

LAND OFF BEECH DRIVE, THORNTON

BARWOOD HOMES

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY REPORT

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1.0 INTRODUCTION

- 1.1 ADC Infrastructure have been commissioned by Barwood Homes to produce a joint Flood Risk Assessment and Drainage Strategy report in support of a full planning application for a proposed residential development of 49 dwellings on a site off Beech Drive in Thornton, Leicestershire.
- 1.2 This Flood Risk Assessment has been carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) and associated Planning Practice Guidance (PPG). It investigates the flood risk posed to the site from fluvial, pluvial, sewer and groundwater-based sources. A section in this report provides recommendations for mitigation and an analysis of any likely residual risks.
- 1.3 An initial drainage strategy for both foul and surface water seeks to identify the potential constraints that need to be considered as the development proposals progress. Leicestershire County Council as the Lead Local Flood Authority (LLFA), the Environment Agency and Severn Trent Water Limited have all been consulted as the relevant statutory authorities to inform the drainage strategy for the site.

2.0 SOURCES OF INFORMATION

2.1 This report has been based upon a variety of information sources as listed below:

- CIRIA SuDS Manual
- Environment Agency Flood Mapping
- Hinckley and Bosworth Borough Council Local Plan
- Hinckley and Bosworth Level 2 SFRA
- Lead Local Flood Authority consultation
- PRP Environmental (2014) – Flood Risk Assessment for site
- PRP Environmental (2014) – Foul and Stormwater Drainage Strategy for site
- Severn Trent Water Developer Enquiry response
- Severn Trent Water sewer asset record plans

3.0 SITE DESCRIPTION

- 3.1 The development site is located to the west of the village centre of Thornton, approximately 13km from the centre of Coalville. It covers an area of approximately 3ha and is currently undeveloped, greenfield land. The site is bound by existing residential development to the north and east, and agricultural land which slopes down to a minor watercourse to the south-west. The location of the site is included in Figure 1 below and is centred on grid reference 446414,307737.



Figure 1 – The site location, with the red line boundary shown.

- 3.2 A walkover of the site, and the surrounding area was undertaken by ADC Infrastructure in February 2020. Photographs were taken across the site and focused on the existing drainage features and onsite levels, copies of the photos taken during the site walkover can be found in **Appendix A**.

Topography

- 3.3 A topographical survey of the site was undertaken by NJC Surveys Ltd in May 2014, as part of the previous planning application for the site. A copy of the survey is provided within **Appendix B**.
- 3.4 The survey shows that the site has a relatively steep gradient and falls from the eastern site boundary adjacent to the existing residential properties on Main Street down towards the north-west site corner. There is a total level difference between the highest and lowest parts of the site of approximately 19m. The highest levels are located adjacent to eastern boundary at 147.02m AOD, whilst the lowest portion of the site is in the north-west site corner near to the access track off Beech Drive at 127.73m AOD.
- 3.5 The publicly available LiDAR datasets for the surrounding area were obtained and reviewed to gain a better appreciation of the general topography of the area. Contour lines were then extracted from the LiDAR data.

- 3.6 A false colour extract from the available LiDAR data can be found in Figure 2 below, the contour lines with the elevation in m AOD have also been shown.

