Herefordshire Council

HEREFORDSHIRE STRATEGIC FLOOD RISK ASSESSMENT

Level 2

70043501
MARCH 2019

PUBLIC

Herefordshire Council

HEREFORDSHIRE STRATEGIC FLOOD RISK ASSESSMENT

Level 2

TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT REF. NON-HAP LEVEL 2 SFRA

OUR REF. NO. 70043501

DATE: MARCH 2019

Herefordshire Council

HEREFORDSHIRE STRATEGIC FLOOD RISK ASSESSMENT

Level 2

WSP

Kings Orchard
1 Queen Street
Bristol
BS2 0HQ

Phone: +44 117 930 6200

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Issued for comment	Amended draft for consultation	Final version following BBLP remarks	
Date	08/11/2018	01/03/2019	15/3/2019	
Prepared by	S Haberfield	S Haberfield	S Haberfield	
Checked by	J Goodwin	J Goodwin	J Goodwin	
Authorised by	J Goodwin	J Goodwin	J Goodwin	
Project number	70043501	70043501	70043501	
Report number	1.0	2.0	2.1	

CONTENTS

APPENDICES

1. INTRODUCTION

1.1. OVERVIEW

1.1.1. This Level 2 Strategic Flood Risk Assessment (SFRA) builds on the Herefordshire Level 1 SFRA and provides a more detailed assessment of flood risk at a number of the strategic development sites identified by the Council in the Local Plan. The Level 2 SFRA has been completed in accordance with the National Planning Policy Framework (NPPF) and the supporting Planning Practice Guidance (PPG).

1.1.2. The strategic development sites identified by the Council for consideration within this Level 2 SFRA include:

- BR2 – Land at Hardwick Bank, Bromyard
- LO2 – Leominster Urban Expansion
- LB2 – Land North of Viaduct, Ledbury
- RW2 – Land at Hildersley, Ross-on-Wye

1.1.3. Strategic development sites located within and around Hereford are being considered separately as part of the Hereford Area Plan (HAP) and its supporting Level 2 SFRA.

1.1.4. The Herefordshire Level 1 SFRA was updated in March 2017 and assesses the risk of flooding within Herefordshire from all sources, now and in the future, taking into account climate change. The Level 1 SFRA provides the basis for the application of the Sequential Test and, where required, the Exception Test, and summarises key development control policies for the management of flood risk and surface water runoff.

1.1.5. This Level 2 SFRA builds on the recommendations of the Level 1 SFRA and applies these to specific site locations, namely the four strategic development sites listed above that are allocated in the Local Plan. The Level 2 SFRA considers the application of the Sequential and Exception Tests for these sites and provides advice on appropriate policies for each strategic development site that should be demonstrated as part of any subsequent planning application.

1.1.6. A summary of key requirements and development control policies is provided below to inform this Level 2 SFRA, although reference should always be made to the Level 1 SFRA for a comprehensive summary of these requirements for all developments within Herefordshire.

1.1.7. The Level 2 SFRA has been informed through predominantly desk-based review of the data sources summarised within the Level 1 SFRA. This has been supplemented by further consultation with the relevant sewerage authorities, namely Dwr Cymru Welsh Water and Severn Trent Water. No hydraulic modelling or other quantitative analysis has been undertaken, although reference has been made to existing hydraulic studies where these are known to be available.

1.1.8. The information provided within this Level 2 SFRA is the best available at the time of writing. More up to date information may be available and contact should always be made with the Environment Agency, Herefordshire Council, Dwr Cymru Welsh Water and Severn Trent Water at an early stage of any development planning to ensure that the detailed site-based flood risk assessment is using the most current datasets. It is the developer's responsibility to ensure that the most up to date datasets are being used to inform their proposed development.

1.1.9. Each of the strategic development sites is discussed within a site-specific appendix to this report to enable appendices to be updated independently if required.

1.1.10. The SFRA has been reviewed and approved by the Environment Agency as a statutory consultee under NPPF.

1.2. THE SEQUENTIAL AND EXCEPTIONS TESTS

1.2.1. The risk of flooding is most effectively addressed through avoidance, which in very simple terms means guiding future development away from areas at risk. The application of the Sequential and Exception Tests form the most important consideration in the allocation of land for development.

1.2.2. The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. In summary, development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. Development should be steered to Flood Zone 1 in the first instance, and only if there are no reasonably available sites located in Flood Zone 1 should sites be considered in Flood Zones 2 and 3.

1.2.3. Within Herefordshire, it is expected that the Sequential Test will also take into consideration risks associated with safe access and egress (for example, if a site is located in Flood Zone 1 and is a dry island surrounded by Flood Zone 3). It is also expected that the potential effects of climate change over the lifetime of the development are taken into consideration when applying the Sequential Test.

1.2.4. The process for applying the Sequential Test to inform the preparation of the Local Plan is illustrated in Figure 1.1, recreated from the NPPF Planning Practice Guidance.

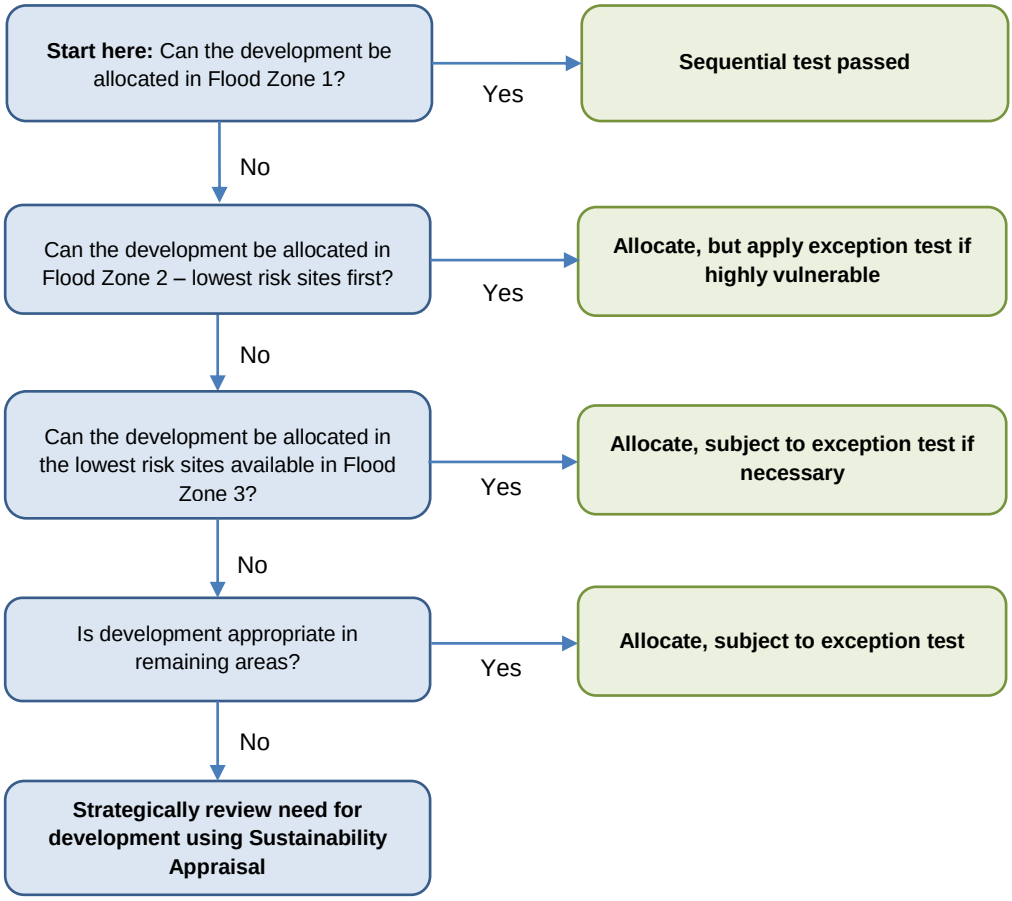

Figure 1.1 Application of the Sequential Test

1.2.5. In addition to the application of the Sequential Test developments are expected to demonstrate that a sequential approach has been applied to the development layout to locate the most vulnerable areas of a development to those areas of the site that are at least flood risk. This also applies to sites that are located in Flood Zone 1 and to all sources of flood risk.

1.2.6. If following the application of the Sequential Test it is not possible for the development to be located in zones with a lower probability of flooding, the Exception Test can be applied if appropriate. Table 3 of the Planning Practice Guidance to NPPF provides recommendations on the compatibility of different types of development based on their vulnerability classification within each of the mapped fluvial and tidal Flood Zones and summarises where the Exception Test will be required, as shown in Table 1.1.

