

ENVIRONMENT

Welcome Break Ltd
Stretton Court
Hinckley
Flood Risk Assessment

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Flood Risk Assessment

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EXECUTIVE SUMMARY

This Flood Risk Assessment (FRA) has been prepared in accordance with the requirements set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance (PPG). It has been produced on behalf of Welcome Break Ltd in respect of a planning application for the Proposed Development of a new Motorway Service Area (MSA) at Stretton Court, Hinckley (approximate grid reference: SP 43173 91034).

This report demonstrates that the Proposed Development is at an acceptable level of flood risk, subject to the recommended flood mitigation strategies being implemented.

The Environment Agency (EA) Flood Map for Planning shows the Site is located entirely within Flood Zone 1 (land at low risk of flooding from rivers and the sea). The nearest EA Main River is the Sketchley Brook which lies approximately 1.9km north of the Site. The Site is considered to be significantly removed from flood risk associated with Main Rivers, as the Site is elevated at least 12m above the nearest recorded Flood Zone 2 extents.

The Soar Brook passes through the southern extent of the Site and a minor unnamed ditch flows adjacent to the western site boundary. There are no Flood Zone extents attributed to the Soar Brook, therefore, a simple channel capacity assessment of the Soar Brook and culvert beneath the M69/A5 has been undertaken to determine the risk posed to the Site from the Soar Brook. The assessment indicated that the Soar brook has adequate capacity to allow for flows up to and including the 1 in 1000-year event. Overall, the flood risk to the Site from the Soar Brook is considered to be low.

In line with the requirements outlined within the Stratford-on-Avon DC, Warwickshire CC, North Warwickshire BC & Rugby BC Level 1 Strategic Flood Risk Assessment (SFRA), the Proposed Development should be located a minimum of 8m from the Soar Brook.

The Site is shown to be at an overall low risk of pluvial flooding. The Site access and egress route is shown to be at a low to medium risk of pluvial flooding. During the 1 in 100-year event, surface water depth and hazard mapping shows the proposed access route to be subject to depths of less than 150mm, presenting a low risk (Caution) hazard. Therefore, this is not expected to impact safe access and egress from the Site.

The Site is considered to be at a high risk of groundwater flooding. A Phase II Geo-Environmental Site Investigation was previously undertaken by BWB Consulting in May 2020 (reference: SPH-BWB-ZZ-00-RP-YE-0001-PH2_P2) where shallow groundwater levels were found during the intrusive ground investigation and post site monitoring. Should shallow groundwater levels be encountered during construction, a groundwater specialist should be appointed, and appropriate dewatering procedures should be employed as necessary.

It is recommended that finished floor levels are raised a minimum of 150mm above surrounding ground levels to help mitigate against any residual surface water and groundwater flood risk. It is also recommended that ground levels are profiled to encourage pluvial runoff away from the built development and towards the nearest drainage point.

The Site has been assessed against other sources of flood risk including canals, reservoirs and large waterbodies, and sewers. None of these are considered to significantly impact development at the Site.

The Proposed Development will increase the area of impermeable surfaces, increasing the rate of runoff from the Site. To mitigate the Proposed Development's impact on the current runoff regime it is proposed to incorporate surface water attenuation and storage as part of the Proposed Development. It is proposed to drain used water from the Proposed Development separately to surface water.

In compliance with the requirements of the NPPF, and subject to the mitigation measures proposed, the Proposed Development could proceed without being subject to significant flood risk. Moreover, the Proposed Development will not increase flood risk to the wider catchment area subject to suitable management of surface water runoff discharging from the Site.

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1. INTRODUCTION

- 1.1 This Flood Risk Assessment (FRA) has been prepared in accordance with the requirements set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance (PPG). The FRA has been produced on behalf of Welcome Break Ltd in respect of a planning application for the Proposed Development of a new Motorway Service Area (MSA) at Stretton Court, Hinckley.
- 1.2 The Site was previously granted planning permission in June 2020 (reference: 20/00531/HYB). A FRA was completed by BWB Consulting Ltd (reference: STP-BWB-ZZ-XX-RP-YE-0001_FRA) in support of this application. In accordance with the principles set out in the previous FRA, it is proposed that similar technical assessments are used to inform flood risk to the existing site.
- 1.3 This FRA is intended to support a full planning application, the level of detail included is commensurate and subject to the nature of the proposals at the planning stage. Summary information is included as **Table 1.1**.

Table 1.1: Site Summary

Site Name	Stretton Court
Location	Hinckley
NGR (approx.)	SP 43173 91034
Application Site Area (ha)	4.2 (approx.)
Development Type	Motorway Service Area
Flood Zone Classification	Flood Zone 1
NPPF Vulnerability	Less Vulnerable
Anticipated Development Lifetime	75 years
Environment Agency Office	West Midlands/East Midlands
Lead Local Flood Authority	Warwickshire County Council/Leicestershire County Council
Local Planning Authority	Rugby Borough Council/Hinckley & Bosworth Borough Council

Sources of Data

- i. Topographical Survey by Advanced Surveys (reference: Dwg. No. 266)
- ii. OS Explorer Series mapping

- iii. Environment Agency (EA) Consultation
- iv. Hinckley & Bosworth Borough Council Strategic Flood Risk Assessment
- v. Leicestershire and Leicester City Level 1 Strategic Flood Risk Assessment
- vi. Stratford-on-Avon DC, Warwickshire CC, North Warwickshire BC & Rugby BC Level 1 Strategic Flood Risk Assessment
- vii. Leicestershire County Council Preliminary Strategic Flood Risk Assessment
- viii. Warwickshire County Council Preliminary Strategic Flood Risk Assessment
- ix. Leicestershire County Council Flood Risk Management Strategy
- x. Warwickshire County Council Flood Risk Management Strategy
- xi. Humber River Basin District Flood Risk Management Plan 2021 to 2027
- xii. Rugby Borough Council Local Plan 2011 – 2031
- xiii. Hinckley & Bosworth Borough Council Local Development Framework Core Strategy
- xiv. 2022 1m spatial resolution EA Light Detection and Ranging (LiDAR) data
- xv. Site visits undertaken by BWB Consulting Ltd, 4th March 2020 and 25th July 2023
- xvi. Severn Trent Water Sewer Records
- xvii. Phase II Geo-Environmental Assessment by BWB Consulting Ltd (reference: SPH-BWB-ZZ-00-RP-YE-0001-PH2_P2)
- xviii. British Geological Survey (BGS) Drift & Geology Maps

Existing Site

- 1.4 The Site is situated within Hinckley, approximately 2.7km south of the town centre, located on the junction between the A5 and M69. The wider ownership boundary encircles an existing residential area in the north-west part of the Site known as Stretton Croft. The Soar Brook is located adjacent to the southern site boundary and flows from west to east through the Site. A minor unnamed ditch is also located adjacent to the western side boundary. The Site's location is illustrated within **Figure 1.1**.
- 1.5 The Site is indicated to lie across a county boundary which impacts the flood risk and planning policies that require consideration provided by each Lead Local Flood Authority (LLFA). The southwest area of the Site is located within Warwickshire and the north east area of the Site is located within Leicestershire. From a planning authority perspective, the Local Planning Authority (LPA) designation also lies over two authorities, Rugby Borough Council in the southwest and Hinckley and Bosworth Borough Council in the northeast. This is shown within **Figure 1.2**.

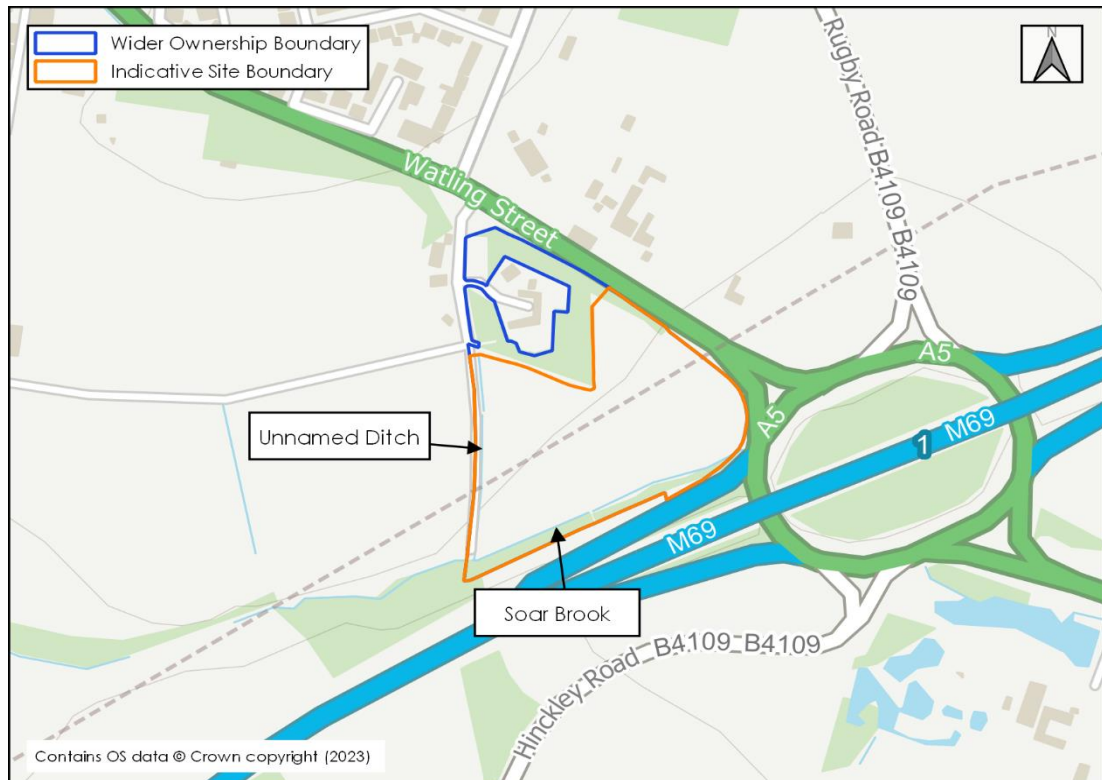


Figure 1.1: Site Location

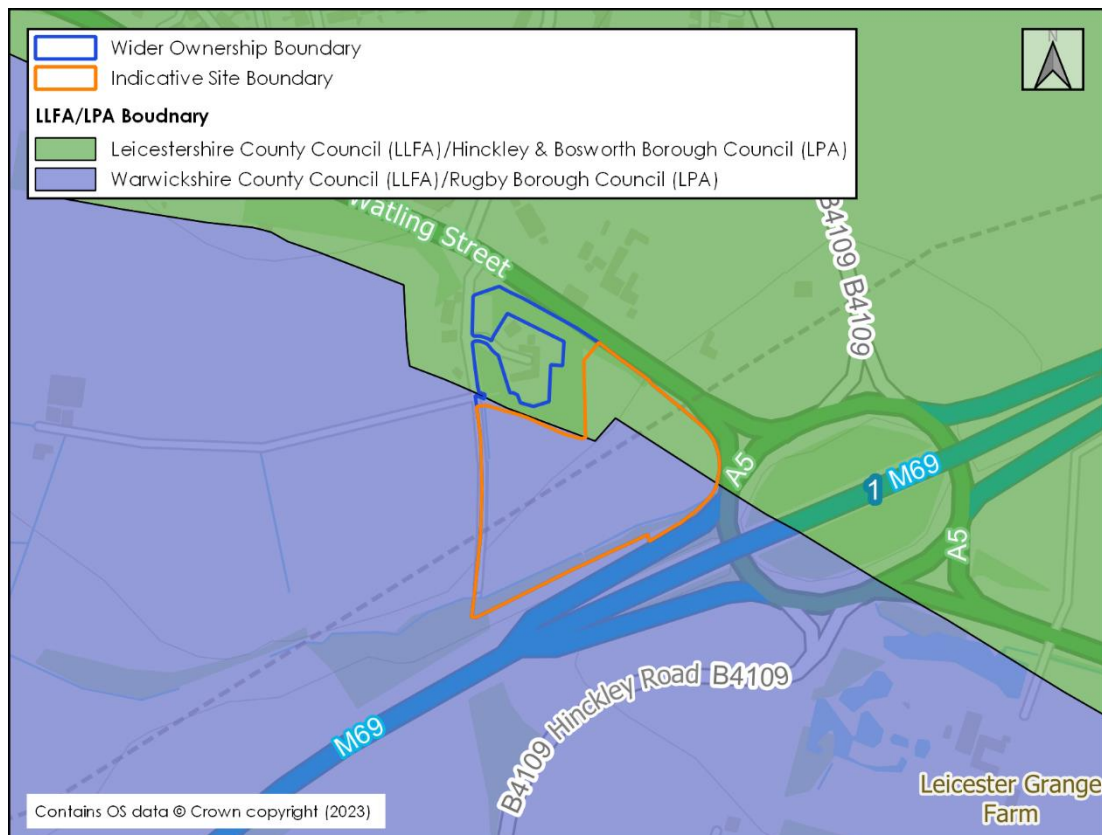


Figure 1.2: LLFA/LPA Boundaries

- 1.6 A topographical survey has been undertaken and included as **Appendix 1**. The survey shows the Site generally falls in a south-easterly direction from a high point of 114.1 metres Above Ordnance Datum (mAOD) in the northwest, to a low point of 106.9mAOD in the southeast. An isolated topographical highpoint is shown to be located to the northeast of the Site with an elevation of 115.5mAOD.
- 1.7 The Site currently comprises undeveloped greenfield grassland.
- 1.8 A site visit was undertaken as part of the previous FRA by BWB Consulting Ltd (reference: STP-BWB-ZZ-XX-RP-YE-0001_FRA) on the 4th March 2020. The Site was revisited on 25th July 2023 to confirm the current conditions. The Site is significantly overgrown which restricted access to large portions of the Site. Present day site condition is shown in **Figure 1.3**.



Figure 1.3: Existing Conditions - View East to West (Taken During Site Visit - 25/07/23)

Proposed Development

- 1.9 The Proposed Development is understood to comprise an MSA, drive thru coffee shop, HGV fuel sales area, and associated car parking areas. The proposed site access will be via the A5 at the north-eastern corner of the Site.
- 1.10 The proposed site layout plan is included as **Appendix 2**.

2. FLOOD RISK PLANNING POLICY & GUIDANCE

National Planning Policy Framework

- 2.1 The NPPF¹ sets out the Government's national policies on different aspects of land use planning in England in relation to flood risk. The PPG is also available online².
- 2.2 The PPG sets out the vulnerability to flooding of different land uses. It encourages development to be located in areas of lower flood risk where possible and stresses the importance of preventing increases in flood risk off site to the wider catchment area.
- 2.3 The PPG also states that alternative sources of flooding, other than fluvial (river flooding), should be considered when preparing a FRA.
- 2.4 The PPG includes a series of tables that define Flood Zones (Table 1), the flood risk vulnerability classification of development land uses (Table 2) and 'compatibility' of development within the defined Flood Zones (Table 3). Table 2 and Table 3 are recreated within **Appendix 3** of this report for reference.
- 2.5 This FRA is written in accordance with the NPPF and the PPG.

Flood Map for Planning

- 2.6 With particular reference to planning and development, the Flood Map for Planning identifies Flood Zones in accordance with Table 1 of the PPG. Further details on the Flood Zone classifications are outlined in **Table 2.1**.

Table 2.1: Flood Zone Classifications

Flood Zone	Description
Flood Zone 1 (Low Probability)	Land having less than a 1 in 1000 annual probability of river or sea flooding (<0.1% Annual Exceedance Probability). All land outside of Flood Zone 2 and 3.
Flood Zone 2 (Medium Probability)	Land having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1% AEP); or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1% AEP).
Flood Zone 3a (High Probability)	Land having a 1 in 100 or greater annual probability of river flooding (>1% AEP); or land having a 1 in 200 or greater annual probability of flooding from the sea (>0.5% AEP). This is represented by "Flood Zone 3" on the Flood Map for Planning.
Flood Zone 3b (The Functional Floodplain)	Flood Zone 3b (The Functional Floodplain) is defined as land where water must flow or be stored in times of flood. This is not identified or separately distinguished from Zone 3a on the Flood Map for Planning.

