Herefordshire Council

HEREFORD MINERALS AND WASTE STRATEGIC FLOOD RISK ASSESSMENT

Level 2

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Herefordshire Council

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Level 2

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APPENDICES

1 INTRODUCTION

1.1 OVERVIEW

1.1.1. This Herefordshire Minerals and Waste 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 strategic development sites identified by the Council in the draft Minerals and Waste Local Plan. The Level 2 SFRA will be used to inform the review of the Local Plan Core Strategy and will form part of the evidence base of the Minerals and Waste Local Plan. This Level 2 SFRA has been completed in accordance with the National Planning Policy Framework (NPPF) and the supporting Planning Practice Guidance.

1.1.2. The Herefordshire Level 1 SFRA published in April 2019 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.

1.1.3. This Level 2 SFRA applies the recommendations of the Level 1 SFRA to specific site locations and considers their vulnerability in accordance with the requirements of the Sequential and Exception Tests, subsequently providing advice on appropriate policies for each site that should be demonstrated as part of any subsequent planning application.

1.1.4. The minerals and waste strategic development sites that have been considered within this Level 2 SFRA include the sites identified in the call for sites as part of the draft Waste and Minerals Local Plan. Only those sites that are considered to be at notable flood risk have been subject to detailed assessment within this Level 2 SFRA. The sites therefore assessed in this Level 2 SFRA include:

- Holmer Road, Hereford
- Wellington Quarry and Moreton Business Park, between Wellington & Moreton-on-Lugg
- Former Lugg Bridge Quarry, Hereford
- Leominster Household Waste Site, Leominster
- Westfields Trading Estate, Hereford
- Southern Avenue, Leominster
- Land between Little Marcle Road and Ross Road, Ledbury
- Leominster Enterprise Park, Leominster
- Three Elms Trading Estate, Hereford

1.1.5. Each of the sites listed above are discussed within a location-specific appendix to this report to enable appendices to be updated independently if required.

1.1.6. Generic policy recommendations for all other sites that have not been subject to detailed assessment in this Level 2 SFRA are provided below, 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. This Level 2 SFRA has been reviewed and approved by the Environment Agency as a statutory consultee under NPPF.

1.2 DATA SOURCES

1.2.1. The Level 2 SFRA has been informed through predominantly desk-based review of the data sources summarised within the Level 1 SFRA, most notably the Environment Agency's Flood Map for Planning, Flood Risk from Surface Water mapping and Flood Risk from Reservoirs mapping. This has been supplemented by detailed hydraulic modelling of the following watercourses:

- The Environment Agency's River Wye 1D ISIS (now Flood Modeller Pro) hydraulic model prepared in 2012. Consideration has been given to updated climate change allowances within Hereford City as part of the Hereford Integrated Catchment Study (ICS)[1] completed in 2019.
- The Environment Agency's River Arrow / River Lugg 1D-2D ISIS (now Flood Modeller Pro)-TUFLOW hydraulic model prepared in 2013.
- Herefordshire Council's 1D-2D Flood Modeller Pro–Tuflow model of the Yazor Brook in Hereford, from upstream of Credenhill to its confluence with the River Wye, encompassing its downstream bifurcations of the Widemarsh and Eign Brooks. The existing model of the Yazor Brook held by Herefordshire Council was updated in 2019 to inform the Hereford ICS.
- Herefordshire Council's broadscale 2D Tuflow model of the Withy, Norton and Red Brooks to the south of Hereford prepared in 2019 to inform the Hereford ICS. The model extends approximately 3.5km upstream of each watercourse from their confluence with the River Wye.

1.2.2. The hydraulic models listed above have not yet been incorporated into the Environment Agency's Flood Map for Planning, however it is understood that this is the intention and, as such, it has been agreed that the flood extents generated for the 1 in 100 (1%) annual probability event and 1 in 1000 (0.1%) annual probability event can be used to inform the policies that would be typically applied to the Flood Map for Planning's Flood Zone 1, Flood Zone 2 and Flood Zone 3(2) extents for this Level 2 SFRA.

1.2.3. The Environment Agency's Flood Map for Planning does not illustrate the extents of the functional floodplain, Flood Zone 3b[3]. Where available, the extent of the functional floodplain has been extracted from the detailed hydraulic models listed above. Where this was not available, the indicative extent of the functional floodplain was created using the Environment Agency's national

[1] The Hereford ICS is an independent study commissioned by Herefordshire Council in 2019 that aims to improve understanding of flood risk and other water related impacts and opportunities within Hereford, providing an evidence base to inform proposed plans and policies and ensure sustainable development that manages risk and seeks to provide opportunity and betterment elsewhere.

[2] Flood Zone 1 is defined as land with an annual probability of flooding from fluvial sources of less than 1 in 1000 (0.1%). Flood Zone 2 is defined as land with an annual probability of flooding from fluvial sources of between 1 in 100 (1%) and 1 in 1000 (0.1%). Flood Zone 3 is defined as land with an annual probability of flooding from fluvial sources of greater than 1 in 100 (1%).

[3] The functional floodplain is defined as land where water has to flow or be stored in times of flood, typically representing areas that flood naturally during the 1 in 20 (5%) annual probability event or areas that are designed to flood (such as a flood attenuation scheme) in an extreme 1 in 1000 (0.1%) annual probability event. However, urban areas or areas that are located behind flood defences are not usually classified as functional floodplain.

generalised floodplain model (JFLOW) to indicate the fluvial extent of the 1 in 20 (5%) annual probability event.

1.2.4. 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 to inform site-specific assessments 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 and that these are fit for purpose.

1.3 THE SEQUENTIAL AND EXCEPTION TESTS

1.3.1. 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.

1.3.2. 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.

1.3.3. 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.

1.3.4. 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.

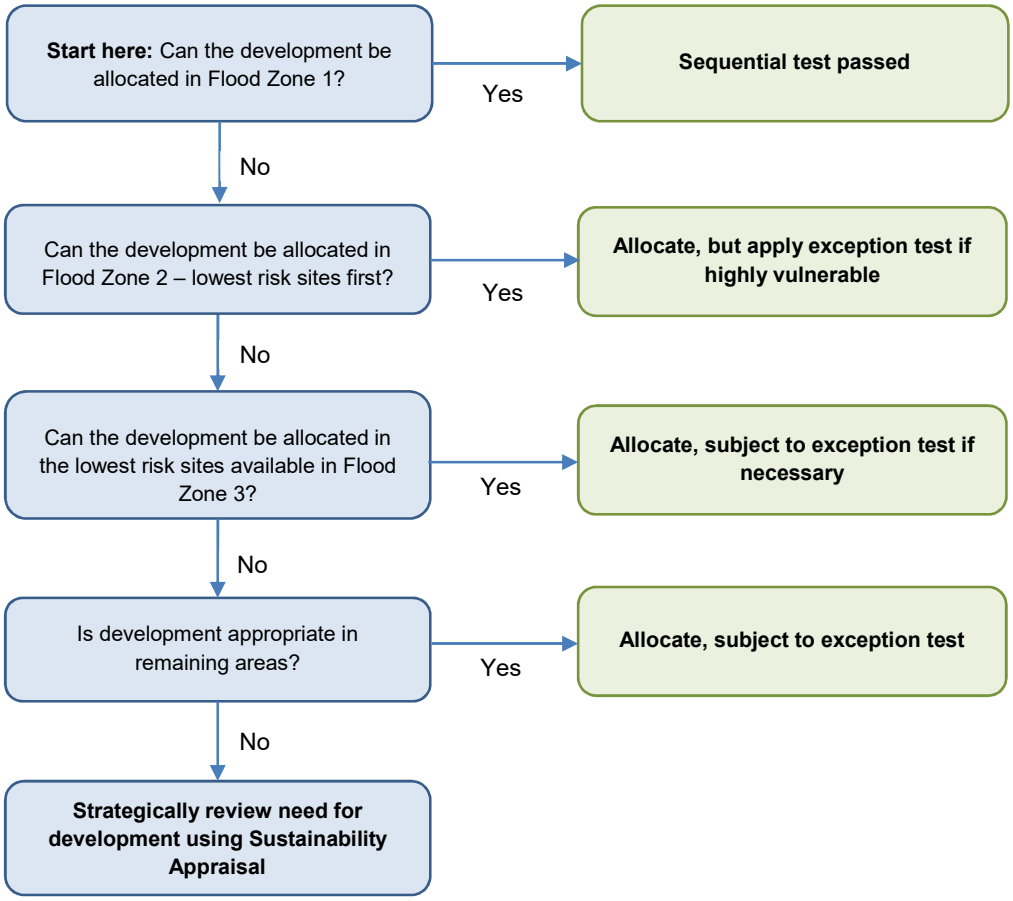

Figure 1.1 Application of the Sequential Test

1.3.5. 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.

1.3.6. 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 must be applied as appropriate. Table 3 of the NPPF Planning Practice Guidance 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

1.3.7. The proposed development of the minerals and waste sites will comprise:

- Water compatible development: Sand and gravel workings;
- Less vulnerable development: Minerals working and processing (except for sand and gravel working), waste treatment (except landfill and hazardous waste facilities), and general industry; or
- More vulnerable development: Landfill and sites used for waste management facilities for hazardous waste.

1.3.8. 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.

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

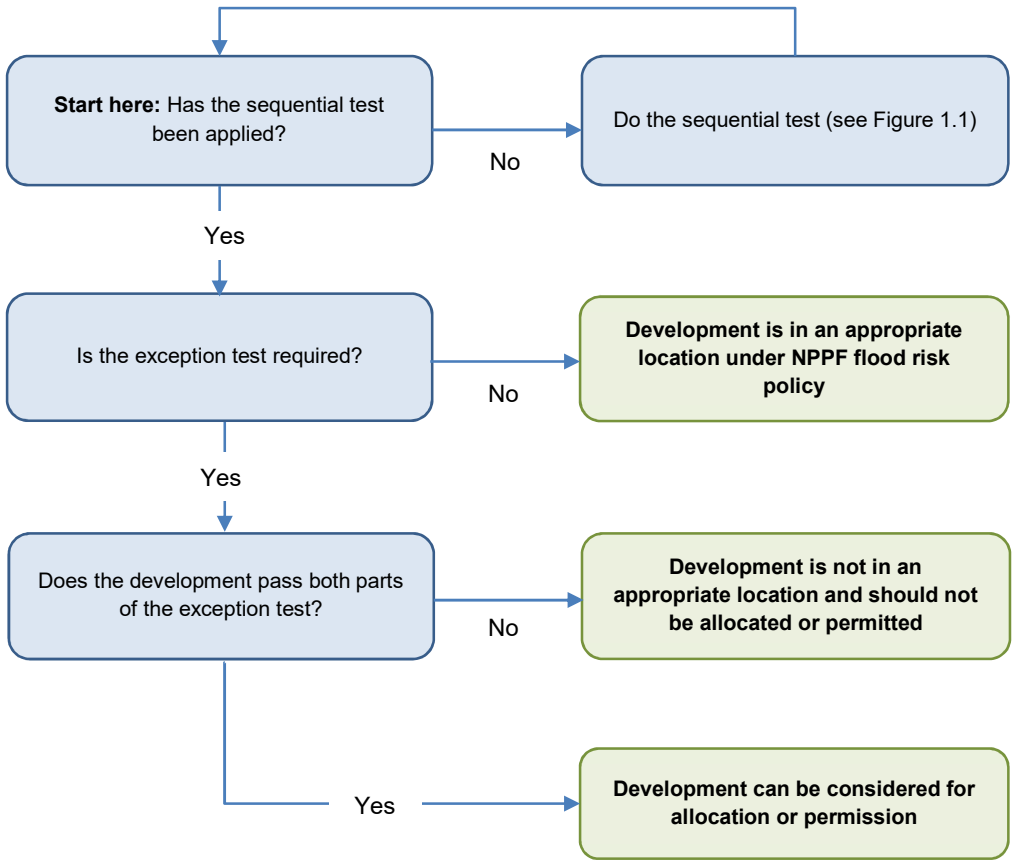

Figure 1.2 Application of the Exception Test

1.3.10. 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.

1.3.11. In accordance with the NPPF, applications for some minor development[4] and changes of use should not be subject to the Sequential or Exception Tests but should still meet the requirements for site-specific flood risk assessments (as discussed below and within each site-specific appendix) and apply a sequential approach to site layout. A change of use is generally considered to comprise a change of use to existing buildings rather than a change of use to land within the site boundary.

1.4 DEVELOPMENT CONTROL

1.4.1. 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

[4] Small non-residential extensions with a footprint of less than 250m^2

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 climate change allowances considered applicable for each of the sites discussed in the detailed assessments of this Level 2 SFRA are presented in the relevant appendices.
- 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. This includes consideration of the 'design' scenario and 'test' scenario as set out within Section 6.5 of the Level 1 SFRA. 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.

1.4.2. 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 (ha) 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 or reservoirs).

1.4.3. 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 1ha 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.

1.5 SUSTAINABLE DRAINAGE SYSTEMS

1.5.1. 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.

1.5.2. The Herefordshire Council SuDS Handbook provides detailed guidance on the expectations and use of SuDS within Herefordshire. This document, along with a useful flood risk and drainage checklist of the information that developers are expected to submit as part of their planning application, is available on the Council's website.

1.5.3. It is expected that large site allocations 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, the 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; further consideration of larger rainfall events that goes beyond consideration of just the 1 in 100 (1%) annual probability event; and the use of vegetated systems that promote infiltration, evapotranspiration and treatment even in impermeable soils.

1.6 CITY WIDE RECOMMENDATIONS

1.6.1. As discussed in Section 1.1, only those sites that are considered to be at notable flood risk have been subject to a detailed assessment within this Level 2 SFRA. The remaining sites that have been identified in the draft Minerals and Waste Local Plan and that are not considered to be at notable flood risk are listed below for reference, with discussion of any other key considerations that have been identified by Herefordshire Council. It is still important to note that these sites must consider flood risk as part of future planning applications in line with the Level 1 SFRA and generic recommendations discussed above, and that a detailed drainage strategy and (if required) site-specific flood risk assessment submitted to support the planning application.

Table 1.2 Summary of strategic minerals and waste sites not subject to detailed assessment

Site Reference	Flood Risk	Sequential and Exception Tests	Key Recommendations
Upper Lyde Quarry, nr Hereford	Site area c.7.5ha. Located in Flood Zone 1. Isolated pocket of surface water flooding within the quarry associated with depression in topography. No other significant sources of flood risk.	Site allocation passes Sequential Test and Exception Test.	Existing site. Recommended to use existing drainage systems if appropriate. If not, infiltration may be possible but onsite testing required. Surface water drainage could be a site constraint.

Site Reference	Flood Risk	Sequential and Exception Tests	Key Recommendations
Former City Spares MRS Site, Watery Lane, Hereford	Site area c. 1.06ha. Located in Flood Zone 1. Unnamed tributary of Red Brook flows along the southern and eastern site boundaries. May pose local flood risk to Watery Lane to the north of the site. No other significant sources of flood risk.	Site allocation passes Sequential Test and Exception Test.	Existing site. Recommended to use existing drainage systems if appropriate. If not, discharge to unnamed tributary of Red Brook with rate attenuated to Qbar as far as practicable.
Shobdon Quarry, nr Shobdon	Site area c. 18ha. Majority of site located in Flood Zone 1, with a small area in east located in Flood Zone 2. Surface water ponding within site boundary associated with depressions in topography and gravel pits.	Site allocation passes Sequential Test and Exception Test.	Consideration to be given to surface water ponding. Existing site. Infiltration may be possible, underlying soils are freely draining. Discharge to Pinsley Brook to the east of the site may be possible, with rate attenuated to Qbar as far as practicable.
Perton Quarry (land north west of), nr Hereford	Site area c. 3.6ha. Located in Flood Zone 1. Small pockets of surface water flooding within the quarry associated with depressions in topography. No other significant sources of flood risk.	Site allocation passes Sequential Test and Exception Test.	Consideration to be given to surface water ponding and potential springs. Existing site. Some infiltration may be possible. Alternatively discharge to the unnamed watercourse to the south of the site at an attenuated rate.
Leinthall Quarry (land west of), nr Wigmore	Site area c.8.7ha. Located in Flood Zone 1. Small pockets of surface water flooding within the quarry associated with depressions in topography. No other significant sources of flood risk.	Site allocation passes Sequential Test and Exception Test.	Consideration to be given to surface water ponding and potential springs. Existing site. Some infiltration may be possible. Alternatively discharge to the unnamed watercourse to the south of the site at an attenuated rate. Crossing of third party land may be required.
Westonhill Wood Delves, nr Bredwardine	Site area c.73ha. Located in Flood Zone 1. Number of overland flow paths due to the steepness of topography. No other significant sources of flood risk.	Site allocation passes the Sequential Test and Exception Test.	Consideration to be given to overland flow paths. Existing site. Some infiltration may be possible. Alternatively discharge to the unnamed watercourse along the northern site boundary.

Site Reference	Flood Risk	Sequential and Exception Tests	Key Recommendations
Black Hill Delve, nr Hay-on-Wye	Site area c.1.38ha. Located in Flood Zone 1. No other significant sources of flood risk.	Site allocation passes Sequential Test and Exception Test.	Existing site. Infiltration unlikely. Discharge to small unnamed tributaries to the north-west or south of the site.
Model Farm, Ross-on-Wye	Site area c.10.4ha. Located in Flood Zone 1. Unnamed watercourse flows through site. Surface water flood risk associated with ponds and site topography.	Site allocation passes Sequential Test and Exception Test.	Consideration to be given to watercourse and overland flow routes that pass through site with development set back / raised to mitigate flood risks. Greenfield site. Infiltration may be possible although restricted by presence of SPZ. Discharge into unnamed watercourse viable although crossing third party land may be required. FRA submitted for application 173600 details that discharge will be attenuated prior to discharge to culverted watercourse underneath the railway to the north-west of the site.
Kington Household Waste Recovery Centre, Kington	Site area c.0.85ha. Located in Flood Zone 1. No other significant sources of flood risk.	Site allocation passes Sequential Test and Exception Test.	Existing site. Application NW090875/N states that surface water discharge will be attenuated below ground and discharged to adjacent watercourse to the east of the site. Site located within SPZ so consideration of contamination risks required.
Ledbury Household Waste Recovery Centre, Ledbury	Site area c.0.3ha. Located in Flood Zone 1. High risk of flooding from surface water flooding due to site topography. No other significant sources of flood risk.	Site allocation passes Sequential Test and Exception Test.	Consideration to be given to surface water ponding and overland flow routes. Existing site. Some infiltration may be possible. Alternatively discharge to the River Leadon to the south-west of the site at an attenuated rate. Crossing of third party land may be required.

Site Reference	Flood Risk	Sequential and Exception Tests	Key Recommendations
Llandraw Delve, nr Michaelchurch Escley	Site area c.0.61ha. Located in Flood Zone 1. Unnamed tributary of the River Monnow flows immediately adjacent to the site. No other significant sources of flood risk.	Site allocation passes Sequential Test and Exception Test.	Consideration to be given to potential springs. Existing site. Some infiltration may be possible. Alternatively direct discharge to the unnamed watercourse at an attenuated rate.
Rotherwas Industrial Estate, Hereford	Predominantly Flood Zone 2 with some areas located in Flood Zone 3. West of site located within area at risk of flooding from reservoirs. Isolated pockets of surface water flooding.	Existing site that forms part of the Hereford Enterprise Zone Local Development Order (LDO). Site-wide flood risk strategy developed that included fluvial flood compensation to facilitate development. Further development within site boundary passes Sequential Test and Exception Test, assuming compliance with LDO policies.	Site-specific assessments required to demonstrate compliance with LDO polices. Development requirements set out within the Drainage and Flood Management Strategy (September 2009 and (draft) September 2019). Includes requirements for building floor levels and recommendations for surface water management.

1.7 DETAILED ASSESSMENT SUMMARY

Detailed assessments of the selected strategic minerals and waste sites considered within this 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 draft Minerals and Waste Local Plan, noting that a sequential approach may still need to be applied to steer development to areas at lowest flood risk.

Where flood risks have been identified and the Exception Test is required, it is likely that this can be best managed through the appropriate location of more vulnerable development in areas at lower flood risk and, where required, there are feasible mitigation measures that can be implemented to manage these risks without increasing flood risk elsewhere.

A brief overview of the key requirements for future development is provided below.

Table 1.3 Summary of strategic minerals and waste sites subject to detailed assessment in this Level 2 SFRA

Site	Flood Risk	Sequential and Exception Tests	Key Recommendations
Holmer Road, Hereford	Site area c. 1.03ha. Site located in Flood Zones 1, 2 and 3a attributable to Ayles Brook. Flood extents highly indicative. Ayles Brook flows through a culvert immediately to the north of the site. High surface water flood risk (most likely attributable to Ayles Brook) within access road adjacent to north of the site.	Sequential Test required for development that does not comprise change of use of existing buildings. Recommend Sequential Test passed for redevelopment of brownfield site. Exception Test required for more vulnerable development, although hydraulic modelling likely to show site at lower risk of flooding than currently indicated therefore more vulnerable development may be acceptable.	Site-specific FRA required to address flood risk to the site and potential increase in flood risk elsewhere. Flood risk from fluvial and surface water sources will influence site development. Detailed hydraulic modelling of Ayles Brook likely to be required for more vulnerable development and may be required for less vulnerable development if ground raising proposed / development is vulnerable to flooding. Shallow infiltration may be possible. Alternatively attenuated discharge to Ayles Brook or discharge to DCWW surface water network are viable.
Wellington Quarry and Moreton Business Park, Wellington & Moreton-on-Lugg	Combined site area c. 308ha. Significant areas located in Flood Zone 3a and 3b attributable to the River Lugg and unnamed watercourse to south. Flood extents highly indicative. Wellington Brook flows through the site. Significant surface water flood risk in Moreton Business Park.	Sequential Test required for development in Flood Zones 2 and 3 that does not comprise change of use of existing buildings or expansion to existing quarry workings or provision of a minerals working and processing site that closely align with site's current use. Only water compatible development considered acceptable in Flood Zone 3b. Exception test required for more vulnerable development in Flood Zone 3a.	Site-specific FRA required to address flood risk to the site and potential increase in flood risk elsewhere. Flood risk from fluvial sources will influence site development. Detailed hydraulic modelling of River Lugg and ordinary watercourse to south likely to be required for more vulnerable development and may be required for less vulnerable development if ground raising proposed / development is vulnerable to flooding. Attenuated discharge to Wellington Brook and ordinary watercourse to south promoted. Site located close to River Lugg SAC and SSSI therefore robust treatment important.