Table 1.1 Flood risk vulnerability and flood zone compatibility

EA Flood Zone	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	×	Exception test required	✓
Zone 3b	Exception test required	✓	×	×	×

✓ Development considered acceptable

× Development considered unacceptable

1.2.7. The majority of development proposed within the strategic development sites comprises residential, employment and educational development. In accordance with guidance provided in the Planning Practice Guidance to NPPF, residential and educational development would typically be classified as 'more vulnerable' and commercial or industrial development would typically be classified as 'less vulnerable'.

1.2.8. For the Exception Test to be passed:

- 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.

1.2.9. Figure 1.2 summarises the application of the Exception Test in the preparation of a Local Plan, recreated from the NPPF Planning Practice Guidance.

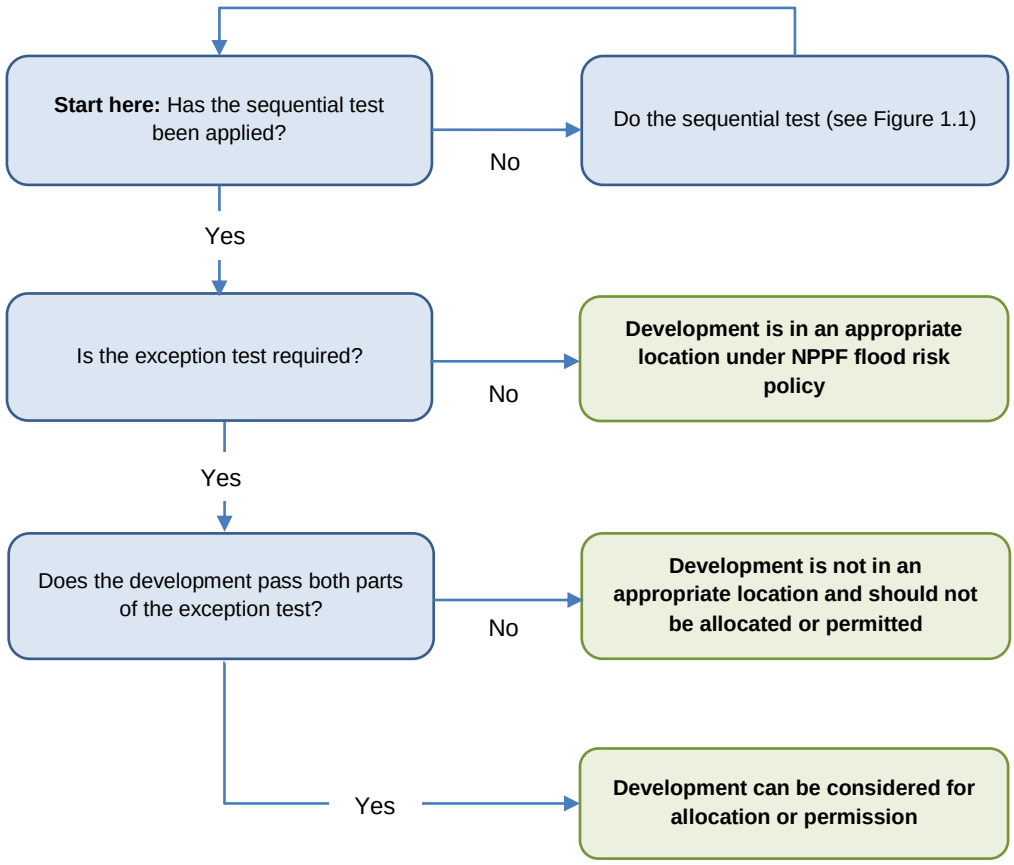

Figure 1.2 Application of the Exception Test

1.2.10. Within Herefordshire it is expected that even where a development passes the Exception Test and is considered acceptable in accordance with Table 1.1, the Sequential Test and sequential approach (as discussed above) must still be applied and summarised within the site-specific flood risk assessment.

1.3. DEVELOPMENT CONTROL

1.3.1. If after the application of the Sequential and Exception Tests the development is considered appropriate at the proposed location, identified flood risks can be managed through consideration of recommended development control policies. These recommendations are presented in detail in Section 6 of the Level 1 SFRA. A brief summary of key recommendations is provided below for reference for this Level 2 SFRA:

- All sources of flood risk must be considered. This includes flooding from main rivers, ordinary watercourses, surface water, groundwater emergence, the sewerage system, reservoirs and other artificial sources, as well as flooding that could be attributable to overland flow, blocked culverts, or temporary exceedance of drainage systems and failure of flood defence schemes.

- Consideration must be given to fluvial flood risks associated with smaller watercourses that may not be illustrated on the Environment Agency's Flood Map for Planning, typically watercourses with a small catchment of less than 3km^2.

- The assessment of fluvial flood risk must consider the potential effects of climate change that may occur over the design life of the development. This includes consideration of the 'design' scenario and 'test' scenario as set out within Section 6.5 of the Level 1 SFRA.

- The design of surface water drainage systems must consider the potential effects of climate change that may occur over the design life of the development. All new drainage should be designed for the Central allowance category, and the resilience of the design tested for the Upper End allowance category.

- Developments should include appropriate flood resilience and resistance measures that may include but not be limited to:
  - Raised floor levels and other measures to prevent flood water ingress;
  - Designing buildings to recover quickly after flood water ingress;
  - Provision of safe access and egress routes, or provision of safe refuge;
  - Avoidance of high risk structures such as basements where these are not appropriate.

1.3.2. A site-specific flood risk assessment will be required to support any planning application that is located within:

- The medium risk Flood Zone 2 or high risk Flood Zone 3 taking the potential effects of climate change into account, and excluding benefits that may be offered by flood defences;
- The low risk Flood Zone 1 where the development is 1 hectare or greater in area; or
- The low risk Flood Zone 1 where the development is at risk of flooding from other sources of flooding (i.e. surface water, sewerage systems or reservoirs).

1.3.3. The site-specific flood risk assessment should identify and assess the risks of all forms of flooding to and from the development and demonstrate how these flood risks will be managed so that the development remains safe throughout its lifetime, taking climate change into account. Site-specific flood risk assessments for sites greater than 1 hectare in Flood Zone 1 and with no identified risks from other sources should focus on the sustainable management of surface water runoff generated by the proposed development and opportunities to reduce risk elsewhere.

1.4. SUSTAINABLE DRAINAGE SYSTEMS

1.4.1. Sustainable drainage systems, commonly referred to as SuDS, promote an improved approach to the management of surface water runoff that maximises the additional benefits that can be achieved when compared to traditional piped systems. The use of SuDS within Herefordshire is considered paramount to successful and sustainable development.

1.4.2. The Herefordshire Council SuDS Handbook provides detailed guidance on the expectations and use of SuDS within Herefordshire. A useful flood risk and drainage checklist of the information that developers are expected to submit as part of their planning applications is available on the Council's website.

1.4.3. It is expected that the strategic development sites will be exemplars of good SuDS design and, where practicable, go beyond the minimum design standards set out within Defra's Non-Statutory Technical Standards for Sustainable Drainage Systems, Herefordshire Council SuDS Handbook and the Level 1 SFRA. This is likely to include, for example, further reduction in the rate and volume of runoff to rates and volumes to those more comparable with Qbar and the use of vegetated systems that promote infiltration, evapotranspiration and treatment even in impermeable soils.

1.4.4. The long term maintenance of surface water drainage systems is essential to their ability to manage flood risk and protect the natural water environment. Information regarding the proposed adoption and maintenance of surface water drainage systems must be submitted as part of the planning application. A copy of the proposed operational and maintenance plan manual will be required for major development planning applications for all proposed drainage features that are not being adopted by Dwr Cymru Welsh Water or Severn Trent Water and that are to be adopted and maintained by a third party management company. Appendix C of the Council's SuDS Handbook, available on the Council's website, contains information regarding the arrangements for maintenance and adoption of SuDS features.

1.5. ASSESSMENT SUMMARY

1.5.1. Assessments of the four strategic development sites considered within the Level 2 SFRA are presented within the subsequent report appendices. In summary, it is considered that all sites pass the Sequential Test and are appropriate for proposed development as set out within the Local Plan. Where flood risks have been identified, there are feasible mitigation measures that can be implemented to manage these risks without incurring significant cost or residual risk. A brief overview of the key requirements for future development is provided below:

- The planning application for all sites will need to be supported by a site-specific Flood Risk Assessment prepared in accordance with Section 6.10 of the Level 1 SFRA.
- All sites should apply a sequential approach to the development layout and provide an appropriate buffer between areas that have been identified to be at flood risk from fluvial, surface water and overland flow sources. This is most applicable to sites LB2, LO2 and RW2 that should consider overland flow paths and maintain an appropriate distance between new development and existing drainage channels.
- Development of site LB2 should be set back from the banks of the Liver Leadon by a recommended minimum distance of 8m, with floor levels raised a minimum of 600mm above the 1 in 100 (1%) annual probability fluvial flood level including climate change allowance.
- All sites offer options for the management of surface water run-off and it is recommended that all sites strive to reduce discharge to Qbar rates and volumes as much as practicable. Surface water runoff from BY2 and parts of LO2 may require discharge to the adjacent public sewerage network. This may pose constraint to the development of LO2. Infiltration is likely to be most viable for site RW2.
- All sites offer options for the management of foul discharge, although all sites may require some upgrade to the existing public sewerage network. The majority of site LO2 will require foul water to be pumped, as will discharge from site LB2.
- Consideration must be given to seasonally high groundwater levels that may be a constraint for sites BY2, LO2 and LB2.
- Consideration must be given to the infiltration of contaminated runoff within site RW2 that is partially located within a groundwater Source Protection Zone.

