sites, to support WBC in the preparation of the LPU.
- To provide a comprehensive set of maps presenting flood risk from all sources that can be used as evidence base for use in the update to the Local Plan.
- To provide advice for applicants carrying out site-specific Flood Risk Assessments (FRAs) and outline specific measures or objectives that are required to manage flood risk.

Summary of flood risk in Wokingham Borough:

- **Fluvial**: The primary fluvial flood risk is along the River Thames, River Loddon, River Blackwater, Emm Brook, Foudry Brook, and their main tributaries. The fluvial flood extents cover the majority of the western and northern border of the borough and split the area through the centre along the path of the River Loddon, which flows in a north-easterly direction through the borough.
- **Surface water**: The Risk of Flooding from Surface Water map shows a number of prominent overland flow routes that largely follow the topography of the watercourses. There are some areas where there are additional flow paths and

areas of ponding, for example where water is impounded at road or rail embankments and in low-lying areas. There are also considerable flow routes following the roads through the main urban areas of Wokingham, Earley and Lower Earley, and Finchampstead which, alongside isolated areas of ponding, may affect many properties across these settlements.

- **Climate change**: Areas at risk of flooding today are likely to become at increased risk in the future and the frequency of flooding will also increase in such areas, because of climate change. Flood extents will increase; in some locations, this may be minimal, but flood depth, velocity and hazard may have more of an impact due to climate change. It is recommended that WBC work with other Risk Management Authorities (RMAs) to review the long-term sustainability of existing and new development when developing climate change plans and strategies for Wokingham Borough.
- **Sewer**: South East Water provides water services to the east side of the Borough whilst Thames Water provides water services to the west side of the Borough and sewerage services across the entirety of the Borough. Thames Water have provided details of historic sewer flooding across the Borough.
- **Groundwater**: The Areas Susceptible to Groundwater Flooding map shows that in general, areas with greater than 50% susceptibility to groundwater flooding are along the main flow routes of the River Thames, River Loddon, River Blackwater, and Foudry Brook. The JBA groundwater emergence map emulates this, with similar areas experiencing emergence levels within 0.5m of the surface, with the addition of the south east of the Borough. The Risk of Flooding due to Surface Water map suggests that any groundwater emerging in these areas is likely to follow the low-lying topography and path of the River Thames, River Loddon, River Blackwater, Emm Brook, and Foudry Brook.
- **Reservoirs**: There is a potential risk of flooding from reservoirs both within Wokingham Borough and those outside. The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from reservoirs is relatively low. However, there is a residual risk of a reservoir breach, and this risk should be considered in any site-specific FRAs (where relevant).

Defences

The EA AIMS dataset provides information on flood defence assets across the borough. The main defence type across the study area is 'Natural High Ground', located along the main watercourses of the River Thames, River Loddon, River Blackwater, Emm Brook, and Foudry Brook. Additional engineered defences including a wall, embankments and demountable defences also line parts of the River Loddon, Emm Brook, and a tributary of Old River, which itself is a tributary of the River Loddon. The condition of these defences varies from poor to good, with the Standard of Protection (SoP) varying between the defences.

Development and flood risk

The sequential and exception test procedures for both Local Plans and FRAs have been documented, along with guidance for planners and developers. Links have been provided for relevant guidance documents and policies published by other Flood RMAs such as the Lead Local Flood Authority (LLFA) and the Environment Agency (EA).

The risk of flooding should be reviewed as early as possible in the development process to ensure that opportunities are taken to reduce the risk of flooding on and off the site. Where necessary, development and redevelopment within Wokingham Borough will require a FRA appropriate to the scale of the development and to the scope as agreed with the LLFA and/or EA. FRAs should consider flood risk from all sources including residual risk, along with promotion of Sustainable Drainage Systems (SuDS) to create a conceptual drainage strategy and safe access/egress at the development in the event of a flood. Latest climate change guidance (last updated in May 2022) should also be taken into account, for the lifetime of developments. Planners and developers must check that modelling in line with the most up to date EA climate change guidance has been run.

How to use this report

Planners

The SFRA provides recommendations regarding all sources of flood risk in Wokingham Borough, which can be used to inform policy on flood risk within the emerging LPU. This includes how the cumulative impact of development should be considered.

It provides the latest flood risk data and guidance to inform the sequential test and provides guidance on how to apply the exception test. The Council can use this information to apply the sequential test to strategic allocations and identify where the exception test will also be needed.

The SFRA provides guidance for developers, which can be used by development management staff to assess whether site-specific FRAs meet the required quality standard.

Developers

For sites that are not strategic allocations, developers will need to use this SFRA to help apply the sequential test. For both strategic allocations and windfall sites, developers will need to apply the exception test in the following cases:

- Highly vulnerable development in Flood Zone 2
- Essential infrastructure in Flood Zone 3a or 3b
- More vulnerable development in Flood Zone 3a
- Proposed development in locations affected by surface water flood risk

A site-specific FRA should be used to inform the exception test at the planning application stage.

This SFRA is a strategic assessment and does not replace the need for site-specific FRAs where a development is either within Flood Zones 2 or 3 or greater than a hectare in Flood Zone 1 or is in an area affected by surface water flood risk. In addition, a surface water drainage strategy will be needed for all major developments in any Flood Zone to satisfy WBC, the LLFA.

Developers can use the information in this SFRA, alongside site-specific research to help scope out what additional work will be needed in a detailed FRA. To do this, they should refer to Section 5, Appendix A (Interactive PDF mapping) and Appendix B (Data sources used in the SFRA). At the planning application stage, developers may need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances, last updated in May 2022), inform masterplanning and demonstrate, if required, that the exception test is satisfied. As part of the EA's updated guidance on climate change, which must be considered for all new developments and planning applications, developers will need to undertake a detailed assessment of the impact of climate change on flood risk to the site as part of the planning application process when preparing FRAs.

Developers need to check that new development does not increase surface water runoff from a site or contribute to cumulative effects at sensitive locations, see Section 7 and Appendix F (Cumulative Impact Assessment (CIA)). Section 9 provides information on the surface water drainage requirements of the LLFA. SuDS should be considered at the earliest stages that a site is developed which will help to minimise costs and overcome any site-specific constraints.

Site-specific FRAs will need to identify how flood risk will be mitigated so development is safe from flooding for its lifetime and does not have an adverse effect on third parties or other areas. In high-risk areas the FRA will also need to consider emergency arrangements, including how there will be safe access and egress from the site.

Any developments located within an area protected by flood defences and where the SoP is not of the required standard (either now or in the future) should be identified and the use of developer contributions considered to fund improvements to the defences.

Neighbourhood plans

Neighbourhood planning groups can use the information in this SFRA to assess the risk of flooding to sites within their community, using Section 5, the sources of flooding in Wokingham Borough and the flood mapping in Appendix A. The SFRA will also be helpful for developing community level flood risk policies in high flood risk areas. Similarly, all known available recorded historical flood events for Wokingham Borough

are listed in Section 5.1. This can be used to supplement local knowledge regarding areas worst hit by flooding. Ongoing and proposed flood alleviation schemes planned by WBC are outlined in Section 6 and Section 8.3 discusses mitigations, resistance and resilience measures which can be applied to alleviate flood risk to an area.

Mapping

The SFRA mapping highlights on a strategic scale flood risk from fluvial, surface water and reservoirs sources, and where groundwater emergence may occur; as well as where the effects of climate change are most likely. The maps are useful to provide a community level view of flood risk but may not identify if an individual property is at risk of flooding or depict small scale changes in flood risk. Local knowledge of flood mechanisms will need to be included to complement this mapping. Similarly, all known available recorded historical flood events for Wokingham Borough are listed in Section 5.1. This can be used to supplement local knowledge regarding areas worst hit by flooding. Ongoing and proposed flood alleviation schemes planned by WBC are outlined in Section 6.5 and Section 8.3 discusses mitigations, resistance and resilience measures which can be applied to alleviate flood risk to an area.

Cumulative Impact Assessment (CIA)

Under the NPPF, strategic policies and their supporting SFRAs, are required to 'consider cumulative impacts in, or affecting, local areas susceptible to flooding' (para.160). A Cumulative Impact Assessment (CIA) has identified which catchments in Wokingham Borough are more sensitive to the cumulative impact of development and where more stringent policy regarding flood risk is recommended. Any development in these areas should seek to contribute to work that reduces wider flood risk in those catchments.

1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

“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 EA and other relevant flood RMAs, such as lead local flood authorities and internal drainage boards.”.
(NPPF, paragraph 160).

In May 2022, Wokingham Borough Council (WBC) commissioned an addendum to their existing Level 1 SFRA for the Borough following the promotion of additional land for potential development and changes in the preferred spatial strategy for meeting development needs. The following are the current strategic development sites being delivered through the adopted local plan:

- North Wokingham
- South Wokingham
- Arborfield Garrison
- South of the M4 (Shinfield)

Following the updates to the PPG in August 2022, WBC commissioned a fully updated Level 1 SFRA. This study provides a comprehensive and robust evidence base to support the local plan. This SFRA replaces the previous Level 1 report (2020).

This 2023 SFRA will be used to inform decisions on the location of future development and the preparation of land use planning policies for the long-term management of flood risk, reflecting the implications of the August 2022 changes to the PPG. Annex 1 – Updates to the Planning Practice Guidance (25 August 2022) provides more information on the August 2022 changes.

As the data available for SFRAs and the relevant legislation is continually changing, a SFRA should be a live document and updated to reflect changes where applicable and practicable.

1.2 Local Plan

WBC are working to update the existing Local Plan for Wokingham, which will replace the current Core Strategy (2010) and Managing Development Delivery Local Plan (2014) (MDD) which look from 2006 to 2026. The review process is known as the Local Plan Update (LPU). The LPU will guide where and how growth will take place in the Borough in the years up to at least 2039/40.

1.3 Levels of SFRA

The PPG identifies the following two levels of SFRA:

- A Level 1 assessment is required where flooding is not a major issue in relation to potential site allocations and where development pressures are low. The assessment should be of sufficient detail to enable application of the sequential test.
- A Level 2 assessment is required where land outside Flood Zones 2 and 3 cannot appropriately accommodate all necessary development, creating the need to apply the NPPF's exception test. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

This is a Level 1 SFRA assessment. If all the development proposed is not located outside areas of flood risk, a Level 2 assessment may be required. The PPG can be accessed on the Government's website here.

1.4 SFRA Outputs

- Identification of existing national and local policy and technical updates.
- Identification of any strategic flooding issues or cumulative effects which may have cross boundary implications.
- Appraisal of all potential sources of flooding, including main river, ordinary watercourse, surface water, sewers, groundwater, and reservoirs.
- Review of historic flooding incidents.
- Reporting on the SoP provided by existing flood risk management infrastructure.
- Mapping showing distribution of flood risk across all Flood Zones from all sources of flooding including climate change allowances.
- Assessment of the potential increase in flood risk due to climate change.
- FRA guidance for developers.
- Assessment of surface water management issues, how these can be addressed through development management policies and the application of SuDS.
- Recommendations of the criteria that should be used to assess future development proposals and the development of a sequential test and sequential approach to flood risk.
- Assessment of strategic flood risk solutions that can be implemented to reduce risks.

1.5 SFRA Study Area

WBC is a Unitary Authority in Berkshire, Southeast England.

The main urban area in Wokingham Borough is the town of Wokingham. Other areas include Arborfield, Barkham, Charvil, Earley, Finchampstead, Hurst, Sonning, Remenham, Ruscombe, Shinfield, Twyford, Wargrave, Three Mile Cross, Winnersh, Spencer's Wood and Woodley.

Wokingham is bounded by eight other authorities:

- Basingstoke and Deane Borough
- Bracknell Forest
- Buckinghamshire
- Hart District
- Reading Borough
- South Oxfordshire District
- West Berkshire
- Royal Borough of Windsor and Maidenhead

An overview of the study area showing the neighbouring authorities is shown in Figure 1-1. The water service providers are South East Water in the east of the Borough and Thames Water in the west of the Borough, shown in Figure 1-2. Thames Water is the sewerage provider across the whole Borough.

The major watercourses which run through Wokingham Borough are the River Thames, its tributary the River Loddon, and the main tributaries of the River Loddon (Twyford Brook, Emm Brook, Barkham Brook and the River Blackwater) Foudry Brook, a tributary of the River Kennet, also runs through the west side of the Borough. These watercourses are shown in Figure 1-3.

1.6 Consultation

SFRAs should be prepared in consultation with other RMAs. In addition to the WBC Growth and Delivery Team, the following parties have been consulted during the preparation of this version of the SFRA either through data requests or draft report reviews:

- WBC LLFA
- EA
- Thames Water
- South East Water
- Neighbouring authorities to provide data on cross-boundary development implications:
    - Basingstoke and Deane Borough Council
    - Bracknell Forest Council
    - Buckinghamshire Council
    - Hart District Council
    - Reading Borough Council
    - South Oxfordshire District Council
    - West Berkshire Council
    - Royal Borough of Windsor and Maidenhead

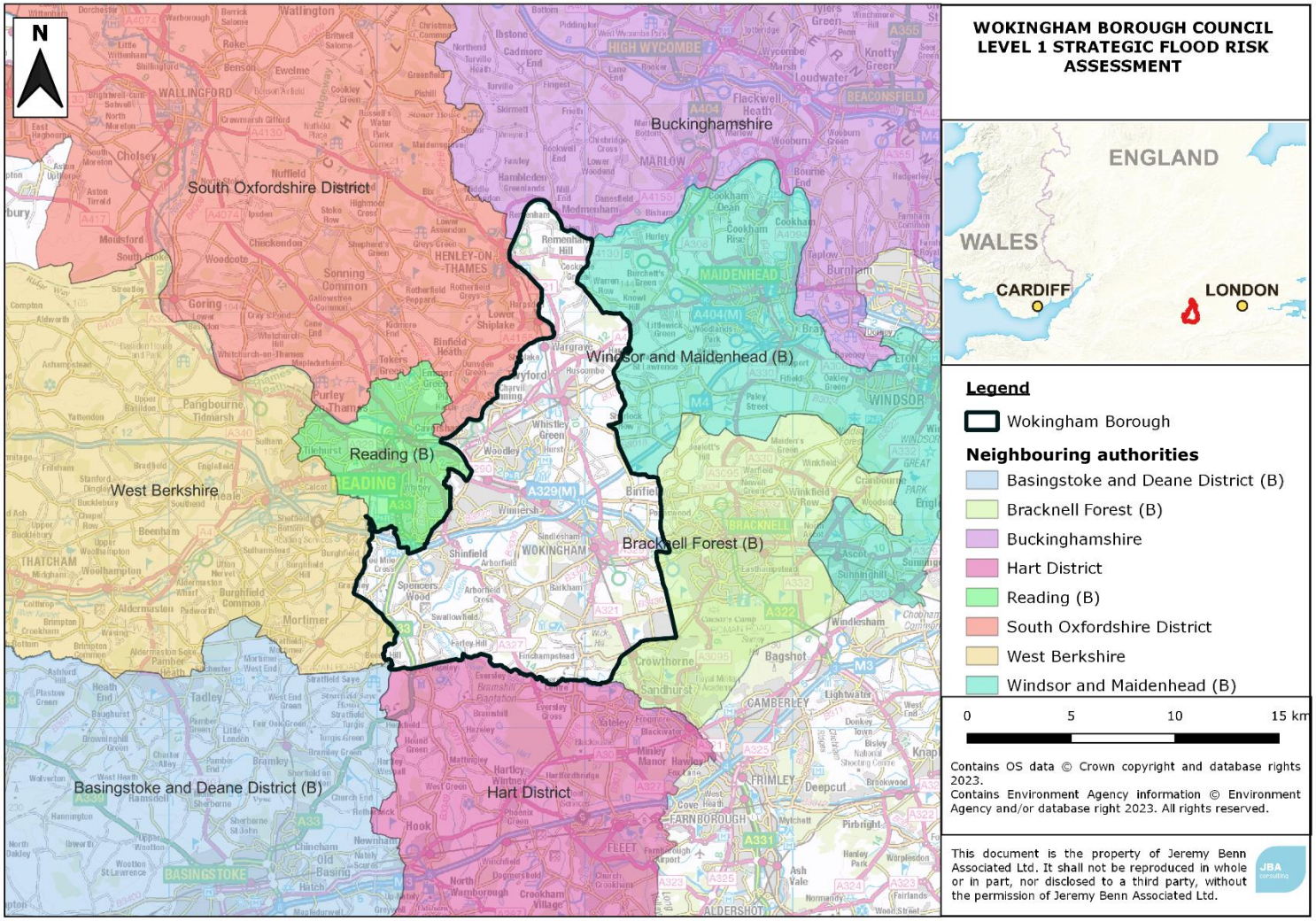


Figure 1-1: Neighbouring authorities to Wokingham Borough.

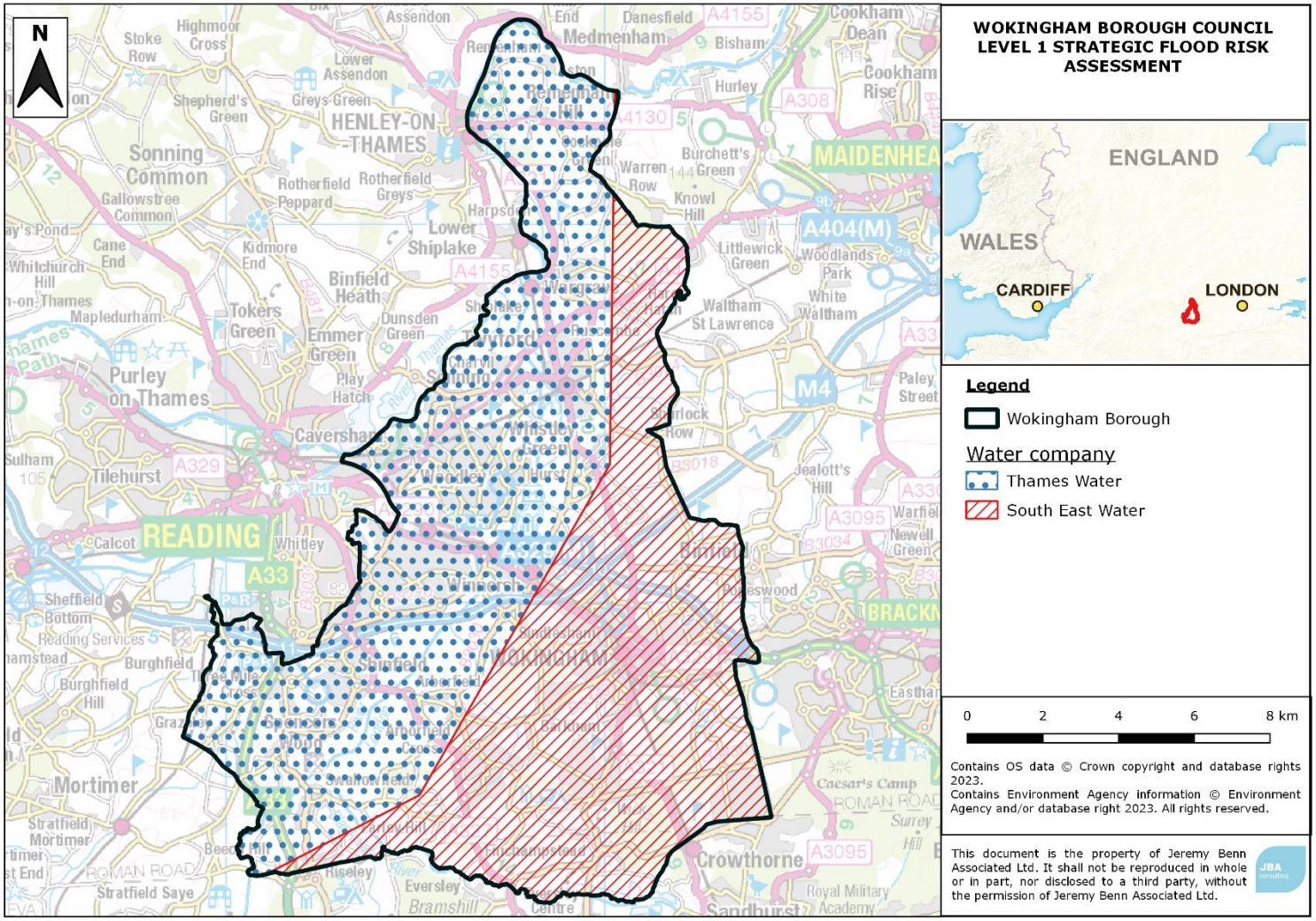


Figure 1-2: Water companies across Wokingham Borough.

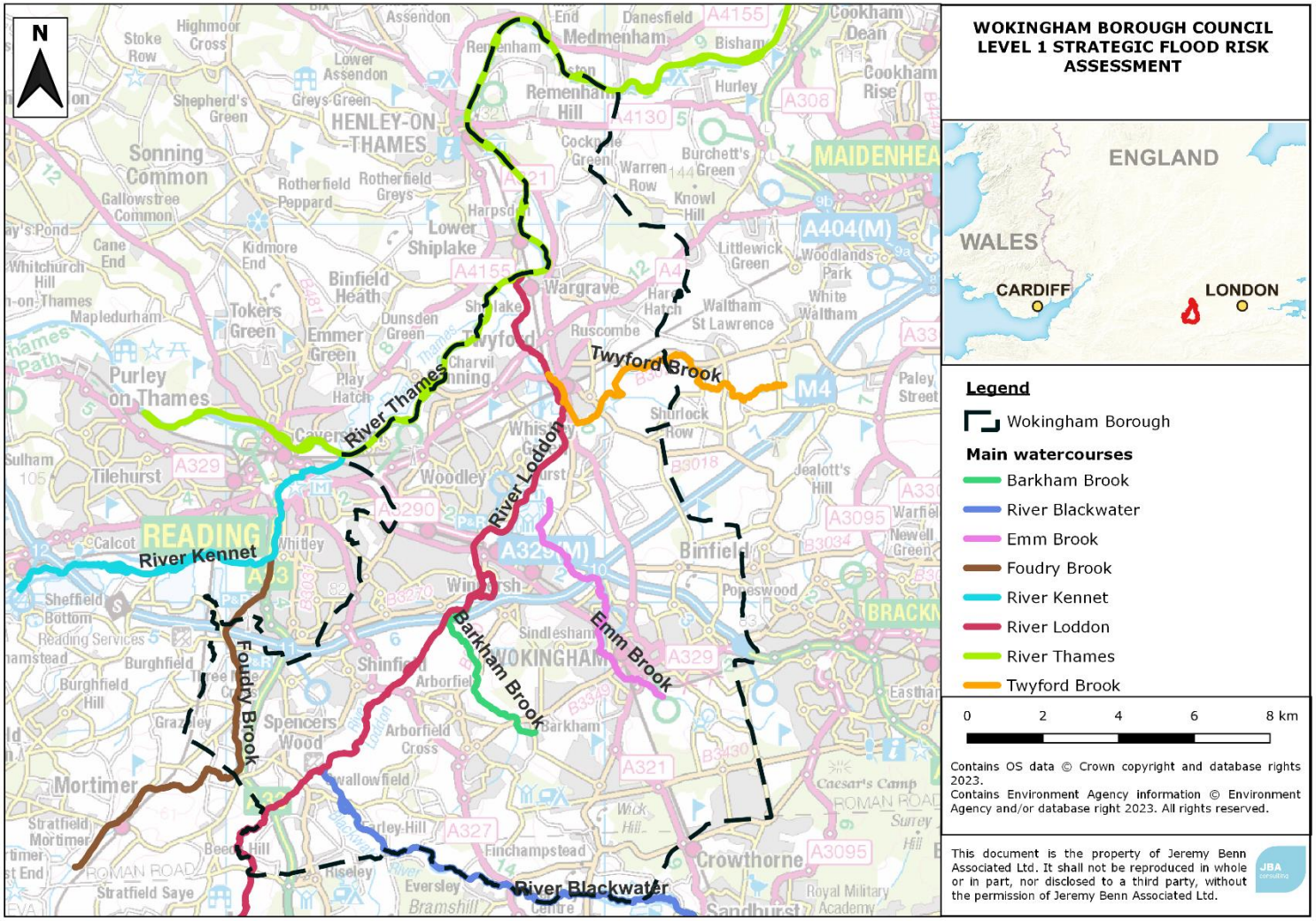


Figure 1-3: Main watercourses in Wokingham Borough.

1.7 Use of SFRA data

Level 1 SFRAs are high-level strategic documents and do not go into detail on an individual site-specific basis. The primary purpose is to provide an evidence base to inform the preparation of Local Plans and any future flood risk policies.

Developers will still be required to undertake site-specific FRAs where required to support Planning Applications. Developers will be able to use the information in the SFRA to scope out the sources of flood risk that will need to be explored in more detail at site level.

Appendix C presents a SFRA User Guide, further explaining how this SFRA data should be used, including reference to relevant sections of the SFRA, how to consider different sources of flood risk and recommendations and advice for sequential and exception tests.

