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# 2012s5947 South Worcestershire Strategic Flood Risk Assessment Level 2 Update

Final Report

December 2012



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## Revision History

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## Contract

This Level 2 Strategic Flood Risk Assessment (SFRA) Update is commissioned by Malvern Hills District Council, Wychavon District Council and Worcester City Council. The councils' representatives for the contract were Fred Davies, Rosie Murray and Ann Cooper. Claire Gardner, Sophie Dusting and David Kearney of JBA Consulting carried out this work.

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## Purpose

This document has been prepared as a Final Report for Malvern Hills District Council, Wychavon District Council and Worcester City Council. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

## Acknowledgements

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- Adesanya Ayeni (Malvern Hills District Council)
- Fred Davies and Jessica Woolley (Wychavon District Council)
- Martyn Wilson and Steve Lambe (Worcestershire County Council)
- Ruth Clare (Environment Agency)

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## Executive Summary

This report is an update to the South Worcestershire Joint Core Strategy Strategic Flood Risk Assessment (SFRA) published in 2009. The study area comprises Wychavon District, Malvern Hills District and Worcester City which, for the purposes of planning, are known as South Worcestershire. This SFRA update had been prepared in accordance with current best practice, the National Planning Policy Framework (NPPF) and Technical Guidance and uses the best available data at the time.

The SFRA constitutes one of a number of planning tools that enables the Local Authorities to select and develop sustainable site allocations away from areas of greatest vulnerability of flooding in the South Worcestershire Area. The assessment includes allocations sites that are proposed for the South Worcestershire Development Plan, with detailed assessment undertaken for any sites shown at risk from Flood Zones 2 or 3.

The report discusses the flood risk within South Worcestershire area as a whole, allowing an informed decision to be taken when allocating future development sites, and sets out the procedure to be followed when assessing sites in the future. The SFRA update will form part of the evidence base used to inform the Development Plan and assist the local authorities to make the spatial planning decisions required.

Changes to high level planning, policy and guidance since the previous SFRA have been identified and taken into account in preparing this SFRA update.

A review of existing information and execution of additional flood modelling work has identified the level of flood risk in the South Worcestershire area from fluvial and other sources. An assessment of the impact of climate change on flood risk in the catchment has also been assessed. A review of flood defences has been undertaken to determine any changes since the issue of the previous version of the SFRA.

The Flood Map for Surface Water has been used in this SFRA to determine the level of risk from surface water. This is consistent with the Local Agreed Surface Water Information used in the Worcestershire Preliminary Flood Risk Assessment.

Maps and GIS layers have been provided with the report showing the extents of Flood Zones 2, 3a and 3b, and the effects of climate change of Flood Zone 3a.

An overview of flood risk within South Worcestershire has been undertaken, allowing the Councils to apply the Sequential Test. This SFRA update provides advice on any site-specific requirements for a flood risk assessment, and advises the Councils on the use of the Exception Test should the Sequential Test be passed.

In addition, concise outlines have been included that describe the requirements of developers preparing Flood Risk Assessments, with supporting guidance on reducing flood risk and making development safe, including Sustainable Urban Drainage Systems (SUDS) and flood mitigation measures. Advice is also given on environmental improvement opportunities and other issues to consider as part of a development proposal.

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## Abbreviations and Glossary of Terms

Term	Definition
1D model	One-dimensional hydraulic model
2D model	Two-dimensional hydraulic model
AEP	Annual Exceedance Probability
CC	Climate change- Long term variations in global temperature and weather patterns caused by natural and human actions.
CDA	Critical Drainage Area - A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure.
CFMP	Catchment Flood Management Plan- A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CIRIA	Construction Industry Research and Information Association
Cumecs	The cumec is a measure of flow rate. One cumec is shorthand for cubic metre per second; also m <sup>3</sup> /s (m <sup>3</sup> s <sup>-1</sup> ).
Defra	Department for Environment, Food and Rural Affairs
DEM	Digital Elevation Model
DPD	Development Plan Documents
DTM	Digital Terrain Model
EA	Environment Agency
EU	European Union
FEH	Flood Estimation Handbook
FMfSW	Flood Map for Surface Water
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Floods and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a main river
FRA	Flood Risk Assessment - A site specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
FRM	Flood Risk Management
FZ	Flood Zones
Ha	Hectare
HOST	A delineation of UK soil types according to their hydrological properties to produce the 29-class Hydrology of Soil Types (HOST) classification. It is available as a 1km grid.
IDB	Internal Drainage Board
JBA	Jeremy Benn Associates
LDDs	Local Development Documents
LDF	Local Development Framework
LFRMS	Local Flood Risk Management Strategy
LIDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority
mAOD	metres Above Ordnance Datum
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
MHDC	Malvern Hills District Council
NFCDD	National Flood and Coastal Defence Database
NPPF	National Planning Policy Framework

NRD	National Receptor Dataset – a collection of risk receptors produced by the Environment Agency
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.
OS NGR	Ordnance Survey National Grid Reference
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
PPG	Planning Policy Guidance – superseded by the NPPF
PPS25	Planning and Policy Statement 25: Development and Flood Risk
ReFH	Revitalised Flood Hydrograph
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Return Period	Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
SAB	SUDS Approval Body - responsible for approving, adopting and maintaining drainage plans and SUDS schemes that meet the National Standards
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SHLAA	Strategic Housing Land Availability Assessment - The Strategic Housing Land Availability Assessment (SHLAA) is a technical piece of evidence to support the SWDP and Sites & Policies Development Plan Documents (DPDs). Its purpose is to demonstrate that there is a supply of housing land in the District which is suitable and deliverable.
SFRA	Strategic Flood Risk Assessment
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SPRHOST	Standard Percentage Runoff (%) associated with each HOST soil class
SUDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
Surface water flooding	Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity, thus causing what is known as pluvial flooding.
SWMP	Surface Water Management Plan - The SWMP plan should outline the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner. It is the principal output from the SWMP study.
WCC	Worcester City Council
WDC	Wychavon District Council
WFD	Water Framework Directive

# 1 Introduction

## 1.1 About this report

This South Worcestershire Level 2 Strategic Flood Risk Assessment (SFRA) Update report updates the document "South Worcestershire Joint Core Strategy Level 1 and Level 2 Strategic Flood Risk Assessment, November 2009". This update report has been prepared to update the work that was included in the previous SFRA and provide appropriate supporting evidence for the South Worcestershire Development Plan.

Since the previous SFRA, there have been a number of changes to the planning system including the Localism Act (2011) and the National Planning Policy Framework (2012) with accompanying Technical Guidance.

The Localism Act and the proposed revocation of the Regional Spatial Strategies provided the opportunity for the three Councils to closely re-examine the local evidence base and establish their own local development requirements for employment, housing and other land uses through the plan making process. As such, although there has been no change with the overall development strategy, there have been a number of changes to the proposed allocation sites, with some sites removed, additional sites included and modifications to some sites, and therefore an update to the SFRA is required to provide supporting evidence for these changes. In addition the provisions of the Flood and Water Management Act (2010) have been substantially commenced under a programme that was initiated by Defra in April 2010 and the Flood Risk Regulations came into force in December 2009 (these regulations transposed the EU 'Floods Directive' into UK law).

This Level 2 SFRA update will

- provide information on the changes to planning, policy and guidance since the previous SFRA;
- provide a detailed assessment of the flood hazard within the flood zone;
- provide information on existing defences and flood risk management measures;
- allow a sequential approach to site allocation to be undertaken within a flood zone; and
- allow development of the policies and practices required to ensure that development in Flood Zones 2 and 3 satisfies the requirements of the Exception Test.

This document has been prepared under the requirements of the National Planning Policy Framework (NPPF) and accompanying Technical Guidance to the National Planning Policy Framework published in March 2012.

The extent of the study area, including the principal watercourses, is shown in Figure 1-1.

## 1.2 SFRA objectives

The SFRA update will form an integral part of the Councils' evidence base in terms of identifying locations for development and preparation of flood risk policies in the South Worcestershire Development Plan (SWDP). The primary objective of the SFRA update is to be part of the evidence base supporting the SWDP to inform proposed employment and housing allocations so they are in accordance with the NPPF<sup>1</sup>. The SWDP supersedes the South Worcestershire Joint Core Strategy. In order to achieve this, the NPPF states that SFRAs need to provide sufficient detail on all types of flood risk to enable to LPA to

- apply the Sequential and, where necessary, Exception tests in determining land use allocations;
- refine information on the areas that may flood, taking into account other sources of flooding and the impacts of climate change;
- inform the Sustainability Appraisal of local development documents;
- prepare appropriate policies for flood risk management for these areas;

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<sup>1</sup> National Planning Policy Framework (Department for Communities and Local Government, March 2012)  
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- identify the level of detail required for site-specific flood risk assessments; and
- determine the acceptability of flood risk in relation to emergency planning capability.

The SFRA should also

- identify strategic measures (if required) that are needed to support new development; and
- influence and provide evidence that assists when making decisions on windfall planning applications.

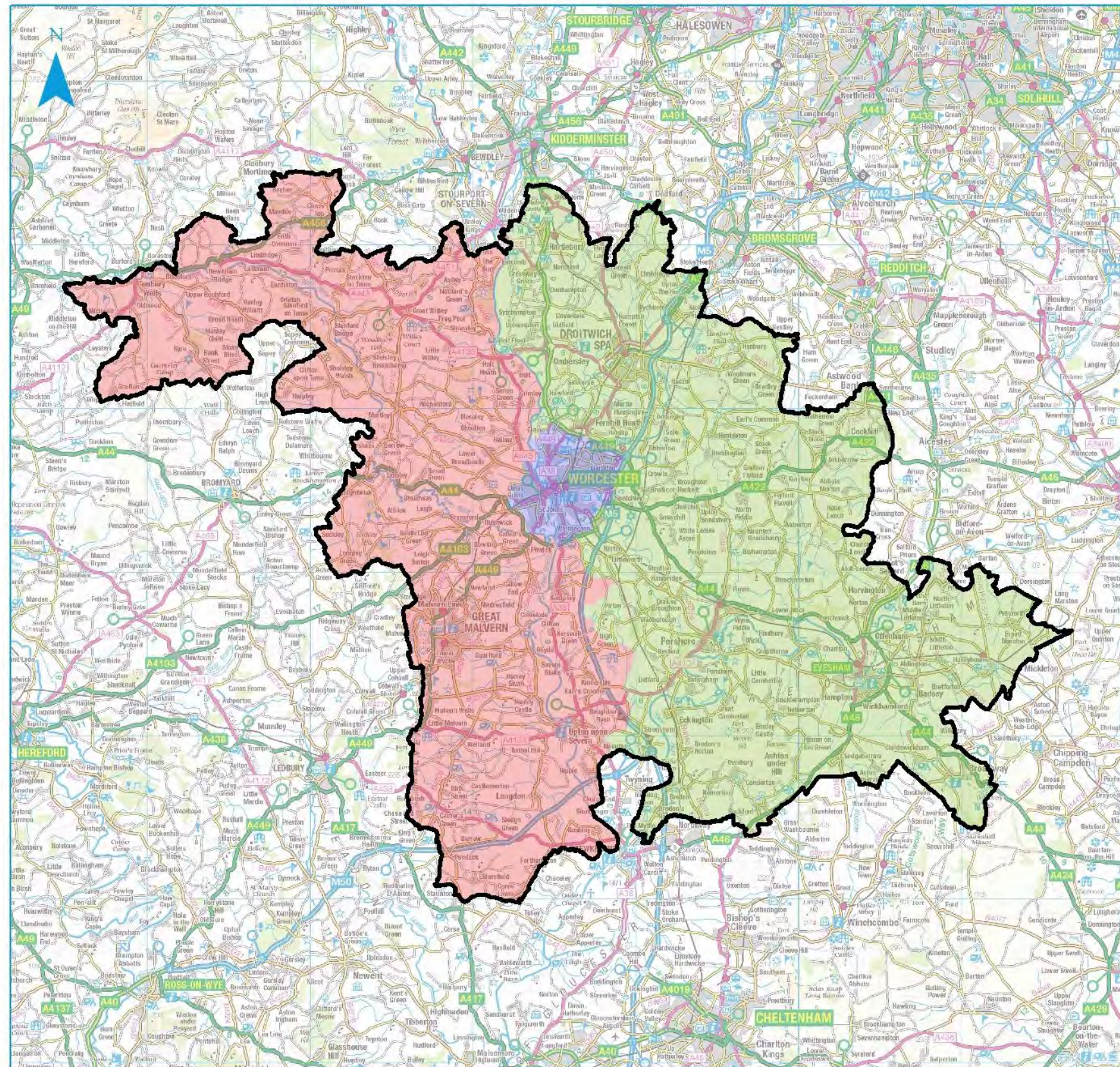
### 1.3 Report user guide

Table 1-1 outlines the information contained in each chapter and how it can be used.

**Table 1-1: SFRA chapters and contents**

Chapter	Contents
1. Introduction	Provides a background to the study, defines objectives, outlines the approach adopted and the consultation performed
2. The Planning Framework	Provides details on the changes to planning and flood risk policies since the last SFRA, and describes what implications these have for the South Worcestershire area.
3. Understanding flood risk in South Worcestershire	Gives an introduction to the assessment of flood risk and provides an overview of the characteristics of flooding affecting the South Worcestershire area. Provides a summary of responses that can be made to flood risk, together with policy and institutional issues that should be considered.
4. How Flood Risk is Assessed	Provides an overview of flooding and risk and flood zones
5. Mapping and Risk-based Approach	Summary of the modelling used for the assessment. Description of mapping that should be used for Sequential and Exception testing. Application of the Sequential Approach and Sequential/Exception Test process.
6. Assessment of future development	Summarises the development proposals for the South Worcestershire area
7. Summary assessment of development sites	Summary of risk to proposed site allocations proposed in the SWDP. Tabulated information and maps summarising risks to proposed site allocations located within Flood Zones, including specific requirements for FRAs.
8. FRA requirements	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development.
9. Recommended policy for management of flood risk	Recommended policy to cover the management of flood risk within the South Worcestershire area, to go alongside the blue, yellow and red sub-divisions of the Flood Zones.
10. Summary and conclusions	Reviews Level 2 SFRA update and its implications

Figure 1-1: SFRA study extent



**Legend**

**District Boundaries**

- Malvern Hills District
- Worcester District (B)
- Wychavon District



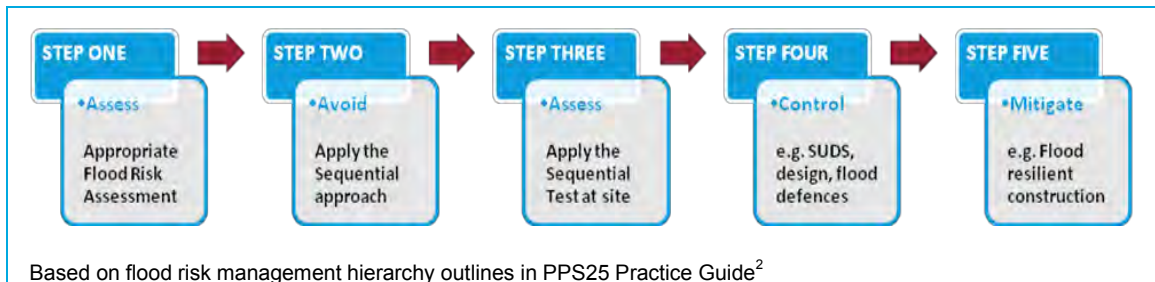
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## 1.4 Approach

### 1.4.1 General Assessment of Flood Risk

The NPPF Technical Guidance retains key elements of Planning Policy Statement 25. The SFRA update adopts the flood risk management hierarchy originally laid out in the PPS25 Practice Guide and is summarised in Figure 1-2.

Figure 1-2: Flood Risk Management Hierarchy



This hierarchy underpins the risk based approach and must be the basis for making all decisions involving development and flood risk. When using the hierarchy, account should be taken of

- the nature of the flood risk (the **source** of the flooding);
- the spatial distribution of the flood risk (the **pathways** and areas affected by flooding);
- climate change impacts, and
- the degree of vulnerability of different types of development (the **receptors**).

Proposed site allocations should reflect the application of the Sequential Test using the maps and guidance in this SFRA. The information in this SFRA should be used as evidence and, where necessary, reference should also be made to relevant evidence in the documents described in Section 5.2. The Flood Zone maps and flood risk information on other sources of flooding contained in this SFRA should be used, where appropriate, to apply the Sequential Test. In the future, when the SFRA is used, developers must check and use the latest available information.

Where other sustainability criteria outweigh flood risk issues, the decision making process should be transparent. Information from this SFRA should be used to justify decisions to allocate land in areas at high risk of flooding. This report contains information on the level of flood hazard at the allocated sites proposed by Malvern Hills and Wychavon District Councils and Worcester City Council within the South Worcestershire area.

### 1.4.2 Technical Assessment of Flood Hazards

Flood risk within the South Worcestershire area has been assessed by using generalised and detailed (where available) model results supplied by the Environment Agency, existing Environment Agency Flood Zone mapping, and additional modelling undertaken as part of this SFRA. In particular:

- Generalised modelling using Jflow+, supplied by the Environment Agency
- Detailed model outlines for the following watercourses
  - River Severn (Abermule to Worcester). Note: the 1000-year return period (Flood Zone 2) extent for the River Severn is a composite of generalised Jflow+ modelling and the 150-year outline from the detailed model, as used by the EA in their November 2012 Flood Maps.
  - River Avon
  - River Teme

<sup>2</sup> Planning Policy Statement 25: Development and Flood Risk Practice Guide (Department for Communities and Local Government, December 2009)



- River Salwarpe
- Barbourne Brook
- Kyre Brook
- Modelled outlines using Jflow+ have been developed to determine Flood Zone 3a, Flood Zone 3b and Flood Zone 2 for the following watercourses, as well as the effects of climate change
  - A small watercourse, to the north west of Droitwich Spa, draining into a tributary of Hadley Brook
  - A small drain that flows through Pebworth before joining Noleham Brook
  - A small, unnamed drain, to the east of Welland
  - Battleton Brook and tributaries, to the south of Evesham
  - Two small, unnamed drain, flowing through Malvern Wells
  - Three, unnamed drains, flowing through Poolbrook
  - Unnamed drain, flowing through Great Malvern
  - Madresfield Brook, at Great Malvern
  - Unnamed drain at Pershore High School
  - Unnamed drain at Drake's Broughton
  - Unnamed drain flowing to the north of Pinvin
  - Two, unnamed drains, flowing through Kemerton
  - Three, unnamed tributaries of Laughern Brook at Rushwick
  - Upstream section of Barbourne Brook, not covered by Environment Agency flood zones
  - Unnamed drain near Swinesherd
  - Small tributary of Bengeworth Brook, near Bengeworth Lake
- The Flood Map for Surface Water (FMfSW) has been used to assess the level of risk from surface water
- The Areas Susceptible to Groundwater (ASStGW) map has been used, along with Worcestershire County Council's database of past flooding events, to identify areas potentially at risk from groundwater flooding.

## 1.5 Consultation

The following parties (external to the three councils) have been consulted during the preparation of this update to the Level 2 SFRA. A summary of key meetings and communications is provided in Appendix 0.

### 1.5.1 Environment Agency

The Environment Agency was consulted at an early stage to determine what models were available for use to define the flood risk in the South Worcestershire area. The Environment Agency was consulted regarding the areas and boundaries of the functional floodplain (Flood Zone 3b) and the Policy Zone Maps (see Appendix E). They also reviewed the SFRA at the draft and final stages.

### 1.5.2 Worcestershire County Council

Worcestershire County Council has gathered a considerable amount of data about flood risk and past flooding within the county as part of their role as Lead Local Flood Authority. Access to the County Council datasets has been provided for this SFRA update and consultation with the County Council undertaken to understand the links between the SFRA and the Local Flood Risk Management Strategy (LFRMS) and other frameworks, including the Worcestershire Infrastructure Strategy and Green Infrastructure Strategy. They were also provided with the opportunity to comment on the draft SFRA report.

### 1.5.3 Severn Trent Water

Severn Trent Water was consulted to provide information on any sewer flooding issues within the South Worcestershire area (DG5 register). They were also provided with the opportunity to comment on the draft SFRA report.

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## 2 The Planning Framework and Flood Risk Policy

### 2.1 Introduction

The over arching aim of planning policy on development and flood risk is to ensure that flood risk is taken into account at all stages of the planning process. The purpose of this section of the report is to highlight the main changes to the planning framework and flood risk responsibilities since the previous SFRA was published in 2009. These changes have been taken into account in preparing this SFRA update.

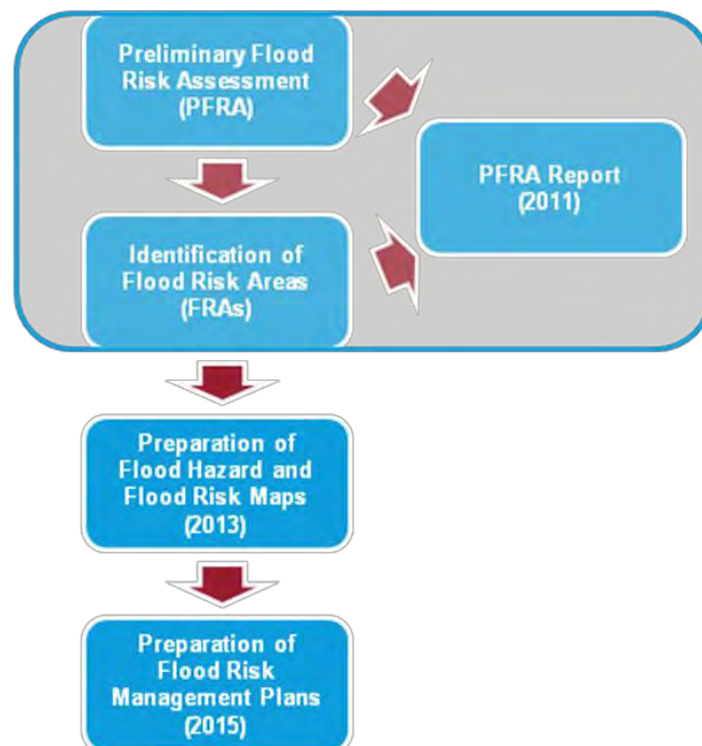
### 2.2 Flood Risk Regulations (2009) and Flood and Water Management Act (2010)

#### 2.2.1 Background

The Flood Risk Regulations transpose the EC “Flood Directive” into UK law and place responsibility upon all Lead Local Flood Authorities (LLFAs) to manage local flood risk. The Flood and Water Management Act (FWMA) received Royal Assent in April 2010. The FWMA aims to create a simpler and more effective means of managing the risk of flood and coastal erosion and implements Sir Michael Pitt’s recommendations following his review of the 2007 floods.

Figure 2-1 sets out the requirements and timescales for implementing the requirements of the Directive.

Figure 2-1: Flood Risk Regulation Requirements



The FWMA also calls for the establishment of a SUDS Approving Body (SAB) to be set up in county, county borough or unitary local authorities. This requires SAB approval of drainage systems for new and redeveloped sites to be obtained before construction can commence. Additionally the proposed drainage system must meet the new National Standards for design, construction, operation and maintenance. The SAB will be responsible for approving, adopting and maintaining drainage plans and SUDS schemes that meet the National Standards. The responsibilities of the SAB are likely to rest with the LLFA (in this case, Worcestershire County

Council), although there is flexibility in the FWMA if it considered more effective for another body to take on the role.

The FWMA defines the following bodies as risk management authorities:

- A Lead Local Flood Authority
- The Environment Agency
- A district council for an area for which there is no unitary authority
- An internal drainage board
- A water company
- A highway authority

### 2.2.2 Worcestershire Preliminary Flood Risk Assessment

In the first instance, the regulations required Worcestershire County Council (as the LLFA) to prepare and publish a Preliminary Flood Risk Assessment (PFRA) on past and future flood risk from local sources of flooding. The Regulations also require the LLFA to identify significant Flood Risk Areas. The PFRA reports on significant past and future flooding from all sources except Main River and Reservoir (covered by Environment Agency) and sub-standard performance of the adopted sewer network (under the remit of Severn Trent Water).

Key outputs of the Worcestershire PFRA include<sup>3</sup>:

- Assessment has shown that, despite the map of 'Nationally Significant Areas of Flood Risk' indicating a small part of the Midlands risk area crosses the Worcestershire border, in reality there are no areas of 'Nationally Significant Areas of Flood Risk' within Worcestershire (agreed with the Environment Agency and Birmingham City Council)
- No areas in Worcestershire have met the criteria defined for 'Locally Significant Flood Risk'
- A considerable number of smaller scale floods have had a sizeable impact upon people, property, the economy and the environment, although each in isolation were unlikely to meet the defined criteria for 'Locally Significant Flood Risk'

### 2.2.3 Water Framework Directive

The Water Framework Directive (WFD) is designed to improve and integrate the way water bodies are managed throughout Europe. In the UK, much of the implementation work will be undertaken by competent authorities. It came into force on 22 December 2000, and was put into UK law (transposed) in 2003<sup>4</sup>.

Under this Directive, many of the parties listed in Table 2-1 have a specific statutory duty to protect and address water quality issues within the area, and in many cases this will be considered as part of flood risk management or development proposals. For example, removing culverts, creating riparian zones or creating open space for water.

## 2.3 Localism Act

The Localism Act was given Royal Assent on 15 November 2011 with the purpose of shifting power from central government back to councils, communities and individuals. The Government proposes that the Regional Spatial Strategies (RSS) are to be abolished, providing the opportunity for the three Councils to re-examine the local evidence base and establish their own local development requirements for employment, housing and other land used through the plan making process<sup>5</sup>. The Government is consulting on the Environmental Reports assessing proposals to revoke the RSS. To date, reports have been published and consulted on for East of England, the South East, and Yorkshire and Humberside. The report for the West Midlands is still awaited.

<sup>3</sup> Preliminary Flood Risk Assessment 2011: Preliminary Assessment Report (Worcestershire County Council, June 2011)

<sup>4</sup> <http://www.defra.gov.uk/environment/quality/water/legislation/water-framework-directive/>

<sup>5</sup> South Worcestershire Development Plan: Public Consultation Document (Malvern Hills District Council, Worcester City Council and Wychavon District Council, September 2011)

Additionally Provision 110 of the Act places a duty to cooperate on local authorities in relation to planning of sustainable development. This duty to cooperate requires local authorities to “engage constructively, actively and on an ongoing basis in any process by means of which development plan documents are prepared so far as relating to a strategic matter”<sup>6</sup>.

The Localism Act also provides new rights to allow parish or town councils to deliver additional development through neighbourhood planning. This means local people can help decide where new homes and businesses should go and what they should look like. Local planning authorities will be required to provide technical advice and support as neighbourhoods draw up their proposals.

## 2.4 National Planning Policy Framework

The National Planning Policy Framework (NPPF) was published on 27<sup>th</sup> March 2012, as part of reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth. It replaces most of the Planning Policy Guidance Notes (PPGs) and Planning Policy Statements (PPSs).

The NPPF is guidance for local planning authorities to help them prepare Local Plans. Paragraph 100 of the NPPF states “Local Plans should be supported by a strategic flood risk assessment and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as Lead Local Flood Authorities and Internal Drainage Boards. Local Plans should apply a sequential, risk-based approach to the location of development to avoid, where possible, flood risk to people and property and manage any residual risk, taking account of the impacts of climate change”<sup>1</sup>.

Technical guidance on flood risk has been published alongside the NPPF and sets out how the policy should be implemented, although it is stated that this is an interim measure.

Whilst the NPPF concentrates on high level national policy and avoids prescriptive guidance, Environment Agency guidance published in May 2012 states the Planning Policy Statement 25 (PPS25) Practice Guide is still extant <sup>7</sup>(it has been assumed that this Environment Agency statement on policy is appropriate).

## 2.5 South Worcestershire Water Cycle Study Update

A Water Cycle Study for South Worcestershire was completed in 2010 and is undergoing an update in 2012. New homes require the provision of clean water, safe disposal of wastewater and protection from flooding. A large number of homes may cause existing infrastructure to be overwhelmed and can adversely affect the environment. Climate change brings with it new challenges such as increased rainfall that can put greater pressure on the existing infrastructure, planning for water has to take this into account.

The updated Water Cycle Study will assist local authorities to select and develop sustainable development allocations where there is minimal impact on the environment, water quality, water resources, infrastructure and flood risk. This will be achieved by identifying areas where there may be conflict between any proposed development and the requirements of the environment and by recommending potential solutions. As part of the Water Cycle Strategy, assessment will be made of Severn Trent Water’s infrastructure to identify any need for extra capacity and where connections to existing infrastructure are appropriate. If new development were to require a new separate system then this could have implications for flood risk management strategies and be used to reduce sewer flooding.

## 2.6 Surface Water Management Plans

Currently, no Surface Water Management Plans (SWMPs) have been undertaken at the District Level. A county wide Surface Water Management Plan is currently being produced by Worcestershire County Council (as LLFA). This SWMP is being informed by data from the District Drainage Officers and Severn Trent Water. The SWMP plan outlines the preferred

<sup>6</sup> Localism Act 2011: Section 110. <http://www.legislation.gov.uk/ukpga/2011/20/section/110>

<sup>7</sup> Quick Guide 364\_12: National Planning Policy Framework – Flood and Coastal Change Risk Management (Environment Agency, 2012)

surface water management strategy in a given location. SWMPs establish a long-term action plan to manage surface water in an area and should influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments<sup>8</sup>.

The preparation of the SWMP is being led by the Flood Risk Regulations and the FWMA and will form an important part of the Local Flood Risk Management Strategy (LFRMS).

## 2.7 Association of British Insurers: Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England

The Association of British Insurers (ABI) and the National Flood Forum have published guidance for local authorities on planning in flood risk areas. The guidance aims to help local authorities in England when producing local plans and dealing with planning applications in flood risk areas. The guidance complements the National Planning Policy Framework. The key recommendations from the guidance are<sup>9</sup>:

- Ensure strong relationships with technical experts on flood risk
- Consider flooding from all sources, taking account of climate change
- Take potential impacts on drainage infrastructure seriously
- Ensure that flood risk is mitigated to acceptable levels for proposed developments
- Make sure Local Plans take account of all relevant costs and are regularly reviewed

## 2.8 Implications for South Worcestershire

Worcestershire County Council’s emerging Local Flood Risk Management Strategy is a statutory document and the district councils have a duty, under the FWMA, to “exercise their flood risk management functions in a manner consistent with local and national strategies, and to have regard to those strategies in their other functions.”

The new and emerging responsibilities for the risk management authorities under the Flood and Water Management Act and the Flood Risk Regulations are summarised in Table 2-1.

**Table 2-1: Roles and Responsibilities in South Worcestershire**

Risk Management Authority (RMA)	Strategic Level	Operational Level
Environment Agency	National Statutory Strategy  Reporting and supervision (overview role)	Main rivers, reservoirs <ul style="list-style-type: none"> <li>• Preliminary Flood Risk Assessment (per River Basin District)</li> <li>• Identify Significant Flood Risk Area</li> <li>• Flood Risk and Hazard Maps</li> <li>• Flood Risk Management Plan</li> </ul>
Lead Local Flood Authority (Worcestershire County Council)	Input to national strategy.  Formulate and implement local flood risk management strategy.  Surface Water Management Plans  Maintenance of a register of structures/features which have a significant effect on flood risk	Surface water, groundwater, ordinary watercourse (delegated to District authorities), other sources of flooding <ul style="list-style-type: none"> <li>• Prepare and publish a PFRA</li> <li>• Identify Flood Risk Areas</li> <li>• Prepare Flood Hazard and Flood Risk Maps</li> <li>• Prepare Flood Risk Management Plans</li> </ul>

<sup>8</sup> Surface Water Management Plan Technical Guidance (Defra, 2010)

<sup>9</sup> Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England (Association of British Insurers and National Flood Forum, April 2012)

Risk Management Authority (RMA)	Strategic Level	Operational Level
	in the area	SUDS Approval Body
District Councils (Malvern Hills, Wychavon, Worcester City)	Input to National and Local Authority Plans and Strategy (e.g. Local Development Documents) <ul style="list-style-type: none"> <li>• South Worcestershire Development Plan</li> <li>• Surface Water Management Plans</li> </ul>	<ul style="list-style-type: none"> <li>• Ordinary watercourse (delegated to District authorities by Worcestershire County Council, under a Strategic Level Agreement)</li> </ul>
Highways Agency	Input to National, and act consistently with, Local Authority Plans and Strategy <ul style="list-style-type: none"> <li>• Maintain SUDS in public roads</li> <li>• Consultee to SABs</li> <li>• contribute to sustainable development</li> </ul>	<ul style="list-style-type: none"> <li>• Highway drainage</li> <li>• SUDS</li> </ul>
Severn Trent Water	Input to National, and act consistently with, Local Authority Plans and Strategy	<ul style="list-style-type: none"> <li>• Public sewers</li> </ul>
Internal Drainage Boards	Input to National, and act consistently with, Local Authority Plans and Strategy <ul style="list-style-type: none"> <li>• Preliminary Flood Risk Assessments</li> <li>• Designating assets</li> <li>• Consultees to SABs</li> </ul>	<ul style="list-style-type: none"> <li>• Ordinary watercourse</li> </ul>

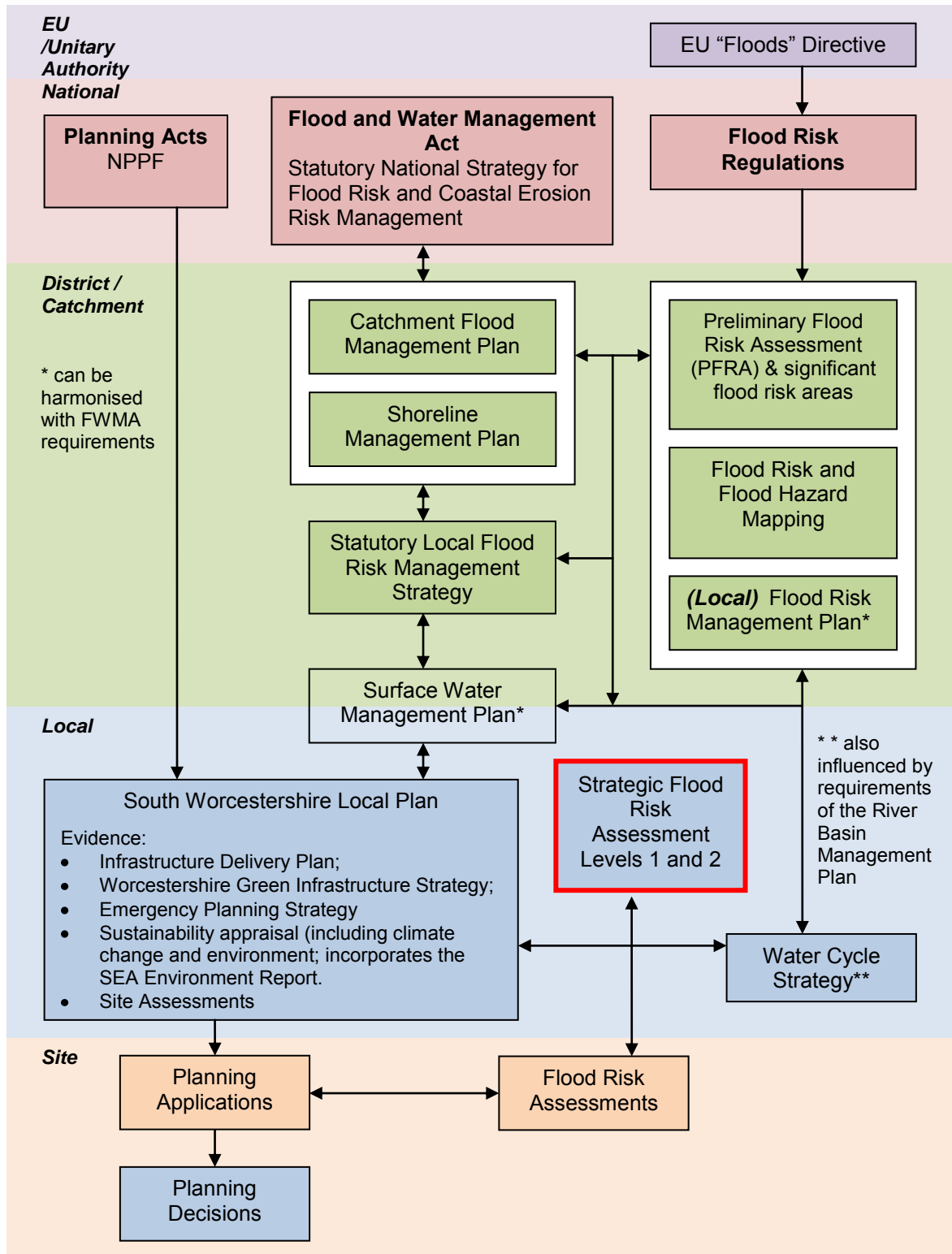
Figure 2-2 shows the key strategic planning links for flood risk and associated documents. It shows how the Flood Risk Regulations and Flood and Water Management Act, in conjunction with the Localism Act’s “duty to cooperate”, introduce a wider requirement for the exchange of information and the preparation of strategies and management plans.

The emerging Local Flood Risk Management Strategy and its evidence base are important in the preparation of the Level 2 SFRA update, the South Worcestershire Development Plan and in development management decisions.

Likewise, SFRAs contain information that should be referred to in responding to the Flood Risk Regulations and the formulation of local flood risk management strategies and plans. SFRAs are also linked to the preparation of catchment flood management plans (CFMPs), shoreline management plans (SMPs) and surface water management plans (SWMPs) and water cycle strategies.



Figure 2-2: Strategic Planning Links and Key Documents for Flood Risk



Legend: Responsibilities are indicated using colour coding as follows

European Union	National Government	Local Planning Authority	EA/LLFA/Maritime Local Authorities	Developer
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## 3 Understanding Flood Risk in South Worcestershire

### 3.1 Historic flooding

The Level 1 and 2 South Worcestershire SFRA published in 2009 included an assessment of historic flooding in the county. To summarise, it describes how the most noticeable events occurred in 1998, 2000 and 2007, when several hundred properties flooded on each occasion. The floods in 2000 and 2007 were the largest flood events since 1947. In 2007, flooding was from a combination of fluvial and surface water with over 1,600 recorded incidents of flooding in Wychavon alone and nearly 200 properties flooded in Worcester<sup>10</sup>.

As described in Section 2.2, Worcestershire County Council was required to assess past flooding as part of the Worcestershire PFRA. As part of the PFRA assessment information was gathered from a number of sources including:

- Parish Councils
- Key interviews
- The previous SFRA
- Partner organisations (including, the Environment Agency, Canal and River Trust [previously known as British Waterways] and Severn Trent Water).

Worcestershire County Council provided their historic flooding dataset for use in this Level 2 SFRA. This consists of a point layer of all historic flooding incidents within the Worcestershire area and a polygon layer of hotspots.

In addition the Environment Agency has supplied their Historic Flood Map which is based on aerial photography and ground survey and observations during past flood events.

### 3.2 The study area

The study area comprises Worcester City and the towns of Evesham, Upton upon Severn, Droitwich Spa, Malvern, Pershore and Tenbury Wells, together with surrounding villages in Malvern Hills and Wychavon Districts. In total, the SFRA covers an area of 1,270km<sup>2</sup> as shown in Figure 1-1.

Significant watercourses within the study area include the River Severn, River Avon, River Salwarpe, River Tene and Barbourne Brook.

The Lower Severn Internal Drainage Board area covers a small part of Malvern Hills District in the south of the South Worcestershire area.

The M5, M50 and A46(T) are key transport routes passing through the study area. Additionally the Cotswold and Malvern Mainline and North East to South West Mainline run through the area.

#### 3.2.1 Geology

The geology can have an effect on the runoff, and the flooding, within a catchment as a result of the permeability of the strata. The geology within South Worcestershire is variable. According to the River Severn Catchment Flood Management Plan<sup>11</sup> (CFMP), the lower reaches of the River Severn flow over Non Aquifer Triassic Mercia Mudstone Group strata and Jurassic Lower Lias Clays. The drift gravels at this point allow groundwater to flow from the drift deposits to the river and vice versa. Impermeable clays and mudstones dominate the Warwickshire Avon sub-catchment.

<sup>10</sup> South Worcestershire Joint Core Strategy Strategic Flood Risk Assessment: Final Report (JBA Consulting, 2009)

<sup>11</sup> River Severn Catchment Flood Management Plan: Summary Report (Environment Agency, 2009)

### 3.2.2 Hydrology

According to the River Severn CFMP the climate in South Worcestershire is typical of western Britain, generally temperate. The area receives rainfall amounts similar to the UK average – less than 700mm per year.

The CFMP describes how, during autumn and winter precipitation (generally due to water fronts and low pressure systems) tends to be of higher volume than rainfall associated with convective summer storms.

### 3.2.3 Summary of flood risk in the districts

#### Worcester City

Flood risk issues in Worcester relate to fluvial flooding from the River Severn, River Teme and the Barbourne Brook.

Other flood risk issues in Worcester are localised surface water flooding and flooding in the Barbourne Brook catchment, caused by a possible combination of fluvial, surface and sewer flooding.

#### Wychavon District Council

In Wychavon, flood risk is from the River Avon in Evesham and Pershore, the River Salwarpe, the Droitwich canals and many small watercourses in the rural areas. In addition surface water is an issue in many locations.

A broad scale surface water sewerage model was developed as part of the original Level 2 SFRA for Droitwich. This model confirmed that surface water discharge in some of the areas of the town will exacerbate flooding from the River Salwarpe.

#### Malvern Hills District Council

The main cause of flooding in Malvern Hills is local watercourses and surface water sewers. In particular, rapid response catchments are of concern, and as many of the watercourses at risk are less than 3km<sup>2</sup> in area there are no flood risk maps covering these areas. Where proposed allocation sites are located in such catchments, modelling will be undertaken for this SFRA update to determine the level of risk.

#### Lower Severn Internal Drainage Board

The area of the Severn Internal Drainage Board within the South Worcestershire area is limited to the Longdon Marshes in the South of the Malvern Hills DC area. The main flood risk issue for the Severn IDB is the condition of the Longdon Brook which will affect the IDB drains that drain into it. Any development proposals affecting the Longdon marshes or Longdon Brook will need to be discussed with the Severn IDB to agree strategies for surface water management and flood protection.

## 3.3 Flood defences

A number of flood defence schemes have been implemented since the previous South Worcestershire Level 2 SFRA. These include:

- **Pershore:** Completed September 2010. Scheme consists of a flood relief channel and earth embankments to the south of the town and a flood wall built through community allotments. The scheme provides protection to 61 properties in Pershore to a 1 in 100 year chance of flooding in any given year.
- **Upton upon Severn:** Completed July 2012. Scheme consists of an



earth embankment, flood wall and floodgates across New Street. Additionally a flood wall was constructed in the Waterside area. The scheme protects 64 properties to a 1 in 150 year chance of flooding in any given year.

- **Powick:** Completed November 2011. Scheme consists of the construction of two flood embankments, providing protection from a flood with a 1 in 75 chance of occurring in any one year.
- **Kempsey:** Completed July 2012. Scheme consists of a 180m long earth embankment constructed downstream of the village to stop flooding from the River Severn. Additionally a large culvert and automated penstock allows Hatfield brook to flow freely into the River Severn in periods of low flow. Pumps are in place to discharge surface water and water from Hatfield Brook to the other side of the embankment when the penstock is closed. The scheme provides protection to a 1 in 100 chance of a flood occurring in one year.
- **Riddings Brook, Wribbenhall:** Completed in 2011. Scheme consists of a 200m earth bund.
- **Uckinghall:** Completed 2011. Scheme consists of an earth embankment, flood wall, pumping station, and highway alterations at Ferry Lane including a flood gate. The scheme provides protection to a 1 in 100 chance of flooding in any one year.

### 3.4 Severn Catchment Flood Management Plan

The Severn Catchment Flood Management Plan (CFMP) was published in September 2008. There are six pre-defined national policies provided in the CFMP guidance and these are applied to specific locations through the identification of 'Policy Units'. These policies are intended to cover the full range of long term flood risk management options in the catchment that can be applied to different locations. The six national policies are:

1. No active intervention (including flood warning and maintenance). Continue to monitor and advise
2. Reducing existing flood risk management actions
3. Continue with existing or alternative actions to manage flood risk at the current level
4. Take further action to sustain the current level of flood risk
5. Take action to reduce flood risk (now and/or in the future)
6. Take action to increase the frequency of flooding to deliver benefits locally or elsewhere

The Severn CFMP is divided into nine sub areas which have respectively been allocated one of the six generic flood risk management policies<sup>11</sup>. Table 3-1 lists the CFMP sub areas and policies relevant to the South Worcestershire area.

**Table 3-1: Severn CFMP policies in the South Worcestershire area**

CFMP Sub area	Policy	Priorities
Sub area 4: Middle Severn Corridor	Policy 4	<ul style="list-style-type: none"> <li>• No increase in flood risk due to development</li> <li>• Set a framework to deliver a sustainable approach to flood risk management that considers the natural functions of the river and reduces long term dependence on raised defences</li> <li>• Maintain existing flood warning areas and improve effectiveness and coverage</li> <li>• Promote SUDS for new development</li> </ul>
Sub area 8: Middle Avon, Tributaries, Arrow and Alne, Redditch, Rugby and Teme	Policy 3	<ul style="list-style-type: none"> <li>• Maintain existing Flood Watch area of Lower Avon</li> <li>• Maintain existing Flood Watch area of River Teme</li> <li>• Safeguard floodplains</li> <li>• Promote SUDS</li> </ul>

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## 4 How Flood Risk is Assessed

### 4.1 Definitions

#### 4.1.1 Flood

Section 1 (subsection 1) of the FWMA defines a flood as:

*'any case where land not normally covered by water becomes covered by water'*.

Section 1 (subsection 2) states 'it does not matter for the purposes of subsection (1) whether a flood is caused by –

- (a) Heavy rainfall
- (b) A river overflowing or its banks being breached
- (c) A dam overflowing or being breached
- (d) Tidal waters
- (e) Groundwater, or
- (f) Anything else (including any combination of factors).

Note: Source does not include the following – flood from any part of a sewerage system, unless caused by an increase in the volume of rainwater, entering or affecting the system, or a flood caused by a burst water main.

#### 4.1.2 Flood Risk

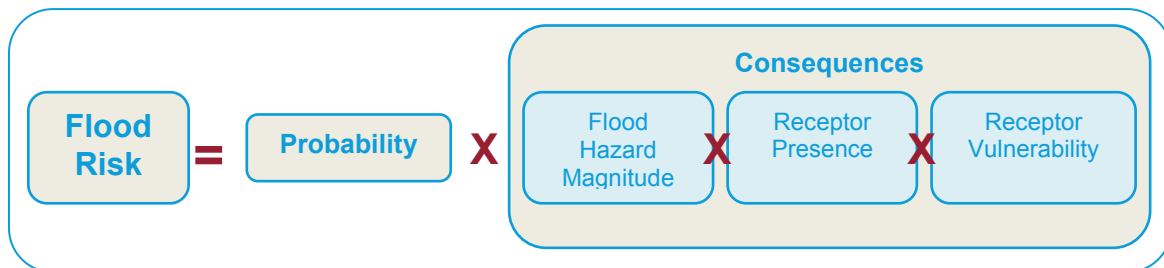
Section 3 (subsection 1) of the FWMA defined flood risk as:

*'a risk in respect of an occurrence assessed and expressed (as for insurance and scientific purposes) as a combination of the probability of the occurrence with its potential consequences.'*

Thus it is possible to define flood risk as:

$$\text{Flood Risk} = (\text{Probability of a flood}) \times (\text{Scale of the Consequences})$$

On that basis it is useful to express the definition as follows:



Using this definition it can be seen that

- **Increasing the probability or chance of a flood being experienced increases the flood risk.** In situations where the probability of a flood being experienced increases gradually over time, for example due to the effects of climate change, then the magnitude of the flood risk will increase.
- **The scale of the consequences can increase the flood risk.**
  - **Flood Hazard Magnitude:** If the direct hazard posed by the depth of flooding, velocity of flow, the speed of onset, rate of risk in flood water or duration of inundation is increased, then the consequences of flooding, and therefore risk, is increased.
  - **Receptor presence:** The consequences of a flood will be increased if there are more receptors affected, for example with an increase in extent or frequency of

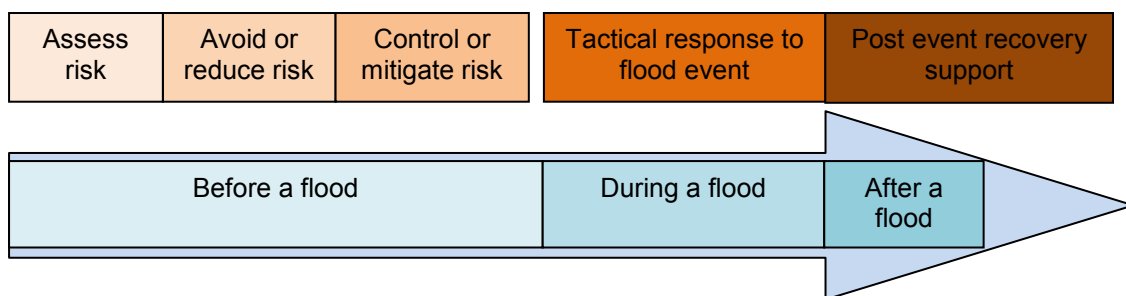
flooding. Additionally, if there is new development that increases the probability of flooding (for example, increase in volume of runoff due to increased impermeable surfaces) or increased density of infrastructure then consequences will also be increased.

- **Receptor vulnerability:** If the vulnerability of the people, property or infrastructure is increased then the consequences are increased. For example, old or young people are more vulnerable if there is a flood.

## 4.2 Using SFRA risk information

This SFRA update contains information that can be used at strategic, operational and tactical levels as shown in Figure 4-1.

Figure 4-1: Uses of SFRA information



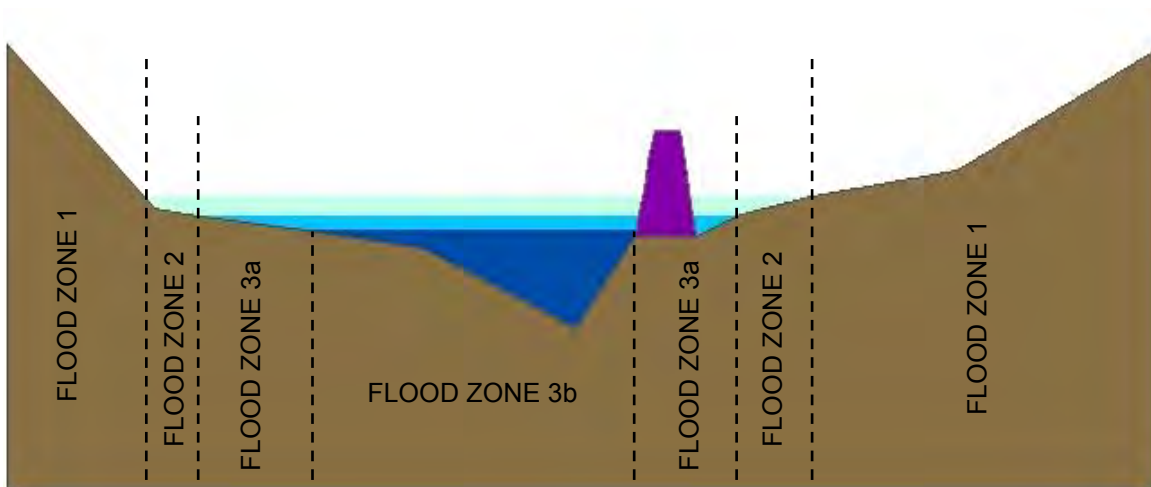
The SFRA will be an important source of information in the preparation of the Local Flood Risk Management Strategy.