Appendix A

BR2 - LAND AT HARDWICK BANK, BROMYARD

ALLOCATION BY2 – LAND AT HARDWICK BANK, BROMYARD

Allocation Reference:	BY2 – Land at Hardwick Bank, Bromyard
Location:	Bromyard
River Catchment:	River Frome
NPPF Flood Zone (majority of area):	Flood Zone 1
NPPF Flood Zone (worst case):	Flood Zone 1

INTRODUCTION

The BY2 strategic development site occupies an area of approximately 27ha and is located to the north of Bromyard as illustrated in Figure BY2.1. The site wraps around the north and west of Bromyard between the A44 in the south and Tenbury Road in the east.

The topography within the majority of the site is relatively flat with a gentle slope towards the north and east. Within the east of the site the topography slopes more steeply at a gradient of approximately 1:10 towards Tenbury Road. The majority of the site is elevated at around 170-150m AOD, approximately 35m above the River Frome Valley. Immediately to the north of the site levels fall steeply down towards the River Frome.

The existing land use within the BY2 strategic development site comprises mixed arable and pasture land.

As stated within the Local Plan, the proposal for the development for the BY2 strategic development site comprises the provision of 250 new homes. However, at the time of preparing this assessment it is known that the following major development application has been made within the BY2 strategic development site boundary:

- Outline planning application for the whole of the BY2 strategic development site comprising 500 dwellings, open space, allotments and landscaping, school expansion land and children's play areas (reference P163932/O awaiting decision).

DESCRIPTION OF FLOOD RISK

FLUVIAL

Review of the Environment Agency's Flood Map for Planning indicates that the BY2 strategic development site is located entirely within the low risk Flood Zone 1.

The nearest mapped flood zone to the site is associated with the River Frome located approximately 200-400m from BY2 strategic development site boundary as illustrated in Figure BY2.2. The river flows broadly parallel to the site's northern and eastern boundaries in an easterly / south-easterly direction. The River Frome is designated as an ordinary watercourse to the west of Tenbury Road under the jurisdiction of Herefordshire Council, and as a main river to the east of Tenbury Road under the jurisdiction of the Environment Agency. The watercourse does not pose significant risk to

the town, although the industrial estates in the east of Bromyard and caravan park in the south of Bromyard are vulnerable to fluvial flooding from the River Frome.

The BY2 strategic development site is sufficiently elevated above the current mapped Flood Zones 2 and 3 associated with the River Frome to not be considered at risk when the potential effects of climate change are considered.

SURFACE WATER AND MINOR WATERCOURSES

The Environment Agency's Risk of Flooding from Surface Water map indicates that the BY2 strategic development site is at very low risk of surface water flooding as illustrated in Figure BY2.3. A very slight valley is located within the centre of the site with the potential for sight concentration of overland flow between Bromyard's existing urban extent and Drythistle Farm, although this is not considered to pose risk to the site or elsewhere.

The mapping indicates no minor watercourses or ditches within the site extents. This is supported by review of detailed OS mapping that also indicates no surface water features.

GROUNDWATER

Review of British Geological Survey data indicates that the BY2 strategic development site is underlain by mudstone, siltstone and sandstone bedrock geology. The east of the site is indicated to comprise predominantly sandstone and the western half of the site is indicated to comprise a mixture of sandstone and argillaceous rocks. There are no superficial deposits indicated within the site boundary.

Review of borehole records available via the British Geological Survey website provides little information regarding the likely depth to the groundwater table. Boreholes within closest proximity to the BY2 strategic development site report seepage at approximately 2m below ground level (at approximately 134m AOD), whereas boreholes located further to the south and south-east indicate groundwater levels in excess of 10m below ground level. Review of OS mapping indicates groundwater springs within the steeper sloping land to the north-west (towards the River Frome) and south-west of the site (towards Hackley Brook that is a tributary of the River Frome), indicated to emerge between the 145-155m contour lines. No springs are indicated within the BY2 site boundary.

The information presented above suggests that the vast majority of the BY2 strategic development site is likely to be at low risk of groundwater flooding. Some emergence may occur within the lower areas of the site, namely to the east as the site falls towards Tenbury Road, although there is no mapped record of groundwater emergence within these areas. Below ground structures such as basements or drainage features could be affected by high (or seasonally high) groundwater levels.

OTHER SOURCES OF FLOOD RISK

The BY2 strategic development site is not located within an area deemed to be risk of flooding on the Environment Agency's Risk of Flooding from Reservoirs map. Review of OS mapping also indicates no reservoirs or other large storage features at a higher elevation to the site that would pose flood risk in the event of failure.

The BY2 strategic development site is not likely to be at significant risk of flooding from adjacent drainage or sewerage systems.

HISTORIC FLOOD RECORDS

At the time of preparing this assessment there are no known historic flooding events that have occurred within or immediately adjacent to the BY2 strategic development site. There are a number of known historic flooding events that have affected property and infrastructure downstream of the site, most notably fluvial flooding from the River Frome that has affected the industrial estates in the east of Bromyard and caravan park in the south of Bromyard.

PLANNING RECOMMENDATIONS

SPATIAL PLANNING AND DEVELOPMENT CONTROL

Development of the BY2 strategic development site should be undertaken in accordance with the principles as set out within Section 1 of the Level 2 SFRA and Section 6 of the Level 1 SFRA. It is understood that proposed development within the BY2 strategic development site will comprise residential uses, open space and, potentially, a school expansion.

The site is located within Flood Zone 1, is not at significant risk from other sources and safe access and egress can be achieved. All types of development are considered appropriate within Flood Zone 1 and the site allocation therefore passes the Sequential and Exception Tests. However, a site-specific Flood Risk Assessment prepared in accordance with the NPPF and supporting PPG will be required for developments that are 1 hectare or greater in area. The FRA should focus on flood risk associated with an increase in the rate or volume of site-generated surface water runoff, and address flood risks associated with potential groundwater emergence or high groundwater levels. These aspects are discussed in greater detail below.

MANAGEMENT OF SITE GENERATED SURFACE WATER RUNOFF

Drainage systems should be designed in accordance with the Herefordshire SuDS Handbook and Section 6 of the Level 1 SFRA, adhering to the following key principles:

- Applying the SUDS hierarchy to promote the infiltration of runoff to ground prior to the consideration of other measures;
- Controlling the rate and volume of runoff to ensure no increased flood risk for all events between the 1 in 1 (100%) and the 1 in 100 (1%) annual probability rainfall events;
- Promoting best practice vegetated and on-ground conveyance and storage features as much as practicable.

Methods for calculating runoff must be in accordance with the methods promoted within the CIRIA SuDS Manual (C753, published in 2015). It is expected that FEH methods and 2013 rainfall data are used in the calculation of existing and post-development scenarios. The calculation of pre-development runoff rates and volumes should not take the potential effects of climate change into account.

Review of the National Soil Resources Institute Soilscapes mapping indicates that the soils within the site may have slightly impeded drainage. Infiltration of runoff may therefore be viable for all or part of the site generated surface water runoff, although onsite testing will be required to determine soil permeability and depth to the groundwater table (including potential for seasonally high groundwater) throughout the site and determine the risk of infiltrated water re-emerging downhill of the site and posing risk to property and infrastructure (as indicated by the presence of springs as discussed above). If onsite testing concludes lower permeability soils and minimal risk associated

with re-emergence, combined attenuation and infiltration features should be promoted to reduce runoff during small rainfall events and provide treatment.

It is expected that for a development site of this size that best practice SUDS measures are incorporated that promote attenuation (and infiltration where appropriate) throughout the development.

If offsite discharge of site-generated surface water runoff is required, consideration should first be given to discharge to the River Frome to the north of the site although it is recognised that this would require crossing of third party land for approximately 200-400m depending on location. An agreement in principle with relevant land owners would be required to demonstrate the viability of this solution. Attenuation of runoff will be of key importance and, at minimum, the Applicant will be required to demonstrate no increase in the rate or volume discharged to this watercourse between the 1 in 1 year and 1 in 100 year (plus climate change) events. However, given the size and strategic importance of this site it is expected that discharge is limited to Qbar as much as practicable.

