Wokingham Borough Council
Local Plan Update

Level 2 Strategic Flood Risk Assessment

On behalf of

WOKINGHAM BOROUGH COUNCIL

Project Ref: 33210523 | Rev: - | Date: November 2021

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Document Control Sheet

Project Name: **WBC Local Plan Update**

Project Ref: **33210523**

Report Title: **Strategic Flood Risk Assessment – Level 2**

Doc Ref: **-**

Date: **November 2021**

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For and on behalf of Stantec UK Limited				

Revision	Date	Description	Prepared	Reviewed	Approved

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Executive Summary

The Wokingham Borough Core Strategy and Managing Development Delivery Local Plans were adopted in 2010 and 2014. Wokingham Borough Council (WBC) is now in the process of reviewing and updating their planning policies through the preparation of a new Local Plan – known as the 'Local Plan Update'.

This 'Local Plan Update – Level 2 Strategic Flood Risk Assessment (SFRA) has been prepared by Stantec on behalf of WBC. This is focussed on the development of strategic masterplan options, in consultation with landowners, the community and key stakeholders, to support the assessment of the two areas of land for potential strategic scale development at:

(i) Hall Farm & Four Valleys site ('Hall Farm') and

(ii) the South Wokingham Strategic Development Location (SDL) Extension.

Compliance with the guidance set out in the SFRA will demonstrate that proposed development is safe and in accordance with the requirements of national and local planning policy.

Abbreviations

ABI	-	Association of British Insurers
BGS	-	British Geological Survey
CDM	-	Construction (Design and Management)
CIRIA	-	Construction Industry Research and Information Association
DDA	-	Disability Discrimination Act
DEFRA	-	Department for Environment, Food and Rural Affairs
EA	-	Environment Agency
FAS	-	Flood Alleviation Scheme
FDC	-	Flood Defence Consent
FHR	-	Flood Hazard Rating
FMfSW	-	Flood Map for Surface Water
FRA	-	Flood Risk Assessment
FRAP	-	Flood Risk Activity Permit
FRMP	-	Flood Risk Management Plan
GIS	-	Geographic Information System
LLFA	-	Lead Local Flood Authority
M. AOD	-	Metres Above Ordnance Datum (Newlyn)
NPPF	-	National Planning Policy Framework
PFRA	-	Preliminary Flood Risk Assessment
PPG	-	Planning Practice Guidance
SuDS	-	Sustainable Drainage Systems
SFRA	-	Strategic Flood Risk Assessment
WBC	-	Wokingham Borough Council
UKCP18	-	United Kingdom Climate Change Projections 2018 Study

1 Introduction

1.1 Scope of Report

1.1.1 This Strategic Flood Risk Assessment (SFRA) has been prepared by Stantec, on behalf of Wokingham Borough Council (WBC) to provide an overview of available flood risk information on two strategic sites to inform future decision making in relation to site allocations.

1.1.2 Stantec has many years of experience in, amongst other areas, the assessment of flood risk, hydrology, flood defence and river engineering. The reviewers of the document are experienced engineers and members of chartered institutions such as the Chartered Institution of Water and Environmental Management (CIWEM) or the Institution of Civil Engineers (ICE).

1.1.3 The existing development plan for Wokingham Borough is centered on the **Core Strategy** local plan (2010) which covers the period 2006 - 2026. The Core Strategy local plan is supported by the **Managing Development Delivery Plan** local plan (2014) which provides more detailed development management policies.

1.1.4 WBC is in the process of reviewing and updating its planning policies through the preparation of the Local Plan Update. The new local plan would cover the period to 2037/2038.

1.1.5 Three rounds of consultation have occurred to date:

- An Issues and Options consultation was undertaken in 2016;
- A 'Homes for the Future' consultation undertaken in late 2018/early 2019 which sought views on how development should be managed and invited comments on the suitability of land promoted by developers; and
- A Draft Plan consultation was undertaken in early 2020 containing draft policies and proposed development allocations.

1.1.6 WBC conducted a consultation on the Draft Plan between 3 February and 3 April 2020. At the heart of the Draft Plan was the creation of a new garden town at Grazeley, providing 3,750 homes in Wokingham Borough in the period to 2036 and in the region of 10,000 homes in the borough by the 2050s. In May 2020, subsequent to the Draft Plan consultation, emergency planning arrangements around AWE Burghfield were extended to encompass the Grazeley area for the first time. The change was initiated by change in legislation and is understood not to be related to any change in activity undertaken at the site. Under the changed circumstances, the Defence Nuclear Organisation, part of the Ministry of Defence, now objects to the Grazeley garden town proposal and requests its removal from the local plan.

1.1.7 In response to deliverability issues surrounding the Grazeley garden town proposal, WBC has started the process of looking at alternative potential planning strategies. The assessment of the alternative potential development areas will support the future decision making process regarding potential allocation of sites within the Local Plan Update.

1.2 Disclaimer

1.2.1 It is important to recognise that the information provided within this SFRA is the best available data at time of issue of the report. The mapping of flood risk is not an exact science, and the risk to a specific area can change over time as greater knowledge on localised flooding is obtained.

1.2.2 The SFRA is a strategic-level document intended to support and inform the spatial planning process and it will trigger the requirement for more detailed site-specific Flood Risk

Assessments to accompany applications for new development; it is anticipated that such reports will further refine and improve the assessment of flood risk at a localised level with the most up-to-date information at the time.

2 Sources of Information

A significant amount of background knowledge exists with respect to flooding within the Borough. This data has been sourced from WBC and the EA and is listed below, with an overview of the source of the information and its relevance/application within the SFRA process.

2.1 Topographical and Geological Data

2.1.1 The topography of land across the Borough has been determined through the provision of LiDAR data. LiDAR data is typically quoted to have accuracy of between +/-5cm to +/-15cm, with the spatial resolutions ranging from 25cm to 2 metres. The data undergoes a filtering process to show a 'bare earth' ground model (i.e. excluding building footprints).

2.1.2 An overview of the geology across the Borough has been obtained from the publicly available data from the British Geological Survey (BGS).

2.2 EA Flood Zone Map

2.2.1 The EA has provided their Flood Zone extents, which delineates the Borough into zones of 'Low', 'Medium' and 'High' probability of river or sea flooding, ignoring the presence of flood defences. These are referred to as the 'Flood Map for Planning' on the GOV.UK website and the definition of these Flood Zones is detailed in **Section 3.1.**

2.2.2 The Flood Zone extents are based on a combination of a coarse national scale generalised computer model ', more detailed hydraulic modelling where available, and in some cases 'worst historic' flood outlines. The availability of EA detailed hydraulic modelling in the Borough is discussed in **Section 2.6.**

2.2.3 The WBC L1 SFRA states the following to define Flood Zone 3b 'Functional Floodplain':

"For the purposes of this SFRA, Flood Zone 3b Function Floodplain has been defined as:

- ***Land subject to flooding in the 5% AEP fluvial flood event, excluding building footprints; and,***
- ***Land which provides a function of flood conveyance (i.e. free flow) or flood storage, either through natural processes, or by design (e.g. washlands and flood storage areas).***

Detailed modelled flood extents for the 5% AEP design event were adopted for the Main Rivers in the Borough as the basis of Flood Zone 3b Functional Floodplain delineation. In areas where the 5% AEP flood event has not been identified in the SFRA, a precautionary approach should be applied, assuming that all of the 1% AEP flood extents is the functional floodplain, until the coverage of the 5% AEP flood extents is adequately demonstrated by a site-specific FRA."

2.2.4 The EA's knowledge of the floodplain, and the associated extent of the Flood Zones, is continuously being improved through ongoing studies, river flow gauging and level monitoring and the impacts of floods. The Flood Zone maps are updated on a quarterly basis.

2.3 EA Surface Water Flood Map

2.3.1 The EA has provided their updated 'Flood Map for Surface Water' ('FMfSW') released in 2013 as their third iteration of a national scale surface water modelling exercise. This follows the

'Areas Susceptible to Surface Water Flooding Maps' released in 2008, and the 'Flood Map for Surface Water' released in 2010.

2.3.2 Whilst the management responsibility for flood risk from surface water lies with the LLFA, this work forms part of the EA's 'strategic overview' role established following the Pitt Review ('The Pitt Review - Learning Lessons from the 2007 floods', Sir Michael Pitt, June 2008), and allows LLFAs to use these maps to meet the requirements of the Flood Risk Regulations – i.e. to produce flood hazard maps for surface water in any designated 'Flood Risk Areas' defined in the PFRA.

2.3.3 The Wokingham PFRA Addendum (2017) states that "*No FRAs have been identified in the Wokingham lead local flood authority (LLFA) area for the purposes of the Flood Risk Regulations second planning cycle".*

2.4 EA Groundwater Flood Map

2.4.1 A series of maps related to groundwater properties and potential groundwater flood risk has been prepared under Appendix A.9 of the WBC Level 1 SFRA. In the absence of any updated information from the EA, this data has been reviewed in relation to the study areas.

2.4.2 These are strategic scale mapping showing groundwater flood potential based on the published underlying geological properties rather than based on detailed modelling or recorded groundwater flooding, and therefore are intended to provide an indication only, which would need further assessment following intrusive site investigations.

2.5 EA Reservoir Flood Map

2.5.1 Paragraph 014 of the NPPF PPG 'Flood Risk and Coastal Change' states:

> *'The failure of a reservoir has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The local planning authority will need to evaluate the potential damage to buildings or loss of life in the event of dam failure, compared to other risks, when considering development downstream of a reservoir. Local planning authorities will also need to evaluate in Strategic Flood Risk Assessments (and when applying the Sequential Test) how an impounding reservoir will modify existing flood risk in the event of a flood in the catchment it is located within, and/or whether emergency draw-down of the reservoir will add to the extent of flooding'.*

2.5.2 One of the key recommendations of the Pitt Review of the summer 2007 floods was that flood maps be prepared for reservoirs, to assess risks and plan for contingency, warning and evacuation.

2.5.3 The EA has produced Reservoir Flood Maps (RFMs) showing the potential extent of flooding in the event of a breach from large reservoirs (over 25,000 cubic metres of water). This mapping study assumes a worst-case scenario; i.e. that a breach occurs for the full height and width of the impounding structure when the water level is near the crest.

2.5.4 The extent provided by the EA has been further refined based on delineation of speed and depth of flooding over the affected area, as identified on the RFM on the EA website.

2.5.5 It is important to emphasise that the results of this study do not provide an assessment of the probability of such an event occurring, nor does it in any way reflect the structural integrity of the reservoir embankment(s).

2.6 Detailed Hydraulic Modelling

2.6.1 Detailed hydraulic modelling studies of watercourses running through the Borough have been obtained to inform the study as follows:

- The **EA Lower Loddon hydraulic model** (Aldershot to Swallowfield, 2007), which was updated for the Lower Earley Way North (LEWN) widening scheme (July 2017) and subsequently inform their Flood Alleviation Scheme investigations (March 2018). This has been referred to as the 'Origin model' and updates the original EA Loddon model by including:
  - The Hatch Farm Dairies proposals (land raising, floodplain culverts, and floodplain compensation);
  - The latest LiDAR data (obtained June 2017 from the Environment Agency);
  - The latest Ordnance Survey Mastermap data;
  - The latest additional channel survey of the River Blackwater, Barkham Brook, Arborfield Ditches, and the Hall Farm Mill pools and Fish Bypass (not represented in the EA Model); and,
  - Data relating to the new Shinfield Relief Road and culverts under the A327

  As part of the current L2 SFRA work, this model has been rerun applying the peak river flow climate change allowance scaling factors to the inflows, based on the latest EA guidance (see **Section 3.3** and **Appendix B**).

- The EA **Barkham Brook hydraulic model**, a 1D ISIS steady state model forming part of the Lower Loddon 2007 Model, which is based on survey information dated May 2006.

  Modelled present day 1 in 5, 20, 50, 100 annual probability extents have been extracted from the original baseline 1D Barkham Brook model (ISIS version 5.4), as part of the EA Loddon model (2006/07). No extreme 1 in 1000 annual probability event results were generated for the model.

  New climate change runs were generated from applying the latest climate change allowances to the baseline 1 in 100 flows and re-running the Barkham Brook model (using Flood Modeller version 4.6), with updated downstream boundary water levels taken from the equivalent updated 2D Loddon model results (utilising TUFLOW version 2020-10-AA). Maximum flood extents have been extracted from the Barkham Brook results, through creating a water surface, and combined with the 2D outputs from the update Loddon model. Due to differences in software, some minor variations may be present in results of equivalent events between the two models.

2.6.2 It should be noted that the detailed hydraulic models developed on behalf of the EA assume *'typical'* conditions within the respective river systems that are being analysed. The predicted water levels may change if the operating regimes of the rivers involved are altered, either due to, for example, engineering works which may be implemented in the future, or poor maintenance (if culverts become blocked, or if the condition of the river channel is allowed to deteriorate).

2.6.3 As part of this SFRA process, Stantec has re-run the River Loddon and Barkham Brook models to generate the reference flood extents based on the EA climate change allowances guidance discussed in **Section 3.3.** and provided in **Appendix B.**

2.7 EA Flood Defence Information

2.7.1 Information has been provided by the EA from their national flood defences database as part of the Flood Zones package of information discussed above. The data has been provided in three discrete GIS layers as follows:

- Flood defences - the location of linear raised flood defences such as embankments and walls;
- Flood storage areas - land designated and operated to store flood water;
- Land that may benefit from the presence of major defences during a 1% fluvial or 0.5% tidal flood event - these are areas that would flood if the defence were not present, but may not flood because the defence is present (areas benefiting from flood storage areas may be remote from the flood defence structure).

2.7.2 A review of the information from the EA Geostore website confirmed that the relevant flood defence layers did not contain any information in the vicinity of the subject sites.

3 Planning Policy

This SFRA has been prepared in accordance with the relevant national, regional and local planning policy - and statutory authority guidance - as follows

3.1 National Flood Risk Policy

3.1.1 National policy is contained within the **National Planning Policy Framework (NPPF)** updated July 2021, issued by the Ministry of Housing, Communities and Local Government, with reference to Section 14 'Meeting the challenge of climate change, flooding and coastal change';

3.1.2 The **NPPF Planning Practice Guidance (PPG)** was released in March 2014 ('Flood Risk and Coastal Change' section) and updated to incorporate the EA **'Flood Risk Assessments: Climate Change Allowances'** guidance (most recently updated July 2021).