On the date of publication, this SFRA contains the latest available flood risk information. Over time, new information will become available to inform planning decisions, such as updated hydraulic models (which then update the Flood Map for Planning), updated information on other sources of flood risk or evidence showing future flood risks, new flood event information, new defence schemes and updates to policy, legislation, and guidance. The River Blackwater and its tributaries are currently programmed to be remodelled by the EA in 2024. The EA are also currently undertaking new nationalised modelling (NaFRA2) which is due to go live in August 2024, although these timescales are subject to change due to the complexities of this project. Developers should check the online Flood Map for Planning in the first instance to identify any major changes to the Flood Zones and the long-term flood risk mapping portal for any changes to flood risk from surface water or inundation from reservoirs.

1.8 Structure of this report

Table 1-1: Sets out the contents of the report and how to use each section

Section	Contents	How to use
Executive summary	This section focuses on how the SFRA can be used by planners, developers, and neighbourhood planners.	Users should refer to this section for a summary of the Level 1 findings and recommendations.

Section	Contents	How to use
1. Introduction	This section provides a background to the study, the Local Plan stage the SFRA informs, the study area, the roles and responsibilities for the organisations involved in flood management and how they were involved in the SFRA. It also provides a short introduction to how flood risk is assessed and the importance of considering all sources.	Users should refer to this section for general information and context.
2. Flood risk policy and strategy	This section sets out the relevant legislation, policy, and strategy for flood risk management at a national, regional, and local level.	Users should refer to this section for any relevant policy which may underpin strategic or site-specific assessments.
3. Planning policy for flood risk management	This section provides an overview of both national and existing Local Plan policy on flood risk management. This includes the Flood Zones, application of the Sequential Approach and sequential/exception test process. It provides guidance for WBC and Developers on the application of the sequential and exception test for both allocations and windfall sites, at allocation and planning application stages.	Users should use this section to understand and follow the steps required for the sequential and exception tests.
4. Impact of climate change	This section outlines the latest climate change guidance published by the EA and how this was applied to the SFRA. It also sets out how developers should apply the guidance to inform site-specific FRAs.	This section should be used to understand the climate change allowances for a range of epochs and conditions, linked to the vulnerability of a development.

Section	Contents	How to use
5. Understanding flood risk in the Wokingham Borough	This section provides an overview of the characteristics of flooding affecting the study area and key risks including historical flooding incidents, flood risk from all sources and flood warning arrangements.	This section should be used to understand all sources of flood risk in Wokingham Borough including where has flooded historically. This section may also help identify any data gaps, in conjunction with Appendix B.
6. Flood alleviation schemes and assets	This section provides a summary of current flood defences and asset management and future planned schemes. It also introduces actual and residual flood risk.	This section should be used to understand if there are any defences or flood schemes in a particular area, for further detailed assessment at site specific stage.
7. Cumulative impact of development and strategic solutions	This section introduces the Cumulative Impact Assessment (CIA), which is included as Appendix F.	Planners should use this section to help develop policy recommendations for the cumulative impact of development, in conjunction with Appendix F.
8. Flood risk management for developers	This section contains guidance for developers on FRAs, considering flood risk from all sources.	Developers should use this section to understand requirements for FRAs and what conditions/guidance documents should be followed, as well as mitigation options.
9. Surface water management and Sustainable Drainage Systems	This section provides an overview of SuDS, Guidance for developers on Surface Water Drainage Strategies, considering any specific local standards and guidance for SuDS from the LLFA.	Developers should use this section to understand what national, regional, and local SuDS standards are applicable. Hyperlinks are provided.
10. Summary and recommendations	This section summarises sources of flood risk in the study area and outlines planning policy	Developers and planners should use this as a summary of

Section	Contents	How to use
	recommendations. It also sets out the next steps.	the SFRA. Developers should refer to the Level 1 SFRA recommendations when considering site specific assessments.
Appendices	Appendix A: Interactive flood risk maps Appendix B: Data sources used in the SFRA Appendix C: SFRA User Guide Appendix D: Flood Alert and Flood Warning Areas Appendix E: Summary of flood risk across Wokingham Borough Appendix F: Cumulative Impact Assessment (CIA) Annex 1: August 2022 PPG changes	Planners should use these appendices to understand what data has been used in the SFRA, to inform the application of the sequential and exception tests, as relevant, and to use these maps and tabulated summaries of flood risk to understand the nature and location of flood risk.

1.9 Understanding flood risk

The following content provides useful background information on how flooding arises and how flood risk is determined.

1.9.1 Sources of flooding

Flooding is a natural process and can happen at any time in a wide variety of locations. It constitutes a temporary covering of land not normally covered by water and presents a risk when people and human or environmental assets are present in the area that floods. Assets at risk from flooding can include housing, transport and public service infrastructure, commercial and industrial enterprises, agricultural land, and environmental and cultural heritage. Flooding can occur from many different and combined sources and in many ways. Major sources of flooding include:

- Fluvial (rivers) - inundation of floodplains from rivers and watercourses; inundation of areas outside the floodplain due to influence of bridges, embankments and other features that artificially raise water levels; overtopping or breaching of defences; blockages of culverts; blockages of flood channels/corridors.
- Surface water - direct run-off from adjacent land.
- Sewer flooding - surcharging of piped drainage systems (public sewers, highway drains, etc.).

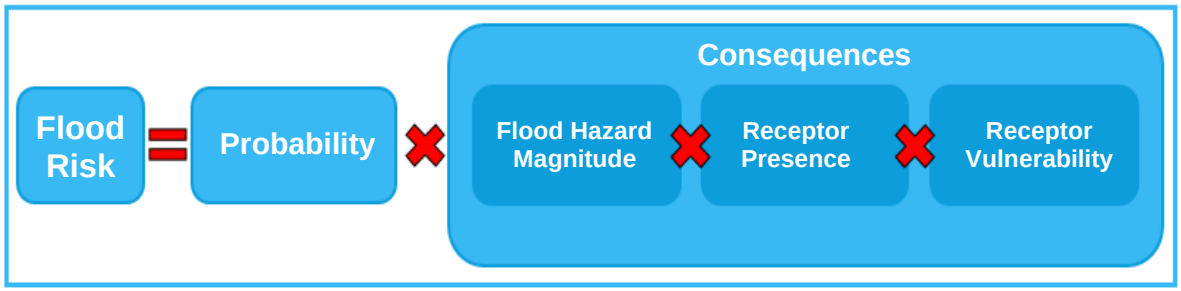
- Groundwater - water table rising after prolonged rainfall to emerge above ground level remote from a watercourse; most likely to occur in low-lying areas underlain by permeable rock (aquifers); groundwater recovery after pumping for mining or industry has ceased.
- Infrastructure failure - reservoirs; industrial processes; burst water mains; blocked sewers or failed pumping stations.
- Other sources of flooding including breaching of flood defences, overwhelmed canals, lakes, and other artificial sources.

Different types and forms of flooding present a range of different risks and the flood hazards of speed of inundation, depth and duration of flooding, can vary greatly. With climate change, the frequency, pattern, and severity of flooding are expected to change and become more damaging.

1.9.2 Defining flood risk

Section 3 (subsection 1) of the Flood and Water Management Act (FWMA) defines the risk of a potentially harmful event (such as flooding) as 'a risk in respect of an occurrence is assessed and expressed (as for insurance and scientific purposes) as a combination of the probability of the occurrence with its potential consequences.'

Thus, it is possible to summarise flood risk as:



1.9.2.1 Source-Pathway-Receptor model

Flood risk can be assessed using the Source-Pathway-Receptor model where:

- the source is the origin of the floodwater, principally rainfall
- a pathway is a route or means by which a receptor can be affected by flooding, which includes rivers, drains, sewers, and overland flow, and,
- a receptor is something that can be adversely affected by flooding, which includes people, their property, and the environment.

This is a standard environmental risk model common to many hazards and should be the starting point of any assessment of flood risk. All these elements must be present for flood risk to arise. Having applied the Source-Pathway-Receptor model it is possible to mitigate the flood risk by addressing the source (often very difficult),

blocking or altering the pathway, or removing the receptor, e.g. steer development away.

The planning process is primarily concerned with the location of receptors, taking appropriate account of potential sources and pathways that might put those receptors at risk. It is therefore important to define the components of flood risk to apply this guidance in a consistent manner.

1.9.2.2 Probability

The probability of flooding is expressed as a percentage based on the average frequency measured or extrapolated from records over many years. A 1% probability indicates the flood level that is expected to be reached on average once in a hundred years, i.e., it has a 1% chance of occurring in any one year, not that it will occur at least once every hundred years.

Considered over the lifetime of development, such an apparently low frequency or rare flood has a significant probability of occurring. For example:

- A 1% flood has a 26% (1 in 4) chance of occurring at least once in a 30-year period - the period of a typical residential mortgage
- And a 49% (1 in 2) chance of occurring in a 70-year period - a typical human lifetime

1.9.2.3 Consequences

The consequences of flooding include fatalities, property damage, disruption to lives and businesses, with severe implications for people (e.g. financial loss, emotional distress, health problems). Consequences of flooding depend on the hazards caused by flooding (depth of water, speed of flow, rate of onset, duration, wave-action effects, water quality), the receptors that are present and the vulnerability of these receptors (type of development, nature, e.g. age-structure, of the population, presence, and reliability of mitigation measures etc).

2 Flood risk policy and strategy

This section sets out the flood risk management roles and responsibilities for different organisations and relevant legislation, policy, and strategy.

2.1 Roles and responsibilities for Flood Risk Management in Wokingham Borough

There are different organisations in and around Wokingham Borough that have responsibilities for flood risk management, known as RMAs. These are listed in Table 2-1, with a summary of their responsibilities. Further information on the roles and responsibilities of the EA is available in Annex A of the National Flood and Coastal Erosion Risk Management Strategy (FCERM) for England, available from the Government website here.

It is important to note that land and property owners are responsible for the maintenance of watercourses either on or next to their properties, called Riparian Owners. Riparian Owners are also responsible for the protection of their properties from flooding as well as other management activities, for example by maintaining riverbeds/ banks, controlling invasive species, and allowing the flow of water to pass without obstruction. More information can be found on the Government website in the EA publication 'Owning a watercourse' (2018).

When it comes to undertaking works to reduce flood risk, the EA, and WBC as LLFA do have jurisdiction, but limited resources must be prioritised and targeted to where they can have the greatest effect. Permissive powers mean that RMAs are permitted to undertake works on watercourses but are not obliged.

Table 2-1: Roles and responsibilities for RMAs

Risk Management Authority	Strategic Level	Operational Level	Planning role
EA	Strategic overview for all sources of flooding, National Strategy, reporting and general supervision	Main River (e.g. the River Thames) and reservoirs (consenting, enforcement, and works)	Statutory consultee for certain development in Flood Zones 2 and 3 and all works within 20 metres of a main river. Advice on when to consult the EA is available on the Government website here.

Risk Management Authority	Strategic Level	Operational Level	Planning role
WBC as LLFA	Preliminary Flood Risk Assessment (PFRA), Local Flood Risk Management Strategy (LFRMS)	Surface water, groundwater, and ordinary watercourses (consenting, enforcement, and works)	Statutory consultee for major developments
WBC as Local Planning Authority (LPA)	Local Plans	Determination of Planning Applications	Determination of Planning Applications
Thames Water and South East Water	Asset Management Plans, supported by Periodic Reviews (business cases), develop drainage and wastewater management plans	Public sewers	Non-statutory consultee
Highways Authorities - Highways England for motorways and trunk roads and WBC for non-trunk roads	Highway drainage policy and planning	Highway drainage	Statutory consultee regarding highways design standards and adoptions

2.2 Relevant legislation

The following legislation is relevant to development and flood risk in Wokingham Borough. Hyperlinks are provided to external documents:

- Flood Risk Regulations (2009) - these transpose the European Floods Directive (2000) into law and require the EA and LLFAs to produce PFRAs and identify nationally significant Flood Risk Areas (FRAs).
- Town and Country Planning Act (1990), Water Industry Act (1991), Land Drainage Act (1991), Environment Act (1995), and Flood and Water Management Act (2010) – as amended and implanted via secondary legislation. These set out the roles and responsibilities for organisations that have a role in Flood Risk Management.

- The Land Drainage Act (1991, as amended) and Environmental Permitting Regulations (2018) also set out where developers will need to apply for additional permission (as well as planning permission) to undertake works to an ordinary watercourse or main river.
- The Water Environment Regulations (2017) – these transpose the European Water Framework Directive (WFD) (2000) into law and require the EA to produce River Basin Management Plans (RBMPs). These aim to improve/maintain the water quality of aquatic ecosystems, riparian ecosystems and wetlands so that they reach 'good' status.
- Other environmental legislation such as the Habitats Directive (1992), Environmental Impact Assessment Directive (2014), and Strategic Environmental Assessment Directive (2001) also apply as appropriate to strategic and site-specific developments to guard against environmental damage.

2.3 Key national, regional, and local policy documents and strategies

Table 2-2 summarises relevant national, regional, and local flood risk policy and strategy documents and how these apply to development and flood risk. Hyperlinks are provided to external documents. These documents may:

- Provide useful and specific local information to inform FRAs within the local area.
- Set the strategic policy and direction for flood risk management and drainage – they may contain policies and action plans that set out what future flood mitigation and climate change adaptation plans may affect a development site. A developer should seek to contribute in all instances to the strategic vision for flood risk management and drainage in Wokingham Borough.
- Provide guidance and/or standards that inform how a developer should assess flood risk and/or design flood mitigation and SuDS.

The following sections provide further details on some of these documents and strategies.

Table 2-2: National, regional, and local flood risk policy and strategy documents

Policy level	Document, lead author and date	Information	Policy and measures	Development design requirements	Next update due
National	Flood and Coastal Management Strategy (EA) 2020	No	Yes	No	Due to be reviewed in 2026
National	National Planning Policy Framework updated in July 2021	No	Yes	Yes	-

Policy level	Document, lead author and date	Information	Policy and measures	Development design requirements	Next update due
National	Planning Practice Guidance (PPG) updated in August 2022	No	No	Yes	-
National	Building Regulations Part H (MHCLG) 2010	No	No	Yes	-
Regional	Thames Catchment Flood Management Plan (EA) 2009	No	Yes	No	-
Regional	Thames river basin district river basin management plan (EA) 2022	No	Yes	No	2027
Regional	Thames river basin district flood risk management plan (EA) 2022	No	Yes	No	2027
Regional	Thames draft Water Resources Management Plan 2024	Yes	No	No	2029
Regional	South East Water draft Water Resources Management Plan 2024	Yes	No	No	2029
Regional	Climate change guidance for development and flood risk (EA) last updated May 2022	No	No	Yes	-
Local	Wokingham Preliminary Flood Risk Assessment (WBC) 2017	Yes	No	No	2023
Local	Wokingham Local Flood Risk Management Strategy (WBC) 2015	No	Yes	No	-

Policy level	Document, lead author and date	Information	Policy and measures	Development design requirements	Next update due
Local	Wokingham SuDS Strategy (WBC) 2017	No	Yes	Yes	-
Local	Wokingham Borough Council Water Cycle Study - Phase 1 Scoping Study	Yes	No	No	-
Local	Wokingham Borough Council Water Cycle Study - Phase 2	Yes	No	No	-

2.3.1 The National Flood and Coastal Erosion Risk Management Strategy for England (2020)

The National Flood and Coastal Erosion Risk Management (FCERM) Strategy for England provides the overarching framework for future action by all RMAs to tackle flooding and coastal erosion in England. The EA brought together a wide range of stakeholders to develop the strategy collaboratively. The Strategy looks ahead to 2100 and the actions needed to address the challenge of climate change.

The Strategy has been split into three high level ambitions:

- Climate resilient places
- Today's growth and infrastructure resilient in tomorrow's climate
- A nation ready to respond and adapt to flooding and coastal change

Measures within the Strategy include:

- Updating the national river, coastal, and surface water flood risk mapping and producing a new set of long-term investment scenarios to improve understanding of future risk and investment needs.
- Trialling new and innovative funding models to contribute to the investment needs for flood and coastal resilience.
- Flood resilience pilot studies.
- Developing an adaptive approach to the impacts of climate change by seeking nature-based solutions towards flooding and erosion issues, integrating Natural Flood Management (NFM) into the new Environmental Land Management scheme, and considering long term adaptive approaches in Local Plans.
- Maximising the opportunities for flood and coastal resilience as part of contributing to environmental net gain for development proposals, investing in flood risk infrastructure that supports sustainable growth, and developing world

leading ways of reducing the carbon and environmental impact from the construction and operation of flood and coastal defences.

- Aligning long term strategic planning cycles for flood and coastal work between stakeholders.
- Consistent approaches to asset management and record keeping.
- Updating guidance on managing high risk reservoirs considering climate change.
- Development of digital tools to communicate flood risk, transforming the flood warning service, supporting communities to plan for flood events, increasing flood response and recovery support, and mainstreaming property flood resilience measures and 'building back better' after flooding.

The Strategy was laid before parliament in July 2020 for formal adoption and published alongside a New National Policy Statement for Flood and Coastal Erosion Risk Management, which can be accessed from the Government website. The statement sets out five key commitments which will accelerate progress to better protect and better prepare the country for the coming years:

1. Upgrading and expanding flood defences and infrastructure across the country,
2. Managing the flow of water to both reduce flood risk and manage drought,
3. Harnessing the power of nature to not only reduce flood risk, but deliver benefits for the environment, nature, and communities,
4. Better preparing communities for when flooding and erosion does occur, and
5. Ensuring every area of England has a comprehensive local plan for dealing with flooding and coastal erosion.

It can be expected that the implementation of the National Strategy will lead to the publication of new guidance and practice that is focused on resilience and adaptation over the coming years. It will be important to adjust the content of the SFRA so that changes in approach are captured in the delivery of the Local Plan.

For further information, the Government has published the full National Flood and Coastal Erosion Risk Management Strategy (FCERM).

2.3.2 Flood Risk Regulations (2009)

The Flood Risk Regulations (2009) translate the European Union (EU) Floods Directive into UK law, which is retained in UK law post-Brexit, and can be accessed on the Government website. The EU requires Member States to complete an assessment of flood risk (known as a PFRA) and then use this information to identify areas where there is a significant risk of flooding. For these Flood Risk Areas, States must then undertake Flood Risk and Hazard Mapping and produce Flood Risk Management Plans (FRMPs).

The Flood Risk Regulations direct the EA to do this work for river, sea, and reservoir flooding. LLFAs must do this work for surface water, ordinary watercourse, and

groundwater flooding. This is a six-year cycle of work and the second cycle started in 2017.

The EA PFRA (2018) for river, sea and reservoir flooding identifies nationally significant Flood Risk Areas for these sources. This PFRA identified 25 FRAs within the Thames River Basin District (RBD), two of which affect the Wokingham Borough: the Wokingham Rivers and Sea FRA lies fully within the Borough and the Reading Rivers and Sea FRA lies partly within the Borough. The full PFRA can be found on the Government website.

The Wokingham PFRA, published in 2011, is a high-level screening exercise which provides an assessment of past flood risk based on historical data from WBC, the EA, Thames Water, and local Parish Councils, Town Councils, and Residents Associations. This identified four historical events (in 1993, 2000, 2003, and 2007) but no Flood Risk Areas (FRAs) were identified within the Wokingham LLFA area. The addendum to the Wokingham PFRA, published in 2017, identified a flood event during the winter 2013/14 period where numerous properties were flooded. This led WBC to conduct several Section 19 Flood Investigations to establish the cause of the flooding and what can be done to reduce future risk. No FRAs for surface water, ordinary watercourse and groundwater flooding were identified in the Wokingham LLFA area during the second cycle. The original 2011 Wokingham PFRA can be downloaded from the Council website and the 2017 addendum to the PFRA is available on the Government website.

The six-year cycle of assessment, mapping, and planning required under the Flood Risk Regulations also requires the development of FRMPs. The EA led the development of the FRMPs. The first FRMPs were published in 2016 and the second cycle plans which describe actions to manage flood risk across England between 2021 and 2027 were published in December 2022.

Wokingham Borough lies within the Thames FRMP area. The second cycle FRMP is a plan to manage significant flood risk in the FRAs identified within the Thames RBD within the EA PFRA. The Thames FRMP identified two FRAs covering Wokingham Borough for main rivers and the sea as:

- Reading Rivers and Sea (RS) FRA
- Wokingham Rivers and Sea (RS) FRA

Measures identified within the FRAs inside Wokingham Borough include:

- Work in partnership to develop a catchment-scale approach which will complement local place based flood risk schemes in non-tidal River Thames catchment (Thames Valley),
- Work in partnership including with Thames Flood Advisors to support all lead local flood authorities to apply for Government funding in Thames River Basin District.

- Work in partnership with other RMAs to support the implementation of the Thames Regional Flood and Coastal Committee 25 year vision in Thames River Basin District.

More information on district and national scale measures is available. on the EA's online interactive mapping.

It is also recognised that there are areas at flood risk outside of these FRAs. The plan has therefore been expanded to show what is happening across the RBD and in locally important areas referred to as 'Strategic Areas' which were put forward by the EA providing they were not already designated FRAs. The Thames RBD FRMP is available on the government website here.

2.3.3 Flood and Water Management Act (2010)

The FWMA was passed in April 2010 following the recommendations made within the Pitt Review following the flooding in 2007. It aims to improve both flood risk management and the way water resources are managed.

The FWMA has created clearer roles and responsibilities and helped to define a more risk-based approach to dealing with flooding. This included the creation of a lead role for Local Authorities, as LLFAs, designed to manage local flood risk (from surface water, ground water and ordinary watercourses) and to provide a strategic overview role of all flood risk for the EA.

The content and implications of the FWMA provide considerable opportunities for improved and integrated land use planning and flood risk management by Local Authorities and other key partners. The integration and synergy of strategies and plans at national, regional, and local scales, is increasingly important to protect vulnerable communities and deliver sustainable regeneration and growth.

2.3.4 The Water Framework Directive and Water Environment Regulations and River Basin Management Plans

The purpose of the WFD, which was transposed into English Law by the Water Environment Regulations (2003), is to deliver improvements across Europe in the management of water quality and water resources through a series of plans called RBMPs.

The WFD requires the production of RBMPs for each River Basin District. RBMPs support the government's framework for the 25-year environment plan and allow local communities to find more cost-effective ways to further improve our water environments. Water quality and flood risk can go hand in hand in that flood risk management activities can help to deliver habitat restoration techniques.

The EA manages the RBMPs and must review and update them every six years. The first cycle of RBMPs were published in 2009 and were most recently updated in 2022.

Wokingham Borough lies within the Thames RBD. The updated Thames RBD RBMP for 2022 can be accessed on the Government website.

2.3.5 Updated Strategic Flood Risk Assessment guidance

There was an update to the 'How to prepare a Strategic Flood Risk Assessment guidance' in March 2022, which requires further adjustment to the approaches to both Level 1 and Level 2 assessments. The Level 1 assessment is undertaken in accordance with the latest guidance. The latest guidance can be accessed on the Government website.

2.3.6 Catchment Flood Management Plans

Catchment Flood Management Plans (CFMPs) are high-level strategic plans providing an overview of flood risk across each river catchment. The EA use CFMPs to work with other key-decision makers to identify and agree long-term policies for sustainable flood risk management.

Wokingham Borough lies within the Thames CFMP region, which sets out policies relating to flooding from rivers, surface water, and groundwater within the River Thames catchment area.

2.3.7 Wokingham Borough Council Local Flood Risk Management Strategy (LFRMS) 2015

WBC is responsible for developing, maintaining, applying, and monitoring a LFRMS. The most recent Strategy was published in April 2015 and is used as a means by which the LLFA co-ordinates Flood Risk Management on a day-to-day basis.

The LFRMS aims to set out how flood risk will be reduced and managed in the Borough, with six objectives developed:

1. Continue to improve knowledge and understanding of current and future local sources of flood risk within Wokingham.
2. Continue to work collaboratively and develop effective partnerships with other Flood RMAs and local communities to deliver a sustainable, cost-effective approach to flood risk management that reduces flood risk and provides wider environmental and social economic benefits where possible.
3. Ensure that land use planning and application decisions takes full account of flood risk, avoiding development in inappropriate locations, preventing an increase in flood risk, and minimising existing flood risk wherever possible.
4. Maintain and, where necessary, improve local flood risk management infrastructure and work with riparian landowners to ensure privately owned flood defence assets, features and ordinary watercourse are well maintained to reduce risk.

5. Ensure that emergency plans and responses to flood incidents are effective and that communities are prepared and resilience to local flood risk.
6. Identify national, regional, and local funding mechanisms to deliver flood risk management solutions and schemes.

2.3.8 Local policy and guidance for SuDS

The 2021 NPPF states that: 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 169). When considering planning applications, local planning authorities (LPAs) should consult the relevant LLFA on the management of surface water to satisfy that:

- The proposed minimum standards of operation are appropriate.
- Using planning conditions or planning obligations there are clear arrangements for on-going maintenance over the development's lifetime.

At the time of writing this SFRA, the following documents and policies are relevant to SuDS and surface water in Wokingham. Hyperlinks are provided to external documents:

- Wokingham SuDS Strategy, 2017
- SuDS Manual (C753), published in 2007 and updated in 2015
- Defra Non-statutory technical standards for sustainable drainage systems, 2015
- Defra National Standards for sustainable drainage systems Designing, constructing (including LASOO best practice guidance), operating and maintaining drainage for surface runoff, 2011
- Building Regulations Part H (MHCLG), 2010

The 2021 NPPF states that flood risk should be managed "using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding". WBC set out in their SuDS strategy that they expect SuDS to be incorporated when planning all major developments, from the Strategic Development Location scale through to a ten-dwelling development.