The assessment of flood risk in the SFRA is primarily based on the following three types of information

### 4.2.1 Flood Zones

The SFRA includes maps that show the flood zones. These zones describe the land that would flood if there were no defences present. The NPPF Guidance identifies the following Flood Zones and these are used in the South Worcestershire SFRA update, see Figure 4-2 and Table 4-1.

Figure 4-2: Flood Zone definition



**Table 4-1: Flood Zone descriptions**

	Probability	Description	Suitable Development*
Zone 1	Low	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). Flood Zone 1 is all areas not in Flood Zones 2 or 3.	<ul style="list-style-type: none"> <li>All uses of land</li> </ul>
	Medium	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (0.1% - 1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.1% – 0.5%) in any year.	<ul style="list-style-type: none"> <li>Water compatible, less vulnerable and more vulnerable uses of land and essential infrastructure are appropriate.</li> <li>The highly vulnerable uses are only appropriate if the Exception Test is passed.</li> </ul>
Zone 3a	High	This zone comprises land assessed as having a greater than 1 in 100 annual probability of river flooding (>1.0%) or a greater than 1 in 200 annual probability of flooding from the sea (>0.5%) in any year.	<ul style="list-style-type: none"> <li>Water compatible and less vulnerable uses of land are appropriate.</li> <li>More vulnerable and essential infrastructure should only be permitted if the Exception test is passed.</li> <li>Highly vulnerable uses should not be permitted.</li> </ul>
Zone 3b	Function Floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes.	<ul style="list-style-type: none"> <li>Water compatible and essential infrastructure that has to be there is permitted.</li> <li>Essential infrastructure should pass the Exception Test and be designed and constructed to meet a number of flood risk related targets.</li> <li>Less vulnerable, more vulnerable and highly vulnerable uses should not be permitted.</li> </ul>

The preference when allocating land is, whenever possible, to place all new development on land in Zone 1. Since the zones identify land that is not reliant on flood defences, placing development on Zone 1 land means that in future there is no commitment to spending money on flood banks or flood alleviation measures and not committing future generations to costly long term expenditure that would become increasingly unsustainable as the effects of climate change increase. However, the runoff from development on Zone 1 land can potentially cause an increase in the probability of flooding to existing downstream development. Information in the SFRA should be used to address this issue.

#### 4.2.2 Sub-divisions of Flood Zone 3 in South Worcestershire

NPPF Technical Guidance, Table 1 defines Flood Risk Zones 3a (high probability) and 3b (functional floodplain). The latter can be defined as the 1 in 20-year return period flood, *or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes.*

**For the South Worcestershire area, the LPAs and the Environment Agency have agreed on three sub-divisions of Flood Zone 3 for the major urban areas (Worcester, Droitwich Spa, Evesham, Pershore, Tenbury Wells and Upton upon Severn) as defined below:**



### **Floodplain [“Blue Zone”]**

Development will not normally be permitted here. Exceptions may be water compatible developments and essential infrastructure, but these must be accompanied by a detailed Flood Risk Assessment;

### **Floodplain [“Yellow Zone”]**

Redevelopment of existing sites within the floodplain in areas not subject to significant flood flows [as defined by the Environment Agency], shown as “yellow zone” on the proposals map, will normally be permitted provided:

- it is for less vulnerable or water compatible use (as defined in Table D2 of PPS25);
- ground floor levels of all buildings are set above the 1 in 100-year flood level including an allowance for climate change, with an appropriate freeboard to be agreed with the LPA and Environment Agency, and should be flood free during an extreme flood event;
- safe access is available for the lifetime of the development and is supported by flood warning and suitable evacuation plans being in place;
- car parking is designed to have regard to potential flood depths and hazards and mitigation measures are put in place. (No basement car parking shall be permitted);
- there is no detriment to the available flood storage capacity of the floodplain and additional flood storage is created; and
- unnecessary obstructions to flood flow are removed, restoring flood flow pathways.

### **Floodplain [“Red Zone”]**

New development (including extensions) and redevelopment will not normally be permitted in areas of existing or previously existing floodplain flow [as defined by the environment agency] shown as “red zone”, or within 8 metres of the top of both banks of other watercourses, as shown on the proposals map. Where options for managed retreat or land swap exist, developers should explore these with the Local Authority.

Maps showing these three Flood Zone 3 sub-divisions are shown in Appendix E.

#### **4.2.3 Actual Flood Risk**

If it has not been possible for all future development to be situated in Zone 1 then a more detailed assessment is needed to understand the implications of locating proposed development in Zones 2 or 3. This is accomplished by considering information on the “actual risk” of flooding. The assessment of actual risk takes account of the presence of flood defences and provides a picture of the safety of existing and proposed development. It should be understood that the standard of protection afforded by flood defences is not constant and it is presumed that the required minimum standards for new development are:

- Residential development should be protected against flooding with an annual probability of river flooding of 1% in any year; and
- Residential development should be protected against flooding with an annual probability of tidal (sea) flooding of 0.5% in any year.

The assessment of the actual risk should take the following issues into account

- The level of protection afforded by existing defences might be less than the appropriate standards and hence may need to be improved if further growth is contemplated
- Temporary and demountable defences have a high residual risk due the possibility of failure to deploy the defences before the onset of flooding. These types of defence are reliant on there being sufficient warning and mobilisation time for deployment.
- The flood risk management policy for the defences will provide information on the level of future commitment to maintain existing standards of protection. If there is a conflict

between the proposed level of commitment and the future needs to support growth then it will be a priority for the Flood Risk Management Strategy to be reviewed

- The standard of safety must be maintained for the intended lifetime of the development (assumed to be 100 years for residential development). Over time the effects of climate change will erode the present day standard of protection afforded by defences and so commitment is needed to invest in the maintenance and upgrade of defences if the present day levels of protection are to be maintained
- The assessment of actual risk can include consideration of the magnitude of the hazard posed by flooding. By understanding the depth, velocity, speed of onset and rate of rise of floodwater it is possible to assess the level of hazard posed by flood events from the respective sources. This assessment will be needed in circumstances where consideration is given to the mitigation of the consequences of flooding or where it is proposed to place lower vulnerability development in areas that are at risk from inundation

Those using the South Worcestershire Level 2 SFRA Update should refer to the Environment Agency's National Flood and Coastal Defence Dataset (NFCDD) for details on the standard of protection of defences.

#### 4.2.4 Residual Risk

The residual risk refers to the risks that remain in circumstances where measures have been taken to alleviate flooding. It is important that these risks are quantified to confirm that the consequences can be safely managed. The residual risk can be:

- The effects of a flood with a magnitude greater than that for which the defences or management measures have been designed to alleviate. This can result in over topping of flood banks, failure of flood gates to cope with the level of flow or failure of pumping systems to cope with the incoming discharges; or
- Failure of the defences or flood risk management measures to perform their intended duty. This could be breach failure of flood embankments, failure of flood gates to operate in the intended manner or failure of pumping stations.

The assessment of residual risk demands that attention be given to the vulnerability of the receptors and the response to managing the resultant flood emergency. In this instance attention should be paid to the characteristics of flood emergencies and the roles and responsibilities during such events.

### 4.3 Possible responses to flooding

#### 4.3.1 Assess

The first response to flooding must be to understand the nature and frequency of the risk. The assessment of risk is not just performed as a "one off" during the process, but rather the assessment of risk should be performed during all subsequent stages of responding to flooding.

#### 4.3.2 Avoid

The sequential approach requires that the first requirement is to avoid the hazard. If it is possible to place all new growth in areas at a low probability of flooding then the flood risk management considerations will relate solely to ensuring that proposed development does not increase the probability of flooding to others. This can be achieved by implementing SUDS systems and other measures to control and manage run-off. In some circumstances it might be possible to include measures within proposed growth areas that reduce the probability of flooding to others and assist existing communities to adapt to the effects of climate change. In such circumstances the growth proposals should include features that can deliver the necessary levels of mitigation so that the standards of protection and probability of flooding are not reduced by the effects of climate change. In South Worcestershire, consideration should be given not only to the peak flows generated by new development but also to the volumes generated during longer duration storm events

### 4.3.3 Substitute, Control and Mitigate

These responses all involve management of the flood risk and thus require an understanding of the consequences (the magnitude of the flood hazard and the vulnerability of the receptor).

There are opportunities to reduce the flood risk by lowering the vulnerability of the proposed development. For instance changing existing residential land to commercial uses will reduce the risk provided that the residential land can then be located on land in a lower risk flood zone.

Flood risk management responses in circumstances where there is a need to consider growth or regeneration in areas that are affected by a medium or high probability will include:

- Strategic measures to maintain or improve the standard of flood protection so that the growth can be implemented safely for the lifetime of the development (must include provisions to invest in infrastructure that can adapt to the increased chance and severity of flooding presented by climate change);
- Design and implement measures so that the proposed development includes features that enables the infrastructure to adapt to the increased probability and severity of flooding whilst ensuring that new communities are safe and that the risk to others is not increased (preferably reduced);
- Flood resilient measures that reduce the consequences of flooding to infrastructure so that the magnitude of the consequences is reduced. Such measures would need to be considered alongside improved flood warning, evacuation and welfare procedures so that occupants affected by flooding could be safe for the duration of a flood event and rapidly return to properties after an event had been experienced.

It would be necessary to address the necessary commitment and provisions for the long term management and maintenance of all measures to control and mitigate flooding, where they have to be deployed.

## 5 Mapping and risk based approach

### 5.1 Summary of mapping for all sources of flood risk

#### 5.1.1 Fluvial

The data used to prepare mapping is based on the results from hydraulic models either provided by the Environment Agency or prepared for the purposes of this SFRA update.

- Generalised modelling using Jflow+, supplied by the Environment Agency. Where detailed model results exist, these have been used in preference to the Jflow modelling. Watercourses with detailed modelling include:
  - River Salwarpe
  - River Severn from Abermule to Worcester
  - Hatfield Brook
  - River Avon
  - Barbourne Brook
  
- Modelled outlines using Jflow+ have been developed to determine Flood Zone 3a, an indicative Flood Zone 3b\* and Flood Zone 2 for the following watercourses, as well as the effects of climate change.
  - A small watercourse, to the north west of Droitwich Spa, draining into a tributary of Hadley Brook
  - A small drain that flows through Pebworth before joining Noleham Brook
  - A small, unnamed drain, to the east of Welland
  - Battleton Brook and tributaries, to the south of Evesham
  - Two small, unnamed drain, flowing through Malvern Wells
  - Three, unnamed drains, flowing through Poolbrook
  - Unnamed drain, flowing through Great Malvern
  - Madresfield Brook, at Great Malvern
  - Unnamed drain at Pershore High School
  - Unnamed drain at Drake's Broughton
  - Unnamed drain flowing to the north of Pinvin
  - Two, unnamed drains, flowing through Kemerton
  - Three, unnamed tributaries of Laughern Brook at Rushwick
  - Upstream section of Barbourne Brook, not covered by Environment Agency flood zones
  - Unnamed drain near Swinesherd
  - Small tributary of Bengeworth Brook, near Bengeworth Lake

\*Note: Flood Zone 3b is indicative and further investigation will be required through detailed site specific Flood Risk Assessments

#### 5.1.2 Surface Water

Mapping of surface water flood risk has been taken from the locally agreed surface water information prepared by Worcestershire Council and described in the PFRA. The information is based on a national scale map identifying those areas where surface water flooding poses a risk. The mapping is based on two rainfall events, one with a 1 in 30 and the other with a 1 in 200 chance of occurring in any year.

#### 5.1.3 Groundwater

The Areas Susceptible to Groundwater (AStGW) map has been used, along with Worcestershire County Council's database of past flooding events, to identify areas potentially at risk from groundwater flooding.

#### 5.1.4 Hazard Maps

Hazard mapping has also been produced for the potential development areas. The hazard rating is calculated directly within the Jflow modelling package and utilises the classifications of hazard presented in DEFRA R&D Technical Note FD2320: Flood Risk Assessment.

Hazard mapping for the Level 2 SFRA update has been produced using depth and velocity, excluding a debris factor, and therefore may underestimate hazard in some areas. Therefore, it should be noted that the hazard mapping prepared for the SFRA using JFlow+ will need to be refined when more detailed consideration is given to preparing development proposals at the respective sites where development is proposed. At that time it is likely that more detailed 1d – 2D modelling will have to be prepared to enable results with an appropriate level of detail and resolution.

#### 5.1.5 Suite of Maps

All of the mapping can be found in the appendices and is presented in the following structure

- Flood Zones
- Climate change outlines
- Hazard Mapping
- Surface Water Flood Risk Mapping
- Floodplain Policy Mapping

### 5.2 Other relevant flood risk information

The mapping prepared for this Level 2 SFRA update provides information on

- The extent of flooding
- The depth of flooding
- Flood water velocity
- Hazard from flood water

Other relevant information on flood risk should be referred to by users of this SFRA, where appropriate. This information includes:

- South Worcestershire Joint Core Strategy Strategic Flood Risk Assessment – Level 1 and 2
- Worcestershire Preliminary Flood Risk Assessment (2011)
- River Severn Catchment Flood Management Plan (2010)
- River Basin Management Plan: Severn River Basin District (2009)
- Hazard and Risk Mapping prepared for the Flood Risk Regulations (available in 2013)
- Flood Risk Management Plan in accordance with the Flood Risk Regulations (available in 2015)
- Surface Water Management Plans
- National Flood and Coastal Defences Dataset (NFCDD) – users should note that recently completed schemes may not yet be included in this dataset.
- National Receptor Dataset (NRD) – users should note the NRD dataset is representative of the current situation. New developments or changes to a property type (i.e. house to flat) or property use (i.e. residential to non-residential) may not be represented.

### 5.3 Sequential approach

It is often the case that it is not possible for all new development to be allocated on land that is not at risk from flooding. In these circumstances the Flood Zone maps (that show the extent of inundation assuming that there are no defences) are too simplistic. A greater understanding of the scale and nature of the flood risks are required. To help achieve this, more detailed modelling has been undertaken, including depth, hazard and velocity outputs.

The ability to manage flood risk for new development must consider a wide range of issues, which includes how any evacuation of the occupants would be handled, how the new development fits in with the existing flood management provision and, should there be an event, how quickly the wider area would recover and return to normal. Some areas, either through natural or artificial topography, are easier to integrate flood management measures into the new development, without causing a significant alteration in its design and its place setting. These measures can have the potential to cause an alteration to the flood risk to adjacent property or in flood cells on the opposite bank.

## 5.4 Sequential Test

The Sequential Test must be performed when considering the placement of future development and for planning application proposals. The NPPF Technical Guidance gives detailed instructions on how to perform the test. These instructions on how to perform the test should be used with the following information from the SFRA:

- Identify the area to be assessed (including alternatives) on the Flood Zone Maps that are provided with this assessment;
- Establish the risk of flooding from other sources again using the Maps in this SFRA; and
- Follow the instructions given in the Technical Guidance.

The Sequential Test is used to direct all new development (through the site allocation process) to locations at least risk of flooding, giving highest priority to Flood Zone 1. MHDC, WDC and WCC have sequentially tested the development sites in the SWDP.

The Level 2 SFRA provides further flood risk evidence which the councils can use to assess whether it is necessary to revisit/update the Sequential Test. The Environment Agency (2009)<sup>12</sup> recommends that the following approach is used by local planning authorities to apply the Sequential Test to planning applications located in Flood Zones 2 or 3. There are three stages to the test, as follows:

- Stage 1 – Strategic application & development vulnerability
- Stage 2 – Defining the evidence base
- Stage 3 – Applying the Sequential Test

### Stage 1 – Strategic Application & Development Vulnerability

**The Sequential Test can be considered adequately demonstrated if both of the following criteria are met:**

- The Sequential Test has already been carried out for the site (for the same development type) at the strategic level (development plan) in line with procedures agreed within the National Planning Policy Framework; and
- The development vulnerability is appropriate to the Flood Zone (see Table 3 of NPPF Technical Guidance)

**1.1 Has the Sequential Test already been carried out for this development at the development plan level?** If yes, reference should be provided to the site allocation and Development Plan Document (DPD) in question.

**1.2 Is the flood risk vulnerability classification of the proposal appropriate to the Flood Zone in which the site is located according to Tables 1 and 3 of the NPPF Technical Guidance?** The vulnerability of the development should be clearly stated.

Finish here if the answer is 'Yes' to both questions 1.1 and 1.2.

Only complete Stages 2 and 3 if the answer to either questions 1.1 and 1.2 is 'No'.

<sup>12</sup> Environment Agency (2009) Demonstrating the flood risk (PPS25) Sequential Test for Planning Applications, PPS25 FRSA (national) version 2.0 Advise issued on 27 January 2009  
2012s5947 S Worcestershire Level 2 SFRA Update FINAL Report v1.0.doc

## Stage 2 – Defining the Evidence Base

**2.1 State the geographical area over which the test is to be applied.**

**2.2 If greater or less than the boundary of South Worcestershire justify why the geographical area for applying the test has been chosen.**

**Identify the geographical area of search over which the test is to be applied:**

This will usually be over the whole of the South Worcestershire but may be reduced where justified by the functional arrangements of the development (e.g. catchment area for a school or doctors surgery) or relevant objectives in the Local Plan. For example, if a local need such as affordable housing or town centre renewal has been identified as part of the Sustainability Appraisal process that has reached 'submission' stage, this might mean that the geographical area of search is restricted to a specific regeneration area. Equally, in some circumstances it may be appropriate to expand the search area beyond the council boundary for uses that have a national market.

**2.3 Identify the source of reasonable available sites, either:**

- Background / evidence base documents (state which), or if not available
- Other sites known to the councils that meet the functional requirements of the application

**Identify the source of 'reasonably available' alternative sites:**

These sites will usually be drawn from the evidence base / background documents that have been produced to inform the emerging Local Plan. For example, an important source of information for housing sites and development land will be provided by the SHLAA and the Employment Land Review (ELR).

In the absence of background documents, 'reasonably available' sites would include any sites that are known to the LPA and that meet the functional requirements of the application in question, and where necessary, meet the Local Plan Policy criterion for windfall development (see below).

**Windfall sites:**

These are sites which have not been allocated in the Local Plan process but are normally within the development boundaries within which the principle of development is acceptable. The Environment Agency recommend that the acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations and quantities of windfall development that would be acceptable or not in Sequential Test terms.

In the absence of a flood risk windfall policy, it may be possible (where the data is sufficiently robust) for the LPA to apply the Sequential Test taking into account historic windfall rates and their distribution across the district relative to Flood Zones. Where historic and future trends evidence indicate that housing need in the district through windfall can be met largely/entirely by development outside high flood risk areas, this may provide grounds for factoring this into the consideration of 'reasonably available' alternative sites at the planning application stage.

**2.4 State the method used for comparing the flood risk between sites, whether it is this SFRA or an alternative (e.g. Environment Agency flood map, site specific flood risk assessment) as new information becomes available.**

**Identify the means of comparing flood risk between each site:**

As a starting point this will be the Environment Agency Map showing the Flood Zones. If comparing sites within the same Flood Zone it is necessary to use a SFRA showing a variation in risk throughout the Flood Zone or site specific FRAs where these are available and suitable for the purpose.

### Stage 3 – Applying the Sequential Test

**Compare the reasonably available sites identified under stage 2 with the application site:**

Sites should be compared in relation to flood risk; development plan status; capacity; and constraints to delivery including availability, policy restrictions, physical problems or limitations, potential impacts of the development, and future environmental conditions that would be experienced by the inhabitants of the development.

- 3.1 State the name and location of the reasonably available site options being compared to the application site**
- 3.2 Indicate whether flood risk on the reasonable available options is higher or lower than the application site.** State the Flood Zone or SFRA classification for each site.
- 3.3 State whether the reasonably available options being considered are allocated in the Development Plan.** Confirm the status of the plan.
- 3.4 State the approximate capacity of each reasonably available site being considered. This should be based on:**
  - the density policy within the Local Plan
  - the current Strategic Housing Land Availability Assessment (SHLAA)
  - past performance
- 3.5 Detail any constraints to the delivery of identified reasonably available options;** for example, availability within a given time period or lack of appropriate infrastructure i.e. flood defences which protect the site through its design lifetime. This part of the test should include recommendations on how these constraints should be overcome and when.

#### Sequential Test Conclusion

Are there any reasonably available sites in areas with a lower probability of flooding, which would be appropriate to the type of development or land use proposed?

**Next Steps**

**Exception Test:**

Where necessary, the Exception Test should now be applied in the circumstances set out by Tables 1 and 3 of NPPG Technical Guidance.

**Applying the sequential approach at the site level:**

In addition to the formal Sequential Test, developers should apply the sequential approach to locating development within the site.

The following questions should be considered:

- Can risk be avoided through substituting less vulnerable uses or by amending the site lay-out?
- Has the applicant demonstrated that less vulnerable uses for the site have been considered and reasonably discounted?
- Can layout be varied to reduce the number of people or flood risk vulnerability or building units located in higher risk parts of the site?

### 5.5 Exception Test

If, following application of the Sequential Test, it is not possible for the development to be located in areas with a lower probability of flooding then the Exception Test can be applied, if appropriate. The aim of the Exception Test is to ensure that more vulnerable property types, such as residential development, are not located in areas at high risk of flooding. For the Test to be passed, both the following elements have to be passed for development to be allocated or permitted:



- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared, and
- A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

If it is proposed that development should include provision of an emergency plan then consultations should be held with the Local Authority Emergency Planner and appropriate emergency services and advice sought.

The NPPF and Technical Guidance give detailed information on how the Test can be applied and should be used in conjunction with the mapping created for this SFRA update.

## 6 Overview of future development

The South Worcestershire Development Plan Preferred Options was published in September 2011. After considering representations on the Preferred Options and new evidence, such as the Strategic Housing Market Assessment (2012), the South Worcestershire Councils consulted on Proposed Significant Changes to the Preferred Options plan in the summer of 2012. The significant Changes (to the Preferred Options) proposed a revised housing requirement of about 23,200 dwellings and 280 hectares of employment land between 2006 and 2030. Around 40% of these dwellings have either been built since 2006, are under construction or have the benefit of planning permission or a previous Local Plan proposed allocation for development<sup>5</sup>.

### 6.1 Extent and type of development

The SWDP to accommodate the future development can be divided into three areas, shown in Table 6-1. The following sections provide greater detail on future development for the main urban areas in South Worcestershire.

**Table 6-1: Dwelling and employment land requirements between 2006 and 2030**

	Requirements for dwellings	Requirement for employment land (hectares)
Wider Worcester Area*	9,400	120
Wychavon	8,900	120
Malvern Hills	4,900	40
<b>Total for South Worcestershire</b>	<b>23,200</b>	<b>280</b>

\* includes urban extensions serving the needs of Worcester City located on land immediately adjoining the city boundary

### 6.2 Review of future development

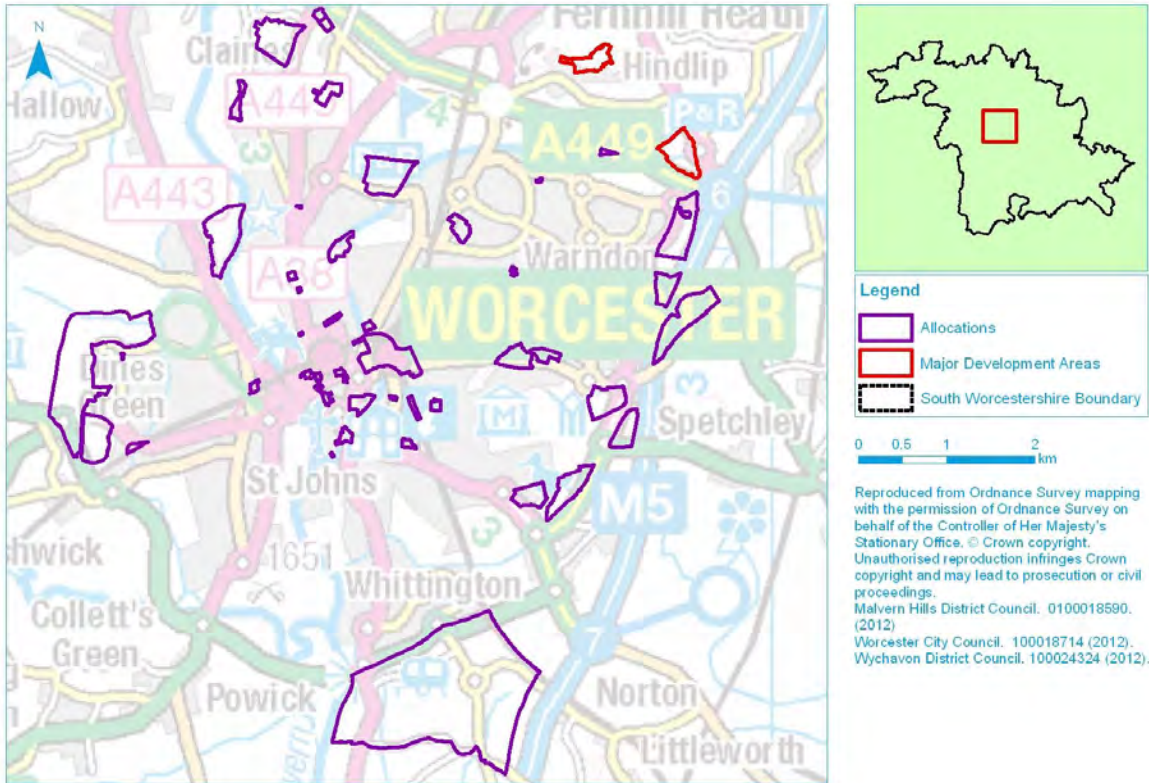
Future development is summarised below.

#### 6.2.1 Worcester

The SWDP proposes a total housing provision of 9,400 dwellings and 120 hectares of employment land in the Wider Worcestershire Area. Of these, 1,770 dwellings and 9.0 hectares of employment land have been completed since 2006. Just fewer than 1,200 dwellings have planning permission. Of the remaining proposed dwellings, approximately 1,400 are proposed in allocations sites within the city boundary, and about 3,900 in urban extensions including:

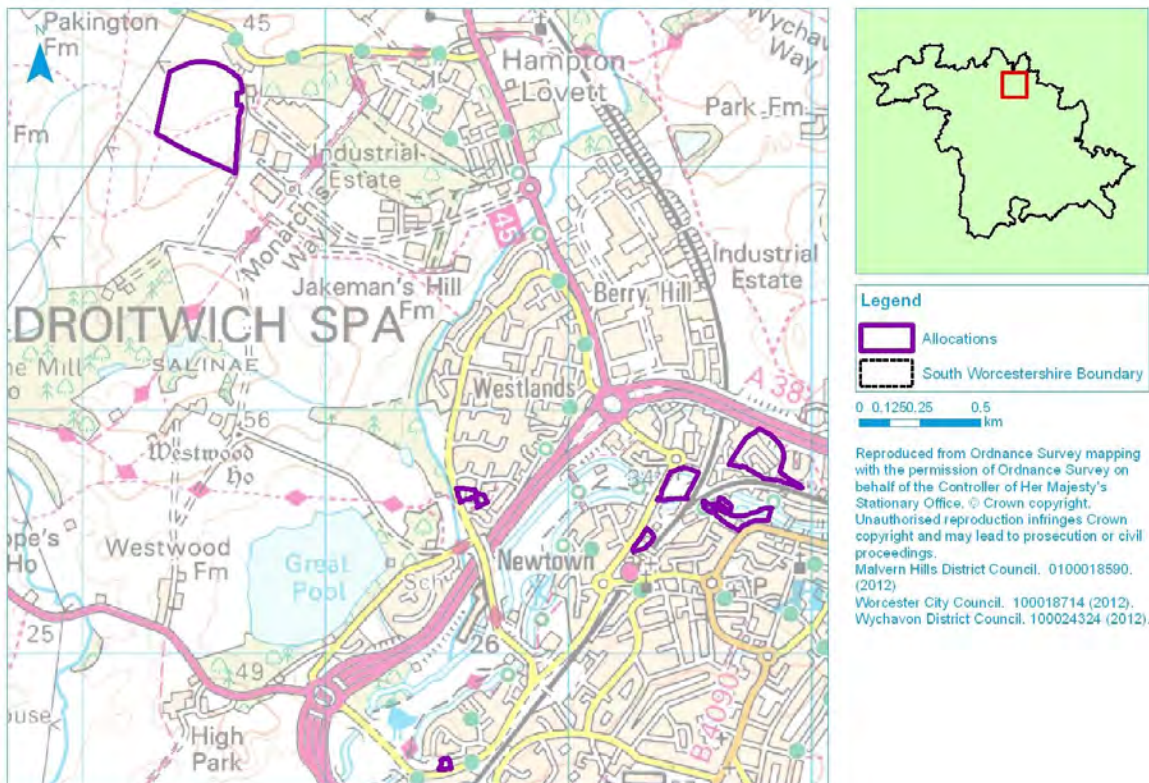
- Worcester South urban extension (Broomhall Community and Norton Barracks Community)
- Worcester West urban extension (Temple Laugherne)
- Worcester East urban extension (Kilbury Drive)
- Worcester North urban extension (Gwillam's Farm)

**Figure 6-1: Proposed Worcester Allocations**



**6.2.2 Droitwich Spa**

**Figure 6-2: Proposed Droitwich Spa Allocations**



A proposed 340 dwellings have been allocated within development boundary of Droitwich Spa, predominantly delivered on 'Brownfield' land within the development boundary. An additional 10ha of employment land has been proposed to the Stonebridge Cross Business Park.

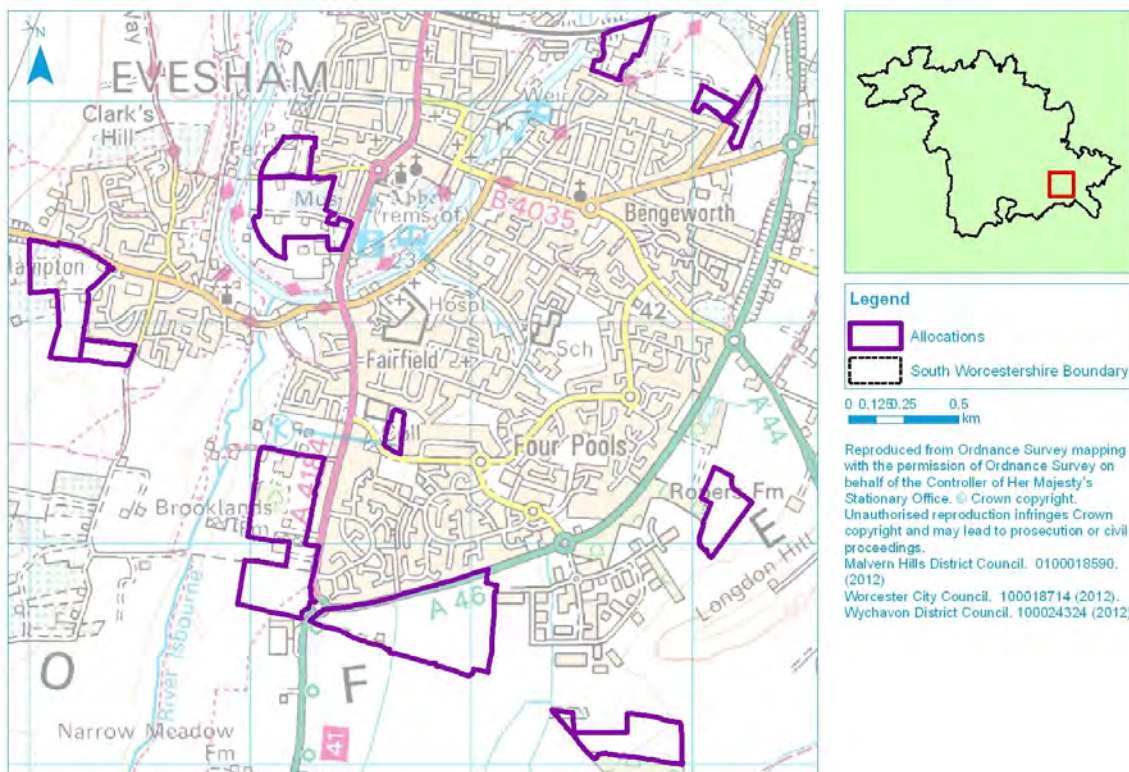
### 6.2.3 Evesham

Approximately 476 dwellings are proposed within the development boundary at Evesham, predominantly on greenfield land. Existing open space will be protected, enhanced and, where appropriate, new accessible green spaces identified. Evesham has insufficient development capacity within the development boundary therefore the SWDP also proposes two urban extensions with a phased delivery of approximately 400 dwellings each. These urban extensions are located at the following sites

- West of Cheltenham Road
- South of Pershore Road

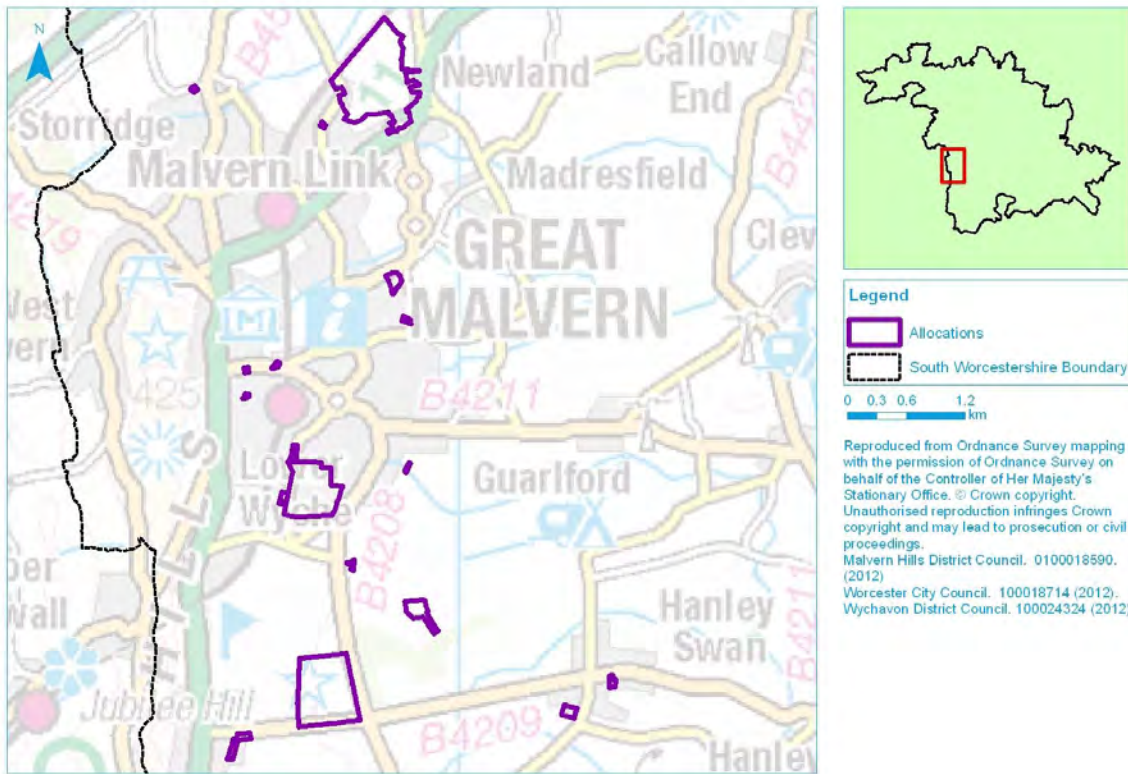
A further extension of Vale Park, to the south of the A46(T) is also proposed with a phased delivery of approximately 20 hectares of employment land.

Figure 6-3: Proposed Evesham Allocations



**6.2.4 Malvern**

**Figure 6-4: Proposed Malvern Allocations**

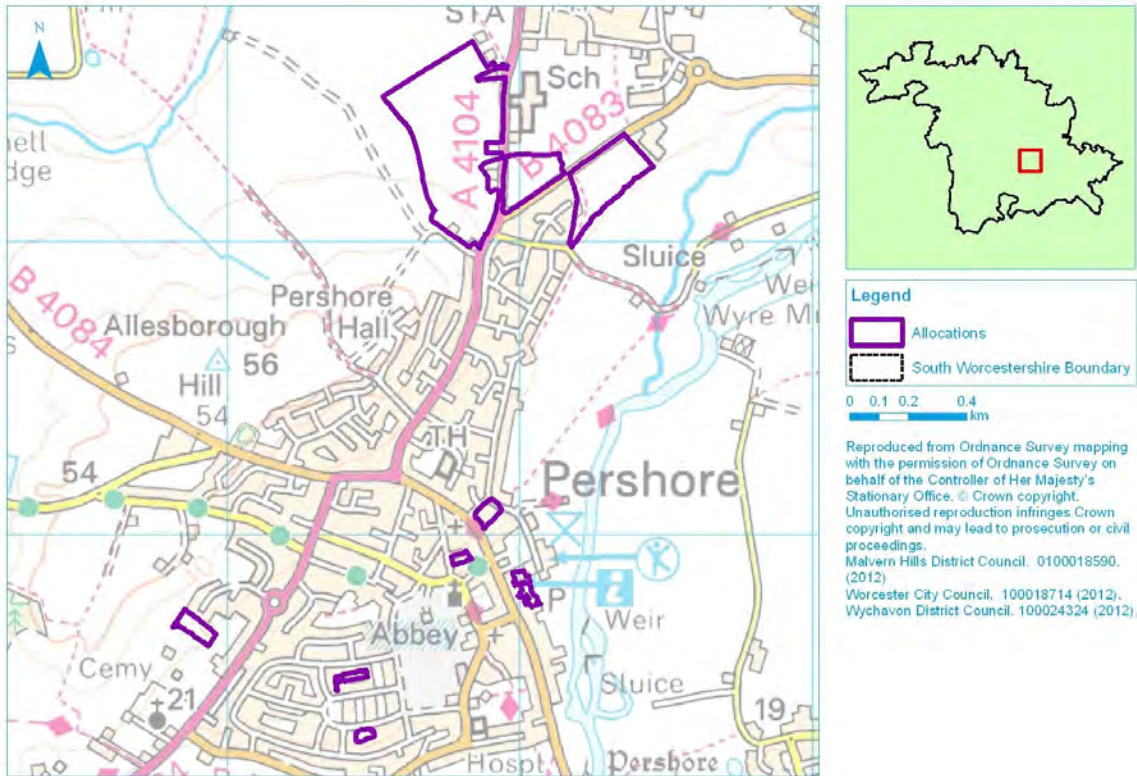


Malvern’s urban capacity has been established at approximately 4.5 hectares of employment land and 170 dwellings on smaller sites, with a proposed additional 250 dwellings and 4.5 hectares of employment land on the Malvern Hills Technology Park (QinetiQ) site. To meet the level of development set out in the Development Strategy, it is proposed that a further 10 hectares of employment land and 700 dwellings will have to be developed outside of the town boundary at Newland, north east Malvern. This site includes approximately 50 hectares of land, allocated for a mixed use urban extension including residential dwellings, employment, community infrastructure, public open space facilities. The Development Plan Consultation Document states a comprehensive master plan would be required for the Newland site.

**6.2.5 Pershore**

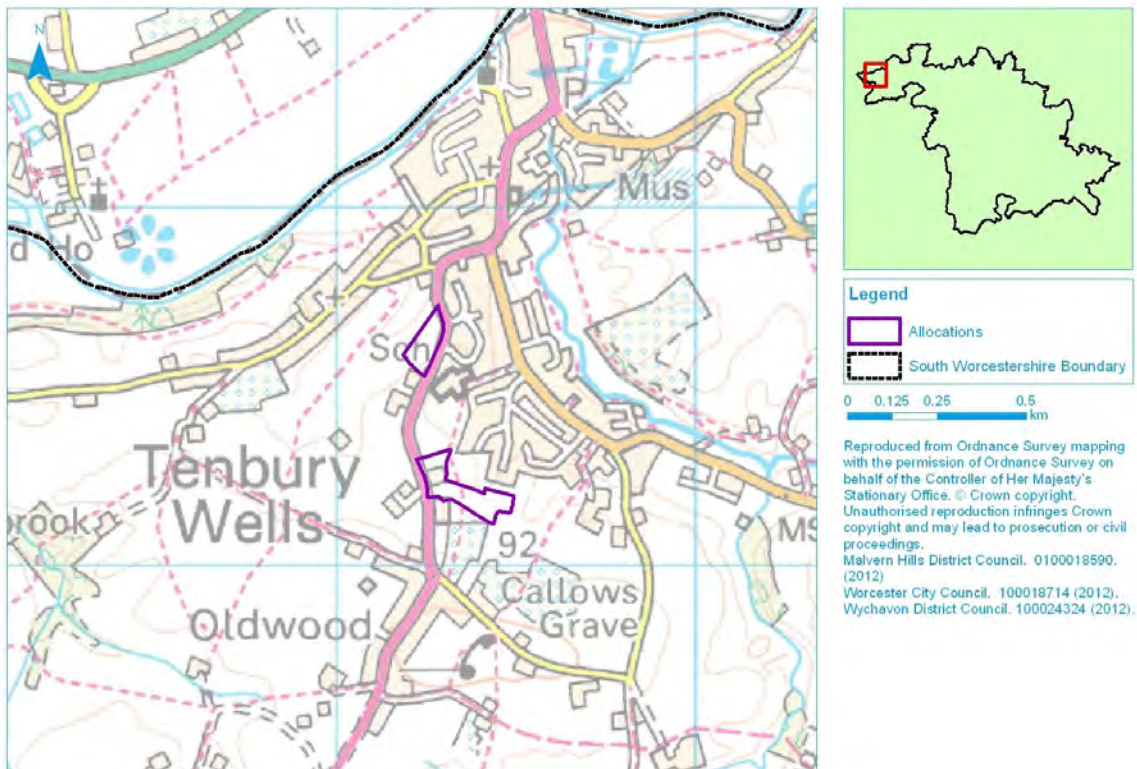
673 dwellings have been allocated in Pershore. Of these, 87 dwellings have been proposed within Pershore and 600 on an urban extension north of Pershore on at Station Road and Wyre Road. Proposed urban extensions in Pershore also allow for the proposed allocation of five hectares of employment land to the north of Wyre Road.

**Figure 6-5: Proposed Pershore Allocations**



**6.2.6 Tenbury Wells**

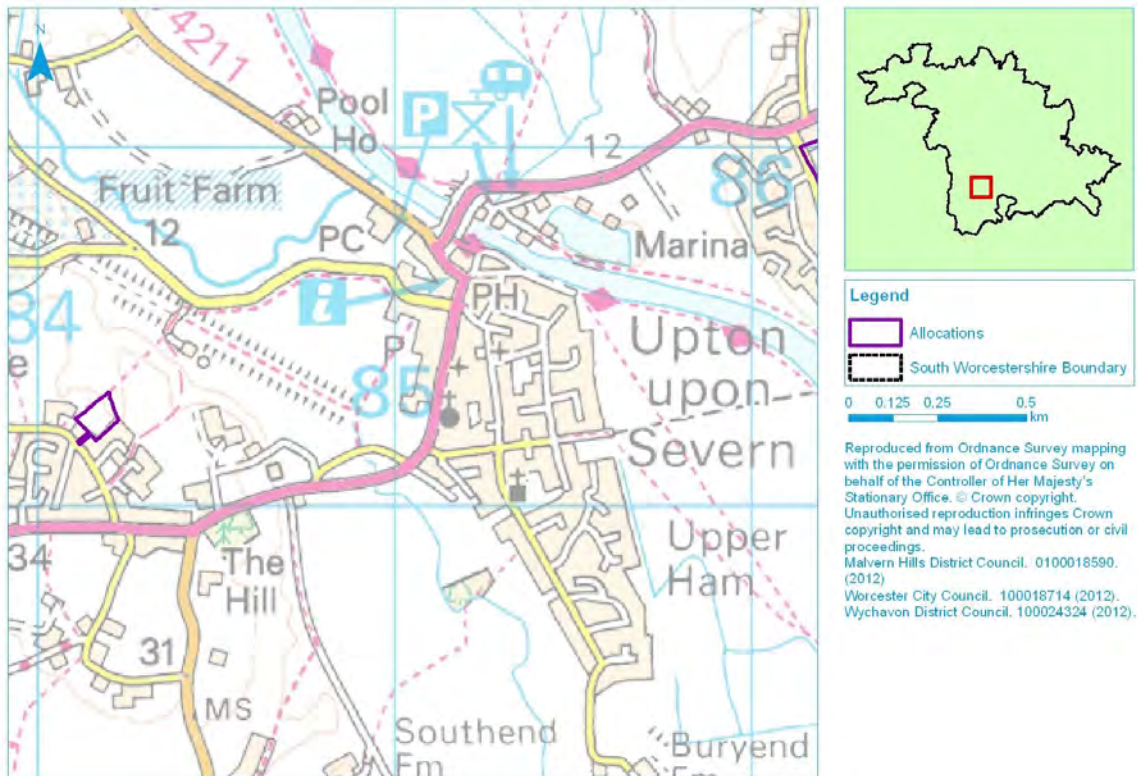
**Figure 6-6: Proposed Tenbury Wells Allocations**



Development at Tenbury Wells is limited due to floodplain, landscape and access issues. The former cattle market site at Teme Street has been allocated to provide 0.88 hectares of employment land with redevelopment or alternative use focussing on retail, commercial, recreation, leisure and community uses. Proposed additional sites in Tenbury Wells have been allocated for approximately 70 dwellings.

### 6.2.7 Upton upon Severn

Figure 6-7: Proposed Upton upon Severn Allocations



Floodplain, landscape and access issues limit the potential for development at Upton upon Severn. Housing and commercial development for this area has been focussed on the settlements of Holly Green, with 25 dwellings allocated to Holly Green. Although there are flooding constraints, the SWDP has defined Upton on Severn as one of the most sustainable settlements in the Malvern Hills District with a large population and associated community, education and community services. The town also supports a large marina and tourist trade.

### 6.2.8 Rural Areas

South Worcestershire is predominantly rural and a key objective of the SWDP is to retain this characteristic. The development strategy for rural areas aims to direct development to rural settlements which contain a variety of services and community facilities, with reasonable existing public transport links. These factors were assessed using the Village Facilities and Rural Transport Survey to determine the sustainability of settlements. Settlements were classified into Category 1, Category 2 and Category 3 settlements, with Category 1 being considered the most sustainable.

The SWDP has allocated approximately 1,800 dwellings in rural areas by 2030. Of these approximately 1,000 have been allocated to Category 1 settlements, 700 to Category 2 and 180 to Category 3 settlements.

### 6.3 Windfall sites

Windfall is unallocated development. Changes introduced by the NPPF enables the South Worcestershire Councils to include an allowance for small, non-garden land, housing windfalls. The windfall allowance for Malvern Hills, Worcester and Wychavon are 45, 75 and 82 for 2015/16 to 2024/25 and then 30, 50 and 55 for 2025/26 to 2029/30 respectively.



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# 7 Summary assessment of SWDP development sites

## 7.1 Introduction

As of 3<sup>rd</sup> July 2012, there are 177 proposed allocation sites proposed for inclusion in the South Worcestershire Development Plan by the three councils.

An initial scoping assessment of these sites was undertaken to identify the level of flood risk to these sites and potential requirement for further, more detailed, assessment. The sites were compared against Flood Zones 1, 2 and 3, the 2007 historic flood map and the Flood Map for Surface Water. The sites were placed into one of four categories.

- Sites in Flood Zone One only and not shown at risk from surface water
- Sites in Flood Zone One only but shown as being at risk from surface water
- Sites in Flood Zone Two (including 2007 historic flood map)
- Sites in Flood Zone Two and Three

**A summary of these findings are provided in**

Table 7-1 and a breakdown of the risk to each site is provided in Appendix F.

**Important Note:** An update to the Environment Agency’s Flood Zones, to be completed later this year, will incorporate the Environment Agency’s Historic Flood Map into the Flood Zone 2 outline. The Historic Flood Map is based on Environment Agency data, aerial photography and ground survey and observations during the flood events.

After discussions with the EA, the Historic Flood Map has been incorporated into Flood Zone 2 for this study. **When using the mapping provided as part of this SFRA update, where the Historic outline extent is greater than the 1 in 1000 year modelled extent (Flood Zone 2) then the Historic outline is considered to be Flood Zone 2, and should be used when undertaking assessments of flood risk.**

**Table 7-1: Summary of risk to proposed allocation sites**

Number of Sites				
Flood Zone One only	Flood Zone One and FMfSW	Flood Zone Two	Flood Zone Two and Three	Total
48	91	9	29	177

Sites with ordinary watercourses not included in the flood zones were modelled for this SFRA to determine the level of risk. Of the 24 sites identified, one was shown to be at risk from Flood Zone 2 and 15 were shown to be at risk from Flood Zone 3. The remaining sites were shown not to be at any risk from fluvial flooding.

Those sites shown to be in Flood Zone Two and Flood Zone 3 have been taken forward in this SFRA for more detailed assessment. This assessment is summarised in the following tables.

Guidance for Flood Risk Assessment requirements for the remaining sites is provided in sections 5 and 8.

Note: Environment Agency guidance provided with the Flood Map with Surface Water places limitations on the base map scale and zoom scale at which it can be displayed<sup>13</sup> as scales larger than those suggested implies an inappropriate degree of accuracy which may lead to increased risk of misinformed decision making. Thus when using the maps it should be appreciated that the level of detail of the analysis does not reflect the high resolution inferred by the scale of the

<sup>13</sup> Using Surface Water Flood Risk Information: Guidance for LRF, RRT, LPA and LLFA. V1 (Environment Agency, November 2010)  
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mapping. To understand the risk of flooding at an individual property scale would require more detailed modelling to be prepared.

### 7.1.1 Flood Hotspots

Historic flooding incidents are based on Worcestershire County Council's historic flooding dataset. This consisted of a point layer of all historic flooding incidents within the Worcestershire area and a polygon layer of hotspots. The hotspots are based on the historic flooding incidents and a buffer applied to allow for any inaccuracy or uncertainty on the exact location of the historic incident.

Therefore, it is important to note that whilst a site may be shown as falling within, or partially within, a flooding hotspot, the site itself may not have experienced any historic flooding. This assessment is indicative only. Detailed of the number of historic flooding incidents recorded for each proposed allocation is provided in Appendix F.

## 7.2 Surface Water Drainage Assessment

A simple scoping assessment was conducted to provide a broad and generalised assessment of the hydraulic and geological characteristics of each development site to determine the constraining factors for surface water management at the proposed development sites. This assessment is designed to inform the early-stage site planning process and is not intended to replace site-specific detailed drainage assessments.

Greenfield runoff rates for each ward have been calculated using the Revitalised Flood Hydrograph (ReFH) method for non-permeable areas and the FEH Statistical method for permeable areas. The data required for these calculations was derived on a ward-by-ward basis using the FEH CD-ROM, a database of numerical descriptors representing the hydrological characteristics of watercourse catchments in the UK. Catchments were chosen which were considered to be representative of the ward, generally with a small area and fully contained within the ward boundaries. The catchment descriptors used are as follows:

BFIHOST	A measure of the catchment permeability (%)
DPLBAR	A measure of drainage path length and a function of site area (km)
DPSBAR	A measure of the average catchment slope (m/km)
SAAR <sub>4170</sub>	A measure of the average annual rainfall (mm)

The required attenuation volume was estimated using the Quick Storage Estimate tool in the software package WinDES by MicroDrainage. This tool derives a range of attenuation volumes by comparing post development runoff rates with maximum allowable discharge rates (i.e. greenfield runoff rates) for two extreme drainage outfall schematisations, assuming one large storage feature serving the entire site. For the purposes of this scoping assessment it has been assumed that development of the sites will create 75% impervious surfaces.

From the catchment characteristics derived above and additional datasets (areas susceptible to groundwater flooding map, Soil map of England and Wales, Environment Agency 'What's in your Backyard' online mapping) a broad criterion for the applicability of SUDS techniques was determined. These criteria were then used to carry out a simple assessment of the likely feasibility of different types of SUDS techniques at each of the proposed development sites. SUDS techniques were categorized into 5 main groups as follows.