¹ Revised National Planning Policy Framework, Ministry of Housing, Communities & Local Government, amended 2021

² Planning Practice Guidance: <https://www.gov.uk/government/collections/planning-practice-guidance>

2.7 The Site is shown to be located entirely within Flood Zone 1, as shown in **Figure 2.1**.



Figure 2.1: Flood Map for Planning

The Design Flood

- 2.8 The PPG identifies that new developments should be designed to provide adequate flood risk management, mitigation, and resilience against the 'design flood' for their lifetime.
- 2.9 This is a flood event of a given annual flood probability, which is generally taken as fluvial (river) and surface water (pluvial) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), or tidal flooding with a 0.5% annual probability (1 in 200 chance each year), against which the suitability of a Proposed Development is assessed and mitigation measures, if any, are designed.

Climate Change

- 2.10 Predicted future changes in peak river flows caused by climate change are provided by the EA³, with a range of projections applied to regionalised 'River Basin Districts', which are further subdivided into Management Catchments.
- 2.11 The Site falls within the Soar Management Catchment of the Humber River Basin District. **Table 2.2** identifies the relevant peak river flow climate change allowances from this Management Catchment.

Table 2.2: Peak River Flow Climate Change Allowances for the Soar Management Catchment within the Humber River Basin District

Allowance Category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2125)
Upper End	28%	35%	60%
Higher Central	18%	21%	37%
Central	14%	16%	28%

- 2.12 When determining the appropriate allowance for use in a FRA the Flood Zone classification, flood risk vulnerability and the anticipated lifespan of the Proposed Development should be considered. **Table 2.3** provides a matrix summarising the EA's guidance on determining the appropriate allowance(s).

Table 2.3: Application of Appropriate Peak River Flow Climate Change Allowances

Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
1	Use the central allowance where a location may fall within Flood Zone 2 or 3 in the future.				
2	Use the higher central allowance	Use the central allowance			
3a	Use the higher central allowance	Development should not be permitted	Use the central allowance		
3b	Use the higher central allowance	Development should not be permitted			Use the central allowance
If development is considered appropriate by the local authority when not in accordance with Flood Zone vulnerability categories, then it would be appropriate to use the higher central allowance.					

³ Environment Agency, Flood risk assessments: climate change allowances; <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>. Last Accessed July 2023.

- 2.13 The Site is located entirely within Flood Zone 1, the Proposed Development is classified as 'Less Vulnerable', and it has an anticipated lifespan of 75 years. Therefore, the Central allowance for the '2080s' epoch should be considered if the Site may fall in Flood Zone 2 or 3 in the future.
- 2.14 Future Flood Zone mapping is included as part of the Leicestershire and Leicester City Level 1 SFRA⁴ and the Hinckley & Bosworth Borough Council Level 1 SFRA⁵. The mapping shown within both SFRAs indicates that the Site is located outside of all modelled fluvial flood extents tested including the 1 in 100-year +50% climate change event.
- 2.15 A review of EA LiDAR data shows that the Site is elevated at least 12m above the nearest EA Main River, and is therefore, not expected to be in a location which may fall into Flood Zone 2 or 3 within the anticipated lifetime of the Proposed Development.
- 2.16 However, this future Flood Zone mapping does not consider flooding from the Soar Brook located at the southern site boundary. In the absence of modelling, a Manning's capacity assessment was considered to be the next best alternative method for estimating flood levels at the Site for the design event. Therefore, the Central Allowance (28%) for the '2080s' epoch will be considered in this FRA for completeness.

Strategic Flood Risk Assessment

- 2.17 A Strategic Flood Risk Assessment (SFRA) is a study carried out by one or more local planning authorities to assess the risk to an area from flooding from all sources, now and in the future.

Hinckley & Bosworth Borough Council Strategic Flood Risk Assessment

- 2.18 The Hinckley & Bosworth Borough Council Level 1 SFRA has been reviewed in the production of this FRA. The SFRA provides a comprehensive and robust evidence base on flood risk issues to support the production of the Hinckley & Bosworth Local Plan to 2036. The SFRA also provides guidance for the application of the Sequential and Exception Tests at a site level and for detailed site-specific FRAs. Information from the Bosworth Borough Council Level 1 SFRA will be referenced within **Section 3** where applicable.
- 2.19 The Hinckley & Bosworth Borough Council Level 2 SFRA⁶ was produced to facilitate the application of Sequential and Exception Tests to screen allocated development sites. The proposed application site is not referenced within the Level 2 SFRA. Upon review no applicable information in relation to flood risk at the Site was identified.

Leicestershire and Leicester City Level 1 Strategic Flood Risk Assessment

- 2.20 The Leicestershire and Leicester City Level 1 SFRA⁷ has also been reviewed in the production of this FRA. The SFRA provides up to date information and guidance on flood risk across Leicestershire County and Leicester City, taking into account the latest flood

⁴ Leicestershire and Leicester City Level 1 Strategic Flood Risk Assessment (JBA Consulting, October 2017)

⁵ Strategic Flood Risk Assessment for Hinckley and Bosworth Borough Council (JBA Consulting, July 2019)

⁶ Hinckley and Bosworth Borough Council Level 2 Strategic Flood Risk Assessment (JBA Consulting, May 2020)

⁷ Leicestershire and Leicester City Level 1 Strategic Flood Risk Assessment (JBA Consulting, October 2017)

risk information and the current national planning policy. Information from the Leicestershire and Leicester City Level 1 SFRA will be referenced within **Section 3** where applicable.

The Stratford-on Avon DC, Warwickshire CC, North Warwickshire BC & Rugby BC Level 1 Strategic Flood Risk Assessment

- 2.21 The Stratford-on-Avon DC, Warwickshire CC, North Warwickshire BC & Rugby BC Level 1 SFRA⁸ has also been reviewed in the production of this FRA. The SFRA's primary objective was to enable the LPA's to undertake sequential testing in line with the Government's principles of flood risk and planning set as out in the NPPF. This requires all developments to be steered to areas of lowest flood risk where possible. Information from the Stratford-on-Avon DC, Warwickshire CC, North Warwickshire BC & Rugby BC Level 1 SFRA will be referenced within **Section 3** where applicable.

Preliminary Flood Risk Assessment

- 2.22 A Preliminary Flood Risk Assessment (PFRA) is an assessment of floods that have taken place in the past and floods that could take place in the future. It generally considers flooding from surface water runoff, groundwater and ordinary watercourses, and is prepared by the LLFAs.

Leicestershire County Council Preliminary Flood Risk Assessment

- 2.23 The Leicestershire County Council PFRA⁹ considers flooding from surface water runoff, groundwater, ordinary watercourses and canals. However, no historical instances of flooding at the Site are referenced. Information from the PFRA will be referenced within **Section 3** where applicable.
- 2.24 The Leicestershire County Council PFRA Addendum¹⁰ has also been reviewed in the production of this FRA. The PFRA Addendum provides an update to the 2011 PFRA. Information from the PFRA Addendum will be referenced within **Section 3** where applicable.
- 2.25 Key findings from the PFRA Addendum include:
- The majority of flooding within the Leicestershire area has been as a result of ordinary watercourses and surface runoff.
 - Since 2011, a number of flooding incidents linked with groundwater have been recorded however their severity was not considered significant.
 - Flood risk areas have been reviewed and Hinckley and Burbage are now considered. However, no further information on the classification is provided.

⁸ Stratford-on Avon DC, Warwickshire CC, North Warwickshire BC & Rugby BC Level 1 Strategic Flood Risk Assessment (URS, September 2013)

⁹ Leicestershire County Council Preliminary Flood Risk Assessment (URS/Scott Wilson, June 2011)

¹⁰ Leicestershire County Council Preliminary Flood Risk Assessment Addendum (Leicestershire County Council, December 2017)

Warwickshire County Council Preliminary Flood Risk Assessment

- 2.26 The Warwickshire County Council PFRA¹¹ presents the results of a high-level screening exercise, identifying areas of significant flood risk. This PFRA also references past flood risk within the county, however, no historical instances of flooding at the Site are referenced. Information from the PFRA will be referenced within **Section 3** where applicable.
- 2.27 The Warwickshire County Council PFRA Addendum¹² has also been reviewed in the production of this FRA. The PFRA Addendum provides an update to the 2011 PFRA. The addendum states that no changes to past and future flood risk have been identified since the 2011 PFRA was published.

Local Flood Risk Management Strategy

- 2.28 A Local Flood Risk Management Strategy (LFRMS) is prepared by an LLFA to help understand and manage flood risk at a local level.
- 2.29 The LFRMS aims to ensure that the knowledge of local flood risk issues is communicated effectively so that they can be better managed. The LFRMS also aims to promote sustainable development and environmental protection.
- 2.30 The Leicestershire County Council LFRMS¹³ and Warwickshire County Council LFRMS¹⁴ have been reviewed and no applicable information in relation to flood risk at the Site was identified.

River Basin Flood Risk Management Plan

- 2.31 Flood Risk Management Plans (FRMPs) explain the risk of flooding from rivers, the sea, surface water, groundwater and reservoirs. FRMPs set out how risk management authorities will work with communities to manage flood and coastal risk. Risk management authorities include the EA, Natural Resources Wales, local councils, internal drainage boards, Highways England and LLFAs.
- 2.32 The first FRMPs were published in March 2016. They describe actions to manage flood risk across England between 2015 to 2021. A series of updated reports were subsequently published at the end of 2022 which cover the period of 2021 to 2027.
- 2.33 The Site is located within the Humber River Basin District, and the Humber River Basin District FRMP¹⁵ has been reviewed. However, there are no relevant site scale objectives which relate to the Site.

¹¹ Warwickshire County Council Preliminary Flood Risk Assessment (Royal Haskoning, May 2011)

¹² Warwickshire County Council Preliminary Flood Risk Assessment Addendum (Leicestershire County Council, December 2017)

¹³ Leicestershire County Council Local Flood Risk Management Strategy (Leicestershire County Council, August 2015)

¹⁴ Warwickshire County Council Local Flood Risk Management Strategy (Warwickshire County Council, April 2016)

¹⁵ Humber River Basin District Flood Risk Management Plan 2021 to 2027 (Environment Agency, December 2022)

Surface Water Management Plan

- 2.34 Surface Water Management Plan (SWMPs) are non-statutory plans which preceded the introduction of the Flood and Water Management Act 2010. They can provide an important evidence base of local flood risk issues which can include surface water drains, groundwater and small watercourses.
- 2.35 The Warwickshire County Council SWMP¹⁶ plan has been reviewed but the proposed application site is not referenced.
- 2.36 The Leicestershire County Council website has been reviewed and a SWMP which covers the Site location has not been identified.

Section 19 Flood Investigation Reports

- 2.37 Under their duties of the Flood and Water Management Act 2010, LLFAs have a responsibility to publish reports of investigations of flood incidents. A section 19 flood investigation report is a public statement of the circumstances of a historical flood event and what parties have a role in managing the risks. The investigation does not always give an in-depth analysis of the flood risk or mechanisms, but it can provide a valuable record of past events.

Leicestershire County Council

- 2.38 Leicestershire County Council have published 35 Section 19 reports on their website, which document the flooding that occurred between 2014 and 2022. The reports have been reviewed in relation to the Site's location, but no evidence of flooding at the Site was identified.

Warwickshire County Council

- 2.39 Warwickshire County Council have published five Section 19 reports on their website, which document the flooding that occurred between 2017 and 2021. The reports have been reviewed in relation to the Site's location, but no evidence of flooding at the Site was identified.

Local Plan

Rugby Borough Council Local Plan 2011-2031

- 2.40 The Rugby Borough Council Local Plan 2011-2031¹⁷ has been reviewed in the production of this FRA. The Local Plan sets out the Council's policies and proposals to support the Proposed Development of the Borough through to 2031. Key policies relating to flood risk and drainage are summarised below:

¹⁶ Warwickshire County Council Surface Water Management Plan Methodology Report (AECOM, August 2015)

¹⁷ Rugby Borough Council Local Plan 2011-2031 (Rugby Borough Council, June 2019)

Policy SDC5: Flood Risk Management

2.41 The Proposed Development will only be permitted when:

- i. The Proposed Development does not increase flood risk elsewhere.
- ii. The most vulnerable development is located in the lowest areas of flood risk.
- iii. Development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems (SuDS).

Policy SDC6: Sustainable Drainage

2.42 SuDS are required in all major developments and all development in Flood Zones 2 and 3. SuDS should be:

- i. Be designed and located outside the floodplain and to integrate with Green and/or infrastructure functions.
- ii. Be appropriate for the needs of the Site.
- iii. Promote enhanced biodiversity.
- iv. Improve water quality.
- v. Increase landscape value.
- vi. Provide good quality open spaces.

2.43 Infiltration SuDS is the preferred way of managing surface water. Where it is proven infiltration is not possible, surface water should be discharged into a watercourse (in agreement with the LLFA) at pre-development greenfield run off rates.

Hinckley & Bosworth Borough Council Local Development Framework Core Strategy

2.44 The Hinckley & Bosworth Council Core Strategy¹⁸ has also been reviewed in the production of this FRA. The Core Strategy sets out the overarching strategy and core policies to guide the future development of the borough up to 2026. Key policies relating to flood risk and drainage will be adhered to where appropriate.

Other Relevant Policy and Guidance

2.45 This FRA has considered the following documents when assessing sources of flood risk and when recommending mitigation and resilience measures.

Flood Risk to People and New Developments

2.46 The Flood Risk to People (FD2321/TR1)¹⁹ document was prepared as a research project considering flood hazard and factors that affect it.

¹⁸ The Hinckley & Bosworth Borough Council Local Development Framework Core Strategy (Hinckley & Bosworth Borough Council, 2008)

¹⁹ Flood Risk to People Methodology (FD2321/TR1), Defra/Environment Agency, 2006

2.47 Flood Risk Assessment Guidance for New Development (FD2320/TR2)²⁰ provides a framework and guidance for assessing and managing flood risks for new developments and sets flood hazard thresholds.

2.48 Hazard ratings are derived using the following equation in line with the above:

$$\text{Hazard Rating} = D * (V+0.5) + DF$$

Where:

D = depth

V = velocity

DF = debris factor

2.49 A supplementary note²¹ provides clarification of the hazard rating thresholds which should be used for development planning and control use. **Table 2.4** identifies the thresholds of the flood hazard categories.

Table 2.4: Hazard to People²²

Threshold for Flood Hazard Rating	Degree of Flood Hazard	Description
< 0.75	Low	Caution "Flood zone with shallow flowing water or deep standing water"
0.75 - 1.25	Moderate	Danger for some (i.e.: children, the elderly and the infirm) "Danger: Flood Zone with deep or fast flowing water"
1.25 - 2.0	Significant	Danger for most (includes the general public) "Danger: Flood Zone with deep fast flowing water"
2.0 >	Extreme	Danger for all (includes the emergency services) "Extreme Danger: Flood Zone with deep fast flowing water"

²⁰ Flood Risk Assessment Guidance for New Development (FD2320/TR2), Defra/Environment Agency, 2005

²¹ Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. (http://randd.defra.gov.uk/Document.aspx?Document=FD2321_7400_PR.pdf)

²² 2008, DEFRA, Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purposes.

3. POTENTIAL SOURCES OF FLOOD RISK

- 3.1 Flooding can occur from a variety of sources, or combination of sources, which may be natural or artificial. **Table 3.1** below identifies the potential sources of flood risk to the Site in its current condition, and the impacts which the Proposed Development could have in the wider catchment, prior to mitigation. These are discussed in greater detail in the forthcoming section. The mitigation measures proposed to address flood risk issues and ensure the Proposed Development is appropriate for its location are discussed within **Section 4**.