2.3.9 Water Cycle Studies

Water Cycle Studies assist local authorities to select and develop growth proposals that minimise impacts on the environment, water quality, water resources, infrastructure, and flood risk and help to identify ways of mitigating such impacts.

A Water Cycle Study Phase 1 Scoping Study for Wokingham Borough was conducted by JBA in 2019. This study found the following conclusions:

- A number of Sites of Special Scientific Interest (SSSIs) exist within Wokingham that should be carefully considered in future plan making.
- Wastewater treatment works serving growth within Wokingham are the most significant point sources of pollution in the study area.

- There is potential for additional discharge from wastewater treatment works to impact sites with environmental designations. A water quality impact assessment is required in the Phase 2 water cycle study to understand this further.
- Development sites within Wokingham could be sources of diffuse pollution from surface runoff.
- Several of the proposed development sites could have a direct surface water pathway to a SSSI.
- Runoff from these sites should be managed through implementation of a SuDS scheme with a focus on treating water quality of surface runoff from roads and development sites.
- Opportunities exist for these SuDS schemes to offer multiple benefits of flood risk reduction, amenity value and biodiversity.
- SuDS for a single site could be demonstrated to have limited impact, but it is the cumulative impact of all development across the catchment (combined with the potential effects of climate change) that should be taken into account. For this reason, SuDS should be considered on sites that do not have a direct pathway to a SSSI.

This Water Cycle Study is available to download from the Council website.

JBA Consulting are conducting a Phase 2 Outline Water Cycle Study for the Borough, which builds on the Phase 1 Scoping Study. This study provides a site-scale Red-Amber-Green (RAG) assessment for different aspects of the water cycle for potential development sites across the Borough Where a development is scored amber or red it means that significant infrastructure may be required to accommodate it. Actions are recommended against each of the different stages of the water cycle. Once published this Water Cycle Study will be available to download from the Council website.

A previous Water Cycle Study was also undertaken by Halcrow in 2011 for the Blackwater Valley Local Authorities, which includes Wokingham Borough, and can also be downloaded from the Council website.

2.3.10 Surface Water Management Plans

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. SWMPs establish a long-term action plan to manage surface water in a particular area and are intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning, and future developments.

The Lower Earley SWMP was published in 2021. This identified three hotspots in Lower Earley:

- Hotspot 1: Junction of Pepper Lane and Elm Road

- Hotspot 2 - Redhatch Drive
- Hotspot 3 - Egremont Drive

Detailed hydraulic modelling and optioneering was undertaken for each hotspot and recommendations were made for the next steps to mitigate flood risk at each hotspot.

Information from the Shinfield SWMP (2018/19) and Lower Earley SWMP (2021) are available from the LLFA.

A Greater Reading SWMP has also been produced which was a joint project between Reading Borough Council and WBC.

2.3.11 Water Resources Management Plans (WRMPs)

Under the duties set out in sections 37A to 37D of the Water Industry Act 1991, all water companies across England and Wales must prepare and maintain a WRMP. This must be prepared at least every five years and reviewed annually.

WRMPs should set out how a water company intends to achieve a secure supply of water for their customers and a protected and enhanced environment.

Thames Water have recently published their draft 2024 WRMP, available on their website here. This sets out how they intend to provide a secure and sustainable water supply over the next 50 years, looking ahead to 2075.

South East Water have also recently published their draft 2024 WRMP, available on their website here. This plan outlines how South East Water intent to invest in building a range of new infrastructure whilst also investing in reducing leaks and customer water use over the next 50 years.

3 Planning policy for flood risk management

This section summarises national planning policy for development and flood risk.

3.1 National Planning Policy Framework and Guidance

The revised NPPF was published in July 2021, replacing the 2019 version. The NPPF sets out Government's planning policies for England and is available on the Government website. It must be considered in the preparation of local plans and is a material consideration in planning decisions. The NPPF advises on how flood risk should be considered to guide the location of future development and FRA requirements. The NPPF 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” (para.160). The PPG on flood risk and coastal change was published in March 2014 and sets out how the policy should be implemented. Diagram 1 in the PPG sets out how flood risk should be considered in the preparation of Local Plans. It was updated on the 25 August 2022, see Annex 1 – Updates to the Planning Practice Guidance (25 August 2022) for more information. The most up-to-date guidance is available on the Government website.

3.2 The risk-based approach

The NPPF takes a risk-based approach to development in flood risk areas. Since July 2021 the approach has adjusted the requirement for the sequential test (as defined in Para 162 of the NPPF) so that all sources of flood risk are included in the consideration. The requirement for the revised sequential test has been addressed by adopting the following approach:

- The test will cease to be based on the use of the Zones describing river and sea flood risk, and instead be based on whether development can be located in the lowest risk areas (high-medium-low) of flood risk both now and in the future. The test now applies to all sources of flood risk – whereas previously the test was only performed for present day flood risk for the “Flood Zones” i.e. river and sea flood risk.
- Understanding flood risk to sites based on their vulnerability and incompatibility as opposed to whether development is appropriate.
- In addition to the flood risk mapping describing river and sea flood risk, there is mapping available to describe surface water flood risk. Although, this is not

conceptually similar to the flood risk mapping for rivers and sea due to the differing nature of flooding.

- As there is no available competent risk mapping for other sources of risk it is not considered appropriate to use such mapping in a strict process that involves comparison of differing levels of flood risk. Reservoir, groundwater and sewer flood risk are addressed through the SFRA using a variety of datasets to analyse and describe the risk to areas across Wokingham Borough.
- A more formal assessment of these sources is undertaken in a Level 2 SFRA and involves a more detailed assessment of the implications of reservoir, sewer, and groundwater flood risk to establish that more appropriate locations at lower risk are not available.
- Consideration is given to all sources of flood risk using the available data to complete the sequential test so decisions on the selection of preferred sites for allocation address the potential implications of groundwater, reservoir, and sewer flooding. Also, where necessary it identifies sites where consideration should be given to satisfying the requirements of the exception test.

3.2.1 Flood Zones - rivers risk

The definition of the Flood Zones is provided below. The Flood Zones do not consider defences. This is important for planning long term developments as long-term policy and funding for maintaining flood defences over the lifetime of a development may change over time.

The Flood Zones do not consider surface water, sewer, or groundwater flooding or the impacts of reservoir failure. They do not consider climate change. Hence there could still be a risk of flooding from other sources and that the level of flood risk will change over the lifetime of a development.

The Flood Zones are:

- Flood Zone 1: Low risk: less than a 0.1% chance of river and sea flooding in any given year.
- Flood Zone 2: Medium risk: between a 1% and 0.1% chance of river flooding in any given year.
- Flood Zone 3a: High risk: between a 3.3% and 1% chance of river flooding in any given year.
- Flood Zone 3b: Functional Floodplain: land where water has to flow or be stored in times of flood (greater than 3.3% AEP). SFRAs identify this Flood Zone in discussion with the LPA and the EA. The identification of functional floodplain takes account of local circumstances. Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. Information on flood risk vulnerability classification is available online

in Annex 3 of the NPPF, here. It may be required to consider climate change on the functional floodplain; this would need hydraulic modelling to confirm extents and therefore it is recommended that this is considered in a FRA and a suitable approach is agreed with the EA.

- FZ3b is based on the best available model data:
  - 3.3% Annual Exceedance Probability (AEP) where available
  - 1% AEP where the 3.3% is not available
- Where model data is not available, FZ3a (1% AEP) is used as a conservative proxy.

Important note on Flood Zone information in this SFRA

Flood Zones 2 and 3a, as shown in the Appendix A mapping, show the same extent as the online Environment Agency's Flood Map for Planning (which incorporates latest modelled data) other than for the watercourses listed below. In these instances, where additional detailed modelling was available that has not been incorporated into the Flood Map for Planning, the modelled extent was used in preference:

- Blackwater (in the west of the area where the 2007 model extent is wider than the 2009 extent, only the 1% AEP output was available for Flood Zone 3a, so the Flood Zone 2 output remains the same as the Flood Map for Planning).
- River Loddon (hydrology was updated as part of this SFRA)
- Arborfield (a new detailed hydraulic model was developed for the unnamed watercourse through Arborfield as part of this SFRA)
- Emm Brook (a detailed hydraulic model was provided by WSP for use within this SFRA)

The EA Flood Zones do not cover all catchments or ordinary watercourses with areas <3km². As a result, whilst the EA Flood Zones may show an area is in Flood Zone 1, there may be a flood risk from a smaller watercourse(s) not shown in the Flood Zones.

Functional floodplain (Flood Zone 3b) is identified as land which would flood with an annual probability of 3.3% AEP (1 in 30 years), where detailed hydraulic modelling exists. The 3.3% AEP modelled flood extents have been used to represent Flood Zone 3b, where available from the EA. 3.3% AEP extents were available for the following models:

- Kennet
- Loddon
- Arborfield
- Thames (Hurley to Teddington)
- Thames (Pangbourne to Sonning)
- Thames (Sonning to Hurley)

For areas covered by detailed models, but with no 3.3% AEP output available, the 1% AEP outputs were used as a proxy. This was the case for the following models:

- Blackwater (2007)
- Blackwater (2009)
- Foudry Brook
- Emm Brook

As this is quite a conservative approach, the 5% AEP outputs have been used to identify areas where the Flood Zone 3b extent is likely to be similar/ considerably different from the 1% AEP output and this has been used to inform the site screening as an additional process to assess the sensitivity between the 5% AEP and 1% AEP extents. The site screening process is described in more detail in Section 10.2.

For areas outside of the detailed model coverage, Flood Zone 3a (1% AEP) has been used as a conservative indication. Further work should be undertaken as part of a detailed site-specific FRA to define the extent of Flood Zone 3b where no detailed modelling exists.

3.2.2 Flood Zones - surface water risk

To address the requirement that flood risk from all sources is included in the sequential test in addition to the fluvial Flood Zones, a further set of surface water zones have also been defined.

The surface water zones define locations at either lower or higher risk of surface water flooding based on the extent of the 1% AEP plus 40% climate change allowance surface water event. This is the upper end allowance for the 2070s epoch which the EA climate change guidance recommends is assessed within SFRAs.

- Zone A – lower risk of surface water flooding (lies outside the 1% AEP plus 40% climate change surface water extent)
- Zone B – higher risk of surface water flooding (lies within the 1% AEP plus 40% climate change surface water extent)

Surface water mapping does not strictly describe the same conceptual risk zone as is defined for river and sea flooding (even though it is notionally associated with the same probability) as the mapping is based on different assumptions. However, it does create a product that can accommodate sequential testing, as it can facilitate strategic decisions that direct development to land in a “lower risk surface water flood zone”. Using this mapping, it is not anticipated that the sequential test for surface water would normally require alternative sites at lower risk to be considered, because the widespread and dendritic nature of surface water flood risk is conceptually very different to river and sea flood risk. However, in some circumstances, for example, for relatively small sites that are potentially substantially affected by surface water, alternatives may be considered (as these could potentially not satisfy the flood risk

requirements when assessed under the exception test). Therefore, a three-step process was proposed to approach the sequential test for surface water in this SFRA:

1. Identify the higher and lower risk surface water zones following the methodology detailed above.
2. Where sites are identified to fall within the higher risk zone, these were assessed on a case-by-case basis and a high-level assessment was made as to whether the site is developable around the surface water risk.
3. Consultation was undertaken with WBC to confirm the sites requiring a Level 2 assessment due to surface water risk.

The application of the test would be accompanied by a commitment as part of the local plan that development on proposed sites would be placed in the “low risk surface water flood zone”. In circumstances where it is not possible to place all proposed development in the “low risk surface water flood zone” or circumstances arose where encroachment on land affected by surface water flood risk could not be avoided, then it would be necessary to provide supplementary evidence that the exception test could be satisfied. For the purpose of the local plan, this supplementary exercise could be set out in the Level 2 SFRA and might simply involve more specific requirements in an FRA. The proposed approach does not completely align with approach to river and sea flood zones (noting that the mapping is not based on the same parameters). However, practically the proposed approach strongly aligns with sequential approach outlined in paragraph 161 of the NPPF. As a result, this approach is considered to be appropriate, and provides the recommended method of applying the sequential test for assessing surface water.

3.2.3 Flood Zones - other sources of flooding

Other sources of flooding also need to be considered as part of the sequential test. This includes reservoir and groundwater flooding.

One source of flooding is from reservoirs, which provide water storage facilities. It is recommended that reservoir flooding is not included in the sequential test. The latest available mapping now shows “wet day” and “dry day” reservoir inundation extents. The “wet day” being a reservoir breach at the same time as a 0.1% AEP river flood (as this is a likely time when a reservoir might fail) and the dry day shows the failure just from the water retained by the dam. However, neither set of mapping describes a risk-based scenario, as they do not indicate the relative risk to land based on the probability of dam failure but are intended to show a “worst credible case”.

By comparing the extent of Fluvial Flood Zone 2 with the Reservoir Flood Map Wet Day Extent two zones can be defined:

1. Where reservoir flooding is predicted to make fluvial flooding worse.
2. Where reservoir flooding is not predicted to make fluvial flooding worse.

The mapping could be used to direct proposed new development away from locations that could potentially be affected by reservoir flood risk. However, it is different to the risk pertaining to river and sea flooding and further assessment would be required to understand the magnitude of the potential hazard. This mapping will also identify locations where proposed development could result in a change to the risk designation of a reservoir. If proposed sites are located in a zone at reservoir risk, it will be necessary to include a more detailed assessment in a Level 2 SFRA.

For the purposes of this SFRA it is not possible to prepare zone maps for sewer flood risk, or groundwater flood risk as the appropriate analyses and data are not available. The existing datasets on sewer flooding, and groundwater are used to inform the sequential approach to development at a site in accordance with paragraph 161 of the NPPF (which could in some instances result in alternative sites being considered).

3.2.4 The sequential test

Firstly, land at the lowest risk of flooding from all sources should be considered for development. A test is applied called the 'sequential test' to do this. Figure 3-1 summarises the sequential test.

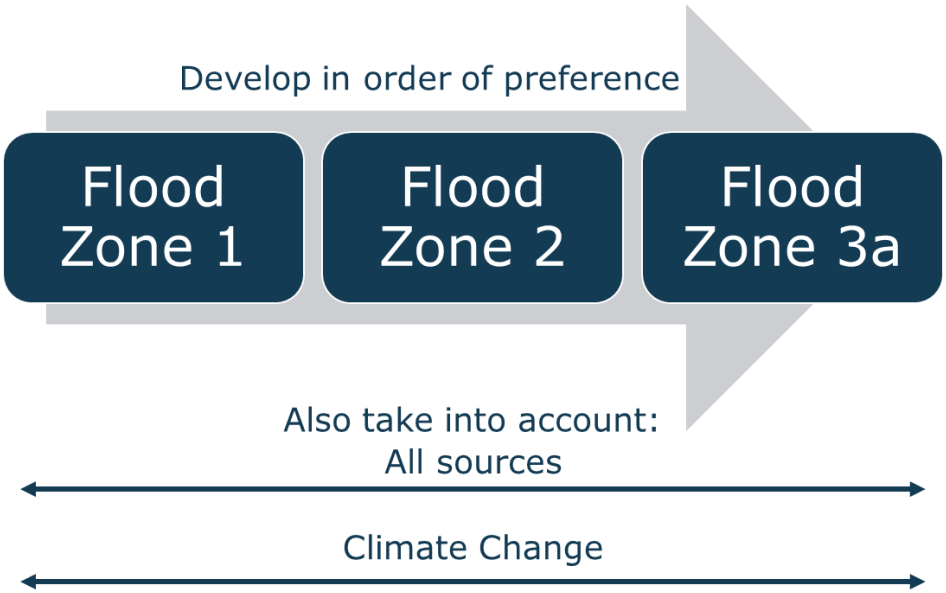


Figure 3-1: A summary of the sequential test

The sequential approach steers development away from areas of flood risk and where the sequential and exception test have been applied (where required) and have not been met, development should not be permitted. It is advised that this approach should be considered early in the design process.

The sequential test should be applied to all potential applications. Developers must supply evidence to the LPA, with a Planning Application, that the development has passed the test.

The LPA should work with the EA to define a suitable search area for the consideration of alternative sites in the sequential test. The sequential test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of Strategic Housing Land or Employment Land Availability Assessments.

Whether any further work is needed to decide if the land is suitable for development will depend on both the vulnerability of the development and the Flood Zone it is proposed for. Table 2 of the PPG defines the flood risk vulnerability and flood zone 'incompatibility' of different development types to flooding which can be found on the Government website here.

Figure 3-2 illustrates the sequential and exception tests as a process flow diagram (Diagram 2 of the PPG) using the information contained in this SFRA to assess potential development sites against the EA's Flood Map for Planning flood zones and development vulnerability compatibilities.

This is a stepwise process, but a complex one, as several of the criteria used are qualitative and based on experienced judgement. The process must be documented, and evidence used to support decisions recorded. In addition, the risk of flooding from other sources and the impact of climate change must be considered when considering which sites are suitable to allocate. The SFRA User Guide in Appendix C shows where the sequential and exception test may be required for the datasets assessed in the SFRA, and how to interpret different sources of flood risk, including recommending what proposed development sites should be assessed at Level 2.

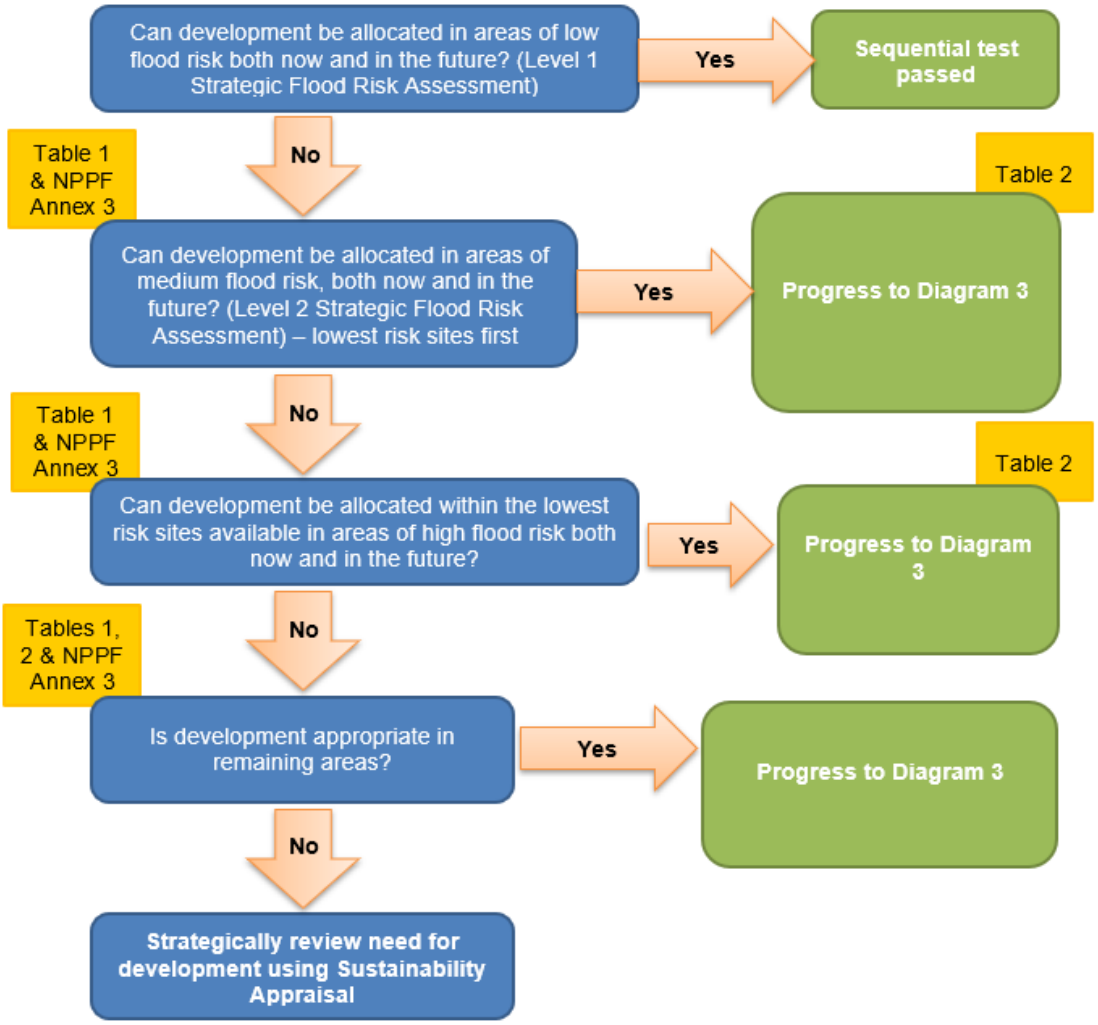


Figure 3-2: Local Plan sequential approach to site allocation

3.2.5 The exception test

It will not always be possible for all new development to be located on land that is not at risk from flooding. To further inform whether land should be allocated, or Planning Permission granted, a greater understanding of the scale and nature of the flood risks is required. In these instances, the exception test will be required.

The exception test should only be applied following the application of the sequential test. It applies in the following instances:

- 'More vulnerable' development in Flood Zone 3a
- 'Essential infrastructure' in Flood Zone 3a or 3b
- 'Highly vulnerable' development in Flood Zone 2
- Any development where a higher risk of surface water has been identified (surface water Zone B) and the site does not clearly show that development can be achieved away from the flood risk.

'Highly vulnerable' development should not be permitted within Flood Zone 3a or Flood Zone 3b. 'More vulnerable' and 'Less vulnerable' development should not be permitted within Flood Zone 3b.

Figure 3-3 summarises the exception test.

For sites proposed for allocation within the Local Plan, the LPA should use the information in this SFRA to inform the exception test. At the planning application stage, the developer must design the site such that it is appropriately flood resistant and resilient in line with the recommendations in national and local planning policy and supporting guidance and those set out in this SFRA. This should demonstrate that the site will still pass the flood risk element of the exception test based on the detailed site level analysis.

For developments that have not been allocated in the Local Plan, developers must undertake the exception test and present this information to the LPA for approval. The Level 1 SFRA can be used to scope the flooding issues that a site-specific FRA should investigate in more detail to inform the exception test for windfall sites.

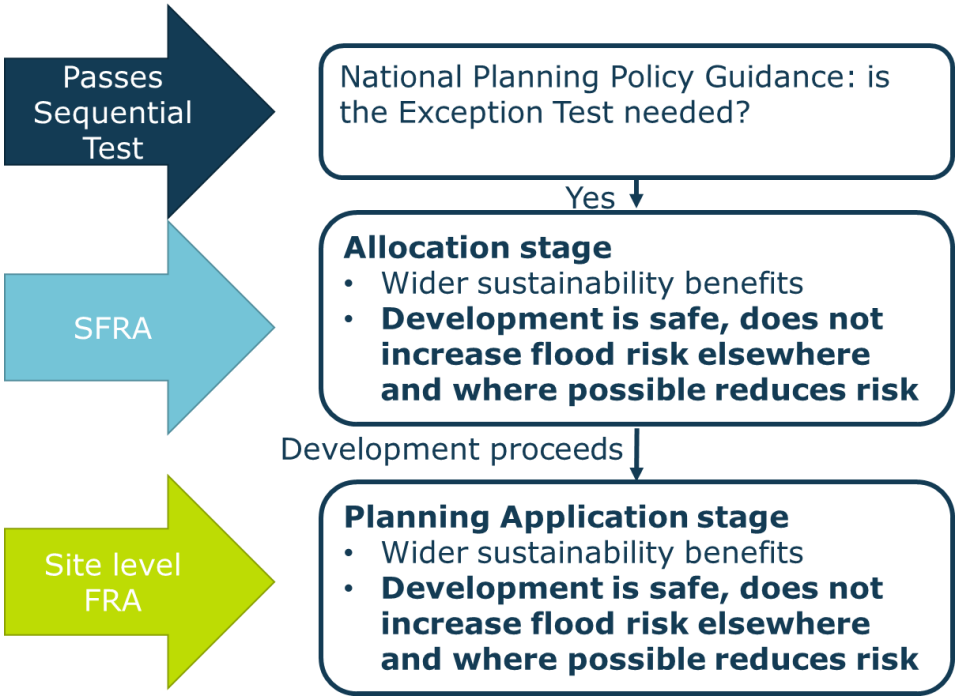


Figure 3-3: The exception test

There are two parts to demonstrating a development passes the exception test:

1. Demonstrating that the development would provide wider sustainability benefits to the community that outweigh the flood risk.

LPAs will need to set out the criteria used to assess the exception test and provide clear advice to developers on the information required. If this information is not provided, the LPA should consider whether the use of planning conditions and / or

planning obligations could allow it to pass the exception test. If this is not possible, this part of the exception test has failed and planning permission should be refused.

At the stage of allocating development sites, LPAs should consider wider sustainability objectives, such as those set out in Local Plan Sustainability Appraisals. These generally consider matters such as biodiversity, green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.