Site	Flood Risk	Sequential and Exception Tests	Key Recommendations
Former Lugg Bridge Quarry, nr Hereford	Site area c. 3.13ha. Site located in Flood Zones 1 and 2 attributable to the River Lugg. Flood extents highly indicative and more of site likely to be in Flood Zone 2 than currently indicated. Site surrounded by Flood Zone 3 and is a 'dry island'. Site likely to be at risk during the 1 in 100 (1%) annual probability event with climate change considered.	Sequential Test required for major extension to existing site or change of use to demonstrate no other suitable sites at a lower risk of flooding (including risks of 'dry island'. Exception Test required for more vulnerable development in Flood Zone 3a, however site not recommended for use by more vulnerable development unless detailed hydraulic modelling demonstrates low risk.	Site-specific FRA required to address flood risk to the site and potential increase in flood risk elsewhere. Flood risk from fluvial sources will influence site development. Detailed hydraulic modelling of River Lugg required for more vulnerable development, and may be required for less vulnerable development if ground raising proposed / development is vulnerable to flooding. Safe access and egress must be demonstrated. Shallow infiltration may be possible. Alternatively attenuated discharge to Little Lugg is viable. Site located close to River Lugg SAC and SSSI therefore robust treatment important.
Leominster Household Waste, Leominster	Site area c. 1.08ha. Detailed modelling of River Lugg indicates site located in Flood Zone 1. Site not at significant risk from other sources.	Sequential Test passed as development is located in Flood Zone 1. Exception Test not applicable.	Site-specific FRA required with focus on management of surface water runoff and maintaining threshold levels above extreme flood levels. Attenuated discharge to River Lugg or Kenwater at attenuated rate is viable. Site located close to River Lugg SSSI therefore robust treatment important.

Site	Flood Risk	Sequential and Exception Tests	Key Recommendations
Westfields Trading Estate, Hereford	Site area c. 45.6ha. Majority of site located in Flood Zone 1. North-east of site may be located in Flood Zone 2 attributable to Ayles Brook although flood extents highly indicative. Yazor and Widemarsh Brooks flow through centre of site. Centre of site at risk of fluvial flooding from Yazor and Widemarsh Brooks if blockage of Yazor Brook FAS occurs. Site not at significant risk from other sources.	Major of site located in Flood Zone 1 and recommended to pass the Sequential Test. Exception test required for more vulnerable development in Flood Zone 3a although majority of land removed from Flood Zone 3a when operation of FAS considered.	Site-specific FRA required to address flood risk to the site and potential increase in flood risk elsewhere. Flood risk from fluvial and surface water sources will influence site development in centre and north-east of site. Detailed hydraulic modelling of Ayles Brook likely to be required for more vulnerable development in north-east of site and may be required for less vulnerable development if ground raising proposed / development is vulnerable to flooding. Shallow infiltration may be possible. Alternatively attenuated discharge to Yazor/Widemarsh Brooks or discharge to DCWW surface water network are viable.
Southern Avenue, Leominster	Site area c. 33.6ha. Significant area of site located in Flood Zone 2 attributable to River Lugg and Arrow. Large number of historic flood records attributable to flooding from sewerage network.	Sequential Test required to demonstrate no other suitable sites at a lower risk of flooding, however given brownfield nature of site recommend that Sequential Test passed. Exception Test not required, however recommend that more vulnerable development is steered to areas at lowest risk (i.e. towards Flood Zone 1).	Site-specific FRA required to address flood risk to the site and potential increase in flood risk elsewhere. Flood risk from fluvial sources will influence site development in areas of Flood Zone 2. Detailed hydraulic modelling of River Lugg likely to be required for more vulnerable development in Flood Zone 2 and may be required for less vulnerable development if ground raising proposed / development is vulnerable to flooding. Shallow infiltration may be possible although presence of SPZ will limit viability. Alternatively attenuated discharge to unnamed watercourse that flows through/to south of site or existing surface water network are viable. Site located close to River Lugg SSSI therefore robust treatment important

Site	Flood Risk	Sequential and Exception Tests	Key Recommendations
Land between Little Marcle Road and Ross Road, Ledbury	Site area c. 11.2ha. Site located in Flood Zones 1, 2 and 3 attributable to the River Leadon adjacent to east of site. Flood extents highly indicative. Ordinary watercourse flows through north of site and poses surface water / fluvial flood risk.	Sequential Test passed if all development located in Flood Zone 1. No development recommended in Flood Zone 3.	Site-specific FRA required to address flood risk to the site and potential increase in flood risk elsewhere. Flood risk from fluvial sources will influence site development. Detailed hydraulic modelling of River Leadon required for all development within and adjacent to fluvial flood extents. Hydraulic modelling of watercourse in north of site may be required if development proposed in close proximity. Infiltration unlikely to be viable. Attenuated discharge to River Leadon is viable.
Leominster Enterprise Park, Leominster	Site area c. 16.9ha. North-east of site located in Flood Zone 2 attributable to River Lugg and Arrow. Minor area of Flood Zone 3 within south-east of site although at location of drainage basins. Number of historic flood records attributable to flooding from sewerage network to north of site. Site not at significant risk from other sources.	Recommend Sequential Test passed as majority of site located in Flood Zone 1. Exception Test not required, however recommend that more vulnerable development is steered to areas at lowest risk (i.e. towards Flood Zone 1).	Site-specific FRA required to address flood risk to the site and potential increase in flood risk elsewhere. Flood risk from fluvial sources will influence site development in areas of Flood Zone 2. Detailed hydraulic modelling of River Lugg likely to be required for more vulnerable development in Flood Zone 2 and may be required for less vulnerable development if ground raising proposed / development is vulnerable to flooding. Shallow infiltration may be possible. Alternatively attenuated discharge to existing drainage system or unnamed watercourse that flows to east of site is viable. Site located close to River Lugg SSSI therefore robust treatment important
Three Elms Trading Estate, Hereford	Site area c. 2.77ha. Site located in Flood Zone 1. Site at significant risk from surface water overland flow path through centre of site.	Sequential Test passed as development located in Flood Zone 1. Exception Test not applicable.	Site-specific FRA required with focus on management of surface water flow path through centre of site and site-generated surface water runoff. Shallow infiltration may be possible. Alternatively attenuated discharge to DCWW network is viable.

Appendix A

HOLMER ROAD, HEREFORD

HOLMER ROAD, HEREFORD

Allocation Reference:	Holmer Road
Location:	Hereford
River Catchment:	Ayles Brook
NPPF Flood Zone (majority of area):	Flood Zone 2
NPPF Flood Zone (worst case):	Flood Zone 3a

INTRODUCTION

The Holmer Road site occupies an area of approximately 1.03ha and is located adjacent to the Hereford Racecourse in the north of Hereford as illustrated in Figure A.1. The site currently comprises an industrial estate and is allocated within Policy HD7 (Hereford employment provision) within the Core Strategy of the Herefordshire Local Plan as land for employment. The site is bound by the A49 Holmer Road to the east, a school to the north, Hereford Racecourse to the west and residential dwellings to the south. It is understood that the site is being considered for waste management activities.

The Ayles Brook flows in culvert immediately to the north of the site and may flow beneath the site boundary. The Ayles Brook is a relatively small watercourse that originates approximately 2.3km upstream of the site adjacent to the A49 to the north of Hereford. The watercourse has as approximate catchment area of 3km². The Ayles Brook flows in a general southerly direction beneath Roman Road and enters a culvert underneath Hereford Racecourse. The watercourse re-emerges into open channel shortly before it enters another culvert at Mortimer Road to the east of the strategic development site. The Ayles Brook confluences with Widemarsh Brook as it passes underneath Widemarsh Street. The Widemarsh Brook (a downstream bifurcation of the Yazor Brook) flows in a west to east direction approximately 600m to the south of the strategic development site. The Ayles Brook, Yazor Brook and Widemarsh Brook are classified as ordinary watercourses and are therefore under the jurisdiction of Herefordshire Council as Lead Local Flood Authority (LLFA).

Topography within the Holmer Road site is relatively flat with a gentle slope from the north-west to the south-east. Ground levels in the north-west of the site are approximately 56.4mAOD and in the south-east of the site are approximately 56.1mAOD.

DESCRIPTION OF FLOOD RISK

FLUVIAL

Review of the Environment Agency's Flood Map for Planning indicates that the Holmer Road site is partially located within the high risk Flood Zone 3, medium risk Flood Zone 2 and low risk Flood Zone 1. Land within Flood Zone 3 is defined as having greater than a 1 in 100 (1%) annual probability of flooding from fluvial sources; land within Flood Zone 2 is defined as having between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of flooding from fluvial sources; and land within

Flood Zone 1 is defined as having less than a 1 in 1000 (0.1%) annual probability of flooding from fluvial sources. The mapped fluvial flood extents are illustrated in Figure A.2 noting that this map 'stitches' together detailed hydraulic modelling of the Widemarsh Brook and broadscale modelling of the Ayles Brook (discussed further below).

The assessment of fluvial flood risk attributable to the Widemarsh Brook has been informed by the 1D-2D FMP-Tuflow hydraulic model of the Yazor Brook and its downstream bifurcations that was updated to support the Hereford ICS as discussed in Section 1.2 of the Minerals and Waste Level 2 SFRA. This modelling indicates that the Holmer Road site is not at risk of fluvial flooding from the Widemarsh Brook.

The source of the mapped fluvial flood risk is therefore deemed to be associated with the Ayles Brook. The detailed hydraulic model of the Widemarsh Brook (discussed above) incorporates inflows received from the Ayles Brook at Widemarsh Street but does not include detailed modelling of the Ayles Brook. The mapped flood extents attributable to the Ayles Brook are therefore based only on broadscale JFLOW modelling that has informed the Environment Agency's Flood Map for Planning. The mapped flood extents are therefore highly indicative and may be overestimated if the JFLOW modelling does not appropriately represent the existing culverts. However, it is likely that flooding from the Ayles Brook could occur when the capacity of the watercourse's culverts are exceeded (or become blocked) and flooding enters the Holmer Road site as overland flow.

Generalised modelling of the Flood Zone 3b functional floodplain has been undertaken by the Environment Agency and indicates that the Flood Zone 3b functional floodplain does not extend to within the site boundary. It should be noted that this is also based on broadscale JFLOW modelling and is also therefore highly indicative. The Flood Zone 3b functional floodplain is defined as land where water has to flow or be stored in times of flood, typically represented by areas that flood naturally during the 1 in 20 (5%) annual probability event. Land immediately to the north and north-west of the site is indicated to be located within Flood Zone 3b, although in accordance with the Herefordshire Council Level 1 SFRA urban or defended areas (i.e. such as the school to the north) would not be classified as functional floodplain (although would still be at risk during the 1 in 20 (5%) annual probability event). The mapped Flood Zone 3b extents are illustrated in Figure A.3.

Consideration has been given to the potential effects of climate change. As no detailed hydraulic modelling of Ayles Brook is available or LiDAR data that accurately represents the land terrain, a qualitative approach has been applied that assumes the future 1 in 100 (1%) annual probability event with 70% climate change allowance would be similar to the current Flood Zone 2 – i.e. the current 1 in 1000 (0.1%) annual probability event. This would mean a greater proportion of the site would be located within the high risk Flood Zone 3. This approach is further supported by review of the peak flow estimates for the Ayles Brook that were derived as part of the detailed hydraulic model of the Widemarsh Brook (discussed above). The 1 in 1000 (0.1%) peak flow estimate is approximately 70% greater than the 1 in 100 (1%) peak flow estimate, supporting the approach adopted for this assessment.

Flood hazard mapping has not been prepared as there is no detailed modelling of the Ayles Brook, however an indicative flood hazard has been estimated from the Environment Agency's Flood Risk from Surface Water mapping. This suggests flood depths of less than 300mm within the site boundary and in the access road adjacent to the south of the site during the 1 in 1000 (0.1%) annual probability event with a corresponding flow velocity of less than 0.25m/s. The indicative flood hazard within the site and access road adjacent to the south is therefore indicated to be Very Low (Caution).

The mapping suggests a greater risk in the access road adjacent to the north of the site, with flood depths of up to 900mm during the 1 in 1000 (0.1%) and 1 in 100 (1%) annual probability events, with a corresponding flow velocity of less than 0.25m/s. The indicative flood hazard in the access road adjacent to the north could therefore be Moderate (Dangerous for Some).

SURFACE WATER AND MINOR WATERCOURSES

The Environment Agency's Risk of Flooding from Surface Water mapping indicates that the majority of the Holmer Road site is at a low risk of flooding from surface water. However, as discussed above the access road adjacent to the north of the site is indicated to have a high risk of flooding from surface water, with flood depths of up to 900mm during the 1 in 1000 (0.1%) and 1 in 100 (1%) annual probability events. Mapped surface water flood extents are reproduced in Figure A.4.

The access road adjacent to the north of the site is located on the approximate alignment of the Ayles Brook that is culverted beneath the road. It is unknown how accurately the Environment Agency's Risk of Flooding from Surface Water mapping takes the culvert of the Ayles Brook into account, however it is considered likely that the mapped surface water flood extents are largely attributable to the fluvial flooding of the Ayles Brook as discussed in the fluvial flood risk section above.

GROUNDWATER

Review of British Geological Survey (BGS) data indicates that the Holmer Road site is underlain by Raglan Mudstone Formation comprising siltstone and mudstone bedrock geology. Superficial deposits comprise glaciofluvial sheet deposits of sand and gravel.

Review of historic borehole logs available through the BGS indicate that groundwater was struck between 2.5m and 4.5m below ground level approximately 100m to the east and south-east of the site. Groundwater emergence is considered unlikely to occur, although could pose risk to below ground drainage systems and structures.

OTHER SOURCES OF FLOOD RISK

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

Review of the Dwr Cymru Welsh Water One Year and 50 Year Headroom datasets indicate a high risk of flooding from combined and surface water sewers along Holmer Road located to the east of the site, and within the access road to the south of the site.

HISTORIC FLOOD RECORDS

Review of Herefordshire Council and Dwr Cymru Welsh Water flood records at the time of preparing this report indicate flooding reported to the primary school located to the north of the site. Records indicate flooding occurred during 2007 and 2012 with the source of flooding stated to be attributed to storm sewers. Flood water is described as entering the building from the adjacent racecourse and flooding up to the level of the skirting boards. There is also a flood record from 2007 at Hereford Racecourse to the west of the site that was attributed to storm sewers.

PLANNING RECOMMENDATIONS

SPATIAL PLANNING AND DEVELOPMENT CONTROL

Development within the Holmer Road 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. Two scenarios are being considered for development within the site: 1) waste management facilities for non-hazardous waste that would be classified as less vulnerable development; and 2) waste management facilities for hazardous waste that would be classified as more vulnerable development.

The greatest source of flood risk to the site is associated with the Ayles Brook. The site is partially located within the high risk Flood Zone 3, medium risk Flood Zone 2 and low risk Flood Zone 1. However, when the potential effects of climate change are considered the majority of the site may be at risk during the 1 in 100 (1%) annual probability event. It is recognised however that the fluvial flood maps are based only on broadscale JFLOW modelling and the mapped flood extents are therefore highly indicative.

The Sequential Test may be applicable to the development of the Holmer Road site. The site is currently an industrial estate and it is not yet known if redevelopment of the site would comprise repurposing of existing buildings (and therefore comprise a change of use that would be exempt from the Sequential Test) or if redevelopment of the site would comprise the demolition and reconstruction of facilities within the site boundary (in which case the Sequential Test would apply). If the latter, the Council must consider the availability and suitability of other sites that are at lower risk of flooding prior to the promotion of the Holmer Road site. However, it is recommended that redevelopment of this site would pass the Sequential Test given the existing brownfield nature of the site and if the vulnerability of the site is not increased. Improved hydraulic modelling of the Ayles Brook may also demonstrate that the site is at lower risk of flooding than currently indicated as updated modelling would provide improved representation of the existing culvert beneath the site.

Regarding the application of the Exception Test, less vulnerable development (i.e. waste management facilities for non-hazardous waste) would be considered acceptable within Flood Zone 2 and 3 and the Exception Test would not be required. However, more vulnerable development (i.e. waste management facilities for hazardous waste) located in Flood Zone 3 would be required to pass the Exception Test. It is therefore considered unadvisable to allocate more vulnerable development to the Holmer Road site unless detailed modelling is undertaken that demonstrates that the site is at lower risk than is currently indicated.

To meet the requirements of the Exception Test, the applicant would need to:

- Demonstrate that the development provides wider sustainability benefits to the community that outweigh flood risk; and
- 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.

For any development located in areas at flood risk (and allowing for climate change) the following points must be achieved:

- Within the site the most vulnerable development is located in areas of lowest flood risk.
- The development is appropriately flood resistant and resilient.
- The development incorporates SUDS where appropriate.

- Demonstration that any residual risks can be safely managed.
- Safe access and egress is provided, where appropriate as part of an agreed emergency plan.

A site-specific Flood Risk Assessment (FRA) prepared in accordance with the NPPF and supporting Planning Practice Guidance will be required. The FRA should address the points listed above and include an assessment of flood risk associated with the Ayles Brook (including climate change allowances), risks in the event of partial or full culvert blockage, the risk associated with surface water or sewerage overland flows, and increased risk associated with an increase in the rate or volume of site-generated surface water runoff. The FRA should also demonstrate safe access and egress is achievable with reference made to DEFRA's Hazard risk guidance (FD2320)[5] and specifically Table 13.1 in terms of depth and velocity.

MANAGEMENT OF FLUVIAL FLOOD RISKS

Further assessment will be required as part of the site-specific FRA to better determine the likely risk of flooding to the Holmer Road site. In accordance with the recommendations set out in Section 6.5 of the Level 1 SFRA, if the site is intended to be used for hazardous waste (classified as more vulnerable) the assessment would need to be informed by detailed hydraulic modelling of the Ayles Brook to determine flood extents and hazard for a range of return period events and allowing for climate change effects. If the site is proposed to be used for non-hazardous waste (classified as less vulnerable) and no changes are proposed to existing building footprints or ground levels then a qualitative assessment may be appropriate depending on the nature and scale of the development. However, if full redevelopment of the site is proposed it is recommended that detailed hydraulic modelling of the Ayles Brook is also undertaken to inform a less vulnerable development use.

A qualitative assessment could be informed through review of the existing JFLOW model extents to determine an indicative flood level and an appropriate increase in flood depth applied to account for potential climate change effects, noting a 200mm increase is considered appropriate for the 25% scenario and a 500mm increase considered appropriate for the 70% scenario. For a qualitative assessment to be considered appropriate, the applicant would need to demonstrate that flooding of the site would not be detrimental to the operation of the site or pose significant risk to water quality; as well as demonstrate that the development would not increase flood risk elsewhere through changes to ground or plot levels or changes to flow conveyance through the site. If it is not possible to demonstrate compliance with these requirements via a qualitative assessment, detailed hydraulic modelling of the Ayles Brook would be required.

Finished floor levels of any new buildings or vulnerable areas of the development (such as areas that could cause pollution risk) should be raised a minimum of 600mm above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'design event'. Finished floor levels should also be located above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'test event'. Recommended climate change allowances for the design event and test event are summarised below in Table A.1.

[5] Flood Risk Assessment Guidance for New Development (2005) DEFRA

Table A.1 Climate change allowances

Development Classification	Design scenario	Test scenario
Non-hazardous waste (less vulnerable)	1 in 100 annual probability event with 25%CC	1 in 100 annual probability event with 35%CC or 1 in 1000 annual probability event, whichever is higher
Hazardous waste (more vulnerable)	1 in 100 annual probability event with 35%	1 in 100 annual probability event with 70%CC or 1 in 1000 annual probability event, whichever is higher

The development must not increase flood risk elsewhere. Given the urban setting of this site it is recommended that there should be no increase in flood risk up to the 1 in 100 (1%) annual probability event with 70% climate change allowance or the 1 in 1000 (0.1%) annual probability event.

Any redevelopment should be designed so that no new buildings are located along the alignment of the culverted Ayles Brook.

The site offers little opportunity for betterment elsewhere due to the small size of the site; however, it is recommended that opportunities to reinstate the Ayles Brook to a natural watercourse are explored.

MANAGEMENT OF SURFACE WATER AND OVERLAND FLOW

As discussed above, the Holmer Road site is likely to be at risk of flooding from surface water and, potentially, surrounding sewerage systems. However, much of the surface water flood risk is likely to be attributable to fluvial flooding from the Ayles Brook and therefore the measures recommended above will assist with mitigating this risk. The management of other sources of overland flow is recommended to comprise raising of building threshold levels and consideration of flow routes through the site, ensuring that overland flows are not deflected towards third parties.

Overland flows must also be considered in the design of the development's proposed drainage system to ensure overland flows do not discharge to the drainage system and reduce system capacity.