Table 3.1: Pre-Mitigation Sources of Flood Risk

Flood Source	Potential Risk				Description
	High	Medium	Low	None	
Fluvial			X		The Site is located entirely within Flood Zone 1. The Soar Brook flows through the southern site extent and is shown to pose a low risk to the Site.
Pluvial runoff			X		The Site is at an overall low risk of pluvial flooding. A low to high risk pluvial low route is shown at the southern extent of the Site in line with the Soar Brook.
Canals				X	The Ashby de la Zouch Canal lies approximately 1.6km to the west of the Site. The Site is suitably removed and elevated at least 14m above the canal, therefore there is not considered to be any flood risk posed from this source at the Site.
Groundwater	X				Shallow groundwater levels were found at the Site during a Phase II site investigation.
Reservoirs and waterbodies			X		The Site is shown to fall outside of the area at risk of reservoir failure.
Sewers			X		There are no public sewers located within the Site. The existing private sewer network located within the Site is not considered to pose risk to the Proposed Development.

Flood Source	Potential Risk				Description
	High	Medium	Low	None	
Effect of Development on Wider Catchment			X		Development will not result in impedance of surface water flow routes.
		X			The Proposed Development will increase the area of impermeable surfaces leading to a potential increase in runoff prior to mitigation.

Fluvial Flood Risk

- 3.2 Flooding from watercourses occurs when flows exceed the capacity of the channel, or where a restrictive structure is encountered, which leads to water overtopping the banks into the floodplain. This process can be exacerbated when debris is mobilised by high flows and accumulates at structures.

Historical Flood Risk

- 3.3 The EA Historical Flood Map shows there are no previously recorded flood outlines which have impacted the Site or immediate surrounding area. Correspondence with the EA confirms that they do not hold any records of historic fluvial flooding at this location.
- 3.4 The Warwickshire County Council and Leicestershire County Council PFRA, and the Leicestershire and Leicester City Level 1 SFRA do not report any historical fluvial flood events which have impacted the Site or surrounding area.
- 3.5 The Hinckley and Bosworth Borough Council Level 1 SFRA reports one previous flood incident located approximately 350m north of the Site, attributed to a combination of fluvial and surface water sources. However, the magnitude and exact locations of flooding are not provided.
- 3.6 The 'Historic Flood Records' map appended to the Stratford-on-Avon DC, Warwickshire CC, North Warwickshire BC & Rugby BC Level 1 SFRA shows there are no previously recorded fluvial flood events which have impacted the Site.

Main Rivers

- 3.7 The Site is shown to be located entirely within Flood Zone 1, which is land at low risk of flooding. The nearest EA Main River is the Sketchley Brook which lies approximately 1.9km to the north of the Site. EA LiDAR data shows the Site is elevated at least 12m above the Sketchley Brook and its nearest Flood Zones.

- 3.8 Overall, the Site is considered to be at low risk of fluvial flooding attributed to EA Main Rivers as the Site is elevated at least 12m above the nearest Flood Zone 2 extents.

Ordinary and Minor Watercourses

- 3.9 The Soar Brook, classified as an Ordinary Watercourse, is located along the southern site boundary and flows from west to east. A minor unnamed ditch is also located adjacent to the western site boundary running from north to south. An extract of mapping with these watercourses annotated is included as **Figure 3.1**.

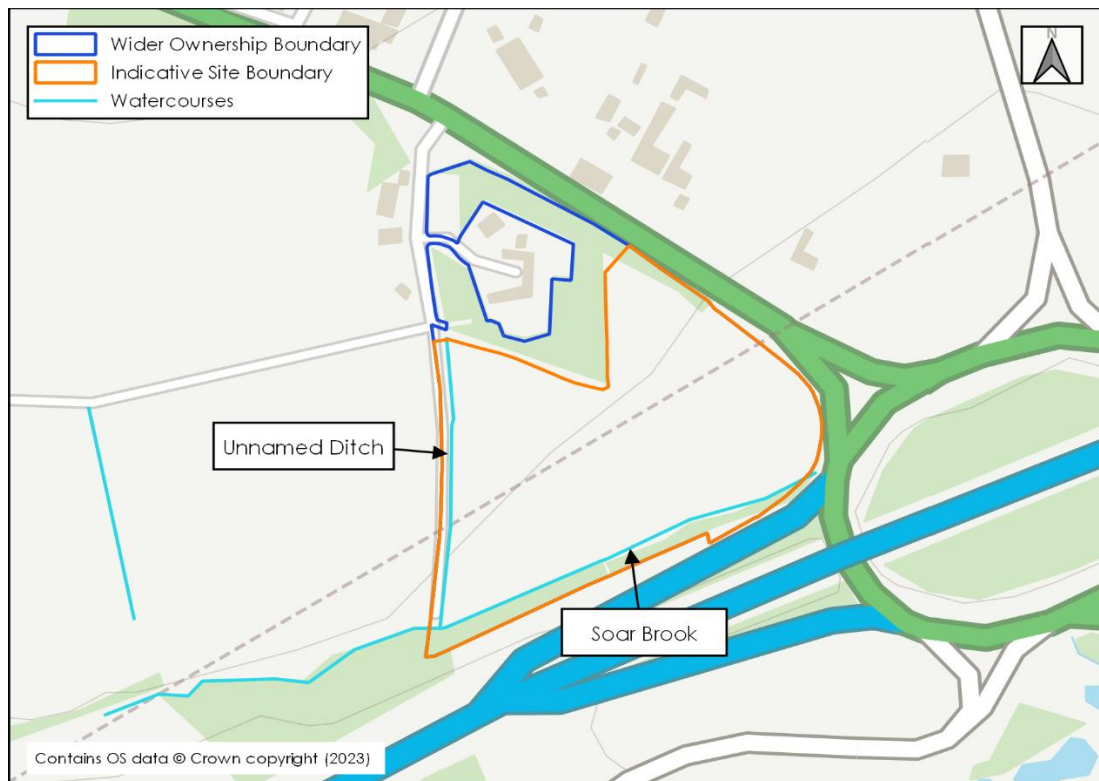


Figure 3.1: Site Watercourses

- 3.10 The ditch on the western site boundary was indicated to be dry on both occasions the Site was visited (04/03/20 and 25/07/23). Upon inspection, there was debris from vegetation within the channel, and over hanging tree branches either side of the channel. There is also a visibly damaged headwall at the confluence between the minor ditch and the Soar Brook. This will be required to be repaired as part of future construction works to ensure flows are not restricted and the minor ditch does not pose a future flood risk to the Site.
- 3.11 The Soar Brook, located at the southern site boundary, was identified to have a shallow channel of approximately 0.9m deep. The side slopes of the channel from the channel bed to the top of bank are typically shallow with an approximate gradient of 1 in 5. Water was present during the Site visit undertaken on 25/07/23, however, minimal flow was visible. The Soar Brook is shown in **Figure 3.2**.



Figure 3.2: Soar Brook within the Site Boundary (Taken During Site Visit - 25/07/23)

- 3.12 The Soar Brook flows from the Site, on the eastern boundary, via a 900mm diameter culvert beneath the A5/M69 interchange.
- 3.13 The EA Flood Map for Planning does not identify watercourses with catchment areas of less than 3km², therefore, the EA Risk of Flooding from Surface Water (RoFSW) mapping can be used as a proxy for assessing fluvial flood risk to the Site, as this dataset provides an indication of the potential floodplain associated with the UOW. An extract of mapping is included as **Figure 3.3**.
- 3.14 The RoFSW mapping shows a low to high risk pluvial flow route along the southern site boundary which aligns with the Soar Brook. This provides an indicative floodplain associated with the watercourse.

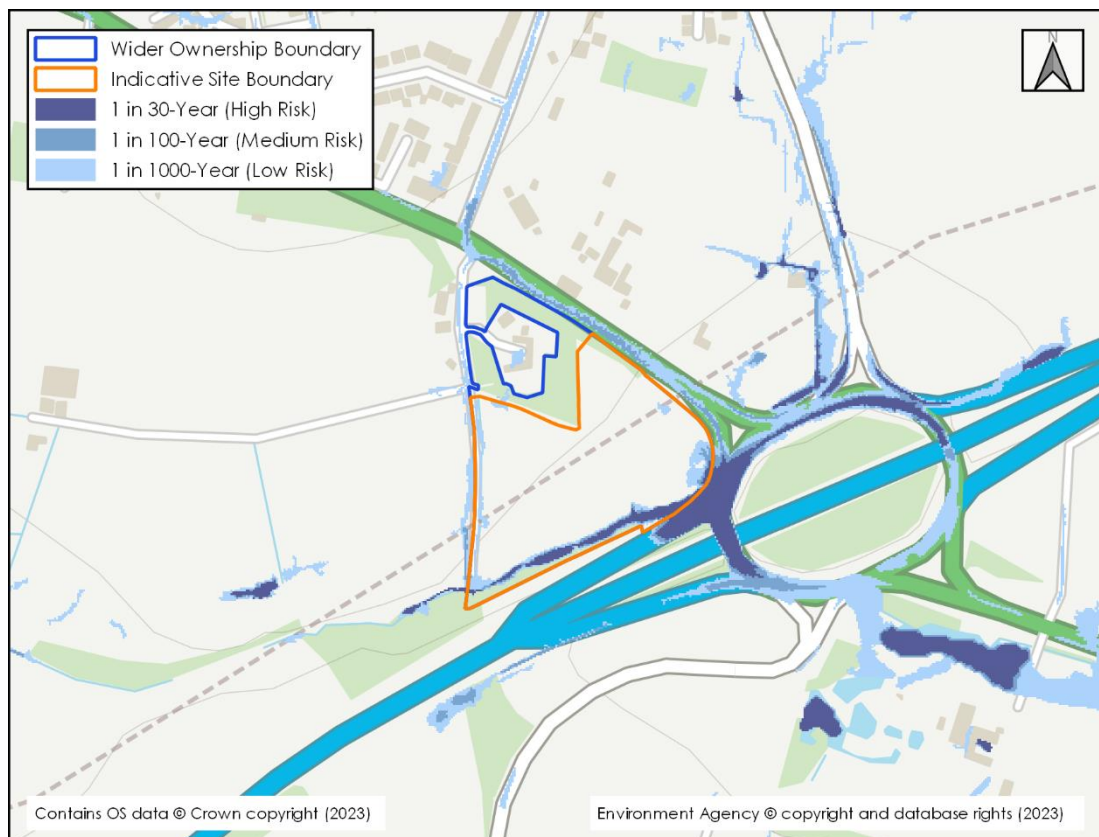


Figure 3.3: Surface Water Flood Map

- 3.15 It is understood that the EA and LLFA do not hold a hydraulic model of the Soar Brook. Therefore, a preliminary assessment of the channel capacity and probable flood flows has been undertaken as part of this FRA to determine the risk posed to the Site from the Soar Brook.

Hydrological Assessment

- 3.16 The Soar Brook is an ungauged watercourse, therefore, there are no hydrometric records of river flows or levels on which a hydrological assessment of flood flows can be made.
- 3.17 The Soar Brook catchment is defined by a series of descriptors which have been downloaded directly from the Flood Estimation Handbook (FEH) website. The FEH web service provides the data and rainfall model outputs that are required to apply the UK flood frequency and rainfall estimation procedures.
- 3.18 There is no catchment for the Soar Brook on the FEH Web Service. In this instance, FEH has incorrectly assigned the headwaters of the Soar Brook to an unnamed ordinary watercourse to the west of the Site (a tributary of the River Anker). Therefore, the catchment descriptors from this other watercourse have been extracted in order to obtain representative data.
- 3.19 The FEH method is only applicable to catchments 0.5km² or greater. Due to the small catchment area which covers the Site, it was necessary to extract a catchment circa

750m downstream of the Site. The extracted catchment is shown to cover an area of approximately 0.76km² (76ha). An extract of mapping is included as **Figure 3.4**.

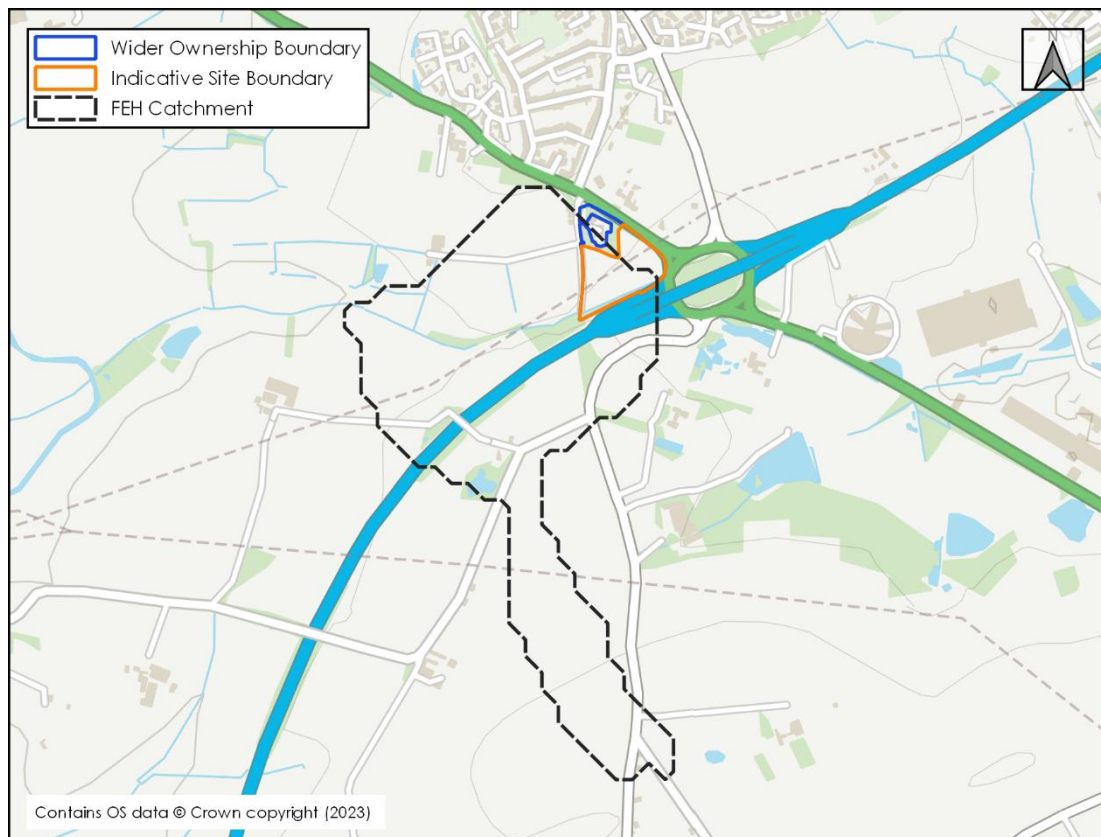


Figure 3.4: FEH Catchment Area

- 3.20 As this FEH catchment includes additional areas downstream of the Site, and outside of the Soar Brook catchment, there will be a greater contribution of flows than the Site experiences. Therefore, the estimated flood flows are considered to be conservative.
- 3.21 The FEH catchment is shown to be essentially rural, with a low urban influence (URBEXT₂₀₀₀: 0.0131). The underlying ground conditions are not shown to be highly permeable (SPRHOST greater than 20% and BFIHOST less than 0.8). Therefore, the standard FEH procedures are applicable.
- 3.22 For this preliminary assessment of channel capacity, the ReFH2 rainfall-runoff model has been used to estimate peak flow rates using the FEH2022 rainfall dataset.
- 3.23 A summary of the peak flow rates taken from the Urbanised Peak Flow derived from the ReFH2 methodology are shown within **Table 3.2**. Outputs for the 100-Year and 1000-Year peak flow rates are included as **Appendix 4**.