**Table 7-2: Summary of SUDS Categories**

<b>SUDS Type</b>	<b>Technique</b>
Source Controls	Green Roof, Rainwater Harvesting, Pervious Pavements, Rain Gardens
Infiltration	Infiltration Trench, Infiltration Basin, Soakaway
Detention	Pond, Wetland, Subsurface Storage*, Shallow Wetland, Extended Detention Wetland, Pocket Wetland, Submerged Gravel Wetland, Wetland Channel, Detention Basin
Filtration	Surface Sand filter, Sub-Surface Sand Filter, Perimeter Sand Filter, Bioretention, Filter Strip, Filter Trench
Conveyance	Dry Swale, Underdrained Swale, Wet Swale

\* The use of sub-surface storage is not encouraged by the EA as it provides no water quality treatment and is not considered the most sustainable option. Early master planning should consider above ground drainage features as early as possible.

The suitability of each SUDS type for the proposed developments has been displayed using a traffic light colour system in the summary tables.

<b>Suitability</b>	<b>Description</b>
	The SUDS Group and its associated techniques are unlikely to be suitable at the development site based on the results of this assessment More detailed assessment may demonstrate that this type of SUDS is suitable for use at this site
	The SUDS Group and its associated techniques may be suitable at the development but is likely to require additional engineering works. Some techniques from this group may not be suitable for use at the development.
	The SUDS Group and its associated techniques are likely to be suitable at the development site based on the results of this assessment. More detailed assessments should be carried out during the site planning stage to confirm the feasibility of this type of SUDS.

### 7.3 Groundwater Assessment

The Environment Agency’s Areas Susceptible to Groundwater Flooding (AStGWF) has been used to provide an indication of whether an area may be at risk of flooding from groundwater.

The AStGWF is a strategic scale map showing groundwater flood areas on a 1km square grid. It shows the proportion of each 1km grid square where geological and hydrogeological conditions show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. The maps should not be used to identify areas where groundwater is actually likely to flow or pond but may be used to give an indication of where further studies may be required. Each grid square is classified using one of the following four categories:

Proportion of each 1km grid square that is susceptible to groundwater flood emergence.
<25%
>=25% <50%
>=50% <75%
>=75%

Note: for this SFRA update the AStGWF has been used to identify sites where further studies may be required, as part of a detailed FRA, to determine whether a site is at risk from groundwater flooding.

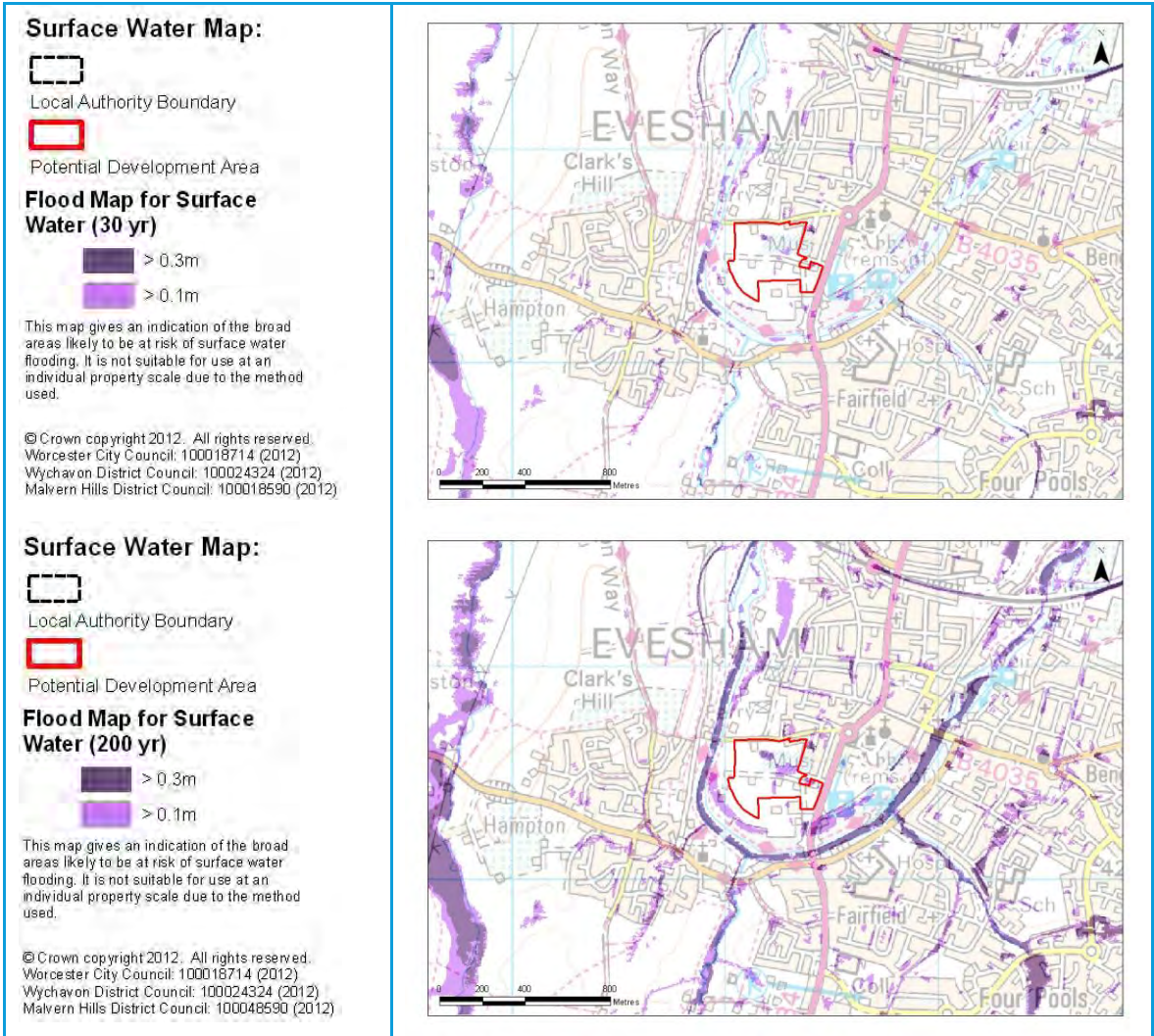
In addition, historic flooding data provided by Worcestershire County Council has been used to identify any locations where groundwater flooding is known to have occurred in the past.

Analysis of the historic flooding data has shown there is no recorded groundwater flooding events within the proposed allocation sites.

**The flood mapping information provided for this Level 2 Strategic Flood Risk Assessment update will be given full consideration during the preparation of the South Worcestershire Development Plan.**

## 7.4 Summary tables and maps

Table 7-3: 37-N16 (Land to the West of Abbey Road, South of Boat Lane)				
<b>OS NGR:</b> SP 031435	<b>Area:</b> 10.4ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 0%	<b>FZ3b:</b> <1%	<b>FZ2:</b> 7%	<b>FZ1:</b> 93%
<b>Exception Test required?</b> Yes, for Highly Vulnerable Infrastructure development in FZ2.				
<b>Requirements for passing the Exception Test:</b>				
<ul style="list-style-type: none"> <li>To pass Part 'b' of the Exception Test, a FRA should demonstrate that the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.</li> <li>Development should be located away from the River Avon and Flood Zone 2 and 3. It should be possible to reduce flood risk at this development area by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.</li> <li>New development being located outside of Flood Zone 2 and 3 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space, with the potential for a buffer.</li> <li>Safe access and egress would need to be demonstrated.</li> <li>Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.</li> </ul>				
<p><b>Flood Zone Map:</b></p> <p> Local Authority Boundary</p> <p> Potential Development Area</p> <p><b>Flood Zones</b></p> <ul style="list-style-type: none"> <li> Flood Zone 3b</li> <li> Flood Zone 3a</li> <li> Flood Zone 2</li> <li> 2007 historic flood map</li> </ul> <p>Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.</p> <p><small>© Crown copyright (2012). All rights reserved. Malvern Hills District Council: 0100018590 (2012) Worcester City Council: 100018714 (2012) Wychavon District Council: 100024324 (2012)</small></p>				
<p><b>Climate Change:</b></p> <p> Local Authority Boundary</p> <p> Potential Development Area</p> <p><b>Flood Zone 3 with Climate Change</b></p> <p></p> <p><small>© Crown copyright 2012. All rights reserved. Worcester City Council: 100018714 (2012) Wychavon District Council: 100024324 (2012) Malvern Hills District Council: 100048590 (2012)</small></p>				



**Sources of Flood Risk:**

- The main source of flood risk to the site is from surface water. Surface water is shown to cover parts of the main access roads to the site including the A4184 Abbey Road and the minor roads of Abbey Lane and Boat Lane.
- The western edge of the site falls within Flood Zone 2 and Flood Zone 3b. Primary fluvial risk is to the western edge of the site resulting from overtopping of the River Avon. The western edge of the site is located in the Blue Zone of the Policy Maps. Sections of the A4184 Abbey Road and Boat Lane, some of the main access roads to the site, fall within Flood Zone 3.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	10
	1 in 100 year (plus climate change)	39.4
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	3,536 – 4,898.4	

<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All forms of source control are likely to be suitable
Infiltration		Mapping suggests the underlying soil type may hinder the performance of such devices and therefore would not be viable
Detention		Mapping suggests that the site slopes are suitable for all forms of detention
Filtration		Mapping suggests that filtrations would be suitable but require a form of liner to prevent ingress of groundwater into the SUDS system
Conveyance		All forms of conveyance are likely to be suitable

- This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.
- The site is not located within a groundwater source protection zone.
- Residential and commercial developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**  
None.

**Effects of Climate Change:**  
Increased rainfall intensity. Increased flood risk from the River Avon.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Flood Zone 2 should be used as public open space with the potential for a buffer.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The main access roads; A4184 Abbey Road, Abbey Lane and Boat Lane are at risk of fluvial flooding and \ or surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.



**Table 7-4: 37-N17 (Land to the north of Boat Lane)**

<b>OS NGR:</b> SP 031435	<b>Area:</b> 3.33ha	<b>Brown/Greenfield:</b> Greenfield		
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 0%	<b>FZ3b:</b> 0%	<b>FZ2:</b> 6%	<b>FZ1:</b> 94%

**Exception Test required?** Yes, for Highly Vulnerable development in FZ2.

**Requirements for passing the Exception Test:**

- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Development should be located away from the west of the site and Flood Zone 2. It should be possible to reduce flood risk at this development area by using sequential design to locate more vulnerable developments towards higher ground through building design and by meeting drainage requirements.
- New developments being located outside of Flood Zone 2 need to ensure that no increase in flood risk occurs. Areas with Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage

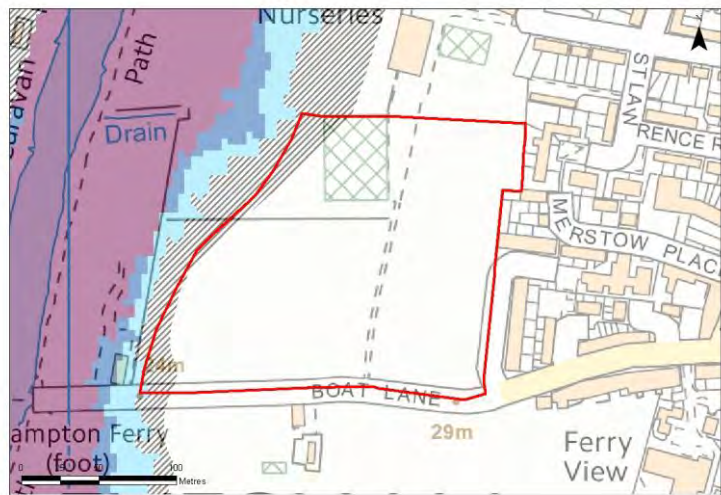
**Flood Zone Map:**

**Flood Zones**

- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2
- 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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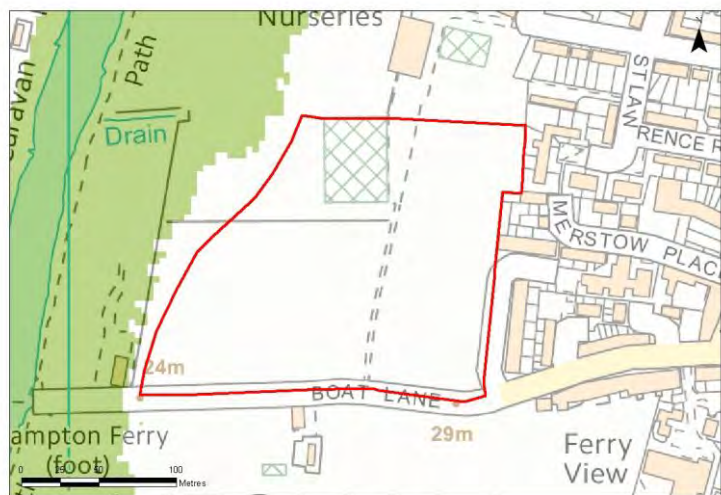


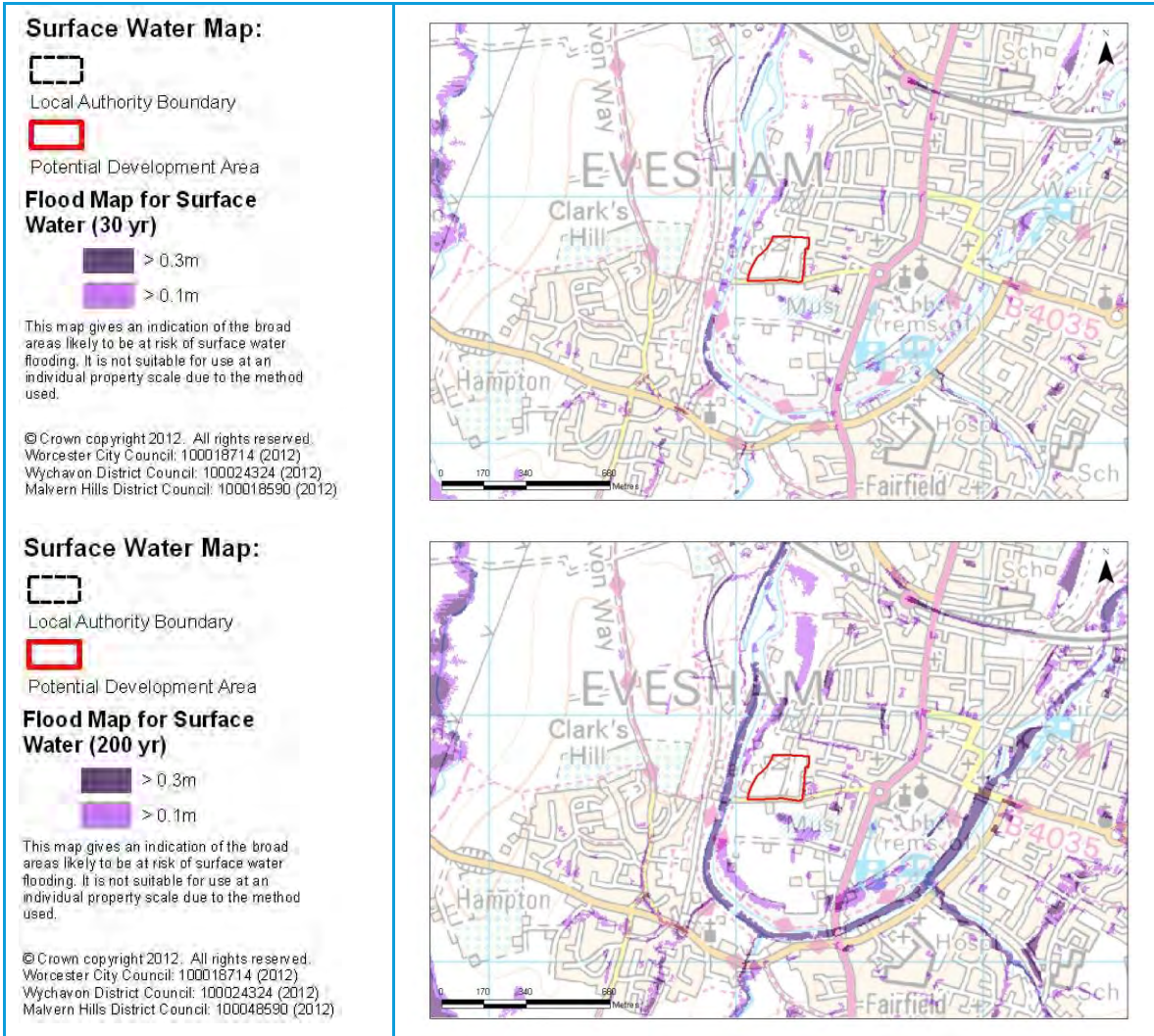
**Climate Change:**

**Flood Zone 3 with Climate Change**

- Flood Zone 3 with Climate Change

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- Sources of Flood Risk:**
- Primary flood risk to the site is fluvial resulting from overtopping of the River Avon. The western edge of the site falls within the historic flood map (Flood Zone 2). The western end of Boat Lane, the main access road to the site, is risk from fluvial flooding.
  - Surface water presents a risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The main access road, Boat Lane, is at risk of surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	10.0
	1 in 100 year (plus climate change)	39.4
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	1132.2-1568.4	

<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All source control techniques are likely to be suitable
Infiltration		Mapping suggests low permeability at this site, site investigation should be carried out to assess potential for drainage by infiltration
Detention		Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater. Mapping suggests that site slopes may be steep so larger features may not be viable
Filtration		All filtration techniques are likely to be suitable
Conveyance		All conveyance techniques are likely to be suitable

- This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.
- The site is not located within a groundwater source protection zone.
- Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**  
None.

**Effects of Climate Change:**  
Increased rainfall intensity. Increased water levels in the River Avon.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Development of the site is proposed to focus on residential uses.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The site falls within an area highly susceptible to groundwater emergence (>25-50%). An assessment of suitable surface water mitigation techniques should be made.
- The main access road to the site, Boat Lane, is at risk from both fluvial flooding and surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe

**Table 7-5: LP1 (Ivy Lane)**

<b>OS NGR:</b> SP 089443	<b>Area:</b> 0.7ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 0%	<b>FZ3b:</b> 0%	<b>FZ2:</b> 100%	<b>FZ1:</b> 0%

**Note:** the 2007 historic flood map in this location has been questioned by council drainage officers and is in the process of being investigated by the Environment Agency. This could potentially mean this area may be removed from future EA Flood Zone mapping.

**Exception Test required?** Yes, for Highly Vulnerable development in FZ2.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- It may be possible to reduce flood risk at this development area by using sequential design to locate more vulnerable developments towards higher ground through building design and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

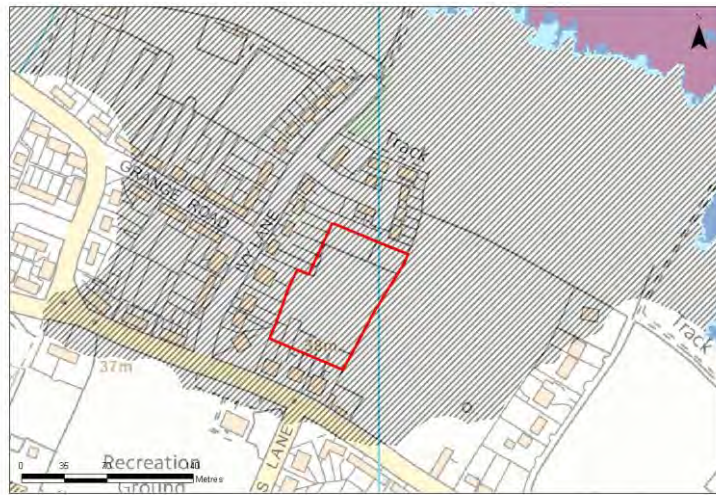
**Flood Zone Map:**

**Flood Zones**

- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2
- 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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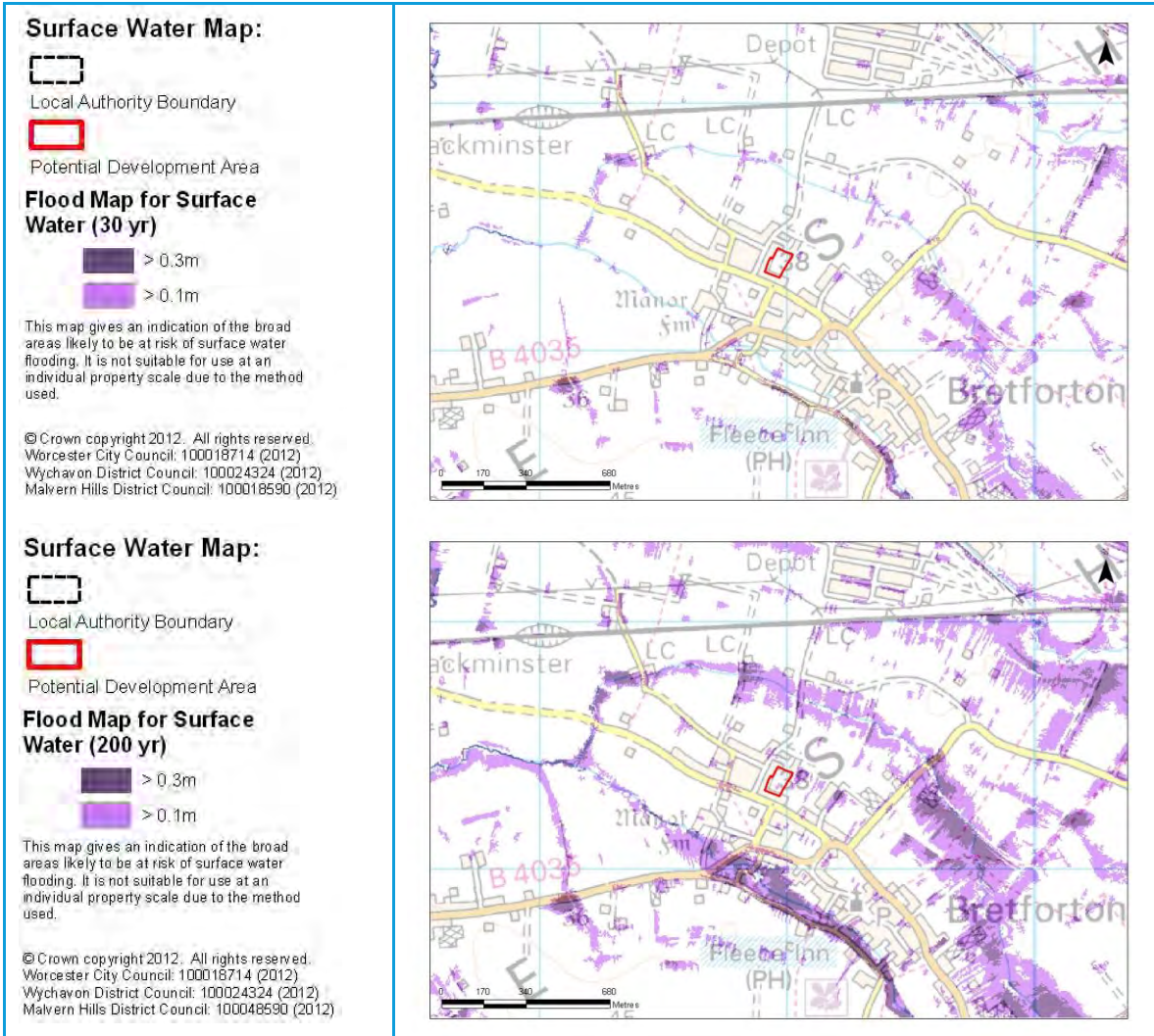
**Climate Change:**

**Flood Zone 3 with Climate Change**

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**Sources of Flood Risk:**

- Primary flood risk is fluvial resulting from overtopping of an unnamed watercourse to the north of the development site. The site is fully within the historic flood map (Flood Zone 2). Note: the 2007 historic flood map in this location has been questioned by council drainage officers and is in the process of being investigated by the Environment Agency. This could potentially mean this area may be removed from future EA Flood Zone mapping.
- Surface water may present a risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Unknown – More Permeable	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	8.4
	1 in 100 year (plus climate change)	32.0
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	251.3 – 351.4	

<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding
Infiltration		Mapping suggests underlying soil is likely to be permeable. However, the high risk of groundwater flooding would make infiltration unsuitable
Detention		Mapping suggests that the site slopes are suitable for all forms of detention
Filtration		Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Conveyance		All conveyance techniques are likely to be suitable

- This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.
- The site is not located within a groundwater source protection zone.
- Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**  
None

**Effects of Climate Change:**  
Increased rainfall intensity. Increased water levels in the unnamed watercourse.

**Flood Risk Implications for Development:**

- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Development of the site is proposed to focus on residential uses.
- Built development should be located outside of Flood Zone 2. As the site is 100% covered by Flood Zone 2, this site should not be considered as suitable for built development.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Any development at this site will require a site-specific flood risk assessment.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- There are currently no access roads to the site. If new access roads are considered flood risk needs to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-6: 69\_05 (Land adjacent to Honeybourne Road)**

<b>OS NGR:</b> SP 131465	<b>Area:</b> 1.11ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 5%	<b>FZ3b:</b> 7%	<b>FZ2:</b> 1%	<b>FZ1:</b> 87%

**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.  
Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the unnamed tributary of Noleham Brook and Flood Zone 2 and 3, located to the east and north-east of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

Local Authority Boundary

Potential Development Area

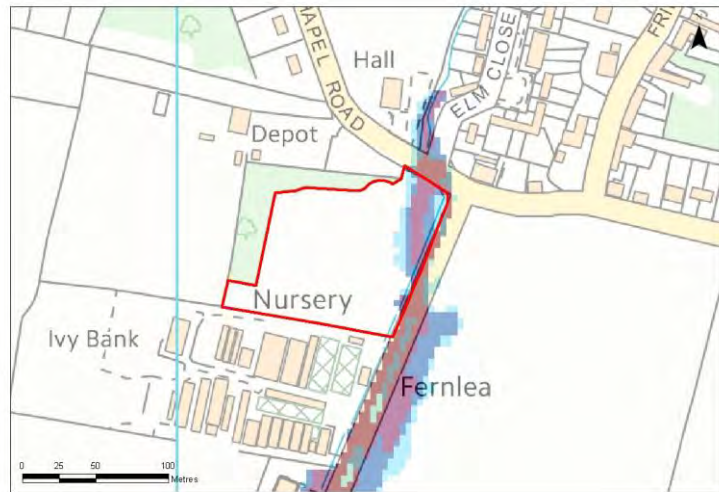
**Flood Zones**

- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2

2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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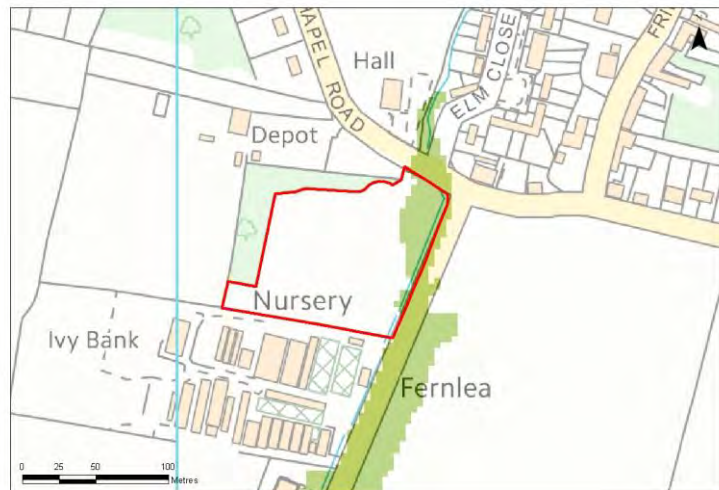
**Climate Change:**

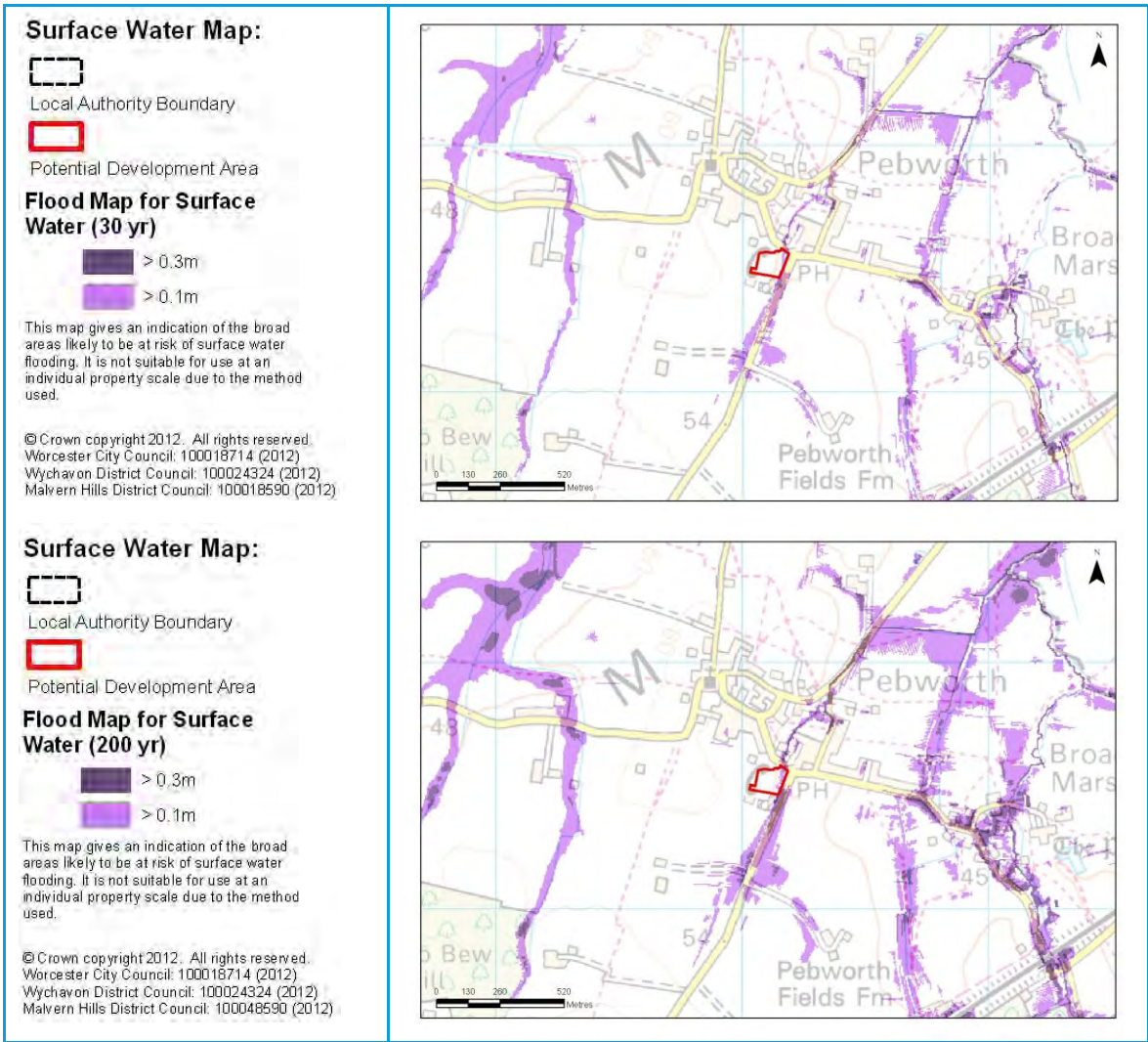
Local Authority Boundary

Potential Development Area

**Flood Zone 3 with Climate Change**

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**Sources of Flood Risk:**

- Primary flood risk to the site is fluvial from an unnamed tributary of Noleham Brook, resulting from overtopping of the banks to the east and north-east of the site. The eastern and north-eastern edge of the site falls within Flood Zone 3b. The east and north-east edge of the site are located in the Blue Zone of the Policy Maps. The Chapel Road and the Stratford road, the main access roads to the site are at risk from fluvial flooding.
- Surface water presents a risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The Chapel Road and the Stratford road, the main access roads to the site are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Unknown – Less Permeable	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	8.4



	1 in 100 year (plus climate change)	31.1
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	420 – 600	
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All source control techniques are likely to be suitable
Infiltration		Mapping suggests low permeability at this site and a risk of groundwater flooding. A site investigation should be carried out to assess potential for drainage by infiltration
Detention		Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater.
Filtration		Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater.
Conveyance		All conveyance techniques are likely to be suitable
<ul style="list-style-type: none"> <li>• This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.</li> <li>• The site is not located within a groundwater source protection zone.</li> <li>• Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensity. Increased water levels in the unnamed tributary of Noleham Brook.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>• Development of the site is proposed to focus on residential uses.</li> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>• A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>• Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>• Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>• Assessment for runoff should include allowance for climate change effects.</li> <li>• New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>• Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>• The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.</li> <li>• All current access roads to the site, the Chapel Road and the Stratford road, are at risk from both fluvial and surface water flooding. Suitable alternative access arrangements away from the floodplain will need to be investigated further.</li> <li>• Demonstration that development at this location can be made safe.</li> </ul>		

**Table 7-7: 2012SC (Stonebridge Cross)**

<b>OS NGR:</b> SO 874652	<b>Area:</b> 11.49ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 1%	<b>FZ3b:</b> 1%	<b>FZ2:</b> 3%	<b>FZ1:</b> 95%
<p><b>Exception Test required?</b> Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.</p> <p>Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.</p> <p><b>Requirements for passing the Exception Test:</b></p> <ul style="list-style-type: none"> <li>To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.</li> <li>Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the unnamed tributary of Hadley Brook and Flood Zone 2 and 3 located to the west of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.</li> <li>Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.</li> </ul>				

**Flood Zone Map:**

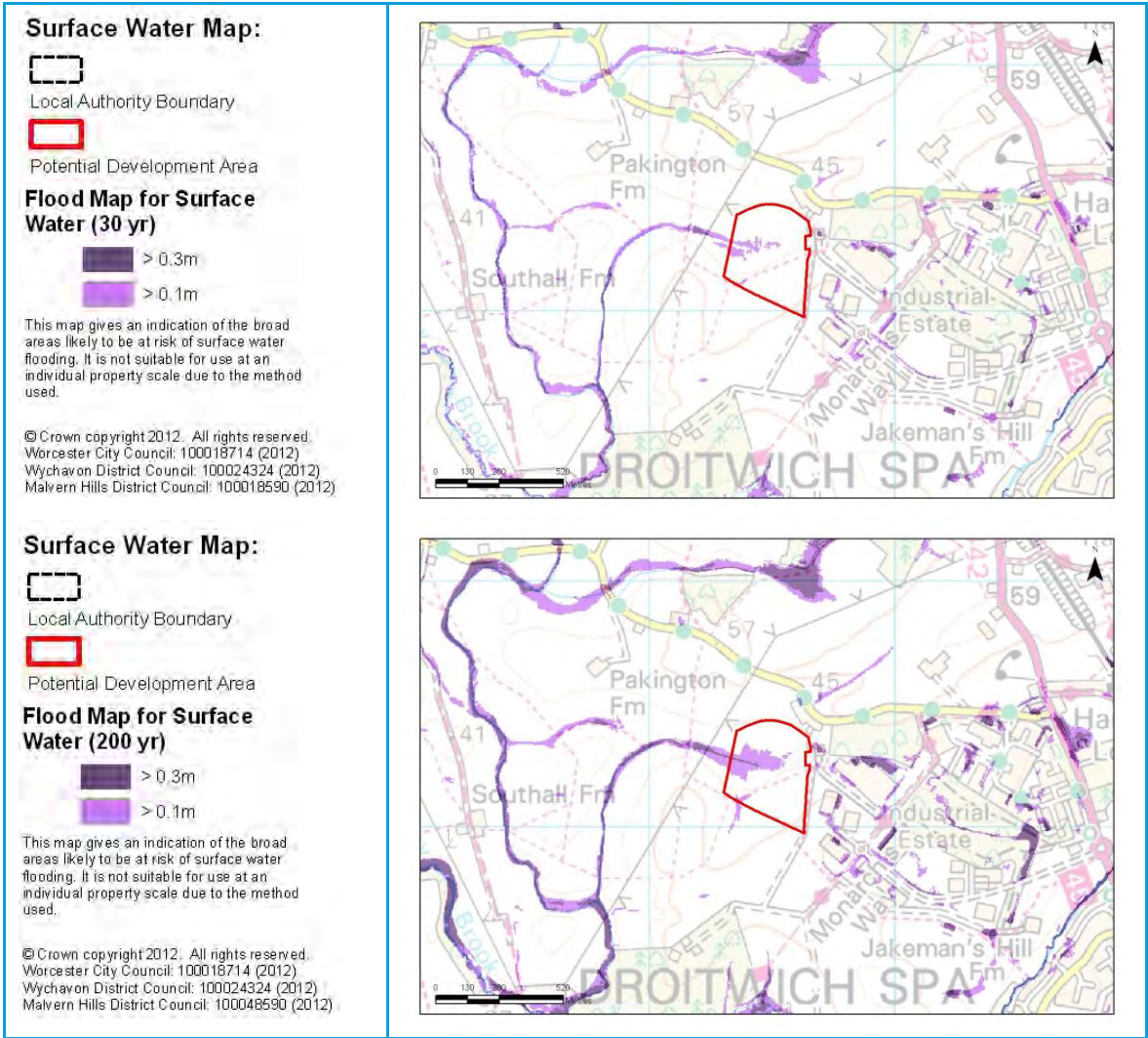
Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.  
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**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**  
 Flood Zone 3 with Climate Change  
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- Sources of Flood Risk:**
- The main source of flood risk to the site is from surface water, shown to inundate a large central portion of the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk.
  - The central and western portion of the site falls within Flood Zone 3b. Primary fluvial risk is to the central and western portions of the site resulting from overtopping of the unnamed tributary of Hadley Brook. The central and western portion of the site falls within the Blue Zone of the Policy Maps.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Unknown – Less Permeable	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	9.4
	1 in 100 year (plus climate change)	35.8
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	2,530 – 3,680	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control		All source control techniques are likely to be suitable
Infiltration		Mapping suggests low permeability at this site, site investigation should be carried out to assess potential for drainage by infiltration
Detention		Mapping suggests that site slopes may be steep, larger 'above ground' features may not be viable
Filtration		All filtration techniques are likely to be suitable
Conveyance		All conveyance techniques are likely to be suitable

- The site is not located within a groundwater source protection zone.
- Commercial developments should provide at least two independent SUDS features. in series to provide a suitable level of water quality treatment.

**Flood Defences:**

None.

**Effects of Climate Change:**

Increased rainfall intensity. Increased water levels in the unnamed tributary of Hadley Brook.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Development of the site is proposed to focus on commercial uses.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- There are currently no access roads to the site. If new access roads are considered flood risk needs to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-8: MHWD10 (Land at The Pheasant Inn)**

<b>OS NGR:</b> SO 797400	<b>Area:</b> 0.33ha		<b>Brown/Greenfield:</b> Brownfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 1%	<b>FZ3b:</b> 2%	<b>FZ2:</b> 1%	<b>FZ1:</b> 96%

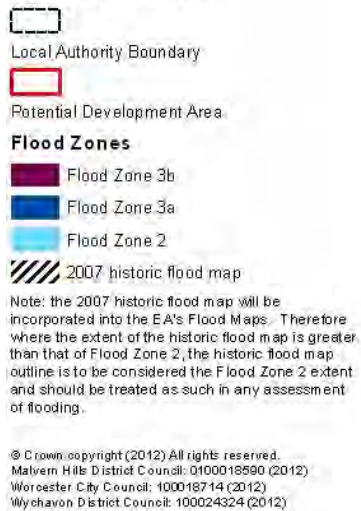
**Exception Test required?** Yes, for More Vulnerable and Essential Infrastructure development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from an unnamed tributary of the China Brook and Flood Zone 2 and 3, located to the eastern edge of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

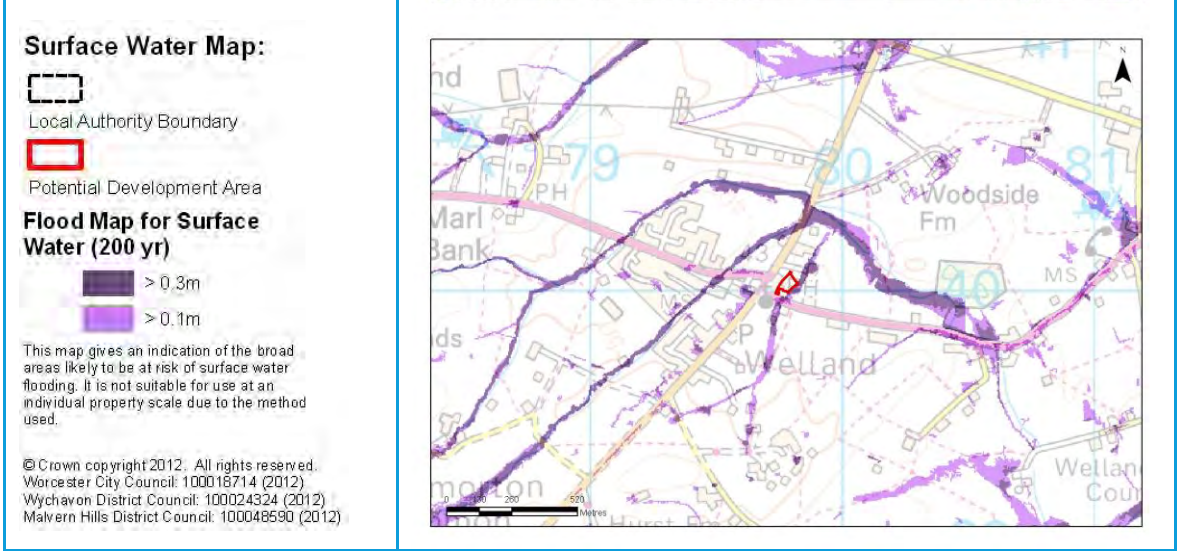
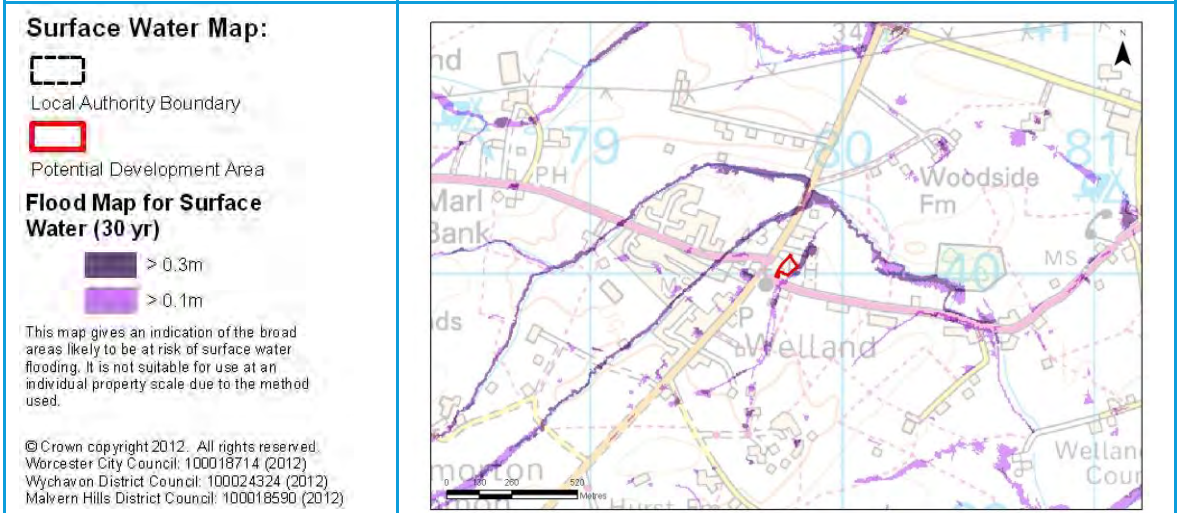
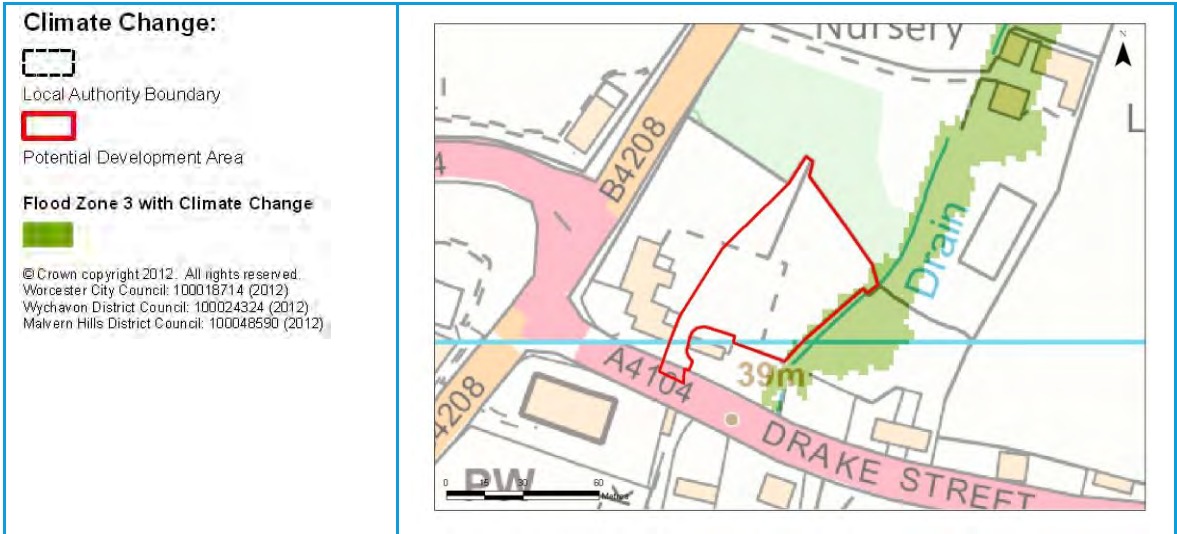


Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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- Sources of Flood Risk:**
- Primary flood risk to the site is fluvial, resulting from overtopping of the unnamed tributaries of the China Brook, to the eastern edge of the site. The eastern boundary of the site falls within Flood Zone 3b. The eastern boundary of the site falls within the Blue Zone of the Policy Maps.
  - This site is shown to be partially within one of the County Council's historic flood hotspots.
  - Surface water presents a risk to the site, to the eastern boundary. Further development and creation of impermeable surfaces may result in an increase of

surface water flood risk. The A4104 Drake Street road and the B4028, the main access roads to the site, are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Unknown – Low Permeability	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	10
	1 in 100 year (plus climate change)	39.1
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	65 – 100	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control	Green	All source control techniques are likely to be suitable
Infiltration	Red	Mapping suggests underlying soil is unlikely to be permeable. A site investigation should be carried out to assess suitability of drainage by infiltration
Detention	Yellow	Mapping suggests that site slopes may be steep so larger 'above ground' features may not be viable
Filtration	Green	All filtration techniques are likely to be suitable.
Conveyance	Green	All conveyance techniques are likely to be suitable

- The site is not located within a groundwater source protection zone.
- Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**

None.

**Effects of Climate Change:**

Increased rainfall intensity. Increased water levels in the unnamed tributary of the China Brook.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Redevelopment of the site is proposed to be residential uses.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The site falls within an area indicated to potentially be susceptible to groundwater

emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.

- The A4104 Drake Street road and the B4028, the main access roads to the site, are at risk from surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.