MANAGEMENT OF SITE GENERATED SURFACE WATER RUNOFF

The management of surface water runoff is important for the Holmer Road minerals and waste strategic development site given downstream flood risks associated with Widemarsh Brook and potential capacity issues in the adjacent Dwr Cymru Welsh Water sewerage network. 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, where appropriate;
- 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.

It is assumed that the existing site discharges to the Dwr Cymru Welsh Water sewer network or directly to the Ayles Brook, most likely at an unattenuated rate. Development of the site may therefore provide opportunity to reduce the rate and volume of discharge as well as provide treatment.

Review of the National Soil Resources Institute Soilscapes mapping indicates that the soils beneath the site are freely draining. As discussed above groundwater levels are likely to be between approximately 2.5m and 4.5m below ground level. Shallow infiltration of runoff may therefore be viable (for example via permeable paving) although the site's previous/existing uses may pose increased contamination risks. Onsite testing will be required to determine soil permeability, depth to the groundwater table (including potential for rising groundwater) and contamination risks. If onsite testing concludes lower permeability soils, combined attenuation and infiltration features should be promoted where groundwater levels and contamination risks permit to reduce runoff during small rainfall events and provide treatment.

If infiltration is not viable, consideration should be given to the discharge of runoff to the Ayles Brook. Discharge should be attenuated to equivalent greenfield rates and volumes as far as practicable, with a minimum 20% betterment over existing rates expected. If discharge to the Ayles Brook is not viable, discharge to the existing Dwr Cymru Welsh Water surface water sewer in Holmer Road to the east of the site is expected. The required discharge rate would need to be agreed with Dwr Cymru Welsh Water although it is recommended that a maximum discharge rate of 5 l/s is applied to assist with reducing flood risk elsewhere whilst not introducing unacceptable risk in the event of blockage.

Providing robust treatment of runoff will be important (particularly if the site is proposed to be used for hazardous waste) to prevent adverse effect to the quality of the Ayles Brook and downstream watercourses and assist in achieving the objectives of the Water Framework Directive.

MANAGEMENT OF FOUL WATER

Existing Dwr Cymru Welsh Water foul water sewers are located to the east of the site along Holmer Road. Discharge to this network should be agreed in consultation with Dwr Cymru Welsh Water.

Appendix B

WELLINGTON QUARRY AND MORETON BUSINESS PARK, WELLINGTON & MORETON-ON-LUGG

WELLINGTON QUARRY AND MORETON BUSINESS PARK, WELLINGTON & MORETON-ON-LUGG

Allocation Reference:	Wellington Quarry and Moreton Business Park
Location:	Wellington & Moreton-on-Lugg
River Catchment:	River Lugg
NPPF Flood Zone (majority of area):	Flood Zone 3
NPPF Flood Zone (worst case):	Flood Zone 3b

INTRODUCTION

The Wellington Quarry and Moreton Business Park sites occupy a total area of approximately 308ha. The sites are located immediately adjacent to one another and have therefore been considered in the same assessment, although site-specific recommendations are made where appropriate. The two sites are located in Wellington, approximately 6km to the north of Hereford as illustrated in Figure B.1. The existing sites currently comprise an industrial estate, an active sand and gravel quarry, and agricultural land. The village of Moreton on Lugg is located immediately south of both sites. The Wellington Quarry and Moreton Business Park sites are allocated within Policy HD7 (Hereford employment provision) within the Core Strategy of the Herefordshire Local Plan as land for employment.

The River Lugg flows in a general north-south direction along the northern and eastern boundaries of the Wellington Quarry site, before discharging into the River Wye approximately 14km downstream. The River Lugg is classified as a main river and is therefore under the jurisdiction of the Environment Agency.

Wellington Brook flows in a west-east direction through the Wellington Quarry site and discharges into the River Lugg at the site's eastern boundary. Wellington Brook is classified as an ordinary watercourse and is therefore under the jurisdiction of Herefordshire Council as Lead Local Flood Authority (LLFA).

A number of smaller unnamed ordinary watercourses and drains flow through both sites and discharge to Wellington Brook and the River Lugg. Both sites support active sand and gravel extraction with several quarry pits filled with water.

Topography within the sites slopes gently from the north to the south. Ground levels in the north are approximately 59mAOD and in the south are approximately 53mAOD. The Hereford to Shrewsbury railway line passes through the east of the Wellington Quarry site.

At the time of preparing this assessment the following major development application has been made within the Wellington Quarry site boundary:

- Application for the proposed southern extension and consolidation of existing planning permissions (reference P193618/M awaiting determination).

DESCRIPTION OF FLOOD RISK

FLUVIAL

Review of the Environment Agency's Flood Map for Planning indicates that the majority of the Wellington Quarry site 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%), and medium risk Flood Zone 2 where the annual probability of flooding from fluvial sources is between 1 in 100 (1%) and 1 in 1000 (0.1%). The majority of the Moreton Business Park 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%), although the south of this site is located in the high risk Flood Zone 3 attributable to the ordinary watercourse that flows along the site boundary. The mapped fluvial flood extents are illustrated in Figure B.2.

There is currently no detailed hydraulic modelling of the section of the River Lugg adjacent to the Wellington Quarry and Moreton Business Park sites. The Environment Agency's detailed 1D-2D hydraulic model of the River Lugg does not extend as far south as Wellington. The available fluvial mapping of this section of the River Lugg is therefore informed by broadscale JFLOW modelling. This mapping is highly indicative and does not explicitly account for the profile and capacity of existing channels. The LiDAR topographic data within this area is also based on a 2m grid which will contribute to the uncertainty of the model results. These uncertainties must be taken into account when reviewing the current mapped extents. Review of indicative flood extents against LiDAR data within the site indicates a likely 1 in 100 (1%) annual probability flood level of between 57.1 – 57.3mAOD in the northern half of the Wellington Quarry site; 54.2 – 54.6 mAOD in the south of the Wellington Quarry site; and 56.4 – 56.6 mAOD in the south of the Moreton Business Park site.

Generalised modelling of the Flood Zone 3b functional floodplain has been undertaken by the Environment Agency and indicates that the majority of the mapped Flood Zone 3 within the northern section of the Wellington Quarry site would be classified as Flood Zone 3b. Land within the south of both the Wellington Quarry and Moreton Business Park sites is also classified as Flood Zone 3b associated with the ordinary watercourse that flows adjacent to the southern site boundaries. It should be noted that this is also based on broadscale JFLOW modelling and is also therefore highly indicative. The Flood Zone 3b functional floodplain is defined as land where water has to flow or be stored in times of flood, typically represented by areas that flood naturally during the 1 in 20 (5%) annual probability event. The mapped functional floodplain extents are illustrated in Figure B.3.

Consideration has been given to the potential effects of climate change. As no detailed hydraulic modelling of the River Lugg is available at this location or LiDAR data that accurately represents the land terrain, a qualitative approach has been applied that assumes the future 1 in 100 (1%) annual probability event with 70% climate change allowance would be similar to the current Flood Zone 2 – i.e. the current extent of the 1 in 1000 (0.1%) annual probability event. This approach is further supported by review of the peak flow estimates for the River Lugg upstream of the site (extracted from the upstream detailed 1D-2D model of the River Arrow / River Lugg). The 1 in 1000 (0.1%) peak flow estimate is approximately 70% greater than the 1 in 100 (1%) peak flow estimate, supporting the approach adopted for this assessment. The Environment Agency's Flood Map for Planning indicates that the fluvial flood extents for the current Flood Zone 2 and Flood Zone 3 are broadly similar therefore the increase in flood extent associated with climate change would be

relatively minor given the size of the sites (albeit to a slightly greater depth). However, as discussed above the results of the JFLOW modelling are highly indicative.

Flood hazard mapping has not been prepared as there is no detailed modelling of the River Lugg at this location, however this is likely to be an important consideration for future site development, particularly for site access and egress.

SURFACE WATER AND MINOR WATERCOURSES

The Environment Agency's Risk of Flooding from Surface Water map indicates that the Wellington Quarry and Moreton Business Park sites are generally at a very low risk of flooding from surface water. Mapped surface water flood extents are reproduced in Figure B.4.

The majority of the mapped surface water flood risk, particularly in the south of both the Wellington Quarry and Moreton Business Park sites, is associated with fluvial flooding from watercourses and drains that flow through and adjacent to the sites.

The Environment Agency's Risk of Flooding from Surface Water map does however indicate an extensive low to medium risk of flooding in the north of the Moreton Business Park site that is indicated to be located in the low risk fluvial Flood Zone 1. A number of drains flow through this area and water is likely to pond behind the railway line that forms the eastern boundary of the site at this location.

GROUNDWATER

Review of British Geological Survey (BGS) data indicates that the Wellington Quarry and Moreton Business Park sites are underlain by Raglan Mudstone Formation comprising siltstone and mudstone bedrock geology. Superficial deposits comprise alluvium clay, silt and gravel deposits.

Review of historic borehole logs available through the BGS indicates that groundwater is located approximately 2m below ground level. Many of the sand and gravel quarries have also filled with water. There are no known springs within the site and groundwater emergence is unlikely to occur, although groundwater is likely to be close to the ground's surface and could easily pose a risk to below ground drainage systems, excavations and foundations.

OTHER SOURCES OF FLOOD RISK

Review of the Environment Agency's Flood Risk from Reservoirs mapping indicates that a small section of the Wellington Quarry and Moreton Business sites are located within an area deemed to be at risk of flooding from reservoirs along their southern boundary. The source is a covered reservoir located approximately 2km upstream of the site. The covered reservoir is identified on OS mapping.

The Wellington Quarry and Moreton Business Park sites are located on the outskirts of the villages of Wellington and Moreton on Lugg and in a relatively rural area. The sites are not likely to be at significant risk of flooding from adjacent sewerage or drainage systems.

HISTORIC FLOOD RECORDS

Review of Herefordshire Council and Dwr Cymru Welsh Water historic flood records at the time of preparing this report indicate that there are no historic flood records within the site boundaries. There are however a number of reports from February 2014 and December 2012 to the west of the sites at Wellington Marsh, with the source of flooding stated likely to be sewerage. There are also a

number of isolated flooding records to the east of the sites that are stated to be attributable to fluvial flooding from the River Lugg from 2007, 2012 and 2016.

PLANNING RECOMMENDATIONS

SPATIAL PLANNING AND DEVELOPMENT CONTROL

Development of the Wellington Quarry and Moreton Business Park sites 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. Several scenarios are being considered for the development of both sites:

- The Wellington Quarry site may comprise: 1) an expansion to the sand and gravel quarry that would be classified as water compatible development; 2) a minerals working and processing site with the potential for inert material to be deposited on site (excluding landfill or hazardous waste) that would be classified as less vulnerable development; or 3) landfill and waste management facilities for hazardous waste which would be classified as more vulnerable development.
- The Moreton on Lugg site may comprise: 1) general industry that would be classified as less vulnerable development; or 2) landfill and waste management facilities for hazardous waste which would be classified as more vulnerable development.

The majority of the Wellington Quarry site and, to a lesser extent, the north and south of the Moreton Business Park site are located within the high risk Flood Zone 3 attributable to the River Lugg, Wellington Brook and other ordinary watercourses and drains that flow through and adjacent to the sites; although as discussed above the current broadscale JFLOW modelling is highly indicative. When the potential effects of climate change are considered the sites may be at greater risk during the 1 in 100 (1%) annual probability event, although are unlikely to extend beyond the extent of the current 1 in 1000 (0.1%) annual probability flood extents.

The Sequential Test will need to be applied for any new development in areas not classified as Flood Zone 1 and that does not comprise the change of use of existing buildings. To pass the Sequential Test the Council must consider the availability and suitability of other sites that are at lower risk of flooding prior to the promotion of the Wellington Quarry and Moreton Business Park sites.

With regard to the Wellington Quarry site, an expansion to the sand and gravel quarry or provision of a minerals working and processing site is recommended to pass the Sequential Test as this would closely align with the site's current use and, given the nature of the quarrying, these sites are typically located close to fluvial floodplains that have deposited alluvial materials. The use of land within Flood Zones 2 or 3 for landfill and waste management facilities may not pass the Sequential Test unless there are no other suitable sites within the required area for this activity. All development proposed in Flood Zone 1 would however pass the Sequential Test and it is expected that any development not associated with quarrying activities would be prioritised in areas of Flood Zone 1.

With regard to the Moreton Business Park site, the change of use of existing buildings located in Flood Zones 3 in the south of the site would not require the application of the Sequential Test. However, full redevelopment of this land would require the application of the Sequential Test and to pass the Sequential Test it is recommended that the redevelopment of this land locates development away from areas at risk of flooding and towards areas in Flood Zone 1. It should also be noted that detailed hydraulic modelling of the watercourse to the south of Moreton Business Park

may indicate that the site is at lower risk than is currently indicated by the broadscale JFLOW modelling.

Any new development within areas of the site not subject to change of use may require the application of Exception Test as summarised below. In accordance with the NPPF:

- Water compatible development (i.e. sand and gravel workings) is considered acceptable in all Flood Zones following successful application of the Sequential Test.
- Less vulnerable development (i.e. minerals working and processing sites, waste treatment (excluding landfill or hazardous waste) or general industry) is considered acceptable in Flood Zones 2 and 3a following successful application of the Sequential Test, but not within Flood Zone 3b.
- More vulnerable development (i.e. landfill and waste management facilities for hazardous waste) is considered acceptable in Flood Zone 2 following successful application of the Sequential Test, but would usually only be acceptable within Flood Zone 3a following the successful application of the Exception Test and would not be considered acceptable within Flood Zone 3b.

To meet the requirements of the Exception Test, the applicant would need to:

- Demonstrate that the development provides wider sustainability benefits to the community that outweigh flood risk; and
- 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.

For any development located in areas at flood risk, the following points must be achieved:

- Within the site the most vulnerable development is located in areas of lowest flood risk.
- The development is appropriately flood resistant and resilient.
- The development incorporates SUDS where appropriate.
- Demonstration that any residual risks can be safely managed.
- Safe access and egress is provided, where appropriate as part of an agreed emergency plan.

A site-specific Flood Risk Assessment (FRA) prepared in accordance with the NPPF and supporting Planning Practice Guidance will be required for all development applications located in Flood Zone 2 and 3; for all development applications within the area of low to medium surface water flood risk in the north of the Moreton Business Park site; and for all development applications with an area of 1ha or greater in Flood Zone 1. The FRA should address the points discussed above and assess the risk of flooding associated with the River Lugg, Wellington Brook and unnamed ordinary watercourses located within and adjacent to the site (including climate change allowances). The FRA should also assess the risks associated with surface water flooding, reservoir breach, high groundwater levels and any increase in the rate or volume of site-generated surface water runoff.

MANAGEMENT OF FLUVIAL FLOOD RISKS

Further assessment will be required as part of the site-specific FRA to better determine the likely risk of flooding to the Wellington Quarry and Moreton Business Park sites.

In accordance with the recommendations set out in Section 6.5 of the Level 1 SFRA, all major development within or near to Flood Zones 2, 3a and 3b would need to be informed by detailed hydraulic modelling of the River Lugg, Wellington Brook and ordinary watercourse to the south of the sites to determine flood extents and hazard for a range of return period events and allowing for

climate change effects. An exception to this requirement would be if the development comprised expansion of the existing quarries if the applicant demonstrated that no land raising was required and that a robust flood management plan was in place to reduce flood risk (and offer flood risk betterment where it is viable) such as removing excavated material from Flood Zone 3 as soon as possible, keeping material in broken heaps when in the floodplain and not storing material in areas that may push flood waters towards more vulnerable areas.

If development comprises a small development of typically less than 1ha located within or near to Flood Zones 2 or 3a then a qualitative assessment may be appropriate depending on the nature and scale of the development. A qualitative assessment could be informed through review of the existing JFLOW model extents to determine an indicative flood level and apply an appropriate increase in flood depth to account for potential climate change effects, noting a 200mm increase is considered appropriate for the 25% scenario and a 500mm increase considered appropriate for the 70% scenario. For a qualitative assessment to be considered appropriate, the applicant would need to demonstrate that flooding of the site would not be detrimental to the operation of the site or pose risk to the quality of water environment receptors (most notably the River Lugg); as well as demonstrate that the development would not increase flood risk elsewhere through changes to ground or plot levels. If it is not possible to demonstrate compliance with these requirements via a qualitative assessment, detailed hydraulic modelling would be required.

Detailed modelling would not be required if development is located in Flood Zone 1, although the applicant must demonstrate with confidence that the development will not be at risk whilst taking climate change and the uncertainty of the existing model data into account.

The need for modelling will need to be agreed on a case-by-case basis with Herefordshire Council and the Environment Agency. The applicant would also need to demonstrate that risks to site operatives could be appropriately managed through the implementation of a flood management and emergency response plan.

Finished floor levels of any new buildings or vulnerable areas of the development (such as areas that could cause pollution risk) should be raised a minimum of 600mm above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the ‘design event’. Finished floor levels should also be located above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the ‘test event’. Recommended climate change allowances for the design event and test event are summarised below in Table B.1.

Table B.1 Climate change allowances

Development Classification	Design scenario	Test scenario
Sand and gravel workings, non-hazardous waste, general industry (Water compatible and less vulnerable)	1 in 100 annual probability event with 25%CC	1 in 100 annual probability event with 35%CC or 1 in 1000 annual probability event, whichever is higher
Landfill and hazardous waste (more vulnerable)	1 in 100 annual probability event with 35%	1 in 100 annual probability event with 70%CC or 1 in 1000 annual probability event, whichever is higher

Access to the Wellington Quarry and Moreton Business Park sites is provided by the A49 located immediately west of the sites. The A49 is not indicated to be at significant risk of flooding therefore safe access and egress can be provided. However, the FRA must consider the risk and hazard to access roads within the sites and demonstrate that these are appropriate to the proposed use of the development. If flood waters are predicted to be greater than 300mm or have a hazard rating of Moderate (Danger for Some) during the 1 in 100 (1%) annual probability event with 35% climate change allowance, developers of the site should strive to reduce this risk or demonstrate that the site could remain unmanned during a flooding event. Reference should be made to DEFRA's Hazard risk guidance (FD2320)[6] and specifically Table 13.1 in terms of depth and velocity.

The development must not increase flood risk elsewhere. At minimum there should be no increase in flood risk up to the 1 in 100 (1%) annual probability event with 35% climate change allowance. Third-party impacts should also be tested for the residual risk events discussed above, noting that the acceptability of risks to third party land during these events will be assessed on a case-by-case basis (in consultation with Herefordshire Council and the Environment Agency) that takes the vulnerability of the land and the increase in risk into account.

If required, any new crossing of the Wellington Brook must be a clear span crossing and must demonstrate (via hydraulic modelling) that the crossing will not pose flood risk to the development or elsewhere. A minimum 300mm freeboard to the soffit of the crossing should be maintained above the 1 in 100 (1%) annual probability event with 35% climate change allowance. A lower freeboard is likely to be acceptable for smaller watercourses and drains although hydraulic assessment must demonstrate no restriction to flood flow conveyance that would pose risk to the site or elsewhere. Consideration must also be given to maintenance access and ecological requirements (including mammal passage) noting that a higher freeboard may be required.

MANAGEMENT OF SURFACE WATER FLOOD RISK

Mapped surface water flood risk to the Wellington Quarry and Moreton Business Park sites that is associated with fluvial flooding rather than overland flow (i.e. attributable to the Wellington Brook and other unnamed ordinary watercourses that flow within and adjacent to the site) can be managed via the fluvial flood management recommendations discussed above.

Development of the Moreton Business Park must give consideration to the mapped surface water ponding in the north of the site adjacent to the railway line, ideally ensuring development is set back from this area and finished floor levels raised appropriately. If this is not possible, the applicant must demonstrate how the mapped flood risk will be managed without increasing flood risk elsewhere (i.e. by displacing surface water storage or increasing flows within downstream watercourses). It may be necessary to maintain an area of sacrificial land within the site to provide storage for displaced overland flows. Consideration should also be given to safe access and egress through this area, ensuring flood depths to the road do not exceed 300mm during a 1 in 100 (1%) annual probability event.

[6] Flood Risk Assessment Guidance for New Development (2005) DEFRA

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, where appropriate;
- 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.

It is assumed that the current sites either infiltrate to ground or discharge to the River Lugg, Wellington Brook or other ordinary watercourse that flow within and adjacent to the sites. Whilst it is assumed that consideration will be given to reusing existing drainage systems, it is expected that opportunities for betterment are explored (for example by striving to increase infiltration, attenuating discharge to adjacent watercourses and providing robust treatment).

Review of the National Soil Resources Institute Soilscapes mapping indicates that the soils within the north of the Wellington Quarry site are naturally wet with a naturally high groundwater. Infiltration of runoff is therefore unlikely to be viable for this part of the site. Soils to the west and south of the Wellington Quarry site and within the Moreton Business Park site are described as freely draining. Infiltration of runoff using shallow infiltration techniques may therefore be viable for this part of the site and should be promoted, 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.

If infiltration is not viable then a controlled discharge to the adjacent watercourses is expected. Discharge should be attenuated to equivalent greenfield rates and volumes for development on any previously undeveloped site. Any redevelopment of an existing site is also expected to achieve this requirement as far as practicable, with a minimum 20% betterment over existing rates expected.

The River Lugg is designated as a Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI). Providing robust treatment of runoff will therefore be especially important to prevent adverse effect to the quality of the River Lugg and downstream watercourses and assist in achieving the objectives of the Water Framework Directive.

MANAGEMENT OF POTENTIALLY HIGH GROUNDWATER LEVELS AND GROUNDWATER RESOURCES

The risk of high groundwater levels must be considered in the drainage design and design of foundations and other below ground structures, most notably the risk that high groundwater levels could reduce the effectiveness of infiltration systems or reduce the capacity of unlined attenuation

features. If these systems are proposed, winter groundwater monitoring should be undertaken to better understand and mitigate these risks.