Table 3.2: Summary of Peak Flow Rates

Return Period	Estimated Flow (m ³ /s)
2-Year	0.06
30-Year	0.14
100-Year	0.18
100-Year +28%	0.23
1000-Year	0.31

Manning's Capacity Assessment

- 3.24 To investigate the Soar Brook's capacity, a Manning's calculation has been undertaken. This is based upon a typical cross-sectional profile of the Soar Brook as taken from EA LiDAR elevation data. The cross-section location is shown within **Figure 3.5** and cross-sectional profile is shown within **Figure 3.6**.

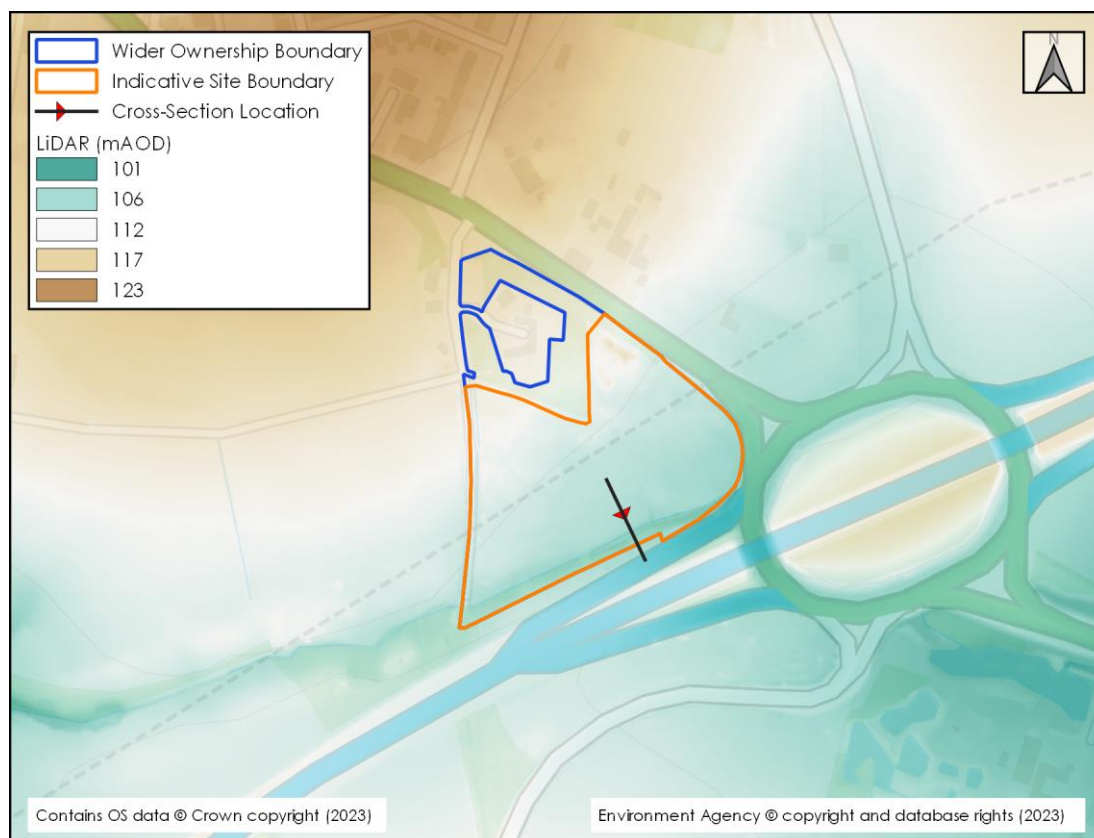


Figure 3.5: Site Topography

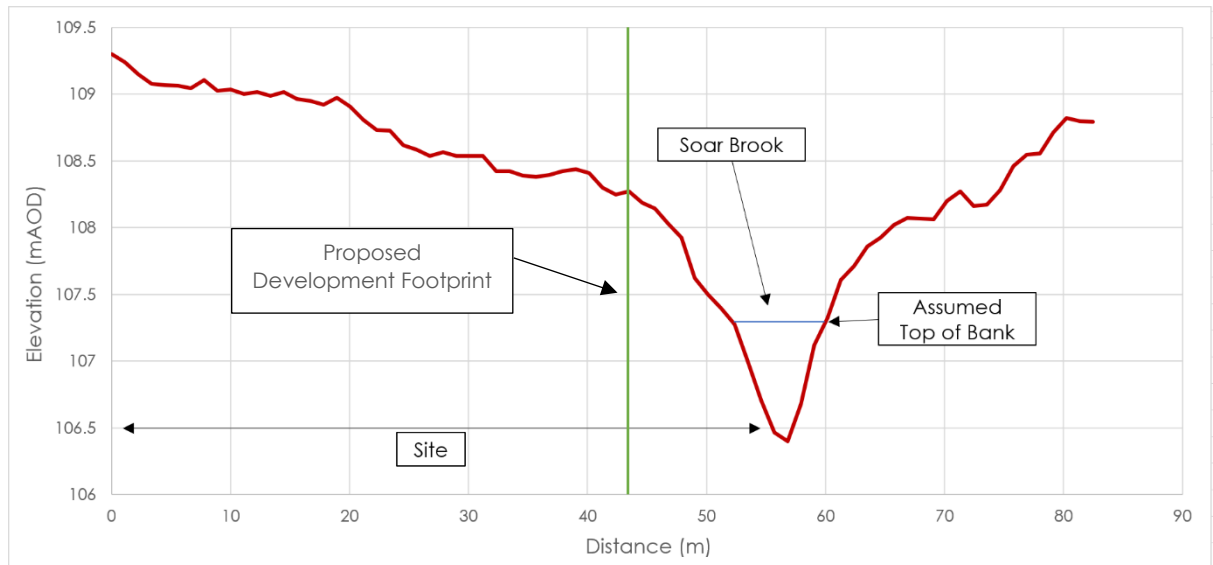


Figure 3.6: LiDAR Cross-Section of Soar Brook

- 3.25 To determine the flow capacity of the channel cross-section, the Manning's equation for open channel flows was used. The equation is shown below:

$$Q = \frac{K A R^{2/3} S^{1/2}}{n}$$

Whereby:

- Q = Flow rate (m³/s)
- A = Cross-sectional area of flow
- R = Hydraulic radius (cross-sectional area divided by wetted perimeter)
- S = Slope of the channel at the point of measurement
- n = Surface roughness (based upon channel material and condition)
- K = Constant dependent upon units

- 3.26 The capacity has been calculated based upon the cross-section shown within **Figure 3.6**. The top of bank has been assumed based on where a break in slope occurs between the bank levels and the Site. Based upon the channels condition during the Site visit (25/07/23), a Manning's roughness coefficient (n) of 0.05 for a natural vegetated channel has been used.
- 3.27 The cross-sectional area of flow (A) and wetted perimeter (P) were measured from the cross section taken. The (S₀) value is the average gradient along a typical length of the channel through the south of the Site. Results of the hydraulic analysis are included within **Table 3.3**. Calculation outputs are included within **Appendix 4**.

Table 3.3: Channel Capacity Estimates

A (m ²)	P (m)	S ₀	n	Q (m ³ /s)
3.71	8.18	1 in 150	0.05	3.56

- 3.28 Based upon this preliminary assessment, the channel has sufficient capacity for the estimated flood flows up to, and including, the 1 in 1000-year event. It is worth noting that this is including a conservative estimate of flood flows at this location (due to overestimation of the contributing catchment).

Assessment of the (M69/A5) Culvert Capacity

- 3.29 The Soar Brook is conveyed beneath the M69/A5 roundabout downstream of the Site. The topographical survey (**Appendix 1**) confirms the presence of a 900mm diameter culvert, which is considered to potentially act as a restrictive structure in the occurrence of an extreme rainfall event.
- 3.30 This culvert was identified on both site visits; however, imagery could not be obtained during the second site visit (25/07/23) due to the Site being significantly overgrown reducing safe access. The culvert is shown in **Figure 3.7**.



Figure 3.7: Soar Brook (M69/A5) Culvert (Taken During Site Visit – 04/03/20)

- 3.31 The Colebrook-White equation has been used to identify the capacity of the existing culvert. The culvert dimensions have been taken from the topographical survey and the gradient approximated from EA LiDAR data based on elevation at the inlet and outlet of the culvert. Outputs are shown within **Table 3.4** and calculations included within **Appendix 4**.

Table 3.4: Estimated Capacity of Existing Pipe Network (Colebrook-White)

Pipe Ref.*	Pipe Diameter (mm)	Roughness Ks (mm)	Pipe Gradient	Pipe Full Capacity (l/s)
M69/A5 Culvert	900	0.6	1 in 385	1011.2
Total				1011.2

- 3.32 Based upon this preliminary assessment, the culvert has sufficient capacity for the estimated flood flows up to, and including, the 1 in 1000-year event.
- 3.33 Overall, the Site is considered to be at a low risk of fluvial flooding. Mitigation measures to reduce any residual risk posed by the Soar Brook are discussed within **Section 4**.

Pluvial Flood Risk

- 3.34 Pluvial flooding can occur during prolonged or intense storm events when the infiltration potential of soils, or the capacity of drainage infrastructure is overwhelmed leading to the accumulation of surface water and the generation of overland flow routes.
- 3.35 RoFSW mapping has been collated and published by the EA, this shows the potential flooding which could occur when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead. An extract from the mapping is included as **Figure 3.3** above.
- 3.36 RoFSW mapping shows the Site to be at an overall very low risk of pluvial flooding, with small, isolated areas of low risk surface water ponding to the north and east of the Site attributed to topographical low points.
- 3.37 The Site access and egress route via the A5 is shown to be at a low to medium risk of pluvial flooding. Surface water depth and hazard maps have been included as **Figure 3.8** and Figure 3.9 to assess this residual risk.
- 3.38 The mapping shows that during the 1 in 100-year event, the proposed access route via the A5 is shown to be subject to depths of less than 150mm, presenting a low risk (Caution) hazard, as per definitions within **Table 2.4**.

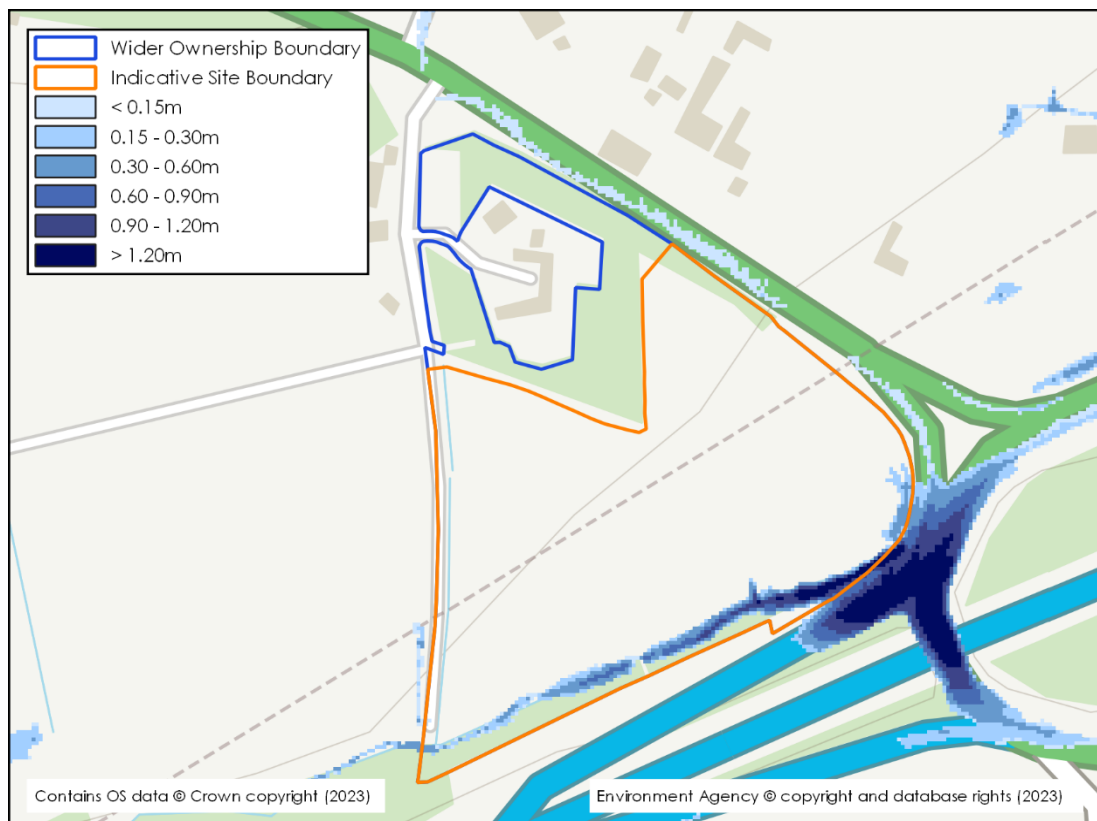


Figure 3.8: Surface Water Depth Map (1 in 100-year)

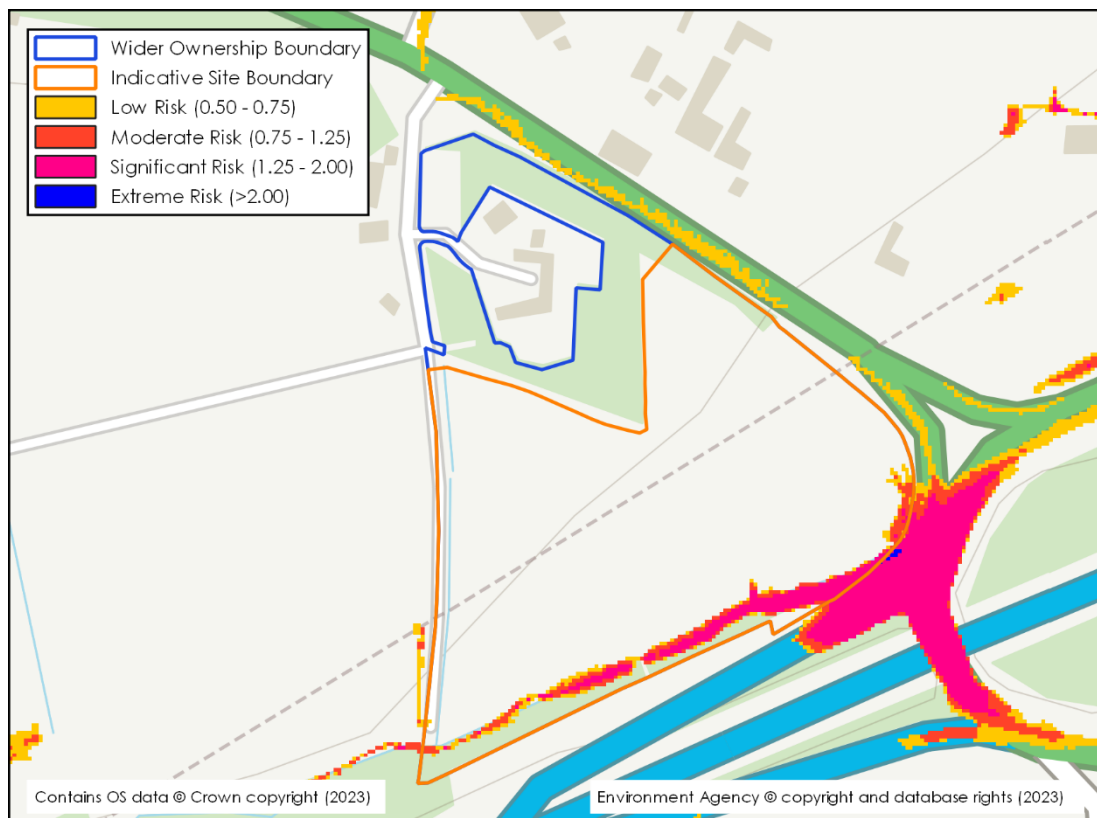


Figure 3.9: Surface Water Hazard (1 in 100-year)

- 3.39 In the absence of flood mapping for the Soar Brook, the pluvial flood outline provides an indication of the watercourse's potential floodplain. The flood risk associated with the Soar Brook is discussed within the 'Fluvial Flood Risk' section.
- 3.40 An area of surface water ponding is shown to the southeast corner of the Site where the Soar Brook enters a 900mm diameter culvert at the M69/A5. The RoFSW mapping is considered conservative due to limitations associated with the modelling approach whereby structures (such as bridges, culverts and weirs) are not represented. As such, the risk in this area may be overrepresented due to the nature of the mapping. Surface water is subsequently shown to impound behind the M69/A5 roundabout where water is otherwise expected to be conveyed via the culvert.
- 3.41 The Warwickshire County Council¹¹ and Leicestershire County Council PFRA⁹, and the Leicestershire and Leicester City⁷ and Hinckley and Bosworth Borough Council Level 1 SFRA⁵ do not report any historical surface water flood events which have impacted the Site or surrounding area.
- 3.42 The 'Flood Map for Surface Water 1 in 200 year Flood Extents' map appended to the Stratford-on-Avon DC, Warwickshire CC, North Warwickshire BC & Rugby BC Level 1 SFRA⁸ shows the Site is not at risk of deep surface water flooding (>0.3m).
- 3.43 Overall, the Site is considered to be at a low risk of pluvial flooding. There is a low to medium risk of surface water flooding posed to site access and egress route, mitigation measures to address any residual risk are discussed in **Section 4**.