**Table 7-9: SWDP6/NEWB (A44 Service Station Bromyard Road)**

<b>OS NGR:</b> SO 827542	<b>Area:</b> 1.1ha	<b>Brown/Greenfield:</b> Brownfield \ Greenfield		
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 14%	<b>FZ3b:</b> 32%	<b>FZ2:</b> 21%	<b>FZ1:</b> 33%

**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.

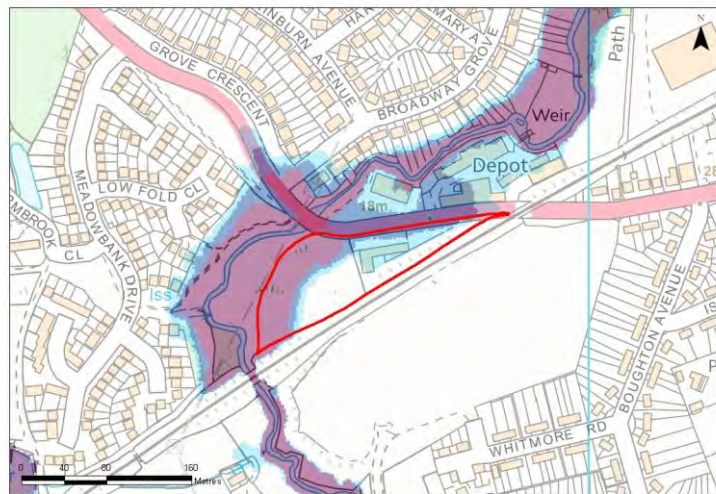
Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the Laughern Brook and Flood Zone 2 and 3 by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

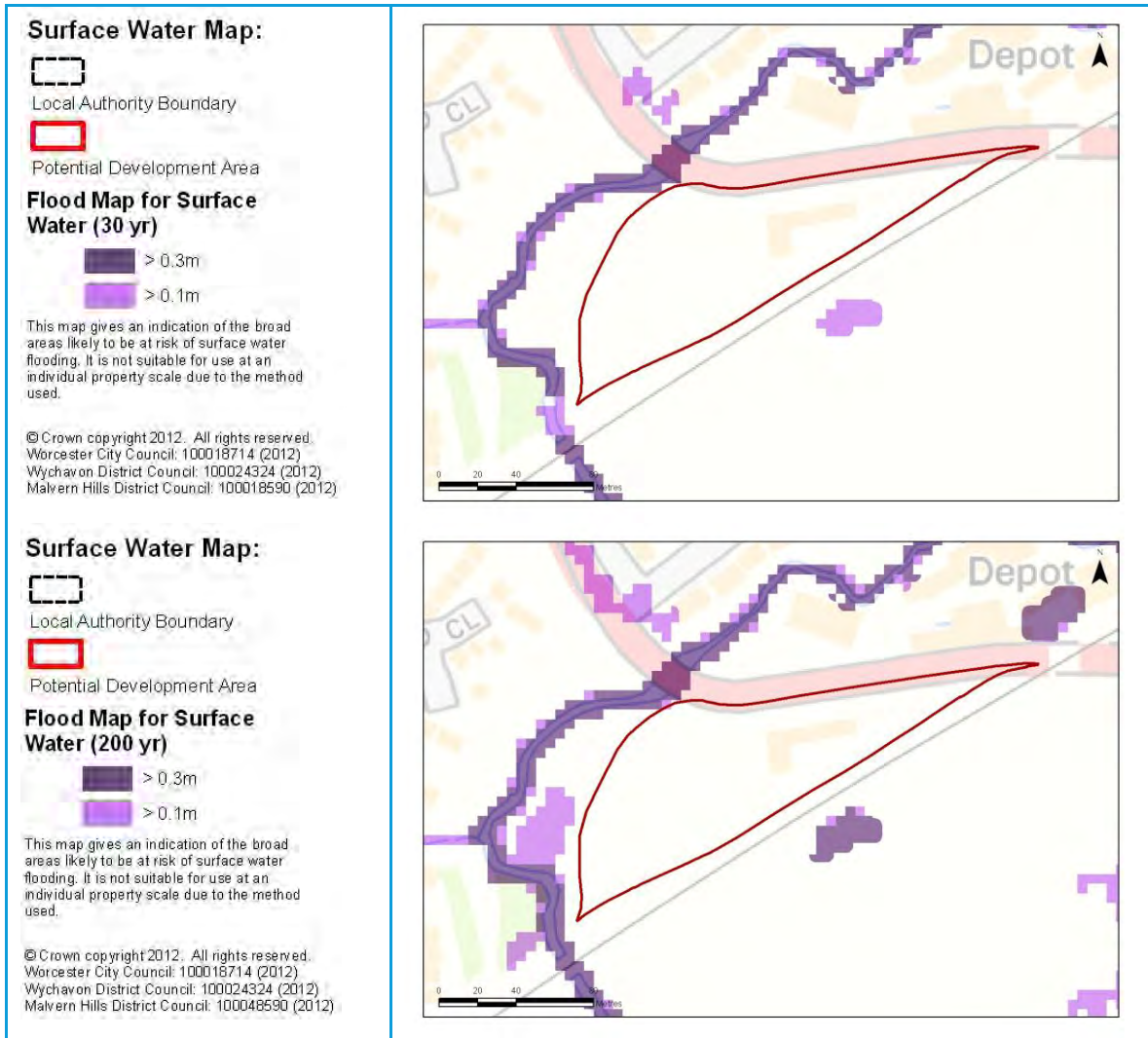
Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.  
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**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**  
 Flood Zone 3 with Climate Change  
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**Sources of Flood Risk:**

- Primary flood risk to the site is fluvial from Laughern Brook, resulting from overtopping of the banks to the west and north of the site. Approximately half of the site, the north and west portions fall within Flood Zone 3. The north and west portions of the site are located within the Blue Zone of the Policy Maps. The A44 Bromyard road, the main access road to the site is at risk from fluvial flooding.
- This site is shown to be partially within one of the County Council’s historic flood hotspots.
- Surface water presents a very low risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The A44 Bromyard road, the main access road to the site is at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	9.1

	1 in 100 year (plus climate change)	34.5
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>		246 – 344
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All forms of source control excluding previous pavements would be suitable
Infiltration		Mapping suggests underlying soil is likely to be permeable. However, the high risk of groundwater flooding would make infiltration unsuitable
Detention		Mapping suggests that site slopes are steep and detention storage 'above ground' may therefore not be viable
Filtration		Mapping suggests that filtrations would be suitable but require a form of liner to prevent ingress of groundwater into the SUDS system
Conveyance		Mapping suggests that site slopes would be suitable for conveyance. However, due to the steepness of slope may require check dams to slow flows
<ul style="list-style-type: none"> <li>• The site is not located within a groundwater source protection zone.</li> <li>• Mixed use developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased water levels in the Laughern Brook. Increased rainfall intensities.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance. As such, there is limited scope for development at this site.</li> <li>• A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>• The site is not suitable for residential development.</li> <li>• Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>• Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>• Assessment for runoff should include allowance for climate change effects.</li> <li>• New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>• The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.</li> <li>• Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>• The A44 Bromyard road, the current and only access road to the site is at risk from both fluvial flooding and surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.</li> <li>• Demonstration that development at this location can be made safe.</li> </ul>		

**Table 7-10: SWDP6/NEWJ (Land North of Warndon Woods)**

<b>OS NGR:</b> SO 889570	<b>Area:</b> 18.46ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 0%	<b>FZ3b:</b> 0%	<b>FZ2:</b> 2%	<b>FZ1:</b> 98%

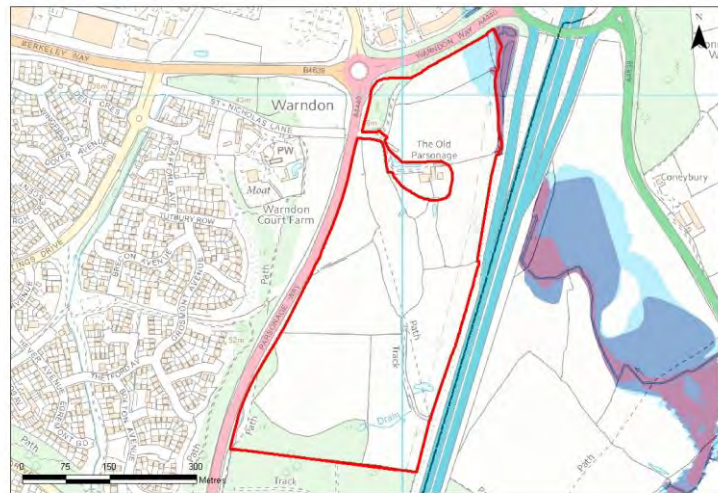
**Exception Test required?** Yes, for Highly Vulnerable Infrastructure development in FZ2.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- It should be possible to reduce flood risk at this development area by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

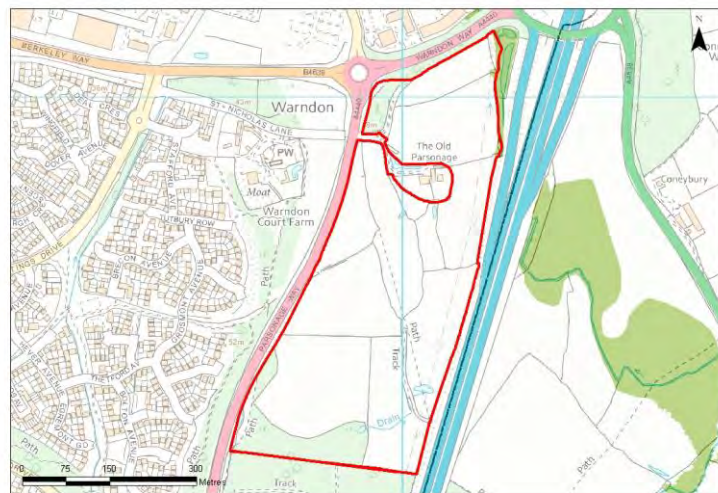
**Flood Zone Map:**

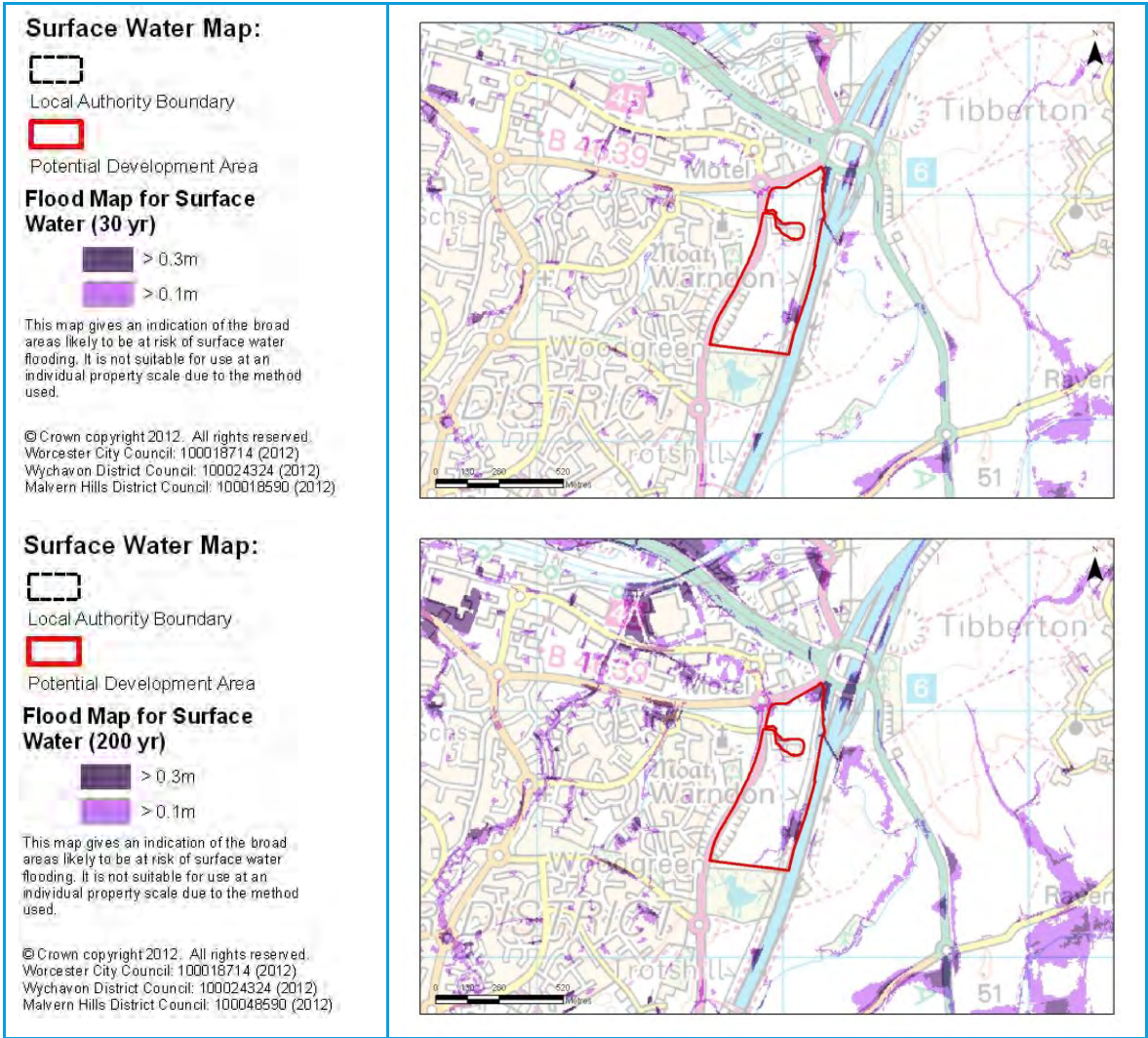
Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.  
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**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**  
 Flood Zone 3 with Climate Change  
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- Sources of Flood Risk:**
- The main source of flood risk to the site is from surface water. With further development and creation of impermeable surfaces, surface water flooding may become a problem. The M5 and A4440 Warndon road, the main access roads to the site, are at risk, in isolated places, from surface water.
  - A small portion of the site, located to the very north-east corner, falls within Flood Zone 3b. Primary fluvial risk is to the north-eastern edge of the site resulting from overtopping of an unnamed tributary of the Bourne Brook. The north-east corner of the site is located in the Blue Zone of the Policy Maps.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Unknown – Lower Permeability	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	9.1
	1 in 100 year (plus climate change)	34.5

<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>		4,140 – 5,780
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All source control techniques are likely to be suitable
Infiltration		Mapping suggests underlying soil is unlikely to be permeable. A site investigation should be carried out to assess suitability of drainage by infiltration
Detention		Mapping suggests that site slopes may be steep so larger features 'above ground' may not be viable
Filtration		All filtration techniques are likely to be suitable
Conveyance		All conveyance techniques are likely to be suitable
<ul style="list-style-type: none"> <li>The site is not located within a groundwater source protection zone.</li> <li>Commercial, recreational and leisure developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensity. Increased water levels in the unnamed tributary of the Barbourne Brook.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>Redevelopment or alternative use of the site will focus on commercial, recreational and leisure uses, either singly or as mixed use proposals.</li> <li>Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>Assessment for runoff should include allowance for climate change effects.</li> <li>New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.</li> <li>All current access roads to the site are at risk from surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further, as part of a detailed FRA.</li> <li>Demonstration that development at this location can be made safe.</li> </ul>		

**Table 7-11: WO93 (Henwick Road/Chequers Lane)**

<b>OS NGR:</b> SO 841548	<b>Area:</b> 1.0ha		<b>Brown/Greenfield:</b> Brownfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 4%	<b>FZ3b:</b> 18%	<b>FZ2:</b> 71%	<b>FZ1:</b> 7%

**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.

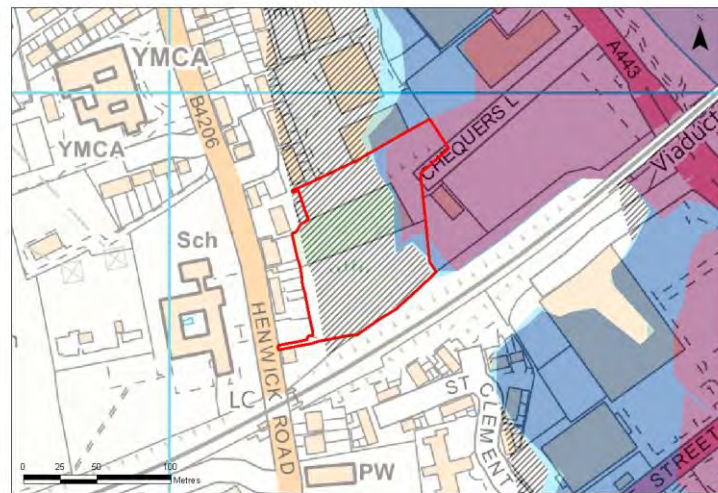
Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the River Severn to the north-east of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

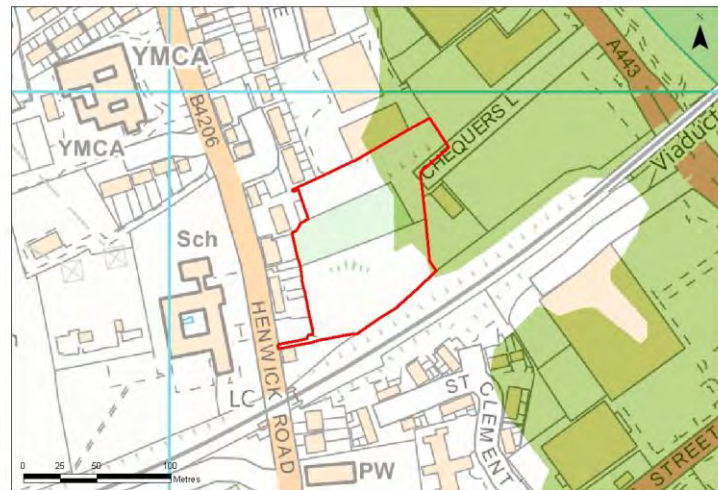
**Flood Zone Map:**

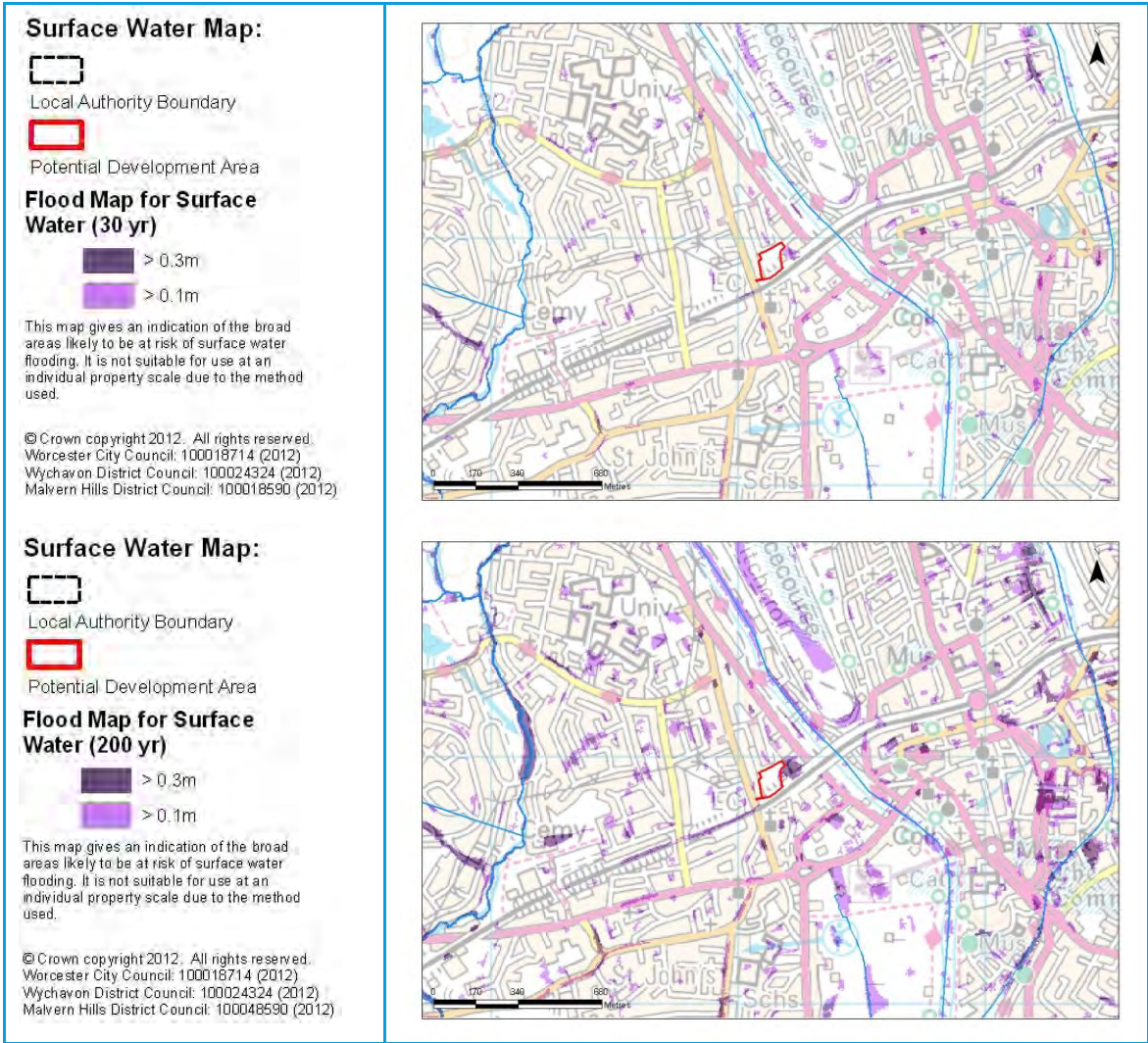
Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.  
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**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**  
  
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- Sources of Flood Risk:**
- Primary flood risk to the site is fluvial from overtopping of the banks of the River Severn east of the site. The north-east corner of the site falls within Flood Zone 3b and the majority of the site falls within Flood Zone 2. The north-east part of the site is located in the Yellow Zone of the Policy Maps. The Chequers Lane, one of the main access roads to the site are is risk from fluvial flooding.
  - Surface water presents a low risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The Chequers Lane, one of the main access roads to the site are is risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

Soil Type	Fluvial Deposit	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	9.1
	1 in 100 year (plus climate change)	34.5



<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>		224 – 313
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All forms of source control excluding previous pavements would be suitable
Infiltration		Mapping suggests underlying soil is likely to be permeable. However, the high risk of groundwater flooding would make infiltration unsuitable
Detention		Mapping suggests that site slopes are steep and detention storage 'above ground' may therefore may not be viable
Filtration		Mapping suggests that filtrations would be suitable but require a form of liner to prevent ingress of groundwater into the SUDS system
Conveyance		Mapping suggests that site slopes would be suitable for conveyance. However, due to the steepness of slope may require check dams to slow flows
<ul style="list-style-type: none"> <li>• The site is not located within a groundwater source protection zone.</li> <li>• Commercial developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensities. Increased water levels in the River Severn.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>• A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>• Redevelopment or alternative use of the site will focus on mixed use proposals.</li> <li>• Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>• Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>• Assessment for runoff should include allowance for climate change effects.</li> <li>• New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>• The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.</li> <li>• Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>• Access needs would need to be outside of the floodplain onto Henwick Road.</li> <li>• Demonstration that development at this location can be made safe.</li> </ul>		

**Table 7-12: SWDP6/6 (Old Northwick Farm)**

<b>OS NGR:</b> SO 839580	<b>Area:</b> 3.1 ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 0%	<b>FZ3b:</b> 0%	<b>FZ2:</b> 26%	<b>FZ1:</b> 74%

**Exception Test required?** Yes, for Highly Vulnerable Infrastructure development in FZ2.

**Requirements for passing the Exception Test:**

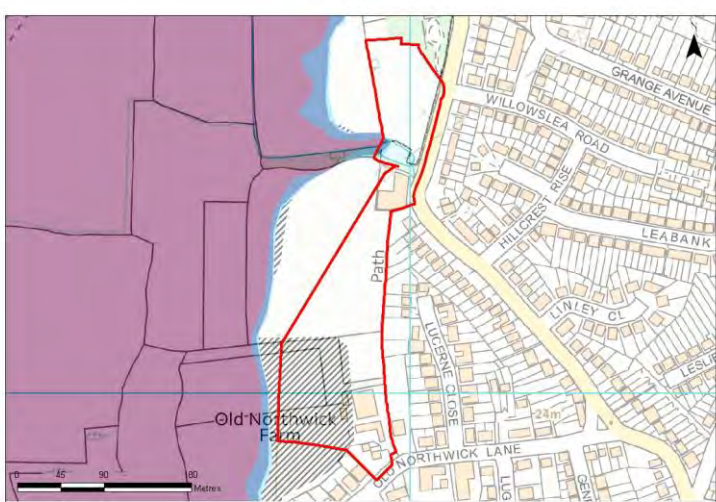
- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given first to locating development away from the unnamed tributary of the River Severn and Flood Zone 2, to the west of the site. It should be possible to reduce flood risk at this development area by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**




 Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

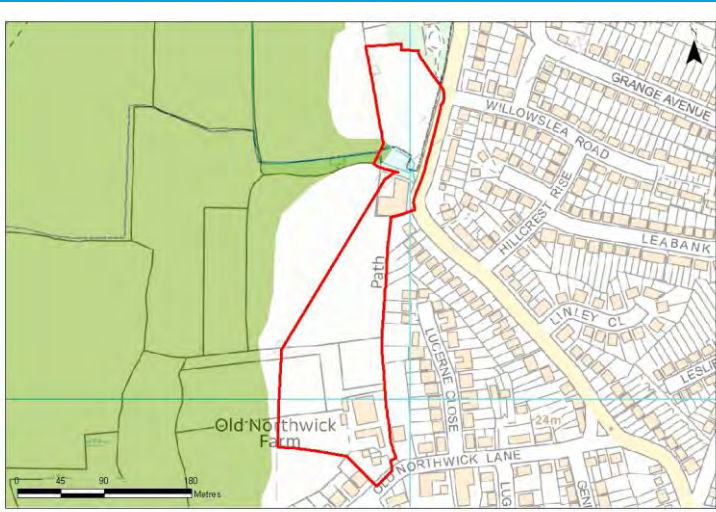
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**Climate Change:**

 Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**  
 Flood Zone 3 with Climate Change

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**Surface Water Map:**



Local Authority Boundary



Potential Development Area

**Flood Map for Surface Water (30 yr)**

 > 0.3m

 > 0.1m

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Surface Water Map:**



Local Authority Boundary



Potential Development Area

**Flood Map for Surface Water (200 yr)**

 > 0.3m

 > 0.1m

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Sources of Flood Risk:**

- Primary flood risk to the site is fluvial, resulting from overtopping of the unnamed tributaries of the River Severn, to isolated areas the west of the site and south-west corner. The south-west corner of the site falls within Flood Zone 2, with a very slight encroachment of Flood Zone 3 to the central-west edge of the site. The central-western portion of site falls within the Blue Zone of the Policy Maps.
- Photographic evidence provided by Claines Flood Action Group from 2007 show historic flooding to part of the site – this is supported by the 2007 historic flood map which is to be incorporated into the EA's Flood Zone 2.
- Surface water presents a very low risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The southern arm of the Northwick Road, the main access road to the site, falls within an area of surface water though the northern arm is shown not to be at risk on the mapping.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

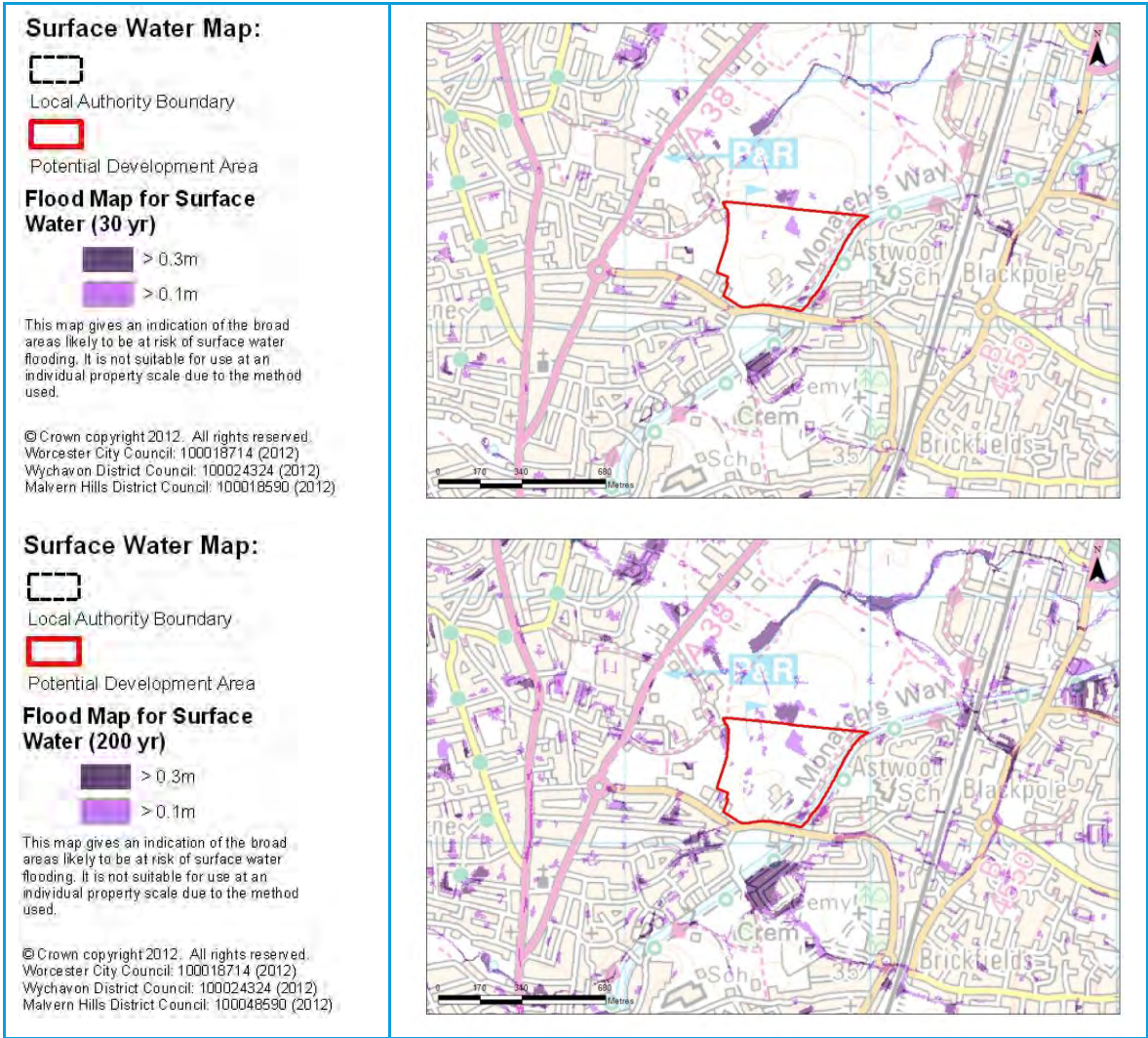
PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	9.1
	1 in 100 year (plus climate change)	34.5
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	700 – 980	
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding
Infiltration		Mapping suggests underlying soil is likely to be permeable. However, the high risk of groundwater flooding would make infiltration unsuitable
Detention		Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater.
Filtration		Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Conveyance		All conveyance techniques are likely to be suitable
<ul style="list-style-type: none"> <li>The site is not located within a groundwater source protection zone.</li> <li>Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensity. Increased water levels in the unnamed tributary of the River Severn.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>Redevelopment of site is proposed to be residential uses.</li> <li>Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>Assessment for runoff should include allowance for climate change effects.</li> <li>New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.</li> <li>Access needs would need to be outside of the floodplain, onto the northern arm of Northwick Road.</li> <li>Demonstration that development at this location can be made safe.</li> </ul>		

Table 7-13: SWDP6/19 (Perdiswell (Leisure uses))				
OS NGR: SO 856573	Area: 18.1ha		Brown/Greenfield: Brownfield / Greenfield	
Flood Zone Coverage:	FZ3a: 0%	FZ3b: 0%	FZ2: 0%	FZ1: 100%
Exception Test required? No.				

**Requirements for passing the Exception Test: N \ A.**

<p><b>Flood Zone Map:</b></p> <p> Local Authority Boundary</p> <p> Potential Development Area</p> <p><b>Flood Zones</b></p> <p> Flood Zone 3b</p> <p> Flood Zone 3a</p> <p> Flood Zone 2</p> <p> 2007 historic flood map</p> <p>Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.</p> <p><small>© Crown copyright (2012) All rights reserved. Malvern Hills District Council: 0100018590 (2012) Worcester City Council: 100018714 (2012) Wychavon District Council: 100024324 (2012)</small></p>	
<p><b>Climate Change:</b></p> <p> Local Authority Boundary</p> <p> Potential Development Area</p> <p><b>Flood Zone 3 with Climate Change</b></p> <p></p> <p><small>© Crown copyright 2012. All rights reserved. Worcester City Council: 100018714 (2012) Wychavon District Council: 100024324 (2012) Malvern Hills District Council: 100048690 (2012)</small></p>	



- Sources of Flood Risk:**
- Surface water presents the primary flood risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The B4482 Bilford road and the Droitwich road, the main access routes to the site, are at risk from surface water.
  - Fluvial flood risk investigations indicate the site is not within an area of flood risk. The site falls completely within Flood Zone 1.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

Soil Type	Fluvial Deposits	
Greenfield Runoff Rate (l/s/ha)	1 in 2 year	9.1
	1 in 100 year (plus climate change)	34.5
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	<b>4,054 – 5,565</b>	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control		All forms of source control excluding previous pavements would be suitable
Infiltration		Mapping suggests underlying soil is likely to be permeable. However, the high risk of groundwater flooding would make infiltration unsuitable
Detention		Mapping suggests that the site slopes are suitable for all forms of detention
Filtration		Mapping suggests that filtrations would be suitable but require a form of liner to prevent ingress of groundwater into the SUDS system
Conveyance		All forms of flow conveyance are likely to be suitable

- The site is not located within a groundwater source protection zone.
- Residential and commercial developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**

None.

**Effects of Climate Change:**

Increased rainfall intensities. Increased water levels in the Barbourne Brook.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Redevelopment or alternative use of the site will focus on commercial, recreation and leisure uses, either singly or as mixed use proposals.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- There is a culvert through the site that is in a bad state of repair. Consider culvert removal.
- The site is located on a historic landfill site, at Bilford Road Depot.
- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- All current access roads to the site are at risk from surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-14: SWDP6/21 (Former Hallow Road Tip)**

<b>OS NGR:</b> SO 837566	<b>Area:</b> 21.4ha	<b>Brown/Greenfield:</b> Greenfield		
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 38%	<b>FZ3b:</b> 22%	<b>FZ2:</b> 40%	<b>FZ1:</b> 0%

**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

- Requirements for passing the Exception Test:**
- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
  - Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the unnamed tributaries of the River Sever and Flood Zone 2 and 3, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
  - Safe access and egress would need to be demonstrated.
  - Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

Local Authority Boundary

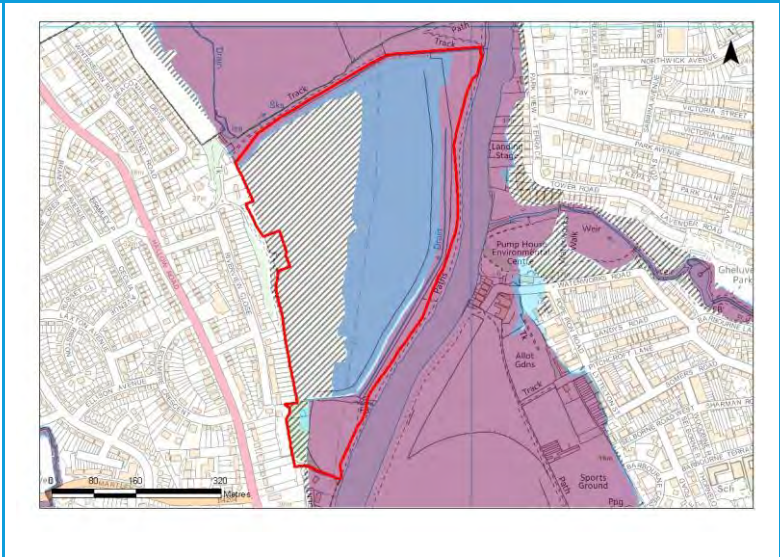
Potential Development Area

**Flood Zones**

- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2
- 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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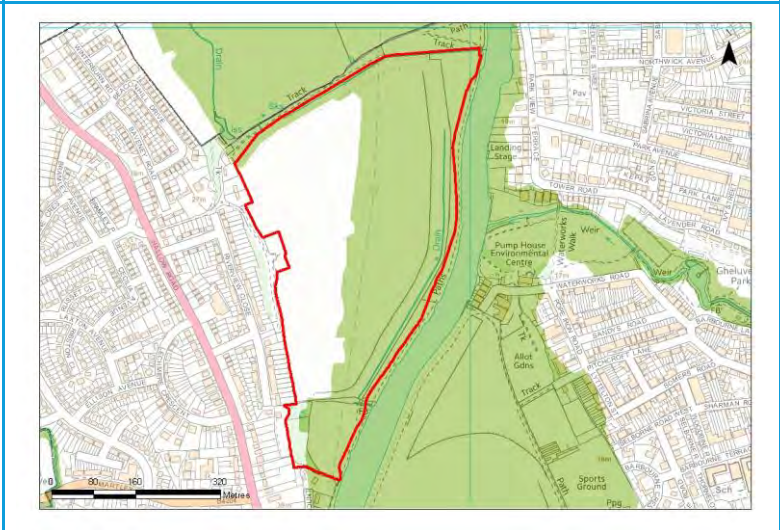
**Climate Change:**

Local Authority Boundary

Potential Development Area

**Flood Zone 3 with Climate Change**

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**Surface Water Map:**

Local Authority Boundary

Potential Development Area

**Flood Map for Surface Water (30 yr)**

> 0.3m

> 0.1m

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Surface Water Map:**

Local Authority Boundary

Potential Development Area

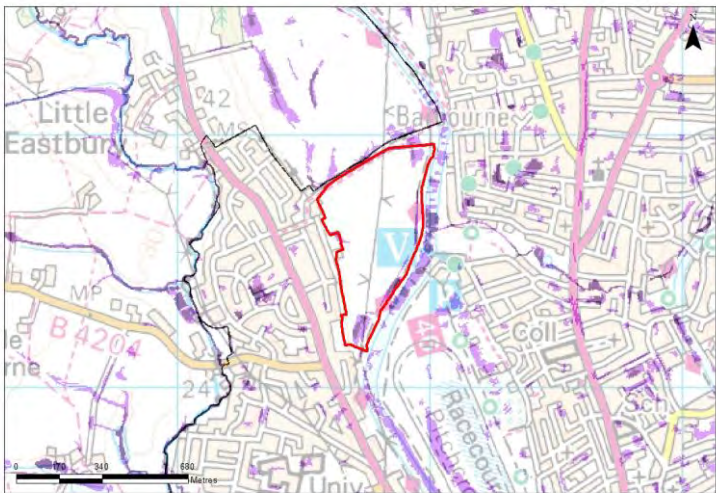
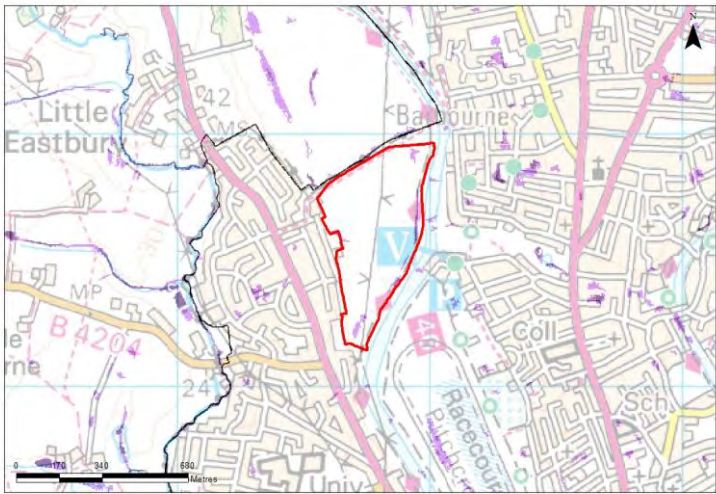
**Flood Map for Surface Water (200 yr)**

> 0.3m

> 0.1m

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- Sources of Flood Risk:**
- Primary flood risk to the site is fluvial, resulting from overtopping of the River Severn, to the east of the site and an un-named drain to the north. The total site area falls within Flood Zone 2 and 3. The majority of the site falls within the Red Zone of the Policy Maps.
  - Surface water presents a risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	9.1
	1 in 100 year (plus climate change)	34.5
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	4,793 – 6,698	

<b>SUDS and the development site</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All forms of source controls are likely to be suitable
Infiltration		Mapping suggests underlying soil is likely to be permeable. However, the high risk of groundwater flooding would make infiltration unsuitable
Detention		Mapping suggests that site slopes are steep and therefore some larger 'above ground' features may not be viable
Filtration		Mapping suggests that filtrations would be suitable but require a form of liner to prevent ingress of groundwater into the SUDS system
Conveyance		All forms of conveyance are likely to be suitable

- The site is not located within a groundwater source protection zone.
- Mixed use developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**  
None.

**Effects of Climate Change:**  
Increased rainfall intensities. Increased water levels in the River Severn.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- The site is located within the Red Zone of the Flood Policy maps.
- Redevelopment or alternative use of the site will focus on recreation and leisure either singly or as mixed use proposals.
- The site is not appropriate for residential allocation as it is a former landfill site.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development
- Assessment for runoff should include allowance for climate change effects
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- There are currently no access roads to the site. If new access roads are considered flood risk needs to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-15: SWDP7/6 (Sidbury)**

<b>OS NGR:</b> SO 851543	<b>Area:</b> 2.0ha		<b>Brown/Greenfield:</b> Brownfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 1%	<b>FZ3b:</b> 5%	<b>FZ2:</b> 1%	<b>FZ1:</b> 93%

**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.

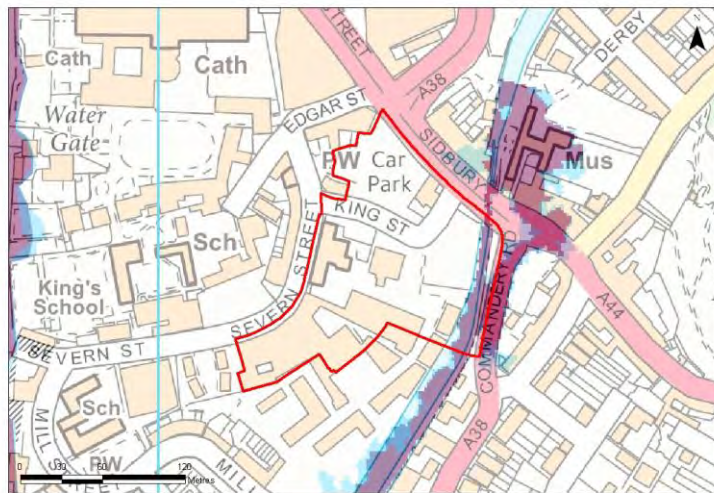
Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the Worcester and Birmingham Canal and Flood Zone 2 and 3 by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

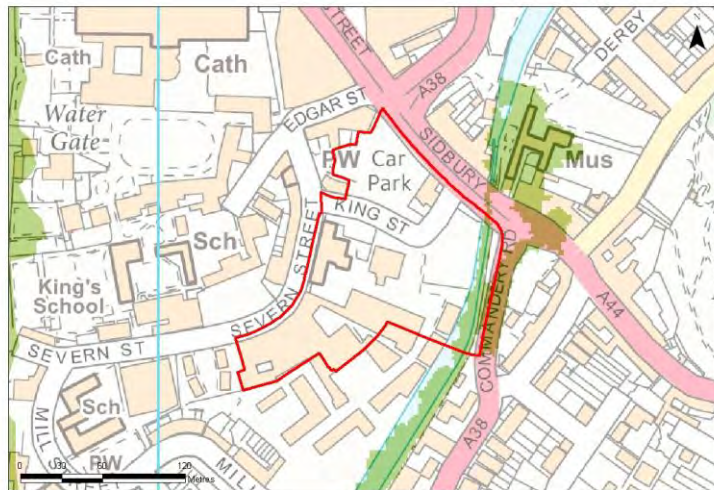
**Flood Zone Map:**

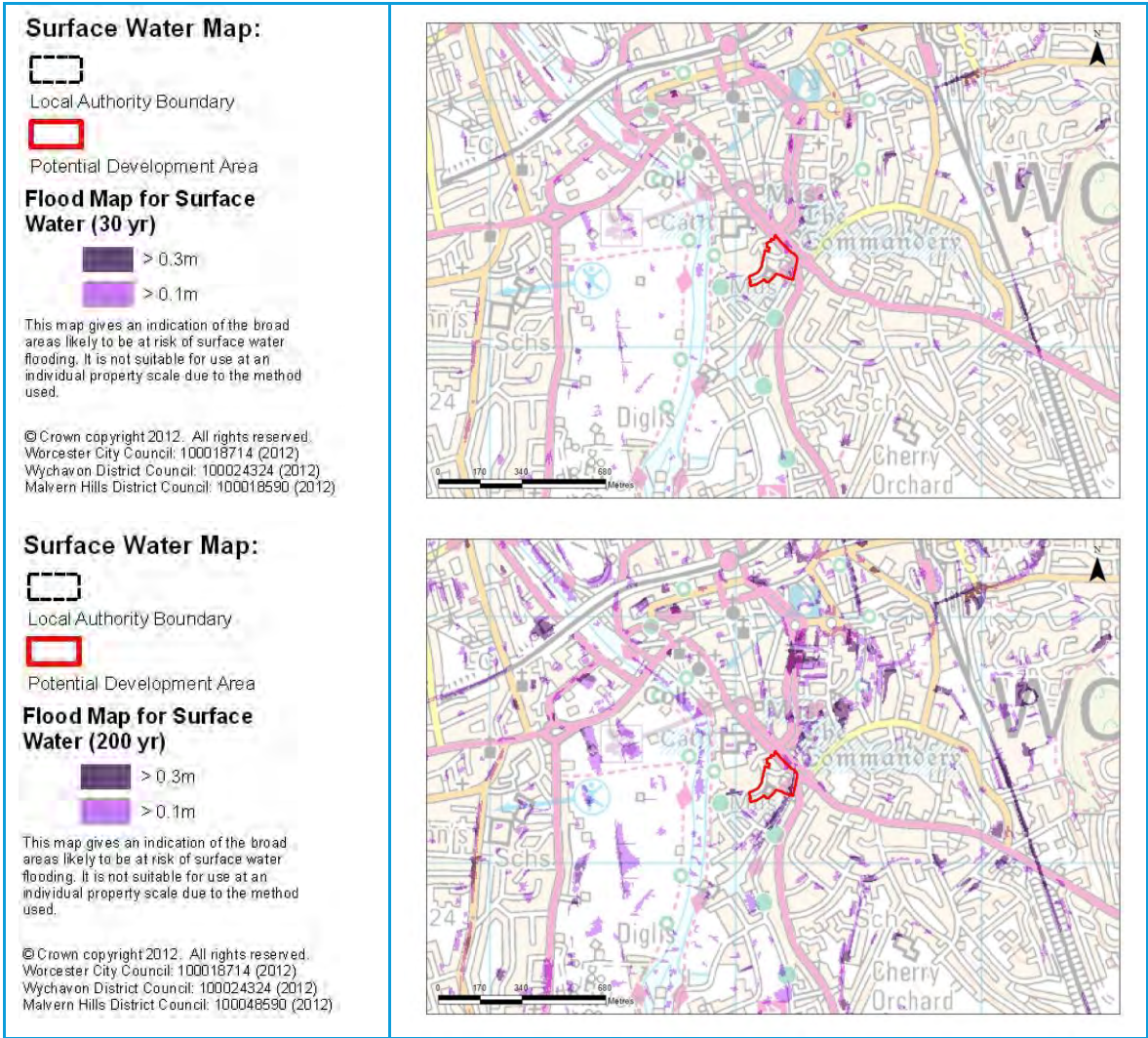
Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.  
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**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**  
 Flood Zone 3 with Climate Change  
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- Sources of Flood Risk:**
- Primary flood risk to the site is from the Worcester and Birmingham Canal, resulting from overtopping of the banks. The eastern edge of the site falls within Flood Zone 3b. The eastern edge of the site falls with the Blue Zone of the Policy Maps. The A44 Sidbury road and A38 Commandery Road, some of the main access roads to the site are at risk from fluvial flooding.
  - This site is shown to be partially within one of the County Council's historic flood hotspots.
  - Surface water presents a risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The A44 Sidbury road and A38 Commandery Road, some of the main access roads to the site are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	9.1

	1 in 100 year (plus climate change)	34.5
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	248 – 626	
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All forms of source control are likely to be suitable
Infiltration		Mapping suggests underlying soil is likely to be permeable. However, the high risk of groundwater flooding would make infiltration unsuitable
Detention		Mapping suggests that site slopes are steep and therefore some larger features 'above ground' may not be viable
Filtration		Mapping suggests that filtrations would be suitable but require a form of liner to prevent ingress of groundwater into the SUDS system
Conveyance		All forms of conveyance are likely to be suitable
<ul style="list-style-type: none"> <li>• The site is not located within a groundwater source protection zone.</li> <li>• Mixed use developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensities.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>• A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>• Redevelopment or alternative use of the site will focus on mixed use proposals.</li> <li>• Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>• Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>• Assessment for runoff should include allowance for climate change effects.</li> <li>• New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>• The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.</li> <li>• Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>• Access needs would need to be outside of the floodplain, onto Severn Street and Edgar Street.</li> <li>• Demonstration that development at this location can be made safe.</li> </ul>		

**Table 7-16: SWDP8/1 (Broomhall Community and Norton Barrack)**

<b>OS NGR:</b> SO 859912	<b>Area:</b> 247ha		<b>Brown/Greenfield:</b> Brownfield / greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 2%	<b>FZ3b:</b> 3%	<b>FZ2:</b> 5%	<b>FZ1:</b> 90%

**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

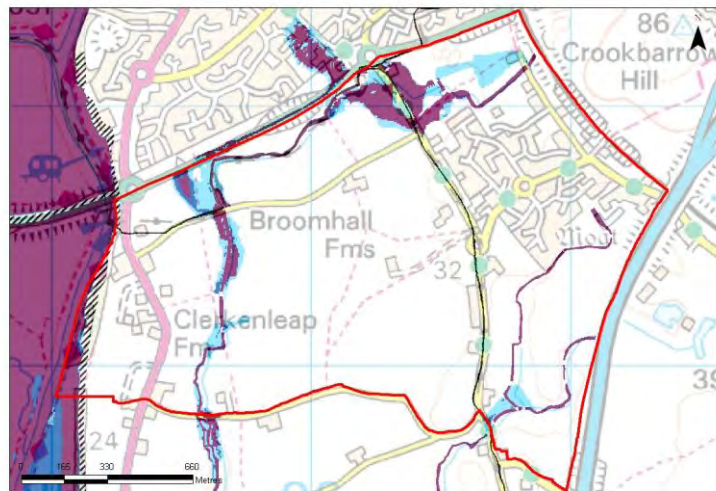
- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the Hatfield Brook in the east of the site, the unnamed tributary of the Hatfield Brook to the west of the site, River Severn to the west boundary of the site and Flood Zone 2 and 3, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 and 3 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space, with the potential for a buffer.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**


-  Local Authority Boundary
-  Potential Development Area
- Flood Zones**
-  Flood Zone 3b
-  Flood Zone 3a
-  Flood Zone 2
-  2007 historic flood map


Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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**Climate Change:**

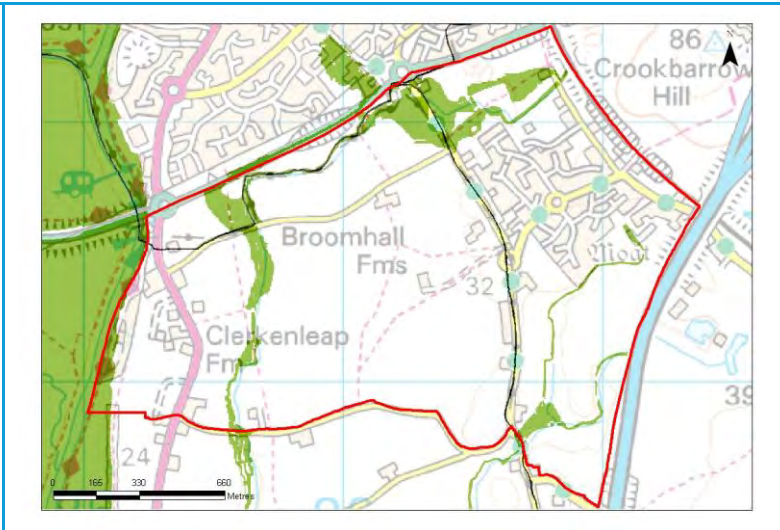
 Local Authority Boundary

 Potential Development Area


**Flood Zone 3 with Climate Change**




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**Surface Water Map:**

 Local Authority Boundary

 Potential Development Area

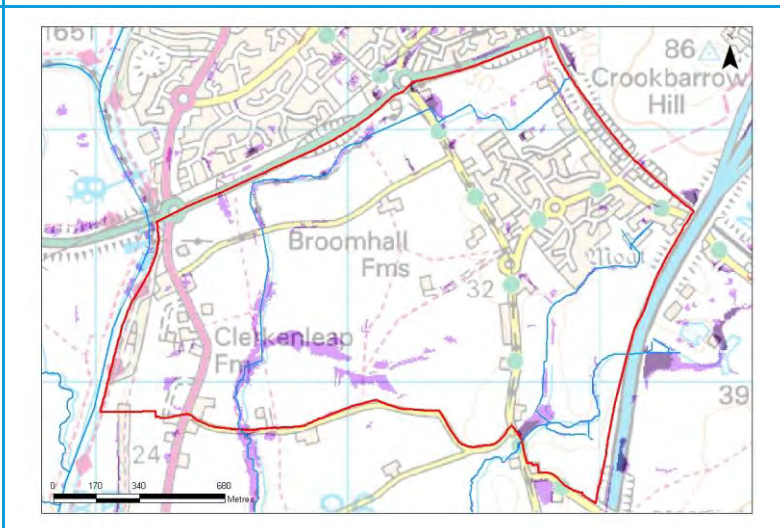
**Flood Map for Surface Water (30 yr)**

 > 0.3m


 > 0.1m


This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Surface Water Map:**

 Local Authority Boundary

 Potential Development Area

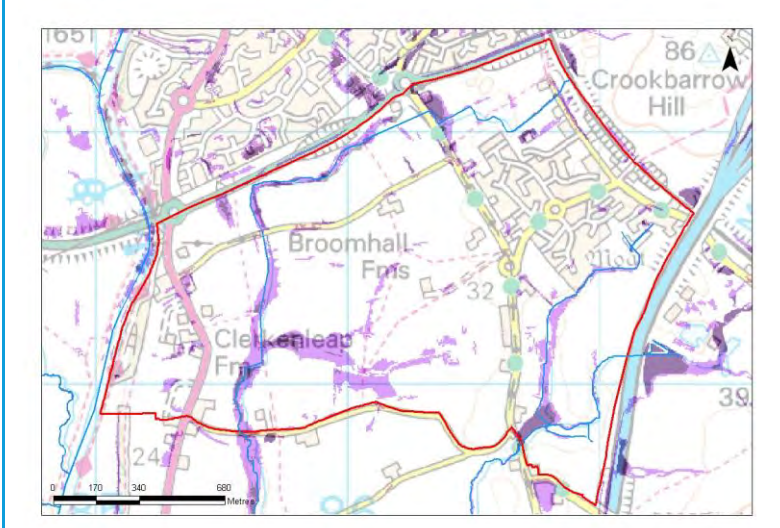
**Flood Map for Surface Water (200 yr)**

 > 0.3m

 > 0.1m

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Sources of Flood Risk:**

- Primary flood risk to the site is from overtopping of the banks of the Hatfield Brook to the east of the site, the unnamed tributary of the Hatfield Brook to the west of the site and the River Severn to the west boundary of the site. A minority of the site falls within Flood Zone 3b and the Blue Zone on the Policy Maps. The Taylors Lane and Norton Road, some of the main access roads within the site area are at risk from fluvial flooding.
- This site is shown to be partially within five of the County Council's historic flood hotspots.