A full Water Features Survey may be required to support a planning application for an expansion to the sand and gravel quarry site. This would ensure that a comprehensive review of potential private water supplies, licenced and unlicensed abstractions, springs, wells and boreholes is undertaken. These can be requested from the Environment Agency, Herefordshire Council's Private Water Supplies team and the British Geological Survey, alongside local landowner checks.

MANAGEMENT OF FOUL WATER

As part of the site is an existing development it is likely to be served by an existing foul water drainage system. It is expected that any new development will utilise existing on-site systems if these are appropriate, although opportunities to discharge to the Dwr Cymru Welsh Water sewerage network should be promoted in the first instance. Any changes to the existing system should be discussed with the relevant authority.

If discharge to the public sewerage network cannot be achieved consideration will need to be given to discharge via a package treatment plant with infiltration to ground or discharge to the adjacent watercourse. Control of pollution and elevated phosphate levels will be important. The base of any infiltration system must be an appropriate height above groundwater levels and be located a minimum of 10m from any watercourse,15m from any building and 50m from an abstraction point of any groundwater supply. Any receiving watercourse must have a non-seasonal constant flow and be a minimum of 500m upstream of the River Lugg SAC. The design of the system will need to be developed in consultation with Herefordshire Council, the Environment Agency and Natural England.

Appendix C

FORMER LUGG BRIDGE QUARRY, HEREFORD

FORMER LUGG BRIDGE QUARRY, NR HEREFORD

Allocation Reference:	Former Lugg Bridge Quarry
Location:	North-east of Hereford
River Catchment:	River Lugg
NPPF Flood Zone (majority of area):	Flood Zone 2
NPPF Flood Zone (worst case):	Flood Zone 2

INTRODUCTION

The Former Lugg Bridge Quarry site occupies an area of approximately 3.13ha and is located approximately 3km to the north-east of Hereford as illustrated in Figure C.1. The site currently comprises a recycling plant which accepts demolition and construction waste and is allocated as part of Policy W5 (Preferred locations for solid waste treatment facilities) in the draft Herefordshire Minerals and Waste Local Plan. The site is bound by the Cotswold railway line to the north, agricultural land and the River Lugg to the west, an unnamed watercourse to the east and ponds to the south.

The River Lugg flows in a north-south direction to the west of the site before discharging into the River Wye approximately 8km downstream. The River Lugg is classified as a main river and is therefore under the jurisdiction of the Environment Agency. The Little Lugg and other unnamed ordinary watercourses flow in a north-southwest direction to the east of the site and discharge into the River Lugg approximately 1.2km downstream. The Little Lugg and other unnamed watercourses are classified as ordinary watercourses and are therefore under the jurisdiction of Herefordshire Council as Lead Local Flood Authority (LLFA). The River Lugg Internal Drainage Board maintains smaller drainage channels in the surrounding area.

Topography within the Former Lugg Bridge Quarry site is relatively flat. Ground levels in the north of the site are approximately 49mAOD and in the south of the site are approximately 51mAOD.

DESCRIPTION OF FLOOD RISK

FLUVIAL

Review of the Environment Agency's Flood Map for Planning indicates that the Former Lugg Bridge Quarry site is partially located within the medium risk Flood Zone 2 where the annual probability of flooding from fluvial sources is between 1 in 100 (1%) and 1 in 1000 (0.1%), and partially 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 mapped fluvial flood extents are illustrated in Figure C.2.

There is currently no detailed hydraulic modelling of the section of the River Lugg adjacent to the Former Lugg Bridge Quarry site. The Environment Agency's detailed 1D-2D hydraulic model of the River Arrow / River Lugg does not extend as far south as the site. The available fluvial mapping of this section of the River Lugg has therefore been informed by broadscale JFLOW modelling. This mapping is highly indicative and does not explicitly account for the profile and capacity of existing

channels. The LiDAR topographic data within this area is also based on a 2m grid which will contribute to the uncertainty of the model results, noting that review of the LiDAR data suggests it is affected by the on-site workings and temporary material stockpiles, and may therefore not represent the 'normal' site levels. It is therefore considered likely that more of the site would be located in Flood Zone 2 than is currently indicated. Review of indicative flood extents against LiDAR data within the vicinity of the site indicates a likely 1 in 100 (1%) annual probability flood level of between 49.9 - 50.0mAOD. This level is similar or higher than the 'normal' level of most of the Former Lugg Bridge Quarry site (i.e. not considering localised ground raising and stockpiles), with the LiDAR data indicating localised raised ground around the site that is currently providing protection from the 1 in 100 (1%) annual probability event.

Generalised modelling of the Flood Zone 3b functional floodplain has been undertaken by the Environment Agency and indicates that the Former Lugg Bridge Quarry site is not located within the Flood Zone 3b functional floodplain. It should be noted that this is also based on broadscale JFLOW modelling and is also therefore highly indicative. The Flood Zone 3b functional floodplain is defined as land where water has to flow or be stored in times of flood, typically represented by areas that flood naturally during the 1 in 20 (5%) annual probability event. Land surrounding the site is located within the Flood Zone 3b functional floodplain. The mapped functional floodplain extents are illustrated in Figure C.3.

Consideration has been given to the potential effects of climate change. As no detailed hydraulic modelling of the River Lugg is available at this location or LiDAR data that accurately represents the land terrain, a qualitative approach has been applied that assumes the future 1 in 100 (1%) annual probability event with 70% climate change allowance would be similar to the current Flood Zone 2 – i.e. the current extent of the 1 in 1000 (0.1%) annual probability event. This would mean that the majority of the site would be located within the high risk Flood Zone 3 when considering future climate change. Land within Flood Zone 3 is defined as having greater than a 1 in 100 (1%) annual probability of flooding from fluvial sources. This approach is further supported by review of the peak flow estimates for the River Lugg upstream of the site (extracted from the upstream detailed 1D-2D model of the River Arrow / River Lugg). The 1 in 1000 (0.1%) peak flow estimate is approximately 70% greater than the 1 in 100 (1%) peak flow estimate, supporting the approach adopted for this assessment.

Flood hazard mapping has not been prepared as there is no detailed modelling of the River Lugg at this location, however this is likely to be an important consideration for future site development, particularly for site access and egress.

SURFACE WATER AND MINOR WATERCOURSES

The Environment Agency's Risk of Flooding from Surface Water mapping indicates that the Former Lugg Bridge Quarry site is generally not at risk of flooding from surface water. There are a number of isolated areas across the site boundary that are at a low risk of flooding from surface water. Mapped surface water flood extents are reproduced in Figure C.4. The Environment Agency's Risk of Flooding from Surface Water mapping also provides an indication of flood risk associated with the unnamed ordinary watercourse that flows along the eastern boundary of the site, indicating the risk is largely contained within the watercourse channel.

GROUNDWATER

Review of British Geological Survey (BGS) data indicates that the Former Lugg Bridge Quarry site is underlain by Raglan Mudstone Formation comprising siltstone and mudstone bedrock geology. Superficial deposits comprise alluvium clay, silt and gravel deposits.

Review of historic borehole logs available through the BGS indicates that groundwater was struck 4.9m below ground level approximately 1km to the south-west of the site. There are no other borehole records with recorded groundwater levels closer to the site although the former gravel quarries have filled with water suggesting high groundwater levels. Groundwater emergence is considered unlikely to occur, although could pose a risk to below ground drainage systems and structures.

OTHER SOURCES OF FLOOD RISK

Review of the Environment Agency's Flood Risk from Reservoirs mapping indicates that the Former Lugg Bridge Quarry minerals and waste strategic development site is not located within an area deemed to be at risk of flooding from reservoirs. Review of OS mapping also indicates no reservoirs or other large raised storage features at a higher elevation to the site that would pose a flood risk in the event of failure.

The Former Lugg Bridge Quarry minerals and waste strategic development site is located on the outskirts of Hereford and is not located near to existing urban or rural developments. The site is not likely to be at significant risk of flooding from any adjacent sewerage or drainage systems.

HISTORIC FLOOD RECORDS

Review of Herefordshire Council's historic flood records at the time of preparing this report indicate that there are no historic flood records within the site boundary or the surrounding area.

PLANNING RECOMMENDATIONS

SPATIAL PLANNING AND DEVELOPMENT CONTROL

Development of the Former Lugg Bridge Quarry 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. Two scenarios are being considered for proposed development within the Former Lugg Bridge Quarry site: 1) a minerals working and processing facility or a waste treatment facility (excluding landfill or hazardous waste), both of which would be classified as less vulnerable development, or 2) landfill and waste management facilities for hazardous waste which would be classified as more vulnerable development.

The majority of the site is located within the medium risk Flood Zone 2 attributable to the River Lugg, although as discussed above the current broadscale JFLOW modelling is highly indicative and more of the site may be located in Flood Zone 2 than is currently indicated if the LiDAR data is affected by the on-site workings and temporary material stockpiles. When the potential effects of climate change are considered the site may also be at risk during the 1 in 100 (1%) annual probability event.

Expansion of the existing site use that comprises less vulnerable development (as an inert waste recycling centre for demolition and construction waste) and that remains within the site boundary is recommended to pass the Sequential Test. However, the Sequential Test will need to be applied for any major expansion to the site or other new development or change of site usage in areas not

classified as Flood Zone 1 (that does not comprise the change of use of existing buildings). To pass the Sequential Test the Council must consider the availability and suitability of other sites that are at lower risk of flooding prior to the promotion of the Former Lugg Bridge Quarry site. Consideration must also be given to the availability of safe access and egress, noting that this site is a 'dry island' surrounded by Flood Zone 3. The site may also be at greater risk of flooding than is currently indicated if redevelopment of the site requires lowering of existing ground levels or removal of existing stockpiles.

Regarding the application of the Exception Test, less vulnerable development (i.e. minerals working and processing facility or a waste treatment facility excluding landfill or hazardous waste) would be considered acceptable in Flood Zones 2 and 3 and the Exception Test would not be required. More vulnerable development (i.e. landfill and waste management facilities for hazardous waste) would also be considered acceptable in Flood Zone 2 (although modelling would be required to demonstrate that the site is within Flood Zone 2), however the Exception Test would be required for more vulnerable development to be located in Flood Zone 3. It is therefore considered unadvisable to allocate more vulnerable development at this site unless detailed modelling is undertaken that demonstrates that the site in not located in Flood Zone 3 and taking climate change into account.

To meet the requirements of the Exception Test, the applicant would need to:

- Demonstrate that the development provides wider sustainability benefits to the community that outweigh flood risk; and
- 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.

For any development located in areas at flood risk, the following points must be achieved:

- Within the site the most vulnerable development is located in areas of lowest flood risk.
- The development is appropriately flood resistant and resilient.
- The development incorporates SUDS where appropriate.
- Demonstration that any residual risks can be safely managed.
- Safe access and egress is provided, where appropriate as part of an agreed emergency plan.

A site-specific Flood Risk Assessment (FRA) prepared in accordance with the NPPF and supporting Planning Practice Guidance will be required. The FRA should address the points listed above and assess the risk of flooding associated with the River Lugg and unnamed ordinary watercourses that flow through and adjacent to the site (including climate change allowances). The FRA should also assess the risks associated with any increase in the rate or volume of site-generated surface water runoff.

MANAGEMENT OF FLUVIAL FLOOD RISKS

Further assessment will be required as part of the site-specific FRA to better determine the likely risk of flooding to the Former Lugg Bridge Quarry site.

In accordance with the recommendations set out in Section 6.5 of the Level 1 SFRA, if this site is intended to be used for landfill or hazardous waste (classified as more vulnerable) the assessment would need to be informed by detailed hydraulic modelling of the River Lugg to determine flood extents and hazard for a range of return period events and allowing for climate change effects.

If the site is proposed to be used for a minerals working and processing facility or a waste treatment facility (excluding landfill or hazardous waste) (classified as less vulnerable) then a qualitative assessment may be appropriate depending on the nature and scale of the development. A qualitative assessment could be informed through review of the existing JFLOW model extents to determine an indicative flood level and apply an appropriate increase in flood depth to account for potential climate change effects, noting a 200mm increase is considered appropriate for the 25% scenario and a 500mm increase considered appropriate for the 70% scenario. Consideration must also be given to the potential implications that existing LiDAR data is not truly representative of site ground levels. For a qualitative assessment to be considered appropriate, the applicant would need to demonstrate that flooding of the site would not be detrimental to the operation of the site or pose risk to the quality of water environment receptors (most notably the River Lugg); as well as demonstrate that the development would not increase flood risk elsewhere through changes to ground or plot levels. If it is not possible to demonstrate compliance with these requirements via a qualitative assessment, detailed hydraulic modelling of the River Lugg would be required.

Finished floor levels of any new buildings or vulnerable areas of the development (such as areas that could cause pollution risk) should be raised a minimum of 600mm above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'design event'. Finished floor levels should also be located above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'test event'. Recommended climate change allowances for the design event and test event are summarised below in Table C.1.

Table C.1 Climate change allowances

Development Classification	Design scenario	Test scenario
Non-hazardous waste (less vulnerable)	1 in 100 annual probability event with 25%CC	1 in 100 annual probability event with 35%CC or 1 in 1000 annual probability event, whichever is higher
Landfill and hazardous waste (more vulnerable)	1 in 100 annual probability event with 35%	1 in 100 annual probability event with 70%CC or 1 in 1000 annual probability event, whichever is higher

The Former Lugg Bridge Quarry site is served by an existing access track from the A465 that crosses the Little Lugg and ordinary watercourse to the east of the site. The track is indicated to be located within the high risk Flood Zone 3 and functional floodplain Flood Zone 3b. It is assumed that the access track will also serve any new development of the Former Lugg Bridge Quarry site, however the FRA must consider the risk and hazard to this track and demonstrate that this is appropriate to the proposed use of the site. If flood waters are predicted to be greater than 300mm or have a hazard rating of Moderate (Danger for Some) during the 1 in 100 (1%) annual probability event with 35% climate change allowance, developers of the site should strive to reduce this risk or demonstrate that the site could remain unmanned during a flooding event. Reference should be

made to DEFRA's Hazard risk guidance (FD2320)[7] and specifically Table 13.1 in terms of depth and velocity.

The development must not increase flood risk elsewhere. At minimum there should be no increase in flood risk up to the 1 in 100 (1%) annual probability event with 35% climate change allowance. Third-party impacts should also be tested for the residual risk events discussed above, noting that the acceptability of risks to third party land during these events will be assessed on a case-by-case basis (in consultation with Herefordshire Council and the Environment Agency) that takes the vulnerability of the land and the increase in risk into account.

If required, any new crossing of the Little Lugg must be a clear span crossing and must demonstrate (via hydraulic modelling) that the crossing will not pose flood risk to the development or elsewhere. A minimum 300mm freeboard to the soffit of the crossing should be maintained above the 1 in 100 (1%) annual probability event with 35% climate change allowance. A lower freeboard is likely to be acceptable for the ordinary watercourse to the east of the site although hydraulic assessment must demonstrate no restriction to flood flow conveyance that would pose risk to the site or elsewhere. Consideration must also be given to maintenance access and ecological requirements (including mammal passage) noting that a higher freeboard may be required.

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, where appropriate;
- 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.

It is assumed that the current site either infiltrates to ground or discharges to the settlement lagoons / ordinary watercourse to the south and east of the site that in turn will infiltrate to ground or discharge to the Little Lugg. Whilst it is assumed that consideration would be given to reusing existing drainage systems, it is expected that opportunities for betterment are explored (for example by attenuating discharge to adjacent watercourses and providing robust treatment).

Review of the National Soil Resources Institute Soilscapes mapping indicates that the soils underlying the site are naturally wet with naturally high groundwater. Infiltration of runoff may

[7] Flood Risk Assessment Guidance for New Development (2005) DEFRA

therefore not be viable, 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.

If infiltration is not viable then a controlled discharge to the Little Lugg is expected (either via the ordinary watercourse to the east of the site or the settlement lagoons to the south of the site). Discharge should be attenuated to equivalent greenfield rates and volumes as far as practicable, with a minimum 20% betterment over existing rates expected. It should be noted that crossing third party land may be required. Consultation should be undertaken with Herefordshire Council and the River Lugg Internal Drainage Board regarding any new discharge to the Little Lugg.

The River Lugg is designated as a Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI). Providing robust treatment of runoff will therefore be especially important to prevent adverse effect to the quality of the River Lugg and downstream watercourses and assist in achieving the objectives of the Water Framework Directive.

MANAGEMENT OF FOUL WATER

As the site is an existing development it is likely to be served by an existing foul water drainage system, assumed to comprise a package treatment plant with discharge to ground or the adjacent watercourse. It is expected that any new development will utilise the existing on-site system if this is appropriate. Control of pollution and elevated phosphate levels will be important. The base of any infiltration system must be an appropriate height above groundwater levels and be located a minimum of 10m from any watercourse,15m from any building and 50m from an abstraction point of any groundwater supply. Any receiving watercourse must have a non-seasonal constant flow and be a minimum of 500m upstream of the River Lugg SAC. Any changes to the existing drainage system should be discussed with the relevant authority and the design of the system will need to be developed in consultation with Herefordshire Council, the Environment Agency and Natural England.

Appendix D

LEOMINSTER HOUSEHOLD WASTE

LEOMINSTER HOUSEHOLD WASTE, LEOMINSTER

Allocation Reference:	Leominster Household Waste
Location:	Leominster
River Catchment:	River Lugg
NPPF Flood Zone (majority of area):	Flood Zone 1
NPPF Flood Zone (worst case):	Flood Zone 1

INTRODUCTION

The Leominster Household Waste site occupies an area of approximately 1.08ha and is located in The Marsh to the north of Leominster as illustrated in Figure D.1. Existing land use within the Leominster Household Waste site comprises an active recycling facility for household waste. The site is bound by the River Lugg and a public footpath to the north, an industrial estate to the east, a sports centre to the south, and greenfield land to the south and west.

The River Lugg flows in a general north-west to south-east direction through Leominster, discharging into the River Wye approximately 23km downstream. The River Lugg Bypass Channel (constructed in the 1970's) flows along the northern boundary of the site. The Kenwater, a bifurcation of the River Lugg and the original channel alignment of the River Lugg, flows in a north-west to south-east direction approximately 450m to the south of the site before re-joining the River Lugg approximately 1.4km downstream. The River Lugg and Kenwater are classified as main rivers and are therefore under the jurisdiction of the Environment Agency.

Topography within the Leominster Household Waste site slopes from the west to the east. Ground levels in the west of the site are approximately 81mAOD and in the east of the site are approximately 75mAOD.

DESCRIPTION OF FLOOD RISK

FLUVIAL

The assessment of fluvial flood risk has been informed by the Environment Agency's Flood Map for Planning and the Environment Agency's 1D-2D ISIS (now Flood Modeller Pro) -TUFLOW hydraulic model of the River Lugg and the River Arrow prepared in 2013.

Review of the Environment Agency's Flood Map for Planning indicates that the Leominster Household Waste site is located within Flood Zone 2 with a small area in the east of the site benefiting from the Leominster flood defences. Land within Flood Zone 2 is defined as having between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of flooding from fluvial sources. The Flood Map for Planning is based on broadscale JFLOW modelling that is highly indicative and does not explicitly account for the profile and capacity of existing channels. The mapped Flood Map for Planning fluvial flood extents are illustrated in Figure D.2.

The Environment Agency's 1D-2D detailed hydraulic model of the River Lugg prepared in 2013 includes an undefended scenario that provides a more accurate representation of the likely Flood Zone 2 and 3 extents as represented on the Flood Map for Planning, and a defended scenario that includes the Leominster Flood Alleviation Scheme (discussed below). The undefended model scenario indicates that the Leominster Household Waste site is located outside of the modelled extents of the 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability events, i.e. the site would be classified as being in Flood Zone 1 although is in relatively close proximity to Flood Zone 2 that inundates the leisure centre to the south-east of the site. The defended model scenario indicates that the Leominster Household Waste site is at a lesser risk during the 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability events. Flood defences on the bank of the River Lugg offer protection, whereas flood waters to the south are contained within the playing fields. The outputs of the Environment Agency's detailed hydraulic model for the undefended and defended fluvial flood extents are illustrated in Figure D.3 and Figure D.4 respectively.

The Leominster Flood Alleviation Scheme was first constructed in the 1970s and involved the construction of a flood wall along the Kenwater. A subsequent scheme was delivered in the 1980s, which consisted of a Bypass Channel (the River Lugg) with raised embankments along the northern boundary of the Leominster Household Waste site. The channel drains to where the Ridgemoor Brook joins the River Lugg upstream of the confluence of the Lugg and Kenwater. The original course of the Kenwater through the town centre was also improved, and excess floodwater is stored in the sports centre playing field adjacent to Leominster Town Football Club. Correspondence with the Environment Agency indicates that a planning application has been submitted (pending determination) for work to improve the standard of protection of the existing Leominster Flood Alleviation Scheme. The improved scheme will protect residential properties at The Marsh to a 1 in 100 (1%) plus 35% climate change allowance annual probability standard of protection. These improvements are not yet represented in the Environment Agency's detailed hydraulic model.

The Environment Agency's 1D-2D detailed hydraulic model of the River Lugg includes modelling of the Flood Zone 3b functional floodplain, taking the (current) Leominster Flood Alleviation Scheme into account. This indicates that the Leominster Household Waste site is not located within Flood Zone 3b. The Flood Zone 3b functional floodplain is defined as land where water has to flow or be stored in times of flood, typically represented by areas that flood naturally during the 1 in 20 (5%) annual probability event. The mapped functional floodplain extents are illustrated in Figure D.5.

