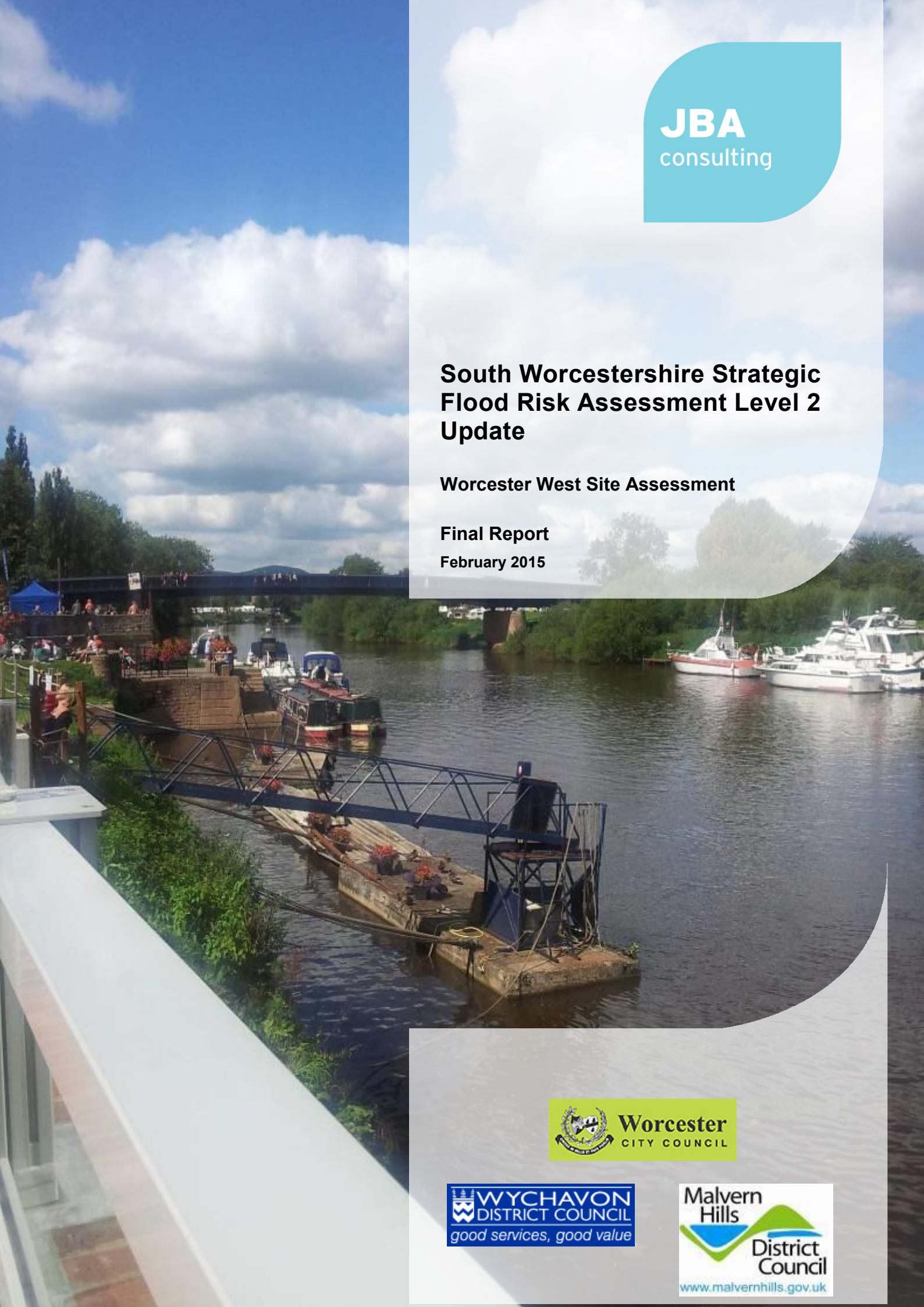

South Worcestershire Strategic Flood Risk Assessment Level 2 Update

Worcester West Site Assessment

Final Report

February 2015

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JBA Project Manager

Claire Gardner
The Library
St Philip's Courtyard
Church End
COLESHILL
B46 3AD

Revision History

Revision Ref / Date Issued	Amendments	Issued to
Draft Version v1(30/01/2015)		Fred Davies (Wychavon District Council)
Final Version v1(10/02/2015)	Amendment to wording in site summary table	Fred Davies (Wychavon District Council)

Contract

This Level 2 Strategic Flood Risk Assessment (SFRA) Update additional assessment is commissioned by Wychavon District Council. The council's representative for the contract were Fred Davies. Claire Gardner and Andrew Waite of JBA Consulting carried out this work.