Flood Risk from Canals

- 3.44 The Canal and River Trust (CRT) generally maintains canal levels using reservoirs, feeders and boreholes and manages water levels by transferring it within the canal system.
- 3.45 Water in a canal is typically maintained at predetermined levels by control weirs. When rainfall or other water enters the canal, the water level rises and flows out over the weir. If the level continues rising it will reach the level of the storm weirs. The control weirs and storm weirs are normally designed to take the water that legally enters the canal under normal conditions. However, it is possible for unexpected water to enter the canal or for the weirs to become obstructed. In such instances the increased water levels could result in water overtopping the towpath and flowing onto the surrounding land.
- 3.46 Flooding can also occur where a canal is impounded above surrounding ground levels and the retaining structure fails.
- 3.47 The nearest canal to the Site is the Ashby de la Zouch Canal, located approximately 1.6km west of the Site. EA LiDAR data shows the Site is elevated at least 14m above the canal.
- 3.48 Due to the significant distance and elevation between the Site and the Ashby de la Zouch Canal, canals are not expected to pose a flood risk to the Site.

Groundwater Flood Risk

- 3.49 Groundwater flooding occurs when the water table rises above ground elevations, or it rises to depths containing basement level development. It is most likely to happen in low lying areas underlain by permeable geology. This is most common on regional scale chalk aquifers, but there may also be a risk on sandstone and limestone aquifers or on thick deposits of sands and gravels underlain by less permeable strata such as that in a river valley.
- 3.50 The BGS mapping shows the Site is entirely underlain by Mercia Mudstone Group (Mudstone). The EA class this geology as a Secondary B Aquifer. Secondary B Aquifers comprise lower permeability layers that may store and yield limited amounts of groundwater through characteristics like thin cracks and openings or eroded layers.
- 3.51 The Site is also underlain by superficial deposits of Oadby Member (Diamicton) to the south, Wolston Sand and Gravel through the centre of the Site, and Bosworth Clay Member (Clay and Silt) to the east. The EA class the Wolston Sand and Gravel as a Secondary A Aquifer, and the Oadby Member (Diamicton) and Bosworth Clay Member (Clay and Silt) as Secondary (Undifferentiated) Aquifers. Secondary A Aquifers are defined as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. Secondary (undifferentiated) Aquifers occur where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type, these have only a minor value. An extract of mapping is included as **Figure 3.10**.

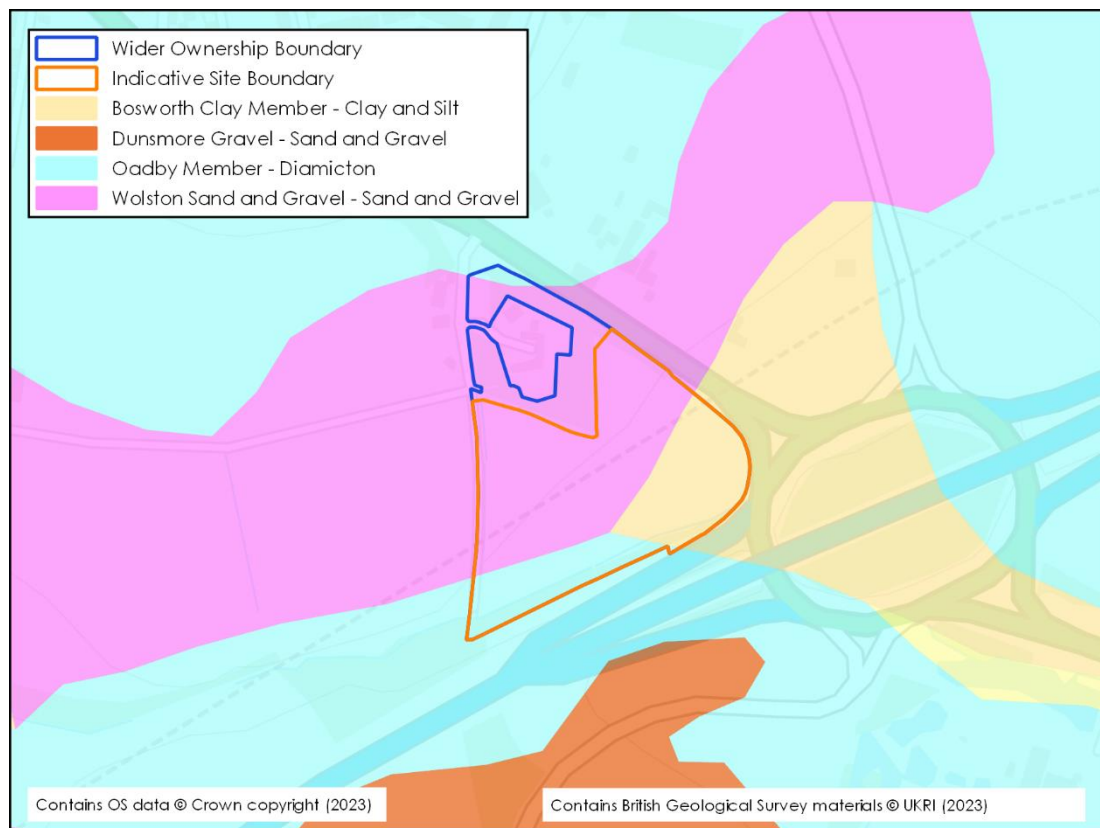


Figure 3.10: BGS Superficial Deposits Map

- 3.52 The 'Areas Susceptible to Groundwater Flooding' mapping included within the Leicestershire and Leicester City, and Stratford-on-Avon DC, Warwickshire CC, North Warwickshire BC & Rugby BC Level 1 SFRAs shows the north of the Site to be situated within an area that is considered to be less than 25% susceptible to groundwater flooding; and the south of the Site to be at a 25%-50% susceptibility to groundwater flooding.
- 3.53 It should be noted that Groundwater Susceptibility mapping is based on strategic scale mapping that uses a kilometre square grid. It identifies areas susceptible to flooding from groundwater at a broad scale on the basis of geological and hydrogeological conditions, and therefore, the classification could potentially be based on another area within the cell.
- 3.54 The BGS holds historical records of borehole samples across the UK which include measurements of groundwater levels taken during the sample. These are measurements taken at one point in space and time and are not a substitute for a long-term record of groundwater levels. However, they can provide an indication of groundwater levels that could potentially be experienced.
- 3.55 There are no borehole logs located within the Site. However, two borehole logs, located approximately 10m north (reference: SP49SW435) underlain by Wolston Sand and Gravel; and approximately 10m south of the Site (reference: SP49SW403) underlain by Oadby Member (Diamicton) report no groundwater strikes.
- 3.56 A Phase II Geo-Environmental Assessment was undertaken by BWB Consulting Ltd in February 2020 (reference: SPH-BWB-ZZ-00-RP-YE-0001-PH2_P2). During the intrusive groundwater investigation, groundwater was struck at all 15 boreholes, with an average water depth of 0.76m below ground level (bgl). As part of the post-site investigation monitoring programme, resting groundwater levels were measured at depths ranging between 0.04mbgl (BH03 on 20th January 2020) and 0.92mbgl (BH02 on 2nd January 2020).
- 3.57 Due to the shallow groundwater levels encountered during the Site investigation, the Site is considered to be at a high risk of groundwater flooding at the Site. It should be noted, however, that the shallowest water depths were encountered on Made Ground which may be removed as part of construction. Due to there being a risk of groundwater flooding, appropriate mitigation measures will be discussed in **Section 4**.

Flood Risk from Reservoirs & Large Waterbodies

- 3.58 Flooding can occur from large waterbodies or reservoirs if they are impounded above the surrounding ground levels or are used to retain water in times of flood. Although unlikely, reservoirs and large waterbodies could overtop or breach leading to rapid inundation of the downstream floodplain.
- 3.59 To help identify this risk, reservoir failure flood risk mapping has been prepared and included as **Figure 3.11** this shows the largest area that might be flooded if a reservoir were to fail and release the water it holds. The map displays a worst-case scenario and is only intended as a guide.

- 3.60 There are two flooding scenarios shown on the reservoir flood maps: a 'dry-day' and a 'wet-day'. The dry-day scenario predicts the flooding that would occur if the dam or reservoir failed when rivers are at normal levels. The wet-day scenario predicts how much worse the flooding might be if a river is already experiencing an extreme flood.

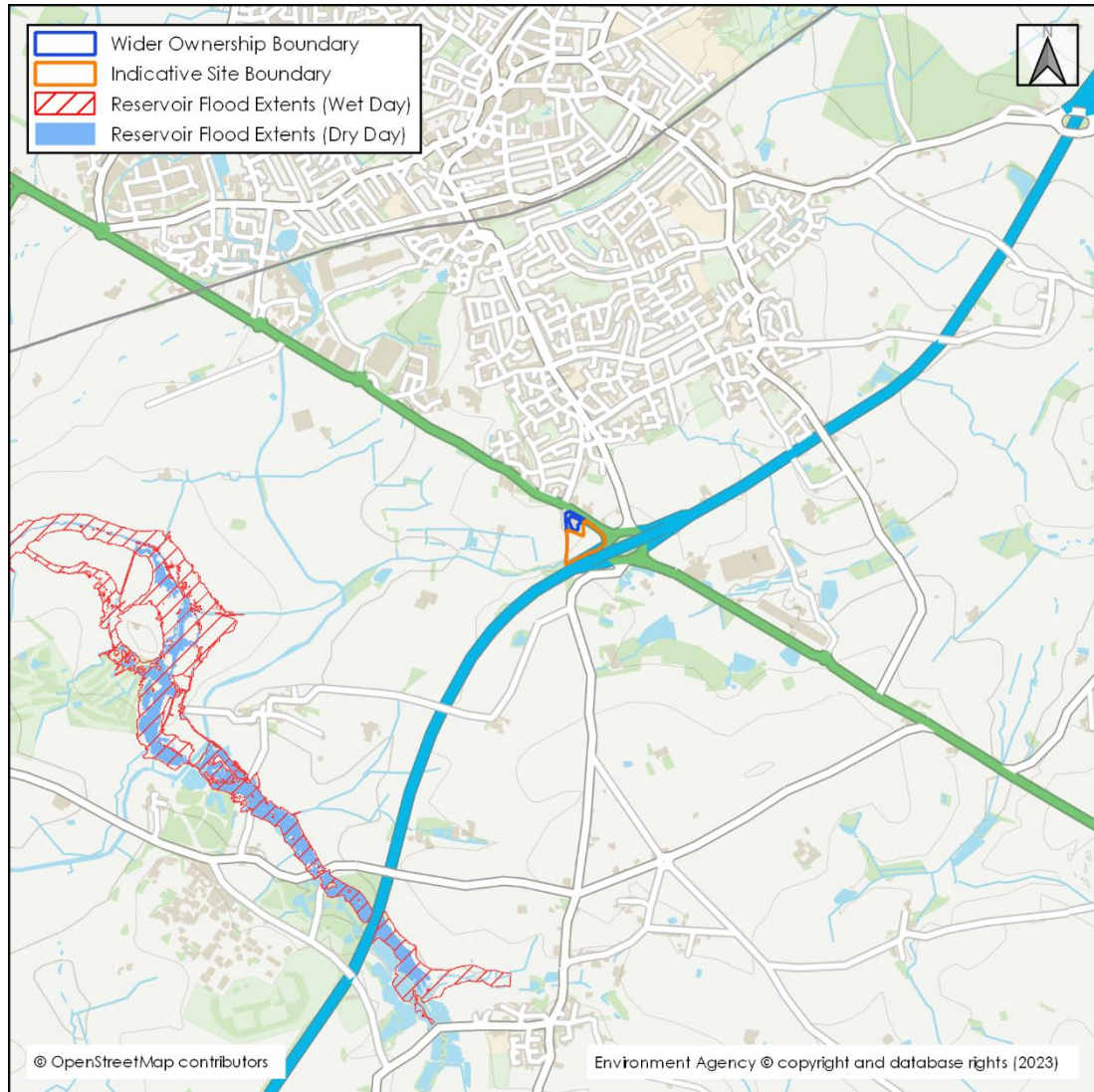


Figure 3.11: Reservoir Failure Extents

- 3.61 **Figure 3.11** shows the Site to be located outside of the reservoir failure extents for both 'dry-day' and 'wet-day' scenarios. The nearest extent is located approximately 2.2km west of the Site, attributed to the Makins Fishery located approximately 3km southwest of the Site.
- 3.62 Due to the significant distance between the Site and Makins Fishery's nearest failure extents, the Site is considered to be at low risk of flooding from reservoirs and large waterbodies.

Flood Risk from Sewers

- 3.63 Sewer flooding can occur when the capacity of the infrastructure is exceeded by excessive flows, or as a result of a reduction in capacity due to collapse or blockage, or if the downstream system becomes surcharged. This can lead to the sewers flooding onto the surrounding ground via manholes and gullies, which can generate overland flows.
- 3.64 The local sewerage undertaker is Severn Trent Water, and a copy of their asset plans is included as **Appendix 5**.
- 3.65 The assets plans show no public sewers to be located within the Site. A 225mm diameter public foul water sewer is located to the north of the Site within the A5. Foul flows are then pumped via a rising main along Wolvey Road and Beechwood Avenue to the north of the Site.
- 3.66 There is understood to be a network of sewers which serve the residential dwellings to the north of the Site known as Stretton Croft. Existing drainage infrastructure is shown to be present as part of a drainage strategy (reference: STP-BWB-DGT-XX-DR-D-500) completed as part of a previous Sustainable Drainage statement (SDS) undertaken at the Site by BWB Consulting Ltd (reference: STP-BWB-ZZ-XX-RP-CD-0001_SDS) in May 2020.
- 3.67 The drainage plans show flows from Stretton Croft run to the north of the Site boundary. Flows are then directed in a southerly direction through the Site and discharge to the Soar Brook. In the event that exceedance of the drainage network within the Site, flows are expected to be routed towards the Soar Brook, following the general site topography.
- 3.68 Severn Trent Water's DG5 register has been provided as part of the Stratford-on-Avon DC, Warwickshire CC, North Warwickshire BC & Rugby BC Level 1 SFRA. The 'Historic Sewer Flooding Records' appended to the SFRA shows there are no previous sewer flooding records located within the Site or surrounding area.
- 3.69 Severn Trent Water also provided their internal flooding records as part of the Leicestershire and Leicester City Level 1 SFRA. The records show that two previous internal flood events occurred within the same postcode as the Site. However, the magnitude and exact location of flooding is not provided.
- 3.70 Overall, the Site is considered to be at a low risk of sewer flooding.