3.1.3 The Flood Zones are defined in Table 1 of the Planning Practice Guidance (PPG) 'Flood Risk and Coastal Change' section as follows:

- **Flood Zone 1 'Low Probability'** – Land at less than 1 in 1000 (0.1%) annual probability of river or sea flooding;
- **Flood Zone 2 'Medium Probability'** – Land between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of river flooding, or between 1 in 200 (0.5%) and 1 in 1000 (0.1%) annual probability of sea flooding;
- **Flood Zone 3a 'High Probability'** – Land at 1 in 100 (1%) or greater annual probability of river flooding, or 1 in 200 (0.5%) or greater annual probability of sea flooding
- **Flood Zone 3b 'Functional Floodplain'** – Land where water has to flow or be stored in times of flood. Local planning authorities should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the EA.

3.1.4 The Flood Zone map does not differentiate between Flood Zone 3a 'High Probability' and Flood Zone 3b 'Functional Floodplain' (the defined Flood Zone 3 is effectively a composite of Zone 3a and Zone 3b. The WBC Level 1 SFRA defines Flood Zone 3b as follows:

- *"Land subject to flooding in the 5% AEP fluvial flood event, excluding building footprints; and,*
- *Land which provides a function of flood conveyance (i.e. free flow) or flood storage, either through natural processes, or by design (e.g. washlands and flood storage areas).*

  Detailed modelled flood extents for the 5% AEP design event were adopted for the Main Rivers in the Borough as the basis of Flood Zone 3b Functional Floodplain delineation. In areas where the 5% AEP flood event has not been identified in the SFRA, a precautionary approach should be applied, assuming that all of the 1% AEP flood extents is the functional floodplain, until the coverage of the 5% AEP flood extents is adequately demonstrated by a site-specific FRA.".

3.2 Local Flood Risk Policy

3.2.1 Local planning policy contained within the **Wokingham Borough 'Local Development Framework Adopted Core Strategy Development Plan Document'**, January 2010, with particular reference to 'Policy CP1 Sustainable Development' and the **'Managing Development**

Delivery Plan' (MDD) (adopted February 2014) which builds on the Core Strategy and includes more detailed policies for development of the borough.

3.2.2 Core Strategy **Policy CP1 'Sustainable Development'** states:

> ***Planning permission will be granted for development proposals that:***
>
> ***1) Maintain or enhance the high quality of the environment;***
>
> ***2) Minimise the emission of pollutants into the wider environment;***
>
> ***3) Limit any adverse effects on water quality (including ground water);***
>
> ***4) Ensure the provision of adequate drainage…***
>
> ***…9) Avoid increasing (and where possible reduce) risks of or from all forms of flooding (including from groundwater)…***

3.2.3 The MDD **Policy CC09 'Development and Flood Risk'** states:

> ***1. All sources of flood risk, including historic flooding, must be taken into account at all stages and to the appropriate degree at all levels in the planning application process to avoid inappropriate development in areas at risk of flooding. Proposals must be consistent with the guidance in paragraphs 99-104 of the National Planning Policy Framework (NPPF); the Technical Guidance to the NPPF and demonstrate how they have used the Strategic Flood Risk Assessment (SFRA) to determine the suitability of the proposal.***
>
> ***2. Development proposals in Flood Zones 2 or 3 must take into account the vulnerability of proposed development.***
>
> ***3. Development must be guided to areas of lowest flood risk by applying the sequential approach taking into account flooding from all sources and shall ensure flood risk is not worsened for the application site and elsewhere, and ideally that betterment of existing conditions is achieved. The sequential test will not be required if at least one of the following applies:***
>
> ***a) Replacement of an existing single residential property. However, the replacement property should, where possible, be located on the part of the site at lowest risk***
>
> ***b) Conversions and change of use unless it involves a change to a more vulnerable class***
>
> ***c) Minor development, as defined in footnote 10 of the Technical Guidance Note to the NPPF.***
>
> ***4. In exceptional circumstances, new development in areas of flood risk will be supported where it can be demonstrated that:***
>
> ***a) The development provides wider sustainability benefits to the community that outweigh flood risk***
>
> ***b) The development will:***
>
> ***i. Be safe for its lifetime, taking account of the vulnerability of its users***
>
> ***ii. Not increase flood risk in any form elsewhere and, where possible, will reduce flood risk overall***
>
> ***iii. Incorporate flood resilient and resistant measures into the design***
>
> ***c) Appropriate evacuation and flood response procedures are in place to manage the residual risk associated with an extreme flood event.***
>
> ***5. Where required, suitable and appropriately detailed flood risk information will need to accompany a planning application. A Flood Risk Assessment (FRA) is required for:***
>
> ***a) All proposals in areas of known historic flooding from all sources***
>
> ***b) Where there is evidence of a risk from all sources of flooding identified in the Strategic Flood Risk Assessment***
>
> ***c) Those proposals set out in footnote 20 to paragraph 103 of the NPPF.***

3.2.4 The WBC draft **'Local Plan Update'** was published for consultation in February 2020.

3.2.5 Particular reference in relation to flood risk is made to **Policy NE8 'Development and Flood Risk (from all sources)'** and **Policy NE9 'Sustainable Drainage'**. Policy NE8 largely replicates and above Policy CC09 and is reproduced overpage.

1. All sources of flood risk, including historic flooding, must be taken into account at all stages of the development and to the appropriate degree at all levels in the planning application process to avoid inappropriate development in areas at risk of flooding. Proposals must be consistent with national policy and guidance and demonstrate how they have used the Strategic Flood Risk Assessment (SFRA) to determine the suitability of the proposal.

2. Development proposals in Flood Zones 2 or 3 must take into account the vulnerability of proposed development.

3. Development must be guided to areas of lowest flood risk, in the first instance, by applying the sequential approach taking into account the effects of climate change and flooding from all sources. Development should ensure flood risk is not worsened for the application site and elsewhere, and ideally that betterment of existing conditions is achieved. The sequential test will not be required if at least one of the following applies:

a) Minor non-residential extensions: industrial/commercial/leisure etc. extensions with a footprint of less than 250 square metres.

b) Alterations: development that does not increase the size of buildings e.g. alterations to external appearance.

c) Householder development: for example shed, garages, games rooms etc. within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.

d) Changes of use, except where the change of use is to a caravan, camping or chalet site, or to a mobile home or park home site.

4. In exceptional circumstances, new development in areas of flood risk will be supported where it can be demonstrated that:

a) The development provides wider sustainability benefits to the community that outweigh flood risk

b) The development will:

- ***i. Be safe for its lifetime, taking account of the vulnerability of its users***
- ***ii. Not increase flood risk in any form elsewhere and, where possible, will reduce flood risk overall***
- ***iii. Incorporate flood resilient and resistant measures into the design***

c) Appropriate evacuation and flood response procedures are in place to manage the residual risk associated with an extreme flood event.

5. Where required, suitable and appropriately detailed flood risk information will need to accompany a planning application. A site-specific Flood Risk Assessment (FRA) is required for:

a) All proposals in areas of known historic flooding from all sources

b) Where there is evidence of a risk from all sources of flooding identified in the Strategic Flood Risk Assessment

c) All development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: i. sites of 1 hectare or more; ii. land which has been identified by the Environment Agency as having critical drainage problems; iii. land identified in a strategic flood risk assessment as being at increased flood risk in future; or iv. land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use".

3.2.6 Of relevance to the Hall Farm site, the **Shinfield Neighbourhood Plan** was 'made' in 2017 and the **Arborfield and Barkham Neighbourhood Plan** was 'made' in 2020, both becoming part of the development plan.

3.2.7 **Policy 8 'Flooding'** of the Shinfield Neighbourhood Plan states the following:

> ***1. Where appropriate, new developments must incorporate the existing open watercourses, points and ditches within the development site, to lessen the risk of flooding to property, fields and roads.***
>
> ***2. Existing open watercourses, ponds and ditches shall be preserves in new developments and substituted only where absolutely necessary or otherwise appropriate.***
>
> ***3. The creation of Sustainable Drainage Systems(SuDS) in new development should be promoted wherever practicable and should be incorporated into the site layout and landscape design, matching with the requirements of existing adjacent land and with regard to provision for fauna, flora and habitats. provisions for the maintenence and management of the features must be made by the developer.***
>
> ***4. No development will be permitted which reduces the ability of the site to alleviate flooding, or which results in increases in surface water run-off rates that would have a detrimental effect offsite, unless suitable mitigation is put in place.***

3.2.8 **Policy AD4 'Address Local Flood Risk Management'** is the equivalent policy of the Arborfield and Barkham Neighbourhood Plan and states the following:

> ***Planning applications for development must ensure that:***
>
> ***a) The principles of flood risk management, including SuDS are fully addressed at outline planning stage and, ideally, in pre-application discussions. This includes SuDS maintenence plans and funding for the lifetime of the development.***
>
> ***b) Applications must show how they have addressed Wokingham Borough Councils SuDS strategy (and any replacement strategy) and have designed appropriate SuDS accordingly.***
>
> ***c) Confirmation from the water company during planning that there would be adequate capacity in the sewerage system prior to occupation of new homes.***
>
> ***d) Provide measures to slow the rate of water run-off by adequate provision of swales, ponds and other SuDS measures.***
>
> ***e) Encourage tree planting to reduce run-off rates. As an ideal a new tree should be planted to replace every one that is removed.***
>
> ***f) Account is taken of known local flooding problems.***

3.3 Climate Change Guidance

3.3.1 It is necessary to fully consider the potential impacts of climate change for the lifetime of development within the mitigation measures. The EA released updated guidance on the application of climate change allowances in flood risk assessments in July 2021:

https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances.

3.3.2 This guidance provides contingency allowances for potential increases due to climate change in:

- Peak river flow;
- Rainfall intensity;
- Sea level rise.

3.3.3 The peak river flow allowances table provides a range of allowances based on percentile (i.e. the degree of certainty of an event occurring, based on the range of climate change scenarios assessed through scientific investigations). The applicable values for a site are dependent on the 'River Management Catchment' in which the site is located, which can be confirmed via an online mapping tool embedded within the guidance.

3.3.4 The peak river flow allowances to be considered for new development in the 'Thames River Basin – Loddon and Tributaries Management Catchment' are as detailed in **Table 3-1**.

Table 3-1: Climate Change – Peak River Flow Allowances – Loddon and Tributaries

River Basin District	Range of Climate Change Allowances requiring consideration		
	Central	Higher Central	Upper End
2020s *(2015-2039)*	***+7%***	***+11%***	*+23%*
2050s *(2040 – 2069)*	***+4%***	***+10%***	*+25%*
2080s *(2070 – 2115)*	***+14%***	***+23%***	*+46%*

3.3.5 The guidance confirms that **SFRAs should assess both the 'Central' and 'Higher Central' allowances**. For most forms of development, a 100-year design life is considered an appropriate estimate and therefore the 2080s values (i.e. to the year 2115) are the design baseline.

3.3.6 The applicable allowances are subject to the Flood Zone classification of a site, and the vulnerability classification of the proposed use. The Central allowance is identified as the design standard for most forms of proposed development in all appropriate Flood Zones (the exception being 'Essential Infrastructure' which requires the 'Higher Central' value).

3.3.7 The guidance also confirms that the Central allowance should be used in most cases to assess off-site impacts and floodplain storage impacts, while the Higher Central allowance is used when the affected area contains essential infrastructure.

- As the Emm Brook tributary flowing through the SDL Extension site has not been subject to hydraulic modelling, the Flood Zone 2 extent should be considered a conservative proxy for the 'design' 1 in 100 annual probability plus climate change scenario.

- The River Loddon and Bearwood Brook flowing through the Hall Farm site have been modelled, and these models have been rerun for this study using the range of climate change scenarios for the 2080s epoch outlined above – see **Appendix B.**

3.3.8 The 'Upper End' value is used as a 'sensitivity test' when considering '*credible maximum scenarios for nationally significant infrastructure projects, new settlements or urban extensions.'*

3.3.9 In relation to the other climate change factors, sea level rise is clearly not an issue at the site. Peak rainfall intensity is a significant factor which is considered in any proposed surface water drainage arrangements and Table 1 of the guidance (replicated in **Table 3-2**) provides the anticipated changes in peak rainfall intensity in small catchments (i.e. less than 5km^2), or urbanised drainage catchments (for large rural drainage catchments the peak river flow allowances should be applied).