The LPA should consider the sustainability issues the development will address and how far doing so will outweigh the flood risk concerns for the site, e.g. by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.

2. Demonstrating that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

In circumstances where the potential effects of proposed development are material a Level 2 SFRA is likely to be needed to inform the exception test for strategic allocations to provide evidence that the principle of development can be supported. At the planning application stage, a site-specific FRA will be needed. Both will need to consider the actual and residual risk and how this will be managed over the lifetime of the development.

3.2.6 Making a site safe from flood risk over its lifetime

LPAs will need to consider the actual and residual risk of flooding and how this will be managed over the lifetime of the development:

- Actual risk is the risk to the site considering existing flood mitigation measures.
- The PPG refers to the 'design flood' against which the suitability of a proposed development should be assessed and mitigation measures, if any, are designed.
    - The 'design flood' is defined as the 1% AEP fluvial event or 1% AEP surface water event, plus an appropriate allowance for climate change. Allowances for climate change can be found on the EA website here.
- Safe access and egress should be available during the design flood event. Firstly, the design of the development should seek to avoid areas of a site at flood risk. If that is not possible then access routes should be located above the design flood event levels. Where that is not possible, access through shallow and slow flowing water that poses a low flood hazard may be acceptable.
- Residual risk is the risk that remains after the effects of flood defences have been taken into account and/ or from a more severe flood event than the design event. The residual risk can be:

- The effects of an extreme 0.1% annual probability flood event. This could lead to the overtopping of flood defences, which may lead to erosion and/or failure, and/ or
- Structural failure of any flood defences, such as breaches in embankments or walls.

- Flood resistance and resilience measures should be considered to manage any residual flood risk by keeping water out of properties and seeking to reduce the damage caused, should water enter a property. Emergency plans should also account for residual risk, e.g. through the provision of flood warnings and a flood evacuation plans where appropriate.

In line with the NPPF, the impacts of climate change over the lifetime of the development should be taken into account when considering actual and residual flood risk.

3.3 Applying the sequential test and exception test to individual planning applications

3.3.1 Applying the sequential test

WBC, with advice from the EA, are responsible for considering the extent to which sequential test considerations have been satisfied.

Developers are required to apply the sequential test to all development sites, unless the site is:

- A strategic allocation and the test has already been carried out by the LPA as part of preparing the local plan, or
- A change of use (except to a more vulnerable use), or
- A minor development (householder development, small non-residential extensions with a footprint of less than 250m^2), or
- A development in fluvial flood zone 1 unless there are other flooding issues in the area of the development (i.e. surface water, ground water, sewer flooding).

The SFRA contains information on all sources of flooding and takes into account the impact of climate change. This should be considered when a developer undertakes the sequential test, including the consideration of reasonably available sites at lower flood risk.

Local circumstances must be used to define geographical scope of the sequential test (within which it is appropriate to identify reasonably available alternatives). To determine the appropriate search area criteria, include the catchment area for the type of development being proposed. For some sites this may be clear, e.g. school catchments, in other cases it may be identified by other Local Plan policies. For some sites, e.g. regional distribution sites, it may be suitable to widen the search area beyond LPA administrative boundaries.

The sources of information on reasonably available sites may include:

- Site allocations in Local Plans
- Sites with Planning Permission but not yet built out
- Strategic Housing and Economic Land Availability Assessments (SHELAAs)/ five-year land supply/ annual monitoring reports
- Locally listed sites for sale

It may be that a number of smaller sites or part of a larger site at lower flood risk form a suitable alternative to a development site at high flood risk.

Ownership or landowner agreement in itself is not acceptable as a reason not to consider alternatives.

3.3.2 Applying the exception test

If, following application of the sequential test, it is not possible for the development to be located in areas with a lower probability of flooding the exception test must then be applied (as set out in Table 3 of the PPG). Developers are required to apply the exception test to all applicable sites (including strategic allocations).

The applicant will need to provide information that the application can pass both parts of the exception test:

1. Demonstrating that the development would provide wider sustainability benefits to the community that outweigh the flood risk.
    - Applicants should refer to wider sustainability objectives in Local Plan Sustainability Appraisals. These often consider matters such as biodiversity, green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.
    - Applicants should assess the suitability issues the development will address and how doing it will outweigh the flood risk concerns for the site, e.g. by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.
2. Demonstrating that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.
    - The site-specific FRA should demonstrate that the site will be safe, and the residents/occupiers will not be exposed to hazardous flooding from any source. The FRA should consider actual and residual risk and how this will be managed over the lifetime of the development, including:
        - the design of any flood defence infrastructure,
        - access and egress,
        - operation and maintenance,

- design of the development to manage and reduce flood risk wherever possible,
- resident awareness,
- flood warning and evacuation procedures, including whether the developer would increase the pressure on emergency services to rescue people during a flood event, and
- any funding arrangements required for implementing measures.

- Further guidance on FRAs for new developments can be downloaded from the government website here.

4 Impact of Climate Change

Climate change projections show an increased chance of warmer, wetter winters and hotter, drier summers with a higher likelihood of more frequent and intense rainfall. This is likely to make severe flooding happen more often.

The NPPF sets out that flood risk should be managed over the lifetime of a development, taking climate change into account. This section sets out how the impact of climate change should be considered.

4.1 Revised climate change guidance

The Climate Change Act 2008 creates a legal requirement for the UK to put in place measures to adapt to climate change and to reduce carbon emissions by at least 80% below 1990 levels by 2050. This was updated in June 2019 under the Climate Change Act 2008 (2050 Target Amendment) Order to a 100% reduction (or net zero) by 2050. The full Act is available on the Government website here and the amendment order is available on the Government website here.

In 2018, the government published new UK Climate Projections (UKCP18). The EA used these projections to update their climate change guidance for new developments with regards to updated fluvial and rainfall allowances. The EA published updated climate change guidance for fluvial risk in July 2021 on how allowances for climate change should be included in both strategic and site-specific FRAs. The guidance adopts a risk-based approach considering the vulnerability of the development and considers risk allowances on a management catchment level, rather than a river basin level. The guidance was further updated in May 2022 to address the changes to the requirements for rainfall allowances.

Before undertaking a detailed FRA, developers should check the government website for the latest guidance. Applying the climate change guidance

To apply the appropriate climate change guidance to a site, the following information is required:

- The vulnerability of the development – see Annex 3 in the NPPF.
- The likely lifetime of the development – in general 75 years is used for commercial development and 100 for residential, but this needs to be confirmed in an FRA. For development that will have an anticipated lifetime significantly beyond 100 years a higher allowance is required.
- The Management Catchment (assigned by the EA) that the site is located in (as shown in Figure 4-1).
    - Most of the Wokingham Borough lies within the Loddon and tributaries Management Catchment.

- The north of the Wokingham Borough lies within the Thames and South Chilterns Management Catchment.
- Small sections on the eastern boundary of the Wokingham Borough lie within the Maidenhead and Sunbury Management Catchment.
- Parts of the western side of the Wokingham Borough lie within the Kennet and tributaries Management Catchment.

Developers should consider the following when deciding which allowances to use to address flood risk for a development or local plan allocation:

- Likely depth, speed, and extent of flooding for each allowance of climate change over time considering the allowances for the relevant epoch (2020s, 2050s and 2080s).
- The 'built in' resilience measures used, for example, raised floor levels.
- The capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach.

Developers should refer to the EA guidance when considering which climate change allowances to use, available on the government website here.

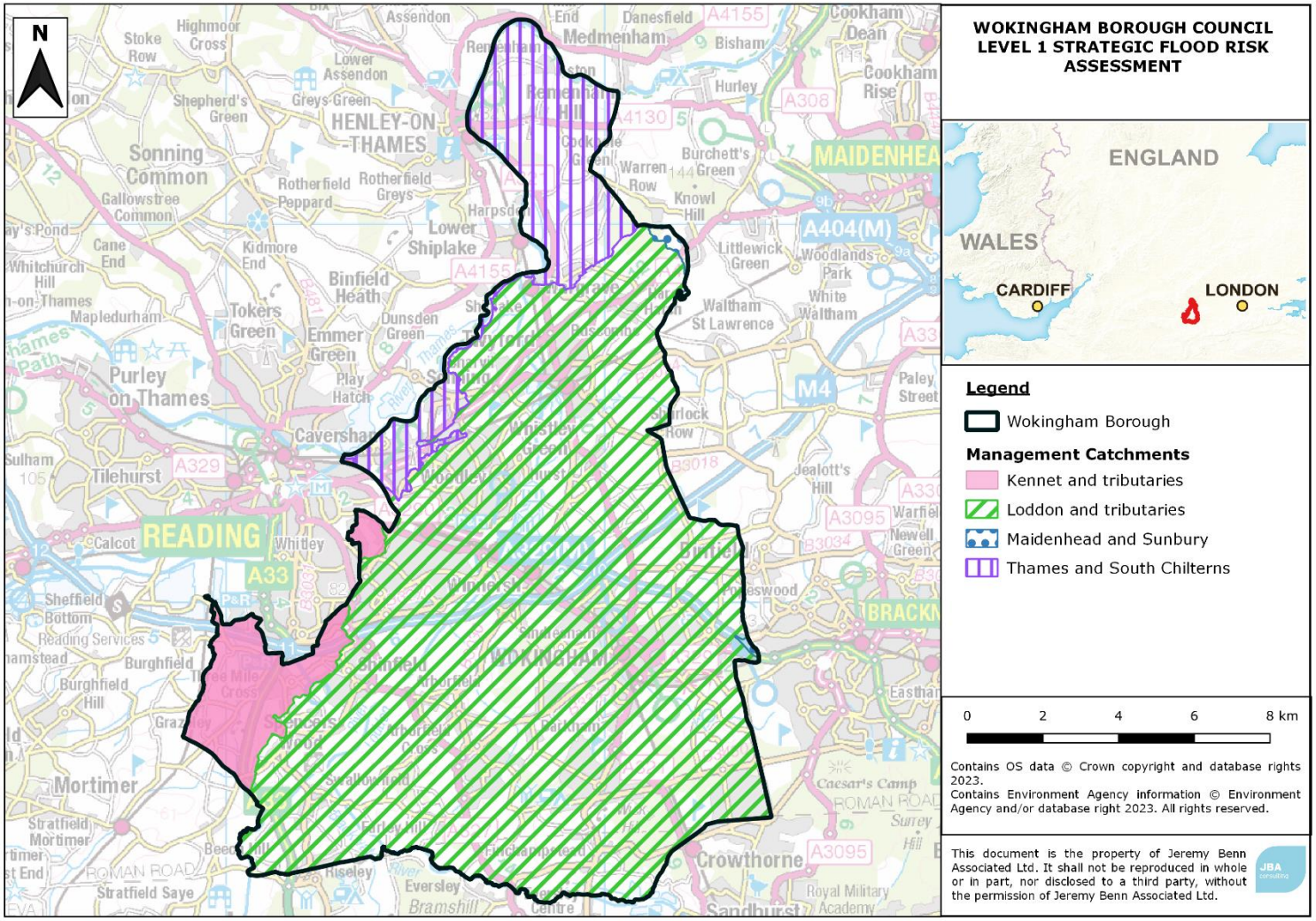


Figure 4-1: Management Catchments (assigned by the EA) across Wokingham Borough.

4.2 Relevant allowances for Wokingham Borough

Table 4-1 shows the updated peak river flow allowances that apply in Wokingham Borough for fluvial flood risk for the Thames and South Chilterns, Loddon and tributaries, Maidenhead and Sunbury and Kennet and tributaries Management Catchments. These allowances supersede the previous allowances by River Basin District. Where the previous climate allowances were within +/- 5% of the updated guidance, these were not re-run.

The range of allowances are based on percentiles which describe the proportion of possible scenarios that fall below an allowance level:

- The central allowance is based on the 50th percentile (exceeded by 50% of the projections in the range).
- The higher central allowance is based on the 70th percentile (exceeded by 30% of the projections in the range).
- The upper end allowance is based on the 95th percentile (exceeded by 5% of the projections in the range).

Table 4-1: Peak river flow allowances for the Management Catchments which cover Wokingham Borough

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 2115)
Thames and South Chilterns	Upper end	30%	42%	76%
Thames and South Chilterns	Higher central	17%	22%	43%
Thames and South Chilterns	Central	12%	14%	31%
Loddon and tributaries	Upper end	23%	25%	46%
Loddon and tributaries	Higher central	11%	10%	23%
Loddon and tributaries	Central	7%	4%	14%
Maidenhead	Upper end	32%	45%	81%

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 2115)
and Sunbury				
Maidenhead and Sunbury	Higher central	19%	25%	47%
Maidenhead and Sunbury	Central	14%	17%	35%
Kennet and tributaries	Upper end	32%	39%	76%
Kennet and tributaries	Higher central	16%	16%	35%
Kennet and tributaries	Central	10%	8%	21%

Table 4-2 shows the updated rainfall intensity allowances that apply in Wokingham for surface water flood risk for the different Management Catchments. These allowances supersede the previous country wide allowances. These allowances should be used for site-scale applications and for surface water flood mapping in small catchments (less than 5km^2) and urbanised drainage catchments.

Table 4-2: Peak rainfall intensity allowances for small and urban catchments for the Management Catchments which cover Wokingham Borough

Management Catchment	Allowance category	Total potential change anticipated for '2050s' (2022 to 2060) 3.3% AEP	Total potential change anticipated for '2050s' (2022 to 2060) 1% AEP	Total potential change anticipated for '2070s' (2061 to 2125) 3.3% AEP	Total potential change anticipated for '2070s' (2061 to 2125) 1% AEP
Thames and South Chilterns	Upper end	35%	40%	35%	40%
Thames and South Chilterns	Central	20%	20%	25%	25%
Loddon and tributaries	Upper end	35%	40%	35%	40%

Management Catchment	Allowance category	Total potential change anticipated for '2050s' (2022 to 2060) 3.3% AEP	Total potential change anticipated for '2050s' (2022 to 2060) 1% AEP	Total potential change anticipated for '2070s' (2061 to 2125) 3.3% AEP	Total potential change anticipated for '2070s' (2061 to 2125) 1% AEP
Loddon and tributaries	Central	20%	20%	25%	25%
Maidenhead and Sunbury	Upper end	35%	40%	35%	40%
Maidenhead and Sunbury	Central	20%	20%	25%	25%
Kennet and tributaries	Upper end	35%	40%	35%	40%
Kennet and tributaries	Central	20%	20%	25%	25%

4.3 Representing climate change in the Level 1 SFRA

Representation of climate change within the SFRA was discussed with the EA. Where previous climate change runs were within +/- 5% of the updated climate change allowances, these were able to be used. This is due to the marginal change in allowance and subsequent results. As the Borough lies across four Management Catchments, the allowances are varied between watercourses.

The following models and allowances were used to represent the 2080s central climate change estimate (or 2070s central climate change estimate for peak rainfall intensity allowances):

- Blackwater 2007 – 1% AEP plus 15% climate change
- Blackwater 2009 – 1% AEP plus 15% climate change
- Foudry Brook – 1% AEP plus 20% climate change
- Kennet – 1% AEP plus 25% climate change
- Loddon Lower – 1% AEP plus 14% climate change
- Thames (Hurley to Teddington) – 1% AEP plus 35% climate change
- Thames (Pangbourne to Sonning) – 1% AEP plus 35% climate change
- Thames (Sonning to Hurley) – 1% AEP plus 35% climate change

The following models and allowances were used to represent the 2080s higher central climate change estimate:

- Blackwater 2007 – 1% AEP plus 25% climate change

- Blackwater 2009 – 1% AEP plus 25% climate change
- Kennet – 1% AEP plus 35% climate change
- Loddon Lower – 1% AEP plus 23% climate change
- Emm Brook – 1% AEP plus 25% climate change

The Arborfield model was developed as a direct rainfall model to best represent the flooding, therefore the peak rainfall intensity allowances have been used to represent central and upper end climate change for the 2070s period.

For the Thames models, the 70% estimates are slightly outside of the +/- 5% allowance for the upper end climate change (which is 76%). This model extent will be used as part of the site screening process to inform the sensitivity of sites to climate change in the absence of any suitable outputs for the higher central allowance. Further information on the site screening process can be found in Section 10.2.

Appendix B details the models used in this assessment.

For any sites not covered by the EA's detailed modelling or not able to be run for appropriate climate change allowances, the modelled 0.1% AEP outline is used as an indicative climate change extent. This is appropriate given the Upper End climate change estimates are often similar to the 0.1% AEP/ Flood Zone 2 extents; therefore, the differences in the effects of climate change are anticipated to be minimal.

The 0.1% AEP surface water extent can be used as an indication of surface water risk, and the risk from smaller watercourses, which are too small to be covered by the EA's Flood Zones. Modelled Climate Change uplifts for the 3.3% and 1% AEP events were included as part of this SFRA and are presented in in Appendix A: GeoPDFs as 'Surface Water Extent plus Climate Change' for the following events and scenarios:

- 3.3% AEP plus 35% Climate Change
- 1% AEP plus 40% Climate Change

Developers will need to undertake a more detailed assessment of climate change as part of the planning application process when preparing FRAs, using the percentage increases which relate to the proposed lifetime and the vulnerability classification of the development. In areas where no modelling is present, this may require development of a 'detailed' hydraulic model, using channel topographic survey. Developers should consult the EA to provide further advice on how best to apply the new climate change guidance.

Climate change mapping has been provided in Appendix A: GeoPDFs. The climate change outputs have been presented under:

- 'Fluvial Flood Extent with Climate Change' including central and higher central allowances.

It is important to note that although the flood extent may not increase noticeably on some watercourses, the flood depth, velocity, and hazard may increase compared to the 1% AEP current-day event.

When undertaking a site-specific FRA, developers should:

- Confirm which national guidance on climate change and new development applies by visiting the Government website here.
- Apply this guidance when deciding the allowances to be made for climate change, having considered the potential sources of flood risk to the site (using this SFRA), the vulnerability of the development to flooding and the proposed lifetime of the development. If the site is just outside the indicative climate change extents in this SFRA, the impact of climate change should still be considered because the site may be affected should the more extreme climate change scenarios materialise.
- Refer to Section 8 which provides further details on climate change for developers, as part of the FRA guidance, and the SFRA User Guide in Appendix C.

4.4 Impacts of climate change in Wokingham Borough

This section explores which areas of Wokingham Borough are most sensitive to increases in flood risk due to climate change. It should be noted that areas that are already at high risk will also become at increasing risk in future and the frequency of flooding will increase in such areas.

It is recommended that the 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 Borough.

4.4.1 Impact of climate change on fluvial flood risk

Climate change modelled flood extents can be compared to the 1% AEP flood extent (Flood Zone 3a), and where no detailed modelling exists, compared against Flood Zone 2, for an indication of areas most sensitive to climate change.

Areas in Wokingham Borough most sensitive to fluvial impacts of climate change are:

- Along the River Loddon and Broadwater Brook at Twyford.
- Along the River Loddon in the east side of Reading through Winnersh, Earley and Woodley.
- Along the River Blackwater in the south of the Borough.
- Along the River Thames at Wargrave.
- Along Barkham Brook and its unnamed tributary at Arborfield Green.
- Along the unnamed tributary of Emm Brook which flows north from Heathlake Nature Reserve through the Gorrick Plantation.

4.4.2 Impacts of climate change on surface water flood risk

The 1% AEP surface water event with a 40% climate change uplift can be compared to the present day 1% AEP extent for an indication of areas most sensitive to climate change.

Areas in Wokingham most sensitive to changes in surface water flood risk are typically in areas of low-lying topography on the floodplains of the main watercourses. In particular the following areas are sensitive to increased surface water flooding due to climate change:

- Along the path of the River Loddon between Charvil and Twyford.
- Along the flow paths to the east of Hurst village.
- Along the path of the River Loddon and the flow paths flowing west towards this watercourse through Shinfield and Spencer's Wood.
- Along the paths of the River Loddon and the River Blackwater at Swallowfield.
- Along the path of the unnamed tributary of Emm Brook which flows north from Heathlake Nature Reserve through the Gorrick Plantation.
- Along the paths of Emm Brook and its unnamed tributary through Wokingham.

4.4.3 Impacts of climate change on groundwater flood risk

There is no technical modelling data available to assess climate change impacts on groundwater. It would depend on the flooding mechanism, historic evidence of known flooding and geological characteristics, for example prolonged rainfall in a chalk catchment. Flood risk could increase when groundwater is already high or emerged, causing additional overland flow paths or areas of still ponding.

A high likelihood of groundwater flooding may mean infiltration SuDS are not appropriate and groundwater monitoring may be recommended.

4.4.4 Adapting to climate change

The PPG Climate Change guidance contains information and guidance for how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change. Examples of adapting to climate change include:

- Considering future climate risks when allocating development sites so that the risks are understood over the development’s lifetime.
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development.
- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality.

- Promoting adaptation approaches in design policies for developments and the public realm, for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses.
- Identifying no or low-cost responses to climate risks that also deliver other benefits, such as green infrastructure that improves adaptation, biodiversity, and amenity, for example by leaving areas shown to be at risk of flooding as public open space.
- Considering the Standard of Protection (SoP) of defences and sites for future development, in relation to sensitivity to climate change. WBC and developers will need to work with RMAs and use the SFRA datasets to understand whether development is affordable or deliverable. Locating development in such areas of risk may not be a sustainable long-term option, such as at the defence locations mentioned in Section 6; and
- It is recommended that the differences in flood extents from climate change are compared by WBC when allocating sites, to understand how much additional risk there could be, where this risk is in the site, whether the increase is marginal or activates new flow paths, whether it affects access/ egress and how much land could still be developable overall. Recommendations for development are made for the levels of risk in the SFRA User Guide in Appendix C.

5 Understanding flood risk in Wokingham Borough

This section explores the key sources of flooding in Wokingham Borough and the factors that affect flooding including topography, soils, and geology. The main sources of flooding affecting Wokingham Borough are from watercourses, surface water, and sewers, as detailed in information provided by WBC, the EA, and Thames Water.

This is a strategic summary of the risk in Wokingham Borough. Developers should use this section to scope out the flood risk issues they need to consider in greater detail in a site-specific FRA to support a Planning Application.

Appendix B contains a list of the sources of data used in the SFRA and the approach to using hydraulic model data to inform the mapping.

5.1 Historical flooding

5.1.1 Historical flood records

Wokingham Borough has an extensive historical flooding record. Table 5-1 details the major flood events of which WBC has records of. Table 5-2 details the flood events shown within the EA Recorded Flood Outlines dataset. The watercourses and areas affected by these events are detailed further in Appendix E.

Table 5-1: Historic flooding incidents provided by WBC.

Flood date	Flood source	Flood cause	Receptors
March 1947	Other	Local drainage/surface water	The flood impacted the west of the Borough. No additional information was provided regarding the receptors affected during this flood
February 1990	Other	Local drainage/surface water	The flood impacted the north of the Borough. No additional information was provided regarding the receptors affected during this flood
December 2000	Other	Channel capacity exceedance Surface water	Approximately 13 highways were flooded across the Borough. At least 10 properties were flooded externally, and a further 4 properties were flooded internally, with many centred around the urban centre of Wokingham.

Flood date	Flood source	Flood cause	Receptors
December 2003/January 2003	Other	Local drainage/surface water Sewer	This flood event mostly impacted areas immediately adjacent to the Foudry Brook and River Loddon. No information provided regarding the receptors affected during this flood.
July 2007	Other	Local drainage/surface water	At least 58 highways and 120 properties flooded externally across the entire Borough, for example residents' gardens, driveways, and garages. At least 80 properties were flooded internally, including a local school.
2008	Surface water	Surface water	At least 15 highways and 30 properties were flooded externally including many gardens. Over 25 properties were also flooded internally. Most reported incidences were clustered around Wokingham, Winnersh, and Three Mile Cross
2009	Surface water	Surface water	One highway flooded in Earley.
January 2013	Other	Local drainage/surface water	Over 30 highways and 50 properties were flooded externally, mostly across the west of the Borough. At least 35 of these properties were flooded internally.
2015	Surface water	Surface water	4 highways were flooded in Wokingham and Arborfield. At least 6 properties flooded in the area; however, it is unclear whether this is internal or external.

Table 5-2: Historic flooding incidents shown in the EA Recorded Flood Outlines dataset. These are also shown in Figure 5-1.

Flood date	Flood source	Flood cause	Areas affected
March 1947	Main river Other	Channel capacity exceedance	Widespread flooding across the Borough, particularly along the River Loddon and its tributaries, the River Thames, and the River

Flood date	Flood source	Flood cause	Areas affected
			Blackwater east of Eversley.
September 1968	Main river	Channel capacity exceedance	Areas of flooding along the River Loddon at Twyford and around the railway line crossing, and along the length of the River Blackwater through the Borough.
June 1971	Main river	Channel capacity exceedance	Affects a small area on the western boundary of the Borough along Foudry Brook.
November 1974	Main river	Channel capacity exceedance	Widespread flooding along the River Thames and the River Loddon and its tributaries. Also, some flooding along the River Blackwater at Swallowfield.
August 1977	Main river	Channel capacity exceedance	Flooding along the River Thames along the northwest boundary of the Borough.
December 1981	Main river	Channel capacity exceedance	Flooding along the River Loddon and its tributaries between Twyford in the north and the M4 in the south.
February 1990	Main river Other	Channel capacity exceedance	Widespread flooding along the River Loddon and the River Blackwater and also the River Thames along the northern boundary of the Borough.
February 1991	Main river	Channel capacity exceedance	Flood along the River Loddon and its tributaries south of the railway line through Twyford.
September 1992	Main river	Channel capacity exceedance	Flooding along Twyford Brook in the west of the Borough and south of the confluence of the River Loddon and the River Thames.
October 1993	Main river	Channel capacity exceedance	A small are of flooding along Twyford Brook in the west of the Borough and around the confluence of the River Loddon and the River Thames.
December 2000	Main river Other	Channel capacity exceedance	Widespread flooding along the River Thames and along the River Loddon by Twyford.