Consideration has been given to the potential effects of climate change. The Environment Agency has supplied undefended flood level data for flow nodes located along the River Lugg and Kenwater adjacent to the Leominster Household Waste site. The model only considers a 20% increase in peak flood flows during the 1 in 100 (1%) annual probability event and therefore a basic interpolation exercise has been undertaken to estimate the likely increase in flood level associated with a 25% and 70% increase in peak flow. Table D.1 summarises the flood level data provided by the Environment Agency and the interpolated levels used to inform this SFRA.

Table D.1 Undefended modelled and interpolated flood levels for the Leominster Household Waste site

	Maximum water levels (m AOD)				
	Modelled 1 in 100	Modelled 1 in 100 + 20% CC	Modelled 1 in 1000	Interpolated 1 in 100 + 25% CC	Interpolated 1 in 100 + 70% CC
River Lugg	71.42	71.59	71.70	71.63	72.00
Kenwater	71.35	71.52	72.07	71.56	71.94

The interpolated flood levels for the 25% and 70% increase in peak flow are likely to be slightly higher than modelled flood levels (i.e. if the model were to be rerun) as a review of model hydrology indicates that the 1 in 1000 (0.1%) peak flow estimate is approximately 70% greater than the 1 in 100 (1%) peak flow estimate. This suggests that the 1 in 100 (1%) annual probability event with 70% climate change peak flood level should be similar to the present day 1 in 1000 (0.1%) annual probability event peak flood level.

Review of LiDAR data and the extent of the modelled 1 in 1000 (0.1%) annual probability flood event indicates that the Leominster Household Waste site would still be located outside of the modelled defended and undefended flood extents when the potential effects of climate change are considered.

Consideration has been given to the residual risk event should the flood defences adjacent to the Leominster Household Waste site fail. Review of the undefended fluvial flood extents illustrated in Figure D.3 (and as discussed above) indicates that the site is not located within areas deemed to be at risk of flooding from fluvial sources in both the 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability events and therefore the risks to the site are extremely low.

SURFACE WATER AND MINOR WATERCOURSES

The Environment Agency's Risk of Flooding from Surface Water mapping indicates that the Leominster Household Waste site is not at risk of flooding from surface water. Mapped surface water flood extents are reproduced in Figure D.6.

Review of OS mapping indicates that there are no other known minor watercourses that could pose risk to the site.

GROUNDWATER

Review of British Geological Survey (BGS) data indicates that the Leominster Household Waste site is underlain by Raglan Mudstone Formation comprising siltstone and mudstone bedrock geology. Superficial deposits comprise alluvium clay, silt and gravel deposits.

There are no historic borehole logs available from the BGS located within or near to the site. However due to the relatively low-lying topography of the site and the site's close proximity to both the River Lugg and Kenwater, it is considered likely that groundwater levels within the site could be high.

The Leominster Household Waste site is located in Zone 3 (Total Catchment) of a Source Protection Zone (SPZ) which is defined as the area around a groundwater abstraction point within which all groundwater recharge is presumed to contribute.

OTHER SOURCES OF FLOOD RISK

Review of the Environment Agency's Flood Risk from Reservoirs mapping indicates that the Leominster Household Waste site is not located within an area deemed to be at risk of flooding from reservoirs. Review of OS mapping also indicates no reservoirs or other large raised storage features at a higher elevation to the site that would pose flood risk in the event of failure.

The Leominster Household Waste site is located on the northern outskirts of Leominster. The site is not likely to be at significant risk of flooding from adjacent sewerage or drainage systems.

HISTORIC FLOOD RECORDS

Review of Herefordshire Council and Dwr Cymru Welsh Water historic flood records at the time of preparing this report indicates that there are no historic flood records within the site boundary, although there are a number of reports within the surrounding area. These include reports from November 2012 approximately 240m to the east of the site although the source of flooding is stated to be unknown; and a report from June 2014 approximately 230m to the south-east of the site that is stated to be attributable to a combined sewer.

PLANNING RECOMMENDATIONS

SPATIAL PLANNING AND DEVELOPMENT CONTROL

Development of the Leominster Household Waste 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. The proposed development may comprise an expansion to the existing site to be used for landfill or other waste management facilities that could include hazardous waste. These developments would be classified as more vulnerable development in accordance with the NPPF.

Although the Flood Map for Planning indicates that the Leominster Household Waste site is located within Flood Zone 2 attributable to the River Lugg, detailed hydraulic modelling undertaken by the Environment Agency indicates that the site should instead be reclassified as Flood Zone 1. The site is indicated to remain within Flood Zone 1 when the potential effects of climate change are considered. Development of the site is therefore recommended to pass the Sequential and Exception Tests.

The Leominster Household Waste site is served by the B4361 Bridge Street. This is indicated to be located outside of the 1 in 100 (1%) annual probability flood extents and therefore provides safe access and egress for users of the Leominster Household Waste site.

As the site area is greater than 1ha, a site-specific Flood Risk Assessment (FRA) prepared in accordance with the NPPF and supporting Planning Practice Guidance will be required.

The FRA should summarise the risks to the site and assess the risks associated with any increase in the rate or volume of site-generated surface water runoff. These aspects are discussed in greater detail below.

MANAGEMENT OF FLUVIAL FLOOD RISKS

The assessment presented above indicates that the risk of fluvial flooding to the Leominster Household Waste site is low, both now and when the potential effects of climate change are considered. That said, the FRA should summarise the risks to the site and the need for any site-specific mitigation measures.

Finished floor levels of any new buildings or vulnerable areas of the development (such as areas that could cause pollution risk) should be raised a minimum of 600mm above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'design event'. Finished floor levels should also be located above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'test event'. Recommended climate change allowances for the design event and test event are summarised below in Table D.2.

Table D.2 Climate change allowances

Development Classification	Design scenario	Test scenario
Landfill and hazardous waste (more vulnerable)	1 in 100 annual probability event with 35%	1 in 100 annual probability event with 70%CC or 1 in 1000 annual probability event, whichever is higher

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, where appropriate;
- 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.

It is assumed that the current site either infiltrates to ground, discharges to the River Lugg or Kenwater, or discharges to the public sewerage network. Whilst it is assumed that consideration would be given to reusing existing drainage systems, it is expected that opportunities for betterment are explored (for example by attenuating discharge to adjacent watercourses and providing robust treatment).

Review of the National Soil Resources Institute Soilscapes mapping indicates that the soils within the site are naturally wet with naturally high groundwater. Infiltration of surface water runoff to ground is therefore unlikely to be viable. Furthermore, discharge into the SPZ (particularly from

waste and vehicular areas) is unlikely to be supported by the Environment Agency and the site's previous/existing uses may also pose increased contamination risks.

Controlled discharge to the adjacent watercourses should be explored. Discharge should be attenuated to equivalent greenfield rates and volumes as far as practicable, with a minimum 20% betterment over existing rates expected.

The River Lugg and Kenwater are designated as a Site of Special Scientific Interest (SSSI). Providing robust treatment of runoff will therefore be especially important to prevent adverse effect to the quality of the River Lugg and downstream watercourses and assist in achieving the objectives of the Water Framework Directive.

MANAGEMENT OF FOUL WATER

It is expected that foul water discharge from any new development within the Leominster Household Waste site will be managed using existing systems that serve the current site. Opportunities to discharge to the Dwr Cymru Welsh Water sewerage network should be promoted in the first instance. Any changes to the existing system should be discussed with the relevant authority.

If discharge to the public sewerage system cannot be achieved consideration will need to be given to discharge via a package treatment plant with infiltration to ground. Control of pollution and elevated phosphate levels will be important. The base of any infiltration system must be an appropriate height above groundwater levels and be located a minimum of 10m from any watercourse,15m from any building and 50m from an abstraction point of any groundwater supply. Discharge to the adjacent watercourses would require robust treatment given the SSSI designation of the River Lugg and Kenwater. The design of the system would need to be developed in consultation with Herefordshire Council, the Environment Agency and Natural England.

Appendix E

WESTFIELDS TRADING ESTATE, HEREFORD

WESTFIELDS TRADING ESTATE, HEREFORD

Allocation Reference:	Westfields Trading Estate
Location:	Hereford
River Catchment:	Yazor Brook / Widemarsh Brook
NPPF Flood Zone (majority of area):	Flood Zone 1
NPPF Flood Zone (worst case):	Flood Zone 3a

INTRODUCTION

The Westfields Trading Estate occupies an area of approximately 45.6ha and is located to the north-west of Hereford's town centre as illustrated in Figure E.1. The site currently comprises several industrial estates and is allocated within Policy HD7 (Hereford employment provision) within the Core Strategy of the Herefordshire Local Plan as land for employment. The site is bound by Grandstand Road and Hereford Racecourse to the north; and residential development, playing fields and park land to the east, south and west.

The Yazor Brook and Widemarsh Brook (a bifurcation of the Yazor Brook) flow in an easterly direction through the approximate centre of the site. The Yazor Brook enters a culvert as it flows beneath the Heineken brewery in the south of the site, passing beneath the disused railway at the site's eastern boundary via two syphons. The Yazor Brook and Widemarsh Brook are classified as ordinary watercourses and are therefore under the jurisdiction of Herefordshire Council as Lead Local Flood Authority (LLFA).

Topography within the Westfields Trading Estate is relatively flat with a gentle slope from the north to the south. Ground levels in the north of the site are approximately 57.8mAOD and in the south of the site are approximately 56.4mAOD.

DESCRIPTION OF FLOOD RISK

FLUVIAL

The assessment of fluvial flood risk has been informed by both the Environment Agency's Flood Map for Planning for the assessment of flood risk attributable to the Ayles Brook, and the 1D-2D Flood Modeller Pro-TUFLOW hydraulic model of the Yazor Brook that was commissioned by Herefordshire Council in 2019 to inform the Hereford ICS (as discussed in Section 1.2 of the Minerals and Waste Level 2 SFRA) for the assessment of flood risk attributable to the Yazor and Widemarsh Brooks. The mapped fluvial flood extents are illustrated in Figure E.2, noting that this map 'stitches' together the detailed hydraulic modelling of the Yazor and Widemarsh Brooks and broadscale modelling of the Ayles Brook (discussed further below). The majority of the Westfields Trading Estate is located in the low risk Flood Zone 1, defined as land with less than a 1 in 1000 (0.1%) annual probability of flooding from fluvial sources.

Land in the east of the site that comprises a derelict brownfield site to the east of Faraday Road is indicated to be located within the medium risk Flood Zone 2 where the annual probability of flooding

from fluvial sources is between 1 in 100 (1%) and 1 in 1000 (0.1%). The source of this flood risk is associated with the Ayles Brook located approximately 270m to the north of the site. The mapping of the Ayles Brook is based only on broadscale JFLOW modelling and is therefore highly indicative. Flood risk may be overestimated if the JFLOW modelling does not appropriately represent the existing culverts that convey the Ayles Brook beneath the Hereford Racecourse to its confluence with the Widemarsh Brook downstream of the site. However, it is likely that flooding from the Ayles Brook could occur when the capacity of the watercourse's culverts are exceeded (or blocked) and flooding enters the site as overland flow.

The centre of the site, along the alignment of the Widemarsh Brook, is also indicated to be within the medium risk Flood Zone 2, with a small extent of Flood Zone 3 predicted at Plough Lane in the south of the site. Flood Zone 3 is defined as land with greater than a 1 in 100 (1%) annual probability of flooding from fluvial sources. The mapped fluvial flood extents illustrated in Figure E.2 informed by the detailed hydraulic model of the Yazor and Widemarsh Brooks does not take into account the Yazor Brook Flood Alleviation Scheme (FAS) (discussed below) that was constructed in 2012 to reduce flood risk in the city centre. This approach has been used to denote the likely worst-case scenario. The playing fields of the Hereford Lads Club immediately east of the site and undeveloped land immediately to the west of the site are also classified as Flood Zone 3, however this is not predicted to encroach to within the Westfields Trading Estate.

It should be noted that the Herefordshire Level 1 SFRA used an earlier version of the hydraulic model for the Yazor Brook and Widemarsh Brook, and as a result there are some minor differences between the mapped flood extents between the Level 1 SFRA and this Level 2 SFRA. The updated hydraulic model indicates a reduction in the Flood Zone 2 extent to the south of Faraday Road.

The Flood Zone 3b functional floodplain is defined as land where water has to flow or be stored in times of flood, typically represented by areas that flood naturally during the 1 in 20 (5%) annual probability event. The detailed undefended fluvial modelling of the Yazor Brook indicates that the Westfields Trading Estate is not located within Flood Zone 3b (although the mapping illustrates the alignment of the watercourses). The mapped functional floodplain extents are illustrated in Figure E.3.

Consideration has been given to the potential effects of climate change. The detailed undefended fluvial model of the Yazor Brook considers a 35% and 70% increase in peak flows during the 1 in 100 (1%) annual probability event. The results are illustrated in Figure E.4. The mapping indicates that the extent of the 1 in 100 (1%) annual probability event with 70% climate change allowance is almost identical to the current extent of Flood Zone 2. This figure only represents flooding associated with the Yazor and Widemarsh Brooks as no detailed modelling is available for the Ayles Brook.

Mapped fluvial flood extents that take into account the operation of the Yazor Brook FAS are illustrated in Figure E.5. The FAS is located upstream of Hereford at Credenhill and diverts flood flows from the Yazor Brook to the River Wye via an overspill weir and c.1.4km long 2m diameter culvert that connects the two watercourses. The defended modelling indicates that the Yazor and Widemarsh Brook pose little risk to the site with the majority of flow predicted to remain in channel up to the 1 in 1000 (0.1%) annual probability event. It should be noted that the underlying topography and LiDAR data used in the hydraulic model is the reason for the abrupt 'end' to the flood extents to the north of Fiennes Way. This is likely due to the presence of bunds and embankments in the local area. Flood level data for flow nodes located along the Yazor and

Widemarsh Brooks within the Westfields Trading Estate have also been extracted from this defended model of the watercourses. The model considers a 35% and 70% increase in peak flows during the 1 in 100 (1%) annual probability event and therefore a basic interpolation exercise has been undertaken to estimate the likely increase in flood level associated with a 25% increase in peak flow. Table E.1 summarises the flood level data from the hydraulic model of the Yazor and Widemarsh Brooks and the interpolated levels used to inform this SFRA.

Table E.1 Defended modelled and interpolated flood levels for the Westfields Trading Estate

	Maximum water levels (m AOD)				
	Modelled 1 in 100	Modelled 1 in 100 + 35% CC	Modelled 1 in 1000	Interpolated 1 in 100 + 25% CC	Modelled 1 in 100 + 70% CC
Yazor Brook	56.24	56.27	56.29	56.26	56.29
Widemarsh Brook	55.23	55.57	55.98	55.47	56.00

As no modelling of the Ayles Brook is available, a qualitative approach to the impacts of climate change has been applied that assumes the future 1 in 100 (1%) annual probability event with 70% climate change allowance would be similar to the current Flood Zone 2 – i.e. the current 1 in 1000 (0.1%) annual probability event. Review of estimated hydrology of the Ayles Brook indicates that the flows for the 1 in 1000 (0.1%) annual probability event are approximately 70% greater than the flows for the 1 in 100 (1%) annual probability event, thereby supporting this generalised approach. Land within the east of the Westfields Trading Estate may therefore be at risk of flooding during the 1 in 100 (1%) annual probability event with climate change allowance, although as discussed above the mapped flood extents associated with the Ayles Brook may be overestimated if the JFLOW modelling does not appropriately represent the existing culverts.

SURFACE WATER AND MINOR WATERCOURSES

The Environment Agency's Risk of Flooding from Surface Water mapping indicates that the majority of the Westfields Trading Estate is at low or very low risk of flooding from surface water. The most notable risks are to land adjacent to the Widemarsh Brook (therefore most likely attributable to fluvial flood risk that has not taken the Yazor FAS into account) and within the east of the site in areas similar to those indicated to be at fluvial flood risk from the Ayles Brook. The mapping also indicates isolated ponding of water throughout the site, most likely representing localised low spots within the site's topography, and potentially significant flooding within Harrow Road and Plough Lane in the south of the site. Mapped surface water flood extents are reproduced in Figure E.6.

GROUNDWATER

Review of British Geological Survey (BGS) data indicates that the Westfields Trading Estate is underlain by Raglan Mudstone Formation comprising siltstone and mudstone bedrock geology. Superficial deposits comprise alluvium along the alignments of the Yazor Brook and Widemarsh Brook, and glacial deposits comprising sand and gravel in the majority of the rest of the site.

An Environment Agency groundwater monitoring borehole is located in the playing fields at the Hereford Lads Club. Recent monitoring completed in January 2020 indicates a groundwater level at

approximately 52.9m AOD to 52.6mAOD, approximately 2.5m below ground level, although historic records indicate that groundwater levels have risen sharply with the hydrograph showing a 'peaky' response to winter rainfall and groundwater levels rising to approximately 0.5 m below ground level during winter periods.

Review of historic borehole logs available through the BGS indicate a number of borehole logs located within the site boundary. Groundwater was struck at depths of between 2.4 and 2.6m below ground level.

Groundwater emergence is considered unlikely to occur although could pose risk to below ground drainage systems and structures. It is recommended that monitoring data is requested from the Environment Agency to inform development in the Westfields Trading Estate and its associated drainage systems. Further groundwater monitoring within the site boundary may be required to inform future development.

OTHER SOURCES OF FLOOD RISK

Review of the Environment Agency's Flood Risk from Reservoirs mapping indicates that the Westfields Trading Estate is not located within an area deemed to be at risk of flooding from reservoirs. Review of OS mapping also indicates no reservoirs or other large raised storage features at a higher elevation to the site that would pose flood risk in the event of failure.

Review of the Dwr Cymru Welsh Water One Year and 50 Year Headroom datasets indicate a generally low risk of flooding from combined and surface water sewers located within the site boundary and adjacent to the site. The combined and surface water sewers located along Grandstand Road to the north-east of the site are indicated to have a medium to high risk of flooding.

HISTORIC FLOOD RECORDS

Review of Herefordshire Council and Dwr Cymru Welsh Water historic flood records at the time of preparing this report indicates that there are no historic flood records within the Westfields Trading Estate site boundary. There are however a number of reports within the surrounding area: two reports approximately 540m to the east of the site in July 2007 stated to be attributable to Widemarsh Brook; to the primary school located to the north-east of the site in 2007 and 2012 stated to be attributed to storm sewers; at Hereford Racecourse to the north of the site in 2007 stated to be attributed to storm sewers; and approximately 210m to the south-west of the site in 2013 with no source of flooding recorded.

Significant flooding has occurred downstream of the site attributable to the Yazor and Widemarsh Brooks, particularly within the Edgar Street Gird area of Hereford. Surface water runoff from the Westfields Trading Estate may therefore contribute to this risk.

PLANNING RECOMMENDATIONS

SPATIAL PLANNING AND DEVELOPMENT CONTROL

Development of the Westfields Trading Estate 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. Two scenarios are being considered for development within the Westfields Trading Estate: 1) general industry and waste treatment (except landfill and hazardous waste) that would be classified as less

vulnerable development; and 2) landfill and waste management facilities for hazardous waste that would be classified as more vulnerable development.

The majority of the Westfields Trading Estate is located within the low risk Flood Zone 1 with little change predicted when the potential effects of climate change are considered. The greatest source of flood risk is within the north-east of the site associated with Ayles Brook with land classified as Flood Zone 2 (potentially increasing to Flood Zone 3 when climate change is considered), although as discussed above the extent and frequency of flooding in this area is highly indicative. The centre of the site is also classified as Flood Zone 2 (increasing to Flood Zone 3 when climate change is considered), although this does not take the operation of the Yazor Brook FAS into account that would remove this area from flood risk.

As the vast majority of the Westfields Trading Estate is located in the low risk Flood Zone 1, it is recommended that the site passes the Sequential Test. Whilst areas of the site are indicated to be located in Flood Zone 2 and 3 as discussed above, it is noted that flooding in the north-east of the site is highly indicative and likely to be over-estimated, and flooding in the centre of the site does not take the FAS into account.

Land within the north-east and centre of the Westfields Trading Estate may require the application of Exception Test depending on proposed development vulnerability and findings of detailed modelling. In accordance with the NPPF, less vulnerable development is considered acceptable in Flood Zones 2 and 3a and more vulnerable development is considered acceptable in Flood Zone 2. However, more vulnerable development would usually only be acceptable within Flood Zone 3a following the successful application of the Exception Test that requires:

- Demonstration that the development provides wider sustainability benefits to the community that outweigh flood risk; and
- Demonstration 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.

It is however recommended that all development is located away from areas at risk of flooding as much as practicable and, given the size of the site, it is expected that all development (with the exception of reuse of existing buildings) can be located in Flood Zone 1.For any development in areas at flood risk, the following points must be achieved:

- Within the site the most vulnerable development is located in areas of lowest flood risk.
- The development is appropriately flood resistant and resilient.
- The development incorporates SUDS where appropriate.
- Demonstration that any residual risks can be safely managed.
- Safe access and egress is provided, where appropriate as part of an agreed emergency plan.

A site-specific Flood Risk Assessment (FRA) prepared in accordance with the NPPF and supporting Planning Practice Guidance will be required for all development applications located in Flood Zone 2 or Flood Zone 3; and for all development applications with an area of 1ha or greater in Flood Zone 1. For any development in areas of fluvial flood risk, the FRA should address the points listed above and assess the risk of flooding associated with the Yazor, Widemarsh and Ayles Brooks (including climate change allowances). The FRA should also assess the risks associated with failure of the Yazor Brook FAS, surface water and sewerage flooding, and any increase in the rate or volume of site-generated surface water runoff. Any development is the south-east of the site (i.e. in the

vicinity of the Heineken brewery) must also give consideration to fluvial flood risk in the event of blockage of the Yazor Brook syphons beneath the disused railway.