Table 3-2: Climate Change – Peak Rainfall Intensity Allowance in Small Catchments

	Total potential change anticipated (within specified epoch)		
	2020s *(2015-2039)*	***2050s*** *(2040 – 2069)*	***2080s*** *(2070 – 2115)*
Upper End	***10%***	***20%***	***40%***
Central	***5%***	***10%***	***20%***

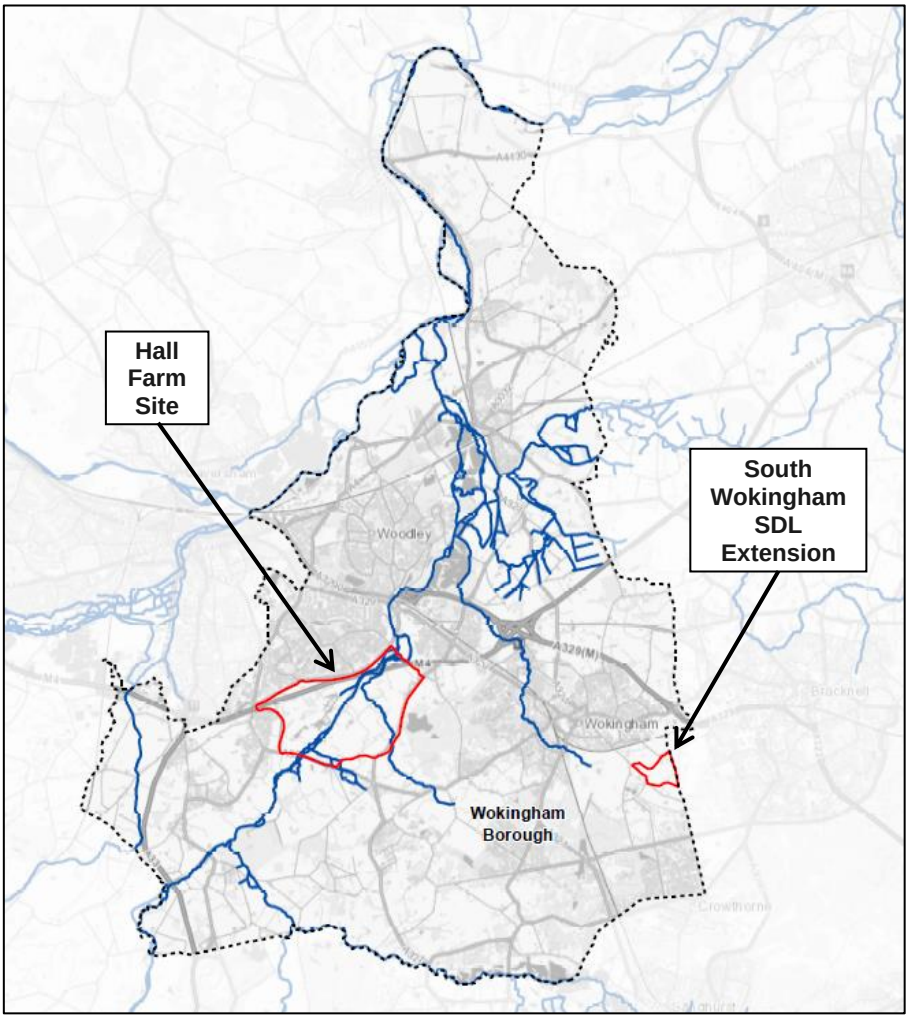
3.3.10 Further details of the design criteria for surface water drainage arrangements are provided in **Section 9**.

4 Study Areas

4.1 Site Location

4.1.1 The location of the two subject sites in the context of the wider Wokingham Borough is shown in **Figure 4-1** below.

Figure 4-1: Site Location Plan (Borough Wide)



Hall Farm

4.1.2 The Hall Farm area comprises a significant expanse of open countryside largely owned by the University of Reading (UoR) to the south of the M4 straddling the Loddon River valley to the west of Shinfield.

4.1.3 The area referred to as the 'Four Valleys' is located to the west of the Loddon River and consists of relatively flat land used for agricultural purposes. The UoR are currently proposing significant employment related development in this location in the form of a Royal Berkshire Innovation Park proposal (the 'Four Valleys' proposals). The vision is based on themed employment sectors that would cater to the film/media, technology, health, and heritage/ arts industries. The proposal would incorporate the current Thames Valley Science Park near Shinfield and take in additional land to the south and west.

4.1.4 The area known as 'Hall Farm' is situated to the east of the Loddon River, bounded by the the village of Arborfield to the south, and the A3030 Mole Road on its eastern boundary. The land itself is predominantly flat agricultural land with some farm buildings and pockets of ancient woodland and hedgerow boundaries. The UoR's Dairy Research Centre is located here.

4.1.5 The land is also bisected by the Barkham Brook and its confluence with the River Loddon is immediately to the north-west. Adjacent to and north of Hall Farm lie additional parcels of farmland that have been promoted for residential development by other landowners. This additional land is situated between Sindlesham and the M4 and also forms part of the area of interest.

South Wokingham SDL Extension

4.1.6 The South Wokingham Strategic Development Location (SDL) is a major development to the south of Wokingham town, allocated in the adopted Core Strategy local plan. The major development includes new primary schools, local shopping and community facilities in two new neighbourhood centres, open spaces and roads including a South Wokingham Distributor Road.

4.1.7 The area north of the railway line, Montague Park, is largely complete. The neighbourhood centre is currently under construction and will include retail (Co-op) and commercial space as well as a community centre and 2 children's playgrounds, as well as 650 new homes. The area south of the railway line is at an earlier stage with 1850 homes envisaged in adopted policy. Three planning applications have recently been determined in this area as follows:

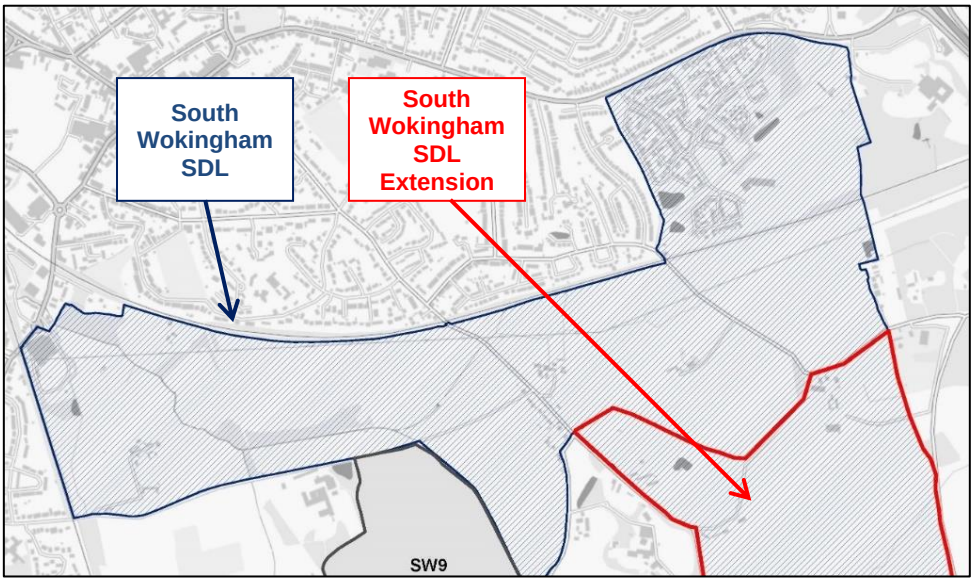
- **Application no. 192928 -** full planning application for the construction of the South Wokingham Distributor Road (SWDR) between Finchampstead Road and Waterloo Road, including a link to Heathlands Road, together with associated works including demolition of Nos 76A and 76B Finchampstead Road;

- **Application no. 190914 - land at Phase 2a of the South Wokingham Strategy Development Location (SDL) -** Outline application with all matters reserved except for principal means of access to the highways, for up to 215 dwellings;

- **Application no. 191068 - land at Phase 2b of the South Wokingham Strategy Development Location (SDL) -** Hybrid planning application comprising an outline application for a mixed use development of up to 1,434 dwellings, a two-form entry primary school, local centre and associated open space and infrastructure.

4.1.8 The subject site – the potential SDL extension – lies within the south-east section of the SDL and is bounded by Easthampstead Road to the west, Waterloo Road to the north and Old Wokingham Road to the east. The southern boundary is defined by a tributary of the Emm Brook.

Figure 4-2: Site Location Plan (not to scale)



4.1.9 The hamlet of Holme Green lies on the western side of the site. Locks Farm lies at the northern end of the site, while beyond the north-eastern site boundary lies the Oakwood Youth Challenge climbing centre and the Foundation Church.

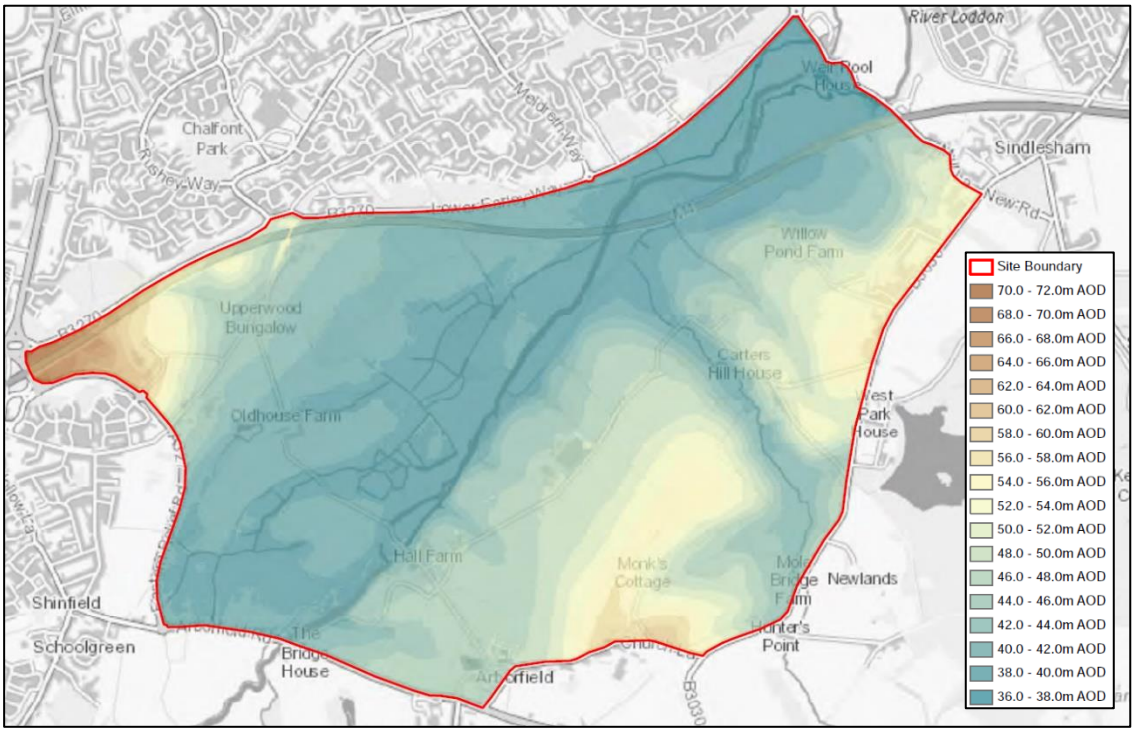
4.2 Topography and Hydrological Setting

Hall Farm

4.2.1 The **River Loddon** is the predominant feature of the Hall Farm site, flowing north-east through the centre of the site with a wide floodplain extending across the low lying agricultural land on the north side of the main channel.

4.2.2 The watercourse is a natural channel over the majority of its length through the site, although there are some localised flow controls (e.g. at Arborfield Mill House, Mill Farm), as well as constrictions at the crossing points of the A327 Arborfield Road (at the upstream boundary of the site) and the M4 Motorway.

Figure 4-3: LiDAR Topographic Data - Hall Farm Site



4.2.3 The **Barkham Brook** flows north-west across the site, entering the site at Mole Bridge Farm and mainly flowing in a more incised nominal valley, resulting in a narrower associated fluvial floodplain. A short distance south of the M4 Motorway, the channel turns north-east, and it continues in parallel with the River Loddon until its confluence with the Loddon around Weir Pool House, at the downstream end of the site.

4.2.4 The **Marsh Farm Ditch** is another small main river channel, located in the north-eastern part of the site. This channel provides land drainage for the north-western part of the site, and becomes main river shortly before passing under the M4 Motorway. It flows on the north side of the River Loddon through the northern part of the site before its confluence a short distance downstream of the northern site boundary.

4.2.5 Finally, a number of interconnected main river channels lie at the south-western end of the site and provide land drainage from the Arborfield Cross and Arborfield areas. These are known as the **Arborfield Drain**, the **Arborfield Existing Line** and the **Arborfield Original Line**, that flow north-west in channels either side of the A327 Arborfield Road to outfall into the River Loddon at Bridge House.

4.2.6 The site topography ranges from 36.0m AOD to 72.0m AOD. The lowest levels denote the base of the Loddon Valley as defined by the dark green shading in the LiDAR plan in **Figure 4-3** (with the lowest elevation on the River Loddon channel at the downstream end of the study area). The highest elevation lies in the north-eastern extremity of the site, where the A327 Shinfield Road crosses over the M4 Motorway.

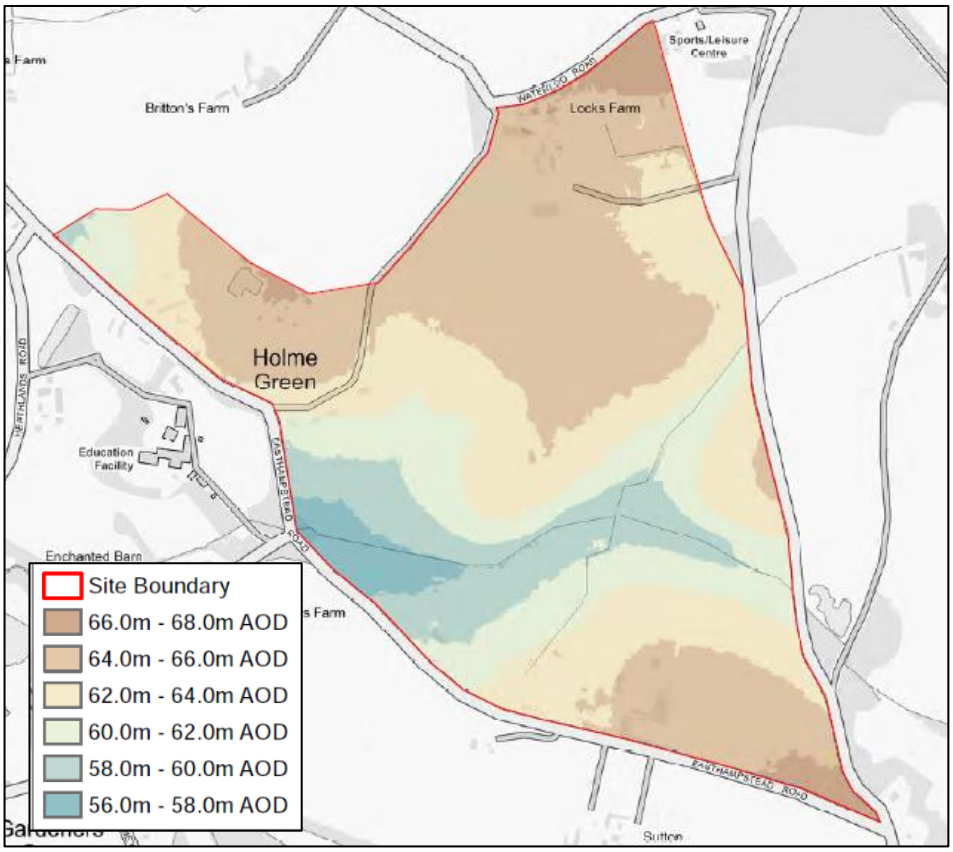
4.2.7 Further areas of elevated land lie to the east approaching Sindlesham, and to the south-east towards Arborfield. These two areas of high ground are bisected by the narrower river valley of the Barkham Brook.