Flood date	Flood source	Flood cause	Areas affected
January 2003	Main river Other	Channel capacity exceedance	Widespread flooding along the River Thames and along the River Loddon north of Dinton Pastures Country Park. Also a small area of flooding in the west of the area along Foudry Brook.
July 2007	Main river Other	Channel capacity exceedance	Widespread flooding throughout the Borough along the River Thames, the River Loddon and its tributaries.
Winter 2013-2014	Main river Other	Channel capacity exceedance	Widespread flooding along the River Thames and along the River Loddon by Twyford.

In addition, the EA's Historic Flood Map (HFM) shows areas of land that have been previously subject to fluvial flooding in the area. This includes flooding from rivers, the sea and groundwater springs but excludes surface water. The HFM outlines for Wokingham Borough are shown in Figure 5-1 alongside the RFO outlines and included in the interactive mapping in Appendix A. Please note some of the historic extents may refer to older historic flood events, prior to flood defence improvements.

Information on sewer flooding across the Borough is included in Section 5.6 and a list of historic flooding incidences provided by Thames Water is available in Table 5-3.

5.1.2 Section 19 Flood Investigation

Under the Flood and Water Management Act (2010), the Lead Local Flood Authority (LLFA) has a duty to investigate flood incidence where considered necessary or appropriate and produce a report. Section 19 Flood Investigation reports are available for the following flood events:

- Various locations, winter 2013/14
- Sandford Lane, January 2016
- Knowl Hill, February 2020
- Wargrave, June 2020

Reports detailing the flood events, recommendations and conclusions are available through the Wokingham Borough Council website or via request to the LLFA.

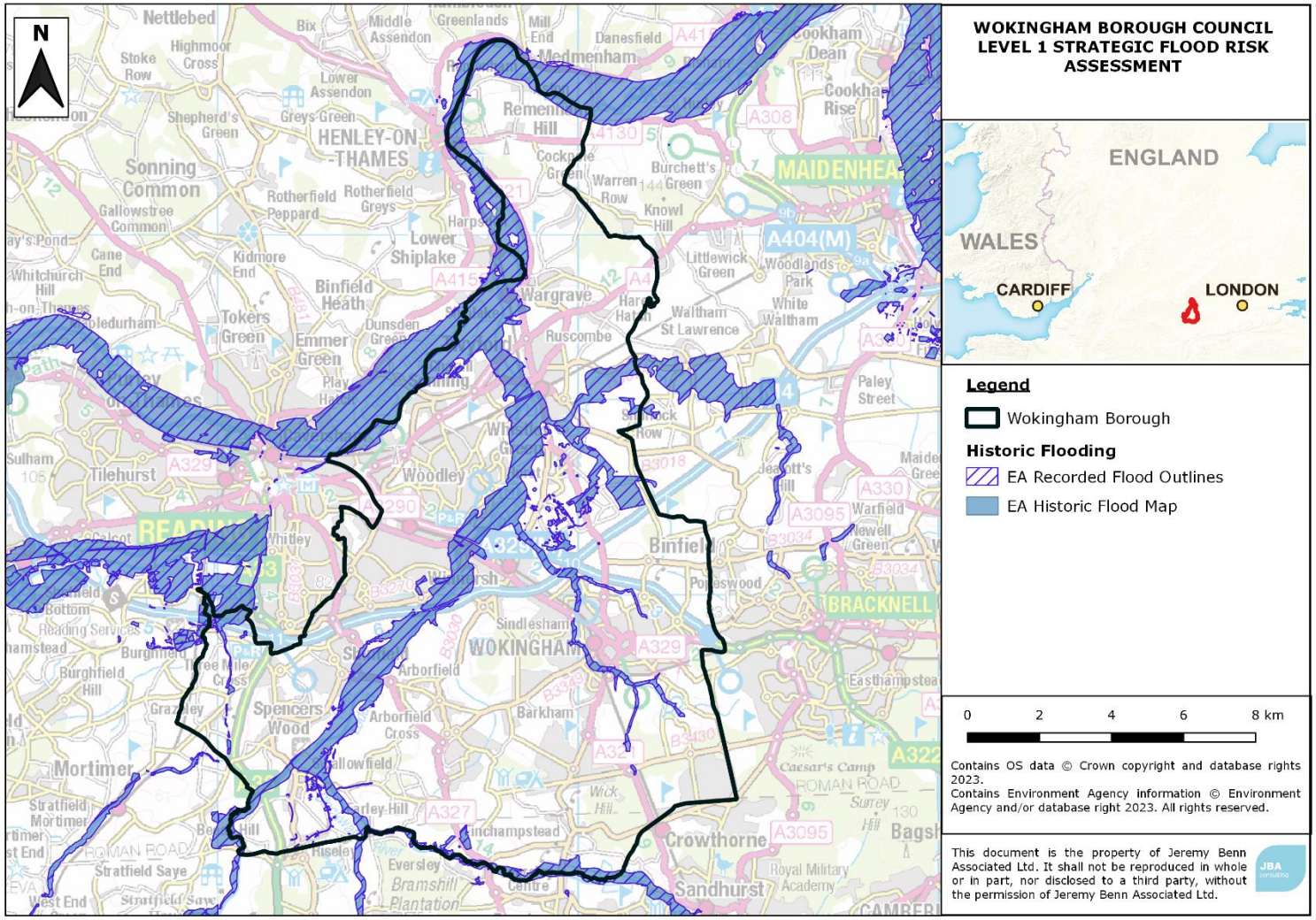


Figure 5-1: Historic flooding outlines across Wokingham Borough.

5.2 Topography, geology, soils, and hydrology

The topography, geology and soil are all important in influencing the way the catchment responds to a rainfall event. The degree to which a material allows water to percolate through it, the permeability, affects the extent of overland flow and therefore the amount of run-off reaching the watercourse. Steep slopes or clay rich (low permeability) soils will promote rapid surface runoff, whereas more permeable rock such as limestone and sandstone may result in a more subdued response.

5.2.1 Topography

Figure 5-2 shows how the topography of Wokingham Borough comprises of low-lying land along the north-western border and through the centre of the catchment, associated with major watercourses such as the River Thames and River Loddon. Areas with higher elevations include Crazies Hill and Knowl Hill to the north, The Ridges in the southeast of the Borough. The maximum elevation in the Borough is approximately 143mAOD at the peak of Crazies Hill.

5.2.2 Geology

Information on the bedrock and superficial geology in the Borough can be viewed online in the British Geology Society Geology Viewer.

In the north of the Borough, bedrock geology is primarily made up of white chalk. A band of clay, silt, and sand then extends across the south of Reading to Whistley Green. South of this band, the geology consists of a combination of clay, silt, and sand, with higher densities of sand around Barkham and Wokingham.

The EA also provides mapping of different types of aquifer, the underground layers of water-bearing permeable rock from which groundwater can be extracted. Aquifers are designated as either principal or secondary aquifers. Principal aquifers are designated by the EA as strategically important rock units that have high permeability and water storage capacity. In the Borough, there is an area of principal aquifer in the north but most of the Borough is classified either as a secondary aquifer or unproductive. The aquifer designations across the Borough for bedrock geology are shown in Figure 5-3.

There is limited information regarding the superficial geology of the Wokingham Borough. Along the immediate route of the River Thames and River Loddon, it is mostly superficial deposits, including silt, alluvium, and Gravel. Diverging from here, it is mostly river terrace deposits. There are also small patches of clay, silt, sand, gravel, and brickearth throughout the Borough.

5.2.3 Soils

Soils across Wokingham are primarily loamy, meaning they are moderately permeable. Areas further to the north, and to the south-east are also quite sandy,

therefore more freely draining. In contrast, a band of more clayey loam extends from the south-west to north-east, which is slowly permeable and seasonally wet. Floodplain soils following the River Thames and River Loddon are also loamy and clayey, with naturally high groundwater.

Mapping showing soils information across the Borough can be viewed online on the Cranfield Soil and Agrifood Institute Soilscapes website, available here.

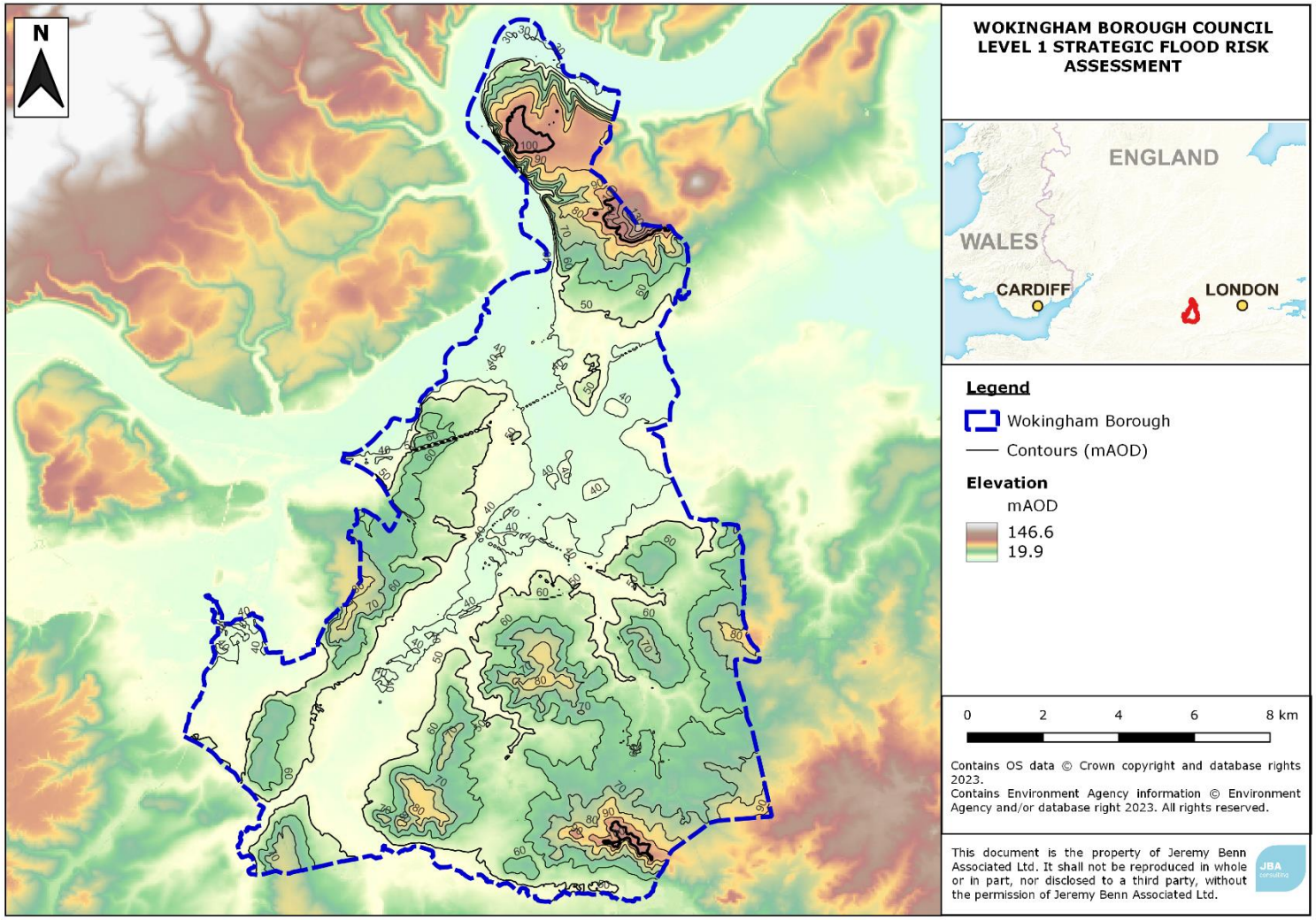


Figure 5-2: OS Terrain 50 dataset showing topography across Wokingham Borough.

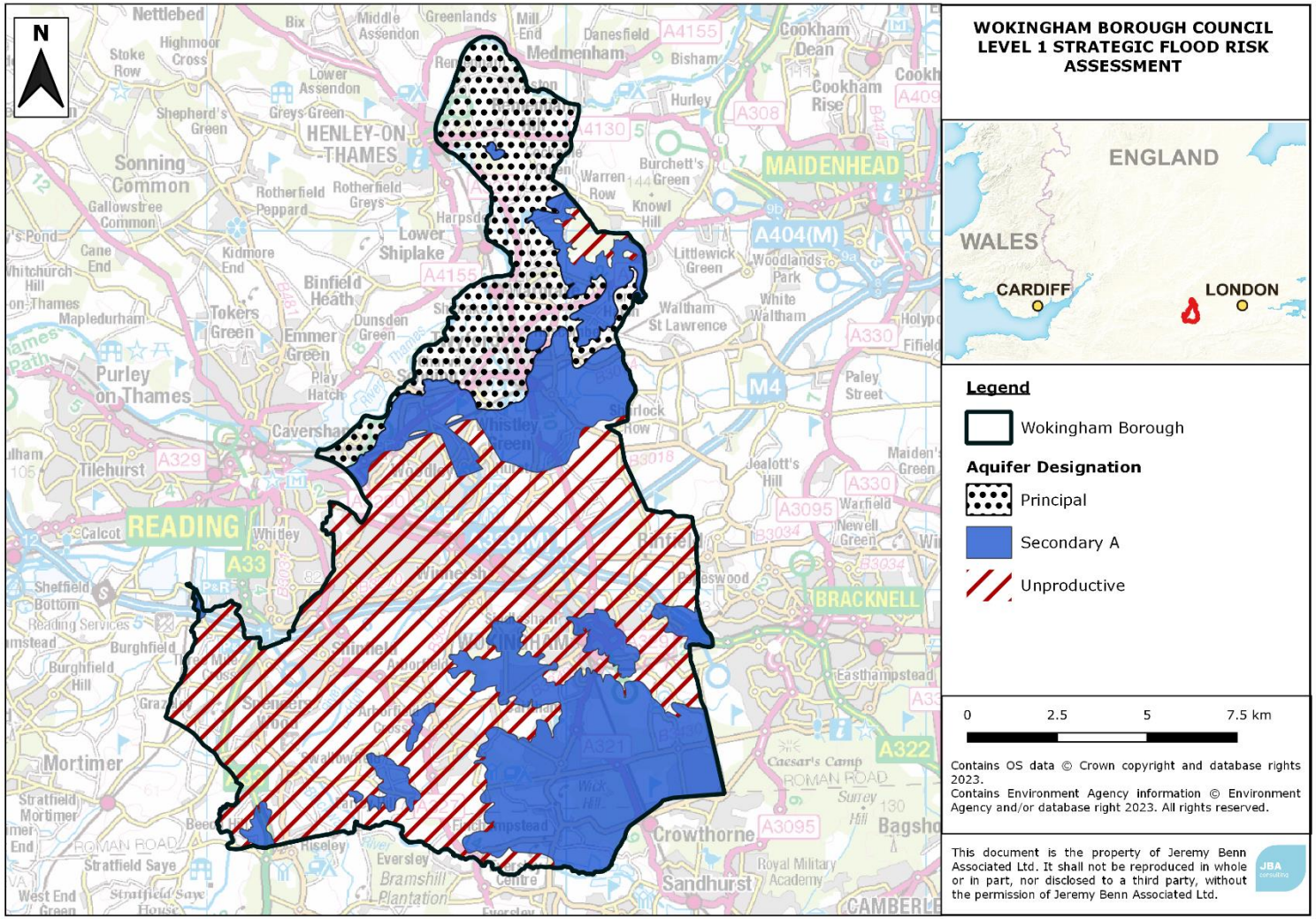


Figure 5-3: Aquifer designations based on bedrock geology across Wokingham Borough.

5.3 Hydrology

The major watercourses flowing through the Wokingham Borough are:

- River Thames, and its tributary the River Loddon
- The main tributaries of the River Loddon:
  - Twyford Brook
  - Emm Brook
  - Barkham Brook
  - River Blackwater
- Foudry Brook, a tributary of the River Kennet which flows to the west of the borough and joins the River Thames at Reading

Tributaries of these watercourses include smaller ordinary watercourses and numerous unnamed drains. There are also several ponds and lakes within the study area. A map of the key watercourses is included in Figure 1-2 and in the Geo-PDF mapping in Appendix A.

5.4 Fluvial flood risk

The primary fluvial flood risk is along the River Thames and the River Loddon. The extents are mainly confined to the route of the River Thames along the north-western border, and River Loddon through the centre of the Borough. Wider extents follow smaller tributaries such as Emm Brook and River Blackwater.

The Flood Zone maps for the Wokingham Borough are provided in Appendix A: Geo-PDFs, split into Flood Zones 2, 3a, and 3b. Section 3.2.1 describes how the fluvial Flood Zones have been derived for this SFRA. The flood risk associated with the major locations in the Borough of Wokingham are detailed in Appendix E.

5.5 Surface water flooding

Surface water runoff is most likely to be caused by intense downpours e.g. thunderstorms. At times, the amount of water falling can completely overwhelm the drainage network, which is not designed to cope with extreme storms. The flooding can also be complicated by blockages to drainage networks, sewers being at capacity and/ or high-water levels in watercourses that cause local drainage networks to back up.

The EA Risk of Flooding from Surface Water mapping (RoFSW) shows that several communities are at risk of surface water flooding. The mapping shows that surface water predominantly follows topographical flow paths of existing watercourses or dry valleys and can pond in low-lying areas. Whilst in the majority of cases the risk is confined to roads, there are notable prominent run-off flow routes around properties, e.g. properties situated at the foot of surrounding hills. The RoFSW mapping for the Wokingham Borough can be found on the Geo-PDF mapping in Appendix A.

5.6 Sewer flooding

Sewer flooding occurs when intense rainfall/river flooding overloads sewer capacity (surface water, foul or combined), and/or when sewers cannot discharge to watercourses due to high water levels.

Sewer flooding can also be caused by blockages, collapses, equipment failure or groundwater leaking into sewer pipes.

Since 1980, the Sewers for Adoption guidelines mean that new surface water sewers have been designed to have capacity for a 3.3% AEP rainfall event, although until recently this did not apply to smaller private systems. This means that sewers can be overwhelmed in larger rainfall and flood events.

New developments should not cause additional pressures on existing sewers due to the requirements to maintain greenfield runoff rates. However, increases in rainfall as a result of climate change can lead to existing sewers becoming overloaded, although this can be reduced through the use of well-designed SuDS to reduce surface water runoff.

Thames Water is the water company responsible for the management of the drainage networks across the Wokingham Borough. Thames Water provided a record of flooding incidents relating to public foul, combined or surface water sewers from January 2000 until May 2022. Table 5-3 below displays this data using truncated postcodes to avoid identifying specific streets or properties.

Table 5-3: Sewer flooding incidents recorded by Thames Water (January 2000-May 2022)

Postcode	Number of recorded incidents 2022	Number of recorded incidents 2021	Number of recorded incidents 2020	Number of recorded incidents 2019	Number of recorded incidents from 2000-2019	Total flooding incidents
RG10 0	0	1	4	2	63	**70**
RG10 8	0	0	0	0	2	**2**
RG10 9	0	5	5	4	94	**108**
RG2 8	0	0	0	0	10	**10**
RG2 9	1	7	10	6	148	**172**
RG27 0	0	0	0	0	5	**5**
RG4 6	0	1	2	0	33	**36**
RG40 1	0	0	0	0	1	**1**
RG40 2	0	0	0	0	3	**3**
RG40 4	0	2	1	1	47	**51**

Postcode	Number of recorded incidents 2022	Number of recorded incidents 2021	Number of recorded incidents 2020	Number of recorded incidents 2019	Number of recorded incidents from 2000-2019	Total flooding incidents
RG40 5	0	0	0	0	3	**3**
RG41 1	0	0	0	0	8	**8**
RG41 2	0	0	1	0	3	**4**
RG41 3	0	0	0	0	1	**1**
RG41 4	1	1	2	0	5	**9**
RG41 5	0	7	7	4	205	**223**
RG45 6	0	0	0	0	16	**16**
RG5 3	2	8	6	12	113	**141**
RG5 4	1	11	14	6	297	**329**
RG6 1	0	5	5	4	34	**48**
RG6 3	0	4	8	8	83	**103**
RG6 4	0	1	7	6	54	**68**
RG6 5	0	0	5	4	62	**71**
RG6 7	0	3	6	7	91	**107**
RG7 1	0	7	17	4	153	**181**

5.7 Groundwater flooding

In general, less is known about groundwater flooding than other sources and availability of data is limited. Groundwater flooding can be caused by:

- High water tables, influenced by the type of bedrock and superficial geology.
- Seasonal flows in dry valleys, which are particularly common in areas of chalk geology.
- Rebounding groundwater levels, where these have been historically lowered for industrial or mining purposes.
- Where there are long culverts that prevent water easily getting into watercourses.

Groundwater flooding is different to other types of flooding. It can last for days, weeks, or even months and is much harder to predict and warn for. Monitoring does occur in certain areas, for example where there are major aquifers or when mining stops.

Two datasets were used to assess potential areas that are likely to be at higher risk of groundwater flooding:

- The EA's Areas Susceptible to Groundwater Flooding (AStGWF) dataset, showing the degree to which areas are susceptible to groundwater flooding based on geological and hydrogeological conditions. It does not show the likelihood of groundwater flooding occurring, i.e., it is a hazard, not risk, based dataset.
- The JBA Groundwater Emergence map, showing the risk of groundwater flooding to both surface and subsurface assets, based on predicted groundwater levels.

In this SFRA, a three-stage approach has been adopted to assess the risk of groundwater flooding:

1. Firstly, the AStGWF dataset was used to identify grid squares that are most susceptible to groundwater flooding. Based on this dataset, any areas with greater than 50% susceptibility to groundwater flooding were taken forward for further analysis. This resulted in 72 out of 188 grid squares being taken forward, which were mostly located along the paths of the River Loddon, River Thames, and River Blackwater.
2. Of the areas identified in the above, the JBA groundwater emergence map was used to locate areas where this groundwater is most likely to emerge. For this assessment, areas where groundwater levels are predicted to be within 0.5m of the surface level were identified.
3. For locations that met both of the above parameters, the 0.1% AEP surface water extent from the EA's RoFSW map was used to identify where any groundwater emerging in these locations is most likely to flow.

The results of this assessment are summarised in Appendix E. It should be noted that this assessment only identifies areas likely to be at risk of groundwater emergence and where this water might flow. It does not predict the likelihood of groundwater emerging or attempt to quantify the volumes of groundwater that might be expected to emerge in a given area. The JBA Groundwater Emergence map and the EA AStGWF dataset for Wokingham Borough are provided in Appendix A. In high-risk areas, a site-specific risk assessment for groundwater flooding may be required to fully inform the likelihood of flooding.

5.8 Flooding from reservoirs

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoirs Act 1975, available on the Government website here, and are on a register held by the EA. The level and standard of inspection and maintenance required by a Supervising Panel of Engineers under the Act means that the risk of flooding from reservoirs is very low.

Flooding from reservoirs occurs following partial or complete failure of the control structure designed to retain water in the artificial storage area. Reservoir flooding is

very different from other forms of flooding; it may happen with little, or no warning and evacuation will need to happen immediately. The likelihood of such flooding is difficult to estimate but is extremely low compared to flooding from other sources. It may not be possible to seek refuge upstairs from floodwater as buildings could be unsafe or unstable due to the force of water from the reservoir breach or failure.

The EA hold mapping showing what might happen if reservoirs fail. Developers and planners should check the Long-Term Risk of Flooding website before using the reservoir data shown in this SFRA to make sure they are using the most up to date mapping. The EA provide two flooding scenarios for the reservoir flood maps: a 'dry-day' and a 'wet-day'. The 'dry-day' scenario shows the predicted flooding which would occur if the dam or reservoir fails when rivers are at normal levels. The 'wet-day' scenario shows the predicted worsening of the flooding which would be expected if a river is already experiencing an extreme natural flood. It should be noted that these datasets give no indication of the likelihood or probability of reservoir flooding.

The current mapping shows that there are seven reservoirs located within Wokingham Borough, detailed in Table 5-4 with their locations shown in Figure 5-4. There are a further eight reservoirs located outside Wokingham Borough but whose flood extents lie within Wokingham Borough boundary, see Table 5-5. Section 8.4.3 provides further considerations for developing in the vicinity of reservoirs. The reservoir flood mapping for both the 'dry-day' and 'wet-day' scenarios in Wokingham Borough has been provided in the Geo-PDFs in Appendix A. The EA maps represent a credible worst-case scenario. In these circumstances it is the time to inundation, the depth of inundation, the duration of flooding and the velocity of flood flows that will be most influential.