MANAGEMENT OF FLUVIAL FLOOD RISKS

The assessment presented above indicates that the risk of fluvial flooding to the Westfields Trading Estate is generally low, both now and when the potential effects of climate change are considered. That said, the FRA should summarise the risks to the site and the need for any site-specific mitigation measures.

Development of the site should consider the operation of the Yazor Brook FAS and finished floor levels of any new buildings or vulnerable areas of the development (such as areas that could cause pollution risk) should be raised a minimum of 600mm above the defended 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'design event'. Finished floor levels should also be located above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'test event' that considers both the defended and undefended scenarios. Recommended climate change allowances for the design event and test events are summarised below in Table E.2.

Table E.2 Climate change allowances

Development Classification	Design scenario	Test scenario
Non-hazardous waste, general industry (less vulnerable)	1 in 100 annual probability event with 25%CC with operational FAS	Highest of: 1 in 100 annual probability event with 35%CC with operational FAS; 1 in 1000 annual probability event with operational FAS; or 1 in 100 annual probability event with 35%CC with fully blocked FAS
Landfill and hazardous waste (more vulnerable)	1 in 100 annual probability event with 35% with operational FAS	Highest of: 1 in 100 annual probability event with 70%CC with operational FAS; 1 in 1000 annual probability event with operational FAS; or 1 in 100 annual probability event with 35%CC with fully blocked FAS

Further assessment will be required as part of the site-specific FRA for any proposed development within the north-east of the site that is indicated to be at fluvial flood risk associated with the Ayles Brook to better determine the likely risk of flooding to this area.

In accordance with the recommendations set out in Section 6.5 of the Level 1 SFRA, if this part of the site is intended to be used for landfill or hazardous waste (classified as more vulnerable) the assessment would need to be informed by detailed hydraulic modelling of the Ayles Brook to determine flood extents and hazard for a range of return period events and allowing for climate change effects.

If this part of the site is proposed to be used for a minerals working and processing facility or a waste treatment facility (excluding landfill or hazardous waste) (classified as less vulnerable) then a qualitative assessment may be appropriate depending on the nature and scale of the development.

A qualitative assessment could be informed through review of the existing JFLOW model extents to determine an indicative flood level and apply an appropriate increase in flood depth to account for potential climate change effects, noting a 200mm increase is considered appropriate for the 25% scenario and a 500mm increase considered appropriate for the 70% scenario. For a qualitative assessment to be considered appropriate, the applicant would need to demonstrate that flooding of the site would not be detrimental to the operation of the site or pose significant risk to water quality; as well as demonstrate that the development would not increase flood risk elsewhere through changes to ground or plot levels or changes to flow conveyance through the site. If it is not possible to demonstrate compliance with these requirements via a qualitative assessment, detailed hydraulic modelling of the Ayles Brook would be required. Development of this site must also demonstrate provision of safe access and egress during a flood event.

The development must not increase flood risk elsewhere. Given the urban setting of this site it is recommended that there should be no increase in flood risk up to the 1 in 100 (1%) annual probability event with 70% climate change allowance or the 1 in 1000 (0.1%) annual probability event.

If required, any new crossing of the Yazor Brook or Widemarsh Brook must be a clear span crossing and must demonstrate (via hydraulic modelling) that the crossing will not pose flood risk to the development or elsewhere. A minimum 300mm freeboard to the soffit of the crossing should be maintained above the 1 in 100 (1%) annual probability event with 35% climate change allowance. Consideration must also be given to maintenance access and ecological requirements (including mammal passage) noting that a higher freeboard may be required.

MANAGEMENT OF SURFACE WATER AND OVERLAND FLOW

Development of the Westfields Trading Estate must give consideration to the mapped surface water flooding within the site. Much of this is likely to be attributable to fluvial flooding from the Yazor, Widemarsh and Ayles Brooks and therefore the measures recommended above will assist with mitigating this risk. The management of other sources of overland flow and surface water ponding is recommended to comprise setting development back from these areas, raising building threshold levels and considering flow conveyance routes through the site to ensure overland flows are not deflected towards third parties. Overland flows must also be considered in the design of the development's proposed drainage system to ensure overland flows do not discharge to the drainage system and reduce system capacity.

MANAGEMENT OF SITE GENERATED SURFACE WATER RUNOFF

The management of surface water runoff is important for the Westfields Trading Estate given the known flood risks associated with the Yazor and Widemarsh Brooks and the surrounding sewerage systems. 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, where appropriate;
- 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.

It is assumed that the existing site discharges to the Dwr Cymru Welsh Water sewer network or directly to the Yazor Brook or Widemarsh Brook, most likely at an unattenuated rate. Development of the site may therefore provide opportunity to reduce the rate and volume of discharge as well as provide treatment.

Review of the National Soil Resources Institute Soilscapes mapping indicates that the soils beneath the site are freely draining. As discussed above groundwater levels are likely to be shallow, although infiltration of runoff using shallow features (such as permeable paving) may be viable in areas of the site at a higher elevation, although consideration would also need to be given to the site's previous/existing uses that may pose increased contamination risks. Onsite testing will be required to determine soil permeability, depth to the groundwater table (including potential for rising groundwater) and contamination risks. If onsite testing concludes lower permeability soils, combined attenuation and infiltration features should be promoted where groundwater levels and contamination risks permit to reduce runoff during small rainfall events and provide treatment.

If infiltration is not viable, consideration should be given to the discharge of runoff to the Yazor Brook or Widemarsh Brook, most likely via existing drainage outfalls if available. Discharge should be attenuated to equivalent greenfield rates and volumes as far as practicable, with a minimum 20% betterment over existing rates expected.

If discharge into the Yazor Brook or Widemarsh Brook is not viable, discharge to the existing Dwr Cymru Welsh Water surface water sewers located around the perimeter of the site should be promoted. The required discharge rate would need to be agreed with Dwr Cymru Welsh Water although it is recommended that a maximum discharge rate of 5 l/s is applied to assist with reducing flood risk elsewhere whilst not introducing unacceptable risk in the event of blockage. Discharge to the Dwr Cymru Welsh Water combined network is unlikely to be acceptable and opportunities to remove existing discharges to this network should be explored.

Providing robust treatment of runoff will be important (particularly if the site is proposed to be used for hazardous waste) to prevent adverse effect to the quality of the Yazor Brook, WIdemarsh Brook and downstream watercourses and assist in achieving the objectives of the Water Framework Directive.

MANAGEMENT OF FOUL WATER

As the site is an existing development it is likely to be served by an existing foul water drainage system, assumed to comprise discharge into the Dwr Cymru Welsh Water sewerage network that serves Hereford. It is expected that any new development will utilise existing on-site systems if these are appropriate and any changes to the existing system should be discussed with Dwr Cymru Welsh Water.

Appendix F

SOUTHERN AVENUE, LEOMINSTER

SOUTHERN AVENUE, LEOMINSTER

Allocation Reference:	Southern Avenue
Location:	Leominster
River Catchment:	River Lugg
NPPF Flood Zone (majority of area):	Flood Zone 2
NPPF Flood Zone (worst case):	Flood Zone 2

INTRODUCTION

The Southern Avenue site occupies an area of approximately 33.6ha and is located to the south-east of Leominster as illustrated in Figure F.1. The site currently comprises an industrial estate with Southern Avenue and Worcester Road running through the centre of the site. The site is allocated within Policy HD7 (Hereford employment provision) within the Core Strategy of the Herefordshire Local Plan as land for employment. The site is bound by the urban area of Leominster to the north and west, the Welsh Marches railway line to the east and the Leominster Enterprise Park to the south. It is understood that the site is being considered for either waste management activities or mineral processing activities.

The River Lugg flows in a general north to south direction approximately 400m to the east of the site, discharging into the River Wye approximately 20km to the south of the site. The River Arrow flows in an easterly direction approximately 750m to the south of the site, discharging to the River Lugg approximately 1.5km to the south-east. The River Lugg and River Arrow are classified as a main rivers and are therefore under the jurisdiction of the Environment Agency.

A small unnamed watercourse flows through the site. The watercourse is in open channel in the south-west of the site just to the east of Glendower Road. The watercourse is assumed to be in culvert upstream and downstream of this channel although the alignment of the watercourse is unknown. Review of OS mapping indicates that the watercourse may flow south and discharge to the short section of open channel that flows adjacent to the southern site boundary. From here the watercourse flows south and discharges to the River Arrow approximately 1km downstream of the site. These unnamed watercourses are classified as ordinary watercourses and are therefore under the jurisdiction of Herefordshire Council as Lead Local Flood Authority (LLFA).

Topography within the Southern Avenue site is relatively flat with a gentle slope from the south-west to the north-east. Ground levels in the south-west of the site are approximately 70.8mAOD and in the north-east of the site are approximately 67.3mAOD.

DESCRIPTION OF FLOOD RISK

FLUVIAL

The assessment of fluvial flood risk has been informed by both the Environment Agency's Flood Map for Planning and the Environment Agency's 1D-2D ISIS (now Flood Modeller Pro) - TUFLOW hydraulic model of the River Lugg and the River Arrow prepared in 2013.

Review of the Environment Agency's Flood Map for Planning indicates that the majority of the Southern Avenue site is located within the medium risk Flood Zone 2, defined as having between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of flooding from fluvial sources. Land within the north of the site is located within the high risk Flood Zone 3, defined as having greater than a 1 in 100 (1%) annual probability of flooding from fluvial sources. Pockets of the site are located within the low risk Flood Zone 1, defined as having less than a 1 in 1000 (0.1%) annual probability of flooding from fluvial sources. The Flood Map for Planning is based on broadscale JFLOW modelling that is highly indicative and does not explicitly account for the profile and capacity of existing channels. The mapped Flood Map for Planning fluvial flood extents are illustrated in Figure F.2.

The Environment Agency's 1D-2D detailed hydraulic model of the River Lugg and River Arrow prepared in 2013 provides a more accurate representation of the likely Flood Zone 2 and 3 extents. The model outputs indicate that the Southern Avenue site is no longer located within the flood extent of the 1 in 100 (1%) annual probability event of flooding from fluvial sources, i.e. the site would be not classified as being in Flood Zone 3. However, the model outputs indicate that the site is still located within the flood extent for the 1 in 1000 (0.1%) %) annual probability event of flooding from fluvial sources - i.e. the site would still be classified as being in Flood Zone 2. The flood extent for the 1 in 1000 (0.1%) annual probability event is broadly similar to the Flood Zone 2 extent shown on the Environment Agency's Flood Map for Planning, although a greater proportion of the site would be classified as Flood Zone 1. The outputs of the Environment Agency's detailed hydraulic model are illustrated in Figure F.3.

The Environment Agency's 1D-2D detailed hydraulic model of the River Lugg and River Arrow includes modelling of the Flood Zone 3b functional floodplain. This indicates that the Southern Avenue site is not located within Flood Zone 3b. The Flood Zone 3b functional floodplain is defined as land where water has to flow or be stored in times of flood, typically represented by areas that flood naturally during the 1 in 20 (5%) annual probability event. The mapped functional floodplain extents are illustrated in Figure F.4.

Consideration has been given to the potential effects of climate change. The Environment Agency has supplied flood level data for flow nodes located along the River Lugg to the east of the site and the River Arrow to the south of the site. The model only considers a 20% increase in peak flood flows during the 1 in 100 (1%) annual probability event and therefore a basic interpolation exercise has been undertaken to estimate the likely increase in flood level associated with a 25% and 70% increase in peak flow. Table F.1 summarises the flood level data provided by the Environment Agency and the interpolated levels used to inform this SFRA.

Table F.1 Undefended modelled and interpolated flood levels for the Southern Avenue site

	Maximum water levels (m AOD)				
	Modelled 1 in 100	Modelled 1 in 100 + 20% CC	Modelled 1 in 1000	Interpolated 1 in 100 + 25% CC	Interpolated 1 in 100 + 70% CC
River Lugg	68.51	68.69	68.98	68.73	69.13
River Arrow	67.86	68.10	68.41	68.16	68.70

The interpolated flood levels for the 25% and 70% increase in peak flow are likely to be slightly higher than modelled flood levels (i.e. if the model were to be rerun) as a review of model hydrology indicates that the 1 in 1000 (0.1%) peak flow estimate is approximately 70% greater than the 1 in 100 (1%) peak flow estimate. This suggests that the 1 in 100 (1%) annual probability event with 70% climate change peak flood level should be similar to the present day 1 in 1000 (0.1%) annual probability event peak flood level. Adopting this approach indicates that the majority of the site could be at risk during the 1 in 100 (1%) annual probability event with 70% climate change allowance.

SURFACE WATER AND MINOR WATERCOURSES

The Environment Agency's Risk of Flooding from Surface Water mapping indicates large pockets of land within the Southern Avenue site that may be at high, medium and low risk of flooding from surface water. The mapping indicates likely overland flow routes along Worcester Road and Southern Avenue, with ponding of surface water occurring in lower lying areas of the site. Site drainage systems are likely to manage much of this risk although the mapping indicates where surcharging or flooding of the drainage systems could occur. Mapped surface water flood extents are reproduced in Figure F.5.

GROUNDWATER

Review of British Geological Survey (BGS) data indicates that the Southern Avenue site is underlain by Raglan Mudstone Formation comprising siltstone and mudstone bedrock geology. Superficial deposits comprise alluvium clay, silt and gravel deposits within the east of the site boundary and glaciofluvial sheet deposits comprising sand and gravel within the south of the site.

Review of historic borehole logs available through the BGS within the site boundary record groundwater encountered at depths of 1.9 – 2m below ground level just to the north of Southern Avenue. Groundwater emergence is considered unlikely to occur, although could pose a risk to below ground drainage systems and structures.

The majority of the site (with the exception of the south-west corner) is located in Zone 2 (Outer Protection Zone) of a Source Protection Zone (SPZ) which is defined by a 400 day travel time to the point of abstraction. The north of the site encroaches to within the mapped extent of Zone 1 (Inner Protection Zone) which is defined as the 50 day travel time to the point of abstraction with a 50m default minimum radius.

OTHER SOURCES OF FLOOD RISK

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

HISTORIC FLOOD RECORDS

Review of Herefordshire Council and Dwr Cymru Welsh Water flood records at the time of preparing this report indicate a large number of historical flood records within the site boundary. In total there are 22 flood incidents located within the site. Fifteen records of flooding are reported to have occurred from the sewerage system between 1997 and 2014, with the majority of incidents stated to

be attributed to combined sewers. There are also seven incidents recorded by Herefordshire Council but the source of flooding was not recorded.

PLANNING RECOMMENDATIONS

SPATIAL PLANNING AND DEVELOPMENT CONTROL

Development of the Southern Avenue 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. Two scenarios are being considered for proposed development within the Southern Avenue site: 1) a minerals working and processing facility or a waste treatment facility (excluding landfill or hazardous waste) or general industry, both of which would be classified as less vulnerable development, or 2) landfill and waste management facilities for hazardous waste which would be classified as more vulnerable development.

The majority of the Southern Avenue site is located within the medium risk Flood Zone 2. Although the Flood Map for Planning indicates that the Southern Avenue site is partially located within Flood Zone 3 attributable to the River Lugg, detailed hydraulic modelling undertaken by the Environment Agency indicates that the site should instead be reclassified as Flood Zone 2.

The Sequential Test may be applicable to the development of the Southern Avenue site. The site is currently an industrial estate and it is not yet known if redevelopment of the site would comprise repurposing of existing buildings (and therefore comprise a change of use that would be exempt from the Sequential Test) or if redevelopment of the site would comprise the demolition and reconstruction of facilities within the site boundary (in which case the Sequential Test would apply). If the latter, the Council must consider the availability and suitability of other sites that are at lower risk of flooding prior to the promotion of the Southern Avenue site. However, it is recommended that redevelopment of this site would pass the Sequential Test given the existing brownfield nature of the site. It is however recommended that a sequential approach is applied to the site's development to locate more vulnerable development (i.e. landfill and waste management facilities for hazardous waste) in areas of Flood Zone 1 and not within areas of Flood Zone 2.

Less vulnerable and more vulnerable development is considered acceptable in Flood Zones 1 and 2 and therefore development of the site would pass the Exception Test. That said, for any development in areas at flood risk, the following points must be achieved:

- Within the site the most vulnerable development is located in areas of lowest flood risk.
- The development is appropriately flood resistant and resilient.
- The development incorporates SUDS where appropriate.
- Demonstration that any residual risks can be safely managed.
- Safe access and egress is provided, where appropriate as part of an agreed emergency plan.

A site-specific Flood Risk Assessment (FRA) prepared in accordance with the NPPF and supporting Planning Practice Guidance will be required for all development applications located in Flood Zone 2; for all development applications within large areas at medium and high surface water flood risk; and for all development applications with an area of 1ha or greater in Flood Zone 1. The FRA should address the points listed above and assess the risk of flooding associated with the River Lugg and River Arrow (including climate change allowances). The FRA should also assess the risks associated with any increase in the rate or volume of site-generated surface water runoff and protection from surface water or sewerage overland flows.

MANAGEMENT OF FLUVIAL FLOOD RISKS

Further assessment will be required as part of the site-specific FRA to better determine the likely risk of flooding to the Southern Avenue site.

In accordance with the recommendations set out in Section 6.5 of the Level 1 SFRA, development located in Flood Zone 2 that is intended to be used for landfill or hazardous waste (classified as more vulnerable) should be informed by detailed hydraulic modelling of the River Lugg and River Arrow to determine flood extents and hazard using the most up to date climate change allowances. Consultation with the Environment Agency would be required to determine the scope and scale of any updates required to the hydraulic model to make it fit for purpose.

A qualitative assessment of flood risk may be appropriate for development located in Flood Zone 2 that is intended to be used for general industry, minerals working and processing facilities or a waste treatment facility (excluding landfill or hazardous waste) (classified as less vulnerable) depending on the nature and scale of the development. For a qualitative assessment to be considered appropriate, the applicant would need to demonstrate that flooding of the site would not be detrimental to the operation of the site or pose risk to the quality of water environment receptors (most notably the River Lugg and River Arrow); as well as demonstrate that the development would not increase flood risk elsewhere through changes to ground or plot levels. If it is not possible to demonstrate compliance with thee requirements via a qualitative assessment, detailed hydraulic modelling of the River Lugg and River Arrow would be required.

Finished floor levels of any new buildings or vulnerable areas of the development (such as areas that could cause pollution risk) should be raised a minimum of 600mm above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'design event'. Finished floor levels should also be located above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'test event'. Recommended climate change allowances for the design event and test event are summarised below in Table F.2.

Table F.2 Climate change allowances

Development Classification	Design scenario	Test scenario
Non-hazardous waste and general industry (less vulnerable)	1 in 100 annual probability event with 25%CC	1 in 100 annual probability event with 35%CC or 1 in 1000 annual probability event, whichever is higher
Landfill and hazardous waste (more vulnerable)	1 in 100 annual probability event with 35%	1 in 100 annual probability event with 70%CC or 1 in 1000 annual probability event, whichever is higher

The Southern Avenue site is served by two main roads: Southern Avenue which joins onto the B4361 Hereford Road and Worcester Road which joins onto Etnam Street. Both access roads pass through the medium risk Flood Zone 2. The FRA must consider the risk and hazard to these access roads and demonstrate that this is appropriate to the proposed use of the site. If flood waters are predicted to be greater than 300mm or have a hazard rating of Moderate (Danger for Some) during the 1 in 100 (1%) annual probability event with 35% climate change allowance, developers of the

site should strive to reduce this risk or demonstrate that the site could be safely and appropriately managed during a flooding event. Reference should be made to DEFRA's Hazard risk guidance (FD2320)[8] and specifically Table 13.1 in terms of depth and velocity.

The development must not increase flood risk elsewhere. At minimum there should be no increase in flood risk up to the 1 in 100 (1%) annual probability event with 35% climate change allowance. Third-party impacts should also be tested for the residual risk events discussed above, noting that the acceptability of risks to third party land during these events will be assessed on a case-by-case basis (in consultation with Herefordshire Council and the Environment Agency) that takes the vulnerability of the land and the increase in risk into account.

MANAGEMENT OF SURFACE WATER AND OVERLAND FLOW

Development of the Southern Avenue site must give consideration to the mapped surface water flows and ponding throughout the site, demonstrating how this will be managed through the provision of appropriate drainage systems and, if required, raising of finished floor levels. Consideration must also be given to the large number of historic flooding events and how these may affect development of the site and, ideally, offer betterment.

MANAGEMENT OF SITE GENERATED SURFACE WATER RUNOFF

The management of surface water runoff is important for the Southern Avenue minerals and waste strategic development site given the recorded historical flooding attributable to sewerage systems. 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, where appropriate;
- 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.

It is assumed that the current site is served by a comprehensive drainage network that either discharges to the small watercourse within or located along the southern boundary of the site, or into the Dwr Cymru Welsh Water sewerage network. Whilst it is assumed that consideration would be given to reusing existing drainage systems, it is expected that opportunities for betterment are

[8] Flood Risk Assessment Guidance for New Development (2005) DEFRA

explored (for example by striving to reduce discharge into the combined sewerage network and providing robust treatment).

Review of the National Soil Resources Institute Soilscapes mapping indicates that the soils beneath the site are freely draining. As discussed above groundwater levels are indicated to be between approximately 1.9m and 2m below ground level. Infiltration of surface water runoff into the SPZ (particularly from waste and vehicular areas) is unlikely to be supported by the Environment Agency, and the site's previous/existing uses may also pose increased contamination risks. Some discharge of roof water may be permitted although this should be confirmed on a site-by-site basis.