South Wokingham SDL Extension

4.2.8 An 'ordinary watercourse' tributary of the Emm Brook flows west through the southern part of the study area, draining the Easthampstead Park area south-east of the study area.

4.2.9 The watercourse merges with another tributary south of Holme Green and continues north-west. It becomes the main river Emm Brook at Chapel Green, before continuing north through Wokingham

Figure 4-4: LiDAR Topographic Data – SDL Extension Site



4.2.10 A second land drainage channel flows south-west across the eastern part of the site to merge with the Emm Brook tributary within the site. This is formed by land drainage channels draining the Locks Farm area in the northern part of the site, and the fields to the east.

4.2.11 The LiDAR topographic data is displayed in **Figure 4-4** and illustrates the fall in elevation from 68.0m AOD along the northern boundary down to 56.0m AOD on the western boundary.

4.3 Water Quality

4.3.1 The EA Catchment Data Explorer web application is used to view catchment summaries and download data. Both sites lie within the 'River Loddon and Tributaries' operational catchment located here:

https://environment.data.gov.uk/catchment-planning/ManagementCatchment/3048

Figure 4-5: View north-east along River Loddon corridor within Hall Farm Study Area

4.3.2 The environmental condition, or status, of water bodies has been defined based on the second cycle of river basin management planning under the Water Framework Directive (WFD), covering the period from publication of the first cycle of plans in 2015 to 2021.

Table 4-1: Water Quality of Catchments

River Basin District	2019 Classification		Overall Status
	Ecological	Chemical	
Loddon (Swallowfield to River Thames confluence)	***Moderate***	***Fail***	***Moderate***
Barkham Brook	***Moderate***	***Fail***	***Moderate***
Emm Brook	***Moderate***	***Fail***	***Moderate***

4.3.3 The above identified a 'fail' for the specified reach of the River Loddon due to the presence of 'priority hazardous substances' of Polybrominated diphenyl ethers (PBDE) and Perfluorooctane sulphonate (PFOS). The river was otherwise recorded as 'good' for other chemical measures).

4.3.4 The Barkham Brook and Emm Brook catchments also failed due to presence of PBDE, and were otherwise rated as 'good' under chemical criteria.

4.4 Geology and Hydrogeology

4.4.1 The British Geological Survey (BGS) Geology of Britain Viewer identifies the geology of the study areas as follows:

Hall Farm

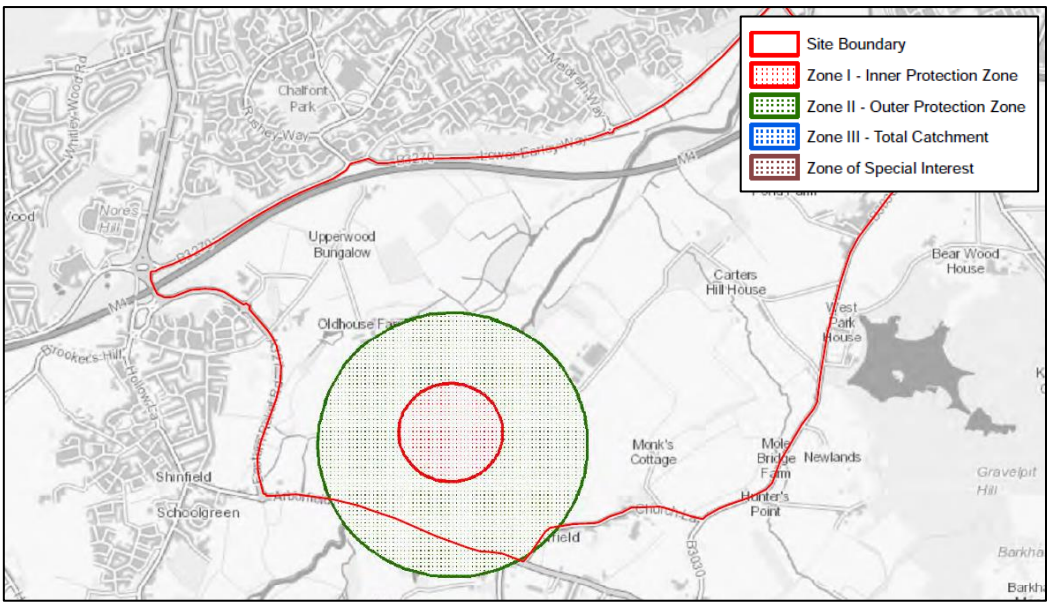
- **Bedrock** – 'London Clay Formation - Clay, Silt and Sand'.
- **Superficial deposits** –
  - 'Alluvium - Clay, Silt, Sand and Gravel' along River Loddon and Barkham Brook floodplain corridors;
  - 'Brickearth - Clay, Silt and Sand' and 'River Terrace Deposits, 2 - Sand and Gravel' over north side of Loddon floodplain;
  - 'River Terrace Deposits, 4 - Sand and Gravel' or no superficial deposits over the land south of the Loddon floodplain.

4.4.2 The bedrock is classed as an 'unproductive' aquifer, while the superficial deposits are 'Secondary A' aquifers – i.e. *"comprise permeable layers that can support local water supplies, and may form an important source of base flow to river".*

4.4.3 From consideration of the geomorphological and topographical setting of the site, it is expected that groundwater level will be broadly consistent with the typical River Loddon river level, with locally higher water levels may be present following periods of prolonged rainfall and elevated river levels.

4.4.4 Infiltration drainage is further constrained in part of the site by a groundwater source identified in the Hall Farm area, and a circular area of approximately 250m radius identifies the 'Inner Protection Zone' around this source (i.e. defined as the 50-day travel time from any point below the water table to the source). The 'Outer Protection Zone' (400-day travel time from a point below the water table) is a 600m radius area around the same point and the remainder of the site is outside the catchment – see **Figure 4-6**.

Figure 4-6: Groundwater Source Protection Zones – Hall Farm Study Area



South Wokingham SDL Extension

- **Bedrock** – 'London Clay Formation - Clay, Silt and Sand';
- **Superficial deposits** –
  - 'River Terrace Deposits, 4 - Sand and Gravel' lies over a central area of the site, with no superficial deposits over the land beyond this central area to the east and west of the site;
  - 'Alluvium - Clay, Silt, Sand and Gravel' along the south-western site boundary, with a wider corridor of 'Head - Clay, Silt, Sand and Gravel' along the watercourse on the southern boundary.

4.4.5 The bedrock is classed as an 'unproductive' aquifer, while the superficial deposits on the southern part of the site are 'Secondary A' or Secondary (undifferentiated) aquifers.

4.4.6 The above suggest that the bands of Alluvium through the centre of the site may be the most conducive to infiltration drainage measures than the higher ground to the north-west and south-east, but conversely the groundwater levels are likely to be closer to the surface within this area, potentially precluding such measures.

4.4.7 Infiltration drainage within the wider areas of Superficial Deposits may be feasible subject to site-specific testing and dependant on the depth of these deposits.

4.4.8 The site does not lie within an EA Groundwater Source Protection Zone.

5 Historic Flooding Records

5.1.1 Historic records of flooding across the Borough have been collated as part of the Level 1 SFRA. In addition, the EA historic flood maps for a range of events have been generated for the two study areas and are also referenced (maps provided in **Appendix A**).

5.2 South Wokingham SDL Extension

5.2.1 The historic flooding can be summarised as follows:

- The site is outside the EA historic flood extent and outside any recorded flood outlines;
- Historic maps in the WBC Level 1 SFRA (Appendix A.5) indicate no historic spot records of flooding at the site;
- The site is not within the WBC 'Recorded Flooding Heatmap', which is based on the recorded flooding form the severe surface water flood event of May 2018 (L1 SFRA Appendix A.12).

5.3 Hall Farm

5.3.1 The historic flooding can be summarised as follows:

- The EA historic flood extent extends south-west to north-east through the site, centred on the River Loddon and approximately replicating the Flood Zone 3 extent through the area (although no historic flood outline is associated with the Barkham Brook);
- There are areas of 'recorded flood outline' included flooding within the Loddon floodplain to the north and south of the site, but the central site area is excluded;
- Historic maps (1947 to 1990) in the WBC Level 1 SFRA (Appendix A.5) indicate extensive flooding through the site (consistent with the historic flood outline) based on the flood of 1990, but no flooding in the other identified flood events (1947, 1968, 1971, 1977, 1981);
- Recent flooding records (1991 to 2019) in the SFRA indicate flooding across the site, approximately corresponding with Flood Zone 3, in the years 1991, 2007 and post-2009. Additional flooding has been recorded but the scale and overlay of events makes this difficult to establish.
- The majority of the site is outside the WBC 'Recorded Flooding Heatmap' (L1 SFRA Appendix A.12). The only area shown in the moderate flood risk area (light blue) on the map is centred on Arborfield in the south-western part of the site, where highway flooding occurred during the specified event.

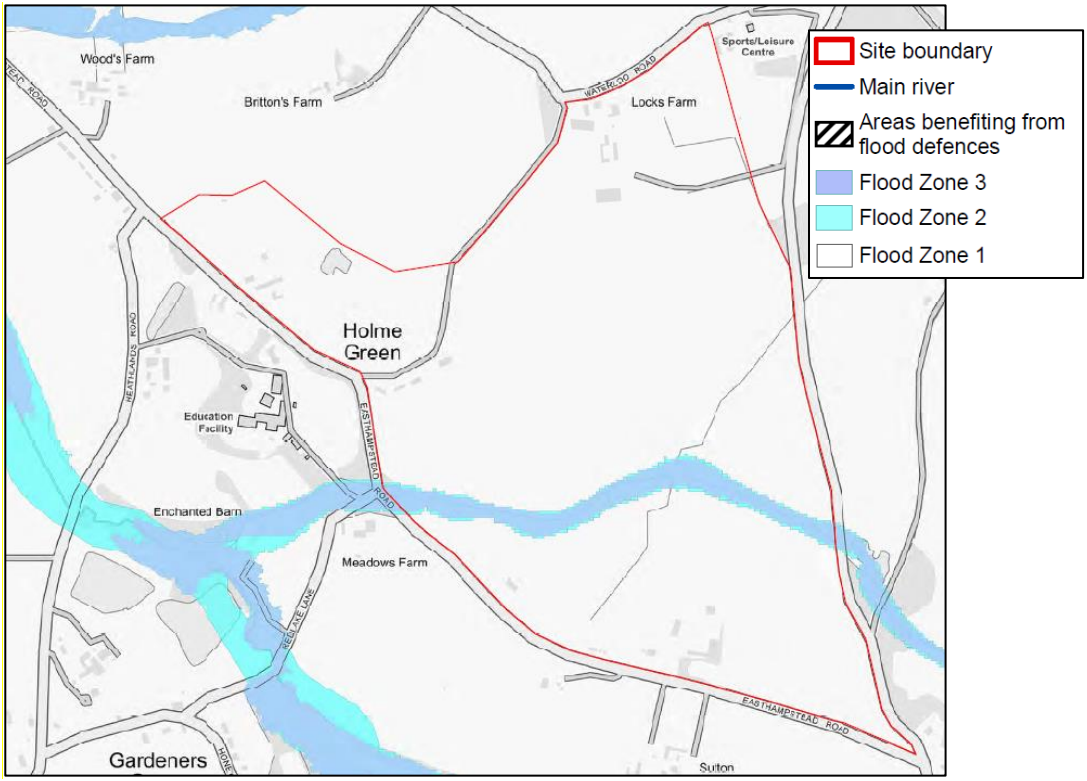
5.3.2 It is important to note that the accuracy of historic mapping is largely dependent on the frequency of flooding, and critically whether the site is in an area with sensitive receptors to flooding (i.e. a watercourse through a highly urbanised area is more likely to have an accurate record of flooding as flooding would have a greater potential impact on the local community than in a sparsely inhabited rural area). In the case of Hall Farm, it is clear that the central River Loddon floodplain impacts parts of the site on a frequent basis and the more recent records corroborate this approximate flood extent. Flood extents of earlier events are likely to have overlooked such impacts due to the relative low sensitivity of what is largely agricultural land along a river corridor.

6 Flood Risk Overview - South Wokingham SDL Extension

6.1 Flood Zone

6.1.1 The first phase in identifying whether a site is potentially at risk of flooding is to consult the Flood Zone maps. This provides an initial indication of the extent of the Flood Zones, which is refined through the use of more detailed site-specific level survey and modelled flood levels.

Figure 6-1: EA Flood Zone Map – SDL Extension



6.1.2 **Figure 6-1** confirms that the site is almost all within Flood Zone 1 'Low Probability', with the only areas of Flood Zone 2 and 3 along the southern boundary of the site, associated with an upper catchment tributary of the Emm Brook (discussed in **Section 4.2**).

6.1.3 The EA has confirmed this channel – an ordinary watercourse – has not been subject to detailed hydraulic modelling and the resulting Flood Zones are therefore based on the coarse national-scale modelling. As noted in the WBC L1 SFRA, in the absence of detailed hydraulic modelling "a precautionary approach should be applied, assuming that the extent of Flood Zone 3b 'Functional Floodplain' is the equivalent of Flood Zone 3a 'High Probability' until the 1 in 20 annual probability extent is adequately demonstrated through detailed modelling as part of a site-specific FRA.