Prepared by ..... Andrew Waite BSc MRes
Assistant Analyst

Reviewed by ..... Claire Gardner BSc MSc MCIWEM C.WEM
Chartered Senior Analyst

Purpose

This document has been prepared as a Final Report for Wychavon District 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

JBA Consulting would like to thank the following people for their assistance with this project:

- Fred Davies and Alexandra Millward (Wychavon District Council)

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Abbreviations and Glossary of Terms

Term	Definition
Cumecs	The cumec is a measure of flow rate. One cumec is shorthand for cubic metre per second; also m^3/s (m^3s-1).
EA	Environment Agency
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).
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.
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.
JBA	Jeremy Benn Associates
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
NPPF	National Planning Policy Framework
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
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.
SFRA	Strategic Flood Risk Assessment
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.
WCC	Worcester City Council
WDC	Wychavon District Council

1 Introduction

1.1 About this report

This South Worcestershire Level 2 Strategic Flood Risk Assessment (SFRA) Update report was published in 2012[1]. A further update was published in 2014 in the form of an addendum to the 2012 report. The 2014 addendum included the assessment of additional proposed allocations. These reports were prepared to provide appropriate supporting evidence for the South Worcestershire Development Plan.

Since the previous reports were published the South Worcestershire Councils have identified at extension to the Worcester West potential site allocation.

This document has been prepared under the requirements of the National Planning Policy Framework (NPPF)[2] and accompanying Guidance to the National Planning Policy Framework published in March 2014[3].

Important Note:

This document should be read in conjunction with the South Worcestershire Level 2 Strategic Flood Risk Assessment Update report (2012) and the 2014 South Worceestershire Level 2 SFRA Addendum Report.

1.2 Data sources

1.2.1 Flood zones

The flood zones, including climate change, derived as part of the 2012 South Worcestershire SFRA update were used in the assessment.

1.2.2 Surface water

Since the 2012 SFRA update was published a new surface water dataset, the updated Flood Map for Surface Water, was been released by the Environment Agency in December 2013.

This information is based on a national scale map identifying those areas where surface water flooding poses a risk. Flooding is separated into the following four categories:

- **High** – An area has a chance of flooding greater than 1 in 30 (3.3%) each year.
- **Medium** – An area has a chance of flooding between 1 in 100 (0.1%) and 1in 30 (3.3%) each year.
- **Low** – An area has a chance of flooding between 1 in 1000 (0.1%) and 1in 100 (1%) each year.
- **Very Low** – An area has a chance of flooding of less than 1 in 1000 (0.1%) each year.

This new, more up-to-date, dataset has been used to assess surface water flood risk to the site.

1.2.3 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.

[1] South Worcestershire Strategic Flood Risk Assessment Level 2 update: Final Report (JBA Consulting, December 2012)

[2] National Planning Policy Framework (Department for Communities and Local Government, March 2012)

[3] National Planning Policy Framework Planning Practice Guidance: Flood Risk and Coastal Change (Department for Communities and Local Government, March 2014)

2 Notes

2.1 Flood Zones

Important Note: The Environment Agency's Flood Zones 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 was incorporated into Flood Zone 2 for the 2012 SFRA update study. **When using the mapping provided as part of the 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.**

2.2 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)
$SAAR_{4170}$	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 2-1: Summary of SUDS Categories

SUDS Type	Technique
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.

Suitability	Description
	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.

2.3 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.

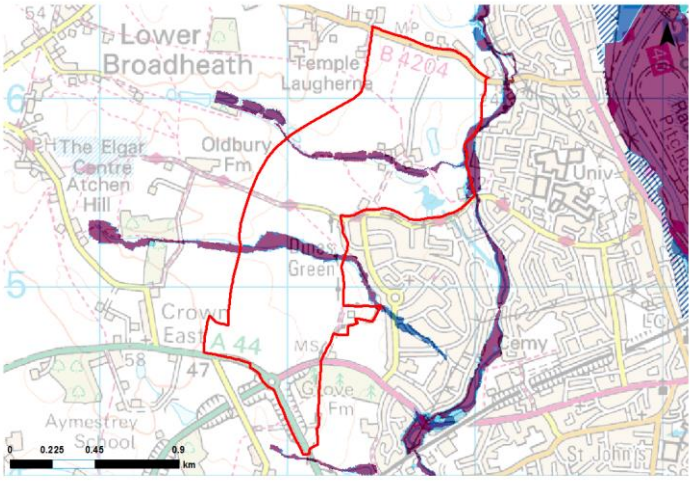
The AStGWF is a strategic scale map showing groundwater flood areas on a 1km square grid. It shows the proportion of each 1km grid square where geological and hydrogeological conditions show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. The maps should 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: the AStGWF has been used to identify 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 site.