- Surface water presents a risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. Taylors Lane, Norton Road and Church Lane, some of the main access roads within the site area are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Unknown – Lower Permeability	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	4.3
	1 in 100 year (plus climate change)	16.4
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	93,613 – 137,332	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control		All forms of source controls are likely to be suitable
Infiltration		Mapping suggests high permeability at this site, site investigations should be carried out to assess potential for drainage by infiltration
Detention		Mapping suggests that site slopes are steep and therefore some larger features 'above ground' may not be viable
Filtration		All forms of filtration are likely to be suitable
Conveyance		All forms of conveyance are likely to be suitable

- This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.
- The site is not located within a groundwater source protection zone.
- Mixed use developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**

Kempsey flood defences.

**Effects of Climate Change:**

Increased rainfall intensities. Increased water levels in the Hatfield Brook, the unnamed tributary of the Hatfield Brook and the River Severn.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Redevelopment or alternative use of the site is proposed to focus on residential, leisure, commercial and recreational mixed use proposals.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.



- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- Access needs would need to be outside of the floodplain, onto the A38 Worcester road.
- Demonstration that development at this location can be made safe.
- The current defences may not be of an appropriate standard for urban expansion. Should new development be proposed, the protection offered by the defences will need to be reviewed and if appropriate, improved.

**Table 7-17: SWDP8/2 (Temple Laugherne – Worcester West urban expansion)**

<b>OS NGR:</b> SO 820534	<b>Area:</b> 77.79ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 1%	<b>FZ3b:</b> 6%	<b>FZ2:</b> 1%	<b>FZ1:</b> 92%

**Exception Test required?** Yes, for More Vulnerable and Essential Infrastructure development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

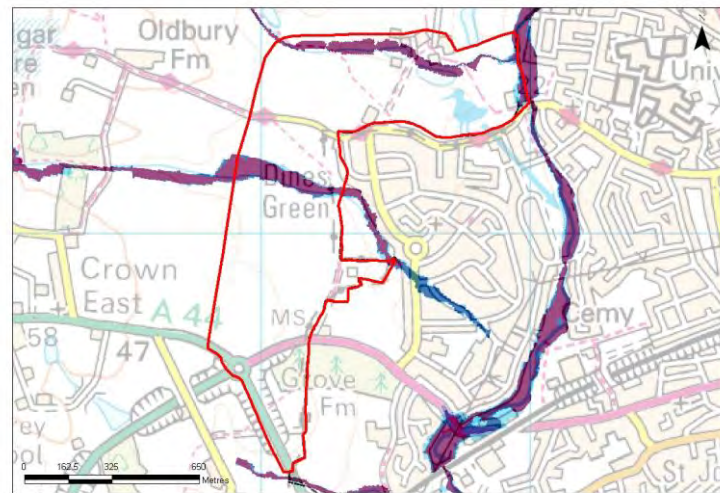
- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the unnamed tributaries of the Laughern Brook, confined to the lakes and channels to the north, west and central parts of the site and Flood Zone 2 and 3, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 and 3 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space, with the potential for a buffer.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

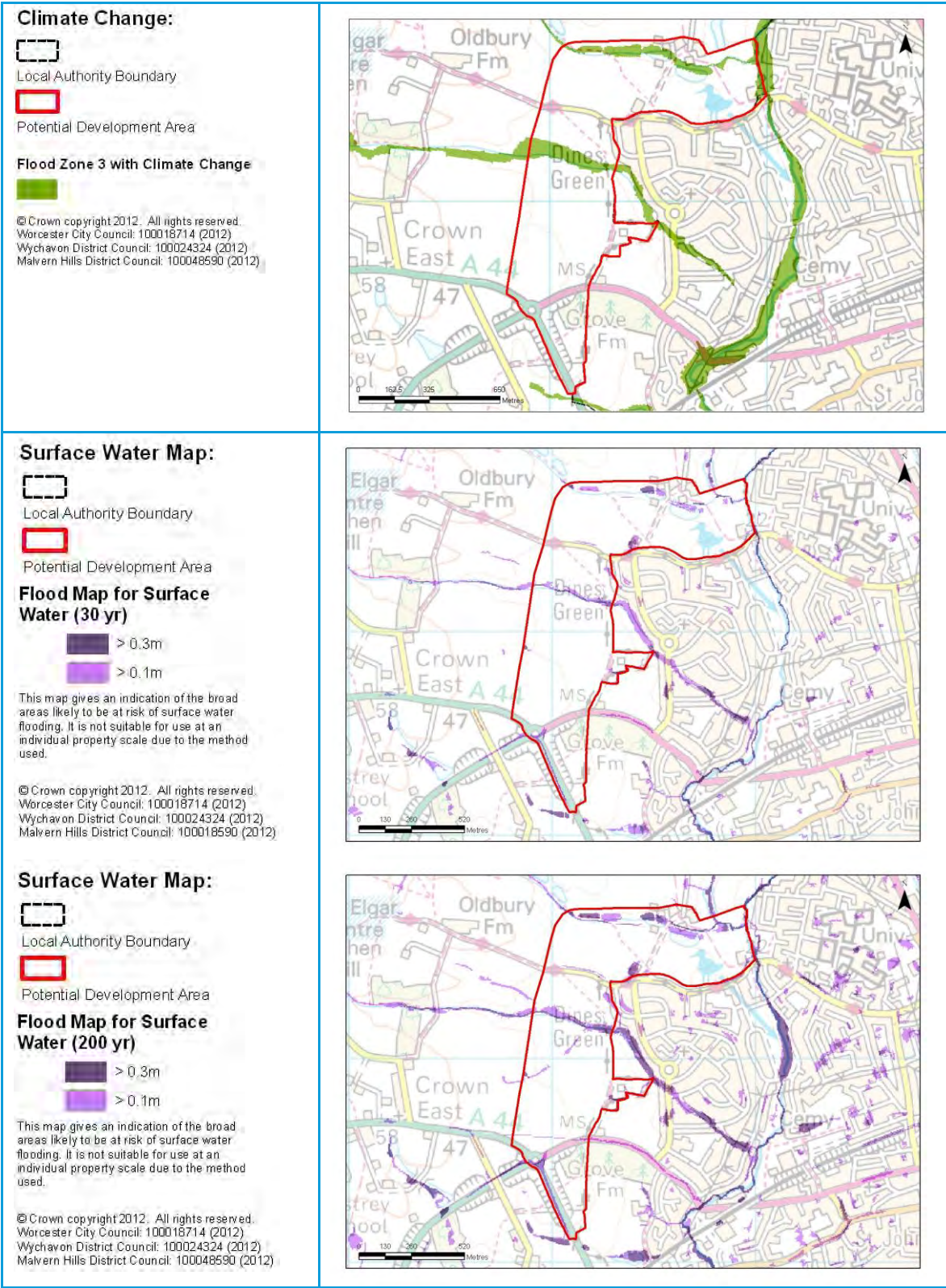
**Flood Zone Map:**

-  Local Authority Boundary
-  Potential Development Area
- Flood Zones**
-  Flood Zone 3b
-  Flood Zone 3a
-  Flood Zone 2
-  2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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**Sources of Flood Risk:**

- Primary flood risk to the site is fluvial, resulting from overtopping of the unnamed tributaries of the Laughern Brook, confined to the lakes and channels to the north, west and central parts of the site. The central and northern parts of the site falls within Flood Zone 3b and the Blue Zone of the Policy Maps. The right arm of the A44 Bromyard road, the A4440 Grove Way, Tudor Way and the Oldbury road, some of the main access roads to the site, are at risk from fluvial flooding.
- Surface water presents a risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The

A44 Bromyard road, the A4440 Grove Way, Tudor Way and the Oldbury road, the main access roads to the site, are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	2.1
	1 in 100 year (plus climate change)	7.7
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	13,220 – 29,560	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control	Yellow	Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding
Infiltration	Red	Mapping suggests underlying soil is likely to be permeable. However, the high risk of groundwater flooding would make infiltration unsuitable
Detention	Yellow	Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater. Mapping suggests that site slopes may be steep so larger features 'above ground' may not be viable
Filtration	Yellow	Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Conveyance	Green	All conveyance techniques are likely to be suitable

- The site is not located within a groundwater source protection zone.
- Commercial, recreational and leisure developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**

None

**Effects of Climate Change:**

Increased rainfall intensity. Increased water levels in the unnamed tributaries of the Laughern Brook.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Redevelopment or alternative use of the site will focus on commercial, recreational and leisure uses, either singly or as mixed use proposals.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.

- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- All current access roads to the site, The right arm of the A44 Bromyard road, the A4440 Grove Way, Tudor Way and the Oldbury road, some of the main access roads to the site, are at risk from fluvial flooding are at risk from fluvial flooding and \ or surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-18: SWDP8/3 (Land to the read of Kilbury Drive)**

<b>OS NGR:</b> SO 877534	<b>Area:</b> 12.0ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 3%	<b>FZ3b:</b> 8%	<b>FZ2:</b> 1%	<b>FZ1:</b> 88%







**Exception Test required?** Yes, for More Vulnerable and Essential Infrastructure development in FZ3a and for Highly Vulnerable development in FZ2.

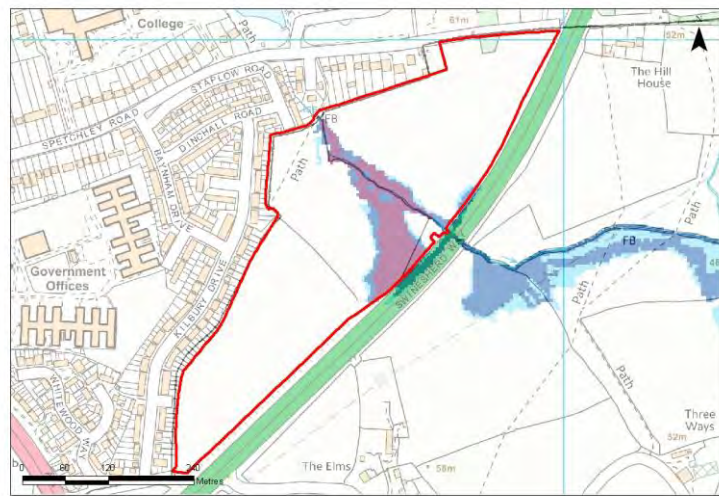
Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from an unnamed tributary of the Bow Brook, located to the central portion of the site and Flood Zone 2 and 3, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 and 3 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space, with the potential for a buffer.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.


**Flood Zone Map:**

 Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.  
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**Climate Change:**

 Local Authority Boundary

 Potential Development Area


**Flood Zone 3 with Climate Change**




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**Surface Water Map:**

 Local Authority Boundary

 Potential Development Area

**Flood Map for Surface Water (30 yr)**

 > 0.3m


 > 0.1m


This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Surface Water Map:**

 Local Authority Boundary

 Potential Development Area

**Flood Map for Surface Water (200 yr)**

 > 0.3m

 > 0.1m

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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- Sources of Flood Risk:**
- Primary flood risk to the site is fluvial, resulting from overtopping of the unnamed tributaries of the Bow Brook, to the central portion of the site. The central portion of the site falls within Flood Zone 3b and the Blue Zones of the Policy Maps. The A440 Swineshead Way road one of the main access roads to the site, are at risk from fluvial flooding.
  - This site is shown to be partially within one of the County Council's historic flood hotspots.
  - Surface water presents a risk to the site. Further development and creation of

impermeable surfaces may result in an increase of surface water flood risk. The A440 Swineshead Way road, Staplow road, the Dinchall road and Kilbury Drive the main access roads, are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Unknown – Lower permeability	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	7.7
	1 in 100 year (plus climate change)	29.3
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	2,830 – 3,770	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control		All source control techniques are likely to be suitable
Infiltration		Mapping suggests underlying soil is unlikely to be permeable. A site investigation should be carried out to assess suitability of drainage by infiltration
Detention		Mapping suggests that site slopes may be steep so larger features 'above ground' may not be viable
Filtration		All filtration techniques are likely to be suitable
Conveyance		All conveyance techniques are likely to be suitable

- The site is not located within a groundwater source protection zone.
- Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**

None

**Effects of Climate Change:**

Increased rainfall intensity. Increased water levels in the unnamed tributary of the Bow Brook.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Development of the site is proposed to focus on residential uses.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the



catchment.

- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- All access roads to the site; the A440 Swinesheard Way road, the Staplow road, the Dinchall road and the Kilbury Drive are at risk from fluvial and \ or surface water flooding. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-19: SWDP9/2 (Land east of Salwarpe Road, between Canal & River Salwarpe)**

<b>OS NGR:</b> SO 894637	<b>Area:</b> 1.4ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 18%	<b>FZ3b:</b> 2%	<b>FZ2:</b> 45%	<b>FZ1:</b> 35%







**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.

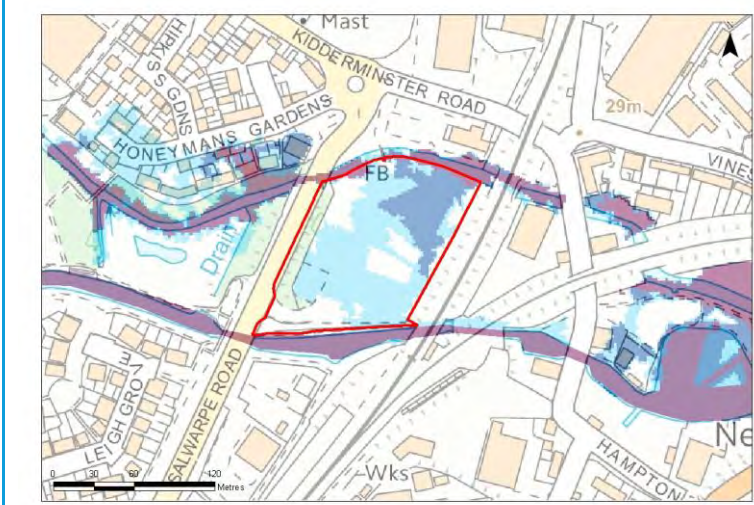
Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**


- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the River Salwarpe to the north of the site and the Droitwich Canal to the south of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 and 3 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space, with the potential for a buffer.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.


**Flood Zone Map:**

 Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.  
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**Climate Change:**

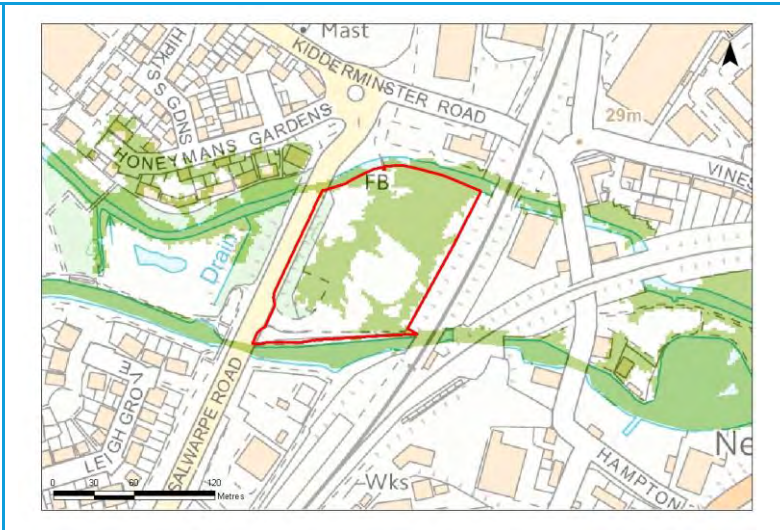
 Local Authority Boundary

 Potential Development Area


**Flood Zone 3 with Climate Change**




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**Surface Water Map:**

 Local Authority Boundary

 Potential Development Area

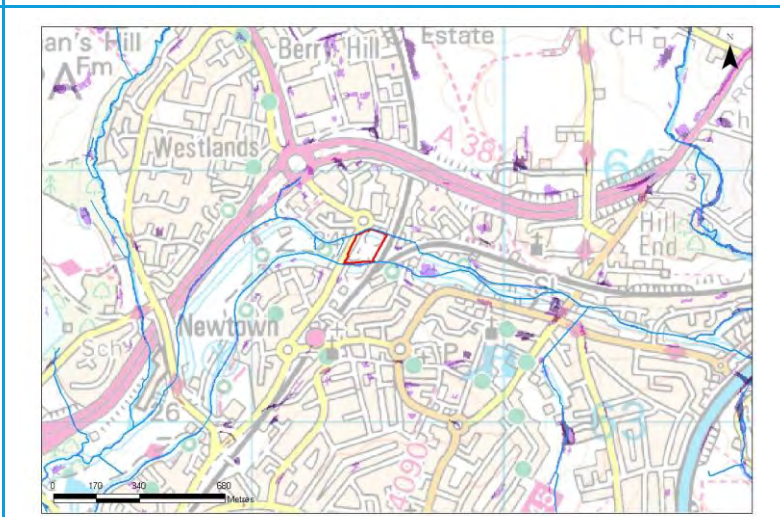
**Flood Map for Surface Water (30 yr)**

 > 0.3m


 > 0.1m


This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Surface Water Map:**

 Local Authority Boundary

 Potential Development Area

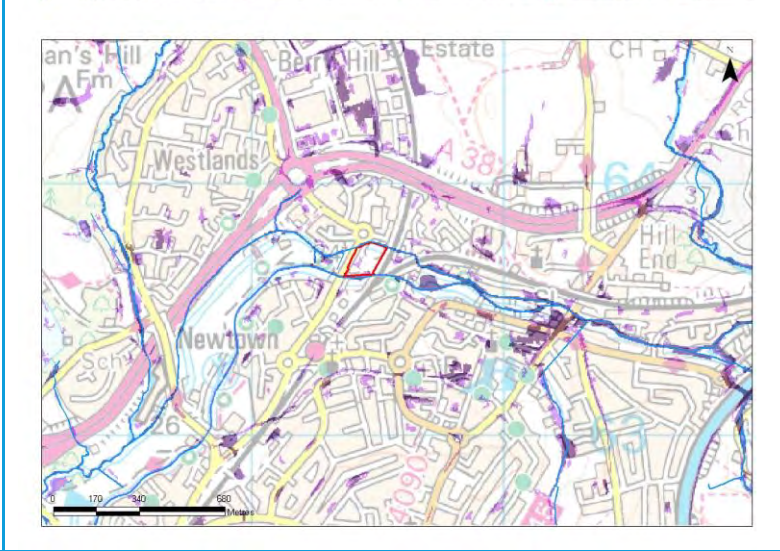
**Flood Map for Surface Water (200 yr)**

 > 0.3m

 > 0.1m

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Sources of Flood Risk:**

- Primary flood risk to the site is from overtopping of the banks of the River Salwarpe to the north and the Droitwich Canal to the south of the site. The northern and southern edges of the site fall within Flood Zone 3b; the majority of the site area falls within Flood Zone 2. The northern portion of the site falls within the Yellow Zone of the Policy Maps; the north-west and southern edge of the site fall within the Blue Zone. The Salwarpe road, the main access roads to the site is at risk from fluvial flooding.
- Surface water presents a risk to the site. Further development and creation of

impermeable surfaces may result in an increase of surface water flood risk. The Salwarpe road, the main access roads to the site is at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	7.4
	1 in 100 year (plus climate change)	27.6
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	481 – 655	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control	Green	All forms of source control are likely to be suitable
Infiltration	Red	Mapping suggests underlying soil is likely to be permeable. However, the high risk of groundwater flooding would make infiltration unsuitable
Detention	Red	Mapping suggests that site slopes are steep and detention storage 'above ground' may therefore may not be viable
Filtration	Green	All forms of filtration are likely to be suitable
Conveyance	Green	Mapping suggests that site slopes would be suitable for conveyance. However, due to the steepness of slope may require check dams to slow flows

- This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.
- The site is not located within a groundwater source protection zone.
- Residential developments should provide at least two independent water treatment stages SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**

None.

**Effects of Climate Change:**

Increased rainfall intensities. Increased water levels in the River Salwarpe.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Redevelopment or alternative use of the site is proposed to focus on residential uses. Flood risk indicates that the site would not be suitable for residential uses.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development
- Assessment for runoff should include allowance for climate change effects
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.

- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The currently and only access road to the site, the Salwarpe road, is at risk from fluvial flooding and surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-20: SWDP9/3 (Boxing Club)**

<b>OS NGR:</b> SO 895636	<b>Area:</b> 0.1ha		<b>Brown/Greenfield:</b> Brownfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 0%	<b>FZ3b:</b> 0%	<b>FZ2:</b> 1%	<b>FZ1:</b> 99%

**Exception Test required?** Yes, for Highly Vulnerable development in FZ2.

**Requirements for passing the Exception Test:**

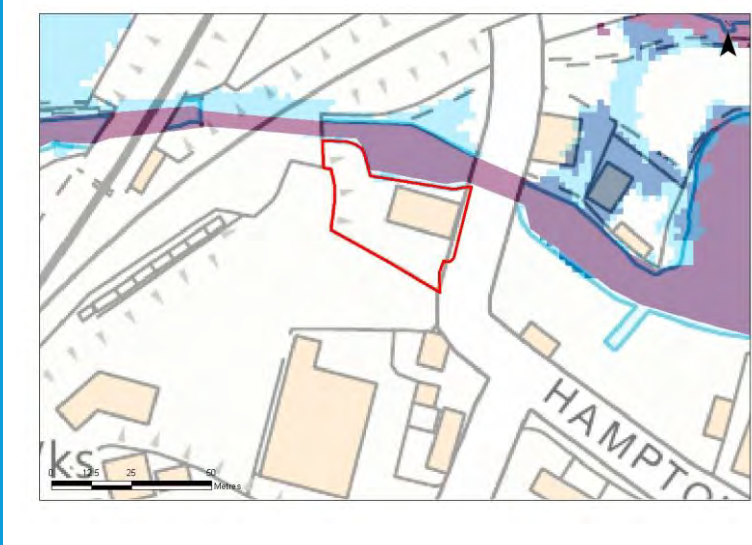
- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given first to locating development away from unnamed tributaries of the Droitwich Canal located north of the site and Flood Zone 2. It should be possible to reduce flood risk at this development area by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

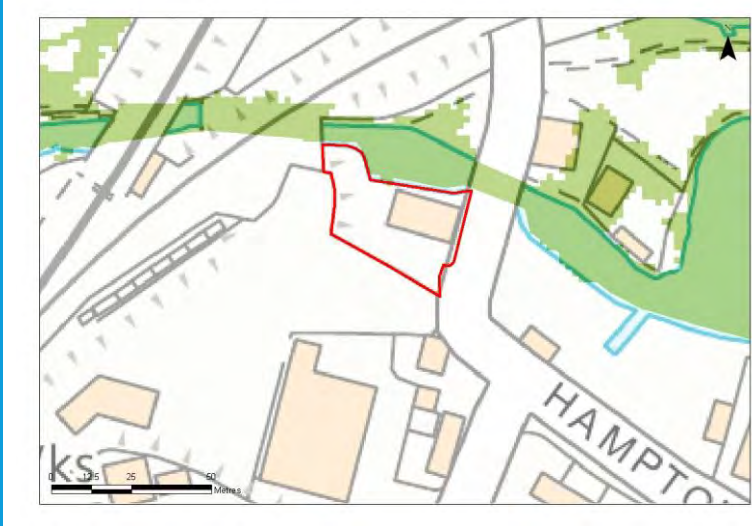
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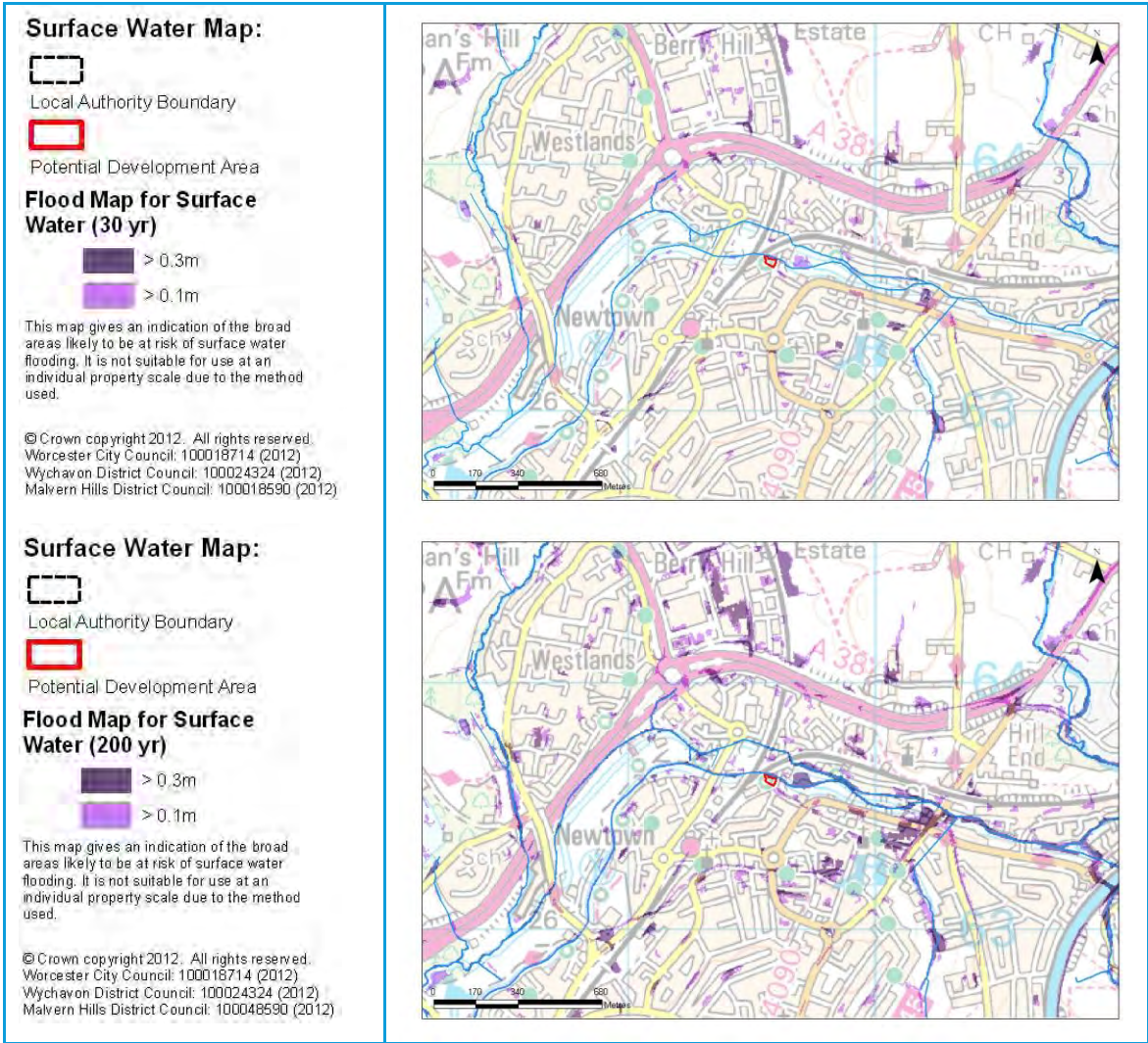


**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**  
 Flood Zone 3 with Climate Change

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- Sources of Flood Risk:**
- The main source of flood risk to the site is from surface water. With further development and creation of impermeable surfaces, surface water flooding may become a problem. Hampton Road, the main access roads to the site, is at risk from surface water.
  - This site is shown to be partially within one of the County Council’s historic flood hotspots.
  - The northern edge of the site just falls within Flood Zone 2. Primary fluvial risk is to the northern edge of the site resulting from overtopping of an unnamed tributary of the Droitwich canal. The northern edge of the site falls within the Blue Zone of the Policy Maps. Hampton Road, the main access roads to the site, is at risk from fluvial flooding.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	7.4

	1 in 100 year (plus climate change)	27.6
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	34 – 46	
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All forms of source control are likely to be suitable
Infiltration		Mapping suggests underlying soil is likely to be permeable. However, the high risk of groundwater flooding would make infiltration unsuitable
Detention		Mapping suggests that site slopes are steep and detention storage 'above ground' may therefore not be viable
Filtration		All forms of filtration are likely to be suitable
Conveyance		Mapping suggests that site slopes would be suitable for conveyance. However, due to the steepness of slope may require check dams to slow flows
<ul style="list-style-type: none"> <li>• This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.</li> <li>• The site is not located within a groundwater source protection zone.</li> <li>• Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensities.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>• A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>• Redevelopment or alternative use of the site is proposed to focus on residential uses.</li> <li>• Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>• Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development</li> <li>• Assessment for runoff should include allowance for climate change effects</li> <li>• New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>• The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.</li> <li>• Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>• The current and only access road to the site, the Hampton Road, is at risk from both fluvial flooding and surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.</li> <li>• Demonstration that development at this location can be made safe.</li> </ul>		



**Table 7-21: SWDP9/6 (Willow Court, Westwood Road)**

<b>OS NGR:</b> SO 885636	<b>Area:</b> 0.5ha	<b>Brown/Greenfield:</b> Brownfield / Greenfield		
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 8%	<b>FZ3b:</b> 45%	<b>FZ2:</b> 14%	<b>FZ1:</b> 33%

**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the Elmbridge Brook and Flood Zone 2 and 3, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

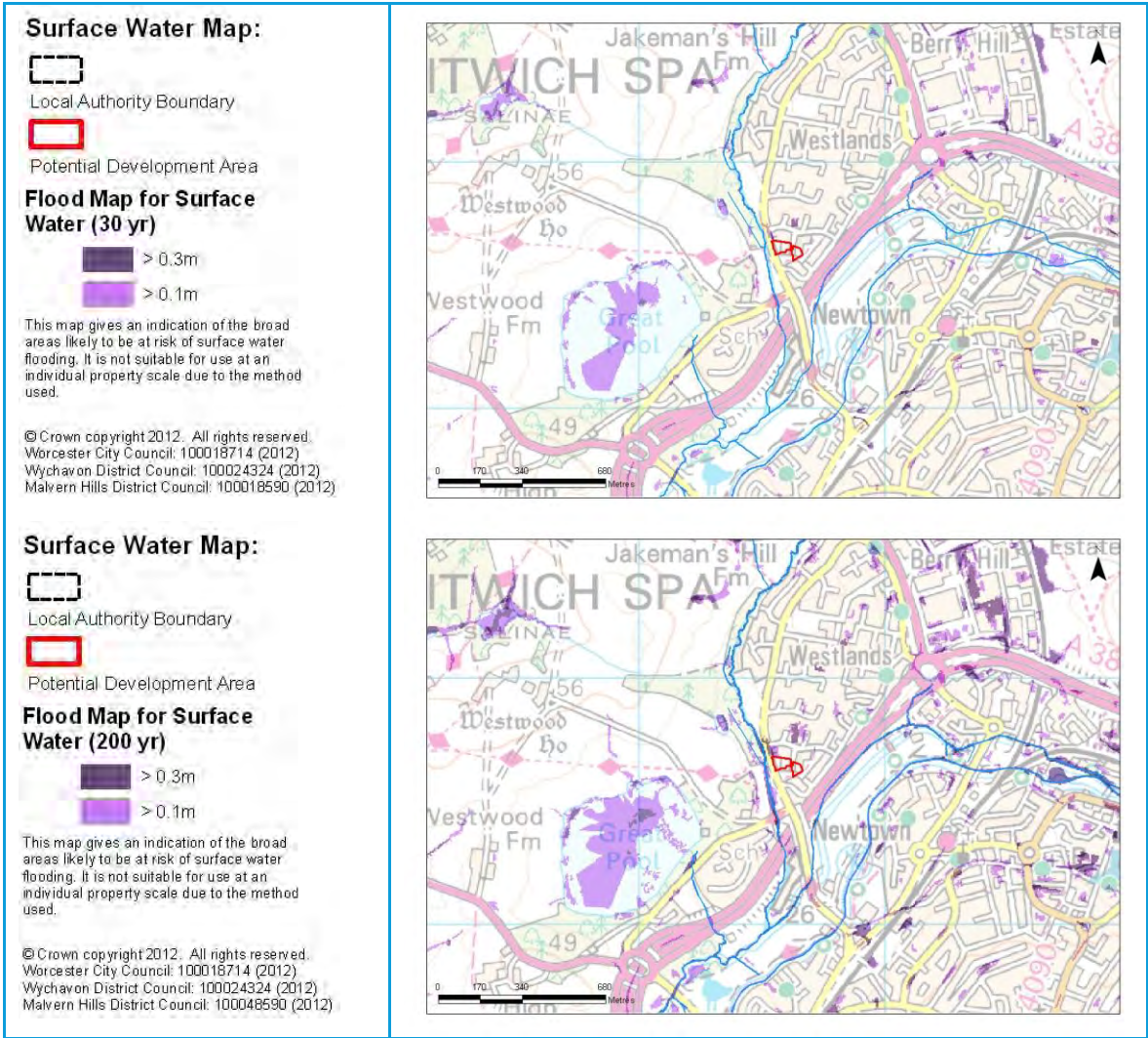
Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.  
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**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**  
 Flood Zone 3 with Climate Change  
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- Sources of Flood Risk:**
- Primary flood risk to the site is fluvial from the Elmbridge Brook, resulting from overtopping of the banks. The majority of the western branch of the site falls within Flood Zone 3b; a small portion of the eastern branch of the site falls within Flood Zone 2. The western branch of the site falls within the Yellow Zone of the Policy Maps. The Westwood-Briar Mill road and Hunters Way, the main access roads to the site are at risk from fluvial flooding.
  - This site is shown to be partially within one of the County Council's historic flood hotspots.
  - Surface water presents a low risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The Westwood-Briar Mill road and Hunters Way, the main access roads to the site are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Unknown – Less Permeable
------------------	--------------------------

<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	7.4
	1 in 100 year (plus climate change)	27.6
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	172 – 234	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control		All forms of source control are likely to be suitable
Infiltration		Mapping suggests low permeability at this site, site investigation should be carried out to assess potential for drainage by infiltration
Detention		Mapping suggests that site slopes are steep and detention storage 'above ground' may therefore not be viable
Filtration		All forms of filtration are likely to be suitable
Conveyance		All forms of conveyance are likely to be suitable

- This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.
- The site is not located within a groundwater source protection zone.
- Mixed use developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**

None.

**Effects of Climate Change:**

Increased rainfall intensities. Increased water levels in the Elmbridge Brook.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Redevelopment or alternative use of the site will focus on mixed use proposals.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The Westwood-Briar Mill road and Hunters Way, the main access roads to the site are at risk from both fluvial flooding and surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-22: SWDP9/7 (Canal Basin Project)**

<b>OS NGR:</b> SO 896635	<b>Area:</b> 1.1ha		<b>Brown/Greenfield:</b> Brownfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 7%	<b>FZ3b:</b> 1%	<b>FZ2:</b> 4%	<b>FZ1:</b> 88%

**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.

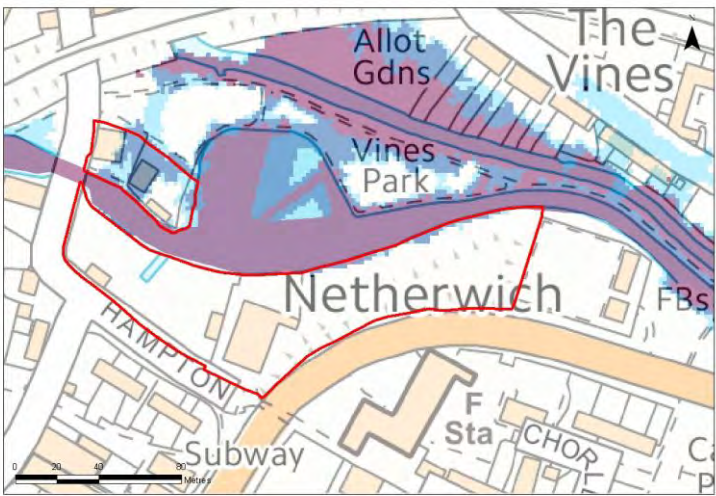
Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the Droitwich Canal located between the two plots in the site, the River Salwarpe to the north of the site and Flood Zone 2 and 3, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

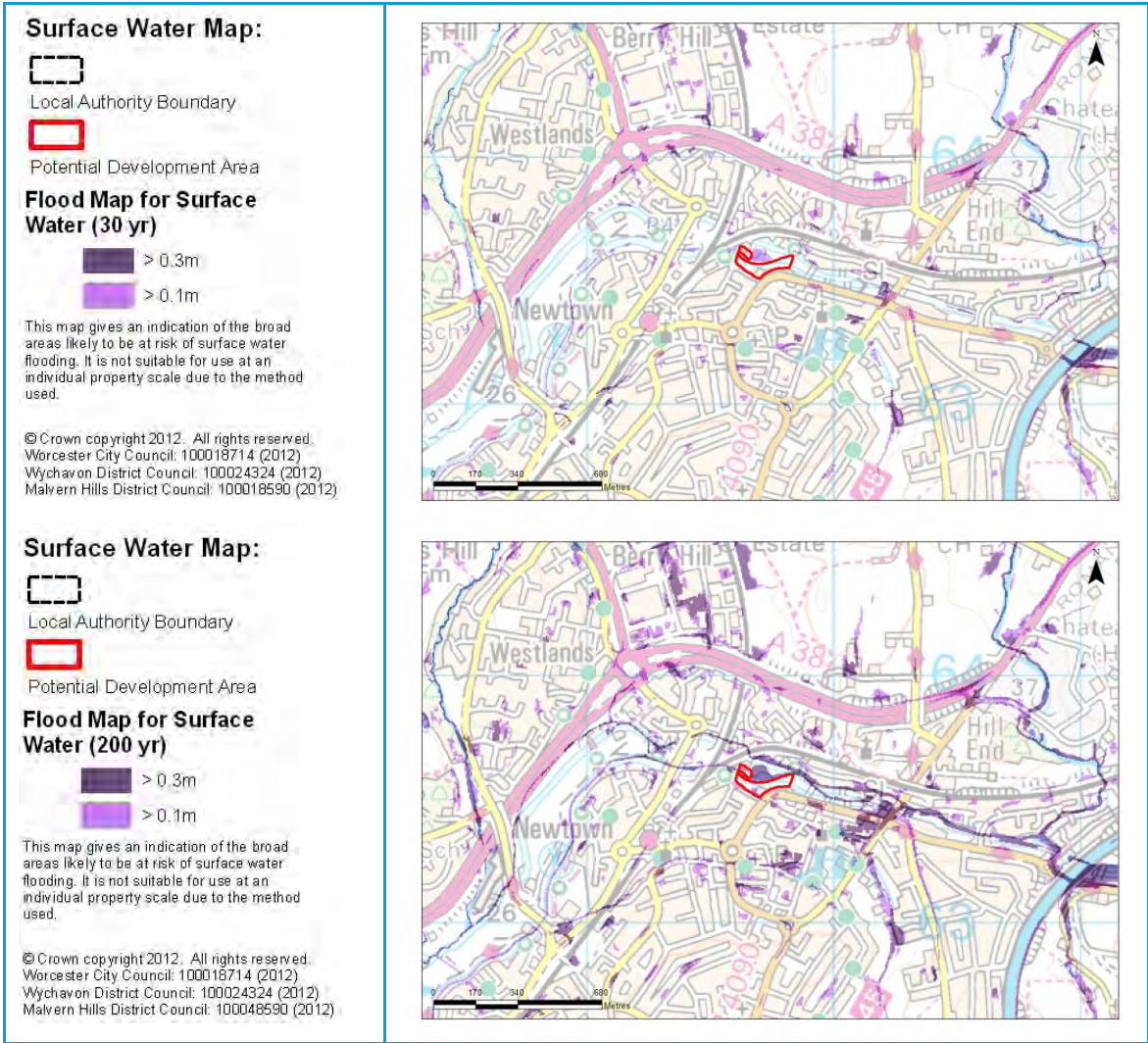
Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.  
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**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**  
  
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**Sources of Flood Risk:**

- Primary flood risk to the site is fluvial from overtopping of the banks of the River Salwarpe located between the two plots with the site area and the Droitwich Canal to the north of the site. The majority of the northern plot of the site and the northern edge of the southern part of the site falls within Flood Zone 2. The majority of the northern plot is within the Yellow Zone of the Policy Maps and the northern edge of the southern plot is within the Blue Zone. The Hampton road, one of the main access roads to the site are at risk from fluvial flooding.
- This site is shown to be partially within one of the County Council’s historic flood hotspots.
- Surface water presents a risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The Hampton road and the B4090 Saltway road, one of the main access roads to the site are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	7.4
	1 in 100 year (plus climate change)	27.6
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	378 – 514	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control		All forms of source control are likely to be suitable
Infiltration		Mapping suggests underlying soil is likely to be permeable. However; the high risk of groundwater flooding would make infiltration unsuitable
Detention		Mapping suggests that site slopes are steep and detention storage 'above ground' may therefore may not be viable
Filtration		All forms of filtration are likely to be suitable
Conveyance		Mapping suggests that site slopes would be suitable for conveyance. However, due to the steepness of slope may require check dams to slow flows

- This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.
- The site is not located within a groundwater source protection zone.
- Mixed use developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**

None.

**Effects of Climate Change:**

Increased rainfall intensities. Increased water levels in the River Salwarpe.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Redevelopment or alternative use of the site will focus on mixed use proposals.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development
- Assessment for runoff should include allowance for climate change effects
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The Hampton road and the B4090 Saltway road, the main access roads to the site are at risk from fluvial flooding and \ or surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-23: SWDP11/4 (Employment Site, top of Kings Road)**

<b>OS NGR:</b> SP046442	<b>Area:</b> 3.8 ha		<b>Brown/Greenfield:</b> Brownfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 0%	<b>FZ3b:</b> 0%	<b>FZ2:</b> 7%	<b>FZ1:</b> 93%

**Exception Test required?** Yes, for Highly Vulnerable Infrastructure development in FZ2.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given first to locating development away from Evesham Marina and River Avon and Flood Zone 2. It should be possible to reduce flood risk at this development area by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

Local Authority Boundary

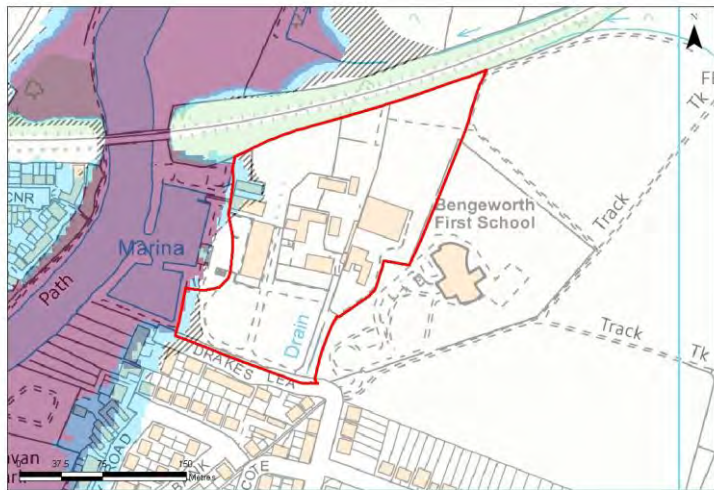
Potential Development Area

**Flood Zones**

- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2
- 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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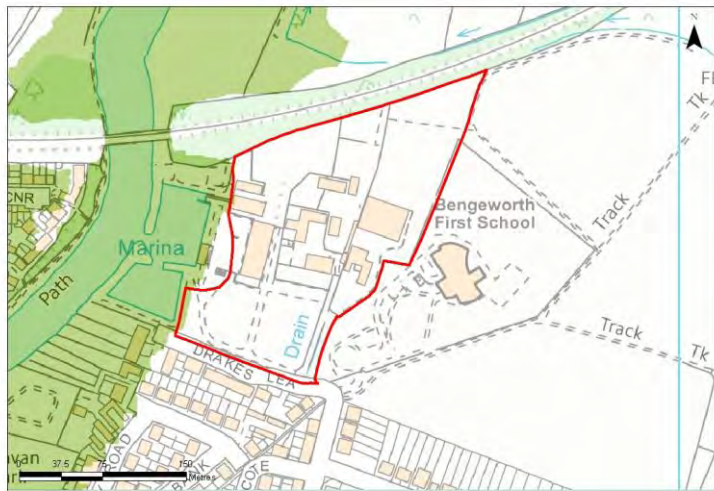
**Climate Change:**

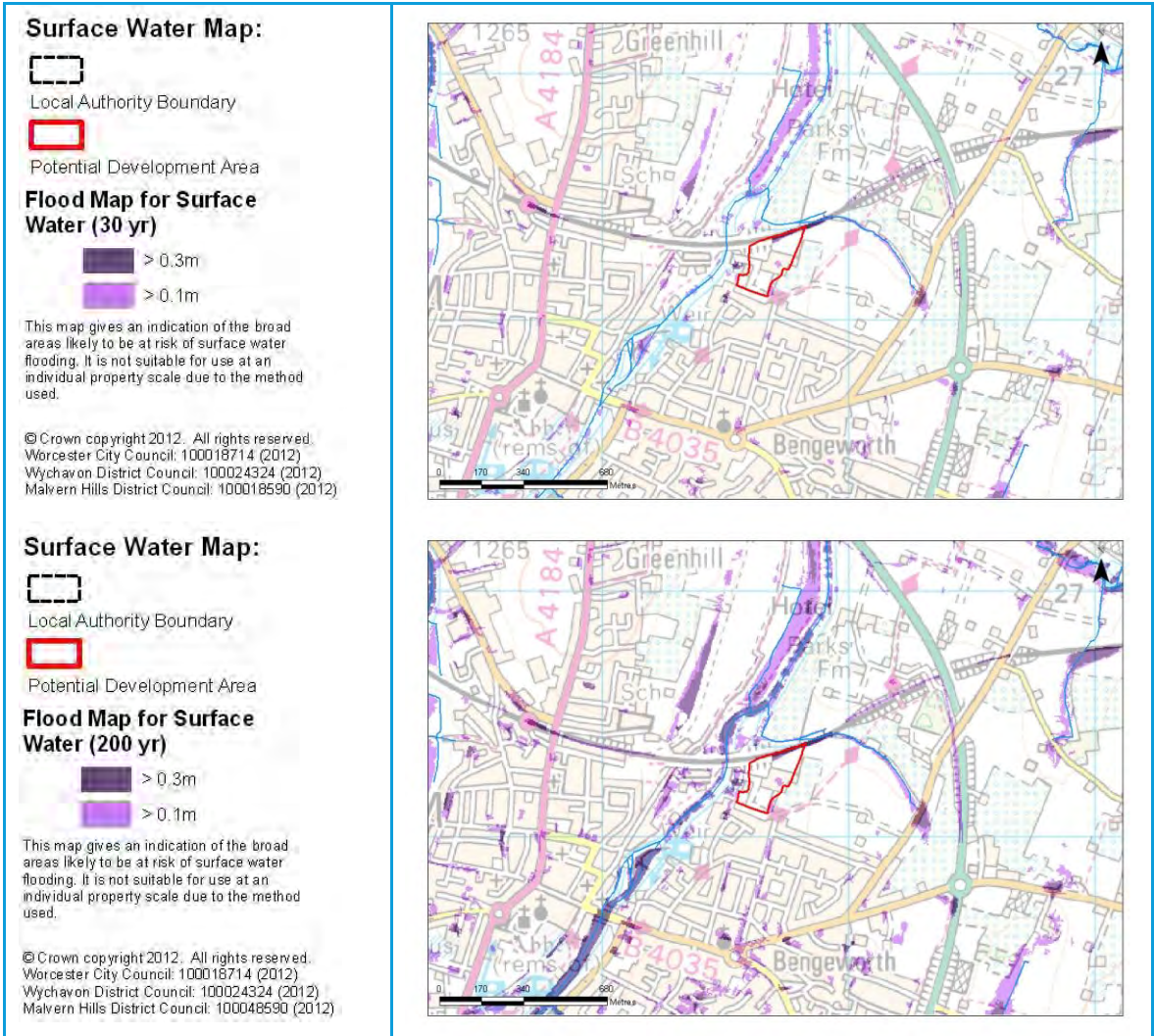
Local Authority Boundary

Potential Development Area

**Flood Zone 3 with Climate Change**

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- Sources of Flood Risk:**
- The main source of flood risk to the site is from surface water. With further development and creation of impermeable surfaces, surface water flooding may become a problem. The Drakes Lea road, the main access road to the site is at risk of surface water.
  - This site is shown to be partially within one of the County Council's historic flood hotspots.
  - Primary fluvial risk is to the western edge of the site resulting from overtopping of the River Avon and Evesham Marina. The western edge of the site falls within Flood Zone 2 with the majority of the site falling in Flood Zone 1. The western edge of the site falls within the Blue Zone of the Policy Maps. The Drakes Lea road, the main access road to the site is at risk of fluvial flooding.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	<b>Fluvial Deposits</b>	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	10



	1 in 100 year (plus climate change)	39.4
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>		1,292 – 1,789
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All forms of source control are likely to be suitable
Infiltration		Mapping suggests underlying soil is likely to be permeable. However; the high risk of groundwater flooding would make infiltration unsuitable
Detention		Mapping suggests that the site slopes are steep and that detention storage 'above ground' would not be viable
Filtration		Mapping suggests that filtrations would be suitable but require a form of liner to prevent ingress of groundwater into the SUDS system
Conveyance		All forms of conveyance are likely to be suitable
<ul style="list-style-type: none"> <li>• This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.</li> <li>• The site is not located within a groundwater source protection zone.</li> <li>• Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensity. Increased water levels in the River Avon.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>• A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>• Proposed for residential uses.</li> <li>• Flood Zone 2 should be used as public open space.</li> <li>• Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>• Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>• Assessment for runoff should include allowance for climate change effects</li> <li>• New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>• Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>• The current and only access road to the site, Drakes Lea road, is at risk from fluvial flooding and surface. Suitable alternative access arrangements away from the floodplain will need to be investigated further.</li> <li>• Demonstration that development at this location can be made safe.</li> </ul>		

**Table 7-24: SWDP13/4 (Former playing fields, Green Lane, Malvern Wells)**

<b>OS NGR:</b> SO 777422	<b>Area:</b> 1.92ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 5%	<b>FZ3b:</b> 10%	<b>FZ2:</b> 2%	<b>FZ1:</b> 83%

**Exception Test required?** Exception Test required? Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the unnamed tributaries of Pool Brook located to the west of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

Local Authority Boundary

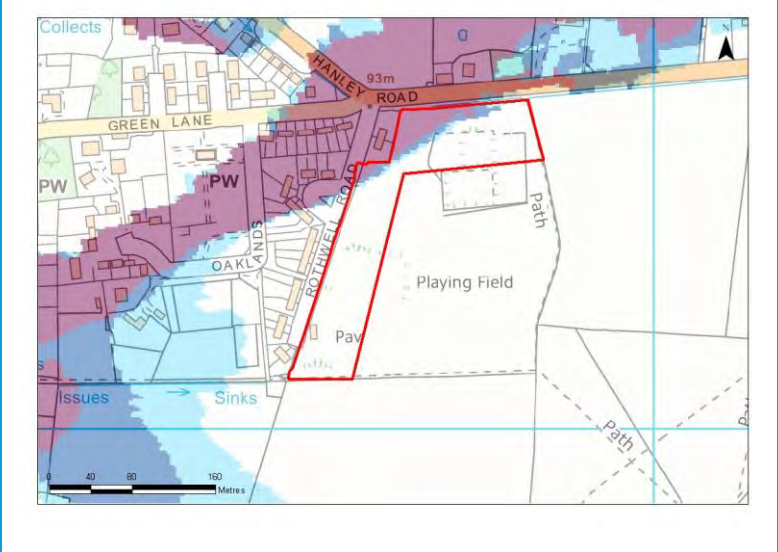
Potential Development Area

**Flood Zones**


- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2
- 2007 historic flood map


Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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**Climate Change:**

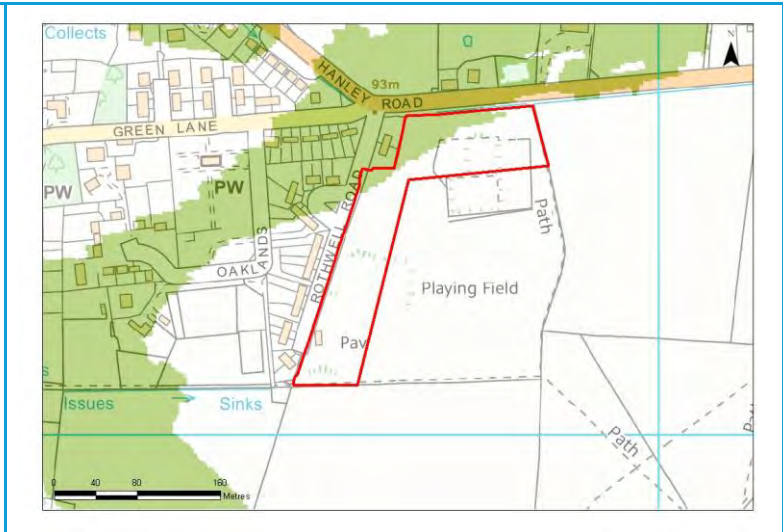
 Local Authority Boundary

 Potential Development Area


**Flood Zone 3 with Climate Change**




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**Surface Water Map:**

 Local Authority Boundary

 Potential Development Area

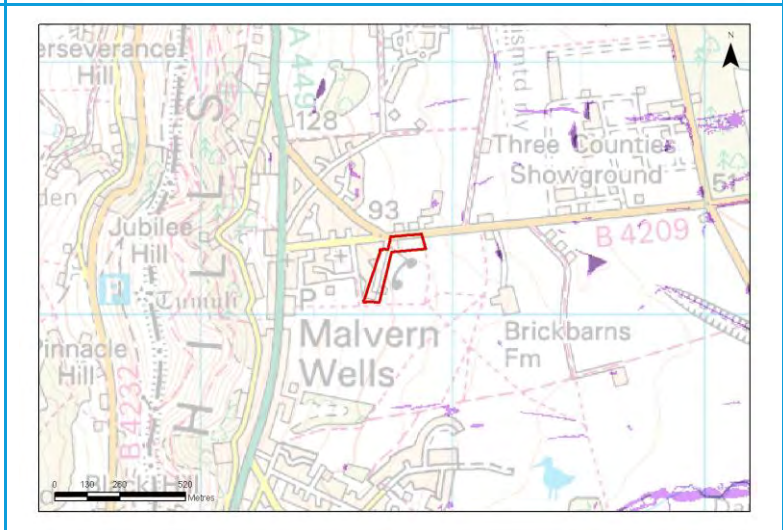
**Flood Map for Surface Water (30 yr)**

 > 0.3m


 > 0.1m


This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Surface Water Map:**

 Local Authority Boundary

 Potential Development Area

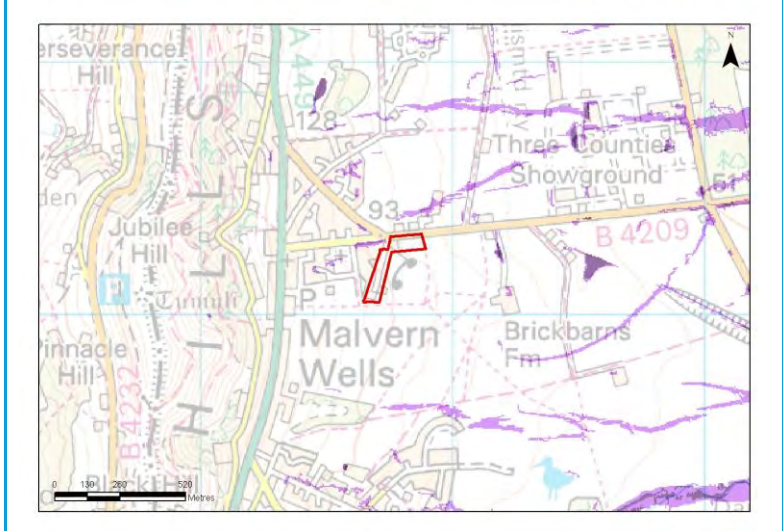
**Flood Map for Surface Water (200 yr)**

 > 0.3m

 > 0.1m

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Sources of Flood Risk:**

- Primary flood risk to the site is fluvial, resulting from overtopping of from the unnamed tributaries of Pool Brook, to the north, west and south portions of the site. The north-west part of the site falls within Flood Zone 3b and the Blue Zone on the Policy Maps. The B4209 Hanley Road and the Rothwell road, the main access roads to the site are at risk from fluvial flooding.
- Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The B4209 Hanley Road and the Rothwell road, the main access roads to the site are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Alluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	9.6
	1 in 100 year (plus climate change)	37.1
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	400 – 620	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control		Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding
Infiltration		Mapping suggests underlying soil is likely to be permeable. However the high risk of groundwater flooding would make infiltration unsuitable
Detention		Mapping suggests that the site will be too steep to allow 'above ground' detention features to be used at this development
Filtration		Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Conveyance		All conveyance techniques are likely to be suitable

- The site is not located within a groundwater source protection zone.
- Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**

None.