Table 5-4: Reservoirs within Wokingham Borough. The locations of these reservoirs are shown in Figure 5-4.

Reservoir	Easting and Northing	Reservoir owner	Physical Status	Risk Category	Category	Year built	Surface Area (m^2)	Dam Type
Bearwood Lake	477284, 168602	Reading Football Club Ltd	In operation	B	Impounding	1860	190,000	TE Earthfill
Black Swan Lake, Dinton Pastures	478074, 172285	Wokingham Borough Council	In operation	Unknown	Impounding	1979	260,000	TE Earthfill
Longmoor Lake	478538, 165154	Wokingham Borough Council	In operation	C	Impounding	1800	40,000	TE Earthfill
Maiden Erlegh Lake	474928, 171037	Earley Town Council	In operation	A	Impounding	1885	Unknown	Gravity and Earthfill
Queen's Mere	481383, 165521	Dr Pavle Matijevic	In operation	C	Impounding	1850	45,000	TE Earthfill
Southlake	475656, 172155	Wokingham Borough Council	In operation	A	Impounding	Unknown	70,000	Gravity and Earthfill
White Knights Lake -	473735, 172209	The University of Reading	In operation	A	Impounding	1850	44,140	Gravity and Earthfill

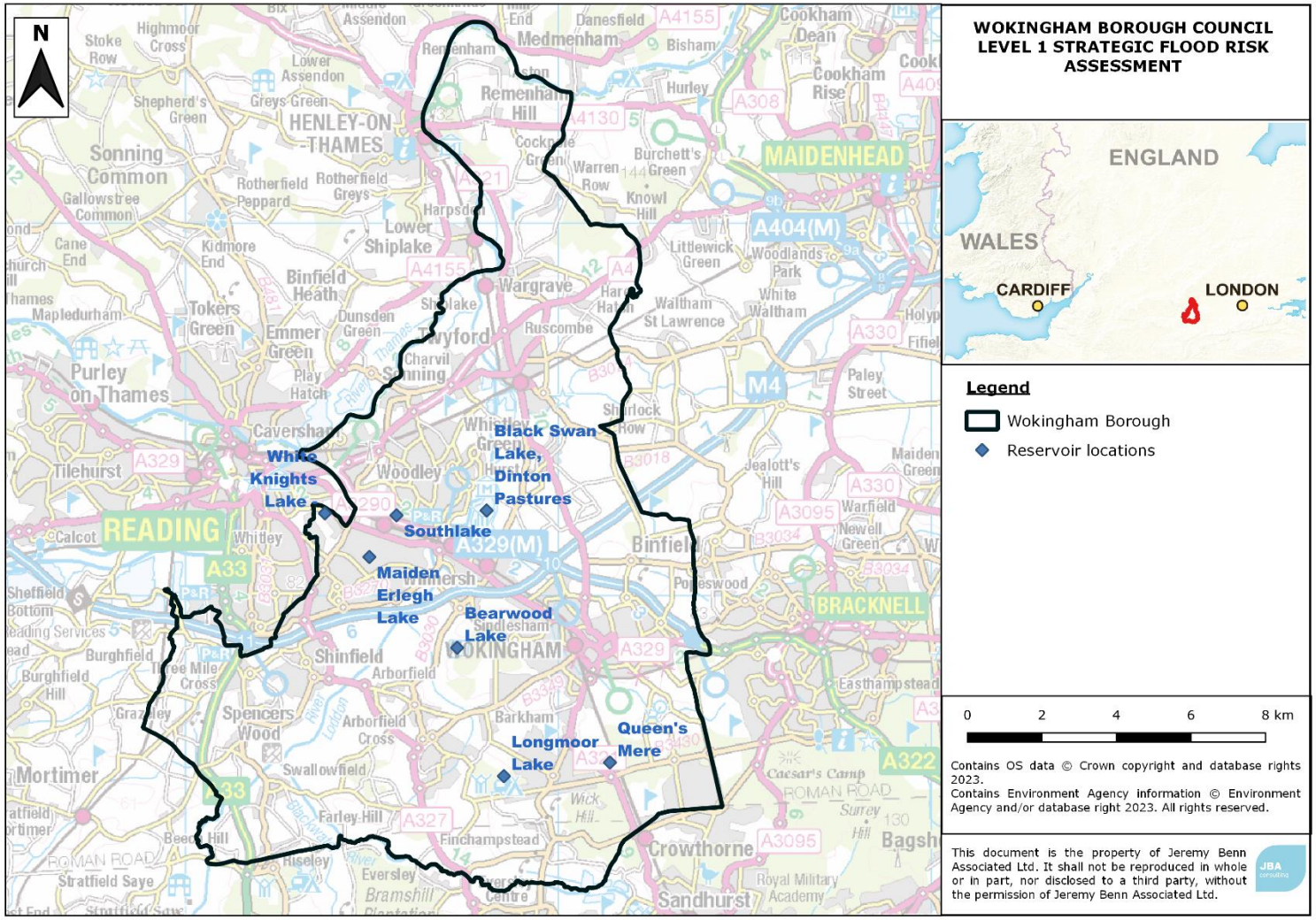


Figure 5-4: Location of the reservoirs within Wokingham Borough.

Table 5-5: Reservoirs located outside Wokingham Borough but where the flood extents impact the Borough.

Reservoir	Easting and Northing	Reservoir owner	Local Authority Area	LLFA	Does the reservoir impact the study area in the 'dry-day' scenario?
Decoy Pond	460639, 163403	EA	West Berkshire	Hampshire County Council	Yes
Dogmersfield Park Lake	475930, 151783	Mr Viktor Fedotov	Hart District	Hampshire County Council	Yes
Farmoor No.1	444545, 206189	Thames Water Limited	Vale of White Horse District	Oxfordshire County Council	No
Farmoor No.2	444545, 206189	Thames Water Limited	Vale of White Horse District	Oxfordshire County Council	No
Hawley Lake	484090, 157654	Ministry of Defence	Hart District	Hampshire County Council	Yes
Sandhurst Lower Lake	486219, 160670	Ministry of Defence	Bracknell Forest	Bracknell Forest Council	Yes
Southlake	475656, 172155	Wokingham Borough Council	Wokingham Borough	Wokingham Borough Council	Yes
Tundry Pond	477502, 152533	Mr Richard Revell	Hart District	Hampshire County Council	No

As above, the risk of reservoir flooding is extremely low. However, there remains a residual risk to development from reservoirs which developers should consider during the planning stage.

- Developers should seek to contact the reservoir owner to obtain information which may include:
  - reservoir characteristics: type, dam height at outlet, area/volume, overflow location;
  - operation: discharge rates/maximum discharge;

- discharge during emergency drawdown; and
- inspection/maintenance regime.

- Developers should apply the sequential approach to locating development within the site.
- Consult with relevant authorities regarding emergency plans in case of reservoir breach.
- The reservoir owners are contacted to confirm the Reservoir Risk Designation (if determined) and the inspection and maintenance regime of the reservoir.
- Consider the impact of a breach and overtopping, particularly for sites proposed to be located immediately downstream of a reservoir. This should consider whether there is sufficient time to respond.
- It should also be understood that the “risk category” of a reservoir is set by the potential damage and loss of life in circumstances where there is a breach or an extreme flood event. Accordingly, it is possible that allocation of new development downstream of an existing reservoir could potentially change the risk category and result in a legal requirement (under the Reservoirs Act 1975) to improve the structural and hydraulic capacity of the dam. As the cost of implementing such works can be substantial consideration should be given to considering the implications and whether it would be more appropriate to place development in alternative locations not associated with such risk.
- The EA online Reservoir Flood Maps contain information on the extents following a reservoir breach (note: flood extents are not included for smaller reservoirs or for reservoirs commissioned after the reservoir modelling programme began in October 2016). For proposed sites located within the extents, consideration should be given to the extents shown in these online maps.
- In addition to the risk of inundation, those considering development in areas affected by breach events should also assess the potential hydraulic forces imposed by the rapid flood event and check that that the proposed infrastructure fabric can withstand the loads imposed on the structures by a breach event.

5.9 Flood alerts and flood warnings

The EA is the lead organisation for providing warnings of river flooding. Flood Warnings are supplied via the Flood Warning System (FWS) service, to homes and business within Flood Zones 2 and 3.

There are currently 11 Flood Alert Areas (FAA) and 18 Flood Warning Areas (FWAs) covering Wokingham Borough. Flood Alerts are issued when there is water out of bank for the first time anywhere in the catchment, signalling that ‘flooding is possible’, and therefore Flood Alert Areas usually cover the majority of main river reaches. Flood Warnings are issued to designated Flood Warning Areas (i.e. properties within the extreme flood extent which are at risk of flooding), when the river level hits a certain

threshold; this is correlated between the FWA and the gauge, with a lead time to warn that ‘flooding is expected’.

The FAAs and FWAs are listed in Appendix D and included in the Geo-PDF mapping in Appendix A.

5.10 Summary of flood risk in Wokingham Borough

A table summarising all sources of flood risk to key settlements in Wokingham Borough can be found in Appendix E. For this summary, the Borough has been delineated into eight Character Areas, taking consideration of Parish boundaries, socioeconomic and future planning characteristics, following the approach of the Level 1 SFRA previously produced in 2020. The Character Areas are detailed below and shown in Figure 5-5:

- Character Area 1 covers the parishes of Remenham and Wargrave, located in the north of the Borough, and is largely rural in nature.
- Character Area 2 is located towards the north of the Borough and contains the parishes of Sonning, Charvil, Twyford and Ruscombe. About a third of the Character Area is settlement but the remainder remains rural.
- Character Area 3 is in the west of the Borough and contains the towns of Earley, and Woodley, which are both almost entirely urbanised.
- Character Area 4 is in the east of the Borough and corresponds to the parish of Hurst. It is predominantly rural.
- Character Area 5 is in the east of the Borough. It is predominantly urban and contains the parish of Winnersh and the town of Wokingham.
- Character Area 6 is in the south-west of the Borough. It is predominantly rural and contains the parishes of Shinfield and Swallowfield.
- Character Area 7 is in the centre-east of the Borough. It is mainly rural and contains the parishes of Arborfield and Barkham.
- Character Area 8 is in the south-east of the Borough. It is mainly rural and contains the parishes of Finchampstead and Wokingham Without.

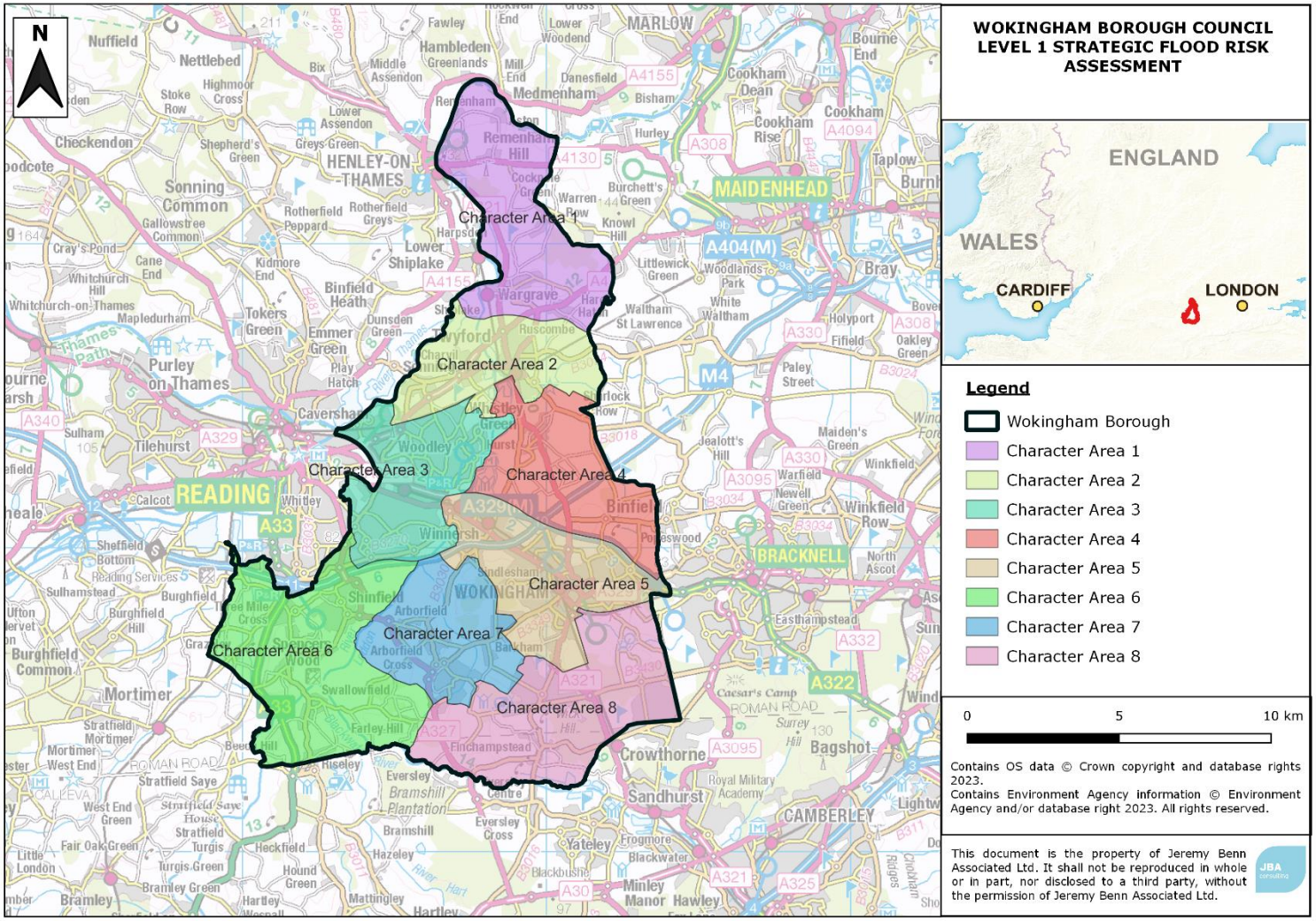


Figure 5-5: Character Areas used to summarise the flood risk across Wokingham Borough.

6 Flood alleviation schemes and assets

This section provides a summary of existing flood alleviation schemes and assets in the Wokingham Borough. Planners should note the areas that are protected by defences where further work to understand the actual and residual flood risk through a Level 2 SFRA may be beneficial. Developers should consider the benefit they provide over the lifetime of a development in a site-specific FRA.

6.1 Asset management

RMAs hold databases of flood risk management and drainage assets according to their jurisdiction as follows:

- The EA holds a national database that is updated by local teams.
- The LLFA holds a database of significant local flood risk assets, required under Section 21 of the FWMA (2010).
- Highways Authorities hold databases of highways drainage assets, such as gullies and connecting pipes.
- Water Companies hold records of public surface water, foul and combined sewers, the records may also include information on culverted watercourses.
- The databases include assets RMAs directly maintain and third-party assets. The drainage network is extensive and will have been modified over time. It is unlikely that any RMA contains full information on the location, condition, and ownership of all the assets in their area. They take a prioritised approach to collecting asset information, which will continue to refine the understanding of flood risk over time.

Developers should collect the available asset information and undertake further survey as necessary to present an understanding of current flood risk and the existing drainage network in a site-specific FRA.

6.2 Standards of Protection

- Flood defences are designed to give a specific Standard of Protection (SoP), reducing the risk of flooding to people and property in flood prone areas. For example, a flood defence with a 1% AEP SoP means that the flood risk in the defended area is reduced to at least a 1% chance of flooding in any given year.
- Over time the actual SoP provided by the defence may decrease, for example due to deterioration in condition or increases in flood risk due to climate change. The understanding of SoP may also change over time as RMAs undertake more detailed surveys and flood modelling studies.

- It should be noted that the EA's on-going hydraulic modelling programme may revise flood risk datasets and, therefore, the SoP offered by flood defences in the area may differ from those discussed in this report.
- Developers should consider the SoP provided by defences and residual risk as part of a detailed FRA.

6.3 Maintenance

Different authorities have responsibilities relating to maintenance of flood risk assets.

- The EA and local authorities have permissive powers to maintain and improve main rivers and ordinary watercourses, respectively. The ultimate responsibility for maintaining watercourses rests with the landowner.
- Highway's authorities have a duty to maintain public roads, making sure they are safe, passable and that the impacts of severe weather have been considered. They are also responsible for maintaining sections of watercourses where they are crossed by highways.
- Water companies have a duty to effectually drain their area. What this means in practise is that assets are maintained to common standards and improvements are prioritised for the parts of the network that do not meet this standard e.g. where there is frequent highway or sewer flooding.
- WBC as the LLFA has permissive powers and limited resources are prioritised and targeted to where they can have the greatest effect.

There is potential for the risk of flooding to increase in areas where flood alleviation measures are not maintained regularly. Breaches in raised flood defences are most likely to occur where the condition of a flood defence has degraded over time. Drainage networks in urban areas can also frequently become blocked with debris and this can lead to blockages at culverts or bridges.

It is important that the authorities work in partnership to maintain flood risk assets and manage flood risk across Wokingham Borough.

Developers should not assume that any defence, asset, or watercourse is being or will continue to be maintained throughout the lifetime of a development. They should contact the relevant RMA about current and likely future maintenance arrangements and make future users of the development aware of their obligations to maintain watercourses.

Formal structural defences are given a rating based on a grading system for their condition. A summary of the grading system used by the EA for condition is provided in Table 6 1.

Table 6-1: Grading system used by the EA to assess flood defence condition

Grade	Rating	Description
1	Very good	Cosmetic defects that will have no effect on performance.
2	Good	Minor defects that will not reduce the overall performance of the asset.
3	Fair	Defects that could reduce the performance of the asset.
4	Poor	Defects that have potential to deteriorate and significantly reduce performance of the asset. Further investigation required.
5	Very poor	Severe defects resulting in significant or complete performance failure.

Source: One Business Condition Assessment Manual – EA 2023

6.4 Major flood risk management assets in Wokingham Borough

- The EA retired the Flood Map for Planning 'Areas Benefiting from Defences' (ABD) dataset in December 2022 which has been replaced by the 'Reduction in Risk of Flooding from Rivers and Sea due to Defences' dataset.
- This dataset will no longer be available on online mapping. Instead, a developer can enter their address on the EA website here to get information about their specific site and request flood risk assessment data for planning (also known as product 4).
- In Wokingham Borough, a small number of areas are shown to have reduced flood risk due to defences including along the River Thames in the north of the area, in several small areas to the east of Hurst, in several small areas between Shinfield and where the River Loddon flows to the east, and in the south end of Reading.
- The EA 'AIMS' (Asset Information Management System) flood defence dataset gives further information on all flood defence assets within Wokingham Borough. The following locations benefit from flood defences at a lower (or unknown) SoP in the study area.

Table 6-2: Locations shown in the EA 'AIMS' data set

Watercourse	Location	Type	Design SoP (AEP)	Condition Rating (1-5)
River Thames	Left bank around Mole Road	Wall	Unknown	Unknown
Tributary of Old River	Along Edward Road	Demountable Defence	Unknown	3
Tributary of Old River	Along Old Acres Lane	Demountable Defence	Unknown	3

Watercourse	Location	Type	Design SoP (AEP)	Condition Rating (1-5)
River Loddon	Right bank around Arborfield Road and Reading Road	Embankment	20%	Unknown
River Loddon	Right bank around confluence with St. Patrick's Stream	Embankment	20%	Unknown
Emm Brook	Right Bank south of Barkham Road in Wokingham	Engineered high ground	20%	Unknown

In addition to the above, there is considerable natural high ground, throughout all character areas, which provide a level of protection again fluvial flood risk. Most high ground lies along the left and right banks of the following watercourses:

- River Thames
- River Loddon
- Emm Brook
- Foudry Brook
- River Blackwater
- River Whitewater
- Barkham Brook

6.5 Existing and future flood alleviation schemes

Below are the current and potential future schemes led by the EA, WBC, and Thames Water.

6.5.1 Fluvial flood alleviation schemes

The EA confirm that they have no current or planned fluvial flood risk schemes on the main rivers in Wokingham Borough.

6.5.2 Surface water flood alleviation schemes

Since 2014, WBC has spent nearly half a million pounds to reduce the risk of surface water flooding across the Borough. This includes upgrading existing highways drainage systems, and installing new infrastructure in places such as Emmbrook Road, Church Lane, Shinfield, Mole Road, and Eastheath Gardens.

An ongoing WBC scheme at Hollow Lane and Church Lane, Shinfield, supported by the EA, involves improvements to the surface water drainage scheme and foul and storm water, as well as hard and soft landscaping works.

The Church Lane Flood Alleviation Scheme, partly funded by Grant in Aid funding from the EA, is currently in the final stages of detailed design. Upon construction, this would improve on surface water flooding along Church Lane at Three Mile Cross.

6.6 Actual and residual flood risk

A Level 2 SFRA (for strategic allocations) or developer site-specific FRA will need to consider the actual and residual flood risk due to the presence of flood and drainage assets in greater detail (although it should be noted that Zone 3b is based on the actual flood risk).

6.6.1 Actual flood risk

This is the risk to the site considering existing flood mitigation measures and any planned to be provided through new development. Note that it is not likely to be acceptable to allocate developments in existing undefended areas on the basis that they will be protected by developer works, unless it can be demonstrated there is a wider community benefit.

The assessment of the actual risk should consider that:

- The level of protection afforded by existing defences might be less than the appropriate standards and hence may need to be improved if further growth is contemplated.
- The flood risk management policy for the defences will provide information on the level of future commitment to maintain existing standards of protection. If there is a conflict between the proposed level of commitment and the future needs to support growth, then it will be a priority for this to be reviewed.
- The standard of safety must be maintained for the intended lifetime of the development. Over time the effects of climate change will erode the present-day SoP afforded by defences and so commitment is needed to invest in the maintenance and upgrade of defences if the present-day levels of protection are to be maintained and where necessary, land secured and safe-guarded that is required for affordable future flood risk management measures.
- By understanding the depth, velocity, speed of onset and rate of rise of floodwater it is possible to assess the level of hazard posed by flood events from the respective sources.

6.6.2 Residual risk

Residual risk is the risk that remains after the effects of flood risk infrastructure have been considered. It is important that these risks are quantified to confirm that the consequences can be safely managed. The residual risk can be:

- The effects of a larger flood than defences were designed to alleviate (the ‘design flood’). This can cause overtopping of flood banks, failure of flood gates

to cope with the level of flow or failure of pumping systems to cope with the incoming amount of water.
- Failure of the defences or flood risk management measures, such as breaches in embankments or walls, failure of flood gates to open or close or failure of pumping stations.

It is the responsibility of the developer to fully assess flood risk, propose measures to mitigate it and demonstrate that any residual risks can be safely managed.

This SFRA does not assess the probability of failure other than noting that such events are very rare. However, in accordance with NPPF, all sources of flooding need to be considered. If a breach or overtopping event were to occur, then the consequences to people and property could be high. Developers should be aware that any site that is at or below defence level, may be subject to flooding if an event occurs that exceeds the design capacity of the defences, or the defences fail, and this should be considered in a detailed FRA.

The assessment of residual risk should consider:

- The flood hazard, depth and velocity that would result from overtopping or breach of defences. Flood gate or pumping station failure and/ or culvert blockage (as appropriate). The EA can provide advice at site-specific development level for advice on breach/ overtopping parameters for flood models.
- The design of the development to take account of the highest risk parts of the site e.g. allowing for flood storage on parts of the site and considering the design of the development to keep people safe, such as sleeping accommodation above the flood level.
- A system of warning and a safe means of access and egress from the site in the event of a flood for users of the site and emergency services.
- Climate change and/ or policy-dependent residual risks (such as those that may be created if necessary, future defence improvements are required, or those associated with any managed adaptive strategies).

6.6.3 Overtopping

The risk from overtopping of defences is based on the relative heights of property or defence, the distance from the defence level and the height of water above the crest level of the defence. The Defra and EA Flood Risks to People guidance document, available from the Government website here, provides standard flood hazard ratings based on the distance from the defence and the level of overtopping.

Any sites located next to defences or perched ponds/ reservoirs, may need overtopping modelling or assessments at the site-specific FRA stage, and climate change needs to be taken in to account.

6.6.4 Defence breach

A breach of a defence occurs when there is a failure in the structure and a subsequent ingress of flood water.

Where defences are present, risk of breach events should be considered as part of the site-specific FRA. Flood flows from breach events can be associated with significant depths and flow velocities in the immediate vicinity of the breach location and so FRAs must include assessment of the hazards that might be present so that the safety of people and structural stability of properties and infrastructure can be appropriately considered. Whilst the area in the immediate vicinity of a breach can be subject to high flows, the whole flood risk area associated with a breach must also be considered as there may be areas remote from the breach that might, due to topography, involve increased depth hazards.

Considerations include the location of a breach, when it would occur and for how long, the depth of the breach (toe level), the loadings on the defence and the potential for multiple breaches. There are currently no national standards for breach assessments and there are various ways of assessing breaches using hydraulic modelling. Work is currently being undertaken by the EA to collate and standardise these methodologies. It is recommended that the EA are consulted if a development site is located near to a flood defence, to understand the level of assessment required and to agree the approach for the breach assessment.