If a connection to the River Frome is proposed, consideration should be given to the risk of water not being able to discharge as intended during periods of high river levels within the Frome.

The majority of Bromyard is served by separate surface water and foul water sewerage systems, although a combined sewerage network still serves the historic town centre. Consultation with Dwr Cymru Welsh Water confirms that the surface water network that serves the north of Bromyard (i.e. adjacent to the BY2 strategic development site) drains directly to the River Frome to the east of Bromyard and that, if required, the existing network would have capacity to receive attenuated discharge from the BY2 strategic development site. Proposed discharges rates must be agreed with Dwr Cymru Welsh Water and an agreement in principal provided to support the planning application.

MANAGEMENT OF POTENTIALLY HIGH GROUNDWATER LEVELS

The risk of high groundwater levels must be considered in the drainage design, most notably the risk that this could reduce the effectiveness of infiltration systems or reduce the capacity of unlined attenuation/infiltration systems. Winter groundwater monitoring should be undertaken to better understand and mitigate these risks.

Basement structures may be appropriate if long term groundwater monitoring demonstrates that groundwater levels do not rise to a level that would pose significant flood risk to these structures.

MANAGEMENT OF FOUL WATER

Foul water from the BY2 strategic development site should be discharged to the public sewerage network that serves Bromyard. Consultation with Dwr Cymru Welsh Water has highlighted capacity issues within the existing foul and combined sewerage network and, in particular, at the existing Terminal Pumping Station located in the south-east of Bromyard adjacent to the River Frome. The Applicant will be required to undertake further consultation with Dwr Cymru Welsh Water to better understand the risks, opportunities and scope for further works prior to the development of the BY2 strategic development site. This may include the need for developer contributions or coordination with Dwr Cymru Welsh Water's programme of proposed upgrades.

OPPORTUNITIES FOR BETTERMENT

Development of the BY2 strategic development site offers little opportunity for betterment with regard to reducing flood risk associated with fluvial flooding or overland flow elsewhere in the catchment. However the sustainable management of surface water runoff and attenuation to rates and volumes comparable to Qbar as much as practicable will manage any increased flood risk and could assist in reducing downstream fluvial flood risk associated with the River Frome.

Appendix B

LO2 - LEOMINSTER URBAN EXPANSION

ALLOCATION LO2 – LEOMINSTER URBAN EXTENSION, LEOMINSTER

Allocation Reference:	LO2 – Leominster Urban Extension, Leominster
Location:	Leominster
River Catchment:	River Arrow / River Lugg
NPPF Flood Zone (majority of area):	Flood Zone 1
NPPF Flood Zone (worst case):	Flood Zone 1

INTRODUCTION

The LO2 strategic development site occupies an area of approximately 130ha and is located to the south-west of Leominster as illustrated in Figure LO2.1. The existing land use within the LO2 strategic development site comprises mixed arable and pasture land and encompasses a number of existing properties along Ivington Road. The site borders Leominster to the north and is bound by the A44 Monkland Road / Baron's Cross Road in the west and the B4361 Hereford Road in the east.

The topography within the site boundary generally slopes south towards the River Arrow that flows in an easterly direction approximately 300-500m south of the site. Topography within the site ranges between approximately 100m AOD in the north to approximately 70m AOD in the south.

Review of OS mapping indicates a small valley located in the approximate centre of the site with two ditches flowing south through the valley as can be seen in Figure LO2.1. The ditches converge at the southern site boundary and continue south towards the River Arrow. Review of OS mapping also indicates a ditch just beyond the western site boundary. The ditch flows south / south-east towards the River Arrow. Both ditch systems flow adjacent to offline ponds located immediately downstream of the site although the intended use or value of these ponds in unknown.

As stated within the Local Plan, the proposal for the development for the LO2 strategic development site comprises the provision of 1500 new homes, a 420-pupil primary school and employment provision. At the time of preparing this assessment it is known that the following major development application has been made within the LO2 strategic development site boundary:

- Application for the construction of 30 houses within the very north of the LO2 strategic development site between Westcroft and Baron's Cross Road (reference P150812/O approved with conditions).

DESCRIPTION OF FLOOD RISK

FLUVIAL

Review of the Environment Agency's Flood Map for Planning indicates that the LO2 strategic development site is located entirely within the low risk Flood Zone 1.

The nearest mapped flood zone to the site is associated with the River Arrow to the south of the site as illustrated in Figure LO2.2. The River Arrow is designated as a main river under the jurisdiction

of the Environment Agency. It flows in an easterly direction broadly parallel to the southern site boundary and confluences with the River Lugg approximately 1.7km east of the B4361 Hereford Road.

The Flood Zone 2 and 3 fluvial floodplain associated with the River Arrow extends to within approximately 100m of the LO2 strategic development site at its closest point. Review of available mapping, including outputs from the 1D-2D ISIS-TUFLOW (noting ISIS is now called Flood Modeller) hydraulic model prepared by the Environment Agency in 2013, indicates that the site is still unlikely to be at risk with the potential effects of climate change are considered. This conclusion assumes that the mapped extent of Fluvial Flood Zone 2 (i.e. extent of the 1 in 1000 (0.1%) annual probability event) provides a good indication of the 1 in 100 (1%) annual probability event plus 70% peak river flow (i.e. Upper End allowance category) and was informed by a review of the model hydrology for the 1 in 100 (1%) annual probability event to the model hydrology for the 1 in 1000 (0.1%) annual probability event to verify that the modelled Flood Zone 2 will be representative of the future Flood Zone 3 with climate change allowance.

The River Arrow and River Lugg pose significant flood risk to Leominster upstream of the LO2 strategic development site. The downstream flood extents are largely located within agricultural lands and are not indicated to pose significant flood risk to urban settlements for some 20km downstream, although the floodplain does pose risk to isolated properties and 'hug' settlements such as Bodenham and Moreton on Lugg.

SURFACE WATER AND MINOR WATERCOURSES

The Environment Agency's Risk of Flooding from Surface Water map indicates that the LO2 strategic development site is generally at very low risk of surface water flooding as illustrated in Figure LO2.3.

The mapping indicates a substantial overland flow path through the centre of the site that follows the approximate alignment of the valley and ditches as discussed above. A second overland flow path is indicated to the west of the site, connecting to the ditch identified just beyond the western site boundary. Surface water flooding is also indicated within the A44 Monkland Road that forms the western site boundary, and within Ivington Road in the centre of the site. The flood hazard (depth and velocity) and extent of these overland flow routes may increase when the potential effects of climate change are considered and should be considered within the development proposals.

GROUNDWATER

Review of British Geological Survey data indicates that the LO2 strategic development site is underlain by mudstone and siltstone bedrock geology overlain in parts with shallow till, head and alluvial deposits.

The British Geological Survey website provides a borehole record within the approximate centre of the site that indicates the groundwater table to be 9m below ground level at this location, at an approximate elevation of 70m AOD. Review of OS mapping indicates springs at the upstream extent of the mapped ditches, issuing at an elevation of approximately 80m AOD suggesting groundwater may rise to a level higher than that indicated by the borehole record.

The LO2 strategic development site is unlikely to be at risk of groundwater flooding, however groundwater may rise to within close proximity of the ground surface within the lower areas of the

site, and below ground structure such as basements or drainage features could be affected by high (or seasonally high) groundwater levels.

OTHER SOURCES OF FLOOD RISK

The LO2 strategic development site is not located within an area deemed to be risk of flooding on the Environment Agency's Risk of Flooding from Reservoirs map. Review of OS mapping also indicates no reservoirs of other large storage features at a higher elevation to the site that would pose flood risk in the event of failure.

The LO2 strategic development site borders the town of Leominster to the north, east and west that is served by surface water and foul water sewerage systems, however topography tends to fall away from the LO2 strategic development site along these boundaries. The site is therefore not likely to be at significant risk of flooding from adjacent drainage or sewerage systems.

HISTORIC FLOOD RECORDS

At the time of preparing this assessment there are no known historic flooding events that have occurred within the LO2 strategic development site. A number of flooding events have occurred within the Barons Cross development to the north-west of the site and adjacent to the A44, indicated to be associated with the surface water drainage system's capacity being exceeded. These incidents, should they reoccur, are not likely to pose risk of flooding to the LO2 strategic development site. Management of risks to access and egress are discussed below.

PLANNING RECOMMENDATIONS

SPATIAL PLANNING AND DEVELOPMENT CONTROL

Development of the LO2 strategic development site should be undertaken in accordance with the principles as set out within Section 1 of the Level 2 SFRA and Section 6 of the Level 1 SFRA. It is understood that proposed development within the LO2 strategic development site will comprise residential and employment uses.