**Effects of Climate Change:**

Increased rainfall intensity. Increased water levels in the unnamed tributaries of Pool Brook.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Development of the site is proposed to focus on residential uses.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The site falls within an area indicated to potentially be susceptible to groundwater

emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.

- The main access roads to the site, the B4209 Hanley Road and the Rothwell road, are at risk from fluvial flooding and surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-25: SWDP13/5 (Former Recreation Field – Poolbrook Close)**

<b>OS NGR:</b> SO 794450	<b>Area:</b> 0.2ha		<b>Brown/Greenfield:</b> Brownfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 6%	<b>FZ3b:</b> 48%	<b>FZ2:</b> 1%	<b>FZ1:</b> 45%







**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

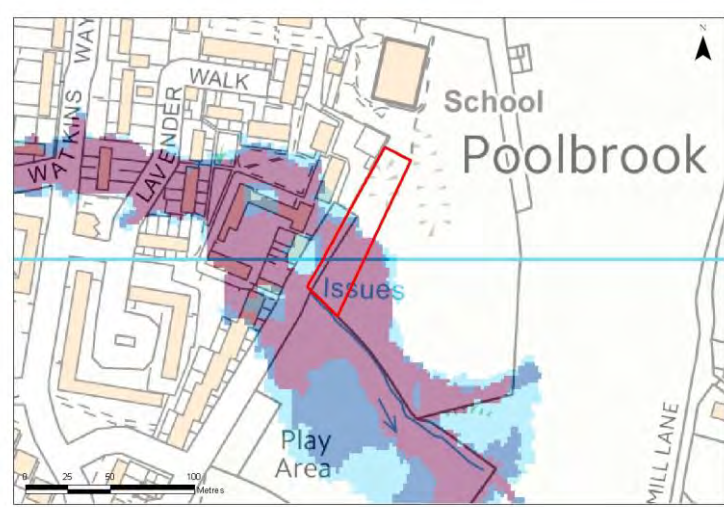
**Requirements for passing the Exception Test:**

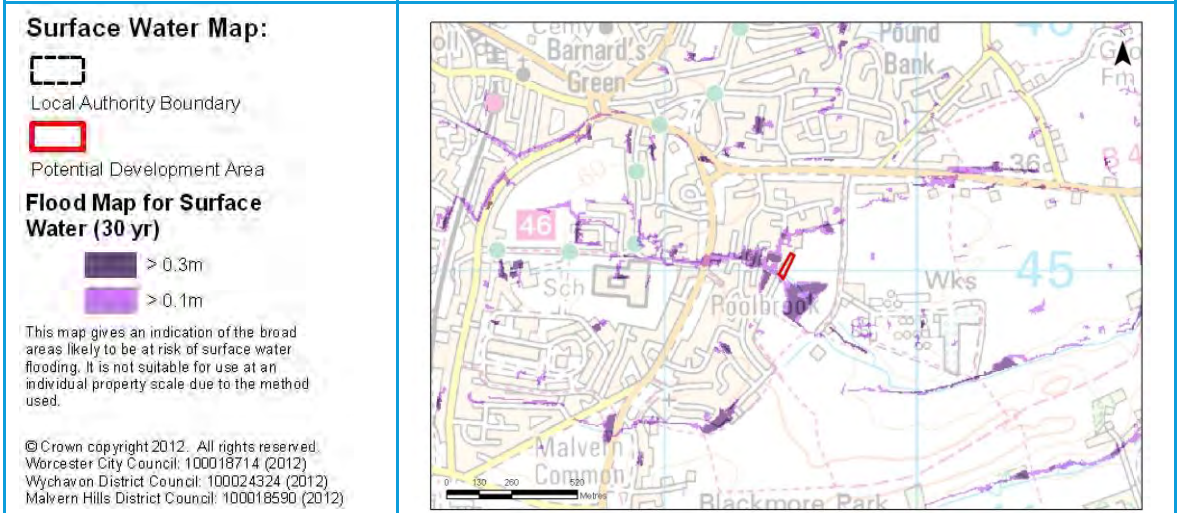
- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from an unnamed tributary of Pool Brook, located to the south of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

 Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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**Sources of Flood Risk:**

- Primary flood risk to the site is fluvial, resulting from overtopping of an unnamed tributary of Pool Brook, to the north and east of the site. The site central and southern parts of the site fall within Flood Zone 3b and the Blue Zone of the Policy Maps. The unnamed road to the west of the site, one of the main access roads to the site, is at risk from fluvial flooding.
- Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The unnamed road to the west of the site, one of the main access roads to the site, is at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Alluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	9.6
	1 in 100 year (plus climate change)	37.1
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	40 – 60	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control	Yellow	Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding
Infiltration	Red	Mapping suggests underlying soil is likely to be permeable. However the high risk of groundwater flooding would make infiltration unsuitable
Detention	Yellow	Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater. Mapping suggests that site slopes may be steep so larger features may not be viable
Filtration	Yellow	Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Conveyance	Green	All conveyance techniques are likely to be suitable

- The site is not located within a groundwater source protection zone.
- Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**

None.

**Effects of Climate Change:**

Increased rainfall intensity. Increased water levels in an unnamed tributary of Pool Brook.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Development of the site is proposed to focus on residential uses.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.



- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- All access roads to the site are at risk from both fluvial flooding and surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-26: SWDP13/9 (Land off Mayfield Road)**

<b>OS NGR:</b> SO 794465	<b>Area:</b> 0.39ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 60%	<b>FZ3b:</b> 0%	<b>FZ2:</b> 32%	<b>FZ1:</b> 8%

**Exception Test required?** Yes, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a.

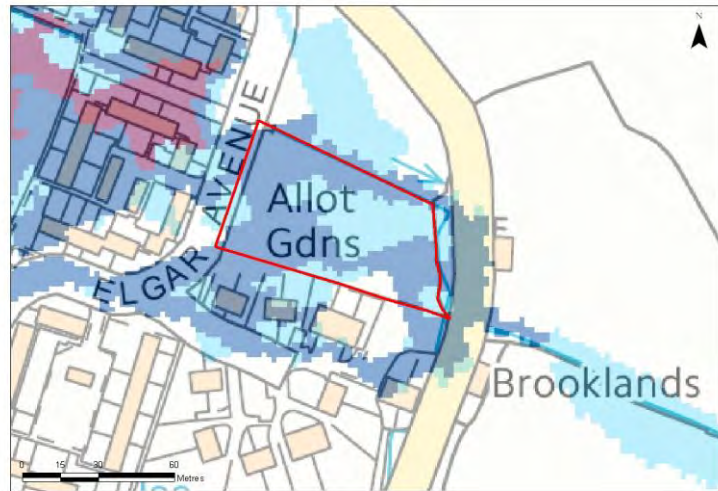
**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the unnamed tributaries of Whiteacres Brook, located to the west and east of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

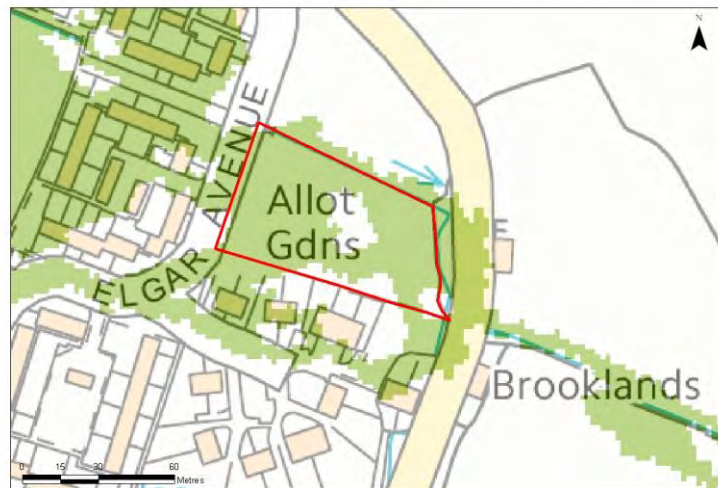
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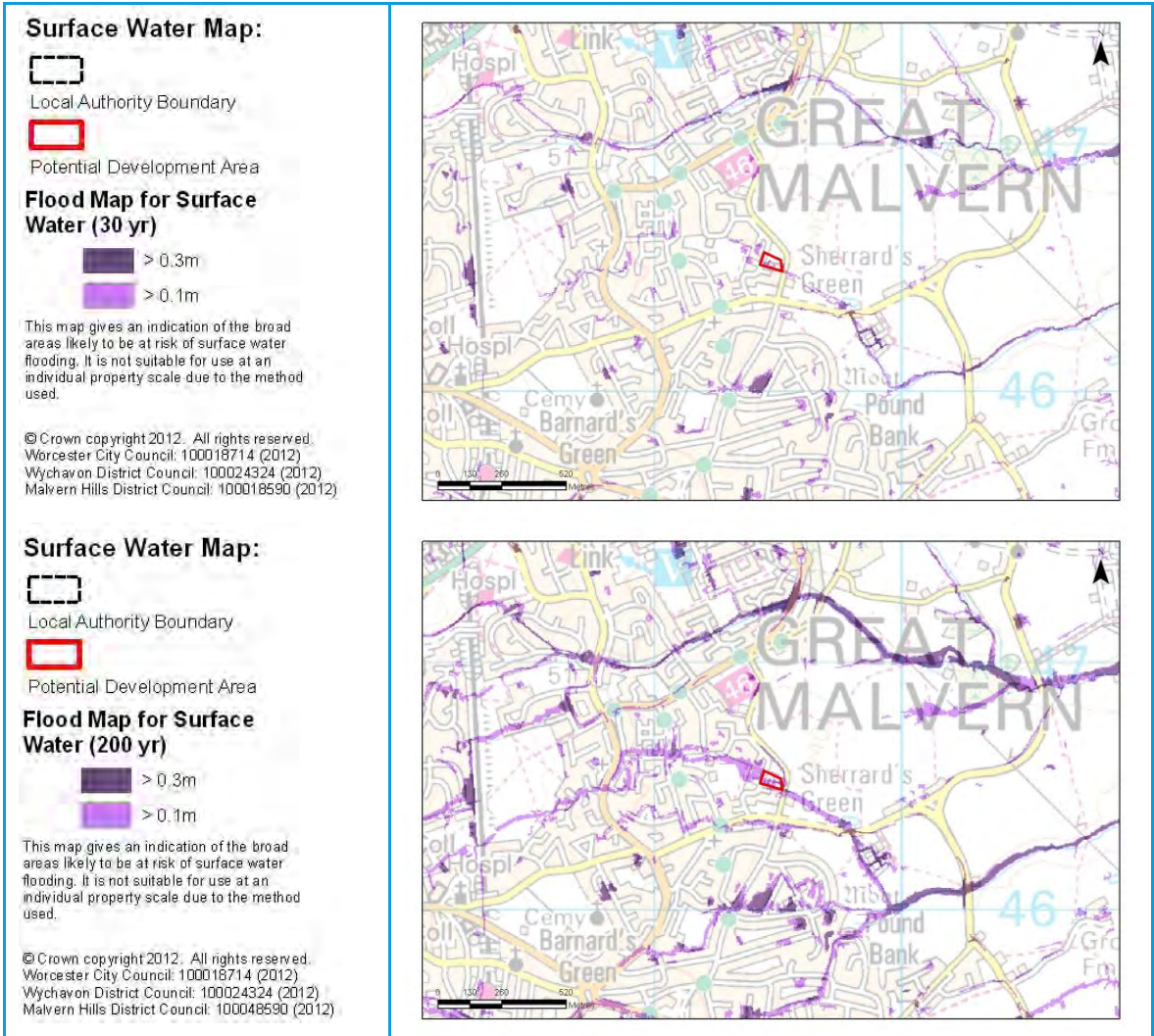


**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**

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**Sources of Flood Risk:**

- Primary flood risk to the site is fluvial, resulting from overtopping of the unnamed tributaries of Whiteacres Brook to the north and east of the site. The site predominately falls within Flood Zone 3a and the majority of the site falls within Flood Zone 2 and 3. The majority of the site falls within the Blue Zone of the Policy Maps. The Mayfield Road and the Elgar Avenue road, the main access roads to the site, are at risk from fluvial flooding.
- This site is shown to be partially within one of the County Council's historic flood hotspots.
- Surface water presents a risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The Mayfield Road and the Elgar Avenue road, the main access roads to the site, are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Alluvial Deposits
------------------	-------------------

<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	11
	1 in 100 year (plus climate change)	42.6
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	80 – 120	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control		Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding
Infiltration		Mapping suggests underlying soil is likely to be permeable. However the high risk of groundwater flooding would make infiltration unsuitable
Detention		Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Filtration		Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Conveyance		All conveyance techniques are likely to be suitable

- The site is not located within a groundwater source protection zone.
- Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**

None.

**Effects of Climate Change:**

Increased rainfall intensity. Increased water levels in an unnamed tributary of Whiteacres Brook.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- A culvert is located through the site.
- Development of the site is proposed to focus on residential uses.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- The Mayfield Road and the Elgar Avenue road, the main access roads to the site, are at risk from fluvial flooding and surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-27: SWDP16 (Three Counties Showground)**

<b>OS NGR:</b> SO 786427	<b>Area:</b> 38.62ha		<b>Brown/Greenfield:</b> Brownfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 9%	<b>FZ3b:</b> 24%	<b>FZ2:</b> 14%	<b>FZ1:</b> 53%

**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

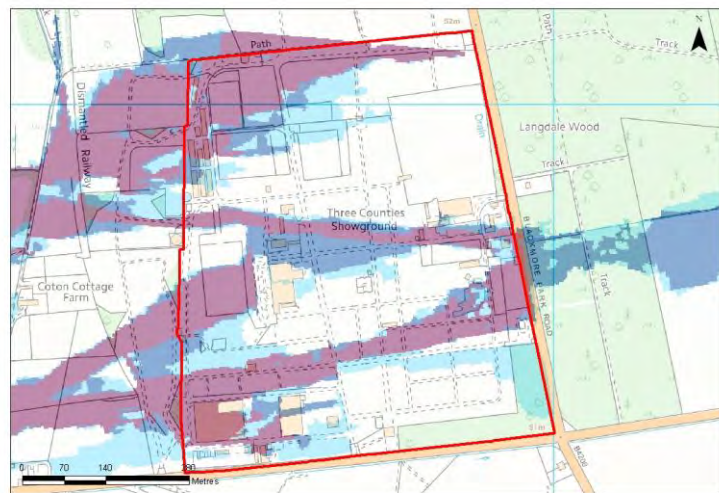
- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the unnamed tributaries of Pool Brook, located north, west and south of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**


 Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map


Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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**Climate Change:**

 Local Authority Boundary

 Potential Development Area


**Flood Zone 3 with Climate Change**




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**Surface Water Map:**

 Local Authority Boundary

 Potential Development Area

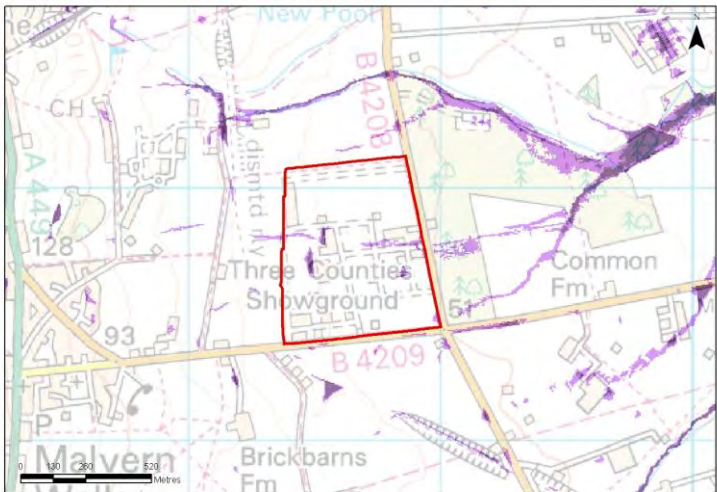
**Flood Map for Surface Water (30 yr)**

 > 0.3m


 > 0.1m


This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Surface Water Map:**

 Local Authority Boundary

 Potential Development Area

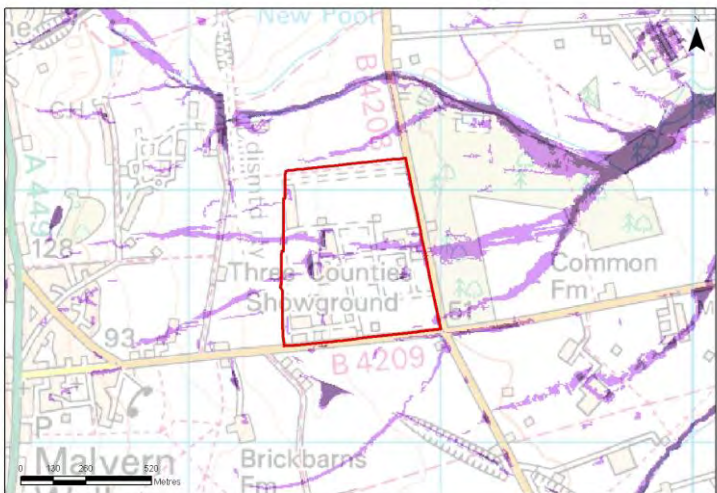
**Flood Map for Surface Water (200 yr)**

 > 0.3m

 > 0.1m

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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- Sources of Flood Risk:**
- Primary flood risk to the site is fluvial, resulting from overtopping of from the unnamed tributaries of Pool Brook, to the north, west and south portions of the site. The site falls within Flood Zone 3b and the Blue Zone on the Policy Maps, to the western, northern and southern portions of the site. The B4209 Hanley Road and the Rothwell road, the main access roads to the site are at risk from fluvial flooding.
  - Surface water presents a risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The B4209 Hanley road and the B4208 Blackmore Park road the main access roads to

the site are at risk from surface water.		
<b>Surface Water Drainage:</b>		
As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.		
PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.		
<b>Soil Type</b>	Alluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	9.6
	1 in 100 year (plus climate change)	37.1
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	8,030 – 12,360	
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding
Infiltration		Mapping suggests underlying soil is likely to be permeable. However the high risk of groundwater flooding would make infiltration unsuitable
Detention		Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Filtration		Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Conveyance		All conveyance techniques are likely to be suitable
<ul style="list-style-type: none"> <li>The site is not located within a groundwater source protection zone.</li> <li>Commercial, recreation, tourism and leisure developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensity. Increased water levels in the unnamed tributaries of Pool Brook.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>Redevelopment or alternative use of the site is proposed to focus on commercial, recreational, tourism and leisure uses, either singly or as mixed use proposals.</li> <li>Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>Assessment for runoff should include allowance for climate change effects.</li> <li>New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>Onsite attenuation schemes would need to be tested against the hydrograph of the</li> </ul>		

receiving watercourse to ensure flows are not exacerbated downstream within the catchment.

- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- The B4209 Hanley Road and the Rothwell road, the main access roads to the site are at risk from fluvial flooding and surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.



**Table 7-28: SWDP18/1 (Garage, High Street)**

<b>OS NGR: 948460</b>	<b>Area: 0.5ha</b>		<b>Brown/Greenfield: Brownfield</b>	
<b>Flood Zone Coverage:</b>	<b>FZ3a: 0%</b>	<b>FZ3b: 0%</b>	<b>FZ2: 1%</b>	<b>FZ1: 99%</b>

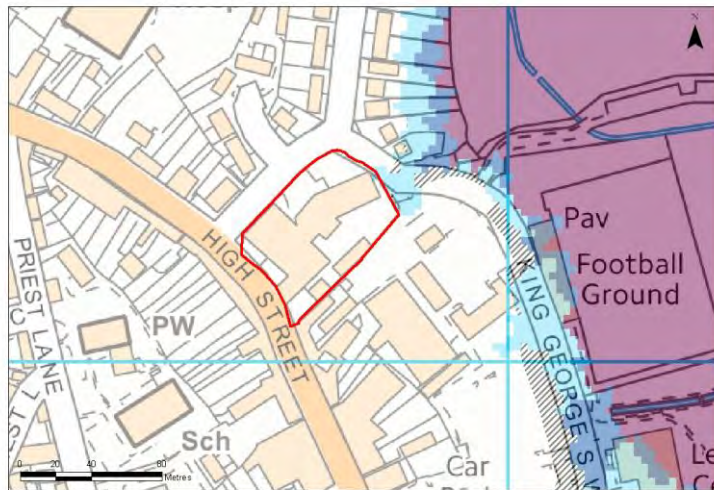
**Exception Test required?** Yes, for Highly Vulnerable Infrastructure development in FZ2.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given first to locating development away from the unnamed tributary of the River Avon and Flood Zone 2. It should be possible to reduce flood risk at this development area by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

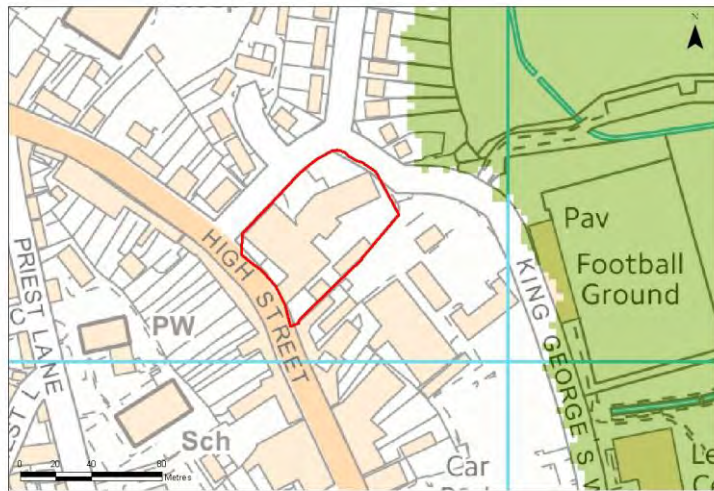
**Flood Zone Map:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.  
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**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**  
 Flood Zone 3 with Climate Change  
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**Surface Water Map:**

Local Authority Boundary

Potential Development Area

**Flood Map for Surface Water (30 yr)**

> 0.3m

> 0.1m

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Surface Water Map:**

Local Authority Boundary

Potential Development Area

**Flood Map for Surface Water (200 yr)**

> 0.3m

> 0.1m

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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- Sources of Flood Risk:**
- The main source of flood risk to the site is from surface water. With further development and creation of impermeable surfaces, surface water flooding may become a problem. High Street, one of the main access roads to the site, is at risk from surface water.
  - This site is shown to be partially within one of the County Council's historic flood hotspots.
  - The north east edge of the site falls within Flood Zone 2 though the site predominately falls within Flood Zone 1. Primary fluvial risk is to the north-east edge of the site resulting from overtopping of an unnamed tributary of the River Avon. King George's Way, one of the main access roads to the site, is at risk from fluvial flooding.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	5.0

	1 in 100 year (plus climate change)	19.3
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	190 – 272	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control		All forms of source control are likely to be suitable
Infiltration		Mapping suggests high permeability at this site, site investigations should be carried out to assess potential for drainage by infiltration
Detention		Mapping suggests that site slopes are steep and detention storage 'above ground' may therefore not be viable
Filtration		Mapping suggests that filtrations would be suitable but require a form of liner to prevent ingress of groundwater into the SUDS system
Conveyance		All forms of conveyance are likely to be suitable

- This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.
- The site is not located within a groundwater source protection zone
- Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment

**Flood Defences:**

None.

**Effects of Climate Change:**

Increased rainfall intensity. Increased water levels in the unnamed tributary of the River Avon.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Proposed for residential use.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development
- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- Assessment for runoff should include allowance for climate change effects
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The High Street and King's Way, the main access roads to the site are at risk from both fluvial flooding and \ or surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

Table 7-29: SWDP18/6 Land rear of the High Street

<b>OS NGR:</b> SO 950458	<b>Area:</b> 0.5ha		<b>Brown/Greenfield:</b> Brownfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 3%	<b>FZ3b:</b> 1%	<b>FZ2:</b> 15%	<b>FZ1:</b> 81%

**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the River Avon, located to the east of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

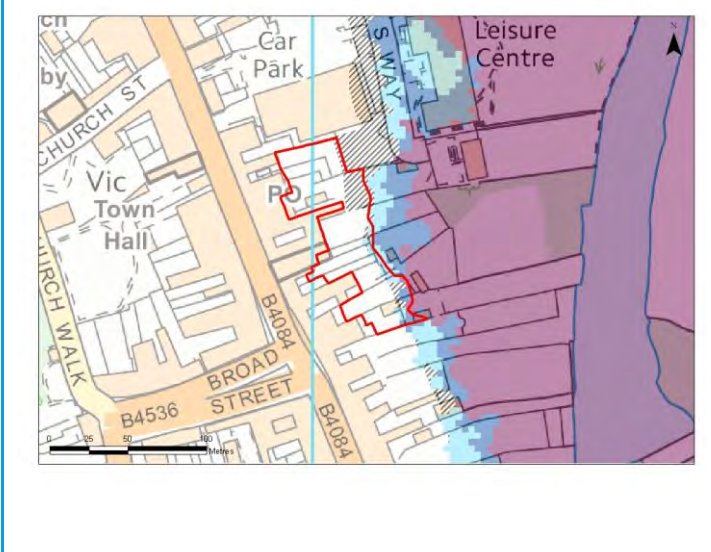
Local Authority Boundary  
Potential Development Area

**Flood Zones**

- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2
- 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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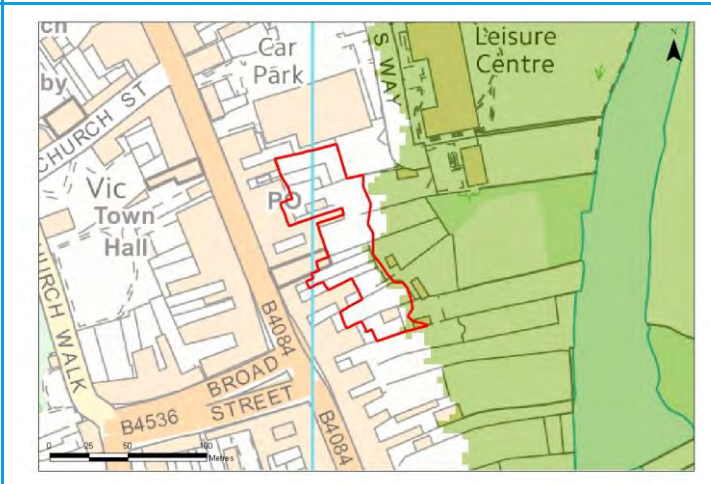


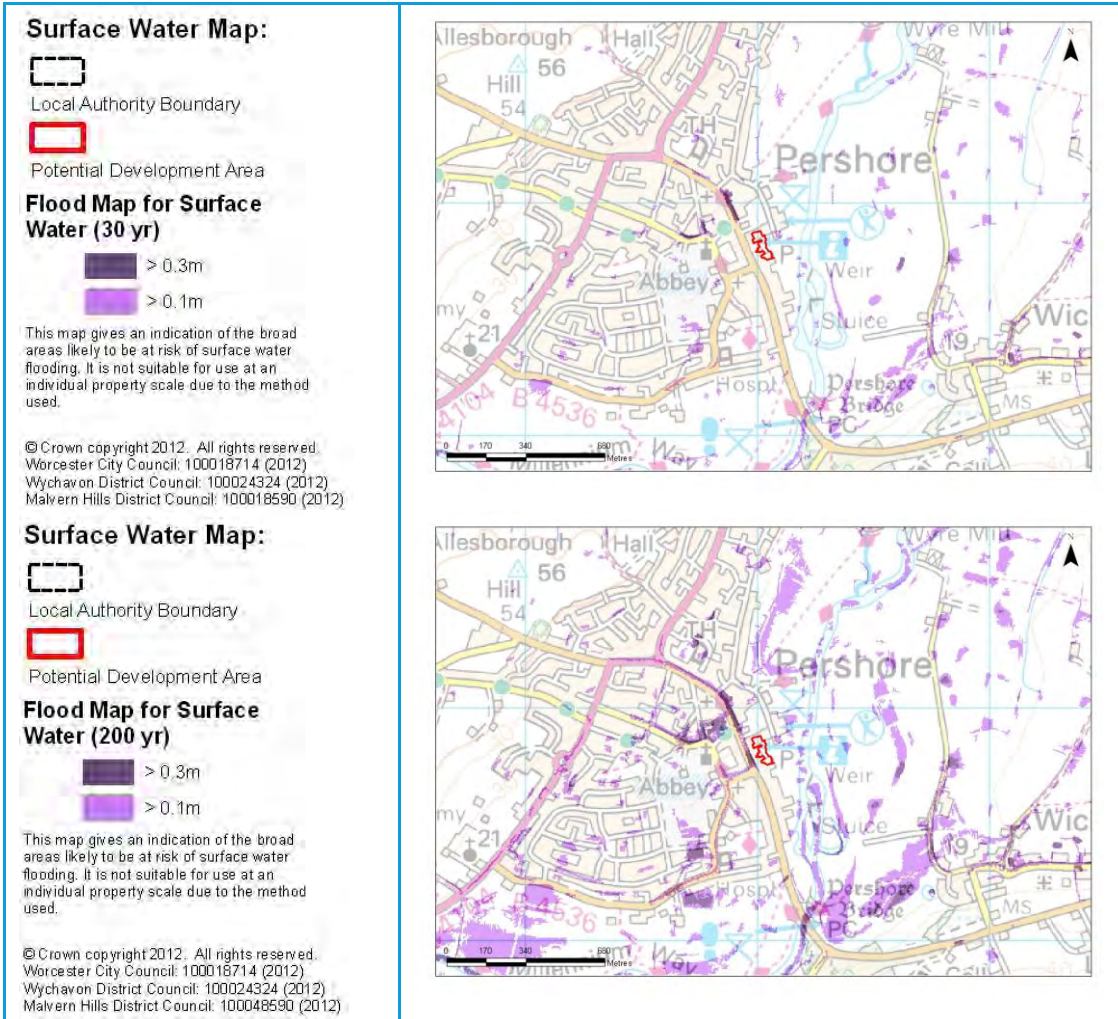
**Climate Change:**

Local Authority Boundary  
Potential Development Area

**Flood Zone 3 with Climate Change**

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**Sources of Flood Risk:**

- Primary flood risk to the site is fluvial from River Avon, resulting from overtopping of the banks to the east of the site. The eastern edge of the site falls within Flood Zone 3b and the Yellow Zone of the Policy Maps. The King George’s Way, one of the main access roads to the site, is at risk from fluvial flooding.
- This site is shown to be partially within two of the County Council’s historic flood hotspots.
- Surface water presents a very low risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The B4084 High Street road and King George’s Way, the main access roads to the site, are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

Soil Type	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	5.0
	1 in 100 year (plus climate change)	19.3

<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>		180-272.5
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding
Infiltration		Mapping suggests underlying soil is likely to be permeable. However, the high risk of groundwater flooding would make infiltration unsuitable
Detention		Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater. Mapping suggests that site slopes may be steep so larger features may not be viable
Filtration		Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Conveyance		All conveyance techniques are likely to be suitable
<ul style="list-style-type: none"> <li>• This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.</li> <li>• The site is not located within a groundwater source protection zone.</li> <li>• Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensity. Increased water levels in the River Avon.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>• A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>• Development of the site is proposed to focus on residential uses.</li> <li>• Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>• Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>• Assessment for runoff should include allowance for climate change effects.</li> <li>• New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>• Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>• The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.</li> <li>• The B4084 High Street road and King George's Way, the main access roads to the site, are at risk from fluvial flooding and \ or surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.</li> <li>• Demonstration that development at this location can be made safe.</li> </ul>		

**Table 7-30: SWDP19/1 (Station Road/Wyre Road, Pershore)**

<b>OS NGR:</b> SO 950472	<b>Area:</b> 23.9ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 4%	<b>FZ3b:</b> 2%	<b>FZ2:</b> 6%	<b>FZ1:</b> 87%

**Exception Test required?** Yes, for More Vulnerable and Essential Infrastructure development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

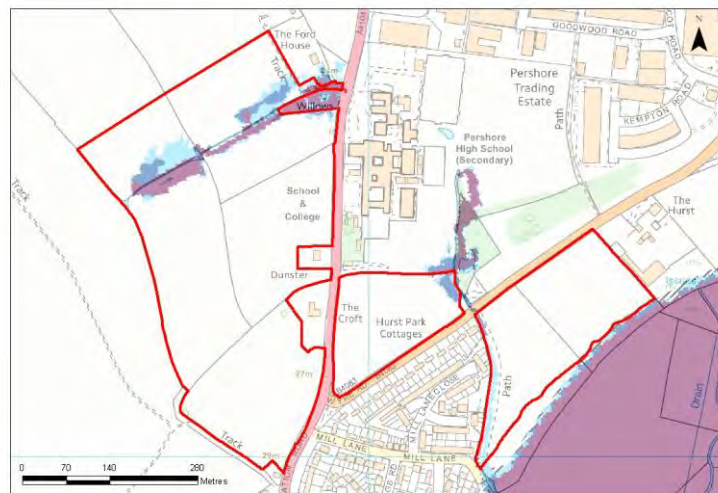
- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the unnamed tributaries of the River Avon, located to the west, east and south of the sites, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

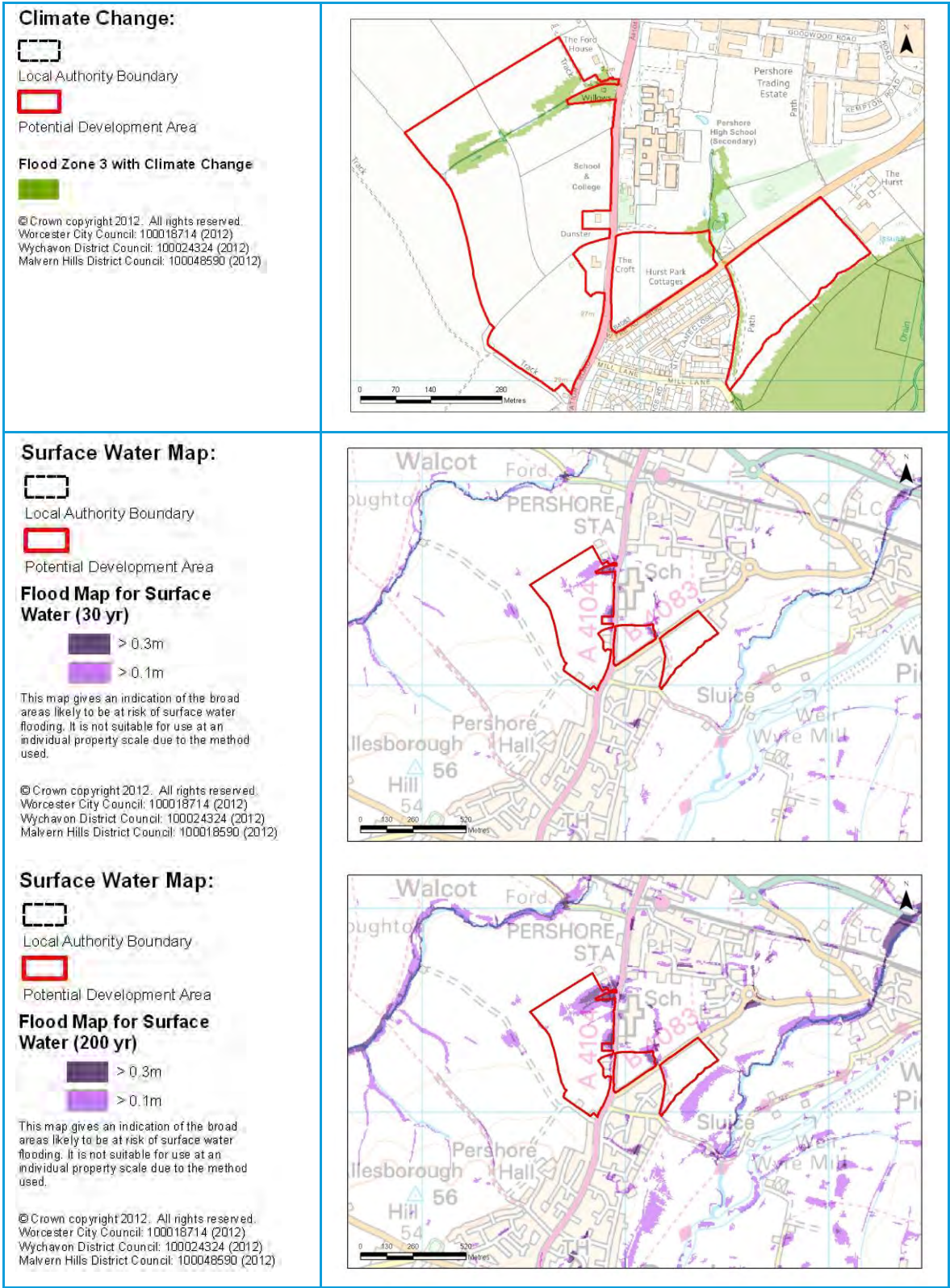
**Flood Zone Map:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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**Sources of Flood Risk:**

- Primary flood risk to the site is fluvial, resulting from overtopping of the unnamed tributaries of the River Avon, to the central-western part of the first plot, north-eastern part of the second plot and eastern and southern boundary of the third plot. The site falls within Flood Zone 3b and the Blue Zone on the Policy Maps, at those locations. The A4104 Station Road and the B4083 Wyre Road, the main access roads to the site, are at risk from fluvial flooding.
- This site is shown to be partially within four of the County Council's historic flood hotspots.



- Surface water presents a risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The A4104 Station Road and the B4083 Wyre Road, the main access roads to the site, are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Unknown – More Permeable	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	5
	1 in 100 year (plus climate change)	19.3
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	9,080 – 13,030	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control		All source control techniques are likely to be suitable
Infiltration		Mapping suggests underlying soil is likely to be permeable. However there is a risk of groundwater flooding. A site investigation should be carried out to assess suitability of drainage by infiltration
Detention		Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Filtration		All filtration techniques are likely to be suitable
Conveyance		All conveyance techniques are likely to be suitable

- This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.
- The site is not located within a groundwater source protection zone.
- Commercial, recreational and leisure developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**

A flood defence scheme for the Pershore area.

**Effects of Climate Change:**

Increased rainfall intensity. Increased water levels in the unnamed tributaries of the River Avon.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Redevelopment or alternative use of the site will focus on commercial, recreational and leisure uses, either singly or as mixed use proposals.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.

- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- The A4104 Station Road and the B4083 Wyre Road, two of the main access roads are at risk from fluvial flooding and surface water. Assessment of the minor access roads flood risk will need to be assessed and if appropriate, suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-31: SWDP23/24 (Land adjacent to Station Road)**

<b>OS NGR:</b> SP 088378	<b>Area:</b> 11ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 0%	<b>FZ3b:</b> 0%	<b>FZ2:</b> 55%	<b>FZ1:</b> 45%

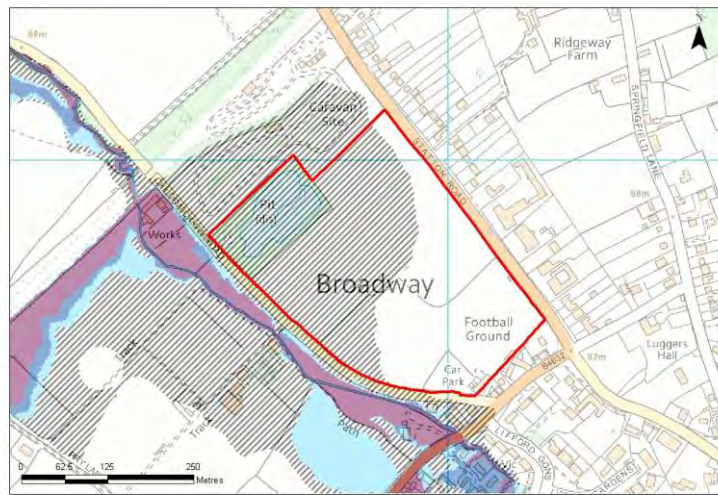
**Exception Test required?** Yes, for Highly Vulnerable development in FZ2.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to locating development away from the west of the site and Flood Zone 2. It should be possible to reduce flood risk at this development area by using sequential design to locate more vulnerable developments towards higher ground through building design and by meeting drainage requirements.
- New developments being located outside of Flood zone 2 need to ensure that no increase in flood risk occurs. Areas with Flood Zone 2 should be kept as open space.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

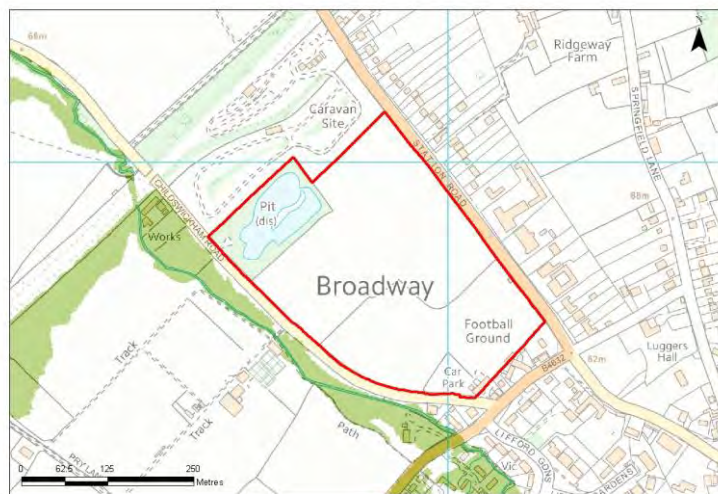
**Flood Zone Map:**

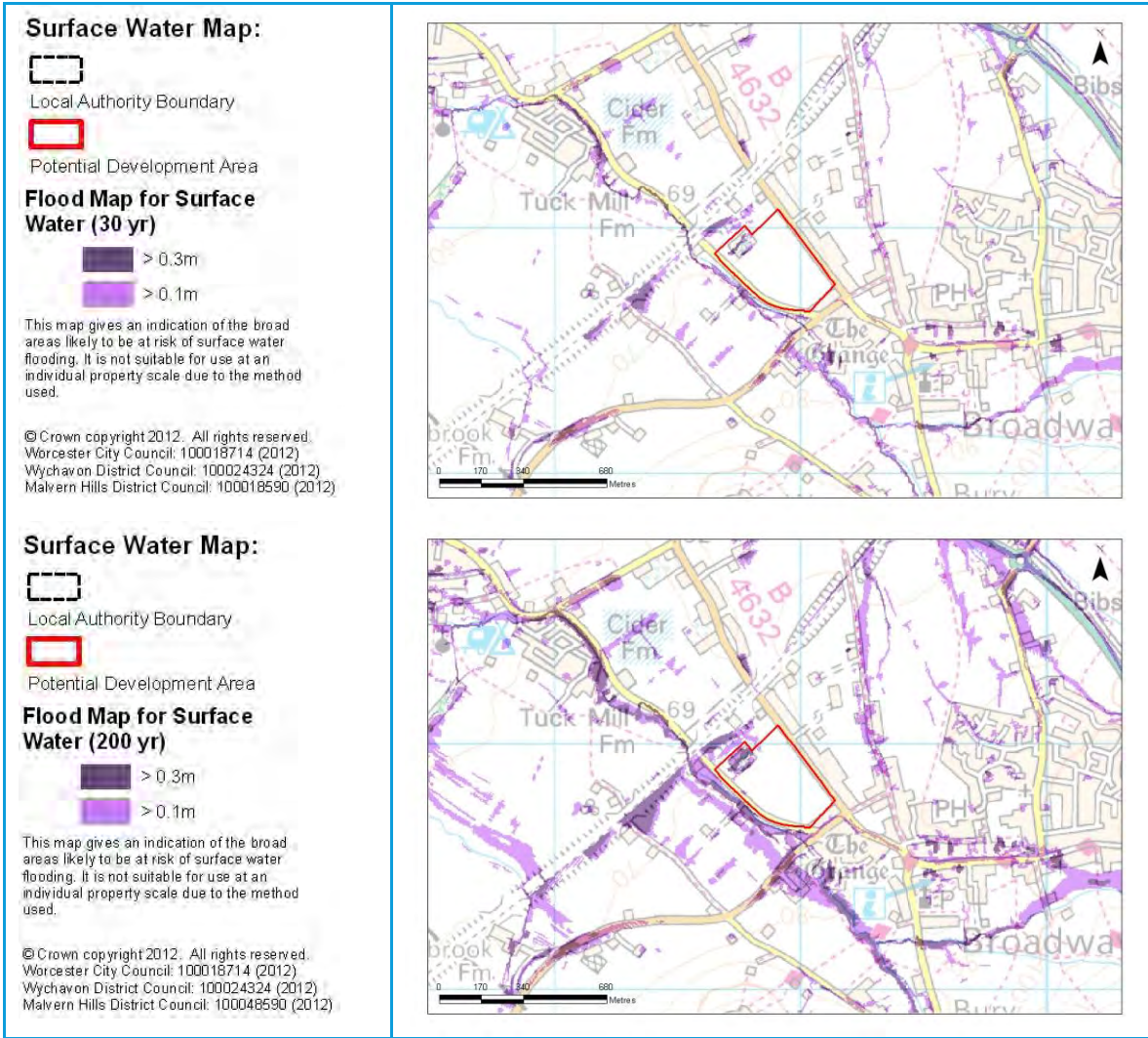
Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.  
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**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**  
  
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- Sources of Flood Risk:**
- Primary flood risk to the site is fluvial, resulting from overtopping of the Brunches Brook, to the west of the site. Roughly half of the site, to the western side, falls within Flood Zone 2. The Childswickham Road and the B4632 Cheltenham Road, some of the main access roads to the site, is at risk from fluvial flooding.
  - This site is shown to be partially within one of the County Council’s historic flood hotspots.
  - Surface water presents a risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. Childswickham Road and the B4632 Cheltenham, some of the main access roads to the site, are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	14.2

	1 in 100 year (plus climate change)	56.1
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>		3520 - 4807
<b>SUDS and the development site:</b>		
SUDS Type	Potential Suitability	Comments
Source Control		Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding
Infiltration		Mapping suggests underlying soil is likely to be permeable. However, the high risk of groundwater flooding would make infiltration unsuitable
Detention		Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater. Mapping suggests that site slopes may be steep so larger features may not be viable
Filtration		Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Conveyance		All conveyance techniques are likely to be suitable
<ul style="list-style-type: none"> <li>• This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.</li> <li>• The site is not located within a groundwater source protection zone.</li> <li>• Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensity. Increased water levels in the Brunches Brook.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>• A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>• Development of the site is proposed to focus on residential uses.</li> <li>• Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>• Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>• Assessment for runoff should include allowance for climate change effects.</li> <li>• New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>• Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>• The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.</li> <li>• Access needs would need to be outside of the floodplain, onto the B4632 Station Road.</li> <li>• Demonstration that development at this location can be made safe.</li> </ul>		

**Table 7-32: SWDP23/26 (Land between High Street and Weston Road)**

<b>OS NGR: SP 116437</b>	<b>Area: 4ha</b>		<b>Brown/Greenfield: Brownfield</b>	
<b>Flood Zone Coverage:</b>	<b>FZ3a: 0%</b>	<b>FZ3b: 0%</b>	<b>FZ2: 16%</b>	<b>FZ1: 84%</b>