7 Cumulative impact of development and strategic solutions

7.1 Cumulative Impact Assessment

Under the NPPF, strategic policies and their supporting SFRAs, are required to 'consider cumulative impacts in, or affecting, local areas susceptible to flooding' (para.160), rather than just to or from individual development sites.

When allocating land for development, consideration should be given to the potential cumulative impact of the loss of floodplain storage volume, as well as the impact of increased flows on flood risk downstream. Whilst the loss of storage for individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe. Similarly, the effect of the loss of surface water flow paths, surface water ponding and infiltration can also give rise to cumulative effects and potentially exacerbate surface water flood risk.

All developments are required to comply with the NPPF and demonstrate they will not increase flood risk elsewhere. Therefore, providing developments comply with the latest guidance and legislation relating to flood risk and sustainable drainage, and appropriate consideration is given to surface water flow paths and storage proposals should normally not increase flood risk downstream.

Catchments within the study area that have the potential to influence existing flood risk issues in neighbouring Local Authorities were identified, as well as catchments in the study area that may be influenced by development in catchments in neighbouring Local Authorities. Historic flood incidents, the current and predicted increase in surface water and fluvial flood risk to properties and cross boundary issues in each catchment were assessed to identify the catchments at greatest risk.

Local planning policies can also be used to identify areas where the potential for development to increase flood risk is highest and identify opportunities for such new development to positively contribute to decreases in flood risk downstream.

Once the proposed development had been assessed against fluvial flood risk, surface water flood risk, historic flooding incidents, and the potential increased development area, the CIA identified five high risk catchments within, or partially within Wokingham Borough. These are:

- Foudry Brook (West End Brook to M4)
- Emm Brook
- Barkham Brook
- Loddon (Swallowfield to River Thames confluence)
- Twyford Brook

It is recommended that the WBC work closely with neighbouring local authorities to develop complementary Local Planning Policies for catchments that drain into and out of the Wokingham Borough to other local authorities to minimise cross boundary issues of cumulative impacts of development.

The CIA can be found in Appendix F.

7.2 Natural Flood Management (NFM)

NFM is used to protect, restore, and re-naturalise the function of catchments and rivers to reduce flood risk. A wide range of techniques can be used that aim to reduce flooding by working with natural features and processes in order to store or slow down flood waters before they can damage flood risk receptors (e.g. people, property, infrastructure, etc.). Techniques and measures, which could be applied in the Wokingham Borough include:

- Creation of offline storage areas
- Re-meandering streams (creation of new meandering courses or reconnecting cut-off meanders to slow the flow of the river)
- Targeted woodland planting
- Reconnection and restoration of functional floodplains
- Restoration of rivers and removal of redundant structures, i.e. weirs and sluices no longer used or needed
- Installation or retainment of large woody material in river channels
- Improvements in management of soil and land use
- Creation of rural and urban SuDS

To maximise the benefits of NFM, it is important that land which is likely to be needed for NFM is protected by safeguarding land for future flood risk management infrastructure. This is particularly important for infrastructure that reduces the risk of flooding to large amounts of existing development, or where options for managing risk in other ways are limited to achieve multiple benefits for flood risk and the environment.

In 2017, the EA published an online evidence base to support the implementation of NFM and maps showing locations with the potential for NFM measures. These maps are intended to be used alongside the evidence directory to help practitioners think about the types of measure that may work in a catchment and the best places in which to locate them.

There is an ongoing project in Wokingham Borough aiming to restore a section of Emm Brook where it flows through Riverside Park. The river was once diverted to power a mill, which has since closed, and is heavily contaminated due to its proximity to the A329M. The river suffers from a significant lack of biodiversity, and it is hoped that by reconnecting Emm Brook to its original flow path away from the highway, restoring fish migration paths, and improving water quality can help create a rich,

healthy, and diverse habitat that is beneficial for residents and animals alike. South East Rivers Trust have been working in partnership with WBC and the EA since 2018 to deliver this project; however, they are currently waiting to secure funding before this can be delivered. The most recent update on this project is available on the South East Rivers Trust website here.

The Riseley Woodland NFM scheme has also recently been awarded funding from the Thames Regional Flood and Coastal Committee (RFCC).

8 Flood risk management requirements for developers

This section provides guidance on site-specific FRAs. These are carried out by (or on behalf of) developers to assess flood risk to and from a site. They are submitted with Planning Applications and should demonstrate how flood risk will be managed over the development's lifetime, considering climate change and vulnerability of users.

The report provides a strategic assessment of flood risk within Wokingham Borough. Prior to any construction or development, site-specific assessments will need to be undertaken so all forms of flood risk and the actual and residual risk, SoP, and safety at a site are considered in more detail. Developers should, where required, undertake more detailed hydrological and hydraulic assessments of watercourses to verify flood extents (including latest climate change allowances), to inform the sequential approach within the site and prove, if required, whether the exception test can be satisfied.

A detailed FRA may show that a site, windfall or other, is not appropriate for development of a particular vulnerability or even at all. The sequential and exception tests in the NPPF apply to all developments and an FRA should not be seen as an alternative to proving these tests have been met.

8.1 Principles for new development

8.1.1 Apply the sequential and exception tests

Developers should refer to Section 3 for more information on how to consider the sequential and exception tests. For allocated sites, WBC should use the information in this SFRA to apply the Sequential test. For windfall sites a developer must undertake the Sequential test, which includes considering reasonable alternative sites at lower flood risk. Only if it passes the sequential test should the exception test then be applied if required.

Where planning applications come forward on sites allocated in the development plan through the sequential test, applicants need not apply the sequential test again. However, the exception test will need to be applied as proposals at the application stage will need to demonstrate flood risk is not increased elsewhere and is safe.

Developers should also apply the sequential approach to locating development within the site. The following questions should be considered:

- can risk be avoided through substituting less vulnerable uses or by amending the site layout?

- can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted? and
- can the site layout be varied to reduce the number of people, the flood risk vulnerability or the building units located in higher risk parts of the site?

8.1.2 Consult with statutory consultees at an early stage to understand their requirements

Developers should consult with the EA, WBC as LLFA, Thames Water and South East Water at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling and drainage assessment and design.

8.1.3 Consider the risk from all sources of flooding and that they are using the most up to date flood risk data and guidance

The SFRA can be used by developers to scope out what further detailed work is likely to be needed to inform a site-specific FRA. At a site level, developers will need to check before commencing on a more detailed FRA that they are using the latest available datasets. Developers should apply the most up-to-date climate change guidance (last updated in May 2022) and consider climate change adaptation measures.

8.1.4 Confirm that the development does not increase flood risk elsewhere

Section 9 sets out these requirements for taking a sustainable approach to surface water management. Developers should also confirm that mitigation measures do not increase flood risk elsewhere and that floodplain compensation is provided where necessary.

8.1.5 Make the development safe for future users

Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised as far as possible, only then should mitigation measures be considered. Developers should consider both the actual and residual risk of flooding to the site, as discussed in Section 3.

Further flood mitigation measures may be needed for any developments in an area protected by flood defences, where the condition of those defences is ‘fair’ or ‘poor’, and where the SoP is not of the required standard.

8.1.6 Enhance the natural river corridor and floodplain environment through new development

Developments should demonstrate opportunities to create, enhance and link green assets. This can provide multiple benefits across several disciplines including flood risk and biodiversity/ ecology and may provide opportunities to use the land for an

amenity and recreational purposes. Development that may adversely affect green infrastructure assets should not be permitted. Where possible, developers should identify and work with partners to explore all avenues for improving the wider river corridor environment. Developers should open up existing culverts and should not construct new culverts on site except for short lengths to allow essential infrastructure crossings.

8.1.7 Consider and contribute to wider flood mitigation strategy and measures in the area and apply the relevant local planning policy

Wherever possible, developments should seek to help reduce flood risk in the wider area, e.g. by contributing to a wider community scheme or strategy for strategic measures, such as defences or NFM or by contributing in kind by mitigating wider flood risk on a development site. Developers must demonstrate in an FRA how they are contributing towards this vision.

8.2 Requirements for site-specific Flood Risk Assessments

8.2.1 When is an FRA required?

Site-specific FRAs are required in the following circumstances:

- Proposals of one hectare or greater in Flood Zone 1.
- Proposals for new development (including minor development such as non-residential extensions, alterations which do not increase the size of the building or householder developments and change of use) in Flood Zones 2 and 3.
- Proposals for new development (including minor development and change of use) in an area within Flood Zone 1 which has critical drainage problems (as notified to the LPA by the EA) (see Section 9.4.4 for more information on critical drainage problems).
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.
- At locations where it is proposed to locate development in a high-risk surface water flood zone.

An FRA may also be required for some specific situations:

- If the site may be at risk from the breach of a local defence (even if the site is in Flood Zone 1)
- Where evidence of historical or recent flood events have been passed to the LPA
- Land identified in an SFRA as being at increased risk in the future.

8.2.2 Objectives of a site-specific FRA

Site-specific FRAs should be proportionate to the degree of flood risk and the scale, nature, and location of the development.

Site-specific FRAs should establish:

- Whether a proposed development is likely to be affected by current or future flooding from any source.
- Whether a proposed development will increase flood risk elsewhere.
- Whether the measures proposed to deal with the effects and risks are appropriate.
- The evidence, if necessary, for the LPA to apply the sequential test; and
- Whether, if applicable, the development will be safe and pass the exception test.

FRAs should follow the approach recommended by the NPPF (and associated guidance) and guidance provided by the EA and WBC. Guidance and advice for developers on the preparation of site-specific FRAs is available from the following websites with hyperlinks provided:

- Standing Advice on Flood Risk (EA)
- Flood Risk Assessment for Planning Applications (EA); and
- Site-specific Flood Risk Assessment: Checklist (NPPF PPG, Defra)

Guidance for LPAs for reviewing FRAs submitted as part of planning applications has been published by Defra in 2015 and is available on the Government website here.

Guidance should be sought from the EA and WBC at the earliest possible stage, and opportunities should be taken to incorporate environmental enhancements and reduce flooding from all sources both to and from the site through development proposals. Developers should seek to go beyond managing the flood risk and support reduction of wider flood risk, whilst enhancing and conserving the natural environment. Further advice can be found at: Flood risk and coastal change - GOV.UK (www.gov.uk).

8.2.3 Site layout and design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. Early engagement with the EA and WBC is advised.

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land uses away from Flood Zones to higher ground and lower flood risk areas, while more flood-compatible development (e.g. vehicular parking, recreational space) can be located in higher risk areas. Higher risk areas can also be retained and enhanced as natural green space. Whether parking in floodplains is appropriate will be based on the likely flood depths and hazard, evacuation procedures and availability of flood warning.

Waterside areas, or areas along known flow routes, can act as green infrastructure, being used for recreation, amenity, and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives.

Landscaping should provide safe access to higher ground from these areas and avoid the creation of isolated islands as water levels rise.

When designing sites, developers should consider the Hierarchy of Drainage, as stated in the PPG, aiming to discharge surface water runoff as high up the drainage hierarchy as reasonably practicable:

1. into the ground (infiltration)
2. to a surface water body
3. to a surface water sewer, highway drain, or another drainage system
4. to a combined sewer

8.2.4 Modification of ground levels

Any proposal for modification of ground levels will need to be assessed as part of a detailed FRA.

Modifying ground levels to raise the land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for flood waters. However, care must be taken as raising land above the floodplain could reduce conveyance or flood storage in the floodplain and could adversely impact flood risk downstream or on neighbouring land. Raising ground levels can also deflect flood flows, so analyses should be performed to demonstrate that there are no adverse effects on third party land or property.

Compensatory flood storage should be provided, and would normally be on a level for level, volume for volume basis on land that does not currently flood but is adjacent to the floodplain (for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary (unless the site is strategically allocated). Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C624, available to download from the CIRIA website here.

Where proposed development results in a change in building footprint, the developer should confirm that it does not impact upon the ability of the floodplain to store or convey water and seek opportunities to provide floodplain betterment.

Raising levels can also create areas where surface water might pond during significant rainfall events. Any proposals to raise ground levels should be tested to check that it would not cause increased ponding or build-up of surface runoff on third party land.

8.2.5 Raised floor levels

If raised floor levels are proposed, these should be agreed with WBC and the EA. The minimum Finished Floor Level (FFL) may change dependent upon the vulnerability and flood risk to the development.

The EA advises that minimum finished floor levels should be set 300mm above the 1% AEP plus climate change peak flood level, where the appropriate new climate change allowances have been used (see Section 4.2 for the climate change allowances). An additional allowance may be required because of risks relating to blockages to the channel, culvert or bridge and should be considered as part of an FRA. Lowering existing FFLs below the existing levels within the 1% AEP plus climate change floodplain would not be acceptable and should be discouraged. New development offers opportunities to improve the resilience of buildings.

Allocating the ground floor of a building for less vulnerable, non-residential, use is an effective way of raising living space above flood levels. Single storey buildings such as ground floor flats or bungalows are especially vulnerable to rapid rise of water (such as that experienced during a breach). This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route.

Similarly, the use of basements should be avoided. Habitable uses of basements within Flood Zone 3 and areas at risk of surface water flooding in the surface water flood zone B should not be permitted, whilst basement dwellings in Flood Zone 2 will be required to pass the exception test. Access should be situated 300mm above the design flood level and waterproof construction techniques used.

8.2.6 Development and raised defences

Construction of localised raised floodwalls or embankments to protect new development is not a preferred option, as a residual risk of flooding will remain. Compensatory storage must be provided where raised defences remove storage from the floodplain.

Where development is located behind, or in an area benefitting from defences, the residual risk of flooding must be considered.

8.2.7 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 can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS). This relates to the Community Infrastructure Levy, a charge that can be levied by local authorities on new development in their area to help them deliver the infrastructure needed to support development in their area, and planning obligations including Section 106. The government website provides further information on the Community Infrastructure Levy and planning obligations.

8.2.8 Buffer strips

The provision of a buffer strip to ‘make space for water’ allows additional capacity to accommodate climate change and means access to the watercourse, structures and defences is maintained for future maintenance purposes. It also enables the avoidance of disturbing riverbanks, adversely impacting ecology, and having to construct engineered riverbank protection. Any watercourse crossings should ensure that flood risk is not impacted. A buffer strip of 8m is required from any main river (16m if tidal influence). Where flood defences are present, these distances should be taken from the toe of the defence.

Building adjacent to riverbanks can cause problems to the structural integrity of the riverbanks and the building itself, making future maintenance of the river much more difficult. Any development in these areas will likely require Flood Risk Activity Permits from the EA alongside any permission. There should be no built development within these distances from main rivers / flood defences (where present). Further advice and guidance on Flood Risk Activity Permits is available on the government website here.

8.2.9 Making space for water

The PPG sets out a clear aim in Flood Zone 3 to create space for flooding by restoring functional floodplain. Generally, development should be directed away from these areas.

All new development close to rivers should consider the opportunity to improve and enhance the river environment. Developments should look at opportunities for river restoration and enhancement as part of the development. Options include backwater creation, de-silting, in-channel habitat enhancement and removal of structures. When designed properly, such measures can have benefits such as reducing the costs of maintaining hard engineering structures, reducing flood risk, improving water quality, and increasing biodiversity. Social benefits are also gained by increasing green space and access to the river.

8.3 Resistance and resilience measures

The consideration of resistance and resilience measures should not be used to justify development in inappropriate locations.

Having applied planning policy, there will be instances where developments, such as those that are water compatible and essential infrastructure are permitted in high flood risk areas. The above measures should be considered before resistance and resilience measures are relied on. The effectiveness of these forms of measures are often dependant on the availability of a reliable forecasting and warning system and the use of back up pumping to evacuate water from a property as quickly as possible. The proposals must include details of how the temporary measures will be erected and decommissioned, responsibility for maintenance and the cost of replacement when they deteriorate. Available resistance and resilience measures include:

- Permanent barriers which can include built up doorsteps, rendered brick walls and toughened glass barriers.
- Temporary barriers which consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale, temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water.
- Community resistance measures which include demountable defences that can be deployed by local communities to reduce the risk of water ingress to several properties. The methods require the deployment of inflatable (usually with water) or temporary quick assembly barriers in conjunction with pumps to collect water that seeps through the systems during a flood.
- Flood resilience measures which aim to limit any permanent damage, prevent the structural integrity of the building being compromised and make the clean up after the flood is easier. Interior design measures to reduce damage caused by flooding can include electrical circuitry installed at a higher level and water resistant materials for floors, walls, and fixtures.

Guidance on flood resilient and flood resistant construction techniques is available on the government website, here.

There are also opportunities for 'change of use' developments to be used to improve the flood resistance and resilience of existing development, which may not have been informed by a site-specific flood risk assessment when it was first constructed.

8.4 Reducing flood risk from other sources

8.4.1 Groundwater

Groundwater flooding has a very different flood mechanism to any other and so many conventional flood mitigation methods are not suitable. The only way to fully reduce flood risk would be through building design (development form), ensuring floor levels are raised above the water levels caused by a 1% AEP plus climate change event. Site design would also need to preserve any flow routes followed by the groundwater overland so that flood risk is not increased downstream.

Infiltration SuDS can cause increased groundwater levels and subsequently may increase flood risk on or off a site. Developers should provide evidence that this will not be a significant risk. Other underground works, such as basements, may also need to be assessed as part of a site-specific FRA in certain prone areas susceptible to groundwater issues.

8.4.2 Surface water and sewer flooding

Developers should discuss public sewerage capacity with the water utility company at the earliest possible stage. It is important that a Surface Water Drainage Strategy (often undertaken as part of a FRA) shows that this will not increase flood risk elsewhere, and that the drainage requirements regarding runoff rates and SuDS for new development are met.

If residual surface water flood risk remains, the likely flow routes and depths across the site should be modelled. The site should be designed so that these flow routes are preserved and building design should provide resilience against this residual risk.

When redeveloping existing buildings, the installation of some permanent or temporary floodproofing and resilience measures could protect against both surface water and sewer flooding. Non-return valves prevent water entering the property from drains and sewers. Non-return valves can be installed within gravity sewers or drains within a property's private sewer upstream of the public sewerage system. These need to be carefully installed and must be regularly maintained.

Consideration must also be given to attenuation and flow ensuring that flows during the 1% AEP plus climate change storm event are retained within the site if any flap valves shut. This should be demonstrated with suitable modelling techniques.

8.4.3 Reservoirs

As discussed in Section 5.8, the risk of reservoir flooding is extremely low. However, there remains a residual risk to development from reservoirs which developers should consider during the planning stage:

- Developers should contact the reservoir owner for information on:
  - the Reservoir Risk Designation
  - reservoir characteristics: type, dam height at outlet, area/volume, overflow location
  - operation: discharge rates / maximum discharge
  - discharge during emergency drawdown; and
  - inspection / maintenance regime.
- The EA online Reservoir Flood Maps contain information on the predicted extents following a reservoir breach both when rivers are at normal levels and in conjunction with rivers in flood conditions (note: only for those reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975). Consideration should be given to the extents shown in these online maps. Depths and velocities were also prepared as part of this study but have not been made publicly available.
- The GOV.UK website on Reservoirs: owner and operator requirements provides information on how to register reservoirs, appoint a panel engineer, produce a flood plan, and report an incident.

- In addition, developers should consult the Thames Valley Local Resilience Forum about emergency plans.

Developers should use the above information to:

- Apply the sequential approach to locating development within the site.
- Consider the impact of a breach and overtopping, particularly for sites proposed to be located immediately downstream of a reservoir. This should consider whether there is sufficient time to respond, and whether in fact it is appropriate to place development immediately on the downstream side of a reservoir.
- Assess the potential hydraulic forces imposed by sudden reservoir failure event and check that that the proposed infrastructure fabric could withstand the structural loads.
- Develop site-specific Emergency Plans and/ or Off-site Plans if necessary and make the future users of the development aware of these plans. This may need to consider emergency drawdown and the movement of people beforehand.

The potential implications of proposed development on the risk designation of the reservoir should also be considered, as it is a requirement that in particular circumstances where there could be a danger to life, that a commitment is made to the hydraulic capacity and safety of the reservoir embankment and spillway. The implications of such an obligation should be identified and understood before new development is permitted, to ensure it can be achieved.

8.5 Emergency planning

Emergency planning covers three phases: before, during and after a flood. Measures involve developing and maintaining arrangements to reduce, control or mitigate the impact and consequences of flooding and to improve the ability of people and property to absorb, respond to and recover from flooding. National Planning Policy takes this into account by seeking to avoid inappropriate development in areas of flood risk and considering the vulnerability of new developments to flooding.

The 2021 NPPF (para. 167) requires site level FRAs to demonstrate that

“d) any residual risk can be safely managed; and

e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.”

Certain sites will need emergency plans:

- Sites with vulnerable users, such as hospitals and care homes
- Camping and caravan sites
- Sites with transient occupants e.g. hostels and hotels
- Developments at a high residual risk of flooding from any source e.g. immediately downstream of a reservoir or behind raised flood defences

- Situations where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain “in-situ” and / or move to a higher floor or safe refuge area (e.g. at risk of a breach).

Emergency Plans will need to consider:

- The characteristics of the flooding e.g. onset, depth, velocity, hazard, flood borne debris
- The vulnerability of site occupants.
- Structural safety
- The impact of the flooding on essential services e.g. electricity, drinking water
- Flood warning systems and how users will be encouraged to sign up for them.
- Safe access and egress for users and emergency services
- How to manage the consequences of events that are un-foreseen or for which no warnings can be provided e.g. managing the residual risk of a breach.
- A safe place of refuge where safe access and egress and advance warning may not be possible, having discussed and agreed this first with emergency planners. Proposed new development that places an additional burden on the existing response capacity of WBC will not normally be appropriate.

It is advised that emergency plans should be provided to support developments ensuring that residual risk is covered. However, it will not be appropriate to rely solely on emergency plans to mitigate residual risk. Further information should be included to understand the approach where residual risk from flood risk management infrastructure affects large areas. This information should be covered in site-specific Flood Risk Assessments (FRAs) and the accepted approach in locating development in these areas to ensure that new development is not put at risk.

The Thames Valley Local Resilience Forum provide 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. Information is available from their website here.

Further information is available from the following documents / websites with hyperlinks provided:

- The National Planning Policy Guidance
- 2004 Civil Contingencies Act
- Defra (2014) National Flood Emergency Framework for England
- FloodRe
- The EA and Defra’s Standing Advice for FRAs
- WBC's 'Flooding and drainage' website page
- EA’s ‘How to plan ahead for flooding’
- Sign up for Flood Warnings with the EA
- The National Flood Forum

- GOV.UK 'Prepare for flooding' page
- ADEPT Flood Risk Plans for new development

9 Surface water management and SuDS

This section provides guidance and advice on managing surface water runoff and flooding.

9.1 Roles of the Lead Local Flood Authority and Local Planning Authority in surface water management

WBC as the LLFA is a statutory planning consultee. They provide technical advice on surface water drainage strategies and designs put forward for major development proposals, to confirm that onsite drainage systems are designed in accordance with the current legislation and guidance.

When considering planning applications, the drainage team will provide advice to the Planning Department on the management of surface water. The LPA should satisfy themselves that the development's proposed minimum standards of operation are appropriate and, using planning conditions or planning obligations, that there are clear arrangements for on-going maintenance over the lifetime of the development.

It is essential that developers consider sustainable drainage at an early stage of the development process – ideally at the pre-application or master-planning stage. To further inform development proposals at the master-planning stage, pre-application submissions are accepted by WBC. This will assist with the delivery of well designed, appropriate, and effective SuDS.

Currently the use of SuDS is driven through planning policy. However, Schedule 3 of the FWMA 2010 is expected to be implemented in 2024 following a government review making SuDS mandatory for new developments in England. Schedule 3 will provide a framework for the approval and adoption of drainage systems, a SuDS Approving Body (SAB) within unitary and county councils, and national standards on the design, construction, operation, and maintenance of SuDS for the lifetime of the development.

9.2 Sustainable Drainage Systems (SuDS)

SuDS are designed to maximise the opportunities and benefits that can be secured from surface water management practices.

SuDS provide a means of dealing with the quantity and quality of surface water and can also provide amenity and biodiversity benefits. Given the flexible nature of SuDS they can be used in most situations within new developments as well as being retrofitted into existing developments. SuDS can also be designed to fit into most spaces. For example, permeable paving could be used in parking spaces or rainwater gardens as part of traffic calming measures.

It is a requirement for all new major development proposals that SuDS for management of runoff are put in place, unless there is clear evidence that this would be inappropriate (NPPF para.169). WBC set out in their SuDS strategy that they expect SuDS to be incorporated when master planning all major developments, from the Strategic Development Location scale through to a ten-dwelling development. The developer is responsible for ensuring the design, construction, and future/ongoing maintenance of such a scheme is carefully and clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and current drainage arrangements is essential.

It is important that SuDS are maintained for the lifetime for the development so that features can function as designed. Consideration should be given to enhancing SuDS to achieve biodiversity net gain.