Effect of Development on Wider Catchment

Displacement of Floodplain

- 3.71 The Soar Brook is shown to have capacity for estimated flood flows up to and including the 1 in 1000-year event. As such, no compensatory flood storage would be required.

Impedance of Flood Flows

- 3.72 The Proposed Development does not impede or re-direct any overland flow routes.

Development Land Use/Drainage Considerations

- 3.73 The Proposed Development will increase the area of impermeable surfaces at the Site. This will result in an increase in surface water runoff, which could increase flood risk downstream unless properly mitigated. Appropriate surface water management is discussed in **Section 4**.

4. FLOOD RISK MITIGATION

- 4.1 **Section 3** has identified the sources of flooding which could potentially pose a risk to the Site and the Proposed Development. This section of the FRA sets out the mitigation measures which are to be incorporated within the Proposed Development to address and reduce the risk of flooding to within acceptable levels.

Development Levels

- 4.2 The EA advises that minimum finished floor levels should be set 600mm above the 100-year plus climate change peak flood level. Given the Site is located in Flood Zone 1 and elevated at least 12m above the Sketchley Brook, it is recommended that finished floor levels of any buildings are raised a minimum of 150mm above surrounding ground levels to help mitigate against any residual surface water and groundwater flood risk.
- 4.3 It is also recommended that ground levels are profiled to encourage pluvial runoff and overland flows away from built development and towards the nearest drainage point.

Watercourse Easement

- 4.4 In line with the requirements outlined within the Stratford-on-Avon DC, Warwickshire CC, North Warwickshire BC & Rugby BC Level 1 SFRA, the Proposed Development should be located a minimum of 8m from the Soar Brook.
- 4.5 As shown in **Figure 3.6** the Proposed Development footprint is considered to be positioned a suitable distance away from the watercourse.

Safe Access and Egress

- 4.6 The access and egress route via the A5 is shown to be at a low to medium risk of surface water flooding. Areas of surface water flooding are shown to be subject to depths of less than 150mm and pose a low risk (Caution) hazard. Therefore, safe access and egress can be achieved for most via the A5.

Groundwater

- 4.7 The Site is considered to be at an overall high risk of groundwater flooding. It is recommended that finished floor levels are raised a minimum of 150mm above surrounding ground levels to help mitigate against any groundwater water flood risk.
- 4.8 Should groundwater be encountered during construction, a groundwater specialist should be appointed, and appropriate dewatering procedures should be employed as necessary.

Surface Water and Foul Water Drainage

- 4.9 To mitigate the Proposed Development's impact on the current runoff regime it is proposed to incorporate surface water attenuation and storage as part of the Proposed Development.
- 4.10 In brief, the Proposed Development will continue to discharge surface water to the local watercourse at the equivalent greenfield QBAR rate. Attenuated surface water storage will be provided in the form of a SuDS detention basin with capacity for the 1 in 100-year storm with an allowance for climate change.
- 4.11 The Proposed Development should be designed with exceedance in mind and the road network should be used to convey excess overland flows towards the attenuation points.
- 4.12 It is proposed to drain used water from the Proposed Development separately to surface water.
- 4.13 Further information on the drainage approach is provided within the accompanying SDS (reference: SCH-BWB-ZZ-XX-RP-CD-0001_SDS).

5. CONCLUSIONS AND RECOMMENDATIONS

- 5.1 This FRA has been prepared in accordance with requirements set out in the NPPF and the associated PPG. The FRA has been produced on behalf of Welcome Break Ltd in respect of a planning application for the Proposed Development of a new MSA at Stretton Court, Hinckley.
- 5.2 This FRA is intended to support a full planning application, the level of detail included is commensurate and subject to the nature of the proposals at the planning stage.
- 5.3 This report demonstrates that the Proposed Development is at an acceptable level of flood risk subject to the recommended flood mitigation strategies being implemented. The identified risks and mitigation measures are summarised within **Table 5.1**:

Table 5.1: Summary of Flood Risk Assessment

Flood Source	Risk & Proposed Mitigation Measures
Fluvial	The Site is located entirely within Flood Zone 1, which is land at low risk of flooding. The Soar Brook flows through the southern extent of the Site. There are no Flood Zone extents attributed to the Soar Brook, and therefore, a channel capacity assessment of the Soar Brook and culvert beneath the (M69/A5) was undertaken to determine the risk posed to the Site from the Soar Brook. The assessment indicated that the Soar Brook has sufficient capacity for flows up to and including the 1 in 1000-year event. Therefore, the fluvial risk associated with the Soar Brook is considered to be low. In line with the requirements outlined within the Stratford-on-Avon DC, Warwickshire CC, North Warwickshire BC & Rugby BC Level 1 SFRA, the Proposed Development should be located a minimum of 8m from the Soar Brook.
Pluvial Runoff	The Site is shown to be at an overall low risk of pluvial flooding. The Site access and egress route is shown to be at a low to medium risk of pluvial flooding. However, during the 1 in 100-year event, the proposed access route is shown to be subject to depths of less than 150mm and poses a low risk (Caution) hazard. Therefore, this is not expected to impact safe access and egress from the Site. It is recommended that finished floor levels are raised a minimum of 150mm above surrounding ground levels to help mitigate against any residual surface water flood risk. It is recommended that ground levels are profiled to encourage pluvial runoff away from the built development and towards the nearest drainage point.
Groundwater	The Site is considered to be at a high risk of groundwater flooding due to shallow groundwater levels found during a previous Phase II Geo-Environmental Site Investigation and post monitoring undertaken by BWB Consulting. It is recommended that finished floor levels are raised a minimum of 150mm above surrounding ground levels to help mitigate against any groundwater flood risk. Should shallow groundwater levels be encountered during construction, a groundwater specialist should be appointed, and appropriate dewatering procedures should be employed as necessary.

Other Sources	The Site has been assessed against other sources of flood risk including canals, reservoirs and large waterbodies, and sewers. None of these are considered to significantly impact development at the Site.
Impact of the Proposed Development	The Proposed Development will increase the area of impermeable surfaces, increasing the rate of runoff from the Site. To mitigate the Proposed Development's impact on the current runoff regime it is proposed to incorporate surface water attenuation and storage as part of the Proposed Development. It is proposed to drain used water from the Proposed Development separately to surface water.
This summary should be read in conjunction with BWB's full report. It reflects an assessment of the Site based on information received by BWB at the time of production.	

- 5.4 In compliance with the requirements of the NPPF, and subject to the mitigation measures proposed, the Proposed Development could proceed without being subject to significant flood risk. Moreover, the Proposed Development will not increase flood risk to the wider catchment area subject to suitable management of surface water runoff discharging from the Site.

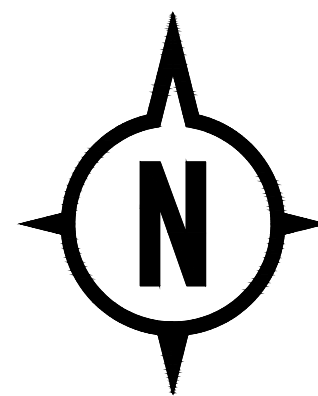
APPENDICES

Appendix 1: Topographical Survey

Not in scale



Appendix 2: Proposed Site Layout



Total Car Spaces - 269
inc:
DDA - 17 (inc EV)
EV- 36
Staff Parking - 11
Motorcycle Parking - 11

HGV Parking - 29
Coach Parking - 6
Caravan Parking - 8

Key

- Ownership boundary
- Site boundary
Site Area 41,940.82sqm / 10.36acres
- Bitmac road finish
- Bitmac path finish
- Concrete pavements
- Concrete
- Concrete Apron
- Concrete Apron
Double reinforced concrete to delivery stand
- Kerb
- Pin Kerb
- Trief Kerb
- DK Drop Kerb
- Stainless steel bollard
- Soft Landscaping
- Tree to be removed
- BWB Root Protection Area
- Tactile paving
- Timber knee rail
- 1.8m timber close boarded fence
- 2.0m timber acoustic fence
- Existing / proposed timber post and rail fence
- Suggested drainage route from Title Plan LT155479
- Non illuminated signage
- Non illuminated sign
NO ENTRY / GIVE WAY
- Proposed Level
- Pedestrian Route
Tactile paving and dropped kerbs at all appropriate points along the route to DDA standards within site demise

0m 10 20 30 40 50
Scale Bar

E	21.08.23	MOTORCYCLE SPACES ADDED
D	28.07.23	AREA FOR EXTERNAL COMPOUND INDICATED
C	18.07.23	PFS PUMP ISLANDS REVISED TO IMPROVE TRACKING DISTANCE BETWEEN PUMPS AND PARKING INCREASED
B	21.07.23	ADDITIONAL PFS PARKING AND HGV BAY LANDSCAPING ADDED. BUILDING UPDATED TREES TO BE REMOVED INDICATED
A	18.07.23	REVISIONS TO DT LANES AND PARKING

REVISIONS

CLIENT	WELCOME BREAK
PROJECT	WELCOME BREAK LAND OFF THE A5 HINCKLEY, LE10 3JB

TITLE

PROPOSED SITE LAYOUT

DATE 12.07.2023

SCALE 1:500 @ A1

JOB ID 1415

DWG 26e

ADS
DESIGN

+44 (0)1943 464152
ADS-DESIGN.NET

Appendix 3: NPPF Flood risk Vulnerability and Flood Zone Compatibility

Flood Risk Vulnerability Classifications (recreated from the NPPF Planning Practise Guidance)

Vulnerability Classification	Description
Essential infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including infrastructure for electricity supply including generation, storage and distribution systems; including electricity generating power stations, grid and primary substations storage; and water treatment works that need to remain operational in times of flood. • Wind turbines. • Solar farms.
Highly Vulnerable	• Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure'.)
More Vulnerable	• Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non-residential uses for health services, nurseries and educational establishments. • Landfill* and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	• Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill* and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place. • Car parks.
Water-Compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • Ministry of Defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Flood Zone Compatibility (recreated from the NPPF Planning Practise Guidance)

Flood Zone	Vulnerability Classification				
	Essential infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone 1 (Low Probability)	Development is appropriate	Development is appropriate	Development is appropriate	Development is appropriate	Development is appropriate
Flood Zone 2 (Medium Probability)	Development is appropriate	To be deemed appropriate an exception test is required to demonstrate: - The development will be safe for its life time without increasing flood risk elsewhere, and where possible reduce overall flood risk - the sustainability benefits of the development to the community outweigh the flood risk.	Development is appropriate	Development is appropriate	Development is appropriate
Flood Zone 3a (High Probability)	To be deemed appropriate an exception test is required to demonstrate: The development will be safe for its life time without increasing flood risk elsewhere, and where possible reduce overall flood risk the sustainability benefits of the development to the community outweigh the flood risk. Additionally, essential infrastructure should be designed and constructed to remain operational and safe in times of flood.	Development should not be permitted	To be deemed appropriate an exception test is required to demonstrate: - The development will be safe for its life time without increasing flood risk elsewhere, and where possible reduce overall flood risk - the sustainability benefits of the development to the community outweigh the flood risk.	Development is appropriate	Development is appropriate

Flood Zone	Vulnerability Classification				
	Essential infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone 3b (The Functional Floodplain)	To be deemed appropriate an exception test is required to demonstrate: - The development will be safe for its life time without increasing flood risk elsewhere, and where possible reduce overall flood risk - the sustainability benefits of the development to the community outweigh the flood risk. Additionally, development should be designed and constructed to: - remain operational and safe for users in times of flood; - result in no net loss of floodplain storage; - not impede water flows and not increase flood risk elsewhere.	Development should not be permitted	Development should not be permitted	Development should not be permitted	Development is appropriate if designed and constructed to: - remain operational and safe for users in times of flood; - result in no net loss of floodplain storage; - not impede water flows and not increase flood risk elsewhere.

Appendix 4: ReFH2 Peak Flow Rates and Soar Brook Capacity Calculations

UK Design Flood Estimation

Generated on Wednesday, August 09, 2023 9:42:38 AM by Water.Team
Printed from the ReFH2 Flood Modelling software package, version 4.0.8560.23190

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details

Checksum: 31E9-E97D

Site name: FEH_Catchment_Descriptors_442350_290900_v5_0_1

Easting: 442350

Northing: 290900

Country: England, Wales or Northern Ireland

Catchment Area (km²): 0.76

Using plot scale calculations: No

Model: 2.3

Site description: None

Model run: 100 year

Summary of results

Rainfall - FEH22 (mm):	53.32	Total runoff (ML):	2.53
Total Rainfall (mm):	33.21	Total flow (ML):	7.61
Peak Rainfall (mm):	11.22	Peak flow (m ³ /s):	0.18

Parameters

Where the user has overridden a system-generated value, this original value is shown in square brackets after the value used.

** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH22)

Name	Value	User-defined?
Duration (hh:mm:ss)	03:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.64	No
ARF (Areal reduction factor)	0.98	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	63.67	No
Cmax (mm)	847.89	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	2.4	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m ³ /s)	0	No
BL (hr)	44.31	No
BR	2.92	No

Urbanisation parameters

Name	Value	User-defined?
Sewer capacity (m ³ /s)	0	No
Exporting drained area (km ²)	0	No
Urban area (km ²)	0.02	No
Urbext 2000	0.01	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m³/s)	Net Rain (mm)	Runoff (m³/s)	Baseflow (m³/s)	Total Flow (m³/s)
00:00:00	1.350	0.000	0.110	0.000	0.000	0.000
00:30:00	3.021	0.000	0.253	0.001	0.000	0.001
01:00:00	6.624	0.000	0.592	0.004	0.000	0.004
01:30:00	11.219	0.000	1.121	0.012	0.000	0.012
02:00:00	6.624	0.000	0.731	0.031	0.001	0.032
02:30:00	3.021	0.000	0.350	0.062	0.002	0.064
03:00:00	1.350	0.000	0.160	0.097	0.005	0.101
03:30:00	0.000	0.000	0.000	0.130	0.008	0.138
04:00:00	0.000	0.000	0.000	0.153	0.012	0.165
04:30:00	0.000	0.000	0.000	0.158	0.017	0.175
05:00:00	0.000	0.000	0.000	0.148	0.021	0.169
05:30:00	0.000	0.000	0.000	0.129	0.025	0.155
06:00:00	0.000	0.000	0.000	0.108	0.029	0.137
06:30:00	0.000	0.000	0.000	0.088	0.031	0.120
07:00:00	0.000	0.000	0.000	0.073	0.034	0.106
07:30:00	0.000	0.000	0.000	0.060	0.035	0.095
08:00:00	0.000	0.000	0.000	0.048	0.037	0.085
08:30:00	0.000	0.000	0.000	0.038	0.038	0.076
09:00:00	0.000	0.000	0.000	0.028	0.038	0.067
09:30:00	0.000	0.000	0.000	0.019	0.039	0.058
10:00:00	0.000	0.000	0.000	0.011	0.039	0.050
10:30:00	0.000	0.000	0.000	0.005	0.039	0.044
11:00:00	0.000	0.000	0.000	0.002	0.038	0.040
11:30:00	0.000	0.000	0.000	0.000	0.038	0.038
12:00:00	0.000	0.000	0.000	0.000	0.038	0.038
12:30:00	0.000	0.000	0.000	0.000	0.037	0.037
13:00:00	0.000	0.000	0.000	0.000	0.037	0.037
13:30:00	0.000	0.000	0.000	0.000	0.036	0.036
14:00:00	0.000	0.000	0.000	0.000	0.036	0.036
14:30:00	0.000	0.000	0.000	0.000	0.035	0.035
15:00:00	0.000	0.000	0.000	0.000	0.035	0.035
15:30:00	0.000	0.000	0.000	0.000	0.035	0.035
16:00:00	0.000	0.000	0.000	0.000	0.034	0.034
16:30:00	0.000	0.000	0.000	0.000	0.034	0.034
17:00:00	0.000	0.000	0.000	0.000	0.034	0.034