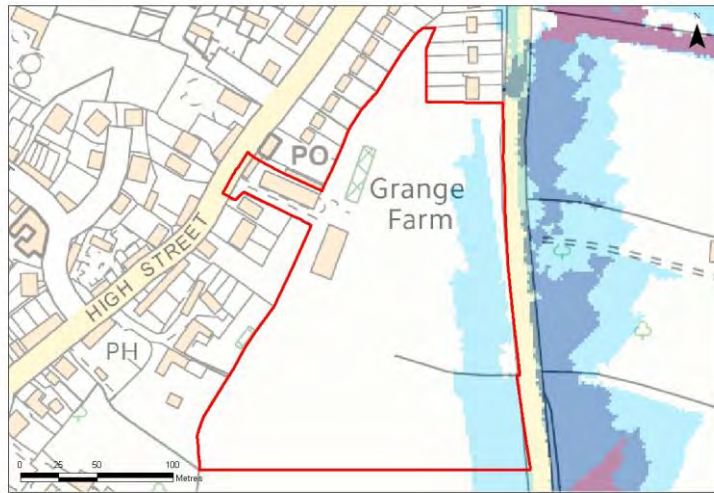
**Exception Test required?** Yes, for Highly Vulnerable development in FZ2.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given first to locating development away from unnamed tributaries of the River Avon located east of the site and Flood Zone 2. It should be possible to reduce flood risk at this development area by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

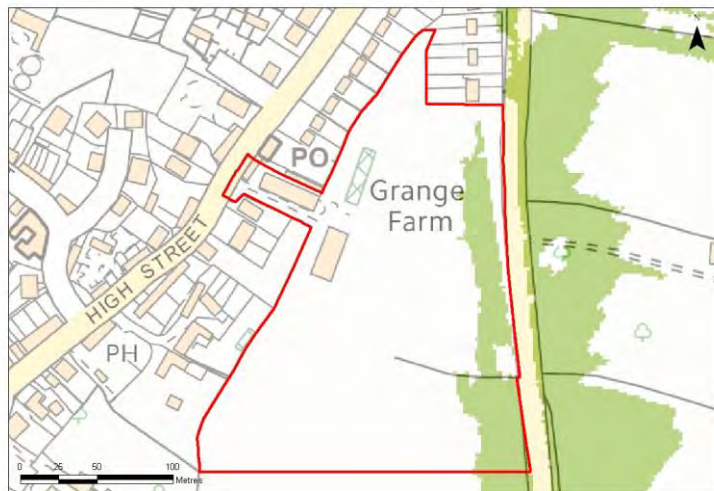
**Flood Zone Map:**

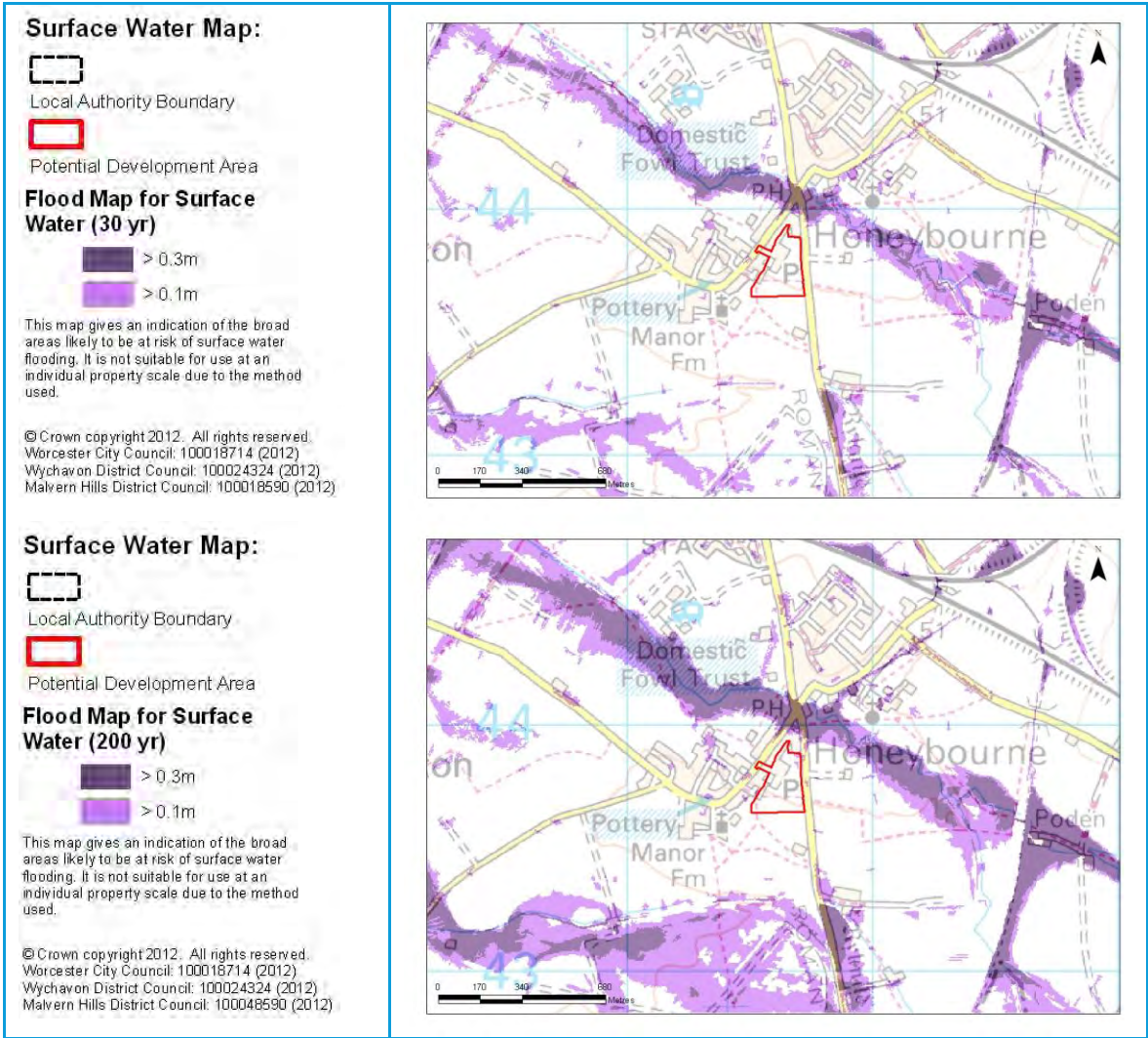
Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.  
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**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**  
  
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**Sources of Flood Risk:**

- Primary flood risk to the site is fluvial from unnamed tributaries of the River Avon to the east of the site. The eastern part of the site falls within Flood Zone 2. Weston Road and High Street, the main access roads to the site, are at risk from fluvial flooding.
- This site is shown to be partially within one of the County Council's historic flood hotspots.
- Surface water presents a low risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. Weston Road and High Street, the main access roads to the site, are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Unknown – Less Permeable	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	8.4

	1 in 100 year (plus climate change)	31.1
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	1,500 – 2,152	
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All forms of source control are likely to be suitable
Infiltration		Mapping suggests high permeability at this site, site investigations should be carried out to assess potential for drainage by infiltration
Detention		Mapping suggests that the site slopes are suitable for all forms of detention
Filtration		All forms of filtration are likely to be suitable.
Conveyance		All forms of flow conveyance are likely to be suitable
<ul style="list-style-type: none"> <li>• This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.</li> <li>• The site is not located within a groundwater source protection zone.</li> <li>• Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased water levels in the River Avon. Increased rainfall intensities.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>• A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>• Proposed for residential use.</li> <li>• Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>• Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>• Assessment for runoff should include allowance for climate change effects.</li> <li>• New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>• The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.</li> <li>• Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>• The Weston Road and High Street road, the main access roads to the site, are at risk from fluvial flooding and surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.</li> <li>• Demonstration that development at this location can be made safe.</li> </ul>		



**Table 7-33: SWDP23/27 Land behind the High Street**

<b>OS NGR:</b> SO 115439	<b>Area:</b> 1.0ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 7%	<b>FZ3b:</b> 14%	<b>FZ2:</b> 3%	<b>FZ1:</b> 76%

**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.  
Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the Gate Inn Brook, located to the north and east of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

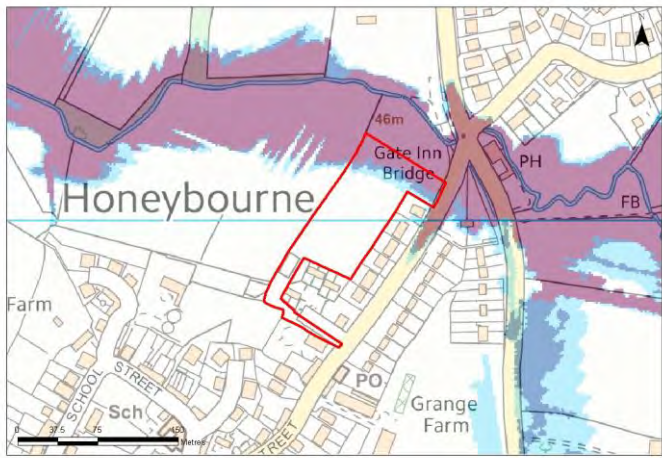
Local Authority Boundary  
Potential Development Area

**Flood Zones**

- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2
- 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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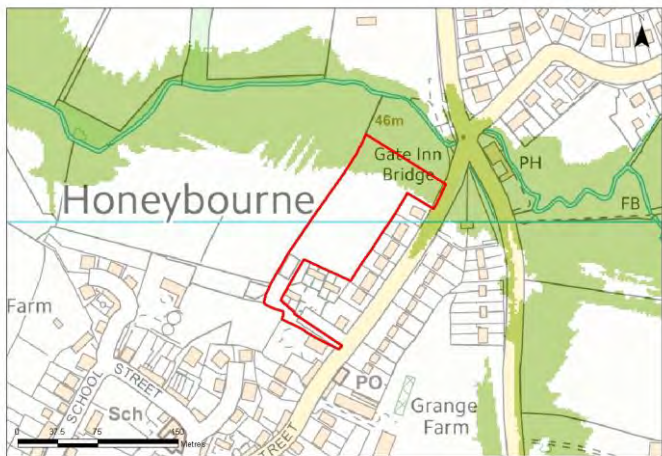


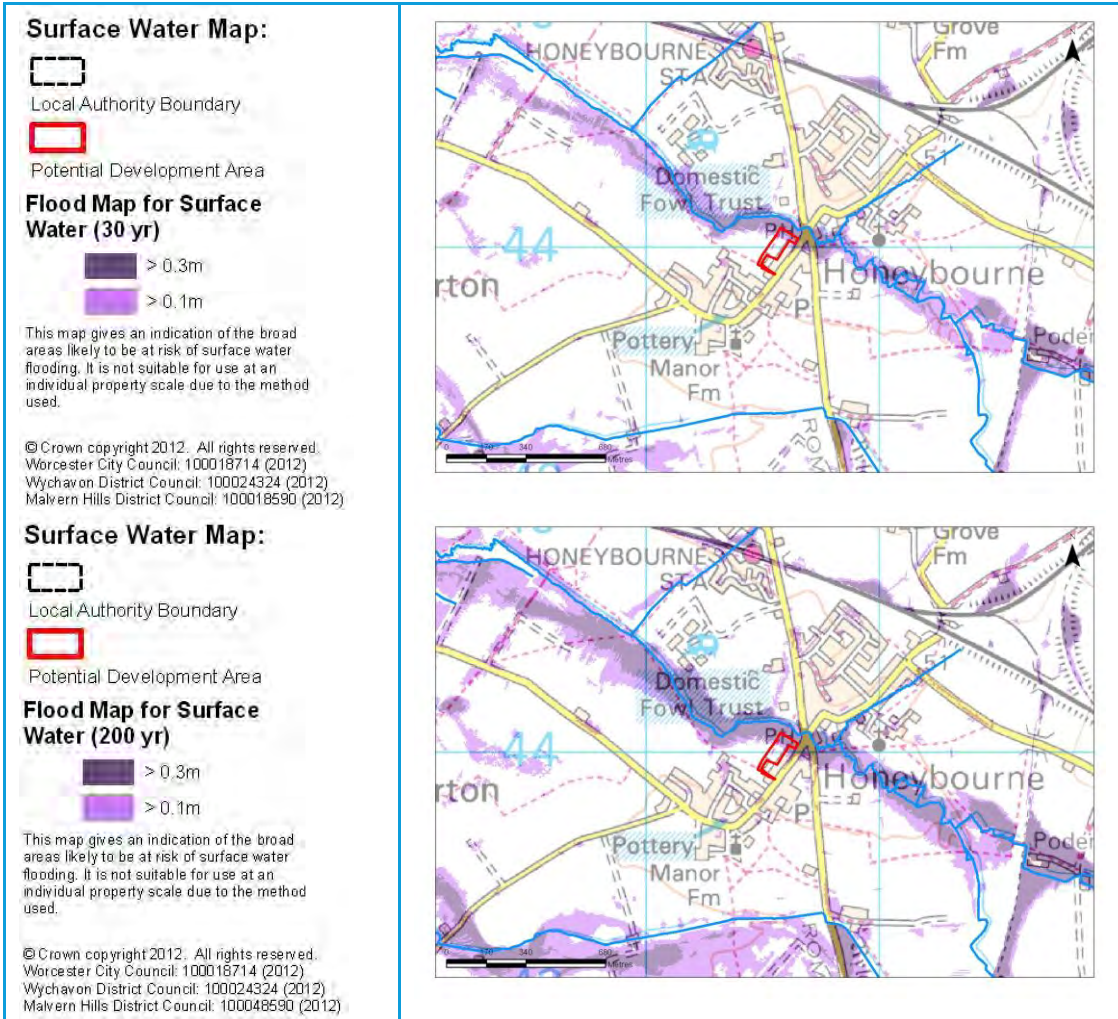
**Climate Change:**

Local Authority Boundary  
Potential Development Area

**Flood Zone 3 with Climate Change**

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**Sources of Flood Risk:**

- The main source of flood risk to the site is from surface water. With further development and creation of impermeable surfaces, surface water flooding may become a problem. The High Street and Station roads, the main access roads to the site, are at risk from surface water.
- This site is shown to be partially within two of the County Council's historic flood hotspots.
- The north-east part of the site falls within Flood Zone 3b and the Blue Zone of the Policy Maps. Primary fluvial risk is to the north and east of the site resulting from overtopping of the Gate Inn Brook to the north and east of the site. The High Street and Station roads, the main access roads to the site, are at risk from fluvial flooding.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

Soil Type	Fluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	5.0
	1 in 100 year (plus climate change)	19.3

<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>		375-538
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All forms of source controls are likely to be suitable
Infiltration		Mapping suggests high permeability at this site, site investigations should be carried out to assess potential for drainage by infiltration
Detention		Mapping suggests that the site slopes are suitable for all forms of detention
Filtration		All forms of filtration are likely to be suitable
Conveyance		All forms of conveyance are likely to be suitable
<ul style="list-style-type: none"> <li>• This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.</li> <li>• The site is not located within a groundwater source protection zone.</li> <li>• Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensity. Increased water levels in the Gate Inn Brook.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>• A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>• Development of the site is proposed to focus on residential uses.</li> <li>• Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>• Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>• Assessment for runoff should include allowance for climate change effects.</li> <li>• New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>• Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>• The site falls within an area with low susceptibility to groundwater emergence (&lt;25%). An assessment of suitable surface water mitigation techniques should be made.</li> <li>• The High Street and Station roads, the main access roads to the site, are at risk from fluvial flooding and surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.</li> <li>• Demonstration that development at this location can be made safe.</li> </ul>		

**Table 7-34: SWDP24/8 (Site behind Hawthorne Close, off Stonebow Road)**

<b>OS NGR: SP 090443</b>	<b>Area: 2.5ha</b>		<b>Brown/Greenfield: Greenfield</b>	
<b>Flood Zone Coverage:</b>	<b>FZ3a: 0%</b>	<b>FZ3b: 0%</b>	<b>FZ2: 89%</b>	<b>FZ1: 11%</b>

**Exception Test required?** Yes, for Highly Vulnerable development in FZ2.

**Requirements for passing the Exception Test:**

- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to locating developments outside of Flood Zone 2. It should be possible to reduce flood risk at this development area by using sequential design to locate more vulnerable developments towards higher ground through building design and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

Local Authority Boundary

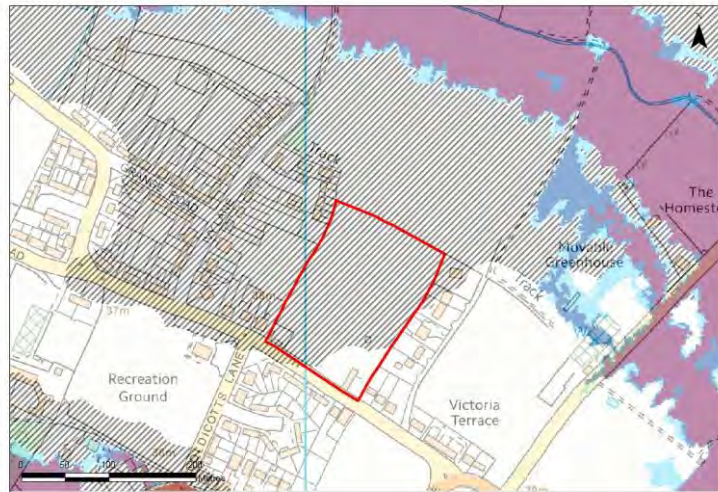
Potential Development Area

**Flood Zones**

- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2
- 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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**Climate Change:**

Local Authority Boundary

Potential Development Area

**Flood Zone 3 with Climate Change**

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**Surface Water Map:**

Local Authority Boundary

Potential Development Area

**Flood Map for Surface Water (30 yr)**

> 0.3m

> 0.1m

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Surface Water Map:**

Local Authority Boundary

Potential Development Area

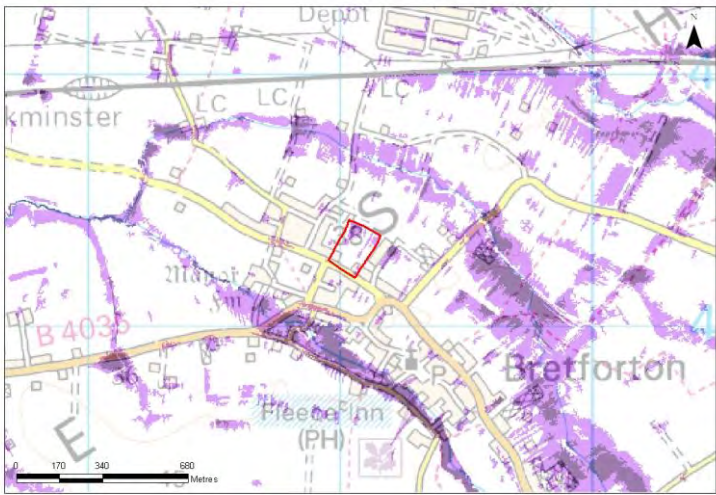
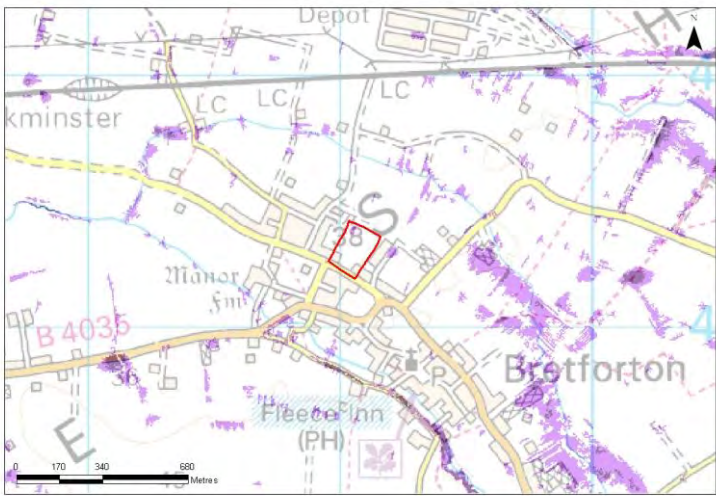
**Flood Map for Surface Water (200 yr)**

> 0.3m

> 0.1m

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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- Sources of Flood Risk:**
- The main source of flood risk to the site is from surface water. With further development and creation of impermeable surfaces, surface water flooding may become a problem.
  - Secondary flood risk is from fluvial flooding resulting from overtopping of an unnamed watercourse to the north of the site. The majority of the site falls within Flood Zone 2. Station Road, the main access road to the site, is at risk from fluvial flooding.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Unknown – More Permeable	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	8.4
	1 in 100 year (plus climate change)	32.0
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	897.5-1255	

<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding
Infiltration		Mapping suggests underlying soil is likely to be permeable. However, the high risk of groundwater flooding would make infiltration unsuitable
Detention		Mapping suggests that the site slopes are suitable for all forms of detention
Filtration		Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Conveyance		Mapping suggests that the site slopes may not be suitable for all forms of conveyance. Further investigation or ground work would be needed. A non-permeable liner may also be required on systems to prevent the ingress of groundwater.

- This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.
- The site is not located within a groundwater source protection zone.
- Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**  
None.

**Effects of Climate Change:**  
Increased rainfall intensity. Increase water levels in unnamed watercourse.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Development of the site is proposed to focus on residential uses.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- Station Road, the main access road to the site, is at risk from fluvial flooding. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-35: SWDP24/9 Littlebrook Nurseries**

<b>OS NGR:</b> SP 085441	<b>Area:</b> 5.3ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 2%	<b>FZ3b:</b> 32%	<b>FZ2:</b> 31%	<b>FZ1:</b> 35%

**Exception Test required?** Yes, for Essential Infrastructure in FZ3b, for More Vulnerable development in FZ3a and for Highly Vulnerable development in FZ2.  
 Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

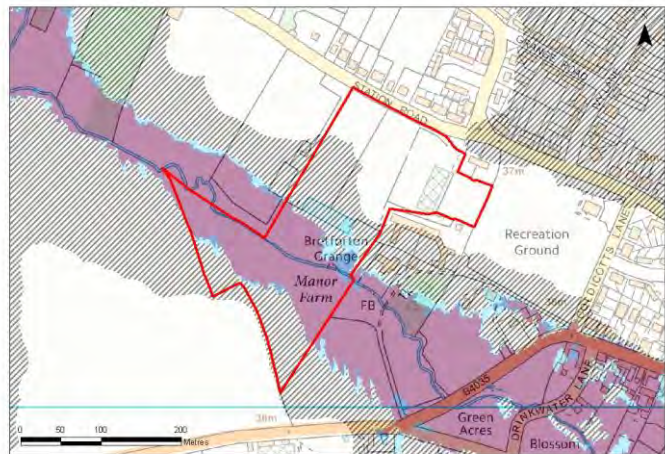
- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from the Bretforton Brook, located to the south and west of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

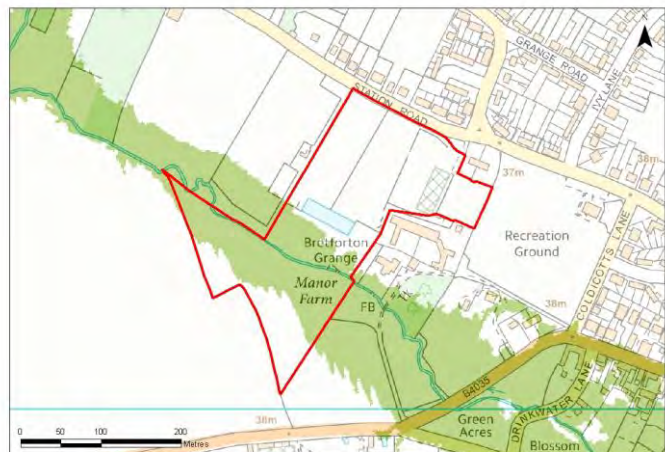
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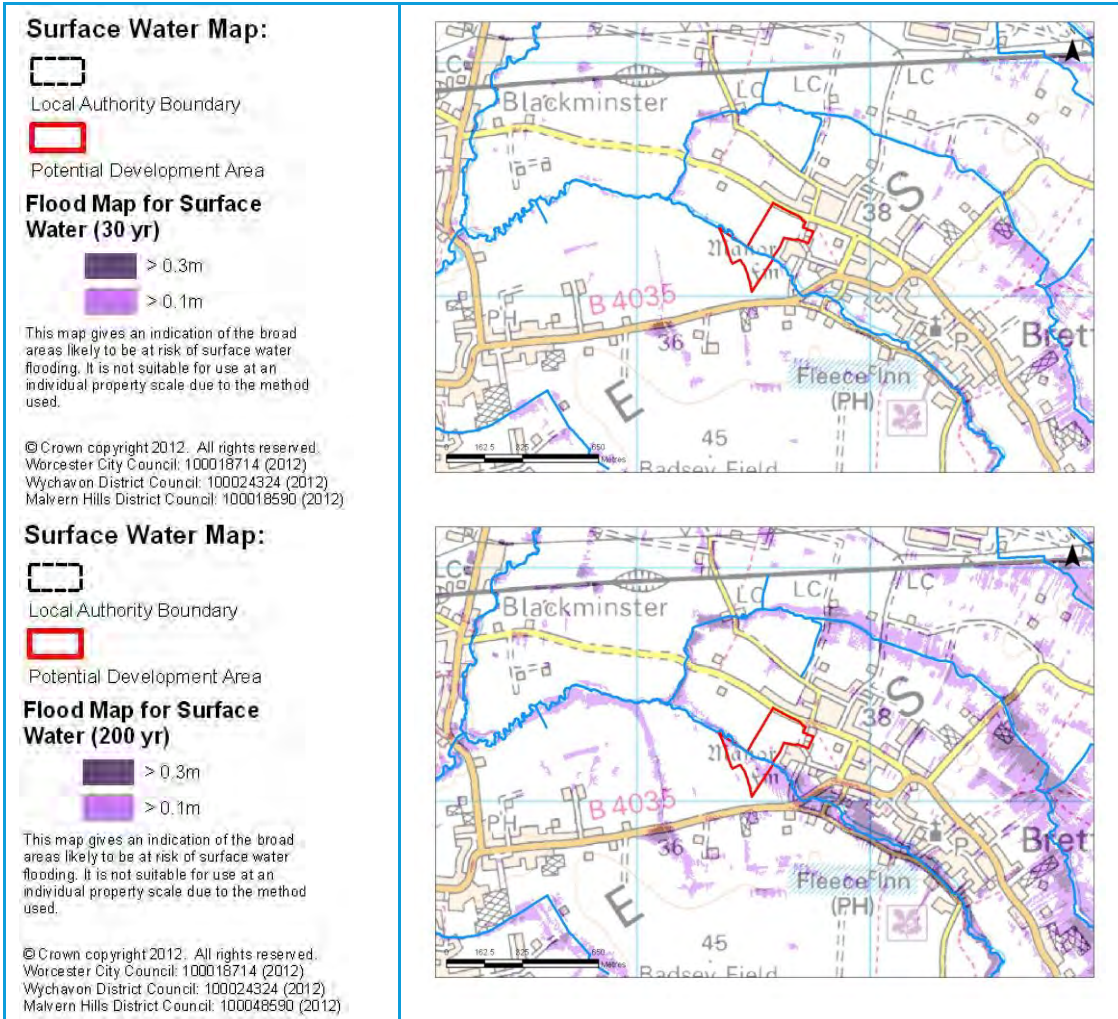


**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**

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 Wychavon District Council: 100024324 (2012)  
 Malvern Hills District Council: 100048590 (2012)





**Sources of Flood Risk:**

- Primary flood risk to the site is fluvial from Bretforton Brook, resulting from overtopping of the banks to the central, southern and western of the site. The southern and central portions of the site fall within Flood Zone 3b and the Blue Zone of the Policy Maps. The Station road and the B4035 Bretforton road, the main access roads to the site, are at risk from fluvial flooding.
- This site is shown to be partially within two of the County Council’s historic flood hotspots.
- Surface water presents a low risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The Station road and the B4035 Bretforton road, the main access roads to the site, are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Fluvial Deposit	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	8.4
	1 in 100 year (plus climate change)	32.0



<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>		1902.7-2660.6
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All forms of source controls are likely to be suitable
Infiltration		Mapping suggests high permeability at this site, site investigations should be carried out to assess potential for drainage by infiltration
Detention		Mapping suggests that the site slopes are suitable for all forms of detention
Filtration		All forms of filtration are likely to be suitable
Conveyance		All forms of conveyance are likely to be suitable
<ul style="list-style-type: none"> <li>• This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.</li> <li>• The site is not located within a groundwater source protection zone.</li> <li>• Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensity. Increased water levels in the Bretforton Brook.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>• A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>• Development of the site is proposed to focus on residential uses.</li> <li>• Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>• Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>• Assessment for runoff should include allowance for climate change effects.</li> <li>• New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>• Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>• The site falls within an area with low susceptibility to groundwater emergence (&lt;25%). An assessment of suitable surface water mitigation techniques should be made.</li> <li>• The Station road and the B4035 Bretforton road, the main access roads to the site, are at risk from fluvial flooding and surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.</li> <li>• Demonstration that development at this location can be made safe.</li> </ul>		

**Table 7-36: SWDP24/11 (Site behind Hawthorne Close, off Stonebow Road)**

<b>OS NGR:</b> SO 929490	<b>Area:</b> 1.03ha		<b>Brown/Greenfield:</b> Brownfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 2%	<b>FZ3b:</b> 19%	<b>FZ2:</b> 2%	<b>FZ1:</b> 77%

**Exception Test required?** Exception Test required? Yes, for More Vulnerable and Essential Infrastructure development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

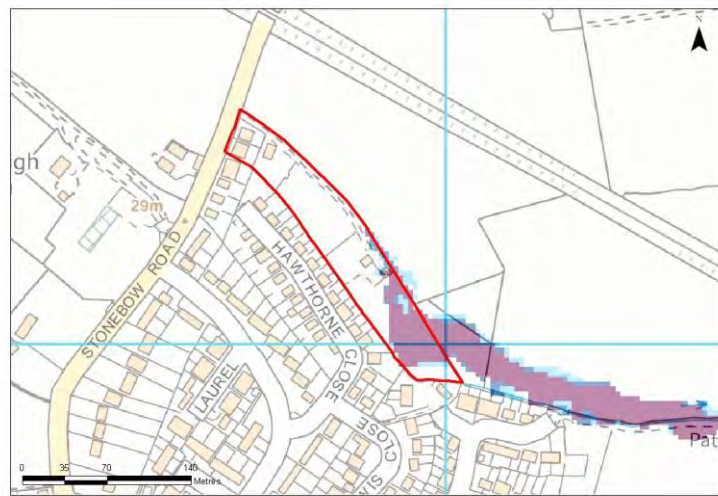
- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from an unnamed tributary of the Bow Brook, located to the east of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

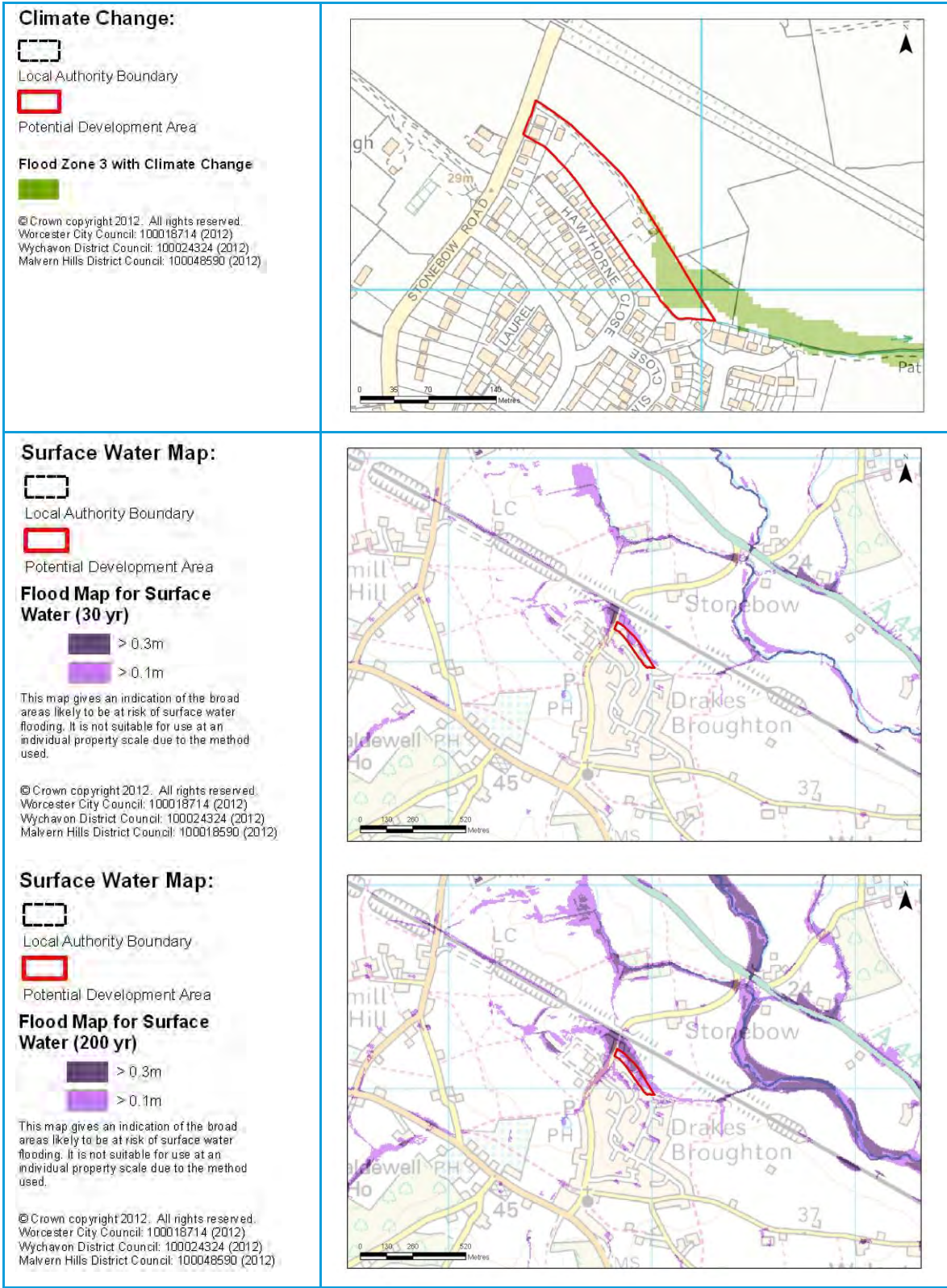
**Flood Zone Map:**

 Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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**Sources of Flood Risk:**

- The main source of flood risk to the site is from surface water. With further development and creation of impermeable surfaces, surface water flooding may become a problem. Stonebow Road, the main access roads to the site, is at risk from surface water.
- This site is shown to be partially within two of the County Council’s historic flood hotspots.
- The south-eastern part of the site falls within Flood Zone 3b and the Blue Zone of the Policy Maps. Primary fluvial risk is to the eastern edge of the site resulting from

overtopping of an unnamed tributary of the Bow Brook.		
<b>Surface Water Drainage:</b>		
<p>As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.</p> <p>PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.</p>		
<b>Soil Type</b>	Unknown – Less Permeable	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	8.7
	1 in 100 year (plus climate change)	32.9
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	340 – 450	
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All source control techniques are likely to be suitable
Infiltration		Mapping suggests underlying soil is unlikely to be permeable and there is a risk of groundwater flooding. A site investigation should be carried out to assess suitability of drainage by infiltration
Detention		Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Filtration		All filtration techniques are likely to be suitable
Conveyance		All conveyance techniques are likely to be suitable
<ul style="list-style-type: none"> <li>• This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.</li> <li>• The site is not located within a groundwater source protection zone.</li> <li>• Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensity. Increased water levels in the unnamed tributaries of Bow Brook.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>• A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>• Redevelopment of the site is proposed to focus on residential uses.</li> <li>• Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>• Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>• Assessment for runoff should include allowance for climate change effects.</li> <li>• New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>• Onsite attenuation schemes would need to be tested against the hydrograph of the</li> </ul>		

receiving watercourse to ensure flows are not exacerbated downstream within the catchment.

- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- The Stonebow Road, the main access roads to the site, is at risk from surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-37: SWDP24/13 (Land east of Stonebow Road, adjacent to railway line)**

<b>OS NGR:</b> SO 955493	<b>Area:</b> 0.97ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 1%	<b>FZ3b:</b> 0%	<b>FZ2:</b> 1%	<b>FZ1:</b> 98%

**Exception Test required?** Yes, for More Vulnerable and Essential Infrastructure development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a.

**Requirements for passing the Exception Test:**

- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from an unnamed tributary of the Piddle Brook, located to the southern portion of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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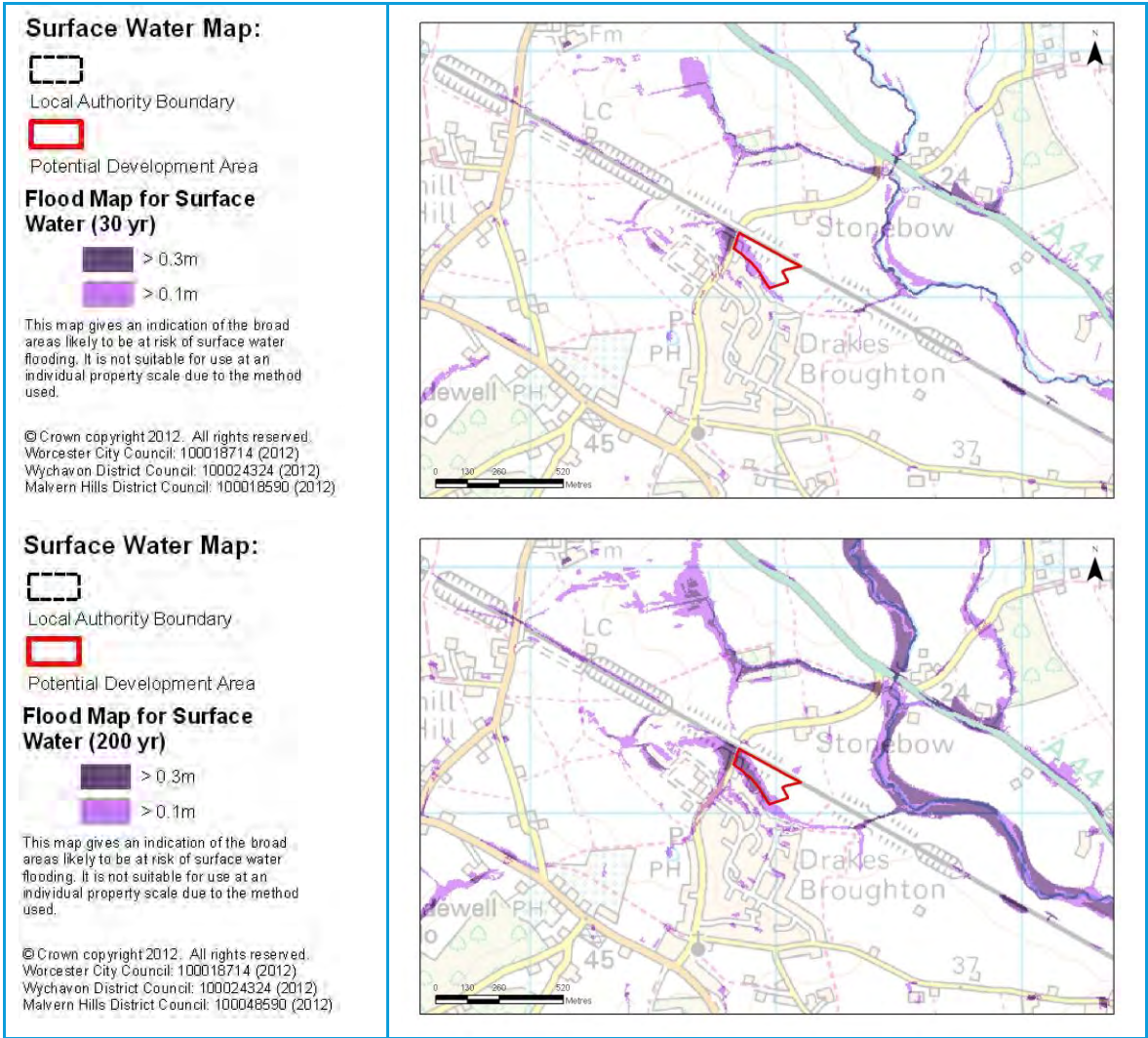


**Climate Change:**

Local Authority Boundary  
 Potential Development Area  
**Flood Zone 3 with Climate Change**

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- Sources of Flood Risk:**
- The main source of flood risk to the site is from surface water. With further development and creation of impermeable surfaces, surface water flooding may become a problem. The Stonebow Road, one of the main access roads to the site, are at risk from surface water.
  - This site is shown to be partially within one of the County Council's historic flood hotspots.
  - The southern edge of the site falls within Flood Zone 3b though the site predominately falls within Flood Zone 1. Primary fluvial risk is to the north-eastern edge of the site resulting from overtopping of an unnamed tributary of the Piddle Brook.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Unknown – Less Permeable	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	8.7

	1 in 100 year (plus climate change)	32.9
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>		790 – 1,060
<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control	Yellow	Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding
Infiltration	Red	Mapping suggests underlying soil is unlikely to be permeable. A site investigation should be carried out to assess suitability of drainage by infiltration
Detention	Yellow	Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Filtration	Yellow	Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Conveyance	Green	All conveyance techniques are likely to be suitable
<ul style="list-style-type: none"> <li>• This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.</li> <li>• The site is not located within a groundwater source protection zone.</li> <li>• Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>		
<b>Flood Defences:</b>		
None.		
<b>Effects of Climate Change:</b>		
Increased rainfall intensity. Increased water levels in the unnamed tributary of the Piddle Brook.		
<b>Flood Risk Implications for Development:</b>		
<ul style="list-style-type: none"> <li>• All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>• A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>• Redevelopment of the site is proposed to focus on residential uses.</li> <li>• Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>• Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>• Assessment for runoff should include allowance for climate change effects.</li> <li>• New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> <li>• Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.</li> <li>• The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.</li> <li>• The Stonebow Road, the main access roads to the site, is at risk from surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.</li> <li>• Demonstration that development at this location can be made safe.</li> </ul>		



**Table 7-38: SWDP24/23 (Land north of Green End & Owls Reach)**

<b>OS NGR:</b> SO 955493	<b>Area:</b> 0.97ha		<b>Brown/Greenfield:</b> Brownfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 1%	<b>FZ3b:</b> 4%	<b>FZ2:</b> 1%	<b>FZ1:</b> 94%

**Exception Test required?** Yes, for More Vulnerable and Essential Infrastructure development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

- To pass Part 'b' of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from an unnamed tributary of the Piddle Brook, located to the north of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

**Flood Zone Map:**

Local Authority Boundary

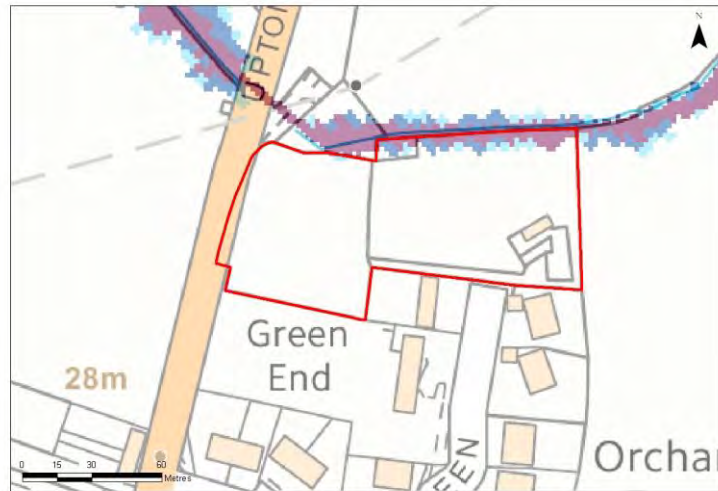
Potential Development Area

**Flood Zones**

- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2
- 2007 historic flood map

Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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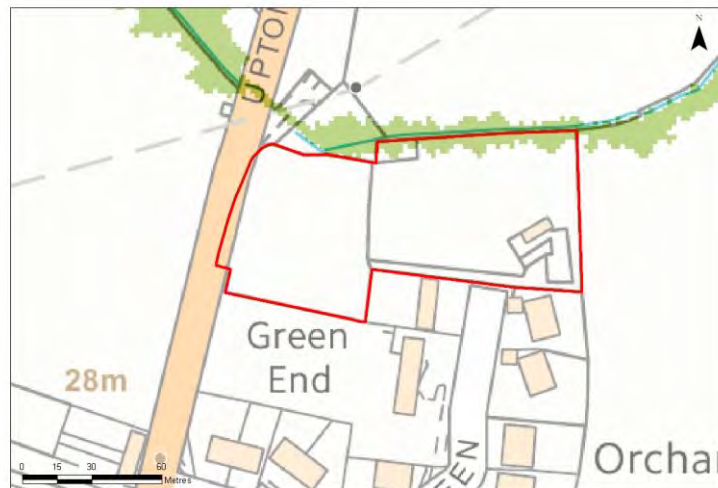
**Climate Change:**

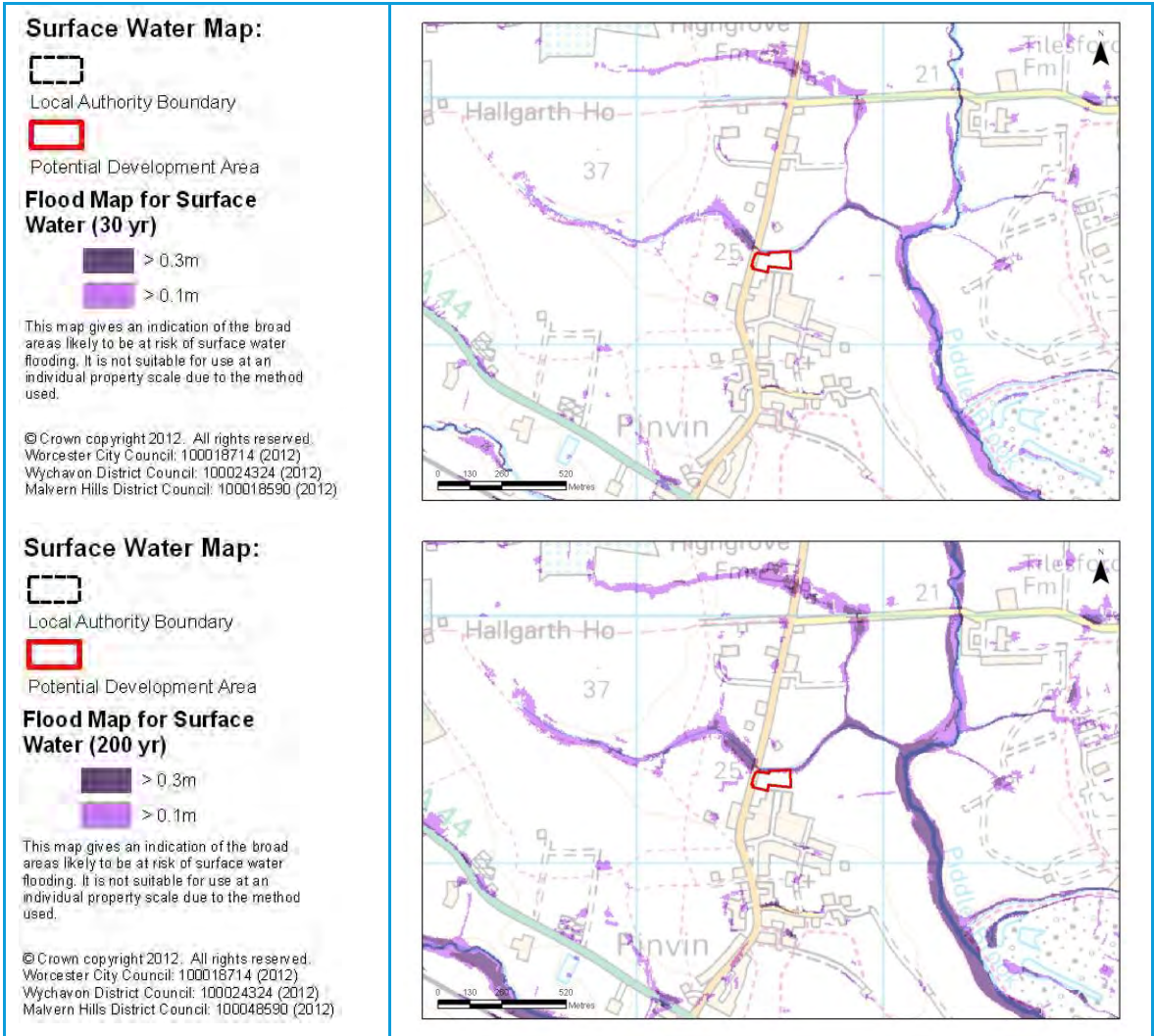
Local Authority Boundary

Potential Development Area

**Flood Zone 3 with Climate Change**

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**Sources of Flood Risk:**

- Primary flood risk to the site is fluvial, resulting from overtopping of the unnamed tributaries of the Piddle Brook, to the north of the site. This northern edge of the site falls within Flood Zone 3b and the Blue Zone of the Policy Maps. The northern B4082 Snodsbury road, the main access road to the site, is at risk from fluvial flooding.
- Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The northern B4082 Snodsbury road, the main access road to the site is at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Unknown – Less Permeable	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	9.2
	1 in 100 year (plus climate change)	35.5
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	220 – 310	

<b>SUDS and the development site:</b>		
<b>SUDS Type</b>	<b>Potential Suitability</b>	<b>Comments</b>
Source Control		All source control techniques are likely to be suitable
Infiltration		Mapping suggests underlying soil is unlikely to be permeable. A site investigation should be carried out to assess suitability of drainage by infiltration
Detention		Mapping suggests that site slopes may be steep, larger 'above ground' features may not be viable
Filtration		All filtration techniques are likely to be suitable
Conveyance		All conveyance techniques are likely to be suitable

- The site is not located within a groundwater source protection zone.
- Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**  
None.

**Effects of Climate Change:**  
Increased rainfall intensity. Increased water levels in the unnamed tributary of the Carrant Brook.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Redevelopment of the site is proposed to focus on residential uses.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.
- New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- Access needs would need to be outside of the floodplain, onto the southern branch of the B4632 Station Road and \ or the Green Road.
- Demonstration that development at this location can be made safe.

**Table 7-39: SWDP25/9 (Land at Park Farm, Jobs Lane)**

<b>OS NGR:</b> SO 946370	<b>Area:</b> 0.34ha		<b>Brown/Greenfield:</b> Brownfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 1%	<b>FZ3b:</b> 5%	<b>FZ2:</b> 1%	<b>FZ1:</b> 93%







**Exception Test required?** Yes, for More Vulnerable and Essential Infrastructure development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**


- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from an unnamed tributary of the Carrant Brook, located to the north-east of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.