The site is located within Flood Zone 1 and the majority of the site is not at significant risk from other sources of flooding. Safe access and egress can be achieved although risks from surface water flooding will need further consideration. All types of development are considered appropriate within Flood Zone 1 and the site allocation therefore passes the Sequential and Exception Tests. A site-specific Flood Risk Assessment prepared in accordance with the NPPF and supporting PPG will be required for any development greater than 1 hectare in area or that encompasses those areas deemed to be at surface water flood risk. The FRA should focus on flood risk associated with an increase in the rate or volume of site-generated surface water runoff, and address flood risks associated with the existing drainage ditches and overland flow routes, as well as consider risks associated with potential groundwater emergence or high groundwater levels. These aspects are discussed in greater detail below.

MANAGEMENT OF SITE GENERATED SURFACE WATER RUNOFF

Drainage systems should be designed in accordance with the Herefordshire SuDS Handbook and Section 6 of the Level 1 SFRA, adhering to the following key principles:

- Applying the SUDS hierarchy to promote the infiltration of runoff to ground prior to the consideration of other measures;

- Controlling the rate and volume of runoff to ensure no increased flood risk for all events between the 1 in 1 (100%) and the 1 in 100 (1%) annual probability rainfall events;
- Promoting best practice vegetated and on-ground conveyance and storage features as much as practicable.

Methods for calculating runoff must be in accordance with the methods promoted within the CIRIA SuDS Manual (C753, published in 2015). It is expected that FEH methods and 2013 rainfall data are used in the calculation of existing and post-development scenarios. The calculation of pre-development runoff rates and volumes should not take the potential effects of climate change into account.

Review of the National Soil Resources Institute Soilscapes mapping indicates that soils within the north-west of the site have slightly impeded drainage. Review of the British Geological Survey indicates no notable superficial deposits overlying the mudstone and siltstone bedrock geology in this area. Infiltration of runoff is therefore unlikely to be viable in this part of the site.

The National Soil Resources Institute Soilscapes mapping indicates freely draining soils within the remainder of the site assumed to be associated with the superficial deposits that overlay the mudstone and siltstone bedrock. Whilst this suggests that infiltration of site-generated runoff may therefore be viable, the likely shallow depth of the superficial deposits and potential for high groundwater may limit the effectiveness of infiltration features. Onsite testing will be required to determine soil permeability and depth to the groundwater table (including potential for rising groundwater) throughout the site. If onsite testing concludes lower permeability soils and minimal risk associated with a high groundwater table, combined attenuation and infiltration features should be promoted to reduce runoff during small rainfall events and provide treatment.

It is expected that for a development site of this size that best practice SUDS measures are incorporated that promote attenuation (and infiltration where appropriate) throughout the development.

If offsite discharge of site-generated surface water runoff is required, this should maximise opportunities to discharge to the existing drainage ditches that flow through the centre of the site. Review of topography indicates that a gravity connection to these ditches is likely to be viable for the central third of the site. Attenuation of runoff will be of key importance and the Applicant will be required to demonstrate, at minimum, no increase in the rate or volume discharged to these ditches between the 1 in 1 year and 1 in 100 year (plus climate change) events. Given the size and strategic importance of this site it is expected that discharge is limited to Qbar as much as practicable. The Applicant will be required to confirm the downstream alignment of the ditches and outfall to the River Arrow. Consideration must also be given to the existing pond located immediately downstream of the site to understand the purpose and value of this pond and the significance of any impact to the flow regime.

Where feasible it is recommended that surface water runoff from the west of the site is discharged to the existing ditch located just beyond the western site boundary although it is recognised that this may require crossing of third party land. An agreement in principle with the relevant landowner would be required to demonstrate the viability of this solution. The downstream alignment of this ditch is indicated to flow beneath Newton Lane and past a number of properties. Discharge to the ditch must therefore ensure no increase in the rate or volume discharged to the ditch between the 1 in 1 year and 1 in 100 year (plus climate change) events (also demonstrating consideration of the

natural ditch catchment), but consideration must also be given to the condition and capacity of any existing culverts, including analysis of blockage risk. If the condition or capacity of existing culverts is considered inadequate and pose flood risk to adjacent property or infrastructure the development of the LO2 strategic development site could offer opportunities for betterment that should be explored. As above, given the size and strategic importance of this site it is expected that discharge from the site is limited to Qbar as much as practicable.

If surface water runoff from the west of the site cannot be discharged to the existing ditch discussed above, consultation with Dwr Cymru Welsh Water indicates a surface water sewerage network located in the A44 to the west of the site. The network is understood to serve development to the south of Cholstrey Road and convey this to the River Arrow. Dwr Cymru Welsh Water indicate available capacity within this network to receive attenuated flow from the LO2 strategic development site if required. Proposed discharges rates must be agreed with Dwr Cymru Welsh Water and an agreement in principal provided to support the planning application.

It is unlikely that land in the north-east of the LO2 strategic development site will be able to drain by gravity to a surface water feature. Infiltration should be promoted as much as practicable within these areas, giving consideration to shallow and wide infiltration features where necessary. If detailed assessment indicates that infiltration cannot manage all runoff, consideration may be given to a connection to the adjacent Dwr Cymru Welsh Water sewerage network but the network within this area comprises a combined system and further capacity analysis will be required. At minimum, flow would need to be attenuated to very low discharge rates for all return period events.

If surface water runoff from the south-east of the site cannot be discharged via infiltration consideration should first be given to discharge to the River Arrow to the south of the site although it is recognised that this would require crossing of third party land or construction of a new sewer within the B4361 for approximately 400m. An agreement in principle would be required to demonstrate the viability of this solution. Consultation with Dwr Cymru Welsh Water indicates a surface water drainage system to the east of the LO2 strategic development site that serves St Botolphs Green, although this in turn discharges to the downstream combined system. As per above, consideration may be given to a connection to this network but further capacity analysis will be required and, at minimum, flow would need to be attenuated to very low discharge rates for all return period events. Alternatively, the development of the LO2 strategic development site may offer opportunity to provide betterment to the drainage system serving this area, extending the separated surface water system from the combined system between St Botolphs Green and the wastewater treatment works approximately 500m downstream.

MANAGEMENT OF MINOR WATERCOURSES AND OVERLAND FLOW

Consideration must be given to flooding associated with the drainage ditches that pass through the centre of the LO2 strategic development site. Where possible, the alignment of the ditches should be maintained and kept as an open channel. Given the size of the ditches hydraulic modelling for the purpose of understanding potential flood extents is unlikely to be required if it can be demonstrated that consideration has been given to local topography and development set back from the channel edge and mapped flood extents. The surface water flood mapping indicates a well-defined and relatively substantial flow route through the site and it is recommended that topographical survey data is used to better understand the likely extent of this flow route to inform the appropriate location of development. A minimum corridor of 4m between the mapped flood extents, associated ditches and the development is considered appropriate to manage residual risk

(including those associated with climate change) and facilitate maintenance of the ditches. Should any new structure be proposed across the ditches (for example an access road) or should the ditches require diversion, hydraulic analysis will be expected to inform the size of any new structures and assess residual risk.

Consideration must also be given to overland flow routes upstream of the ditches, including the overland flow route in the west of the site, demonstrating that these can be maintained without posing flood risk to the proposed development or existing properties. As per above, it is recommended that a minimum corridor of 4m is maintained between the mapped flow routes and proposed development.

Surface water flooding is indicated within the A44 Monkland Road that forms the western site boundary, and within Ivington Road in the centre of the site. Consideration must be given to safe access and egress from these roads, particularly Ivington Road that is indicated to be at high risk of surface water flooding.

MANAGEMENT OF POTENTIALLY HIGH GROUNDWATER LEVELS

The risk of high groundwater levels must be considered in the drainage design, most notably the risk that this could reduce the effectiveness of infiltration systems or reduce the capacity of unlined attenuation/infiltration systems. Winter groundwater monitoring should be undertaken to better understand and mitigate these risks.

Basement structures may be appropriate if long term groundwater monitoring demonstrates that groundwater levels do not rise to a level that would pose significant flood risk to these structures.

MANAGEMENT OF FOUL WATER

Foul water from the LO2 strategic development site should be discharged to the Dwr Cymru Welsh Water public sewerage network that serves Leominster. This is likely to require pumping.

The centre and south of Leominster is served by a combined sewerage network that drains by gravity to the wastewater treatment works in the south-east of Leominster. A gravity connection to this network is likely to be achievable for new development located on the periphery of Leominster, although this is not likely to be achievable for development elsewhere within the LO2 strategic development site given the general site topography that falls towards the south.

Existing development within the west of Leominster drains to a foul water pumping station located to the west of the Barton Cross development that pumps effluent to the wastewater treatment works in the south-east of Leominster. New development within the west of the LO2 strategic development site could potentially drain to this existing pumping station, although consultation with Dwr Cymru Welsh Water has indicated that a new pumped system that discharges foul effluent to (or in close proximity to) the existing wastewater treatment works is likely to be required. Some upgrade to the downstream network and wastewater treatment works may also be required.