6.2 Surface Water

6.2.1 The EA 'Flood Map for Surface Water' ('FMfSW') shows where areas could be potentially susceptible to surface water flooding in an extreme rainfall event. The latest mapping assesses flooding resulting from severe rainfall events based on the following three scenarios:

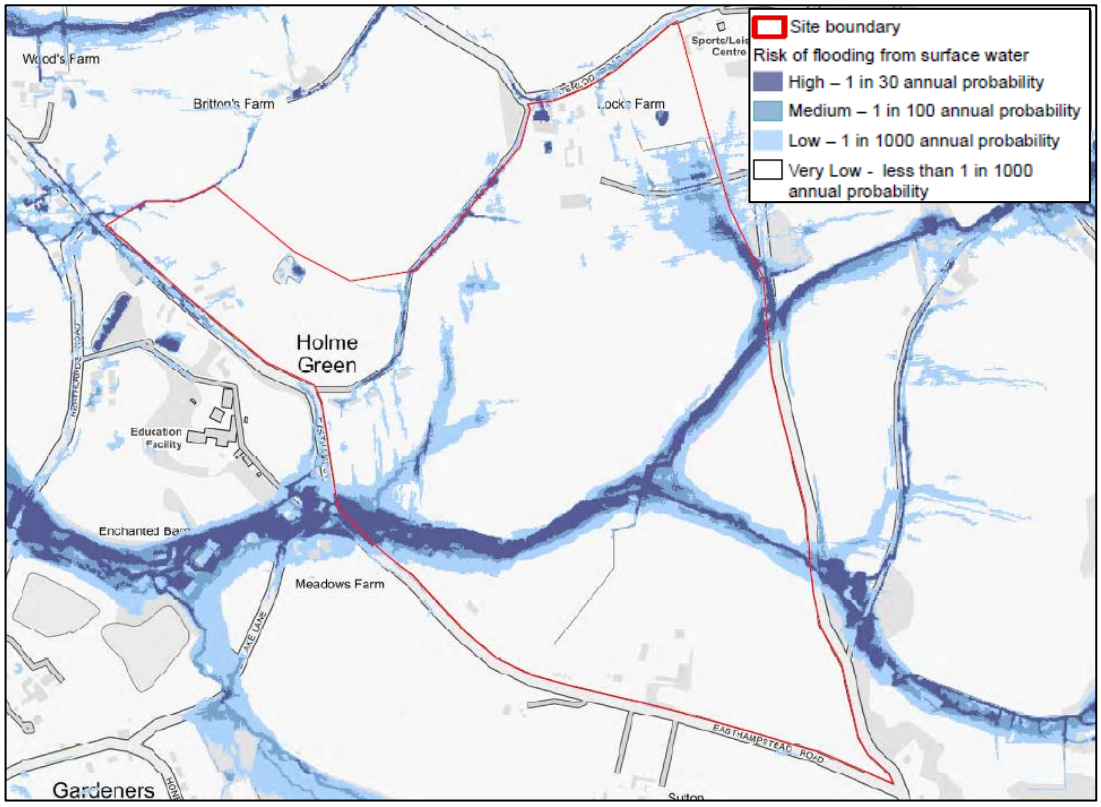
- 1 in 30 (3.3%) annual probability rainfall event ('High' risk);
- 1 in 100 (1%) annual probability rainfall event ('Medium' risk);
- 1 in 1000 (0.1%) annual probability rainfall event ('Low' risk).

6.2.2 Land at lower than 1 in 1000 (0.1%) annual probability of flooding is considered to be 'Very Low' risk of flooding.

6.2.3 The surface water map for the site highlights the flow path of the Emm Brook tributary on the southern site boundary, and is likely to be a more accurate reflection of the fluvial flood risk from this source than the coarse national scale Flood Zone maps for the area.

6.2.4 More significantly, the surface water flood maps identify a secondary drainage channel which flows south-west across the south-eastern corner of the site. This channel provides drainage for an upstream catchment east of the site, and as such it will be necessary to ensure any future development maintains this flow corridor.

Figure 6-2: EA Flood Map for Surface Water – SDL Extension



6.2.5 The flood map also identifies some isolated areas of 'Low' and 'Medium' flood risk over the site which are likely a sign of localised depressions or undulating ground.

6.3 Groundwater

6.3.1 The 'Depth to Groundwater' Map in the Level 1 SFRA indicates the site is at 'Low Risk' of groundwater flooding (more than 5m depth of groundwater from ground surface).

6.3.2 This is inconsistent with the 'BSG Susceptibility to Groundwater Flooding' map in the Level 1 SFRA, which suggests that the area along the Emm Brook Tributary is defined as 'prone to groundwater flooding' which is to be expected.

6.3.3 The differences between the two outputs above illustrate that there is no agreed national scale approach to modelling groundwater flood risk at the current time, and all the referenced mapping reiterates that they are a screening tool to identify areas 'potentially susceptible' to such flooding based on underlying ground conditions. As such, the emphasis is on obtaining site-specific information through intrusive investigations at the appropriate stage of work to accurately determine the groundwater conditions, so that development can be designed accordingly.

6.4 Flood Risk from Artificial Sources – Reservoirs, Sewers

6.4.1 The available online mapping indicates the site is not affected in the breach of any local reservoir.

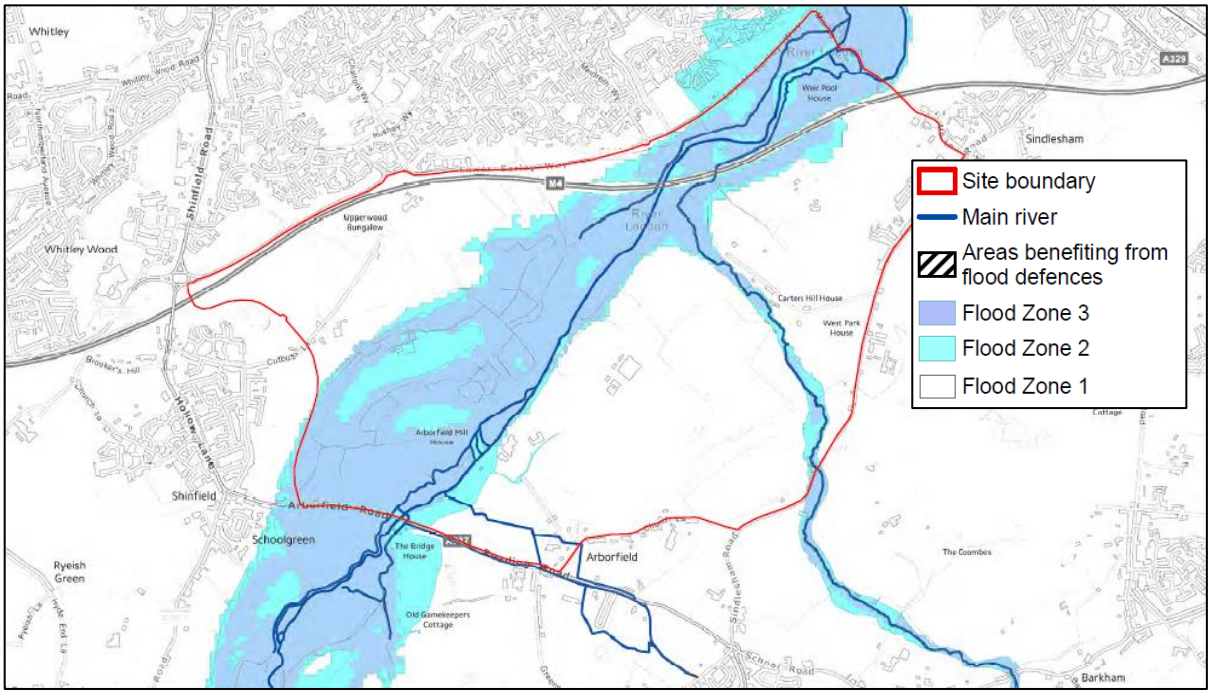
6.4.2 No information was available in relation to sewer flooding. However, as the site is largely undeveloped agricultural land it is unlikely that there would be any such records within the study area.

7 Flood Risk Overview - Hall Farm

7.1 Flood Zone

7.1.1 The River Loddon is the predominant feature through the Hall Farm site, flowing diagonally through the area south-west to north-east and with an expansive floodplain denoted by the Flood Zone 2 'Medium Probability' and Flood Zone 3 'High Probability' across the low lying agricultural land primarily on the north side of the main channel – see **Figure 7-1.**

Figure 7-1: EA Flood Zone Map – Hall Farm



7.1.2 The Barkham Brook enters the site from the south-east side, with a much narrower and relatively uniform corridor of Flood Zone 2 and 3. As it flows north-west towards the River Loddon, the Flood Zone extents merge, and after passing under the M4 Motorway the extent of Flood Zones 2 and 3 is combination of both watercourses.

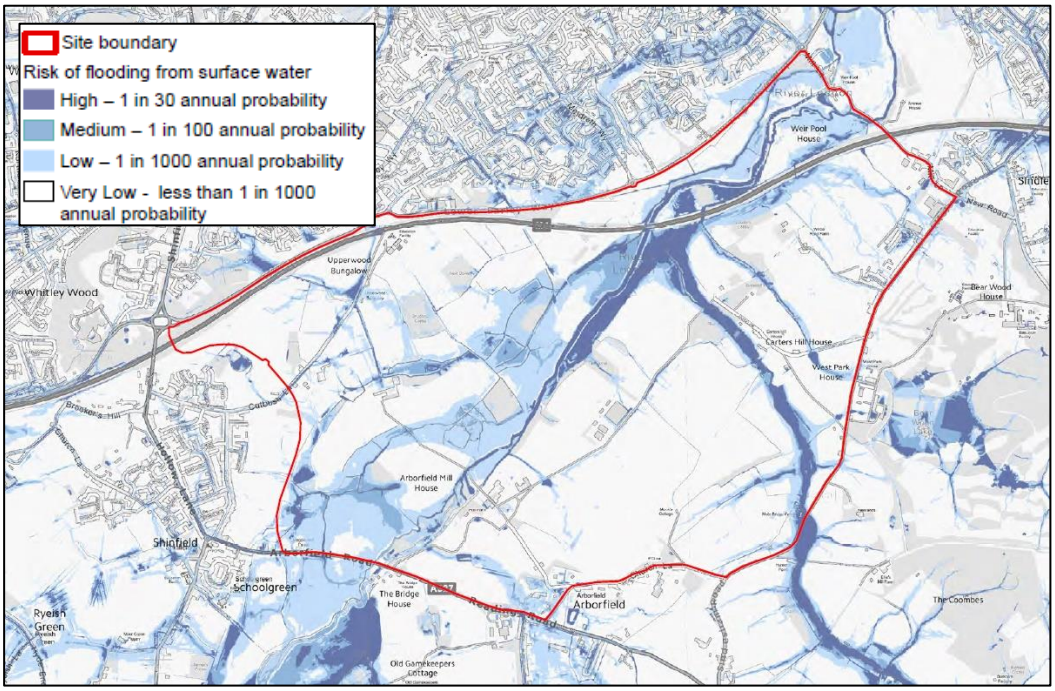
7.1.3 The Marsh Farm Ditch, between Lower early Way and the M4 Motorway, is also consumed as part of the Flood Zones 2 and 3 of the River Loddon.

7.1.4 In the south-eastern corner of the site is another tributary of the River Loddon flowing from Arborfield Cross. The Flood Zone map denoted the multiple main river channels but there is no wider Flood Zone associated with the watercourse.

7.2 Surface Water

7.2.1 The Flood Map for Surface Water over the Hall Farm site follows a similar pattern to the Flood Zone extents, with the pattern of flood risk concentrated along the established river corridors through the site, but it does also highlight the complex network of land drainage channels over the area, particularly across the low lying ground on the north side of the River Loddon – see **Figure 7-2.**

Figure 7-2: EA Flood Map for Surface Water – Hall Farm



7.3 Groundwater

7.3.1 The 'Depth to Groundwater' Map in the Level 1 SFRA indicates the site is at 'Low Risk' of groundwater flooding (more than 5m depth of groundwater from ground surface).

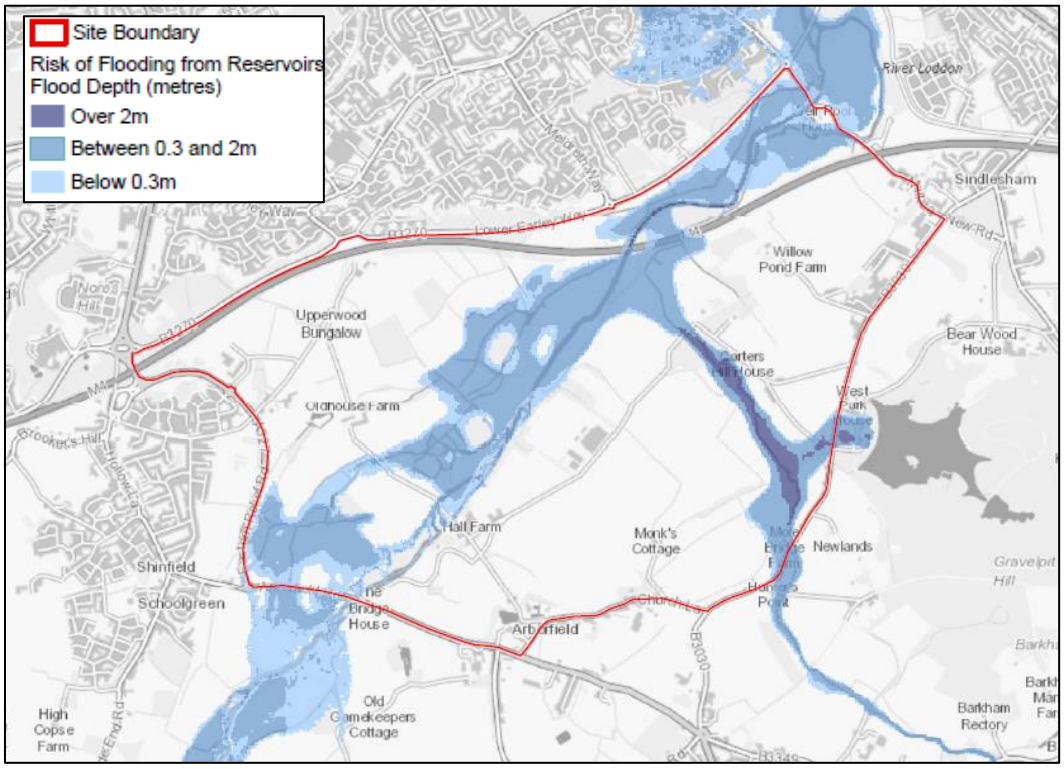
7.3.2 This is inconsistent with the 'BSG Susceptibility to Groundwater Flooding' map in the Level 1 SFRA, which suggests that the area centred on the River Loddon is defined as 'prone to groundwater flooding, with areas of more elevated land to the north-west and south-east at 'limited potential' for groundwater flooding.