If infiltration is not viable, consideration should be given to the discharge of runoff to the unnamed watercourse within and to the south of the site boundary. Discharge should be attenuated to equivalent greenfield rates and volumes as far as practicable, with a minimum 20% betterment over existing rates expected. The River Lugg is designated as a Site of Special Scientific Interest (SSSI). Providing robust treatment of runoff will therefore be especially important to prevent adverse effect to the quality of the River Lugg and downstream watercourses and assist in achieving the objectives of the Water Framework Directive.

If discharge into the unnamed watercourse is not viable, discharge to the existing Dwr Cymru Welsh Water surface water network is expected. The required discharge rate would need to be agreed with Dwr Cymru Welsh Water although it is recommended that a maximum discharge rate of 5 l/s is applied to assist with reducing flood risk elsewhere whilst not introducing unacceptable risk in the event of blockage.

MANAGEMENT OF FOUL WATER

As the site is an existing development it is likely to be served by an existing foul water drainage system, assumed to comprise discharge into the Dwr Cymru Welsh Water sewerage network that serves the city of Leominster. It is expected that any new development will utilise existing on-site systems if these are appropriate and any changes to the existing system should be discussed with Dwr Cymru Welsh Water.

Appendix G

LAND BETWEEN LITTLE MARCLE ROAD AND ROSS ROAD, LEDBURY

LAND BETWEEN LITTLE MARCLE ROAD AND ROSS ROAD, LEDBURY

Allocation Reference:	Land between Little Marcle Road and Ross Road
Location:	Ledbury
River Catchment:	River Leadon
NPPF Flood Zone (majority of area):	Flood Zone 1
NPPF Flood Zone (worst case):	Flood Zone 3b

INTRODUCTION

The Land between Little Marcle Road and Ross Road site occupies an area of approximately 11.2ha and is located to the south-west of Ledbury as illustrated in Figure G.1. The site is predominantly greenfield and comprises agricultural land. The Ledbury Rugby Football Club is located within the south of the site. The Land between Little Marcle Road and Ross Road site is allocated within Policy LB1 (Development in Ledbury) within the Core Strategy of the Herefordshire Local Plan as land for employment.

The site is bound by Little Marcle Road and the Heineken brewery and waste water treatment plant to the north, the River Leadon to the east, Ross Road to the south and agricultural land to the west.

The River Leadon flows in a north to south direction along the eastern boundary of the site, before discharging into the River Severn approximately 20km downstream. The River Leadon is classified as a main river and is therefore under the jurisdiction of the Environment Agency. An unnamed ordinary watercourse flows through the northern part of the site in an easterly direction to discharge into the River Leadon at the site boundary. The watercourse is under the jurisdiction of Herefordshire Council as Lead Local Flood Authority (LLFA). A smaller ditch flows towards the site from the west; the mapped extent of the ditch stops at the Rugby Football Club although it is assumed to continue west (potentially beneath the site) to discharge to the River Leadon.

Topography within the Land between Little Marcle Road and Ross Road site slopes gently from the north-west to the south-east of the site. Ground levels in the north-west of the site are approximately 46mAOD and in the south-east of the site are approximately 43mAOD.

DESCRIPTION OF FLOOD RISK

FLUVIAL

Review of the Environment Agency's Flood Map for Planning indicates that the west of the site is located within Flood Zone 1, where the annual probability of flooding from fluvial sources is less than 1 in 1000 (0.1%). The east of the site is located within Flood Zone 2 where the annual probability of flooding from fluvial sources is between 1 in 1000 (0.1%) and 1 in 100 (1%), and Flood Zone 3 where the annual probability of flooding from fluvial sources is greater than 1 in 100 (1%). The flood

extents for both Flood Zone 3 and Flood Zone 2 are broadly similar. The mapped fluvial flood extents are illustrated in Figure G.2.

There is currently no detailed hydraulic modelling of the River Leadon adjacent to the Land between Little Marcle Road and Ross Road site. The available fluvial mapping has therefore been informed by broadscale JFLOW modelling. This modelling is highly indicative and does not explicitly account for the profile and capacity of existing channels. The LiDAR topographic data within this area is also based on a 2m grid which will contribute to the uncertainty of the model results. Review of indicative flood extents against LiDAR data within the site indicates a likely 1 in 100 (1%) annual probability flood level of 45.2mAOD in the north and 44.6mAOD in the south.

The Environment Agency's Flood Map for Planning does not consider fluvial flood extents of watercourses with small catchments, typically less than 3km^2. The ordinary watercourse that flows through the north of the site is therefore not illustrated on the Flood Map for Planning although may pose fluvial flood risk to the site as discussed in the section below.

Generalised modelling of the Flood Zone 3b functional floodplain has been undertaken by the Environment Agency and indicates that the east of the site would be classified as Flood Zone 3b. It should be noted that this is also based on broadscale JFLOW modelling and is also therefore highly indicative. The Flood Zone 3b functional floodplain is defined as land where water has to flow or be stored in times of flood, typically represented by areas that flood naturally during the 1 in 20 (5%) annual probability event. The mapped functional floodplain extents are illustrated in Figure G.3.

Consideration has been given to the potential effects of climate change. As no detailed hydraulic modelling of the River Leadon is available or LiDAR data that accurately represents the land terrain, a qualitative approach has been applied that assumes the future 1 in 100 (1%) annual probability event with 70% climate change allowance would be similar to the current Flood Zone 2 – i.e. the current extent of the 1 in 1000 (0.1%) annual probability event. The Environment Agency's Flood Map for Planning indicates that the fluvial flood extents for the current Flood Zone 2 and Flood Zone 3 are broadly similar, therefore the increase in flood extent is likely to be relatively minor.

Flood hazard mapping has not been prepared as there is no detailed modelling of the River Leadon, however an indicative flood hazard has been estimated from the Environment Agency's Flood Risk from Surface Water mapping as the mapped flood extents of the two datasets are broadly similar. This suggests flood depths of between 300 and 900mm in the south-east of the site during the low risk 1 in 1000 (0.1%) annual probability event with corresponding velocities of over 0.25m/s. The indicative flood hazard is therefore likely to be Moderate (Dangerous for Some).

SURFACE WATER AND MINOR WATERCOURSES

The Environment Agency's Risk of Flooding from Surface Water mapping indicates that the Land between Little Marcle Road and Ross Road site is generally at a low to very low risk of flooding from surface water, with the majority of the mapped flood extents in also identified to be fluvial flood risk. However, the surface water mapping highlights the potential flood risk associated with the ordinary watercourse that flows through the north of the site. Flood flows are indicated to remain in channel up to the medium risk 1 in 100 (1%) annual probability event, although out of bank flooding is indicated during the low risk 1 in 1000 (0.1%) annual probability event. This flooding should be addressed as a fluvial flood risk and not as a surface water or overland flow flood risk. Ponding of surface water is also indicated within the south of the site in the car park of the Ledbury Rugby Football Club. Mapped surface water flood extents are reproduced in Figure G.4.

GROUNDWATER

Review of British Geological Survey (BGS) data indicates that the Land between Little Marcle Road and Ross Road site is underlain by Raglan Mudstone Formation comprising siltstone and mudstone bedrock geology. Superficial deposits comprise alluvium clay, silt and gravel deposits within the east adjacent to the River Leadon, and sand and gravel within the centre of the site.

Review of historic borehole logs available through the BGS indicate that groundwater was struck approximately 13.7m below ground level approximately 400m to the north of the site. There are no other known borehole records with recorded groundwater levels in closer proximity to the site. Groundwater emergence is considered unlikely to occur, although groundwater is likely to be closer to the ground's surface in the east and south of the site as topography is lower.

OTHER SOURCES OF FLOOD RISK

Review of the Environment Agency's Flood Risk from Reservoirs mapping indicates that the Land between Little Marcle Road and Ross Road site is not located within an area deemed to be at risk of flooding from reservoirs. Review of OS mapping also indicates no reservoirs or other large raised storage features at a higher elevation to the site that would pose a flood risk in the event of failure.

The Land between Little Marcle Road and Ross Road site is located on the outskirts of Ledbury. The site is not likely to be at significant risk of flooding from any adjacent sewerage or drainage systems.

HISTORIC FLOOD RECORDS

Review of Herefordshire Council and Severn Trent Water historic flood records at the time of preparing this report indicate that there no historic flood records within the site boundary. There are however a number of reports within the surrounding area to the south and north-east of the site in April 1998 and also along Ross Road to the south of the site in July 2007. The source of flooding was not recorded.

PLANNING RECOMMENDATIONS

SPATIAL PLANNING AND DEVELOPMENT CONTROL

Development of the Land between Little Marcle Road and Ross Road 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. Two scenarios are being considered for the development of the site: 1) general industry and waste treatment (except landfill and hazardous waste) that would be classified as less vulnerable development; and 2) landfill and waste management facilities for hazardous waste that would be classified as more vulnerable development.

The west of the site is located within the low risk Flood Zone 1 and the east of the site is located within the high risk Flood Zone 3. To comply with the requirements of the Sequential Test it is recommended that all new development is located in Flood Zone 1. Flooding from the minor watercourse within the north of the site will also need to be considered when locating development and a sequential approach is recommended to avoid the location of development within the watercourse's likely flood extent. Safe access and egress can be achieved from Little Marcle Road to the north of the site and from Ross Road to the south of the site.

If development within Flood Zones 2 and 3 is progressed, NPPF recommends the following assessment of vulnerability classification:

- Less vulnerable development (i.e. general industry and waste treatment (except landfill and hazardous waste)) is considered acceptable in Flood Zones 2 and 3a following successful application of the Sequential Test, but not within Flood Zone 3b.
- More vulnerable development (i.e. landfill and waste management facilities for hazardous waste) is considered acceptable in Flood Zone 2 following successful application of the Sequential Test, but would usually only be acceptable within Flood Zone 3a following the successful application of the Exception Test and would not be considered acceptable within Flood Zone 3b.

To meet the requirements of the Exception Test, the applicant would need to:

- Demonstrate that the development provides wider sustainability benefits to the community that outweigh flood risk; and
- 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.

As the majority of the mapped Flood Zone 3 is indicated to comprise Flood Zone 3b functional floodplain, development within this area would not be considered acceptable for either of the proposed use scenarios listed above. For development to be considered acceptable in the mapped Flood Zone 3, detailed modelling would be required to demonstrate that this would not be classified as Flood Zone 3b. However, as discussed above no development is recommended in Flood Zone 2 or Flood Zone 3 to comply with the requirements of the Sequential Test.

A site-specific Flood Risk Assessment (FRA) prepared in accordance with the NPPF and supporting Planning Practice Guidance will be required for all development applications located in Flood Zone 2 and 3; for all development applications within the area of surface water flood risk in the north of the site; and for all development applications with an area of 1ha or greater in Flood Zone 1. The FRA should assess the risk of flooding associated with the River Leadon and ordinary watercourse in the north of the site (including climate change allowances), as well as risks attributable to surface water flooding and an increase in the rate or volume of site-generated surface water runoff.

MANAGEMENT OF FLUVIAL FLOOD RISKS

Further assessment will be required as part of the site-specific FRA to better determine the likely risk of flooding within the Land between Little Marcle Road and Ross Road site and the extent of the fluvial floodplain attributable to the River Leadon and ordinary watercourse in the north of the site, taking the effects of climate change into account.

Detailed hydraulic modelling of the River Leadon and ordinary watercourse to the north of the site would not be required if development is located in Flood Zone 1, although the applicant must demonstrate with confidence that the development will not be at fluvial flood risk whilst taking climate change and the uncertainty of the existing model data into account.

Due to the uncertainty of the existing JFLOW modelling and mapped extent of the Flood Zone 3b functional floodplain, detailed hydraulic modelling for any development located within or in close proximity to the indicative Flood Zone 2 and Flood Zone 3 will be required to determine flood extents and hazard for a range of return period events and allowing for climate change effects.

Detailed modelling of the ordinary watercourse to the north of the site is likely to be required for any more vulnerable development (i.e. landfill and waste management facilities for hazardous waste) located in close proximity (c.8m) to the watercourse. A qualitative assessment may be acceptable for any less vulnerable development (i.e. general industry and waste treatment (except landfill and hazardous waste)). This could be informed through review of the mapped surface water flood extents to determine an indicative flood level and apply an appropriate increase in flood depth to account for potential climate change effects, noting a 200mm increase is considered appropriate for the 25% scenario and a 500mm increase considered appropriate for the 70% scenario. For a qualitative assessment to be considered appropriate, the applicant would need to demonstrate that flooding of the site would not be detrimental to the operation of the site or pose risk to the quality of water environment receptors.

Finished floor levels of any new buildings or vulnerable areas of the development (such as areas that could cause pollution risk) should be raised a minimum of 600mm above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'design event'. Finished floor levels should also be located above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'test event'. Recommended climate change allowances for the design event and test event are summarised in Table G.1 below.

Table G.1 Climate change allowances

Development Classification	Design scenario	Test scenario
Non-hazardous waste, general industry (less vulnerable)	1 in 100 annual probability event with 25%CC	1 in 100 annual probability event with 35%CC or 1 in 1000 annual probability event, whichever is higher
Landfill and hazardous waste (more vulnerable)	1 in 100 annual probability event with 35%	1 in 100 annual probability event with 70%CC or 1 in 1000 annual probability event, whichever is higher

The development must not increase flood risk elsewhere. At minimum there should be no increase in flood risk up to the 1 in 100 (1%) annual probability event with 35% climate change allowance. Third-party impacts should also be tested for the residual risk events discussed above, noting that the acceptability of risks to third party land during these events will be assessed on a case-by-case basis (in consultation with Herefordshire Council and the Environment Agency) that takes the vulnerability of the land and the increase in risk into account.

If required, any new crossing of the ordinary watercourse to the north of the site must be a clear span crossing and must demonstrate (via hydraulic modelling) that the crossing will not pose flood risk to the development or elsewhere. A minimum 300mm freeboard to the soffit of the crossing should be maintained above the 1 in 100 (1%) annual probability event with 35% climate change allowance. Consideration must also be given to maintenance access and ecological requirements (including mammal passage) noting that a higher freeboard may be required.

MANAGEMENT OF MINOR WATERCOURSES AND OVERLAND FLOW

Mapped surface water flood risk to the site that is associated with fluvial flooding rather than overland flow (i.e. attributable to the ordinary watercourses that flows through the north of the site) can be managed via the fluvial flood management recommendations discussed above.

Ponding within the south of the site is likely to be attributable to a local depression in topography and the ditch that flows towards the site from the west. The site-specific FRA must determine the alignment of the ditch and, if relevant, protect, daylight or realign this ditch as it passes through the site.

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, where appropriate;
- 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 underlying the site are clayey soils with impeded drainage. 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.

If discharge to ground cannot be achieved for all or part of the site, discharge to the River Leadon or ordinary watercourse in the north of the site at an attenuated rate should be promoted. It is recommended that discharge is limited to the equivalent Qbar greenfield rate or lower for all return period events up to the 1 in 100 (1%) annual probability event and allow for climate change effects.

It is expected that for a development site of this size, best practice ‘green’ SUDS measures (i.e. vegetated conveyance and storage systems) are incorporated that promote attenuation (and infiltration where appropriate), treatment and biodiversity benefit.

Providing robust treatment of runoff will be important (particularly if the site is proposed to be used for hazardous waste) to prevent adverse effect to the quality of the River Leadon and assist in achieving the objectives of the Water Framework Directive.

MANAGEMENT OF FOUL WATER

Foul water from the Little Marcle Road and Ross Road site should be discharged to the public sewerage network that serves the city of Ledbury. The Applicant should discuss their proposed development with Severn Trent Water to determine if this approach is acceptable and agree the need for any local improvements.

If discharge to the public sewerage network cannot be achieved, consideration will need to be given to discharge via a package treatment plant with infiltration to ground or discharge to the adjacent watercourse. The base of any infiltration system must be an appropriate height above groundwater levels and be located a minimum of 10m from any watercourse,15m from any building and 50m from an abstraction point of any groundwater supply. Any receiving watercourse must have a non-seasonal constant flow. The design of the system will need to be developed in consultation with Herefordshire Council and the Environment Agency.

Appendix H

LEOMINSTER ENTERPRISE PARK, LEOMINSTER

LEOMINSTER ENTERPRISE PARK, LEOMINSTER

Allocation Reference:	Leominster Enterprise Park
Location:	Leominster
River Catchment:	River Lugg
NPPF Flood Zone (majority of area):	Flood Zone 1
NPPF Flood Zone (worst case):	Flood Zone 3a

INTRODUCTION

The Leominster Enterprise Park occupies an area of approximately 16.9ha and is located to the south of Leominster as illustrated in Figure H.1. The site currently comprises an industrial estate and is allocated within Policy HD7 (Hereford employment provision) within the Core Strategy of the Herefordshire Local Plan as land for employment. The site is bound by a large industrial estate to the north, greenfield land and the Welsh Marches railway line to the east, agricultural land to the south and the B4361 Hereford Road to the west. Leominster Cemetery is located to the north-west of the site (outside of the site boundary). It is understood that the site is being considered for waste management activities or mineral processing activities.

The River Lugg flows in a general north to south direction approximately 450m to the east of the site, discharging into the River Wye approximately 20km to the south of the site. The River Arrow flows in an easterly direction approximately 400m to the south of the site, discharging to the River Lugg approximately 1.5km to the south-east. The River Lugg and River Arrow are classified as a main rivers and are therefore under the jurisdiction of the Environment Agency.

A small unnamed watercourse flows along the northern and eastern site boundaries. The watercourse discharges to the River Arrow approximately 1km downstream of the site to the south. The watercourse is classified as ordinary watercourses and is therefore under the jurisdiction of Herefordshire Council as Lead Local Flood Authority (LLFA).

Topography within the Leominster Enterprise Park is relatively flat with a gentle slope from west to east. Ground levels in the west of the site are approximately 72mAOD and in the east of the site are approximately 67.5mAOD.

DESCRIPTION OF FLOOD RISK

FLUVIAL

The assessment of fluvial flood risk has been informed by both the Environment Agency's Flood Map for Planning and the Environment Agency's 1D-2D ISIS (now Flood Modeller Pro) - TUFLOW hydraulic model of the River Lugg and the River Arrow prepared in 2013.

Review of the Environment Agency's Flood Map for Planning indicates that the majority of the Leominster Enterprise Park minerals and waste strategic development site is located within the low risk Flood Zone 1, defined as having less than a 1 in 1000 (0.1%) annual probability of flooding from

fluvial sources. A relatively small area in the north-east of the site is located within the medium risk Flood Zone 2 where the annual probability of flooding from fluvial sources is between 1 in 100 (1%) and 1 in 1000 (0.1%). The Flood Map for Planning is based on broadscale JFLOW modelling that is highly indicative and does not explicitly account for the profile and capacity of existing channels. The mapped Flood Map for Planning fluvial flood extents are illustrated in Figure H.2.

The Environment Agency's 1D-2D detailed hydraulic model of the River Lugg and River Arrow provides a more accurate representation of the likely Flood Zone 2 and 3 extents. The model outputs indicate that the extent of Flood Zone 2 is broadly similar to that illustrated by the Flood Map for Planning, but that a small area in the south-east of the site is located within the extent of the 1 in 100 (1%) annual probability event – i.e. within the high risk Flood Zone 3 where the annual probability of flooding from fluvial sources is greater than 1 in 100 (1%). This mapped area of high flood risk coincides with an area of greenfield land within the Leominster Enterprise Park that incorporates existing drainage basins that serve the wider site. The outputs of the Environment Agency's detailed hydraulic model are illustrated in Figure H.3.

The Environment Agency's 1D-2D detailed hydraulic model of the River Lugg and River Arrow includes modelling of the Flood Zone 3b functional floodplain. This indicates that the Leominster Enterprise Park is not located within Flood Zone 3b. The Flood Zone 3b functional floodplain is defined as land where water has to flow or be stored in times of flood, typically represented by areas that flood naturally during the 1 in 20 (5%) annual probability event. The mapped functional floodplain extents are illustrated in Figure H.4.

Consideration has been given to the potential effects of climate change. The Environment Agency has supplied flood level data for flow nodes located along the River Lugg to the east of the site and the River Arrow to the south of the site. The model only considers a 20% increase in peak flood flows during the 1 in 100 (1%) annual probability event and therefore a basic interpolation exercise has been undertaken to estimate the likely increase in flood level associated with a 25% and 70% increase in peak flow. Table H.1 summarises the flood level data provided by the Environment Agency and the interpolated levels used to inform this SFRA.

Table H.1 Undefended modelled and interpolated flood levels for the Leominster Enterprise Park

	Maximum water levels (m AOD)				
	Modelled 1 in 100	Modelled 1 in 100 + 20% CC	Modelled 1 in 1000	Interpolated 1 in 100 + 25% CC	Interpolated 1 in 100 + 70% CC
River Lugg	67.66	67.69	67.88	67.70	67.77
River Arrow	67.86	68.10	68.41	68.16	68.70

The interpolated flood levels for the 25% and 70% increase in peak flow are likely to be slightly higher than modelled flood levels (i.e. if the model were to be rerun) as a review of model hydrology indicates that the 1 in 1000 (0.1%) peak flow estimate is approximately 70% greater than the 1 in 100 (1%) peak flow estimate. This suggests that the 1 in 100 (1%) annual probability event with 70% climate change peak flood level should be similar to the present day 1 in 1000 (0.1%) annual probability event peak flood level. Adopting this approach indicates that the north-east of the site

could be at risk during the 1 in 100 (1%) annual probability event with 70% climate change allowance.

SURFACE WATER AND MINOR WATERCOURSES

The Environment Agency's Risk of Flooding from Surface Water map indicates that the Leominster Enterprise Park minerals and waste strategic development site is generally at very low risk of flooding from surface water. The mapping indicates some isolated ponding of surface water within the site although this is unlikely to pose constraint to future development. The mapping also provides an indication of flood risk associated with the unnamed ordinary watercourse that flows along the northern and eastern site boundaries; some out of bank flow is predicted during low risk events although this is not indicated to pose risk to the site. Mapped surface water flood extents are reproduced in Figure H.5.