OPPORTUNITIES FOR BETTERMENT

As discussed above, opportunities to reduce surface water runoff from the proposed development of the LO2 strategic development site to rates and volumes more comparable to Qbar should be explored and could reduce downstream fluvial flood risk associated with the River Arrow and River Lugg, as well as to the existing properties adjacent to the Newtown Lane. The development of the site may also offer further opportunity for betterment if overland flows from outside of the site

boundary or from permeable areas of the development could be attenuated. This could for example include provision of attenuation within the existing drainage ditches that pass through the site, or reducing the rate or volume of overland flow that migrates to these ditches.

Appendix C

LB2 - LAND NORTH OF VIADUCT, LEDBURY

ALLOCATION LB2 – LAND NORTH OF THE VIADUCT, LEDBURY

Allocation Reference:	LB2 – Land North of the Viaduct, Ledbury
Location:	Ledbury
River Catchment:	River Leadon
NPPF Flood Zone (majority of area):	Flood Zone 1
NPPF Flood Zone (worst case):	Flood Zone 3

INTRODUCTION

The LB2 strategic development site occupies an area of approximately 28ha and is located to the north of Ledbury as illustrated in Figure LB2.1. The site comprises arable land and is bound by the railway line to the south, by industrial and commercial development in the east, and the B4214 Bromyard Road in the north. The River Leadon flows in a southerly direction adjacent to the western site boundary and forms the boundary of the site upstream of the railway line.

Topography within the LB2 strategic development site is broadly flat with a gentle slope west towards the River Leadon. Site topography typically ranges between approximately 50-60m AOD.

As stated within the Local Plan, the development for the LB2 strategic development site comprises the provision of 625 new homes, 3ha of employment land and 210-place primary school. At the time of preparing this assessment it is known that the following major development application has been made within the LB2 strategic development site boundary:

- Outline planning application for the entirety of the LB2 strategic development site comprising up to 625 new homes and up to 2.9 ha of B1 employment land (reference P171532/O awaiting determination).

DESCRIPTION OF FLOOD RISK

FLUVIAL

Review of the Environment Agency's Flood Map for Planning indicates that the majority of the LB2 strategic development site is located within the low risk Flood Zone 1 where the annual probability of flooding from fluvial sources is less than 1 in 1000 (0.1%). The western boundary of the site that borders the River Leadon is located within the high risk Flood Zone 3 where the annual probability of flooding from fluvial sources is greater than 1 in 100 (1%). The River Leadon is classified as a main river and is therefore under the jurisdiction of the Environment Agency. The mapped fluvial flood extents are illustrated in Figure LB2.2a.

Generalised modelling of the functional floodplain Flood Zone 3b has been undertaken by the Environment Agency and indicates that the fluvial flood extents within the south-west of the site would be classified as Flood Zone 3b. The functional floodplain is defined as land where water has to flow or be stored in times of flood, typically representing areas that flood during the 1 in 20 (5%) annual probability event. The mapped functional floodplain extents are illustrated in Figure LB2.2b.

The mapped flood extents discussed above were generated using generalised broadscale flood modelling techniques. More detailed analysis was undertaken to inform the Outline application submitted in April 2017 (reference P171532/O) using a 1D-2D ESTRY-TUFLOW model. The methodology and results of this model were approved by the Environment Agency. The modelling demonstrated that the LB2 strategic development site would not be at risk of fluvial flooding up to the 1 in 100 (1%) annual probability event, including a 70% increase in peak flow to account for the Upper End climate change allowance. The modelling indicated that the south of the site (adjacent to the railway line) would be at risk of flooding during the 1 in 1000 (0.1%) annual probability event. This detailed modelling is considered to present a more accurate assessment of flood risk to the LB2 strategic development site that is therefore adopted for this Level 2 SFRA. Mapped outputs of this modelling are illustrated in Figures LB2.4a, LB2.4b and LB2.4c.

SURFACE WATER AND MINOR WATERCOURSES

The Environment Agency's Risk of Flooding from Surface Water map indicates that the LB2 strategic development site is generally at very low risk of surface water flooding as illustrated in Figure LB2.3. The mapping indicates an overland flow path adjacent to the southern boundary of the site in a similar location to the mapped fluvial 1 in 1000 (0.1%) annual probability flood extents discussed above.

Review of OS mapping indicates two ditches that pass through the south of the site, flowing from the eastern site boundary and beneath the railway viaduct to discharge to the River Leadon downstream of the site. The surface water flood extent discussed above is likely to be associated with the mapped drainage ditch located adjacent to the southern site boundary. OS mapping also indicates that a third ditch may follow a hedge line through the centre of the site and discharge to the River Leadon although this is not confirmed. Review of historic maps also indicates several historic mill leats and ditches located around and through the site that appear to have been infilled. Future development should take these features into account.

The detailed hydraulic modelling undertaken to inform the Outline application submitted in April 2017 (reference P171532/O) included the drainage ditches discussed above and considered the potential effects of climate change. Out of bank flow was predicted for the southernmost watercourse during the 1 in 1000 (0.1%) annual probability event with flood depths predicted to be less than 30mm.

GROUNDWATER

Review of British Geological Survey data indicates that the LB2 strategic development site is underlain by mudstone bedrock geology. The majority of the site is not overlain by superficial deposits. Alluvial deposits of clay, silt, sand and gravel are indicated along the alignment of the River Leadon and the ditch that is believed to pass through the centre of the site (not mapped).

There are no historic borehole records within or adjacent to the site boundary. Borehole records further to the south within Ledbury indicate that groundwater levels could be between 2-3m below ground level.

The LB2 strategic development site is considered to be at low risk of groundwater flooding, however the potential for shallow groundwater may pose risk to below ground structures and drainage features.

OTHER SOURCES OF FLOOD RISK

The LB2 strategic development site is not located within an area deemed to be risk of flooding on the Environment Agency's Risk of Flooding from Reservoirs map. Review of OS mapping indicates a large pond to the east of the site that is located at a higher elevation than the site, although the pond does not appear to be formed of raised embankments. The pond does not appear on historic mapping and therefore is assumed to be man-made. The risk posed to the site is considered to be low. Review of OS mapping also indicates a raised pond approximately 350m north of the site that is understood to receive discharge from the surrounding polytunnels. Should the raised embankment of the pond fail water would flow west towards the River Leadon. A sudden surge could pose flood risk to the LB2 strategic development site in a similar manner to the mapped fluvial flood extents although this risk is considered to be low.

The LB2 strategic development site is not likely to be at significant risk of flooding from adjacent drainage or sewerage systems, although some historic flooding has occurred within the adjacent industrial and commercial development as discussed below. It is possible that this could flow west towards the LB2 strategic development site although the risk is considered to be low.

HISTORIC FLOOD RECORDS

At the time of preparing this assessment there are no known historic flooding events that have occurred within the LB2 strategic development site. External flooding of the adjacent industrial and commercial development has been recorded and is indicated to be attributable to sewer flooding. Properties downstream of the LB2 strategic development site have also been recorded to experience flooding associated with the River Leadon.

PLANNING RECOMMENDATIONS

SPATIAL PLANNING AND DEVELOPMENT CONTROL

Development of the LB2 strategic development site should be undertaken in accordance with the principles as set out within Section 1 of the Level 2 SFRA and Section 6 of the Level 1 SFRA. It is understood that proposed development within the LB2 strategic development site will comprise residential and employment uses.

The vast majority of the site is located within Flood Zone 1 and safe access and egress can be achieved. The vast majority of the site is not at significant risk from other sources of flooding although risks from surface water and fluvial flooding will need further consideration. The site allocation is therefore deemed to pass the Sequential and Exception Tests, however a site-specific Flood Risk Assessment prepared in accordance with the NPPF and supporting PPG will be required. The FRA should focus on flood risk associated with an increase in the rate or volume of site-generated surface water runoff, and address flood risks associated with the River Leadon and minor watercourses. Consideration should also be given to risks associated with high groundwater levels. These aspects are discussed in greater detail below.

MANAGEMENT OF SITE GENERATED SURFACE WATER RUNOFF

The management of surface water runoff will be of particular importance for the LB2 strategic development site given the proximity of the River Leadon to Ledbury and the historic flooding that has occurred downstream of the site. Drainage systems should be designed in accordance with the

Herefordshire SuDS Handbook and Section 6 of the Level 1 SFRA, adhering to the following key principles:

- Applying the SUDS hierarchy to promote the infiltration of runoff to ground prior to the consideration of other measures;
- Controlling the rate and volume of runoff to ensure no increased flood risk for all events between the 1 in 1 (100%) and the 1 in 100 (1%) annual probability rainfall events;
- Promoting best practice vegetated and on-ground conveyance and storage features as much as practicable.