9.3 Sources of SuDS guidance

9.3.1 C753 CIRIA SuDS Manual (2015)

The C753 CIRIA SuDS Manual (2015) provides guidance on planning, design, construction and maintenance of SuDS. The manual is divided into five sections ranging from a high-level overview of SuDS, progressing to more detailed guidance with progression through the document. The manual can be downloaded from the CIRIA website here.

9.3.2 Non-Statutory Technical Guidance, Defra (March 2015)

Non-Statutory Technical guidance provides non-statutory standards on the design and performance of SuDS. It outlines peak flow control, volume control, structural integrity, flood risk management and maintenance and construction considerations. This guidance can be accessed on the Government website here.

9.3.3 Non-statutory Technical Guidance for Sustainable Drainage Practice Guidance, LASOO (2016)

The Local Authority SuDS Officer Organisation (LASOO) produced their practice guidance in 2016 to give further detail to the Non-Statutory technical guidance. This guidance is available on the SUS Drain website here.

9.3.4 Wokingham Borough Council SuDS Guidance

WBC have a SuDS strategy, which can be downloaded from their website here. This was prepared in 2016 to guide developers and their design teams in the use of SuDS in the Borough. This document is to assist when masterplanning all major developments, so that surface water runoff within the development is discharged in a sustainable manner for the lifetime of the development. The Strategy is centred on

ensuring SuDS are considered as early as possible in the site masterplanning process, allowing them to be successfully integrated into a development. The Strategy also provides advice to help mitigate flood risk, improve water quality, and address biodiversity concerns in the wider catchment.

The Strategy is supported by the SuDS Technical Guide (available as an Appendix to the strategy linked earlier in this paragraph) which sets out the technical requirements and expectations for SuDS in the Borough.

9.4 Other surface water considerations

9.4.1 Groundwater Vulnerability Zones

The EA published new groundwater vulnerability maps in 2015. These maps provide a separate assessment of the vulnerability of groundwater in overlying superficial rocks and those that comprise of the underlying bedrock. The map shows the vulnerability of groundwater at a location based on the hydrological, hydro-ecological and soil properties within a one-kilometre grid square.

The groundwater vulnerability maps should be considered when designing SuDS. Depending on the height of the water table at the location of the proposed development site, restrictions may be placed on the types of SuDS appropriate to certain areas. Groundwater vulnerability maps can be found on Defra's interactive mapping.

9.4.2 Groundwater Source Protection Zones (GSPZ)

The EA also defines Groundwater Source Protection Zones (GSPZs) near groundwater abstraction points. These protect areas of groundwater used for drinking water. The GSPZ requires attenuated storage of runoff to prevent infiltration and contamination. GSPZs can be viewed on Defra's interactive mapping. Three main zones are defined as follows:

- Inner protection zone (Zone 1) - areas from where pollution can travel to the groundwater source within 50 days or is at least a 50m radius.
- Outer protection zone (Zone 2) - areas from where pollution can travel to the groundwater source within 400 days or lies within the nearest 25% of the total catchment area (whichever is largest).
- Total catchment (Zone 3) - the total area needed to support removal/discharge of water from the groundwater source.

Online mapping shows there are currently four GSPZ's which lie partially or wholly within Wokingham Borough.

9.4.3 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate levels in waterbodies are affected by surface water runoff from surrounding agricultural land entering receiving waterbodies. The level of nitrate contamination will potentially influence the choice of SuDS and should be assessed as part of the design process.

NVZs can be viewed on the EA's website here. There are four pre appeal NVZ 2021 to 2024 areas affecting Wokingham Borough:

- Groundwater G88 - Sheeplands
- Surface Water S460 - Emm Brook
- Surface Water S449 - Barkham Brook
- Surface Water S459 - Foudry Brook (West End Brook to M4)

Currently, information on the 2021 to 2024 NVZs post-appeal is unavailable. Landowners can appeal an NVZ designation once notified if their land (or part of it):

- Does not drain into water that has been identified as polluted.
- Drains into water that should not be identified as polluted.

9.4.4 Critical Drainage Areas

A Critical Drainage Area (CDA) is an area with critical drainage problems (which has been formally notified to the LPA by the EA. Within CDAs, proposed development may present increased risks of flooding both on and off site if the surface water runoff is not effectively managed. A dataset containing CDAs is available to download from the EA website here. There are currently no CDAs identified within Wokingham Borough.

10 Summary and recommendations

Parts of the Wokingham study area are at risk of flooding from the following sources: fluvial, surface water, groundwater, sewers, reservoir inundation, and overtopping/ breaches. This study has shown that the most significant sources of flood risk in Wokingham Borough are fluvial and surface water.

- **Fluvial**: The primary fluvial flood risk is along the River Thames, River Loddon, River Blackwater, Emm Brook, Foudry Brook, and their main tributaries. The fluvial flood extents cover the majority of the western and northern border of the borough and splits the area through the centre along the path of the River Loddon, which flows in a north-easterly direction through the borough.
- **Surface water**: The Risk of Flooding from Surface Water map shows a number of prominent overland flow routes that largely follow the topography of the watercourses. There are some areas where there are additional flow paths and areas of ponding, for example where water is impounded at road or rail embankments and in low-lying areas. There are also considerable flow routes following the roads through the main urban areas of Wokingham, Earley and Lower Earley, and Finchampstead which, alongside isolated areas of ponding, may affect many properties across these settlements.
- **Climate change**: Areas at risk of flooding today are likely to become at increased risk in the future and the frequency of flooding will also increase in such areas as a result of climate change. Flood extents will increase; in some locations, this may be minimal, but flood depth, velocity and hazard may have more of an impact due to climate change. It is recommended that WBC work with other Risk Management Authorities (RMAs) to review the long-term sustainability of existing and new development when developing climate change plans and strategies for Wokingham Borough.
- **Sewer**: South East Water provides water services to the east side of the Borough whilst Thames Water provides water services to the west side of the Borough and sewerage services across the entirety of the Borough. Thames Water have provided details of historic sewer flooding across the Borough.
- **Groundwater**: The Areas Susceptible to Groundwater Flooding map shows that in general, areas with greater than 50% susceptibility to groundwater flooding are along the main flow routes of the River Thames, River Loddon, River Blackwater, and Foudry Brook. The JBA groundwater emergence map emulates this, with similar areas experiencing emergence levels within 0.5m of the surface, with the addition of the south east of the Borough. The Risk of Flooding due to Surface Water map suggests that any groundwater emerging in these areas is likely to follow the low-lying topography and path of the River Thames, River Loddon, River Blackwater, Emm Brook, and Foudry Brook.

- **Reservoirs**: There is a potential risk of flooding from reservoirs both within Wokingham Borough and those outside. The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from reservoirs is relatively low. However, there is a residual risk of a reservoir breach, and this risk should be considered in any site-specific FRAs (where relevant).
- **Defences**: the EA AIMS dataset provides information on flood defence assets across the borough. The main defence type across the study area is 'Natural High Ground', located along the main watercourses of the River Thames, River Loddon, River Blackwater, Emm Brook, and Foudry Brook. Additional engineered defences including a wall, embankments, and demountable defences also line parts of the River Loddon, Emm Brook, and a tributary of Old River, which itself is a tributary of the River Loddon. The condition of these defences varies from poor to good, with the Standard of Protection varying between the defences.

10.1 Recommendations

A series of recommendations are proposed, across the following topic areas.

Reduction of flood risk through site allocations and appropriate site design:

- To locate new development in areas of lowest risk, in line with the sequential test, by steering sites to Flood Zone 1 from the Flood Map for Planning and avoiding where possible areas with a higher risk of surface water flooding. If a sequential test is undertaken and a site at flood risk is identified as the only appropriate site for the development, the exception test shall be undertaken. If development can’t be avoided in the higher risk surface water Zone (Zone B), then part “b” of the exception test should be satisfied.
- After application of the exception test, a sequential approach to site design will be used to reduce risk. Any re-development within areas of flood risk which provide other wider sustainability benefits will provide flood risk betterment and made resilient to flooding.
- Identification of long-term opportunities to remove development from the floodplain and to make space for water.
- Ordinary watercourses not currently afforded flood maps should be modelled to an appropriate level of detail to enable a sequential approach to the layout of the development.
- Confirm development is ‘safe’, dry pedestrian egress from the floodplain and emergency vehicular access should be possible for all residential development. If at risk, then an assessment should be undertaken to detail the flood duration, depth, velocity, and flood hazard rating in the 1% AEP plus climate change flood event, in line with FD2320.

- Raise residential and commercial finished floor levels 600mm above the 1% AEP plus climate change flood level. Protect and promote areas for future flood alleviation schemes.
- Identify opportunities for brownfield sites in functional floodplain to reduce risk and provide flood risk betterment.
- Identify opportunities to help fund future flood risk management through developer contributions to reduce risk for surrounding areas.
- Seek opportunities to make space for water to accommodate climate change.

Promote SuDS to mimic natural drainage routes to improve water quality

- SuDS design should demonstrate how constraints have been considered and how the design provides multiple benefits e.g. landscape enhancement, biodiversity, recreation, amenity, leisure and the enhancement of historical features.
- Planning applications for phased developments should be accompanied by a drainage strategy, which takes a strategic approach to drainage provision across the entire site and incorporates adequate provision for SuDS within each phase.
- Use of the SuDS management train to prevent and control pollutants to prevent the 'first flush' polluting the receiving waterbody.
- SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.

Reduce surface water runoff from new developments and agricultural land

- Space should be provided for the inclusion of SuDS on all allocated sites, outline proposals and full planning applications.
- Promote biodiversity, habitat improvements and Countryside Stewardship schemes help prevent soil loss and to reduce runoff from agricultural land.
- Identify opportunities to maintain and enhance permeable surfaces and greenspaces to help reduce surface water runoff whilst promoting other benefits, including biodiversity and wellbeing.

Enhance and restore river corridors and habitat

- Assess condition of existing assets and upgrade, if required, to confirm that the infrastructure can accommodate pressures/flows for the lifetime of the development.
- Natural drainage features should be maintained.
- Identify opportunities for river restoration/enhancement to make space for water.
- A presumption against culverting of open watercourses except where essential to allow highways and/or other infrastructure to cross, in line with CIRIA's Culvert design and operation guide, (C689) and to restrict development over culverts.

- There should be no built development within 8m from the top of a watercourse or main river for the preservation of the watercourse corridor, wildlife habitat, flood flow conveyance and future watercourse maintenance or improvement.

Mitigate against risk, improved emergency planning and flood awareness

- Work with emergency planning colleagues and stakeholders to identify areas at highest risk and locate most vulnerable receptors.
- Exceedance flows, both within and outside of the site, should be appropriately designed to minimise risks to both people and property.
- For a partial or completely pumped drainage system, an assessment should be undertaken to assess the risk of flooding due to any failure of the pumps to be assessed. The design flood level should be determined if the pumps were to fail; if the attenuation storage was full, and if a design storm occurred.
- An emergency overflow should be provided for piped and storage features above the predicted water level arising from a 1% AEP rainfall event, inclusive of climate change and urban creep.
- Consideration and incorporation of flood resilience measures up to the 0.1% AEP event.
- Produce and implement robust emergency (evacuation) plans for major developments.
- Increase awareness and promote sign-up to the EA Flood Warnings Direct (FWD) within the Wokingham Borough.

10.2 Site screening

10.2.1 Purpose of site screening

This Level 1 SFRA has identified potential development sites across Wokingham Borough which fall within areas of flood risk. Due to these findings, a Level 2 SFRA will be required to further assess the flood risk at those sites proposed for development to inform the exception test.

10.2.2 Methodology

To identify the sites to be taken forward for Level 2 assessment, the following screening process was undertaken:

- All promoted sites were screened through JBA's FRISM software to identify fluvial, surface water, and reservoir risks to the site. The outputs of this FRISM screening are shown in Appendix G.
- WBC identified the sites assessed as potentially suitable for development through the latest Housing and Economic Land Availability Assessment (HELAA) including those proposed for allocation in the Revised Growth Strategy (2021)

consultation, from all sites promoted as well as newly promoted sites not yet subject to HELAA assessment.

- A high-level assessment of flood risk was then undertaken using the sites put forward by WBC as potentially suitable for development:
    - Any sites located within the Flood Zones were highlighted for Level 2 assessment. Any sites located within the 1% AEP plus 40% climate change surface water flood extent were visually assessed to determine whether the site can be developed around the areas of risk. If this is not the case, these were also highlighted for Level 2 assessment. Potential access issues were also highlighted during this process. For any sites not promoted for Level 2 assessment, the groundwater and reservoir risks were assessed at these sites, and further sites were highlighted for Level 2 assessment.

10.2.3 Level 2 SFRA assessment

A consultation with WBC was then undertaken to discuss and finalise the sites requiring Level 2 assessment.

The ranking criteria undertaken is as follows:

- Sites at higher risk from fluvial flooding
- Sites at higher risk from surface water flooding
- Sites where particular groundwater or reservoir flooding issues are identified

Sites requiring a Level 2 assessment will be assessed on a site-by-site basis in the Level 2 SFRA report, to inform the requirement for the exception test.

Annex 1 - Updates to the Planning Practice Guidance (25 August 2022)

The PPG on Flood Risk and Coastal Change was updated on the 25 August 2022, triggered by revisions to the NPPF in 2018, 2019 and 2021; practice experience since the PPG was first published in 2014; policy review of development in flood risk areas; and other stakeholder and committee reviews.

Key Details of the changes included in the PPG update of 25 August 2022:

General

- 'Design flood' includes climate change and surface water risk
- Hierarchical approaches prioritise avoidance and passive approaches, which also applies to residual risk.
- Safety of development now accounts for impact of flooding on the services provided by development
- Inappropriate to consider likelihood of defence breach
- Functional floodplain "starting point" for extent uplifted to the 3.3% AEP from 5% AEP
- Lifetime of non-residential development now has a 75 year starting point
- New culverting and building over culverts are discouraged
- Defra FD2320 research referenced for calculating flood hazard to people

Sequential test

- Paragraph 162 of the NPPF has been changed such that the aim of the sequential test is to "steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The SFRA will provide the basis for applying this test. The sequential approach (as described in Para 161) should be used in areas known to be at risk now or in the future from any form of flooding."
- The PPG has not yet been updated to describe how this exercise should be performed.
- Prior to the changes to the NPPF the requirement was set out as follows: 'The aim of the sequential test is to steer new development to areas with the lowest risk of flooding (the PPG advised that the exercise should be performed using the flood zones, as describe river and sea flood risk assuming there are no flood risk management measures or defences in place)'. This only required consideration of river and sea flood risk when applying the sequential test.
- Removal of reference to Flood Zones (Diagram 2) when performing the sequential test. The test must now consider whether development can be located in the lowest areas (high – medium – low) of flood risk both now and in the future (the test applies to all source of flood risk – whereas previously the test was only

performed for present day flood risk for the “Flood Zones” i.e. river and sea flood risk).

- Improved clarity about when the test needs to be applied, including clarification about 'minor' development.
- Clearer roles and responsibilities, with emphasis on the LPA to define the area of search and decide if the test is passed.
- Key terms defined (e.g. ‘reasonably available’)
- Suggests approaches to improve certainty and efficiency
- Clarification about when it’s appropriate to move onto the exception test
- Explicit statement that Table 2 (was Table 3) cannot be used to support performance of sequential test

Exception test

- Key terms defined (e.g. ‘wider sustainability benefits to the community’)
- New section on how to demonstrate development has reduced flood risk overall
- Table 2 (was Table 3) shows flood zone incompatibility, NOT whether ‘development is appropriate’.

Integrated approach to flood risk management

- Catchment based approaches
- Improved connectivity with other strategies e.g. water cycle studies and drainage and wastewater management plans
- Encourages measures which deliver multiple benefits – including those which unlock sustainable development

Impact of development on flood risk elsewhere

- FRA’s must detail any increase in risk elsewhere
- Guidance on compensatory flood storage – requirement for level-for-level storage
- Guidance on mitigating cumulative impacts
- Clarification that stilts/voids should not be relied upon for compensatory storage

Safeguarding land and relocation

- Guidance on how to safeguard land needed for future FCERM infrastructure
- Definition included for unsustainable locations
- Guidance for control of developments in unsustainable locations
- More detail and expectation on the requirement to relocate development that is susceptible to frequent flood risk or coastal erosion.

Sustainable Drainage Systems (SuDS)

- Clearer definition of what SuDS are – this must meet the ‘4 pillars’
- Clearer requirement for SuDS Strategy

- Better recognition of wider SuDS benefits e.g. Biodiversity Net Gain (BNG), carbon sequestration, urban cooling
- Encouragement for earlier consideration in the design process
- Encourages policies setting out where SuDS would bring greatest benefits
- Highlights the need to check for other permits for SuDS

Reducing the causes & impacts of flooding

- Whole new section – links to all the EA's latest NFM tools, maps, and research
- Support for river restoration such as culvert removal and other 'slow the flow' approaches
- Support for making space for river geomorphology e.g. meander migration

Coastal Change

- Encourages more precautionary designation of Coastal Change Management Areas (CCMAs)
- Allows more flexibility for existing buildings/land-use to adapt to change
- Clearer requirement for a 'coastal change vulnerability assessment' with apps for development in CCMAs
- Highlights need to consider removal of some Permitted Development rights in CCMAs

Other changes

- Guidance on how to consider flood risk in LDOs
- More detailed framework for local design code preparation
- Approach to article 4 in relation to flood risk
- Greater clarity on the application of the call-in direction process
- Guidance on development that might affect existing reservoirs
- Updated links to the latest tools and guidance

Summary of influential changes to the NPPF and implications for sequential and exception tests

The sequential test was originally conceived to direct proposed new development to locations that did not rely on Flood Risk Management features, so they are inherently safe and don't place a burden on future generations. This was achieved using a set of "Zone" maps that showed the extent of river and sea flooding for circumstances where no defences were present for events with high, medium, and low probability. Following this approach delivers new development that will not require future investment in flood risk management.

The sequential test process recognised that in some circumstances it would not be possible to locate development in locations outside of medium and high-risk flood Zones, as there were no reasonable alternatives. In circumstances where the

sequential test has been performed but is not satisfied the policy requires that the exception test is performed. The exception test is a two-part process that requires preparation of evidence to demonstrate that development proposals at risk of flooding deliver wider sustainability benefits and that it can be made safe for the intended lifespan (thus it is a requirement to demonstrate that proposed development will be safe under climate change conditions).

The updated NPPF requires the application of the sequential test to any source of flooding. The general implications of this are summarised as follows:

- The sequential test must be based on mapping that enables decision making based on a risk-based sequence.
- For river and sea flooding national mapping is available that describes low, medium and high risk flood zones based on the assumption that no flood risk management features are present.
- The other sources of flood risk that can potentially be included in the sequential test are surface water, groundwater, sewer flooding and reservoir flooding (or other water impounding features).
- It follows that proposed new development placed in locations at high or medium risk from flooding from other sources now and in the future (note that the explicit requirement to include climate change in the test, as set out in the August 2022 PPG will require the preparation of additional modelling and mapping) should be accompanied by evidence that the exception test can be satisfied (in a Level 2 SFRA).

A basic requirement for the sequential test is that appropriate, detailed mapping can be prepared to compare flood risk from different sources at alternative locations, as this is a fundamental requirement to establish a logical “risk sequence”.

The Annex 1 Table below includes a summary which:

- describes the implications of including any source of flooding in the sequential test;
- highlights matter to be considered; and
- identifies a preferred approach.

Annex 1 Table: Summary of inclusion of differences sources of flooding within the sequential test

Source of flooding	Available mapping	Implications of making use of mapping in the sequential test
Rivers and Sea	Flood Map for Planning and detailed models	• The sequential test can be carried out using the Flood Map for Planning for present day low (Flood Zone 1), medium (Flood Zone 2) and high risk (Flood Zone 3) as previously was the case.

Source of flooding	Available mapping	Implications of making use of mapping in the sequential test
		• Where detailed modelling is available, future Flood Zones 2 (0.1% AEP event), 3a (1% AEP event) and 3b (now the 3.3% AEP) will be assessed with climate change allowances. It should be noted that there may be instability issues running the 0.1% AEP event with climate change allowances as most models have not been designed and built to run events of larger magnitude than the 0.1% AEP event. • The fluvial models may experience instabilities during 0.1% AEP plus climate change runs which may mean that results cannot be prepared. • Generalised modelling (JFlow) is used to delineate Flood Zones where there is no detailed mapping but does not include climate change data or risk mapping.

Source of flooding	Available mapping	Implications of making use of mapping in the sequential test
Surface water	RoFSW	• Mapping based on a generalised modelling methodology. • Generally suitable for showing surface water flow routes at different probability flood events (3.3%, 1% and 0.1% AEP), although the uncertainty associated with the predicted outlines for the respective probabilities is high. • Doesn't always include allowance for drainage features such as culverts and can over or underestimate flooding where there are linear features such as embankments. • Unlike the Zone maps for river and sea flooding the surface water mapping makes an allowance for the assumed performance of a local drainage system. • Normal profile of extent and shape of flooding is a "dendritic" pattern that follows low lying topography and is not an extensive blanket, as is most often the case for river and sea flooding. • The flood risk is likely to be relatively short lived and much more localised than would be the case for river and sea flooding (most likely being caused by local high intensity short duration rainfall events). • It is likely that in many circumstances surface water flood risk zones based on the surface water mapping could affect a relatively small proportion of a proposed allocation site, but in practical terms this might not in itself be a factor that demonstrates that the principle of development could not be supported.
Groundwater	British Geological Survey (BGS) Groundwater flood susceptibility maps JBA groundwater emergence flood map WBC historic flood events	• BGS mapping describes the risk of groundwater emergence but does not show the likelihood or risk of groundwater flooding occurring, i.e. it is a hazard and consequence base product and does not enable the application of risk based approach. • JBA groundwater map does potentially enable a risk-based approach to be taken as it depicts different levels of risk. However, this is also based on the risk of emergence of groundwater and not surface flooding due to groundwater. The analyses performed to prepare the mapping are all for a 1% AEP event and so provide a risk

Source of flooding	Available mapping	Implications of making use of mapping in the sequential test
		of groundwater emergence to the surface as they are based on predicted difference between groundwater level and the ground surface. Five zones are defined to describe the risk of groundwater being: at or very near ground surface; between 0.025m and 0.5m below the ground surface; between 0.5m and 5m below the ground surface; at least 5m below the ground surface; and negligible risk of groundwater flooding. • The underlying challenge is that the data is very uncertain and could not be used with confidence unless supported by more detailed local studies. The mapping provides an indication of where risk might be higher, but it would not be easy to defend sequential decisions based on the available mapping. • Historic flood data is available from WBC; however, this does not always list the source of flooding. In addition, it is often difficult to determine the source of historical flood events and groundwater and surface water flooding can often be confused. •There is no climate change mapping available for groundwater and in view of the uncertainty in the present-day data it is unlikely that such mapping will be available in the near future.

Reservoir flooding risk	Reservoir Flood Mapping (RFM)	• The latest available mapping now shows “wet day” and “dry day” reservoir inundation extents. The “wet day” being a reservoir breach at the same time as a 0.1% AEP river flood (as this is a likely time when a reservoir might fail) and the dry day shows the failure just from the water retained by the dam. • Neither set of mapping describes a risk-based scenario as it does not provide the probability of a dam failure but are intended to describe a “worst credible case”. • More detailed information on flood velocities and depths has been prepared as part of the modelling and mapping study, but this is not publicly available and can only be viewed by those with appropriate security classifications. The flood extents are publicly available. • By comparing the extent of Fluvial Flood Zone 2 with the Reservoir Flood Map Wet Day Extent two zones can be defined: 1. Where reservoir flooding is predicted to make fluvial flooding worse. 2. Where reservoir flooding is not predicted to make fluvial flooding worse. • The mapping could be used to direct proposed new development away from locations that could potentially be affected by reservoir flood risk. However, it would not be conceptually similar to the risks pertaining to river and sea flooding and further assessment would be required to understand the magnitude of the potential hazard. • A consideration with respect to the reservoir maps is that placing new development in locations potentially affected by reservoir inundation could potentially change the “risk category” of the reservoir and this could result in the reservoir owner “undertaker” having to invest in substantive remedial works to demonstrate that the reservoir had the appropriate level of safety. This is not strictly related to the sequential test but should be a consideration that should be appropriately managed when planning new development. • The mapping does not provide climate change information on future flood risk and provision of such mapping is unlikely based on the existing

Source of flooding	Available mapping	Implications of making use of mapping in the sequential test
		methodology.

Impacts on the SFRA

The most relevant points to consider in relation to updating the SFRA process relate to the changes to the sequential test and exception test, particularly the requirement for updated climate change modelling for all sources of flood risk and the functional floodplain starting point at 3.3% AEP. Consideration also needs to be made to the changes to Table 2 (was Table 3) and the flood risk vulnerability and flood zone incompatibility. This should be considered during the screening phase prior to the Level 2 SFRA being undertaken.

For more information on the PPG updates, please visit the gov.uk website.

Appendices

A Interactive Flood Risk Mapping and User Guide

B Data sources used in the SFRA

C SFRA User Guide

D Flood Alerts and Flood Warnings

E Summary of flood risk across Wokingham Borough

F Cumulative Impact Assessment (CIA)

G Site Screening - FRISM Outputs

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