7.3.3 The differences between the two outputs above illustrate that there is no agreed national scale approach to modelling groundwater flood risk at the current time, and all the referenced mapping reiterates that they are a screening tool to identify areas 'potentially susceptible' to such flooding based on underlying ground conditions. As such, the emphasis is on obtaining site-specific information through intrusive investigations at the appropriate stage of work to accurately determine the groundwater conditions, so that development can be designed accordingly.

7.4 Flood Risk from Artificial Sources

7.4.1 Bearwood Lake is an earth dam reservoir with a surface area of 190,000m^2 which lies a short distance (a minimum of 150m) beyond the eastern boundary of the study area.

Figure 7-3: Reservoir Flood Map



7.4.2 The reservoir flood map in **Figure 7-3** indicates that in a breach of the embankment, flooding would discharge west from the reservoir, spilling over Mole Road and routing into the river corridor of the Barkham Brook. The area of flooding would be of similar extent to an extreme fluvial flood event on the Barkham Brook, with increased severity in the immediate vicinity of the reservoir.

7.4.3 Flooding is also shown through the River Loddon floodplain corridor as a result of reservoir breach. Again, the extent is similar to the fluvial floodplain (marginally smaller than Flood Zone 3), and it is not clear if this is a result of the Bearwood Lake breach, or resulting from potential reservoir breach of the lake at Wellington Country Park, on the Blackwater River – a tributary of the River Loddon, south of Swallowfield.

7.4.4 The risk of failure of the embankment dam, resulting in a breach, can never be reduced to zero but can be reduced to an acceptable minimal level through effective maintenance and through acting on the recommendations of the Reservoir Panel Engineer's inspections, required in order to comply with Section 10 of the Reservoirs Act 1975 (which requires an inspection by an 'Inspecting Engineer' at intervals not exceeding ten years). In the intervening period it is the responsibility of the appointed Supervising Engineer to ensure that the recommendations of the Inspecting Engineer are being undertaken by the undertaker.

7.4.5 The last inspection took place in 2015, and works are currently being undertaken to reduce the risk of a dam breach further in line with recommendations.

7.4.6 The undertaker – identified in the L1 SFRA as 'The Royal Merchant Navy School Foundation' – has responsibility for the maintenance of the reservoir under the Reservoirs Act.

7.4.7 Whilst the consequences of a reservoir breach could be severe, the probability of such an occurrence is considered to be very low.

7.4.8 No information was available in relation to sewer flooding. However, as the site is largely undeveloped agricultural land it is unlikely that there would be any such records within the study area.

8 Flood Risk Management - Design

8.1 Sequential Approach

8.1.1 The NPPF encourages the application of the 'sequential approach' in the master-planning process for new development, i.e. locating the more sensitive/vulnerable elements of new development in the areas which lie at lowest probability of flooding and, conversely, reserve the areas of the site at greatest risk of flooding for the least vulnerable elements of the development (or, preferably, leave such areas undeveloped or as soft landscaping).

8.1.2 In simple terms, this will mean ensuring that proposed development is limited to land ideally in Flood Zone 1, but critically outside the reference 1 in 100 annual probability plus allowance for climate change floodplain.

8.1.3 The recently updated (July 2021) EA climate change guidance confirms the following (see **Section 3.3** and **Table 3-1**):

- the **Central** allowance for peak river flow should be used for the majority of proposed uses – i.e. the 1 in 100 annual probability +14% allowance for climate change event);
- the **Higher Central** allowance should be used for development which includes essential infrastructure – i.e. the 1 in 100 annual probability +23% allowance for climate change event).

8.1.4 The Hall Farm area is significantly affected by the River Loddon floodplain, which is a key factor in the masterplanning for the site. While the main aspects of development will be located outside the floodplain, it is reasonable for 'water compatible' development to be included within this area – such uses include '*amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.'*

8.1.5 The sequential approach should also consider other sources of flood risk to minimise residual risk to new development. In this case, the flood risk from surface water is the other primary issue and the relevant EA mapping should be considered (although it is noted that some elements of this will be refined as part of any site-specific surface water drainage strategy).

8.1.6 The key issue is to consider the practicality of such uses in areas liable to flood – for example, the main corridor of River Loddon floodplain is impacted by events as frequent as the 1 in 5 annual probability flood and therefore uses within this area would be affected for a potentially prolonged period on a relatively frequent basis.

8.1.7 The South Wokingham SDL Extension site is shown as mainly Flood Zone 1 'Low Probability', but detailed modelling of the adjacent Emm Brook tributary will be required to refine the extent of Flood Zone 2 and 3 over the site (in the absence of such modelling, the EA surface water flood maps should be used to inform this approach – see **Figure 6-2**).

8.2 Building Design

8.2.1 Standard requirements for ground floor levels of new development are set out in BS8533:2017 'Assessing and Managing Flood Risk in New Development – Code of Practice'.

8.2.2 This recommends floor levels are set a minimum of 300mm above the modelled 1 in 100 annual probability plus allowance for climate change flood level, typically based on the Central allowance scenario.

8.2.3 The floor level requirements based on the new climate change allowances should be considered on a site-by-site basis, but the generally accepted approach is to use the lower end of the

specified range of climate change allowances as a baseline for mitigation requirements, and the higher end as a sensitivity test, to consider residual risk and inform freeboard requirements

8.2.4 Where relevant, building floor levels should be an appropriate freeboard above (i) the predicted 1 in 100 (1%) annual probability surface water flood level, and (iii) the maximum anticipated groundwater flood level.

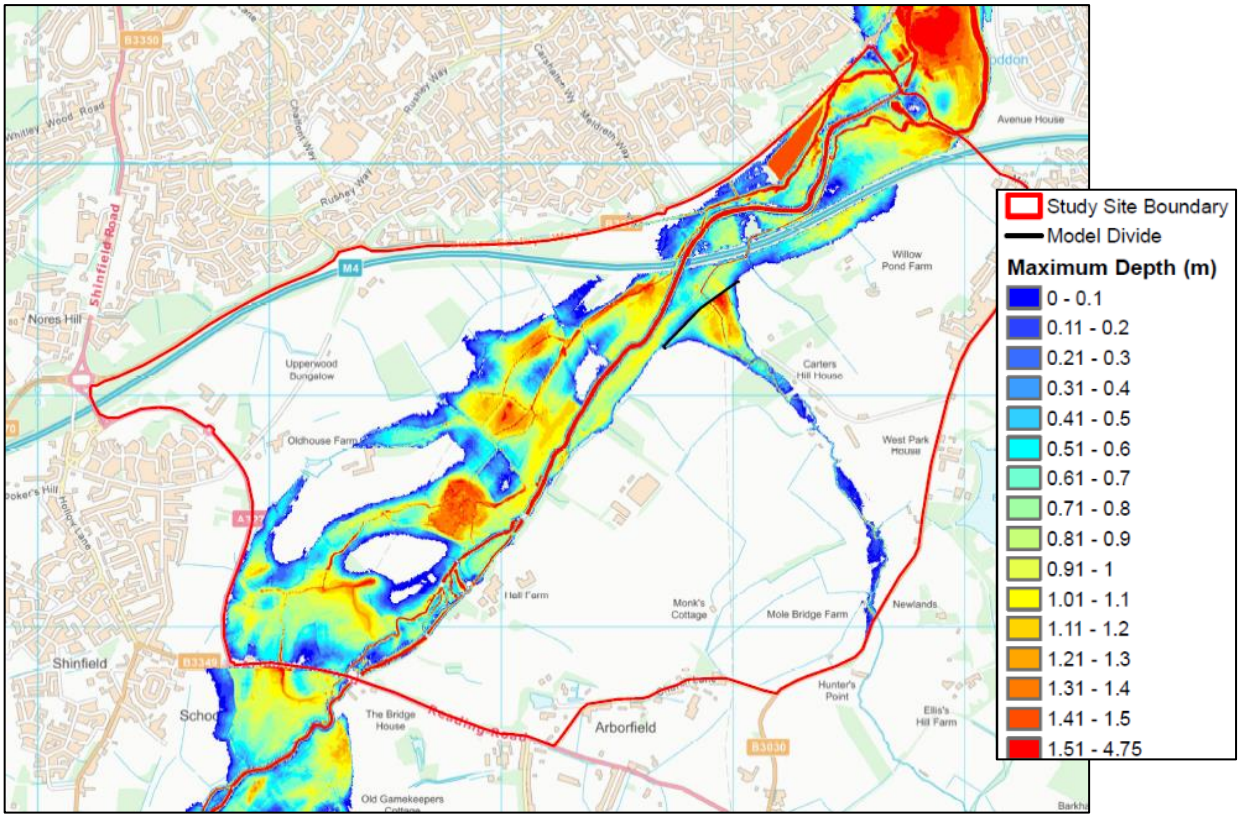
8.2.5 It is also recommended that ground floor levels are set a suitable freeboard above surrounding ground (minimum 150mm) to mitigate the residual flood risk associated with excess surface water runoff in an extreme rainfall event. Similarly, exterior ground levels across any development should be appropriately contoured to direct surface water away from buildings in such a scenario.

8.3 Floodplain Storage Analysis

8.3.1 Any new development located in the vicinity of a watercourse should be constructed such that it does not detrimentally impact on flow routes or reduce the available floodplain storage over a site; either of which could potentially cause an increase in flood levels on-site or elsewhere.

8.3.2 The latest EA climate change allowances guidance (dated July 2021) indicates that this is considered on a 'level-for-level' basis up to the benchmark of the 1 in 100 annual probability flood event +14% allowance for climate change (Central allowance), rising to +23% (Higher Central) where essential infrastructure is proposed as part of any scheme (see **Figure 8-1**).

Figure 8-1: 1 in 100 Annual Probability +23% Climate Change Floodplain – Hall Farm



8.3.3 Where a development site encroaches within the modelled 1 in 100 (1%) annual probability plus allowance for climate change floodplain, a floodplain storage analysis should be undertaken as part of any site-specific FRA to compare the floodplain capacity pre- and post- development, demonstrating no detrimental impact and ideally an improvement over the existing situation.

8.3.4 This is normally undertaken on a 'level-for-level' basis considering the impacts in (typically) 100mm to 200mm depth level bands, to ensure the characteristics of the floodplain are mimicked at all stages of the hydrograph, up to the reference modelled 1 in 100 (1%) annual probability plus allowance for climate change flood level.

8.3.5 In some more complex circumstances, such as larger scale development with any interaction with watercourses, it may be necessary to demonstrate the impacts of a scheme through hydraulic modelling to demonstrate no detriment, and ideally a betterment as a result of the proposals.

8.3.6 Floodplain 'compensation' for any new development should ideally be provided through ground lowering across the site and removal of non-floodable building footprints/structures. Where it is not possible to provide floodplain compensation through the above measures, then it may be acceptable to mitigate the loss of floodplain storage through incorporation of floodable elements at ground level of new development– e.g. open floodable undercrofts or floodable voids. Incorporation of such measures should be discussed with WBC and – if considered acceptable – may require a planning condition to be imposed to ensure (i) the voids remain open in perpetuity, (ii) the capacity of the void space is not compromised and (iii) a maintenance plan is submitted to demonstrate the void will remain functional for the lifetime of the development.

8.3.7 Since a large proportion of the Hall Farm site lies within the River Loddon floodplain it would be inappropriate to locate any significant built development within this area, and it provides an opportunity for significant ground lowering along the river corridor which could serve to provide additional floodplain storage capacity – at least in lower order scenarios – as well as serving to provide enhancements to the river environment through the creation of new habitat, as either wetlands or backwaters off the main channel(s).

8.4 Conservation of Flow Routes

8.4.1 Any new development located in the vicinity of a watercourse should be constructed such that it does not detrimentally impact on flow routes over a site; which could potentially cause an increase in flood levels elsewhere through backing up or diversion of flood flows.

8.4.2 While flood compensation measures would typically address any potential impacts of development on floodplain volume within the site, this does not necessarily take into account the impacts on flood risk if a surface water flow route exists through the site.

8.4.3 Blockage or constriction of such a flow route by development could potentially have a more significant cumulative effect than impacts on floodplain storage capacity. As such, development should carefully consider the presence of any flood routing through the site and ensure such routes – and their capacity - are allowed for to ensure no detrimental impact to third parties either upstream or downstream of the site.

8.4.4 The EA Surface Water Flood Map identifies further flow routes across the South Wokingham SDL Extension site that are not obvious from the Flood Zone maps. The HHFV site also have a n extensive network of ordinary watercourses to provide a land drainage function – within and outside the larger fluvial floodplain – and any development will need to ensure these are maintained and conserved as part of the surface water drainage arrangements in accordance with local policy requirements.

8.4.5 As such, these require appropriate consideration in the masterplanning process so such flow corridors are maintained.

8.5 Safe Access and Road/Bridge Crossings

8.5.1 It is necessary to consider and incorporate safe access arrangements as part of the mitigation strategy, to ensure all future occupants and users of any new development are safe in times of flooding.

8.5.2 The preferred approach advocated by WBC (as the relevant authority responsible for safe access/egress) is to seek a safe access route at the peak of the reference 1 in 100 annual probability plus allowance for climate change flood event.

8.5.3 Consideration of the safety of any pedestrian route is based on the guidance in the EA document '*Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1*'. While the preference is for a 'dry' safe access route, this document confirms that, in slow moving floodwater, it is possible to demonstrate a 'safe' route provided the maximum flood depth does not exceed 250mm (i.e. 'very low hazard' definition).

8.5.4 Future pedestrian or vehicular bridges over the subject sites would need to fully consider and mitigate the impacts on floodplain storage and flow routes.