GROUNDWATER

Review of British Geological Survey (BGS) data indicates that the Leominster Enterprise Park is underlain by Raglan Mudstone Formation comprising siltstone and mudstone bedrock geology. Superficial deposits mostly comprise glaciofluvial sheet deposits comprising sand and gravel.

Review of historic borehole logs available through the BGS within the site boundary record groundwater encountered at depths of 1.9 – 2m below ground level just to the north of Southern Avenue to the north of the site. Groundwater emergence is considered unlikely to occur, although could pose a risk to below ground drainage systems and structures.

The eastern edge of the site is located in Zone 3 (Total Catchment) of a Source Protection Zone (SPZ) which is defined as the area around a groundwater abstraction point within which all groundwater recharge is presumed to contribute. The north-east of the site is also located within close proximity to Zone 2 (Outer Protection Zone) of the SPZ which is defined by a 400 day travel time to the point of abstraction.

OTHER SOURCES OF FLOOD RISK

Review of the Environment Agency's Flood Risk from Reservoirs mapping indicates that the Leominster Enterprise Park is not located within an area deemed to be at risk of flooding from reservoirs. Review of OS mapping also indicates no reservoirs or other large raised storage features at a higher elevation to the site that would pose a flood risk in the event of failure.

HISTORIC FLOOD RECORDS

Review of Herefordshire Council and Dwr Cymru Welsh Water flood records at the time of preparing this report indicate that there are no historic flood records within the Leominster Enterprise Park. However, there are number of reports within the surrounding area. The closest record is approximately 40m to the north of the site and is stated to be attributable to a combined sewer. Other reports are approximately 350m to the north of the site and are either stated to be attributable to a combined sewer or an unknown source.

PLANNING RECOMMENDATIONS

SPATIAL PLANNING AND DEVELOPMENT CONTROL

Development of the Leominster Enterprise Park 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. Two

scenarios are being considered for proposed development within the Leominster Enterprise Park: 1) a minerals working and processing facility or a waste treatment facility (excluding landfill or hazardous waste) or general industry, both of which would be classified as less vulnerable development, or 2) landfill and waste management facilities for hazardous waste which would be classified as more vulnerable development.

The majority of the Leominster Enterprise Park is located within the low risk Flood Zone 1, with an existing developed area in the north-east located in the medium risk Flood Zone 2. Although not indicated on the Flood Map for Planning, detailed hydraulic modelling undertaken by the Environment Agency indicates that the currently undeveloped land in the south-east of the site should be classified as Flood Zone 3a. This land comprises the drainage attenuation basins that serve the Leominster Enterprise Park.

The vast majority of the Leominster Enterprise Park is located in the low risk Flood Zone 1 and is therefore recommended to pass the Sequential Test, particularly given the brownfield nature of this existing site. It is however recommended that a sequential approach is applied to the site's development to locate more vulnerable development (i.e. landfill and waste management facilities for hazardous waste) in areas of Flood Zone 1 and not within areas of Flood Zone 2.

Less vulnerable and more vulnerable development is considered acceptable in Flood Zones 1 and 2 and therefore development of the site would pass the Exception Test. That said, for any in areas at flood risk, the following points must be achieved:

- Within the site the most vulnerable development is located in areas of lowest flood risk.
- The development is appropriately flood resistant and resilient.
- The development incorporates SUDS where appropriate.
- Demonstration that any residual risks can be safely managed.
- Safe access and egress is provided, where appropriate as part of an agreed emergency plan.

No development should be proposed within the south-east of the site (i.e. land indicated to be Flood Zone 3) noting that this land comprises existing drainage attenuation basins.

A site-specific Flood Risk Assessment (FRA) prepared in accordance with the NPPF and supporting Planning Practice Guidance will be required for all development applications located in Flood Zone 2 and 3; and for all development applications with area of 1ha or greater in Flood Zone 1. The FRA should address the points listed above and assess the risk of flooding associated with the River Lugg and River Arrow (including climate change allowances). The FRA should also assess the risks associated with any increase in the rate or volume of site-generated surface water runoff and protection from surface water or sewerage overland flows.

MANAGEMENT OF FLUVIAL FLOOD RISKS

Further assessment will be required as part of the site-specific FRA to better determine the likely risk of flooding to the Leominster Enterprise Park.

In accordance with the recommendations set out in Section 6.5 of the Level 1 SFRA, development located in Flood Zone 2 that is intended to be used for landfill or hazardous waste (classified as more vulnerable) should be informed by detailed hydraulic modelling of the River Lugg and River Arrow to determine flood extents and hazard using the most up to date climate change allowances. Consultation with the Environment Agency would be required to determine the scope and scale of any updates required to the hydraulic model to make it fit for purpose.

A qualitative assessment of flood risk may be appropriate for development located in Flood Zone 2 that is intended to be used for general industry, minerals working and processing facilities or a waste treatment facility (excluding landfill or hazardous waste) (classified as less vulnerable) depending on the nature and scale of the development. For a qualitative assessment to be considered appropriate, the applicant would need to demonstrate that flooding of the site would not be detrimental to the operation of the site or pose risk to the quality of water environment receptors (most notably the River Lugg and River Arrow); as well as demonstrate that the development would not increase flood risk elsewhere through changes to ground or plot levels. If it is not possible to demonstrate compliance with these requirements via a qualitative assessment, detailed hydraulic modelling of the River Lugg and River Arrow would be required.

Finished floor levels of any new buildings or vulnerable areas of the development (such as areas that could cause pollution risk) should be raised a minimum of 600mm above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'design event'. Finished floor levels should also be located above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'test event'. Recommended climate change allowances for the design event and test event are summarised below in Table H.2.

Table H.2 Climate change allowances

Development Classification	Design scenario	Test scenario
Non-hazardous waste and general industry (less vulnerable)	1 in 100 annual probability event with 25%CC	1 in 100 annual probability event with 35%CC or 1 in 1000 annual probability event, whichever is higher
Landfill and hazardous waste (more vulnerable)	1 in 100 annual probability event with 35%	1 in 100 annual probability event with 70%CC or 1 in 1000 annual probability event, whichever is higher

The Leominster Enterprise Park is served by two roads: Southern Avenue to the north of the site that joins onto the B4361 Hereford Road in the west and onto the A49 Leominster Bypass in the east; and Owen Way in the south of the site that also joins onto the B4361 Hereford Road in the west. Owen Way is located in the low risk Flood Zone 1, however Southern Avenue passes through the medium risk Flood Zone 2. The FRA must consider the risk and hazard to Southern Avenue (if required for emergency access and egress to the site) and demonstrate that this is appropriate to the proposed use of the site. If flood waters are predicted to be greater than 300mm or have a hazard rating of Moderate (Danger for Some) during the 1 in 100 (1%) annual probability event with 35% climate change allowance, developers of the site should strive to reduce this risk or demonstrate that the site could be safely and appropriately managed during a flooding event.

Reference should be made to DEFRA's Hazard risk guidance (FD2320)[9] and specifically Table 13.1 in terms of depth and velocity.

The development must not increase flood risk elsewhere. At minimum there should be no increase in flood risk up to the 1 in 100 (1%) annual probability event with 35% climate change allowance. Third-party impacts should also be tested for the residual risk events discussed above, noting that the acceptability of risks to third party land during these events will be assessed on a case-by-case basis (in consultation with Herefordshire Council and the Environment Agency) that takes the vulnerability of the land and the increase in risk into account.

MANAGEMENT OF SURFACE WATER AND OVERLAND FLOW

Development of the Leominster Enterprise Park must give consideration to the mapped surface water ponding within the site, demonstrating how this will be managed through the provision of appropriate drainage systems and, if required, raising of finished floor levels.

MANAGEMENT OF SITE GENERATED SURFACE WATER RUNOFF

Surface water 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, where appropriate;
- 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.

It is assumed that existing development within the Leominster Enterprise Park is served by an existing drainage network that discharges to the attenuation basins in the south-east of the site that in turn discharge to the small watercourse located along the eastern boundary of the site. It is understood that one of the basins is served by a pumping station. Whilst it is assumed that consideration would be given to extending and reusing existing drainage systems, demonstration of applying the NPPF SuDS hierarchy is expected to first investigate infiltration to ground prior to discharge to a watercourse or sewerage network.

Review of the National Soil Resources Institute Soilscapes mapping indicates that the soils beneath the site are freely draining. As discussed above groundwater levels are indicated to be between approximately 1.9m and 2m below ground level. Infiltration of surface water runoff into the SPZ

[9] Flood Risk Assessment Guidance for New Development (2005) DEFRA

(particularly from waste and vehicular areas) is unlikely to be supported by the Environment Agency, and the site's previous/existing uses may also pose increased contamination risks. However, shallow infiltration of runoff (i.e. using permeable paving) may be possible in those areas of the site that are currently undeveloped and not located within the SPZ. 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.

If infiltration is not viable, consideration should be given to the discharge of runoff to the existing site-wide drainage system and unnamed watercourse to the east of the site. Discharge should be attenuated to equivalent greenfield rates and volumes as far as practicable, with a minimum 20% betterment over existing rates expected. The River Lugg is designated as a Site of Special Scientific Interest (SSSI). Providing robust treatment of runoff will therefore be especially important to prevent adverse effect to the quality of the River Lugg and downstream watercourses and assist in achieving the objectives of the Water Framework Directive.

MANAGEMENT OF FOUL WATER

As the site is an existing development it is likely to be served by an existing foul water drainage system, assumed to comprise discharge into the Dwr Cymru Welsh Water sewerage network that serves the city of Leominster. It is expected that any new development will utilise existing on-site systems if these are appropriate and any changes to the existing system should be discussed with Dwr Cymru Welsh Water.

Appendix I

THREE ELMS TRADING ESTATE, HEREFORD

THREE ELMS TRADING ESTATE, HEREFORD

Allocation Reference:	Three Elms Trading Estate
Location:	Hereford
River Catchment:	Yazor Brook
NPPF Flood Zone (majority of area):	Flood Zone 1
NPPF Flood Zone (worst case):	Flood Zone 1

INTRODUCTION

The Three Elms Trading Estate occupies an area of approximately 2.77ha and is located in the north-west of Hereford as illustrated in Figure I.1. The site currently comprises an industrial estate and is allocated within Policy HD7 (Hereford employment provision) within the Core Strategy of the Herefordshire Local Plan as land for employment. The site is bound by the Grandstand Community Park and Westfields Recreation Ground to the north, residential and retail development to the east and west, and Moor Park and the Yazor Brook to the south.

The Yazor Brook flows in a general south-easterly direction through Hereford approximately 50m to the south of the site boundary. Approximately 1km downstream of the site the Yazor Brook bifurcates into the Widemarsh Brook. Both watercourses outfall to the River Wye approximately 2.5km downstream of the site. The Yazor Brook and its downstream bifurcation are classified as ordinary watercourses and are therefore under the jurisdiction of Herefordshire Council as Lead Local Flood Authority (LLFA).

Topography within the Three Elms Trading Estate is relatively flat. Ground levels in the north of the site are approximately 60.5mAOD and in the south of the site are approximately 60.3mAOD.

DESCRIPTION OF FLOOD RISK

FLUVIAL

The assessment of fluvial flood risk has been informed by the 1D-2D Flood Modeller Pro-TUFLOW hydraulic model of the Yazor Brook that was commissioned by Herefordshire Council in 2019 to inform the Hereford ICS as discussed in Section 1.2 of the Minerals and Waste Level 2 SFRA. The modelling and subsequent Flood Zone classification discussed below does not take into account the Yazor Brook Flood Alleviation Scheme (FAS) that was constructed in 2012 to reduce flood risk in the city centre. This approach has been used to denote the likely worst-case scenario.

The updated fluvial modelling of the Yazor Brook indicates that the Three Elms Trading Estate 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 mapped fluvial flood extents are illustrated in Figure I.2.

The Flood Zone 3b functional floodplain is defined as land where water has to flow or be stored in times of flood, typically represented by areas that flood naturally during the 1 in 20 (5%) annual

probability event. The updated fluvial modelling of the Yazor Brook indicates that the site is not located within Flood Zone 3b. The mapped functional floodplain extents are illustrated in Figure I.3.

Consideration has been given to the potential effects of climate change. The detailed undefended fluvial model of the Yazor Brook considers a 35% and 70% increase in peak flows during the 1 in 100 (1%) annual probability event. The results are illustrated in Figure I.4. The mapping indicates that the site would remain flood free during the during the 1 in 100 (1%) annual probability event with 70% climate change allowance and not taking into the benefit of the FAS.

Mapped fluvial flood extents that take into account the operation of the Yazor Brook FAS are illustrated in Figure I.5. The FAS is located upstream of Hereford at Credenhill and diverts flood flows from the Yazor Brook to the River Wye via an overspill weir and c.1.4km long 2m diameter culvert that connects the two watercourses. The defended modelling indicates a reduced floodplain extent in the vicinity of the Three Elms Trading Estate. Flood level data for flow nodes located along the Yazor Brook adjacent to Three Elms Trading Estate have also been extracted from this defended model of the Yazor Brook. The model considers a 35% and 70% increase in peak flows during the 1 in 100 (1%) annual probability event and therefore a basic interpolation exercise has been undertaken to estimate the likely increase in flood level associated with a 25% increase in peak flow. Table I.1 summarises the flood level data from the hydraulic model of the Yazor Brook and the interpolated levels used to inform this SFRA.

Table I.1 Defended modelled and interpolated flood levels for the Three Elms Trading Estate

	Maximum water levels (m AOD)				
	Modelled 1 in 100	Modelled 1 in 100 + 35% CC	Modelled 1 in 1000	Interpolated 1 in 100 + 25% CC	Modelled 1 in 100 + 70% CC
Yazor Brook	58.61	58.68	58.76	58.66	58.76

SURFACE WATER AND MINOR WATERCOURSES

The Environment Agency's Risk of Flooding from Surface Water mapping indicates that the majority of the Three Elms Trading Estate is at low or very low risk of flooding from surface water. However, the mapping indicates the potential for overland flow passing through the site from the north, with potential for ponding of surface water within the centre of the site. Flood depths of up to 900mm are predicted during the medium risk 1 in 100 (1%) annual probability event. Whilst the mapping may not accurately represent the existing site drainage systems it does indicate a potentially significant source of flood risk to the site. Mapped surface water flood extents are reproduced in Figure I.6.

GROUNDWATER

Review of British Geological Survey (BGS) data indicates that the Three Elms Trading Estate is underlain by Raglan Mudstone Formation comprising siltstone and mudstone bedrock geology. Superficial deposits comprise Devensian Till.

Review of historic borehole logs available through the BGS indicate that the nearest borehole log is located approximately 900m to the east of the site. Groundwater was struck approximately 6m below ground level. Groundwater emergence is considered unlikely to occur, although could pose a

risk to below ground drainage systems and structures as ground levels within the Three Elms Trading Estate are slightly lower than the location of the borehole.

OTHER SOURCES OF FLOOD RISK

Review of the Environment Agency's Flood Risk from Reservoirs mapping indicates that the Three Elms Trading Estate is not located within an area deemed to be at risk of flooding from reservoirs. Review of OS mapping also indicates no reservoirs or other large raised storage features at a higher elevation to the site that would pose flood risk in the event of failure.

Review of the Dwr Cymru Welsh Water One Year and 50 Year Headroom datasets indicate a low risk of flooding from combined and surface water sewers adjacent to the east and west of the site. The combined and surface water sewers located along Grandstand Road to the north of the site are indicated to have a high risk of flooding.

HISTORIC FLOOD RECORDS

Review of Herefordshire Council and Dwr Cymru Welsh Water historic flood records at the time of preparing this report indicates that there are no historic flood records within the Three Elms Trading Estate site boundary. Reports of flooding within the surrounding area include flooding from sewers in 2007 approximately 250m to the east of the site at the Hereford Racecourse, and flooding from sewers in 2003 approximately 500m to the south of the site.

Significant flooding has occurred downstream of the site attributable to the Yazor and Widemarsh Brooks, particularly within the Edgar Street Gird area of Hereford. Surface water runoff from the Three Elms Trading Estate may therefore contribute to this risk.

PLANNING RECOMMENDATIONS

SPATIAL PLANNING AND DEVELOPMENT CONTROL

Development of the Three Elms Trading Estate 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. Two scenarios are being considered for the development of the Three Elms Trading Estate: 1) general industry and waste treatment (except landfill and hazardous waste) that would be classified as less vulnerable development; and 2) landfill and waste management facilities for hazardous waste that would be classified as more vulnerable development.

The Three Elms Trading Estate is located within the low risk Flood Zone 1. The site is indicated to remain within Flood Zone 1 when the potential effects of climate change are considered. The greatest source of flood risk to the site is associated with surface water that may flow and pond within the centre of the site.

All development is considered appropriate in the low risk Flood Zone 1 and therefore the Three Elms Trading Estate passes the Sequential and Exception Tests.

The Three Elms Trading Estate is served by Bakers Lane which joins onto the A4110 Three Elms Road. These roads are located within the low risk Flood Zone 1 and provide safe access and egress.

A site-specific Flood Risk Assessment (FRA) prepared in accordance with the NPPF and supporting Planning Practice Guidance will be required for any development located within the mapped surface water flood extents and for any development greater than 1ha. The FRA should address the risk of

flooding from the mapped surface water flows, as well as give consideration to the risk of sewerage flooding and increased risk associated with an increase in the rate or volume of site-generated surface water runoff.

A Combined Sewer Overflow flows through the centre of the site and discharges to the Yazor Brook to the south of the site. Any redevelopment of the site will need to ensure that easements to existing public sewers are maintained.

MANAGEMENT OF FLUVIAL FLOOD RISKS

The assessment presented above indicates that the risk of fluvial flooding to the Three Elms Trading Estate is low, both now and when the potential effects of climate change are considered. That said, finished floor levels of any new buildings or vulnerable areas of the development (such as areas that could cause pollution risk) should be raised a minimum of 600mm above the defended 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'design event'. Finished floor levels should also be located above the 1 in 100 (1%) annual probability event with an appropriate climate change allowance for the 'test event' that considers both the defended and undefended scenarios. Recommended climate change allowances for the design event and test event are summarised below in Table I.2.

Table I.2 Climate change allowances

Development Classification	Design scenario	Test scenario
Non-hazardous waste, general industry (less vulnerable)	1 in 100 annual probability event with 25%CC with operational FAS	Highest of: 1 in 100 annual probability event with 35%CC with operational FAS; 1 in 1000 annual probability event with operational FAS; or 1 in 100 annual probability event with 35%CC with fully blocked FAS
Landfill and hazardous waste (more vulnerable)	1 in 100 annual probability event with 35% with operational FAS	Highest of: 1 in 100 annual probability event with 70%CC with operational FAS; 1 in 1000 annual probability event with operational FAS; or 1 in 100 annual probability event with 35%CC with fully blocked FAS

MANAGEMENT OF SURFACE WATER AND OVERLAND FLOW

Development within the Three Elms Trading Estate must give consideration to the mapped surface water flood risk that is indicated to flow through the site from the north, and potentially pond within the centre of the site. Ideally development should be set back from this area and finished floor levels raised appropriately. The applicant must demonstrate how the mapped flood risk will be managed without posing risk to the development and without increasing flood risk elsewhere (i.e. by displacing surface water and pushing this into an adjacent site).

MANAGEMENT OF SITE GENERATED SURFACE WATER RUNOFF

The management of surface water runoff is important for the Three Elms Trading Estate given the downstream flood risk associated with the Yazor and Widemarsh Brooks. 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, where appropriate;
- 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.

It is assumed that the existing site discharges to the Dwr Cymru Welsh Water sewer network – either as surface water flows into the trunk foul sewer to the south-east of the site, to the foul sewer (Combined Sewer Overflow) that passes through the centre of the site, or to the surface water sewers to the east of the site. Development of the site may therefore opportunity to reduce the rate and volume of discharge as well as provide treatment.

Review of the National Soil Resources Institute Soilscapes mapping indicates that the soils beneath the site are freely draining. As discussed above groundwater levels are likely to be relatively shallow although some infiltration of runoff may be viable (for example via permeable paving) although the site's previous/existing uses may pose increased contamination risks. Onsite testing will be required to determine soil permeability, depth to the groundwater table (including potential for rising groundwater) and contamination risks. If onsite testing concludes lower permeability soils, combined attenuation and infiltration features should be promoted where groundwater levels and contamination risks permit to reduce runoff during small rainfall events and provide treatment.

If infiltration is not viable, it is assumed that surface water runoff will be discharged to the Yazor Brook via the existing Dwr Cymru Welsh Water sewer networks. Discharge should be attenuated to equivalent greenfield rates and volumes as far as practicable, with a minimum 20% betterment over existing rates expected. The required discharge rate would need to be agreed with Dwr Cymru Welsh Water although it is recommended that a maximum discharge rate of 5 l/s is applied to assist with reducing flood risk elsewhere whilst not introducing unacceptable risk in the event of blockage.

Providing robust treatment of runoff will be important (particularly if the site is proposed to be used for hazardous waste) to prevent adverse effect to the quality of the Yazor Brook and downstream watercourses and assist in achieving the objectives of the Water Framework Directive.

MANAGEMENT OF FOUL WATER

As the site is an existing development it is likely to be served by an existing foul water drainage system, assumed to comprise discharge into the Dwr Cymru Welsh Water sewerage network that serves Hereford. It is expected that any new development will utilise existing on-site systems if these

are appropriate and any changes to the existing system should be discussed with Dwr Cymru Welsh Water.

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