**Flood Zone Map:**

 Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.  
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**Climate Change:**

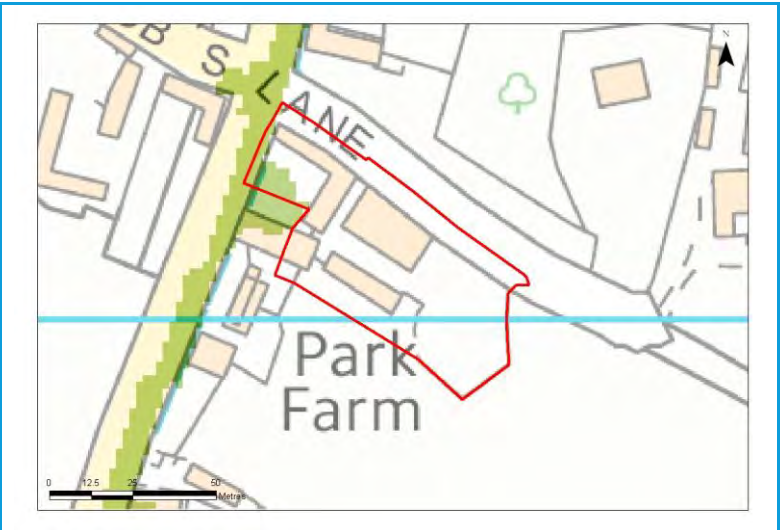
 Local Authority Boundary

 Potential Development Area


**Flood Zone 3 with Climate Change**




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**Surface Water Map:**

 Local Authority Boundary

 Potential Development Area

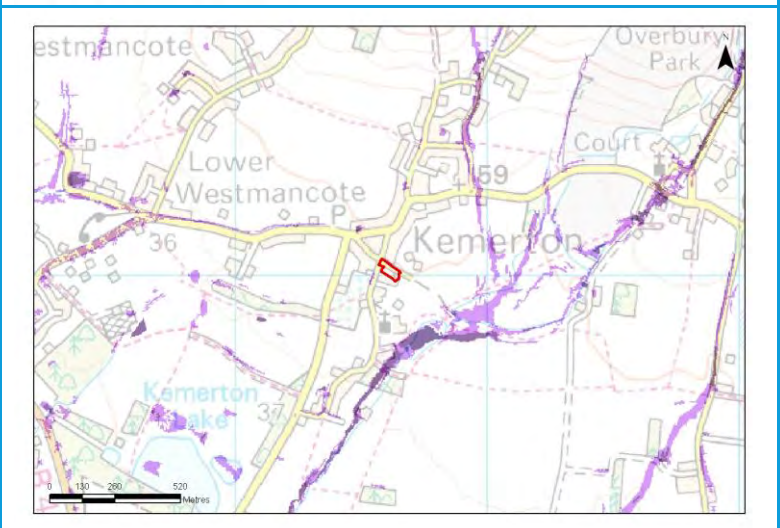
**Flood Map for Surface Water (30 yr)**

 > 0.3m


 > 0.1m


This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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**Surface Water Map:**

 Local Authority Boundary

 Potential Development Area

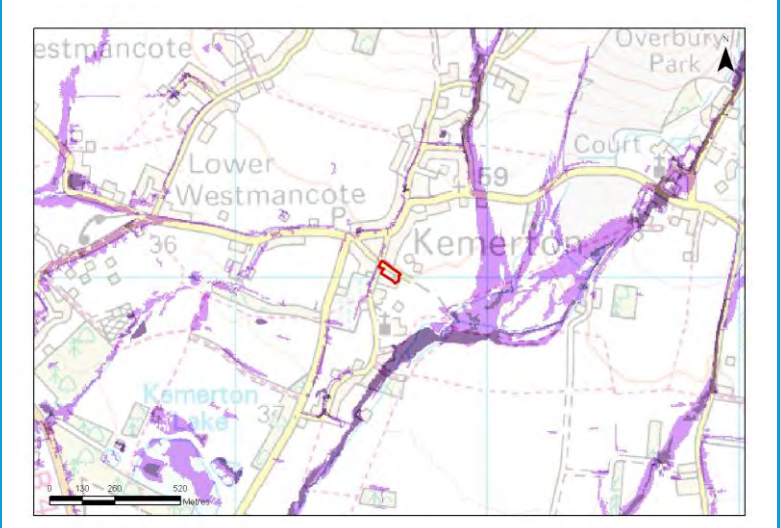
**Flood Map for Surface Water (200 yr)**

 > 0.3m

 > 0.1m

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

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- Sources of Flood Risk:**
- Primary flood risk to the site is fluvial, resulting from overtopping of the unnamed tributaries of the Carrant Brook, to the west of the site. The western edge of site falls within Flood Zone 3b and the Blue Zone of the Policy Maps. The Kinsham road and Job's Lane, the main access roads to the site, is at risk from fluvial flooding.
  - This site is shown to be partially within one of the County Council's historic flood hotspots.
  - Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The Kinsham road and Job's Lane, the main

access roads to the site are at risk from surface water.

**Surface Water Drainage:**

As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.

PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.

<b>Soil Type</b>	Alluvial Deposits	
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	1.2
	1 in 100 year (plus climate change)	4.3
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	60 – 160	

**SUDS and the development site:**

SUDS Type	Potential Suitability	Comments
Source Control	Yellow	Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding
Infiltration	Red	Mapping suggests underlying soil is likely to be permeable. However the high risk of groundwater flooding would make infiltration unsuitable
Detention	Yellow	Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater. Mapping suggests that site slopes may be steep so larger 'above ground' features may not be viable
Filtration	Yellow	Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater
Conveyance	Green	All conveyance techniques are likely to be suitable

- This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.
- The site is not located within a groundwater source protection zone.
- Residential developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.

**Flood Defences:**

None

**Effects of Climate Change:**

Increased rainfall intensity. Increased water levels in the unnamed tributary of the Carrant Brook.

**Flood Risk Implications for Development:**

- All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.
- A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.
- Redevelopment of the site is proposed to focus on residential uses.
- Resilience measures will be required if buildings are situated in the flood risk area.
- Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.
- Assessment for runoff should include allowance for climate change effects.
- New or re-development should adopt exemplar source control SUDS techniques to

reduce the risk of frequent low impact flooding due to post-development runoff.

- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- The Kinsham road and Job's Lane, the main access roads to the site, are at risk from fluvial flooding and surface water. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

**Table 7-40: SWDP/VPx (Vale Park extension)**

<b>OS NGR:</b> SO 929491	<b>Area:</b> 21.83ha		<b>Brown/Greenfield:</b> Greenfield	
<b>Flood Zone Coverage:</b>	<b>FZ3a:</b> 2%	<b>FZ3b:</b> 3%	<b>FZ2:</b> 1%	<b>FZ1:</b> 94%







**Exception Test required?** Yes, for More Vulnerable and Essential Infrastructure development in FZ3a and for Highly Vulnerable development in FZ2.

Highly Vulnerable infrastructure should not be permitted within FZ3a. More Vulnerable and Less Vulnerable Infrastructure should not be permitted within FZ3b.

**Requirements for passing the Exception Test:**

- To pass Part ‘b’ of the Exception Test, a FRA should demonstrate that: the development will be safe, will avoid increasing flood risk elsewhere, and will reduce flood risk overall.
- Preference should be given to water compatible and less vulnerable development at this site. Development should be located away from an unnamed tributary of the Battleton Brook, located to the north, central and the south of the site, by using sequential design to locate more vulnerable development towards higher ground, through building design, and by meeting drainage requirements.
- New development being located outside of Flood Zone 2 needs to ensure that no increase in flood risk occurs. Areas within Flood Zone 2 should be kept as open space.
- Safe access and egress would need to be demonstrated.
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

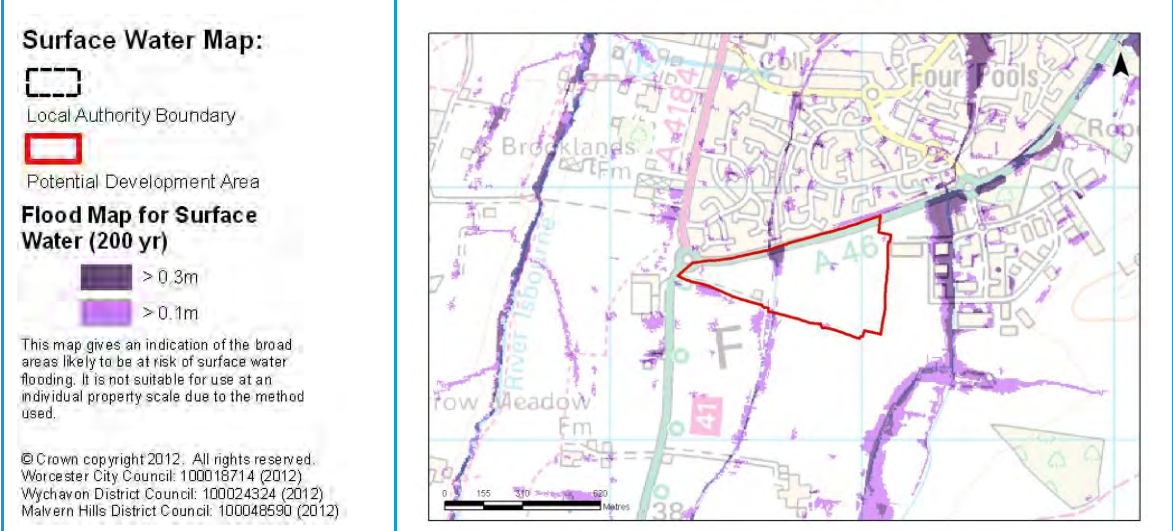
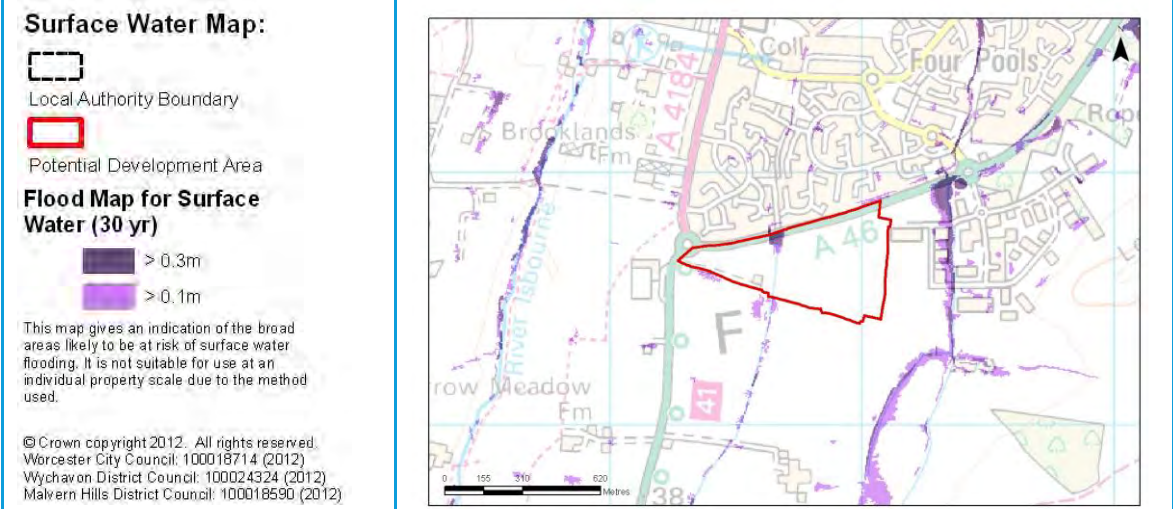
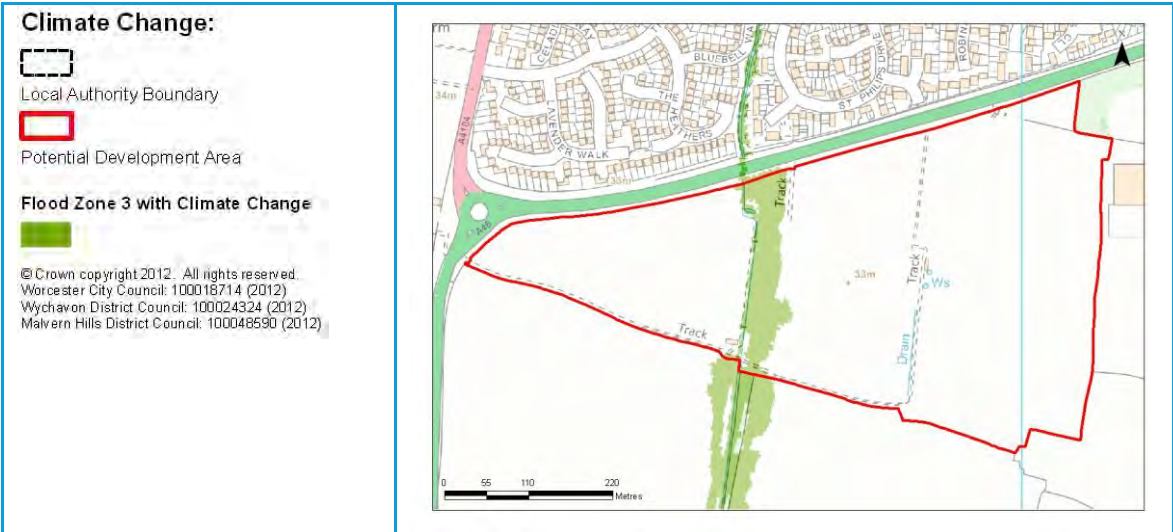
**Flood Zone Map:**

 Local Authority Boundary  
 Potential Development Area  
**Flood Zones**  
 Flood Zone 3b  
 Flood Zone 3a  
 Flood Zone 2  
 2007 historic flood map  
 Note: the 2007 historic flood map will be incorporated into the EA's Flood Maps. Therefore where the extent of the historic flood map is greater than that of Flood Zone 2, the historic flood map outline is to be considered the Flood Zone 2 extent and should be treated as such in any assessment of flooding.

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 Malvern Hills District Council: 0100018590 (2012)  
 Worcester City Council: 100018714 (2012)  
 Wychavon District Council: 100024324 (2012)







- Sources of Flood Risk:**
- Primary flood risk to the site is fluvial, resulting from overtopping of the unnamed tributaries of the Battleton Brook, to the central of the site. The central part of the site fall within Flood Zone 3b and the Blue Zone of the Policy Maps. The A46 road, the main access road to the site, is at risk from fluvial flooding.
  - Surface water presents a risk to the site. Further development and creation of impermeable surfaces may result in an increase of surface water flood risk. The A46 road, the main access road to the site, is at risk from surface water.

<p><b>Surface Water Drainage:</b></p> <p>As an indication of requirements to manage surface water runoff at the development site an assessment of the soil types, greenfield runoff rate and attenuation storage volume is included below. Storage volumes displayed are calculated with an assumption that 75% of the site will be developed impermeable ground. A 25% increase in rainfall depths has been included to represent predicted future climate change effects.</p> <p>PLEASE NOTE: This assessment has been carried out using broad-scale datasets and aims to provide an indication of the likely opportunities and constraints for this development site. A detailed drainage assessment based on site-specific conditions should be carried out by a suitably qualified professional and submitted with any planning application. The values below should not be used for design purposes.</p>																				
<b>Soil Type</b>	Unknown – Lower Permeability																			
<b>Greenfield Runoff Rate (l/s/ha)</b>	1 in 2 year	10.0																		
	1 in 100 year (plus climate change)	39.4																		
<b>Estimated Attenuation Storage Volume (m<sup>3</sup>)</b>	7,410 – 10,270																			
<p><b>SUDS and the development site:</b></p> <table border="1"> <thead> <tr> <th>SUDS Type</th> <th>Potential Suitability</th> <th>Comments</th> </tr> </thead> <tbody> <tr> <td>Source Control</td> <td style="background-color: yellow;"></td> <td>Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding</td> </tr> <tr> <td>Infiltration</td> <td style="background-color: red;"></td> <td>Mapping suggests underlying soil is likely to be permeable. However the high risk of groundwater flooding would make infiltration unsuitable</td> </tr> <tr> <td>Detention</td> <td style="background-color: yellow;"></td> <td>Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater</td> </tr> <tr> <td>Filtration</td> <td style="background-color: yellow;"></td> <td>Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater</td> </tr> <tr> <td>Conveyance</td> <td style="background-color: lightgreen;"></td> <td>All conveyance techniques are likely to be suitable</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>This site is located within a flooding hotspot so all efforts should be made to minimise the rate and volume of runoff leaving the site.</li> <li>The site is not located within a groundwater source protection zone.</li> <li>Commercial, recreational and leisure developments should provide at least two independent SUDS features in series to provide a suitable level of water quality treatment.</li> </ul>			SUDS Type	Potential Suitability	Comments	Source Control		Most source control techniques are likely to be suitable. Permeable paving is unlikely to be suitable due to high risk of groundwater flooding	Infiltration		Mapping suggests underlying soil is likely to be permeable. However the high risk of groundwater flooding would make infiltration unsuitable	Detention		Detention techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater	Filtration		Filtration techniques may be suitable if a non-permeable liner is provided to prevent the ingress of groundwater	Conveyance		All conveyance techniques are likely to be suitable
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Conveyance		All conveyance techniques are likely to be suitable																		
<p><b>Flood Defences:</b></p> <p>None.</p>																				
<p><b>Effects of Climate Change:</b></p> <p>Increased rainfall intensity. Increased water levels in the unnamed tributary of Battleton Brook.</p>																				
<p><b>Flood Risk Implications for Development:</b></p> <ul style="list-style-type: none"> <li>All development should be located within Flood Zone 1, unless appropriate in accordance with NPPF Technical Guidance.</li> <li>A detailed site-specific flood risk assessment, including hazard mapping, will be required for any development in Flood Zone 2, or for sites greater than 1ha in Flood Zone 1.</li> <li>Redevelopment or alternative use of the site will focus on commercial, recreational and leisure uses, either singly or as mixed use proposals.</li> <li>Resilience measures will be required if buildings are situated in the flood risk area.</li> <li>Green infrastructure should be considered within the mitigation measures for surface water runoff from potential development.</li> <li>Assessment for runoff should include allowance for climate change effects.</li> <li>New or re-development should adopt exemplar source control SUDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.</li> </ul>																				

- Onsite attenuation schemes would need to be tested against the hydrograph of the receiving watercourse to ensure flows are not exacerbated downstream within the catchment.
- The site falls within an area indicated to potentially be susceptible to groundwater emergence. Further assessment of groundwater risk would be required and an assessment of suitable surface water mitigation techniques should be made at the detailed FRA level.
- The A46 road, the main access road to the site, is at risk from fluvial flooding and surface water. Assessment of the current access road flood risk and if new access roads are considered flood risk needs to be investigated further. Suitable alternative access arrangements away from the floodplain will need to be investigated further.
- Demonstration that development at this location can be made safe.

## 8 FRA requirements for developers

### 8.1 Over-arching principles

The South Worcestershire SFRA Update focuses on delivering a strategic assessment of flood risk within the area. The Sequential Test needs to be applied to determine whether a site is suitable for development and if the site should be allocated. For some sites that pass the Sequential Test, more information is required, through the preparation of a detailed FRA, to provide confidence on whether the site will pass the Exception Test. Any site that does not pass the Exception Test should not be allocated for development.

Prior to development, site-specific assessments will need to be undertaken to ensure all forms of flood risk at a site are fully addressed. It is normally the responsibility of the developer to provide a FRA with an application. However, a LPA can decide to commission a detailed, site-specific FRA to help them decide upon allocations in the high risk zone. The SFRA Update cannot provide this level of site-specific information.

It should be acknowledged that a detailed FRA may show that a site is not appropriate for development of a particular vulnerability, or at all. Where the FRA shows that a site is not appropriate for a particular usage, a lower vulnerability classification may be appropriate.

### 8.2 Requirements at detailed planning stage

The SFRA update should be used to test that the requirements of the Sequential Test are met. If the development meets with the recommendations of the SFRA strategically then the specific requirements of the Environment Agency should be addressed in a detailed FRA undertaken to NPPF requirements.

Until the SAB regulations are fully established, developers are advised to contact the District Councils' drainage officers and the Environment Agency before presuming a site can be developed. Once the SAB regulations are established developers are advised to contact Worcestershire County Council and the Environment Agency before presuming a site can be developed. This contact should be part of wider pre-application discussions that take other considerations into account with respect to drainage and SUDS, for example ecology, open space and amenity.

A precautionary approach to development and flood risk is required. At each site, applicants for all development proposals need to carry out an assessment of flood risk from all sources and they also need to consider the potential impact the development could have on others through the completion of a flood risk and runoff assessment. Guidance on sustainable development and the detailed required in this assessment for different types of development is provided in the NPPF and by the Environment Agency.

### 8.3 Standard flood risk management guidance for developers

The aim of a FRA is to demonstrate that the development is protected to the 1% annual probability event and is safe during the design flood event, including an allowance for climate change and any historic or extreme events. This includes assessment of mitigation measures required to safely manage flood risk. Development proposals requiring FRAs should:

- Apply the Sequential, and when necessary Exception, Tests
- Not increase flood risk, either upstream or downstream, of the site, taking into account the impacts of climate change
- Not increase surface water volumes or peak flow rates, which would result in increased flood risk to the receiving catchments
- Use opportunities provided by new development to, where practicable, reduce flood risk within the site and elsewhere
- Ensure that where development is necessary in areas of flood risk (after application of Sequential and Exception Tests), it is made safe from flooding for the lifetime of the development, taking into account the impact of climate change

All sources of flood risk, including fluvial, surface water and drainage need to be considered.

FRAs for proposed development in the South Worcestershire area should follow the approach recommended by the NPPF and associated guidance, and guidance provided by the Environment Agency.

These documents describe when an FRA is required and are commensurate with the advice given in this SFRA Update. All proposed development sites require an initial assessment of flood risk. A detailed FRA will be required for all developments that fall into the medium and high flood risk zones and other sites where significant flood risk is identified. A FRA will also be required for sites in Flood Zone 1 which are greater than one hectare, concentrating on the management of surface water through an appropriate drainage strategy.

## 8.4 Preplanning guidance for developers

Early consideration of flooding and drainage issues is important. The flood risk at a site and the type of development that would be appropriate should be considered prior to site acquisition. The requirements for flood storage, above ground surface water attenuation and SUDS should also be considered. Developers should consider:

- Desk studies, site investigations and surveys
- Development layout

## 8.5 Mitigation measures

Mitigation measures should be seen as a last resort to address flood risk issues. Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised, only then should mitigation measures be considered.

The fact that mitigation measures are discussed in this SFRA should not be taken as a presumption that the Sequential Test has been bypassed. It is included to give a fuller picture of the implications of allocating a site, and for use in a subsequent SA. Normally, suitable mitigation measures for a proposed development will be determined through assessment of flood depths via hydrological and hydraulic modelling (or use of existing models) carried out as part of a FRA.

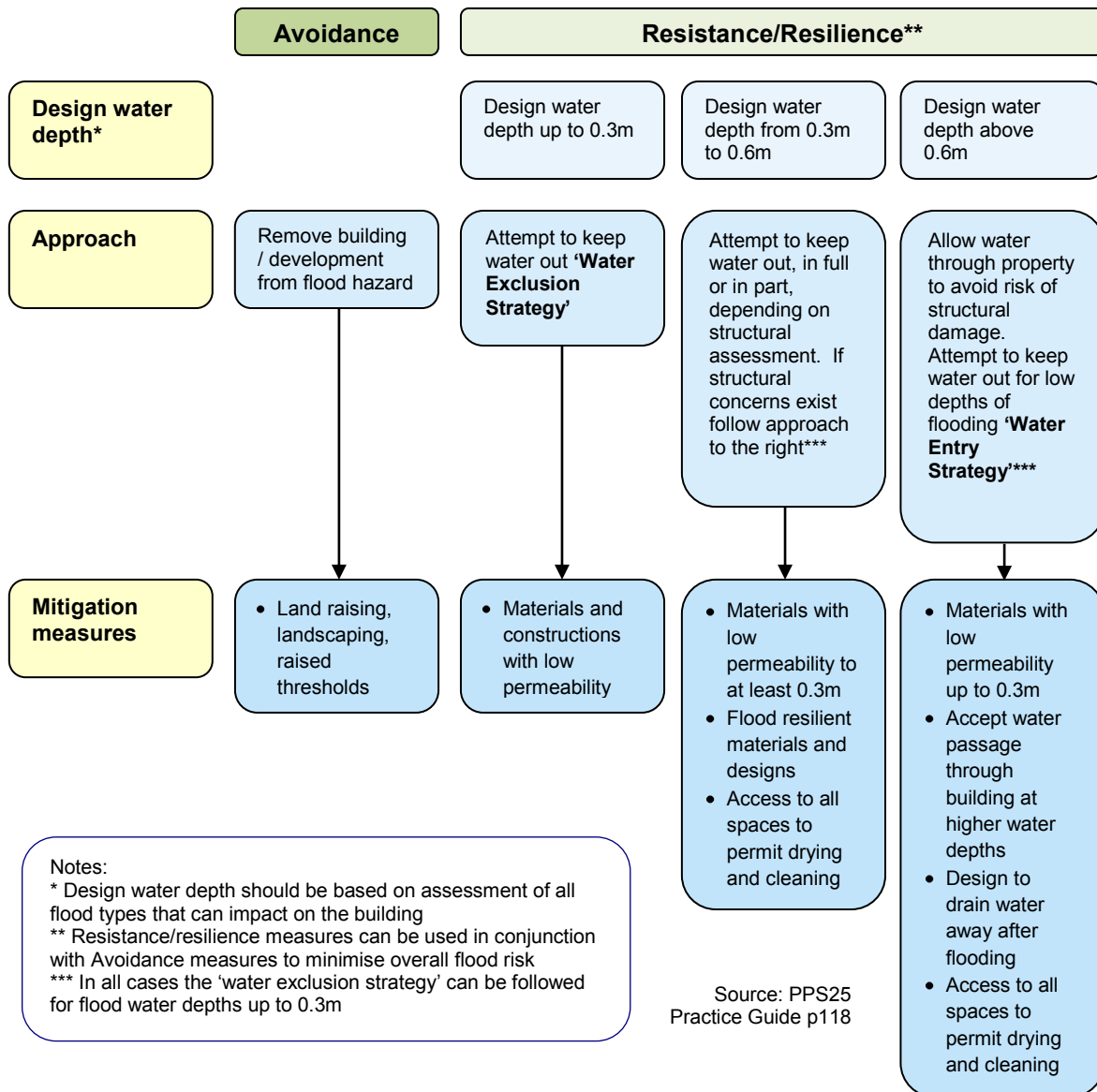
Often the determining factor in deciding whether a particular development can or cannot proceed is the practical feasibility and financial viability/feasibility of flood risk mitigation rather than technical limitations. Detailed technical assessments are required in the FRA to assess the practical feasibility, together with a commercial review by the developer of the cost of the mitigation works. At the SFRA stage, broad assumptions are therefore required regarding the feasibility of flood risk mitigation to ensure that only sites with realistic development potential are put forward.

Some mitigation measures were outlined in the previous guidance (PPS25) and are presented in Figure 8-1. It is assumed that floor level raising will continue to be the traditional mitigation measure. It should be noted that the Environment Agency see actual land raising as a last option. Thought will also be required to ensure safe access and egress is available for flood events including climate change. The Emergency Services should be consulted on the evacuation and rescue capabilities and any advice or requirements included.

There should be no interruption to flood flows or loss of flood storage as a result of any proposed development. Flood storage compensation may be appropriate for sites on the edge of the existing floodplain. Modification of ground levels/compensation works may re-configure the floodplain but should not be used to increase land available for development.

Whilst flooding mitigation measures can be implemented in most sites, it is worth noting that in some instances the findings of individual FRAs may determine that the risk of flooding to a proposed development is too great and mitigation measures are not feasible. In these instances, the development will be subject to an objection by the Lead Local Flood Authority (LLFA) or the Environment Agency.

Figure 8-1: Rationale for flood resilient and/or resistant design strategies<sup>2</sup>



## 8.6 Sustainable Urban Drainage Systems

Sustainable Urban Drainage Systems (SUDS) are management practices which enable surface water to be drained in a way which mimics, as closely as possible, the run-off prior to site development. The choice of flow management facilities within a single site is heavily influenced by constraints including (but not limited to):

- Topography
- Geology (soil permeability)
- Available area
- Former site use
- Proposed site use
- Groundwater conditions
- Future adoption and maintenance possibilities

The design, construction and ongoing maintenance regime of such a scheme must be carefully defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and existing drainage arrangements is essential.

For infiltration SUDS techniques it is imperative that the water table is low enough and a site-specific infiltration test is undertaken. Where sites lie within or close to groundwater protection zones or aquifers further restrictions may be applicable, and guidance should be sought from the Environment Agency.

There are many different SUDS techniques which can be implemented. The suitability of the techniques will be dictated in part by the development proposal and site conditions. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA).

**Table 8-1: Example SUDS Techniques**

SUDS Technique	Flood Reduction	Water Quality Treatment & Enhancement	Landscape and Wildlife Benefit
Living roofs	✓	✓	✓
Basins and ponds	✓	✓	✓
Constructed wetlands	✓	✓	✓
Balancing ponds	✓	✓	✓
Detention basins	✓	✓	✓
Retention ponds	✓	✓	✓
Filter strips and swales	✓	✓	✓
Infiltration devices	✓	✓	✓
Soakaways	✓	✓	✓
Infiltration trenches and basins	✓	✓	✓
Permeable surfaces and filter drains	✓	✓	
Gravelled areas	✓	✓	
Solid paving blocks	✓	✓	
Porous pavements	✓	✓	
Tanked systems	✓		
Over-sized pipes/tanks	✓		
Storm cells	✓		

The inclusion of SUDS within developments should be seen as an opportunity to enhance ecological and amenity value, incorporating above ground facilities into the development landscape strategy. SUDS must be considered at the outset, during preparation of the initial site conceptual layout to ensure that enough land is given to design spaces that will be an asset to the development rather than an after-thought. The future adoption and maintenance of SUDS, particularly those including swales, basins, ponds or reed beds, should be closely aligned with plans for the management of green infrastructure. The emerging Worcestershire Green Infrastructure Strategy is being developed by the Worcestershire Green Infrastructure Partnership, which includes the South Worcestershire authorities.

Under the Flood and Water Management Act, the SUDS Approval Body will be responsible for approving, adopting and maintaining drainage plans and SUDS schemes that meet the National Standards for sustainable drainage.

All new developments will require planning approval from both the SAB and the local planning authority. The Environment Agency will be a statutory consultee when delivering SUDS for any proposed discharge of surface water into a watercourse.

Local planning bodies should:

- Promote the use of SUDS for the management of run off
- Ensure their policies and decisions on applications support and compliment the building regulations on sustainable rainwater drainage, giving priority to infiltration over first watercourses, then sewers
- Incorporate favourable policies within development plans
- Adopt policies for incorporating SUDS requirements into Local Development Documents
- Encourage developers to utilise SUDS wherever practicable, if necessary, through the use of appropriate planning conditions
- Develop joint strategies with sewerage undertakers and the Environment Agency to further encourage the use of SUDS

## 8.7 Reducing flood risk

The minimum acceptable standard of protection against flooding for new property within flood risk areas is 1% annual probability for fluvial flooding and a breach during a 0.5% annual probability tidal event, with allowance for climate change over the lifetime of the development. The measures chosen will depend on the nature of the flood risk. Some of the more common measures include:

### 8.7.1 Reducing Flood Risk through Site Layout and Design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. A number of the South Worcestershire proposed allocations cover all three Flood Zones.

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational space) can be located in higher risk areas. However vehicular parking in floodplains should be based on nature of parking, flood depths and hazard including evacuation procedures and flood warning.

Waterside areas, or areas along known flow routes, can be used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social, economic and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas, and avoid the creation of isolated islands as water levels rise.

### 8.7.2 Modification of Ground Levels

Modifying ground levels to raise the land above the required flood level is a very effective way of reducing flood risk to the site in question, particularly where the risk is entirely from tidal flooding and the land does not act as conveyance for flood waters.

However, in most areas of fluvial flood risk, conveyance or flood storage would be reduced by raising land above the floodplain, adversely impacting on flood risk downstream. Compensatory flood storage must be provided, and should be on a level for level, volume for volume basis on land that does not currently flood but is adjacent to the floodplain (in order for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary (unless the site is strategically allocated). Ground raising in the floodplain should not be undertaken to increase the developable land on a site but merely to configure it for a more convenient use. Raising ground levels can also deflect flood flows, so analyses should be performed to demonstrate that there are no adverse effects on third party land.

Where the site is entirely within the floodplain it is not possible to provide compensatory storage at the maximum flood level and this will not be a viable mitigation option. Compensation schemes must be environmentally sound.

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



### 8.7.3 Raised Defences

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

Temporary or demountable defences are not acceptable flood protection for a new development unless flood risk is residual only.

### 8.7.4 Developer Contributions

In some cases and following the application of the sequential test, it may be necessary for the developer to make a contribution to the improvement of flood defence provision that would benefit both the development in question and the local community. Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SUDS).

Defra's Flood Defence Grant in Aid (FDGiA)<sup>14</sup> goes to flood risk management authorities to pay for a range of activities including flood defence schemes that help reduce the risk of flooding and coastal erosion. Some schemes are only partly funded by FDGiA and therefore any shortfall in funds will need to be found from elsewhere using Partnership Funding, for example local levy funding, local businesses or other parties benefitting from the scheme.

If a developer relies on a project to improve an existing defence, the developer will be expected to make a contribution which should be in proportion to the benefits received by the development. For new development in locations without existing defences, or where development is the only beneficiary, the full costs of appropriate risk management measures for the life of the assets proposed must be funded by the developer.

However, just because the developer is willing to fund the cost of the necessary protection from flooding or coastal erosion, does not mean the development can be made appropriate; other policy aims also need to be met. Funding from developers should be explored prior to the granting of planning permission and in partnership with the local planning authority.

### 8.7.5 Building Design

Internal areas of new development should be designed to be dry during the 1 in 1000-year flood event.

The raising of floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of flood. If it has been agreed with the Environment Agency that, in a particular instance, the raising of floor levels is acceptable, they should be raised to 600mm above the maximum water level caused by a 1 in 100-year (1% AEP) event plus climate change. This additional height that the floor level is raised to is referred to as the "freeboard".

Allocating the ground floor of a building for less vulnerable use is an effective way of raising living space above flood levels.

Putting a building on stilts is not considered an acceptable means of flood mitigation for new development. However it may be allowed in special circumstances if it replaces an existing solid building, as it can improve flood flow routes. In these cases attention should always be paid to safe access and egress and a legal agreement should be entered into to ensure the ground floor use is not changed.

### 8.7.6 Resistance and Resilience

There may be instances where flood risk remains to a development. For example, where the use is water compatible, where an existing building is being changed, where residual risk remains behind defences, or where floor levels have been raised but there is still a risk at the 0.1% annual probability. In these cases (and for existing development in the floodplain), additional measures can be put in place to reduce damage in a flood and increase the speed of recovery. These measures should not be relied on as the only mitigation method.

<sup>14</sup> Principles for implementing flood and coastal resilience funding partnerships (Environment Agency, 2012)  
2012s5947 S Worcestershire Level 2 SFRA Update FINAL Report v1.0.doc

## Temporary Barriers

Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water.

## Permanent barriers

Permanent barriers can include built up doorsteps, rendered brick walls and toughened glass barriers.

## Wet-proofing

Interior design to reduce damage caused by flooding, for example:

- Electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level.
- Water-resistant materials for floors, walls and fixtures.

If redeveloping existing basements, new electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level to minimise damage if the development floods.

Resilience measures will be specific to the nature of flood risk, and as such will be informed and determined by the FRA.

## 8.8 Managing flood risk from other sources

### 8.8.1 Surface water and sewer flooding

Where new development is in an area where the public sewerage network does not currently have sufficient spare capacity to accept additional development flows it is recommended that the developer discusses such issues with Severn Trent Water at the earliest possible stage. The development should improve the drainage infrastructure to reduce flood risk on site. It is important however that a drainage impact assessment shows that this will not increase flood risk elsewhere, and the drainage requirements regarding runoff rates and SUDS for new development are met.

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

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

### 8.8.2 Groundwater

Groundwater flooding has a very different flood mechanism to any other and for this reason many conventional flood defence and mitigation methods are not suitable. The only way to fully reduce flood risk would be through building design, ensuring floor levels are raised above the water levels caused by a 1% annual probability fluvial / 0.5% annual probability tidal plus climate change event. Site design would also need to preserve any flow routes followed by the groundwater overland to ensure flood risk is not increased downstream.

When redeveloping existing buildings it may be acceptable to install pumps in basements as a resilience measure. However for new development this is unlikely to be considered an acceptable solution.

## 8.9 Making development safe

### 8.9.1 Safe Access and Egress

The developer must ensure that safe access and egress is provided to an appropriate level for the type of development. This may involve raising access routes to a suitable level. More vulnerable development such as residential development should have safe access and egress with routes remaining 'operational' during flooding.

As part of the FRA, the developer should review the acceptability of the proposed access in consultation with the Environment Agency.

### 8.9.2 Flood Warning and Evacuation

Emergency/evacuation and rescue plans should be in place for all highly vulnerable and major development within the 1 in 1,000 year floodplain. Those developments which house vulnerable people (i.e. care homes and schools) will require more detailed plans. Other major development may also consider this as it is beneficial from a public safety perspective as well as a socio-economic point of view. The responsibility for approving these plans lies with the emergency planners and emergency services. Advice should be sought from WCC's Emergency Planning team when producing an emergency/evacuation plan for developments as part of an FRA. Detailed emergency/evacuation plans for developments should undertake consultation not only with WCC's emergency planning team but also the emergency services so they know what is expected of them in the event of an emergency.

Areas where no flood warning exists may find it difficult to demonstrate that their development is safe i.e. a car park in Flood Zone 3.

Flood warnings supplied by the Environment Agency's Floodline Warnings Direct service can be provided to homes and businesses within Flood Zones 2 and 3, although the service is not available everywhere. Developers should encourage those owning or occupying developments, where flood warnings can be provided, to sign up to receive them. This applies even if the development is defended to a high standard.

## 8.10 Making Space for Water

### 8.10.1 Opportunities for River Restoration and Enhancement

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

### 8.10.2 Buffer Strips

As a minimum, developers should set back development eight metres from the landward toe of fluvial defences or top of bank where defences do not exist. This provides a buffer strip to 'make space for water', allow additional capacity to accommodate climate change and ensure access to defences is maintained for maintenance purposes.

For watercourses classed as 'Main River' a minimum eight metre easement from the top of bank is recommended for maintenance purposes to avoid disturbing riverbanks, benefiting ecology and having to construct engineered riverbank protection. Building adjacent to riverbanks can also cause problems to the structural integrity of the riverbanks and the building, making future maintenance of the river much more difficult.

### 8.10.3 Drainage Capacity

The capacity of internal drainage infrastructure is often limited and is at or near capacity under existing conditions. Development that leads to increased peak runoff within the drainage catchments may lead to infrastructure capacity being exceeded, with the potential for increased

flood risk. Development locations should be assessed to ensure capacity exists within both the on and off site network.

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## 9 Recommended policy for management of flood risk

### 9.1 Recommended Policy

The following Policy is recommended to cover the management of flood risk within the South Worcestershire area. This policy is to go alongside the blue, yellow and red subdivisions of Flood Zone 3. These maps can be found in Appendix E. Below is the suggested wording:

#### 9.1.1 Management of Flood Risk

##### 1. ["Blue Zone"]

The blue zone is functional floodplain and development will not normally be permitted here.

##### 2. ["Yellow Zone"]

Redevelopment of existing sites within the floodplain in areas not subject to significant flood flows [as defined by the Environment Agency], shown as "yellow zone" on the proposals map, will normally be permitted provided:

- it is for less vulnerable or water compatible use (as defined in Table 2 of NPPF Technical Guidance);
- ground floor levels of all buildings are set above the 1 in 100-year flood level including an allowance for climate change, with an appropriate freeboard to be agreed with the LPA and Environment Agency, and should be flood free during an extreme flood event;
- safe access is available for the lifetime of the development and is supported by flood warning and suitable evacuation plans being in place;
- car parking is designed to have regard to potential flood depths and hazards and mitigation measures are put in place. (No basement car parking shall be permitted);
- there is no detriment to the available flood storage capacity of the floodplain and additional flood storage is created; and
- unnecessary obstructions to flood flow are removed, restoring flood flow pathways.

##### 3. FI ["Red Zone"]

New development (including extensions) and redevelopment will not normally be permitted in areas of existing or previously existing floodplain flow [as defined by the Environment Agency] shown as "red zone", or within 8 metres of the top of both banks of other watercourses, as shown on the proposals map. Where options for managed retreat or land swap exist, developers should explore these with the Local Authority.

#### 9.1.2 Development and Flood Risk

All development must adhere to the advice in the South Worcestershire Strategic Flood Risk Assessment Update and the guidance provided on Flood Risk Assessment requirements in order to:

- protect floodplains from inappropriate development;
- ensure no increase in flood risk;
- where possible provide flood risk betterment; and
- ensure development is safe.

### 9.1.3 Protection and Enhancement of Watercourses

Planning permission for development will only be granted where:

- the natural watercourse system which provides drainage of land is not adversely affected;
- a minimum 8m width access strip is provided adjacent to the top of both banks of any watercourses for maintenance purposes and is appropriately landscaped for open space and Biodiversity benefits, this width may be reduced in particular circumstances with agreement from the Environment Agency and LPA;
- it would not result in the loss of open water features through draining, culverting or enclosure by other means and culverts are opened up where ever possible;
- surface water drainage is delivered by sustainable drainage systems (SUDS); and
- betterment in the surface water runoff regime is ensured; with any residual risk of flooding, from drainage features either on or off site not placing people and property at unacceptable risk.

#### Reasoned justification:

Red Zone – developers should undertake pre-application discussions with the Local Authority to discuss suitable options for managed retreat and the possibility of land swap. Confirmation of pre-application discussions should be submitted at the application stage.

### 9.1.4 SWDP35 static and touring caravans, chalets and camping sites

#### Policy – Caravans and Flood Risk

Development for caravan, mobile home and chalet parks will not be permitted within the 1% plus climate change ('high risk') floodplain. Where existing caravan, mobile home and chalet parks are located within the 'high risk' floodplain, permission will not be granted for intensification of the park through additional caravans and/or increased occupancy. Options for the relocation of the existing development to a suitable area of lower flood risk should be considered.

#### Reasoned justification:

There is a number of existing caravan sites within the South Worcestershire area, which are located within the 'high risk' floodplain along the River Severn, River Avon and the River Teme for example. These sites are located in unsustainable locations, where there should be no intensification of the park and /or increased occupancy. The NPPF acknowledges that the instability of these structures places their occupants at special risk. However to ensure that there are no new (or intensification of) caravans, mobile homes and chalet parks within the "high risk" floodplain we consider a policy is required to strengthen the guidance within NPPF and assist in relocating caravans to areas of lower flood risk.

## 9.2 Key Requirements for future development

- All sites within Zones 2 and 3, and all sites greater than 1ha in Flood Zone 1, will require a detailed Flood Risk Assessment in accordance with NPPF, including assessment of hazard, making reference to Section 0 and associated maps of this report. Consultation with the Environment Agency is strongly recommended at an early stage in the FRA process.
- The layout of buildings and access routes should adopt a sequential approach, steering buildings (and hence people) towards areas of lowest risk within the boundaries of the site. This will also ensure that the risk of flooding is not worsened by, for example, blocked flood flow routes.
- The FRA requirements defined in Section 8 of this SFRA update must be considered for all future development brought forward.

## 10 Outcomes

### 10.1 Summary of work undertaken

- The South Worcestershire SFRA update has considered fluvial, groundwater and surface water flood risk in Worcester City, Wychavon District and Malvern Hills District..
- Flood risk has been assessed on all sites highlighted within the South Worcestershire Development Plan. For sites shown to be at risk in Flood Zones 2 and 3 a more detailed assessment of risk has been undertaken.
- The Flood Zone 3 maps have been provided with climate change to provide advice on the fluvial flood risk.
- The Flood Map for Surface Water is provided, indicating the likelihood of surface water flooding in the South Worcestershire area.
- Surface water flooding is a risk in many of the areas. Advice has been provided regarding suitable SUDS options.
- Guidance for the requirements for a site specific Flood Risk Assessment for the sites where a detailed assessment of risk was undertaken is provided (Section 0), as well as general guidance on flood risk assessment for any development proposals within the South Worcestershire area (Section 8).

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

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a detailed Flood Risk Assessment.

The SFRA update is a living document and should be periodically updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by the South Worcestershire Councils, Worcestershire County Council (in its role as Lead Local Flood Authority), the Highways Authority, Severn Trent Water and the Environment Agency.



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# Appendices

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## A Flood Zone mapping

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## **B Climate change mapping**

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## C Hazard mapping



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## **D Surface water flood risk mapping**

## D.1 30 years

## D.2 200 years

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## **E Floodplain policy mapping**

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## **F Summary of risk to all proposed allocation sites**



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## **G Property and critical infrastructure counts**

## G.1 Property counts for South Worcestershire

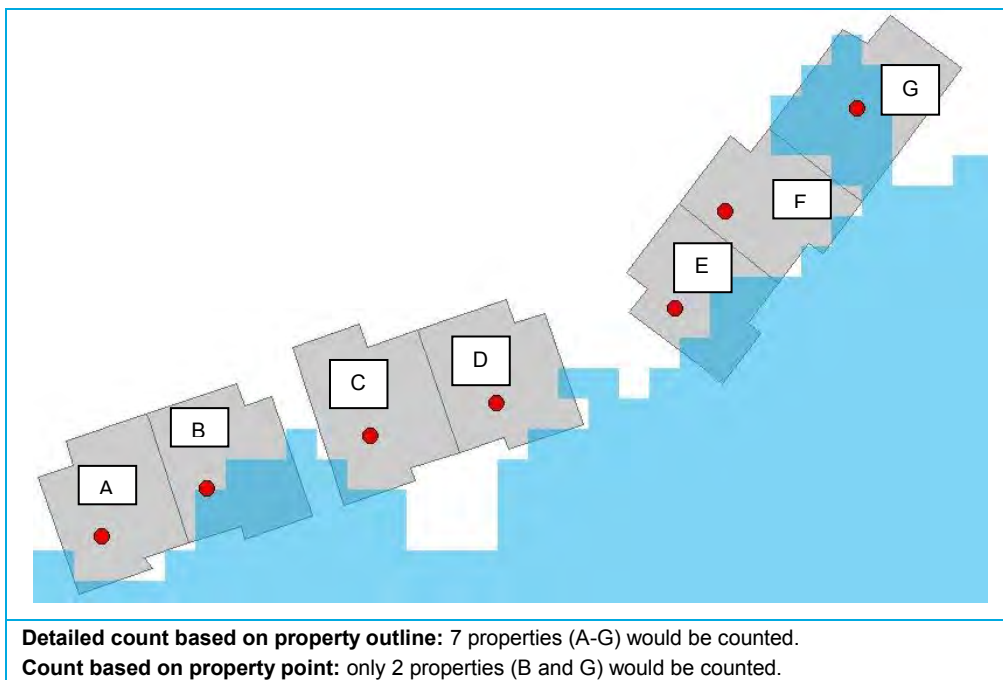
The following section provides property counts for the South Worcestershire area.

The NRD property point dataset was filtered to remove the recommended standard list of property types to exclude, as described in the Environment Agency’s Operational Instruction 353\_10<sup>15</sup>.

Ideally a detailed property count should be used to identify all properties at risk. This method involves selecting building outlines that are intercepted by the flood outline and then relating these selected buildings back to the NRD property points that are associated with them.

This method better represents the number of properties that might be at risk. However, building outline data was not available at the time of the assessment. As such, it should be noted that the property counts are *indicative* only and may be underestimating the number of properties at risk.

**Schematic of differences in property count methodology**



**Number of properties and IPPC sites at risk in the South Worcestershire Area**

Area	Number of Properties						IPPC sites		
	Residential			Non Residential			FZ2	FZ3a	FZ3b
	FZ2	FZ3a	FZ3b	FZ2	FZ3a	FZ3b			
Worcester	802	515	347	342	195	148	0	0	0
Malvern Hills	616	436	331	111	74	55	0	0	0
Evesham	488	211	100	161	107	51	0	0	0
Droitwich Spa	208	116	92	90	70	69	0	0	0
Upton upon Severn	120	1	1	88	12	8	0	0	0
Pershore	221	22	15	82	29	17	0	0	0
Tenbury Wells	233	91	5	181	88	14	0	0	0
Rural areas	1,836	512	359	1,787	834	617	1	1	1

<sup>15</sup> Environment Agency (2011) Operational Instruction 353\_10: National Receptor Dataset: What it is, what it’s used for, and how to access and use it.

**Number of environmental sites at risk in the South Worcestershire Area**

Feature	Number of features located with flood extent		
	FZ2	FZ3a	FZ3b
Local Nature Reserves	5	5	4
Environmentally Sensitive Areas	1	1	1
Areas of Outstanding Natural Beauty	2	2	2
Registered Parks and Gardens	8	8	7
Scheduled Monuments	40	29	29

Sections of the following key transport routes are shown to be within the extent for all flood zones (Flood Zones 2, 3a and 3b)

- Cotswold and Malvern Mainline, North East to South West Mainline
- M50, M5
- A4103
- A422
- A44
- A4440
- A449
- A456
- A46

Note: this assessment is based by querying against the flood outlines. Bridges and embankments protecting the routes may not have been represented in the modelling that the outlines are based on. This assessment is intended to provide an indication of transport links at risk only.

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## **H Consultation and communication**

### Key SFRA meetings and communications

Date	Organisations	Discussion
10 <sup>th</sup> May 2012	<ul style="list-style-type: none"> <li>Malvern Hills District Council</li> <li>Environment Agency</li> <li>JBA Consulting</li> </ul>	Initial project start-up meeting with Ismail Mohammed (Malvern Hills DC) and Ruth Clare (EA) Discussed requirements of the SFRA update, background of the South Worcestershire Development Plan, SFRA methodology, proposed site allocations and timescales.
23 <sup>rd</sup> May 2012	<ul style="list-style-type: none"> <li>Malvern Hills District Council</li> <li>Environment Agency</li> <li>JBA Consulting</li> </ul>	Scoping Report issued to Malvern Hills District Council and EA
13 <sup>th</sup> July 2012	<ul style="list-style-type: none"> <li>Malvern Hills District Council</li> <li>JBA Consulting</li> </ul>	Final SWDP proposed allocations sent to JBA Consulting
6 <sup>th</sup> September 2012	<ul style="list-style-type: none"> <li>Malvern Hills District Council</li> <li>Wychavon District Council</li> <li>JBA Consulting</li> </ul>	Interim meeting with Fred Davies (Wychavon DC) and Ismail Mohammed (Malvern Hills DC) discussing SFRA progress and changes to proposed site allocations. Confirmation that SFRA was meeting requirements.
14 <sup>th</sup> September 2012	<ul style="list-style-type: none"> <li>South Worcestershire Councils</li> <li>Worcestershire County Council</li> <li>Environment Agency</li> <li>Severn Trent Water</li> <li>JBA Consulting</li> </ul>	Level 2 Strategic Flood Risk Assessment DRAFT Report issued
24 <sup>th</sup> September 2012	<ul style="list-style-type: none"> <li>Malvern Hills District Council</li> <li>Wychavon District Council</li> <li>Worcester City Council</li> <li>Worcestershire County Council</li> <li>Environment Agency</li> <li>Highways</li> <li>Severn Trent Water</li> <li>JBA Consulting</li> </ul>	Discussion and feedback on the Draft SFRA Update Report. JBA presented the Draft SFRA Report and initial feedback was provided from review panel. The appropriateness of proposed site allocations and related concerns were discussed with the EA.
2 <sup>nd</sup> October 2012	<ul style="list-style-type: none"> <li>Worcestershire County Council</li> <li>JBA Consulting</li> </ul>	Meeting to discuss what historic flood information the County Council hold and how it could be used with the SFRA, creating a link between the SFRA and the LFRMS.
30 <sup>th</sup> October 2012	<ul style="list-style-type: none"> <li>Worcester County Council</li> <li>JBA Consulting</li> </ul>	Ann Cooper of Worcester City Council brought to JBA's attention some photographs showing historic flooding to one of the proposed site allocations, supplied by a member of a local flood group.
7 <sup>th</sup> November 2012	<ul style="list-style-type: none"> <li>South Worcestershire Councils</li> <li>Worcestershire County Council</li> <li>Environment Agency</li> <li>Severn Trent Water</li> <li>JBA Consulting</li> </ul>	Level 2 Strategic Flood Risk Assessment FINAL DRAFT Report issued



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