2.4 Worcester West Proposed Allocation (SWDP 45/2)

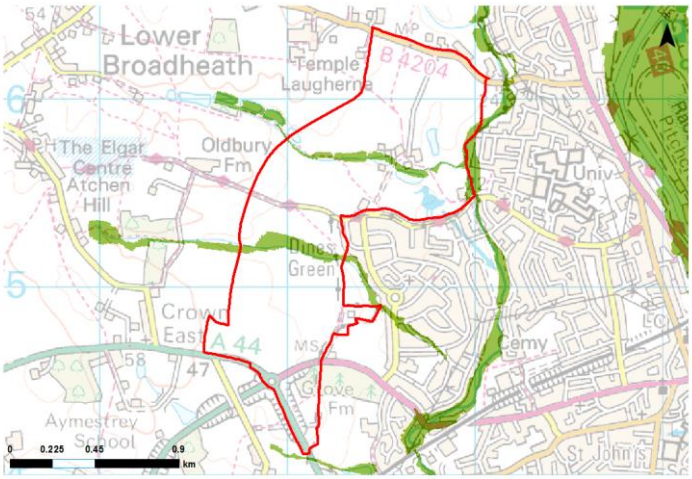
Table 2-2: Worcester West urban expansion (SWDP 45/2)				
OS NGR: SO 820534	**Area:** 139.2ha		**Brown/Greenfield:** Greenfield	
Flood Zone Coverage:	**FZ3a:** 1%	**FZ3b:** 4%	**FZ2:** 1%	**FZ1**: 94%
Exception Test required? Yes, for More Vulnerable and Essential Infrastructure development in FZ3a and 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 the unnamed tributaries of the Laughern Brook, 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: Proposed Development Area Local Authority Boundary Flood Zone 3b Flood Zone 3a Flood Zone 2 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. © Crown copyright 2014. All rights reserved. Worcester City Council: 100018714 (2014) Wychavon District Council: 100024324 (2014) Malvern Hills District Council: 100048590 (2014)				

Climate Change:

Proposed Development Area

Local Authority Boundary

Flood Zone 3 with Climate Change



Surface Water Map:

Proposed Development Area

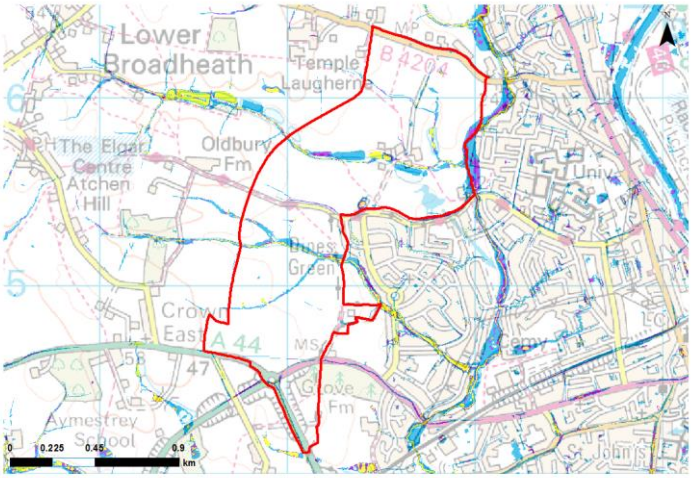
Local Authority Boundary

uFMfSW 30-year Extent

uFMfSW 100-year Extent

uFMfSW 1000-year Extent

This map gives an indication of 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.



Sources of Flood Risk:

- Primary flood risk to the site is fluvial, resulting from overtopping of the unnamed tributaries of the Laughern Brook, and the lakes and channels to the north, west and central parts of the site. Some areas of the central and northern parts of the site fall partially 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.

Soil Type	Fluvial Deposits	
Greenfield Runoff Rate (l/s/ha)	1 in 2 year	2.1
	1 in 100 year (plus climate change)	7.7
Estimated Attenuation Storage Volume (m^3)	23,660 – 52,890	

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. Mapping suggests that site slopes may be steep so larger features 'above ground' 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

- 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.

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North Yorkshire
BD23 3AE

t:+44(0)1756 799919
e:info@jbaconsulting.com

Jeremy Benn Associates Ltd
Registered in England 3246693

Visit our website
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