- On the Hall Farm site any crossing over the Loddon floodplain would have a significant impact on conveyance, although the overall impact may be less than anticipated, since an existing barrier to flow exists already in the form of the M4 Motorway embankment. Any new bridging structure would need to minimise its effective footprint within the floodplain through effective design and the incorporation of flood arches across the floodplain (as well as a clear span over any main river channels).

- The SDL Extension site is less constrained, but any bridging structures impacting the flow routes identified on the EA Surface Water Flood Map would similarly need to be open span and incorporate appropriate mitigation.

8.5.5 Any bridges would need to be tested through detailed hydraulic modelling to the reference climate change scenarios.

8.6 Buffers and Flood Risk Activity Permit Requirements

8.6.1 Proposed works in, over, under or near a main river or a flood defence require a 'Flood Risk Activity Permit' (FRAP) application to be made to the EA (this replaced the previous 'Flood Defence Consent' (FDC) procedure). This is required to demonstrate any new development does not have a detrimental impact on flood risk, either through impacting the integrity of the existing defence or through preventing maintenance access to the defence.

8.6.2 Specifically, the EA requires a FRAP to be completed for any works that occur within the 8m buffer zone of an EA Main River.

8.6.3 The main river watercourses of the River Loddon, the Barkham Brook and the Marsh Farm Ditch flow through the Hall Farm site and are therefore subject to the FRAP requirements.

8.6.4 There are no main river watercourses in the vicinity of the South Wokingham SDL Extension site, although the Emm Brook tributary and other ordinary watercourses through the site serve an important land drainage function to drain the upstream catchments east of the site, so should ensure that these flow corridors are not detrimentally affected by future development

8.6.5 A FRAP or exemption is still a requirement for temporary activities (e.g. construction, demolition and some types of survey), for small structures, and for the removal of existing structures (i.e. the removal of the northern boundary wall and associated landscaping works). It is therefore

essential that FRAP requirements are reviewed as necessary before any works begin in this area.

8.6.6 Outside the specific FRAP requirements, the provision of naturalised buffers along main river corridors are important in serving as an ecological buffer to the river corridor and the EA have recently advised that they would seek a minimum 10m buffer offset from main rivers for such a purpose. As noted in **Section 8.3**, the provision of a significant buffer provides a range of opportunities to greatly enhance the river corridor environment, particularly where the existing boundary is often abutted by agricultural land utilised for arable use (see right hand side of **Figure 8-2**).

Figure 8-2: River Loddon, near Arborfield Mill House

8.6.7 Under the Flood and Water Management Act 2010, the responsibility for issuing and enforcing land drainage consents on ordinary watercourses (streams and ditches both natural and manmade and culverts etc), under sections 23 and 24 of the Land Drainage Act 1991, lies with WBC (as the lead local flood authority). The thrust of local planning policy is to seek to retain (and enhance, where appropriate) these watercourses, and the with WBC typically seeking an 8m offset buffer/offset (within which zone land drainage consent is required from the Council).

9 Surface Water Management

9.1 What are SuDS?

9.1.1 The NPPF recognises that flood risk and other environmental damage can be managed by minimising changes in the volume and rate of surface runoff from development sites. It recommends that priority is given to the use of Sustainable Drainage Systems (SuDS) in new development, this being complementary to the control of development within the floodplain.

9.1.2 SuDS aim to (i) control surface water close to its source, (ii) replicate, as closely as possible, the natural (pre-development) drainage regime of a site, whilst (iii) minimising the transfer of pollution to receiving waters.

9.1.3 There are a number of overarching policy guidance documents and other sources of information relating to surface water management that set out the key requirements, approach and design criteria for the management of surface water. These should be consulted at an early stage to ensure any new development meets current requirements in this regard:

- **'The SuDS Manual'** (CIRIA document reference C753, updated 2015);
- **'Sustainable Drainage Systems - Non statutory technical standards for sustainable drainage systems'** (DEFRA, March 2015);
- '**Flood Risk Assessments: Climate Change Allowances'** (EA, July 2021 – see **Section 3.3**)
- **CIRIA sustainable drainage website http://www.susdrain.org/ ;**
- **Wokingham SuDS Strategy – Guidance on the use of sustainable drainage systems (2016)**

9.1.4 The SuDS Manual states the following in relation to SuDS:

> ***Sustainable Drainage Systems (SuDS) are designed to maximise the opportunities and benefits we can secure from surface water management.***
>
> ***There are four main categories of benefits that can be achieved by SuDS: water quantity, water quality, amenity and biodiversity. These are referred to as the four pillars of SuDS design.***
>
> ***SuDS can take many forms, both above and below ground. Some types of SuDS include planting, others include proprietary/manufactured products. In general terms, SuDS that are designed to manage and use rainfall close to where it falls, on the surface and incorporating vegetation, tend to provide the greatest benefits. Most SuDS schemes use a combination of SuDS components to achieve the overall design objective s for the site.***

9.2 SuDS Requirements for New Development

9.2.1 As of April 2015, the Lead Local Flood Authority (LLFA) has become the statutory consultee for surface water management on planning applications for 'major development'. As the LLFA, WBC are therefore responsible for the approval of surface water drainage systems within such development.

9.2.2 Major development consists of any of the following:

- The provision of dwelling houses where residential development of 10 or more units; or where the development is to be carried out on a site having an area of 0.5 hectares or more and the number of units is not known;
- The provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more; or,
- Development carried out on a site having an area of 1 hectare or more.

9.3 Suitability of SuDS Measures

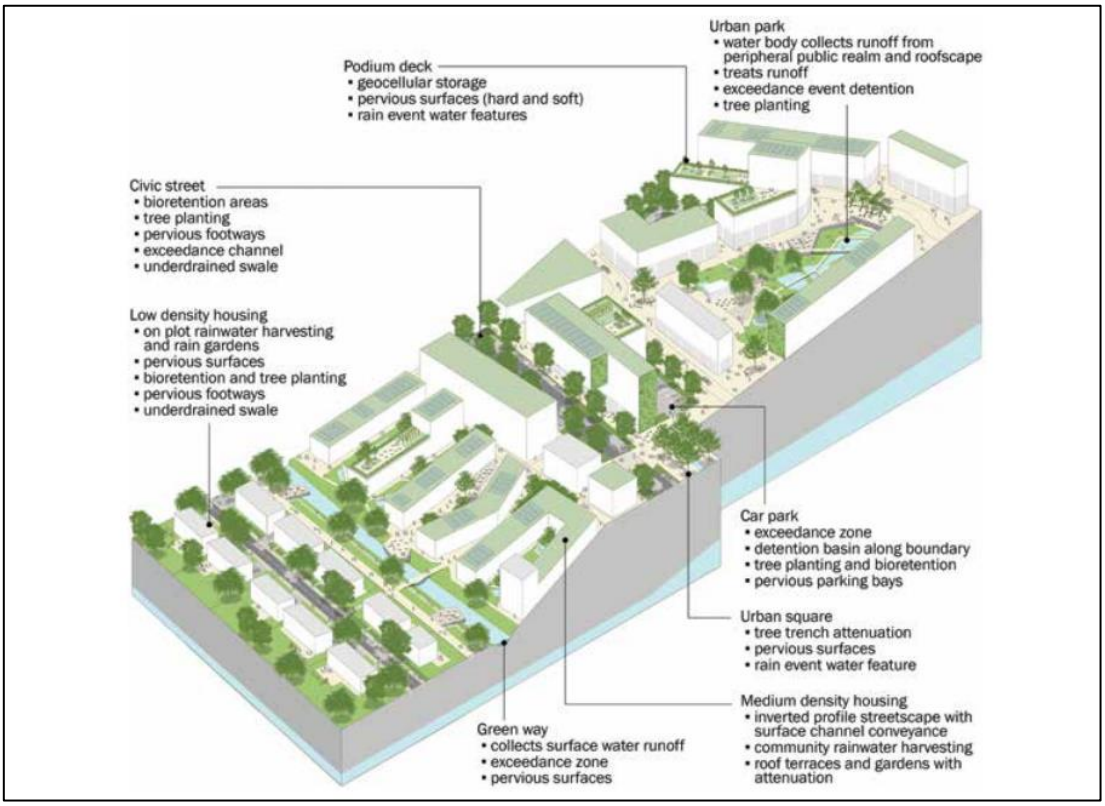
9.3.1 As the intention of SuDS is to mimic the natural drainage regime of the undeveloped site, the NPPF PPG states the following (consistent with the Building Regulations H3 hierarchy):

> ***...the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:***
>
> ***- into the ground (infiltration),***
>
> ***- to a surface water body,***
>
> ***- to a surface water sewer, highway drain or another drainage system,***
>
> ***- to a combined sewer***

9.3.2 The feasibility of infiltration should be the initial consideration for disposal of surface water, which is dependent on the ground conditions underlying the site – see **Section 4.4.** The published geology of both study areas suggests infiltration drainage may be suitable, at least to some degree within areas where Superficial Deposits are identified, but this would be subject to further investigation of the ground conditions (i.e. soil permeability, groundwater levels etc.).

9.3.3 The SuDS Manual should be consulted during the evolution of a surface water drainage strategy for a new development, as this provides extensive guidance on the range of SuDS measures appropriate for all situations. **Figure 9-1** shows an extract from the SuDS Manual illustrating the range of measures commonly used in different development types.

Figure 9-1: Examples of SuDS for Different Development Types (SuDS Manual Fig. 1.6)



9.3.4 Detailed guidance on the suitability and form of SuDS measures is provided in the WBC 'Wokingham SuDS Strategy – Guidance on the use of sustainable drainage systems' document.

9.3.5 **Table 9.1** shows how different forms of SuDS contribute to the key pillars of water quantity, water quality, amenity and biodiversity.

Table 9.1: SuDS Manual Table 7.1 'SuDS component delivery of design criteria'

Component type	Description	Collection mechanism	Design criteria						Further information (Chapter ref)
			Water quantity (Chapter 3)			Water quality (Chapter 4)	Amenity (Chapter 5)	Biodiversity (Chapter 6)	
			Peak runoff rate	Runoff volumes: Small events (Interceptions)	Runoff volumes: Large events				
Rainwater harvesting systems	Systems that collect runoff from the roof of a building or other paved surface for use	P		●	●		●		11
Green roofs	Planted soil layers on the roof of buildings that slow and store runoff	S	○	●		●	●	●	12
Infiltration systems	Systems that collect and store runoff, allowing it to infiltrate into the ground	P	●	●	●	●	●	●	13
Proprietary treatment systems	Subsurface structures designed to provide treatment of runoff	P				●			14
Filter strips	Grass strips that promote sedimentation and filtration as runoff is conveyed over the surface	L		●		●	○	○	15
Filter drains	Shallow stone-filled trenches that provide attenuation, conveyance and treatment of runoff	L	●	○		●	○	○	16
Swales	Vegetated channels (sometimes planted) used to convey and treat runoff	L	●	●	●	●	●	●	17
Bioretention systems	Shallow landscaped depressions that allow runoff to pond temporarily on the surface, before filtering through vegetation and underlying soils	P	●	●	●	●	●	●	18
Trees	Trees within soil-filled tree pits, tree planters or structural soils used to collect, store and treat runoff	P	●	●		●	●	●	19
Pervious pavements	Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/or allowed to infiltrate into the ground below	S	●	●	●	●	○	○	20
Attenuation storage tanks	Large, below-ground voided spaces used to temporarily store runoff before infiltration, controlled release or use	P	●						21
Detention basins	Vegetated depressions that store and treat runoff	P	●	●		●	●	●	22
Ponds and wetlands	Permanent pools of water used to facilitate treatment of runoff – runoff can also be stored in an attenuation zone above the pool	P	●			●	●	●	23

Key

P – Point, L – Lateral, S – Surface, ● – Likely valuable contribution to delivery of design criterion, ○ – Some potential contribution to delivery of design criterion, if specifically included in the design

9.3.6 The recently constructed Shinfield Relief Road, which defines the eastern boundary of the LFFV site, utilises a number of SuDS measures to positive effect, and **Figure 9-2** shows examples of these.

Figure 9-2: Examples of SuDS along Shinfield Relief Road (Swale (left) and Wetland Basin (right))

9.4 Design Criteria

9.4.1 Surface water drainage systems for new development should be designed in accordance with the principles of the NPPF, i.e. the occupants/users of the new development are safe from flooding, and the development does not increase (and ideally decreases) flood risk elsewhere.

9.4.2 To avoid compromising the functionality and capacity of SuDS attenuation features such as detention basins or ponds, these should be located outside the fluvial 1 in 100 annual probability plus allowance for climate change floodplain. The new EA climate change allowances for fluvial flooding could have implications on where they are located, and careful consideration is required when locating such measures over a development site and in ensuring there is sufficient space over the site if fluvial flood risk is also a key design constraint.

9.4.3 The key design criteria for aspects of the surface water drainage system are detailed in the DEFRA 'Non statutory technical standards for sustainable drainage systems' and can be summarised in **Table 9.2.**

Table 9.2: Drainage Design Criteria from DEFRA Non-Statutory Technical Standards

Criteria	*Greenfield site*	*Previously developed site*
Peak Flow Control	**[S2]** Peak runoff rate for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.	**[S3]** Peak runoff rate for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment
Volume Control*	**[S4]** Where reasonably practicable, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.	**[S5]** Where reasonably practicable, the runoff volume from the development in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.
Design Criteria	**[S7]** The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.	
	[S8] The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.	
	[S9] The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.	

***[S6]** Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with **S4** or **S5** above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.*

9.5 Designing for Exceedance

9.5.1 In accordance with Design Standard S7 above, the piped system should be designed to accommodate runoff during storm events up to the 1 in 30 year event.

9.5.2 To ensure that in an exceedance event any flooding does not affect properties or discharge from the development, flows up to the 1 in 100 year plus allowance for climate change rainfall event should be managed on site. This may be achieved by ensuring that site levels are designed to direct flows away from the buildings and towards areas such as car parking or formal landscaping where temporarily shallow flooding can occur, or through the provision of additional storage within the drainage system.