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
17:30:00	0.000	0.000	0.000	0.000	0.033	0.033
18:00:00	0.000	0.000	0.000	0.000	0.033	0.033
18:30:00	0.000	0.000	0.000	0.000	0.032	0.032
19:00:00	0.000	0.000	0.000	0.000	0.032	0.032
19:30:00	0.000	0.000	0.000	0.000	0.032	0.032
20:00:00	0.000	0.000	0.000	0.000	0.031	0.031
20:30:00	0.000	0.000	0.000	0.000	0.031	0.031
21:00:00	0.000	0.000	0.000	0.000	0.031	0.031
21:30:00	0.000	0.000	0.000	0.000	0.030	0.030
22:00:00	0.000	0.000	0.000	0.000	0.030	0.030
22:30:00	0.000	0.000	0.000	0.000	0.030	0.030
23:00:00	0.000	0.000	0.000	0.000	0.029	0.029
23:30:00	0.000	0.000	0.000	0.000	0.029	0.029
24:00:00	0.000	0.000	0.000	0.000	0.029	0.029
24:30:00	0.000	0.000	0.000	0.000	0.028	0.028
25:00:00	0.000	0.000	0.000	0.000	0.028	0.028
25:30:00	0.000	0.000	0.000	0.000	0.028	0.028
26:00:00	0.000	0.000	0.000	0.000	0.027	0.027
26:30:00	0.000	0.000	0.000	0.000	0.027	0.027
27:00:00	0.000	0.000	0.000	0.000	0.027	0.027
27:30:00	0.000	0.000	0.000	0.000	0.026	0.026
28:00:00	0.000	0.000	0.000	0.000	0.026	0.026
28:30:00	0.000	0.000	0.000	0.000	0.026	0.026
29:00:00	0.000	0.000	0.000	0.000	0.026	0.026
29:30:00	0.000	0.000	0.000	0.000	0.025	0.025
30:00:00	0.000	0.000	0.000	0.000	0.025	0.025
30:30:00	0.000	0.000	0.000	0.000	0.025	0.025
31:00:00	0.000	0.000	0.000	0.000	0.024	0.024
31:30:00	0.000	0.000	0.000	0.000	0.024	0.024
32:00:00	0.000	0.000	0.000	0.000	0.024	0.024
32:30:00	0.000	0.000	0.000	0.000	0.024	0.024
33:00:00	0.000	0.000	0.000	0.000	0.023	0.023
33:30:00	0.000	0.000	0.000	0.000	0.023	0.023
34:00:00	0.000	0.000	0.000	0.000	0.023	0.023
34:30:00	0.000	0.000	0.000	0.000	0.023	0.023
35:00:00	0.000	0.000	0.000	0.000	0.022	0.022

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
35:30:00	0.000	0.000	0.000	0.000	0.022	0.022
36:00:00	0.000	0.000	0.000	0.000	0.022	0.022
36:30:00	0.000	0.000	0.000	0.000	0.022	0.022
37:00:00	0.000	0.000	0.000	0.000	0.021	0.021
37:30:00	0.000	0.000	0.000	0.000	0.021	0.021
38:00:00	0.000	0.000	0.000	0.000	0.021	0.021
38:30:00	0.000	0.000	0.000	0.000	0.021	0.021
39:00:00	0.000	0.000	0.000	0.000	0.020	0.020
39:30:00	0.000	0.000	0.000	0.000	0.020	0.020
40:00:00	0.000	0.000	0.000	0.000	0.020	0.020
40:30:00	0.000	0.000	0.000	0.000	0.020	0.020
41:00:00	0.000	0.000	0.000	0.000	0.020	0.020
41:30:00	0.000	0.000	0.000	0.000	0.019	0.019
42:00:00	0.000	0.000	0.000	0.000	0.019	0.019
42:30:00	0.000	0.000	0.000	0.000	0.019	0.019
43:00:00	0.000	0.000	0.000	0.000	0.019	0.019
43:30:00	0.000	0.000	0.000	0.000	0.018	0.018
44:00:00	0.000	0.000	0.000	0.000	0.018	0.018
44:30:00	0.000	0.000	0.000	0.000	0.018	0.018
45:00:00	0.000	0.000	0.000	0.000	0.018	0.018
45:30:00	0.000	0.000	0.000	0.000	0.018	0.018
46:00:00	0.000	0.000	0.000	0.000	0.017	0.017
46:30:00	0.000	0.000	0.000	0.000	0.017	0.017
47:00:00	0.000	0.000	0.000	0.000	0.017	0.017
47:30:00	0.000	0.000	0.000	0.000	0.017	0.017
48:00:00	0.000	0.000	0.000	0.000	0.017	0.017
48:30:00	0.000	0.000	0.000	0.000	0.016	0.016
49:00:00	0.000	0.000	0.000	0.000	0.016	0.016
49:30:00	0.000	0.000	0.000	0.000	0.016	0.016
50:00:00	0.000	0.000	0.000	0.000	0.016	0.016
50:30:00	0.000	0.000	0.000	0.000	0.016	0.016
51:00:00	0.000	0.000	0.000	0.000	0.016	0.016
51:30:00	0.000	0.000	0.000	0.000	0.015	0.015
52:00:00	0.000	0.000	0.000	0.000	0.015	0.015
52:30:00	0.000	0.000	0.000	0.000	0.015	0.015
53:00:00	0.000	0.000	0.000	0.000	0.015	0.015

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
53:30:00	0.000	0.000	0.000	0.000	0.015	0.015
54:00:00	0.000	0.000	0.000	0.000	0.015	0.015
54:30:00	0.000	0.000	0.000	0.000	0.014	0.014
55:00:00	0.000	0.000	0.000	0.000	0.014	0.014
55:30:00	0.000	0.000	0.000	0.000	0.014	0.014
56:00:00	0.000	0.000	0.000	0.000	0.014	0.014
56:30:00	0.000	0.000	0.000	0.000	0.014	0.014
57:00:00	0.000	0.000	0.000	0.000	0.014	0.014
57:30:00	0.000	0.000	0.000	0.000	0.013	0.013
58:00:00	0.000	0.000	0.000	0.000	0.013	0.013
58:30:00	0.000	0.000	0.000	0.000	0.013	0.013
59:00:00	0.000	0.000	0.000	0.000	0.013	0.013
59:30:00	0.000	0.000	0.000	0.000	0.013	0.013
60:00:00	0.000	0.000	0.000	0.000	0.013	0.013
60:30:00	0.000	0.000	0.000	0.000	0.013	0.013
61:00:00	0.000	0.000	0.000	0.000	0.012	0.012
61:30:00	0.000	0.000	0.000	0.000	0.012	0.012
62:00:00	0.000	0.000	0.000	0.000	0.012	0.012
62:30:00	0.000	0.000	0.000	0.000	0.012	0.012
63:00:00	0.000	0.000	0.000	0.000	0.012	0.012

Appendix

Catchment descriptors

Name	Value	User-defined value used?
Area (km ²)	0.76	No
ALTBAR	113	No
ASPBAR	311	No
ASPVAR	0.45	No
BFIHOST	0.75	No
BFIHOST19	0.77	No
DPLBAR (km)	0.85	No
DPSBAR (mkm ⁻¹)	27.6	No
FARL	1	No
LDP	1.88	No
PROPWET	0.3	No
RMED1H	10.5	No
RMED1D	31.2	No
RMED2D	39	No
SAAR (mm)	649	No
SAAR4170 (mm)	678	No
SPRHOST	28.29	No
Urbext2000	0.01	No
Urbext1990	0.01	No
URBCONC	0.17	No
URBLOC	1.23	No
DDF parameter C	-0.03	No
DDF parameter D1	0.37	No
DDF parameter D2	0.34	No
DDF parameter D3	0.25	No
DDF parameter E	0.3	No
DDF parameter F	2.37	No
DDF parameter C (1km grid value)	-0.03	No
DDF parameter D1 (1km grid value)	0.37	No
DDF parameter D2 (1km grid value)	0.34	No
DDF parameter D3 (1km grid value)	0.25	No
DDF parameter E (1km grid value)	0.3	No
DDF parameter F (1km grid value)	2.36	No

UK Design Flood Estimation

Generated on Wednesday, August 09, 2023 9:43:07 AM by Water.Team
Printed from the ReFH2 Flood Modelling software package, version 4.0.8560.23190

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details

Checksum: 31E9-E97D

Site name: FEH_Catchment_Descriptors_442350_290900_v5_0_1

Easting: 442350

Northing: 290900

Country: England, Wales or Northern Ireland

Catchment Area (km²): 0.76

Using plot scale calculations: No

Model: 2.3

Site description: None

Model run: 1000 year

Summary of results

Rainfall - FEH22 (mm):	85.25	Total runoff (ML):	4.52
Total Rainfall (mm):	53.09	Total flow (ML):	13.65
Peak Rainfall (mm):	17.94	Peak flow (m ³ /s):	0.31

Parameters

Where the user has overridden a system-generated value, this original value is shown in square brackets after the value used.

** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH22)

Name	Value	User-defined?
Duration (hh:mm:ss)	03:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.64	No
ARF (Areal reduction factor)	0.98	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	63.67	No
Cmax (mm)	847.89	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	2.4	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m ³ /s)	0	No
BL (hr)	44.31	No
BR	2.92	No

Urbanisation parameters

Name	Value	User-defined?
Sewer capacity (m ³ /s)	0	No
Exporting drained area (km ²)	0	No
Urban area (km ²)	0.02	No
Urbext 2000	0.01	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
00:00:00	2.158	0.000	0.176	0.000	0.000	0.000
00:30:00	4.830	0.000	0.414	0.001	0.000	0.001
01:00:00	10.590	0.000	1.004	0.006	0.000	0.006
01:30:00	17.936	0.000	2.001	0.020	0.000	0.020
02:00:00	10.590	0.000	1.358	0.053	0.002	0.054
02:30:00	4.830	0.000	0.663	0.106	0.004	0.110
03:00:00	2.158	0.000	0.305	0.168	0.008	0.176
03:30:00	0.000	0.000	0.000	0.228	0.014	0.242
04:00:00	0.000	0.000	0.000	0.272	0.021	0.293
04:30:00	0.000	0.000	0.000	0.283	0.029	0.313
05:00:00	0.000	0.000	0.000	0.266	0.038	0.303
05:30:00	0.000	0.000	0.000	0.233	0.045	0.278
06:00:00	0.000	0.000	0.000	0.196	0.051	0.247
06:30:00	0.000	0.000	0.000	0.160	0.056	0.216
07:00:00	0.000	0.000	0.000	0.131	0.060	0.192
07:30:00	0.000	0.000	0.000	0.108	0.063	0.171
08:00:00	0.000	0.000	0.000	0.088	0.066	0.154
08:30:00	0.000	0.000	0.000	0.069	0.068	0.137
09:00:00	0.000	0.000	0.000	0.052	0.069	0.121
09:30:00	0.000	0.000	0.000	0.035	0.070	0.105
10:00:00	0.000	0.000	0.000	0.020	0.070	0.090
10:30:00	0.000	0.000	0.000	0.009	0.070	0.079
11:00:00	0.000	0.000	0.000	0.003	0.069	0.072
11:30:00	0.000	0.000	0.000	0.001	0.068	0.069
12:00:00	0.000	0.000	0.000	0.000	0.067	0.068
12:30:00	0.000	0.000	0.000	0.000	0.067	0.067
13:00:00	0.000	0.000	0.000	0.000	0.066	0.066
13:30:00	0.000	0.000	0.000	0.000	0.065	0.065
14:00:00	0.000	0.000	0.000	0.000	0.065	0.065
14:30:00	0.000	0.000	0.000	0.000	0.064	0.064
15:00:00	0.000	0.000	0.000	0.000	0.063	0.063
15:30:00	0.000	0.000	0.000	0.000	0.062	0.062
16:00:00	0.000	0.000	0.000	0.000	0.062	0.062
16:30:00	0.000	0.000	0.000	0.000	0.061	0.061
17:00:00	0.000	0.000	0.000	0.000	0.060	0.060

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
17:30:00	0.000	0.000	0.000	0.000	0.060	0.060
18:00:00	0.000	0.000	0.000	0.000	0.059	0.059
18:30:00	0.000	0.000	0.000	0.000	0.058	0.058
19:00:00	0.000	0.000	0.000	0.000	0.058	0.058
19:30:00	0.000	0.000	0.000	0.000	0.057	0.057
20:00:00	0.000	0.000	0.000	0.000	0.056	0.056
20:30:00	0.000	0.000	0.000	0.000	0.056	0.056
21:00:00	0.000	0.000	0.000	0.000	0.055	0.055
21:30:00	0.000	0.000	0.000	0.000	0.054	0.054
22:00:00	0.000	0.000	0.000	0.000	0.054	0.054
22:30:00	0.000	0.000	0.000	0.000	0.053	0.053
23:00:00	0.000	0.000	0.000	0.000	0.053	0.053
23:30:00	0.000	0.000	0.000	0.000	0.052	0.052
24:00:00	0.000	0.000	0.000	0.000	0.051	0.051
24:30:00	0.000	0.000	0.000	0.000	0.051	0.051
25:00:00	0.000	0.000	0.000	0.000	0.050	0.050
25:30:00	0.000	0.000	0.000	0.000	0.050	0.050
26:00:00	0.000	0.000	0.000	0.000	0.049	0.049
26:30:00	0.000	0.000	0.000	0.000	0.049	0.049
27:00:00	0.000	0.000	0.000	0.000	0.048	0.048
27:30:00	0.000	0.000	0.000	0.000	0.048	0.048
28:00:00	0.000	0.000	0.000	0.000	0.047	0.047
28:30:00	0.000	0.000	0.000	0.000	0.047	0.047
29:00:00	0.000	0.000	0.000	0.000	0.046	0.046
29:30:00	0.000	0.000	0.000	0.000	0.045	0.045
30:00:00	0.000	0.000	0.000	0.000	0.045	0.045
30:30:00	0.000	0.000	0.000	0.000	0.044	0.044
31:00:00	0.000	0.000	0.000	0.000	0.044	0.044
31:30:00	0.000	0.000	0.000	0.000	0.043	0.043
32:00:00	0.000	0.000	0.000	0.000	0.043	0.043
32:30:00	0.000	0.000	0.000	0.000	0.042	0.042
33:00:00	0.000	0.000	0.000	0.000	0.042	0.042
33:30:00	0.000	0.000	0.000	0.000	0.042	0.042
34:00:00	0.000	0.000	0.000	0.000	0.041	0.041
34:30:00	0.000	0.000	0.000	0.000	0.041	0.041
35:00:00	0.000	0.000	0.000	0.000	0.040	0.040