Methods for calculating runoff must be in accordance with the methods promoted within the CIRIA SuDS Manual (C753, published in 2015). It is expected that FEH methods and 2013 rainfall data are used in the calculation of existing and post-development scenarios. The calculation of pre-development runoff rates and volumes should not take the potential effects of climate change into account.

Review of the National Soil Resources Institute Soilscapes mapping indicates that the soils within the site have slightly impeded drainage. As discussed above groundwater levels may also be within 2-3m of ground level. Infiltration of runoff may therefore not be viable for all or part of the site, although onsite testing will be required to determine soil permeability and depth to the groundwater table (including potential for rising groundwater). If onsite testing concludes lower permeability soils, combined attenuation and infiltration features should be promoted where groundwater levels permit to reduce runoff during small rainfall events and provide treatment.

It is expected that for a development site of this size that best practice SUDS measures are incorporated that promote attenuation (and infiltration where appropriate) throughout the development.

If offsite discharge of site-generated surface water runoff is required it is expected that runoff from the LB2 strategic development site will be discharged to the River Leadon, utilising the existing drainage ditches where appropriate. Attenuation of runoff will be of key importance and the Applicant will be required to demonstrate, at minimum, no increase in the rate or volume discharged from the site between the 1 in 1 year and 1 in 100 year (plus climate change) events. Given the historic flood records downstream of the site it is expected that betterment is achieved during larger rainfall events with discharge limited to Qbar as much as practicable.

There are no known public surface water sewers close to the site. Historic maps show a ditch that used to run parallel with the backfilled mill channel. Surface water runoff from the adjacent industrial site may drain via a culvert on the same route as the fore-mentioned ditch. Investigations will be needed to determine whether there is a ditch system draining surface water from the industrial estate to the River Leadon or whether there is a culvert below the field. These issues should be considered as part of any future development of the site. Connection to the Severn Trent foul water drainage network that is located east of the site is not considered to be an acceptable approach.

MANAGEMENT OF MINOR WATERCOURSES AND OVERLAND FLOW

The alignment of the existing ditches through the LB2 strategic development site should be maintained as open channels as far as practicable, with consideration given to mapped overland flow routes to these ditches from land to the east of the site. Particular attention should be paid to the ditch and overland flow path adjacent to the southern site boundary, with development set back

from this ditch to mitigate flood risk and facilitate maintenance. A minimum corridor of 4m between the mapped flood extents, ditch and the development is considered appropriate. Consideration must be given to any proposed crossings of the ditches (i.e. road or footpath) to maintain hydraulic capacity and understand residual risks in the event of blockage.

MANAGEMENT OF FLUVIAL FLOOD RISKS FROM THE RIVER LEADON

The modelling undertaken to inform the Outline application submitted in April 2017 (reference P171532/O) indicated that the LB2 strategic development site would not be at risk during the 1 in 100 (1%) annual probability event and allowing for the potential effects of climate change. However it is recommended that finished floor levels of any new buildings are raised a minimum of 600mm above the 1 in 100 (1%) annual probability event plus climate change event (Higher Central) to ensure resilience. It is also recommended that no development is located within 8m of the top of bank of the River Leadon.

MANAGEMENT OF POTENTIALLY HIGH GROUNDWATER LEVELS

The risk of high groundwater levels must be considered in the drainage design, most notably the risk that this could reduce the effectiveness of infiltration systems or reduce the capacity of unlined attenuation/infiltration systems. Winter groundwater monitoring should be undertaken to better understand and mitigate these risks.

Basement structures are not recommended for this site given the likely probability of high groundwater levels.

MANAGEMENT OF FOUL WATER

Foul water from the LB2 strategic development site should be discharged to the public sewerage network that serves Ledbury. The adjacent industrial and commercial development to the east of the site is served by a Severn Trent Water foul sewer network that discharges to a foul pumping station located within the boundary of the estate. From here flow is pumped south beneath the railway line to connect to the wider foul network that drains to the wastewater treatment works in the south of Ledbury. It is likely that a connection from the LB2 strategic development site to the foul network serving the adjacent industrial and commercial development will be required. Severn Trent Water has advised that the capacity of the pumping station is not sufficient to receive additional flow and there are existing problems with the network. Hydraulic modelling of the foul water network will be required. Severn Trent Water are currently developing proposals to construct a new pumping station to the south of the viaduct located to the south of the LB2 strategic development site. It is currently proposed that the new pumping station will also receive diverted flow from the adjacent industrial site in order to reduce flood risk from sewers in the area. It is also considered likely that improvement works will be required to the combined foul system to the western edge of Ledbury.

OPPORTUNITIES FOR BETTERMENT

As discussed above, opportunities to reduce surface water runoff from the proposed development of the LB2 strategic development site to rates and volumes more comparable to Qbar should be explored and could reduce downstream fluvial flood risk associated with the River Leadon. The development of the site may also offer further opportunity for betterment if flow within the ditches that pass through the site, including overland flows from outside of the site boundary, could be attenuated. This could for example include provision of attenuation within the existing drainage ditches that pass through the site.

Appendix D

RW2 - LAND AT HILDERSLEY, ROSS-ON-WYE

ALLOCATION RW2 – LAND AT HILDERSLEY, ROSS-ON-WYE

Allocation Reference:	RW2 – Land at Hildersley, Ross-on-Wye
Location:	Ross-on-Wye
River Catchment:	Chatterley Brook / Rudhall Brook; River Wye
NPPF Flood Zone (majority of area):	Flood Zone 1
NPPF Flood Zone (worst case):	Flood Zone 1

INTRODUCTION

The RW2 strategic development site occupies an area of approximately 42ha and is located to the south-east of Ross-on-Wye as illustrated in Figure RW2.1. The site encompasses Hildersley Farm, Model Farm and Spring Farm and the A40 passes through the approximate centre of the site. The site is bound to the north by the former railway and to the west by the Town and Country Trail (also a former railway). A Ministry of Defence (MoD) firing range is located adjacent to the western boundary of the site.

The topography within the site boundary generally slopes down towards the north-west. Within the site boundary the ground slope is relatively gentle at a gradient of around 1 in 30. To the south of the site levels rise steeply up the wooded escarpment of Penyard Park.

The existing land use within the strategic development site comprises agricultural farming and grazing land.

As stated within the Local Plan, the proposed development of the RW2 strategic development site comprises the provision of 200 new homes. However, at the time of preparing this assessment it is known that the following major development applications have been made within the RW2 strategic development site boundary:

- Outline planning application for approximately 15ha of land to the north of the A40 that comprises employment land uses including B1, B2 and B8 (reference P173600/O approved with conditions);
- Outline planning application for approximately 11ha of land to the south of the A40 that comprises approximately 212 dwellings (reference P150930/O approved with conditions).

There is also a full planning application for the demolition of the existing dwelling and the construction of six new dwellings with access onto Gloucester Road located to the south of the A40 and adjacent to the Town and Country Trail (reference P143708/F approved with conditions).

DESCRIPTION OF FLOOD RISK

FLUVIAL

Review of the Environment Agency's Flood Map for Planning indicates that the RW2 strategic development site is located entirely within the low risk Flood Zone 1.

The nearest mapped flood zone to the site is associated with the Chatterley Brook and Rudhall Brook to the north of the site as illustrated in Figure RW2.2. Both watercourses are designated as

ordinary watercourses under the jurisdiction of Herefordshire Council and flow in a westerly direction through the centre of Ross-on-Wye to confluence with the River Wye approximately 0.8km to the west of the town centre.

The Rudhall Brook and Chatterley Brook pose flood risk to areas of the town when periods of high flows within the River Wye cause water to back up in the brooks and overtop. The Ross-on-Wye Flood Alleviation Scheme, constructed in 2008, helps alleviate flooding associated with these watercourses. The scheme comprises an inverted flood relief siphon, improved culvert and channel capacities for the Rudhall Brook and Chatterley Brook, and a flood storage area upstream of Ross-on-Wye to the east of the A40. During periods of high flows within the Rudhall Brook, excess water is diverted away from the culverted section of Rudhall Brook located beneath Greytree Road and into an inverted siphon that flows between the Kings Acre and Homs Road Car Park. The flood flow is conveyed back into Rudhall Brook downstream of Ross-on-Wye after the flood waters subside.

The RW2 strategic development site is sufficiently far away from the current mapped Flood Zones 2 and 3 to not be at flood risk when the potential effects of climate change are considered.

SURFACE WATER AND MINOR WATERCOURSES

The Environment Agency's Risk of Flooding from Surface Water map indicates that the RW2 strategic development site is at very low risk of surface water flooding as illustrated in Figure RW2.3.

The mapping indicates a ditch to the north of the A40 that starts within the strategic development site boundary and generally flows north-west towards Chatterley Brook. The ditch flows beneath the former railway via a culvert. Overland flow routes upstream of this ditch are also illustrated. It should also be noted that land to the south of the RW2 strategic development site is steeply sloping. Whilst the mapping does not indicate a surface water flood risk, it is recommended that this is considered in further as part of any proposed development downhill of this land.