9.5.3 The EA 'Flood risk assessments: climate change allowances' guidance (see **Section 3.3**) provides guidance on the recommended climate change allowances for peak rainfall intensity and should be referred to when a drainage strategy is development. This identifies a range of +20% to +40% for consideration, based on an approximate 100-year design life.

9.6 Adoption and Maintenance Considerations

9.6.1 Long term management of surface water drainage assets, including any SuDS components, is essential to ensure they continue to function to their design standard. As such, there should be consideration of the management and maintenance requirements in order to ensure any systems continue to work effectively.

9.6.2 Advisory information on the typical operation and maintenance requirements for specific forms of SuDS drainage are set out in the SuDS Manual, which confirms there are broadly three types of maintenance activities associated with surface water drainage systems, defined as:

- **Regular Maintenance** – '*basic tasks undertaken on a frequent and predictable schedule' including vegetation management, litter and debris removal, and inspections*.'
- **Occasional Maintenance** – *'tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example.'*
- **Remedial Maintenance** – *'intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.*'

9.6.3 WBC should be satisfied that the proposed minimum standards of operation are appropriate and that there are clear arrangements in place for ongoing maintenance.

9.6.4 The final strategy for adoption of SuDS and the SuDS maintenance plan, including a maintenance schedule and details of easements and outfalls for the drainage system, should be provided at the detailed design stage, once details of SuDS features to be incorporated into a new development have been finalised.

10 Future Flood Defences

South Wokingham SDL Extension

10.1.1 There are no flood defences in or around the SDL Extension site and none are planned.

Hall Farm

10.1.2 The EA has confirmed that the area is identified as having potential for flood alleviation measures as part of a regional scale screening exercise to identify potential sites feasibility for large scale flood storage areas. The EA 'Thames Valley Flood Scheme' is now looking to appraise a wide range of options across the whole of the Thames Valley to determine which options would be best to complement existing and planned flood schemes and reduce flood risk into the future, as well as delivering significant environmental ambitions.

10.1.3 WBC is currently exploring the potential for a flood alleviation scheme for the River Loddon immediately to the south M4 motorway. This would potentially result in a permanent body of water that may provide significant amenity benefits and opportunities to create new ecological habitat.

10.1.4 The WBC assessment of potential options, which were considered primarily to reduce the impact of fluvial flooding at the Showcase Cinema Roundabout (i.e. the junction of the A329 Reading Road, the A3290 and the B3270 Lower Earley Way), was detailed in the 'Lower Loddon Flood Risk Management – Options Study' for WBC, dated March 2018. The study considered options for flood alleviation, including the following (or a combination of the following):

- A flood bund upstream (south) of the M4 Motorway;
- An off-line balancing pond at Swallowfield;
- New wetland areas at Sheepbridge;
- Natural Flood Management methods.

10.1.5 The study used the EA River Loddon hydraulic model, updated to include new survey information (LiDAR and channel survey) and new data related to consented works in the area (e.g. the Hatch Farm Dairies proposals and the new Shinfield Relief Road).

10.1.6 It should be emphasised that the study only considered fluvial impacts to the roundabout. It is clear from historic flooding records that pluvial flooding is also a key factor impacting the area due to the lack of capacity within the surface water sewer system in the area and WBC has taken action to mitigate this through sewer improvement works in the area, in partnership with Thames Water.

10.1.7 The analysis confirmed that the most effective measure at reducing fluvial flood risk at the Showcase Cinema Roundabout was through the use of a flood bund upstream of the M4 Motorway, which would hold back floodwater in an extreme fluvial flood event across the River Loddon floodplain within the Hall Farm study area and limit the peak flow in the River Loddon channel downstream to its in-banks capacity via a control structure (culvert).

10.1.8 The effect of such defence works would be an increased floodplain within the Hall Farm study area – see **Figure 10-1**. This would mainly be over greenfield land, but where any existing development is affected, then further flood defence measures for property will be required to demonstrate nil detriment.

10.1.9 In combination with the above strategy it was proposed to incorporate 'Natural Flood Management' (NFM) techniques to further mitigate the flood risk. After a screening of options, the most viable NFM options for consideration over the study area were as follows:

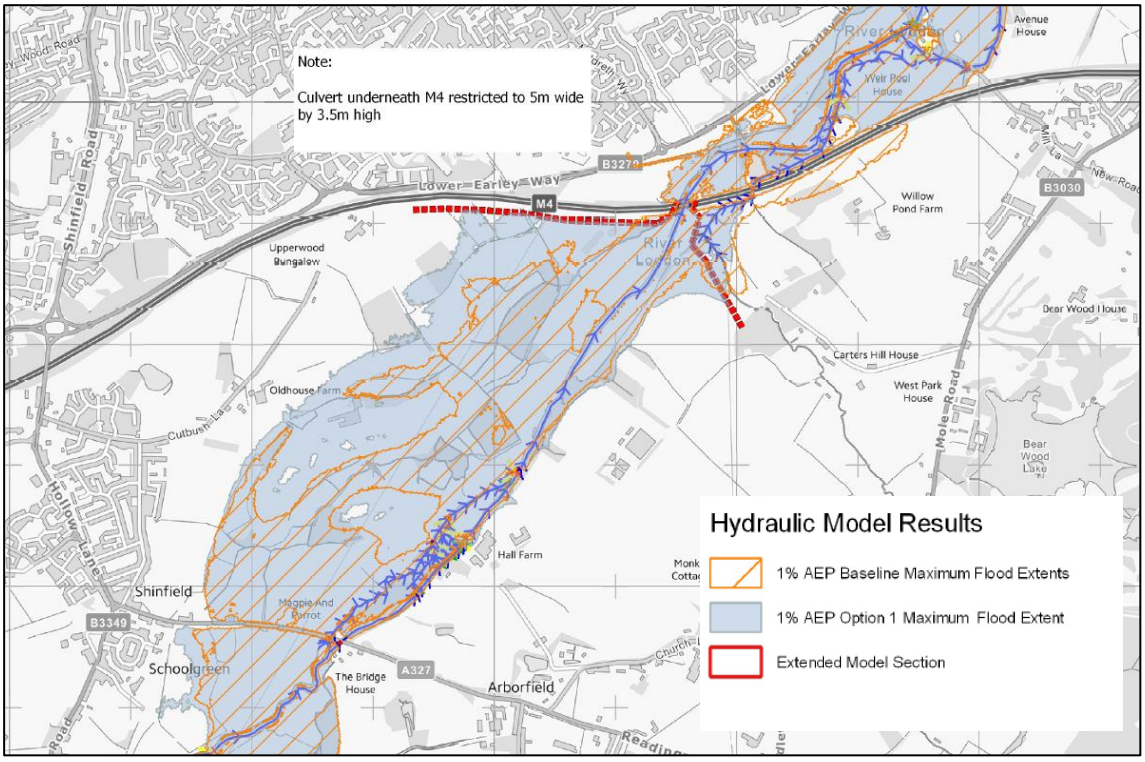
- **Leaky Barriers** – use of natural (primarily wood) barriers across the channel/floodplain to attenuate flows and reduce velocities;
- **Offline storage areas** – lowered ground to provide floodplain storage capacity to reduce peak flow, which could be incorporated as land parcels become available;
- **Catchment Woodland** – woodland to intercept, slow, filter and store water. This can provide an ecological and amenity benefit, although the evidence suggests the benefit becomes negligible in events of the scale of 1 in 100 annual probability or greater.

10.1.10 Initial modelling of this option identified that if flow via the River Loddon is restricted, additional flow would pass through via the Barkham Brook under the M4. A flood defence bund is therefore also required to separate the floodplains of the Barkham Brook and the River Loddon.

10.1.11 The components of the FAS – exclusive of any NFM techniques – can therefore be summarised as:

- Control structure of a box culvert (3m x 5m) in the River Loddon, with spillway
- 2m high flood defence bund, running parallel to the M4 for 1 km in length
- A 2m high, bund, separating the Barkham Brook and River Loddon floodplains, extending for 0.5 km.

Figure 10-1: Extract from Options Report – 'Option 1' Impact of Bund and Flow Control Structure



10.1.12 WBC is continuing to investigate avenues for the funding of the defence scheme and further refinement of any measures to maximise the net benefits to the area.

10.1.13 Given the current status of such proposal, any consideration of 'baseline' flood risk to the Hall Farm study area ignores the potential impacts of the flood defences measures, but it is recommended that the areas outside the present day 1 in 100 annual probability floodplain which fall within the additional areas of flooding due to the scheme (i.e. blue wash, unhatched areas in **Figure 10-1** above) remain free of built development. Such areas are likely to be impacted in more severe climate change scenarios irrespective of the implementation of the defence measures.

10.1.14 It should also be noted that any such flood defence measures would not impact on the extent of Flood Zones over an area, since these Zones represent the 'undefended' scenario and ignore the presence of defences.

11 Conclusions

11.1.1 This Level 2 Strategic Flood Risk Assessment (SFRA) has been prepared by Stantec on behalf of Wokingham Borough Council to provide an overview of available flood risk information on two strategic sites to inform future decision making in relation to site allocations.

11.1.2 National climate change guidance set out in the Planning Practice Guidance (PPG) confirms that the site conditions within the 'Loddon and Tributaries' Management Catchment require consideration of increases in peak river flow of +14% (Central) to +23% (Higher Central), dependant on the inclusion of 'essential infrastructure' uses.

11.1.3 The information obtained as part of the SFRA for the study areas can be summarised as follows

South Wokingham SDL Extension

- EA Flood Zone mapping based on coarse national scale modelling shows that the site lies mainly within Flood Zone 1 'Low Probability', with an area of Flood Zone 3 along the Emm Brook tributary on the southern part of the site;
- EA surface water flood mapping follows a similar pattern but more accurately shows the areas of high flood risk across the southern and south-eastern parts of the site;
- The site is not identified as being at risk from any other sources;
- In summary, development is not significantly constrained over the site and hydraulic modelling will be required to refine the flood risk from the adjacent watercourse.

Hall Farm

- EA Flood Zone mapping shows that a wide corridor of **Flood Zone 3** through the centre of the site defining the floodplain of the River Loddon. Land to the north-west and south-east rises into Flood Zone 1 'Low Probability'.
- The area of **Flood Zone 3** associated with the Barkham Brook is a more confined corridor alongside the river channel running north-west into the site towards the River Loddon.
- Outputs from the River Loddon model (updated in 2017 to incorporate local new developments and improved survey data) indicate the main expanse of Flood Zone 3 is Flood Zone 3b 'Functional Floodplain', and is impacted by flooding in events as frequent as the 1 in 5 annual probability event.
- Surface water flood risk follows a similar pattern as the fluvial flooding, with additional concentrations of high risk along the route of ordinary watercourses draining towards the River Loddon.

11.1.4 The SFRA sets out a range of measures to demonstrate how, through effective masterplanning and design, **future development can be designed to be safe from flooding**, including:

- Adherence to the **Sequential Approach** – ensure that more vulnerable aspects of development are located within Flood Zone 1 'Low Probability' and outside the reference 1 in 100 annual probability plus allowance for climate change floodplain;
- **Elevating building floor levels** a minimum 300mm freeboard above reference fluvial flood levels (including allowance for climate change), and a suitable freeboard above surrounding ground level to mitigate the residual risk of surface water flooding;

- If any remodelling of the fluvial floodplain is proposed, designing to ensure the proposal results in 'level-for-level' **improvements in floodplain storage capacity** and **no detrimental impact on flood flow routes**;

- **Continuous safe access** for all habitable development;

- Masterplanning around the **SuDS surface water drainage strategy** and water environment, with the emphasis on soft engineered surface attenuation features that can provide wider benefits, and with surface water discharge rates limited in accordance with local policy requirements.

11.1.5 There is scope for **future development to reduce flood risk**, through measures such as:

- **Improvements in floodplain storage capacity** through remodelling of the river corridors as part of green pathways or ecological corridors;

- **SuDS surface water drainage strategies** across the site reducing peak runoff rates to below existing (greenfield) rates where feasible;

- Incorporation of 'Natural Flood Management' (NFM) techniques and/or **large scale strategic flood alleviation measures** in partnership with the EA, subject to further feasibility studies and testing (Hall Farm site).

11.1.6 There are significant opportunities to provide **wider sustainability benefits** as part of future development, including:

- **Preservation and enhancement of the river corridors** through the sites, with the potential for significant local community benefit through enhanced accessibility and the creation of riverside parks and green corridors through the wider sites;

- Significant ecological enhancement through the **widening of the river corridor and incorporation of wetlands and backwaters** (which would have the secondary benefit of increasing floodplain storage capacity where ground lowering is undertaken);

- **Utilising areas within the floodplain for 'water compatible' uses** such as sports and recreation, subject to consideration of the depths and frequency of flooding.

11.1.7 Surface water drainage arrangements will form a critical element of new development plans and are likely to consists of a range of SuDS elements to provide on-site attenuation and ensure runoff rates do not exceed existing conditions. This provides a significant opportunity to integrate such measures into the landscape strategy for the sites and provide as part of green corridors and/or amenity features across both sites.

Appendix A OpenData Flood Maps

Hall Farm Site

- Site Location Plan
- Site Location (Aerial Photography)
- Area Topography (LiDAR)
- EA Flood Zone Map
- EA Surface Water Flood Risk
- Reservoir Flood Map
- EA Historic Flood Map

SDL Extension Site

- Site Location Plan
- Site Location (Aerial Photography)
- Area Topography (LiDAR)
- EA Flood Zone Map
- EA Surface Water Flood Risk
- Reservoir Flood Map
- EA Historic Flood Map

Appendix B River Loddon Modelled Flood Data

Drawing 332110523/GIS001 – Modelled Flood Extents – Present Day

Drawing 332110523/GIS002 – Modelled Flood Depths – 1 in 100 Ann. Prob. Event

Drawing 332110523/GIS003 – Modelled Flood Levels – 1 in 100 Ann. Prob. Event

Drawing 332110523/GIS004 – Modelled Flood Extents – Climate Change

Drawing 332110523/GIS005 – Modelled Flood Depths – 1 in 100 AP +23% climate change

Drawing 332110523/GIS006 – Modelled Flood Levels – 1 in 100 AP +23% climate change

Drawing 332110523/GIS007 – Point Sample Flood Levels