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
35:30:00	0.000	0.000	0.000	0.000	0.040	0.040
36:00:00	0.000	0.000	0.000	0.000	0.039	0.039
36:30:00	0.000	0.000	0.000	0.000	0.039	0.039
37:00:00	0.000	0.000	0.000	0.000	0.038	0.038
37:30:00	0.000	0.000	0.000	0.000	0.038	0.038
38:00:00	0.000	0.000	0.000	0.000	0.038	0.038
38:30:00	0.000	0.000	0.000	0.000	0.037	0.037
39:00:00	0.000	0.000	0.000	0.000	0.037	0.037
39:30:00	0.000	0.000	0.000	0.000	0.036	0.036
40:00:00	0.000	0.000	0.000	0.000	0.036	0.036
40:30:00	0.000	0.000	0.000	0.000	0.035	0.035
41:00:00	0.000	0.000	0.000	0.000	0.035	0.035
41:30:00	0.000	0.000	0.000	0.000	0.035	0.035
42:00:00	0.000	0.000	0.000	0.000	0.034	0.034
42:30:00	0.000	0.000	0.000	0.000	0.034	0.034
43:00:00	0.000	0.000	0.000	0.000	0.034	0.034
43:30:00	0.000	0.000	0.000	0.000	0.033	0.033
44:00:00	0.000	0.000	0.000	0.000	0.033	0.033
44:30:00	0.000	0.000	0.000	0.000	0.032	0.032
45:00:00	0.000	0.000	0.000	0.000	0.032	0.032
45:30:00	0.000	0.000	0.000	0.000	0.032	0.032
46:00:00	0.000	0.000	0.000	0.000	0.031	0.031
46:30:00	0.000	0.000	0.000	0.000	0.031	0.031
47:00:00	0.000	0.000	0.000	0.000	0.031	0.031
47:30:00	0.000	0.000	0.000	0.000	0.030	0.030
48:00:00	0.000	0.000	0.000	0.000	0.030	0.030
48:30:00	0.000	0.000	0.000	0.000	0.030	0.030
49:00:00	0.000	0.000	0.000	0.000	0.029	0.029
49:30:00	0.000	0.000	0.000	0.000	0.029	0.029
50:00:00	0.000	0.000	0.000	0.000	0.029	0.029
50:30:00	0.000	0.000	0.000	0.000	0.028	0.028
51:00:00	0.000	0.000	0.000	0.000	0.028	0.028
51:30:00	0.000	0.000	0.000	0.000	0.028	0.028
52:00:00	0.000	0.000	0.000	0.000	0.027	0.027
52:30:00	0.000	0.000	0.000	0.000	0.027	0.027
53:00:00	0.000	0.000	0.000	0.000	0.027	0.027

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m ³ /s)	Net Rain (mm)	Runoff (m ³ /s)	Baseflow (m ³ /s)	Total Flow (m ³ /s)
53:30:00	0.000	0.000	0.000	0.000	0.026	0.026
54:00:00	0.000	0.000	0.000	0.000	0.026	0.026
54:30:00	0.000	0.000	0.000	0.000	0.026	0.026
55:00:00	0.000	0.000	0.000	0.000	0.026	0.026
55:30:00	0.000	0.000	0.000	0.000	0.025	0.025
56:00:00	0.000	0.000	0.000	0.000	0.025	0.025
56:30:00	0.000	0.000	0.000	0.000	0.025	0.025
57:00:00	0.000	0.000	0.000	0.000	0.024	0.024
57:30:00	0.000	0.000	0.000	0.000	0.024	0.024
58:00:00	0.000	0.000	0.000	0.000	0.024	0.024
58:30:00	0.000	0.000	0.000	0.000	0.024	0.024
59:00:00	0.000	0.000	0.000	0.000	0.023	0.023
59:30:00	0.000	0.000	0.000	0.000	0.023	0.023
60:00:00	0.000	0.000	0.000	0.000	0.023	0.023
60:30:00	0.000	0.000	0.000	0.000	0.023	0.023
61:00:00	0.000	0.000	0.000	0.000	0.022	0.022
61:30:00	0.000	0.000	0.000	0.000	0.022	0.022
62:00:00	0.000	0.000	0.000	0.000	0.022	0.022
62:30:00	0.000	0.000	0.000	0.000	0.022	0.022
63:00:00	0.000	0.000	0.000	0.000	0.021	0.021

Appendix

Catchment descriptors

Name	Value	User-defined value used?
Area (km ²)	0.76	No
ALTBAR	113	No
ASPBAR	311	No
ASPVAR	0.45	No
BFIHOST	0.75	No
BFIHOST19	0.77	No
DPLBAR (km)	0.85	No
DPSBAR (mkm ⁻¹)	27.6	No
FARL	1	No
LDP	1.88	No
PROPWET	0.3	No
RMED1H	10.5	No
RMED1D	31.2	No
RMED2D	39	No
SAAR (mm)	649	No
SAAR4170 (mm)	678	No
SPRHOST	28.29	No
Urbext2000	0.01	No
Urbext1990	0.01	No
URBCONC	0.17	No
URBLOC	1.23	No
DDF parameter C	-0.03	No
DDF parameter D1	0.37	No
DDF parameter D2	0.34	No
DDF parameter D3	0.25	No
DDF parameter E	0.3	No
DDF parameter F	2.37	No
DDF parameter C (1km grid value)	-0.03	No
DDF parameter D1 (1km grid value)	0.37	No
DDF parameter D2 (1km grid value)	0.34	No
DDF parameter D3 (1km grid value)	0.25	No
DDF parameter E (1km grid value)	0.3	No
DDF parameter F (1km grid value)	2.36	No

Job No. 232728	Calc. No./Sketch No. 1	Rev. 1	Page 1
Project Stretton Court MSA		Date Prepared 09/08/2023	Prepared by AE
Title Manning's Open Channel Flow - Engineered Channel			Authorised by RM

$$Q = \frac{K A R^{2/3} S^{1/2}}{n}$$

where:

Q: flow (m³/s)

A: cross-sectional flow area (m²)

R: hydraulic radius (m)

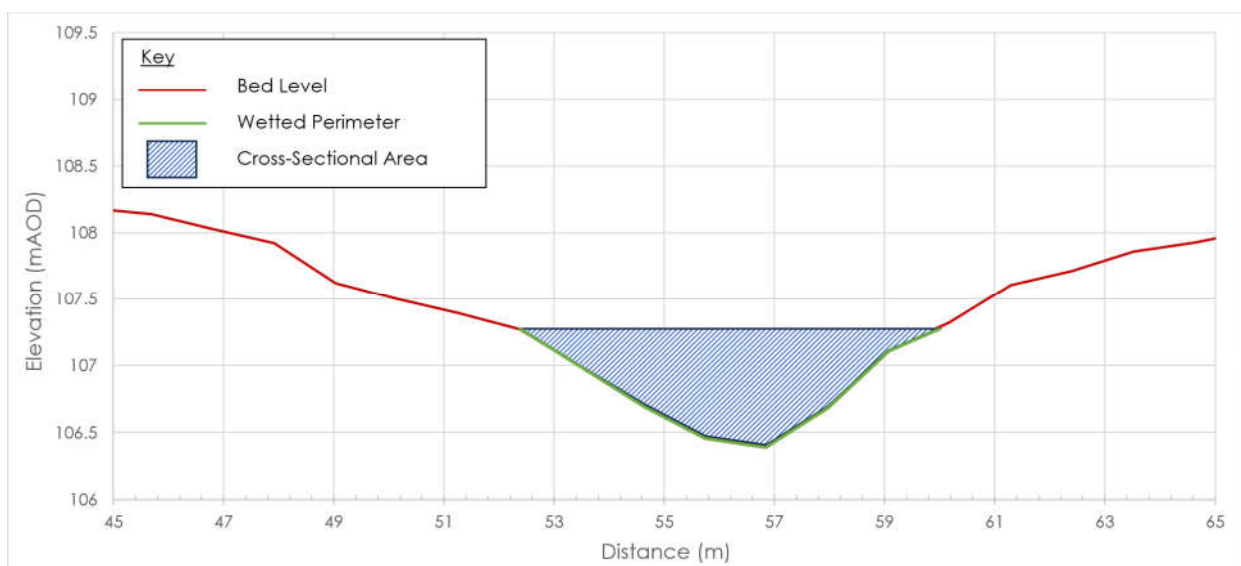
So: bed slope

n: roughness coefficient

K: Constant

 : variables

		Comment
Channel Width (m)	7.80	
A (m ²)	3.71	
Wetted Perimeter (m)	8.18	
R (m)	0.45	
Bed Slope / Gradient	1 in 150	
So	0.0067	
Manning's 'n'	0.050	Medium Vegetation
K	1.000	
Q (m³/s)	3.56	



Job Number: 232728	Calc number: 2	Rev: 1
Project: Stretton Court MSA	Date: 18.08.23	Prepared by: AE
Title: Pipe Full Flow	Authorised by: RM	

Colebrook-White Formula

$$V = -2(2gDS)^{0.5} \log \left(\frac{k}{3.7D} + \frac{2.5\nu}{D(2gDS)^{0.5}} \right)$$

k = Colebrook-White roughness coefficient, in metres

V = velocity, in metres per second

D = circular cross-section pipe, inside diameter, in metres

S = slope, in metres per metre

ν = kinematic viscosity of water, in square metres per second.

g = Gravity 9.81 m/s²

n = kinematic viscosity of water 1.141E-06 m²/s

k = Colebrook-White roughness coeff = 0.600 mm = 6.000E-04 m

D = Inside diameter = 900 mm = 0.900 m

S = Slope, in metres per metre 0.260%
= (Hydraulic Gradient) 1: 385

Discharge:

Q = V x A

V = 1.59 m/s

A = 0.636 m²

Q = 1.011 m³/s = 1011.2 l/s

Appendix 5: Severn Trent Water Sewer Records



GENERAL CONDITIONS AND PRECAUTIONS TO BE TAKEN WHEN CARRYING OUT WORK ADJACENT TO SEVERN TRENT WATER'S APPARATUS

Please ensure that a copy of these conditions is passed to your representative and/or your contractor on site. If any damage is caused to Severn Trent Water Limited (STW) apparatus (defined below), the person, contractor or subcontractor responsible must inform STW immediately on:
0800 783 4444 (24 hours)

- a) These general conditions and precautions apply to the public sewerage, water distribution and cables in ducts including (but not limited to) sewers which are the subject of an Agreement under Section 104 of the Water Industry Act 1991(a legal agreement between a developer and STW, where a developer agrees to build sewers to an agreed standard, which STW will then adopt); mains installed in accordance with an agreement for the self-construction of water mains entered into with STW and the assets described at condition b) of these general conditions and precautions. Such apparatus is referred to as "STW Apparatus" in these general conditions and precautions.
- b) Please be aware that due to The Private Sewers Transfer Regulations June 2011, the number of public sewers has increased, but many of these are not shown on the public sewer record. However, some idea of their positions may be obtained from the position of inspection covers and their existence must be anticipated.
- c) On request, STW will issue a copy of the plan showing the approximate locations of STW Apparatus although in certain instances a charge will be made. The position of private drains, private sewers and water service pipes to properties are not normally shown but their presence must be anticipated. This plan and the information supplied with it is furnished as a general guide only and STW does not guarantee its accuracy.
- d) STW does not update these plans on a regular basis. Therefore the position and depth of STW Apparatus may change and this plan is issued subject to any such change. Before any works are carried out, you should confirm whether any changes to the plan have been made since it was issued.
- e) The plan must not be relied upon in the event of excavations or other works in the vicinity of STW Apparatus. It is your responsibility to ascertain the precise location of any STW Apparatus prior to undertaking any development or other works (including but not limited to excavations).
- f) No person or company shall be relieved from liability for loss and/or damage caused to STW Apparatus by reason of the actual position and/or depths of STW Apparatus being different from those shown on the plan.

In order to achieve safe working conditions adjacent to any STW Apparatus the following should be observed:

1. All STW Apparatus should be located by hand digging prior to the use of mechanical excavators.
2. All information set out in any plans received from us, or given by our staff at the site of the works, about the position and depth of the mains, is approximate. Every possible precaution should be taken to avoid damage to STW Apparatus. You or your contractor must ensure the safety of STW Apparatus and will be responsible for the cost of repairing any loss and/or damage caused (including without limitation replacement parts).
3. Water mains are normally laid at a depth of 900mm. No records are kept of customer service pipes which are normally laid at a depth of 750mm; but some idea of their positions may be obtained from the position of stop tap covers and their existence must be anticipated.
4. During construction work, where heavy plant will cross the line of STW Apparatus, specific crossing points must be agreed with STW and suitably reinforced where required. These crossing points should be clearly marked and crossing of the line of STW Apparatus at other locations must be prevented.
5. Where it is proposed to carry out piling or boring within 20 metres of any STW Apparatus, STW should be consulted to enable any affected STW Apparatus to be surveyed prior to the works commencing.
6. Where excavation of trenches adjacent to any STW Apparatus affects its support, the STW Apparatus must be supported to the satisfaction of STW. Water mains and some sewers are pressurised and can fail if excavation removes support to thrust blocks to bends and other fittings.
7. Where a trench is excavated crossing or parallel to the line of any STW Apparatus, the backfill should be adequately compacted to prevent any settlement which could subsequently cause damage to the STW Apparatus. In special cases, it may be necessary to provide permanent support to STW Apparatus which has been exposed over a length of the excavation before backfilling and reinstatement is carried out. There should be no concrete backfill in contact with the STW Apparatus.
8. No other apparatus should be laid along the line of STW Apparatus irrespective of clearance. Above ground apparatus must not be located within a minimum of 3 metres either side of the centre line of STW Apparatus for smaller sized pipes and 6 metres either side for larger sized pipes without prior approval. No manhole or chamber shall be built over or around any STW Apparatus.
9. A minimum radial clearance of 300 millimetres should be allowed between any plant or equipment being installed and existing STW Apparatus. We reserve the right to increase this distance where strategic assets are affected.
10. Where any STW Apparatus coated with a special wrapping is damaged, even to a minor extent, STW must be notified and the trench left open until the damage has been inspected and the necessary repairs have been carried out. In the case of any material damage to any STW Apparatus causing leakage, weakening of the mechanical strength of the pipe or corrosion-protection damage, the necessary remedial work will be recharged to you.
11. It may be necessary to adjust the finished level of any surface boxes which may fall within your proposed construction. Please ensure that these are not damaged, buried or otherwise rendered inaccessible as a result of the works and that all stop taps, valves, hydrants, etc. remain accessible and operable. Minor reduction in existing levels may result in conflict with STW Apparatus such as valve spindles or tops of hydrants housed under the surface boxes. Checks should be made during site investigations to ascertain the level of such STW Apparatus in order to determine any necessary alterations in advance of the works.
12. With regard to any proposed resurfacing works, you are required to contact STW on the number given above to arrange a site inspection to establish the condition of any STW Apparatus in the nature of surface boxes or manhole covers and frames affected by the works. STW will then advise on any measures to be taken, in the event of this a proportionate charge will be made.
13. You are advised that STW will not agree to either the erection of posts, directly over or within 1.0 metre of valves and hydrants,
14. No explosives are to be used in the vicinity of any STW Apparatus without prior consultation with STW.

TREE PLANTING RESTRICTIONS

There are many problems with the location of trees adjacent to sewers, water mains and other STW Apparatus and these can lead to the loss of trees and hence amenity to the area which many people may have become used to. It is best if the problem is not created in the first place. Set out below are the recommendations for tree planting in close proximity to public sewers, water mains and other STW Apparatus.

15. Please ensure that, in relation to STW Apparatus, the mature root systems and canopies of any tree planted do not and will not encroach within the recommended distances specified in the notes below.
16. Both Poplar and Willow trees have extensive root systems and should not be planted within 12 metres of a sewer, water main or other STW Apparatus.
17. The following trees and those of similar size, be they deciduous or evergreen, should not be planted within 6 metres of a sewer, water main or other STW Apparatus. E.g. Ash, Beech, Birch, most Conifers, Elm, Horse Chestnut, Lime, Oak, Sycamore, Apple and Pear. Asset Protection Statements Updated May 2014
18. STW personnel require a clear path to conduct surveys etc. No shrubs or bushes should be planted within 2 metre of the centre line of a sewer, water main or other STW Apparatus.
19. In certain circumstances, both STW and landowners may wish to plant shrubs/bushes in close proximity to a sewer, water main of other STW Apparatus for screening purposes. The following are shallow rooting and are suitable for this purpose: Blackthorn, Broom, Cotoneaster, Elder, Hazel, Laurel, Privet, Quickthorn, Snowberry, and most ornamental flowering shrubs.