The mapping also indicates a ditch located immediately to the west of the former railway adjacent to the western boundary of the strategic development site. The disused railway is higher than the adjacent field and consequently the ditch appears to only accept flow from the west side of the disused railway embankment. This ditch flows north via a culvert beneath the A40 and emerges north of the Gloucester Road roundabout adjacent to the eastern verge of the A40. From here the ditch continues north and discharges to Chatterley Brook.

GROUNDWATER

Review of British Geological Survey data indicates that the RW2 strategic development site is underlain by sandstone bedrock geology. A slither of alluvial deposits follows the alignment of the ditch that flows north-east towards Chatterley Brook, but elsewhere there are no superficial deposits that overlay the bedrock geology within the site boundary.

Review of borehole records available via the British Geological Survey website indicates that groundwater may be a significant depth below the site. Review of OS mapping indicates no springs in the vicinity if the site, including the escarpment to the south of the site. However the naming of Spring Farm within the site boundary suggests that groundwater springs may be present.

The north-west of the site is located within a groundwater Source Protection Zone. This predominately comprises the Zone 2 Outer Protection Zone, although the site borders the Zone 1 Inner Protection Zone and a small area of the western extent of the site adjacent to the former railway is located within Zone 1.

The RW2 strategic development site is considered to be at low risk of groundwater flooding, although the relatively permeable nature of the underlying geology and naming of Spring Farm suggests that groundwater levels could rise during prolonged rainfall events and should be considered in the design of below ground structures and drainage systems.

OTHER SOURCES OF FLOOD RISK

The RW2 strategic development site is not located within an area deemed to be risk of flooding on the Environment Agency's Risk of Flooding from Reservoirs map. Review of OS mapping also indicates no reservoirs or other large storage features at a higher elevation to the site that would pose flood risk in the event of failure.

The RW2 strategic development site is not considered to be at significant risk of flooding from adjacent drainage or sewerage systems.

HISTORIC FLOOD RECORDS

At the time of preparing this assessment there are no known historic flooding events that have occurred within or immediately adjacent to the RW2 strategic development site. However, historic flooding events have been recorded downstream of the site associated with Chatterley Brook and Rudhall Brook.

PLANNING RECOMMENDATIONS

SPATIAL PLANNING AND DEVELOPMENT CONTROL

Development of the RW2 strategic development site should be undertaken in accordance with the principles as set out within Section 1 of the Level 2 SFRA and Section 6 of the Level 1 SFRA. It is understood that proposed development within the RW2 strategic development site will comprise residential and employment uses.

The site is located within Flood Zone 1, is not at significant risk from other sources and safe access and egress can be achieved. All types of development are considered appropriate within Flood Zone 1 and the site allocation is deemed to pass the Sequential and Exception Tests. A site-specific Flood Risk Assessment prepared in accordance with the NPPF and supporting PPG will be required for developments that are 1 hectare or greater in area. The FRA should focus on flood risk associated with an increase in the rate or volume of site-generated surface water runoff, and address flood risks associated with minor watercourses, overland flow and (potentially) high groundwater levels. These aspects are discussed in greater detail below.

MANAGEMENT OF SITE GENERATED SURFACE WATER RUNOFF

The management of surface water runoff will be of particular importance for the RW2 strategic development site given the sloping topography towards existing urban development and the historic flood records downstream of the site. Drainage systems should be designed in accordance with the Herefordshire SuDS Handbook and Section 6 of the Level 1 SFRA, adhering to the following key principles:

- Applying the SUDS hierarchy to promote the infiltration of runoff to ground prior to the consideration of other measures;
- Controlling the rate and volume of runoff to ensure no increased flood risk for all events between the 1 in 1 (100%) and the 1 in 100 (1%) annual probability rainfall events;

- Promoting best practice vegetated and on-ground conveyance and storage features as much as practicable.

Methods for calculating runoff must be in accordance with the methods promoted within the CIRIA SuDS Manual (C753, published in 2015). It is expected that FEH methods and 2013 rainfall data are used in the calculation of existing and post-development scenarios. The calculation of pre-development runoff rates and volumes should not take the potential effects of climate change into account.

Review of the National Soil Resources Institute Soilscapes mapping indicates that the soils within the site are freely draining. Infiltration of runoff is therefore likely to be viable for all or part of the site, although onsite testing will be required to determine soil permeability and likely depth to the groundwater table (including potential for rising groundwater levels). No infiltration of surface water runoff from road surfaces (of other potentially contaminating sources) would be permitted within Zone 1 of the SPZ, and should be avoided within Zone 2 of the SPZ. If onsite testing concludes lower permeability soils, combined attenuation and infiltration features should be promoted to reduce runoff during small rainfall events and provide treatment, although again this should be restricted in the SPZ. It is expected that for a development site of this size that best practice SUDS measures are incorporated that promote attenuation and infiltration throughout the development.

An alternative drainage strategy should be developed should infiltration prove unviable for the management of all site generated surface water runoff.

It is expected that runoff from land to the north of the A40 will be drained to the ditch that flows north-east towards Chatterley Brook. Attenuation of runoff will be of key importance and the Applicant will be required to demonstrate no increase in peak flow through the ditch during a range of rainfall events. Given the historic flood records downstream of the site, it is recommended that betterment is achieved during larger rainfall events.

The land drainage will need to be investigated in the vicinity of the former railway to the north west of the development site. We understand that the drainage channel to the west of the former railway does not receive inflow from the east of the former railway.

The capacity and condition of the culvert adjacent to the former railway beneath the A40 must be considered and consideration given to blockage risks – both to the proposed development and to existing adjacent properties. Any future development of the RW2 strategic development site that involves the replacement of the culvert beneath the A40 will need to consider if a Section 106 agreement is required.

The management of runoff from land to the south of the A40 may be more challenging if infiltration cannot be supported. The existing drainage ditch located immediately to the west of the former railway flows north to eventually discharge to Chatterley Brook. This is likely to be the Council's preferred approach. However the Applicant will be required to determine the condition, alignment and capacity of the existing ditches and culverts; and upgrade these features to accommodate the development as required without increasing flood risk elsewhere. As per above, consideration must be given to blockage risks. Long term maintenance arrangements will also be of key importance.

The majority of Ross-on-Wye is served by a combined sewerage network. Discharge to the existing sewerage network is therefore unlikely to be supported. Consideration could be given to the construction of a new public sewer.

MANAGEMENT OF MINOR WATERCOURSES AND OVERLAND FLOW

Although there is no mapped flood zone associated with the ditch that flows through land to the north of the A40, consideration must be given to flooding that may be caused by this ditch. Where possible, the alignment of the ditch should be maintained and kept as an open channel. Given the size of the ditch hydraulic modelling for the purpose of understanding potential flood extents is unlikely to be required (noting that this may be required for assessing capacity and blockage risk as per above) if it can be demonstrated that consideration has been given to local topography and development set back from the channel edge. A minimum corridor of 4m between the ditch and the development is considered appropriate. Should any new structure be proposed across this ditch (for example an access road) or should the ditch require diversion, hydraulic analysis will be expected to inform the size of any new structures and assess residual risk. Consideration must also be given to overland flow routes upstream of the ditch, demonstrating that these can be maintained without posing flood risk to the proposed development or existing properties.

Land to the south of the RW2 strategic development site is steeply sloping. Consideration must be given to the management of overland flow to demonstrate that: a) it will not overwhelm the capacity of the proposed surface water drainage system, and b) that it will not pose flood risk to the proposed development.

MANAGEMENT OF FOUL WATER

Foul water from the RW2 strategic development site should be discharged to the public sewerage network that serves Ross-on-Wye. The network and treatment works have known capacity issues however it is understood that works to improve capacity are being progressed by Dwr Cymru Welsh Water. The Applicant should discuss their proposed development aspirations with Dwr Cymru Welsh Water directly to determine the need for developer contributions or coordinate with Dwr Cymru Welsh Water's programme of proposed upgrades.

OPPORTUNITIES FOR BETTERMENT

As discussed above, opportunities to reduce surface water runoff from the proposed development of the RW2 strategic development site to rates and volumes more comparable to Qbar should be explored and could reduce downstream fluvial flood risk associated with Chatterley Brook and Rudhall Brook, as well as potential flood risk to existing properties most notably those that may be at risk in the event of culvert blockage beneath the former railway. The development of the site may also offer further opportunity for betterment if overland flows from steeply sloping land to the south of the site could be attenuated instead of simply diverted through or around the site. This could help to reduce local flood risk, and reduce flooding incidents associated with Rudhall Brook and Chatterley Brook downstream of the site

Kings Orchard
1 Queen Street
Bristol
BS2 0HQ

wsp.com