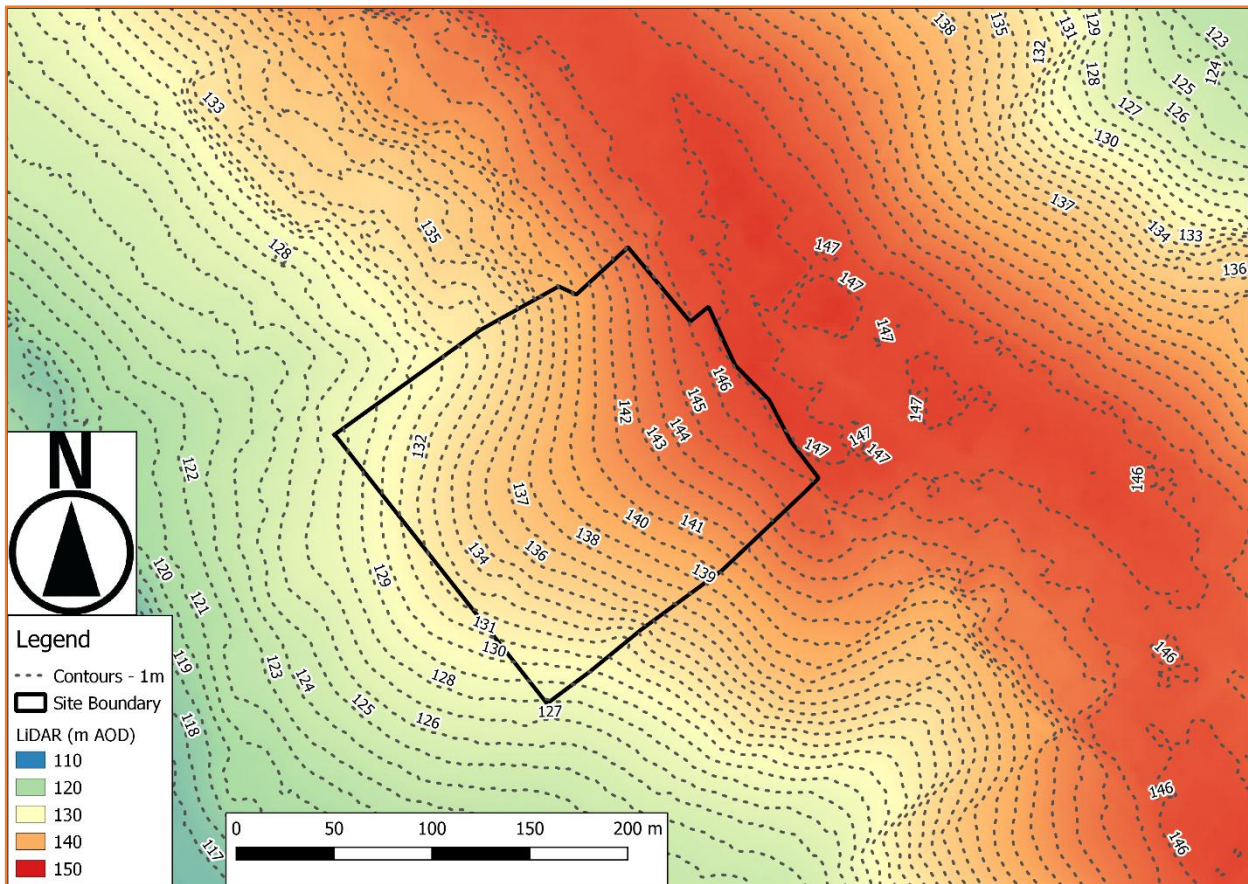


Figure 2 – The digital elevation model of the site taken from the EA LiDAR datasets.

Existing site drainage

- 3.7 The site is greenfield and is not currently served by a formal drainage network for surface water runoff. It is believed that runoff generated onsite drains via a combination of slow infiltration into the underlying soils and overland flow towards the minor watercourse to the south-west of the site.
- 3.8 The adopted sewer network for Thornton is currently maintained by Severn Trent Water. The sewer asset record plans have been obtained for the site and the surrounding area, a copy of the plans can be found in **Appendix C**.
- 3.9 The plans show that there is a separate foul and surface water drainage network within Beech Drive and Hawthorne Drive to the north-west of the site. The foul sewer outfalls into a 300mm gravity conveyed combined sewer to the south-west. The sewers in Beech Drive are shown as a private network on the sewer plan, but it was confirmed in the PRP Drainage Strategy report that these sewers were transferred into the ownership of Severn Trent following the change in legislation in 2011. It is likely that the sewers plans have not been updated to show the adoption transfer.

Geology

3.10 The British Geological Survey (BGS) online mapping was reviewed to give an indication of the underlying ground conditions on site. The online mapping showed that the bedrock geology and superficial deposits are as follows:

- **Bedrock Geology:**
 - *Gunthorpe Member – Mudstone. Sedimentary Bedrock formed approximately 237 to 247 million years ago in the Triassic Period. Local environment previously dominated by hot deserts.*
 - *Cotgrave Sandstone Member – Sandstone. Sedimentary Bedrock formed approximately 228 to 237 million years ago in the Triassic Period. Local environment previously dominated by rivers.*
- **Superficial Deposits:** None recorded

3.11 Initial infiltration testing was undertaken onsite in October 2014 in which a single trial pit was excavated to a depth of 0.6m below existing ground level (bgl).

3.12 The test results showed that an infiltration rate of 1.73×10^{-6} m/s was calculated for the underlying soils. This rate was deemed to be poor and was attributed to the underlying mudstone geology, which is deemed as not being suitable for infiltration drainage features. A copy of the infiltration testing from the previous drainage strategy for the site is included within **Appendix D**.

Soils

3.13 The Cranfield Soil and Agrifood Institute Soils mapping for the site was also reviewed. The mapping defined the underlying soil classification as:

- **Soilscape 8:** *Slightly acid loamy and clayey soils with impeded drainage.*

These soils are described as having a loamy and clayey texture and have slightly impeded drainage.

Onsite drainage implications

3.14 Based on the desktop data, the underlying ground conditions appear to be impermeable in nature, and not conducive for infiltration drainage techniques. Therefore, an alternative option for surface water disposal, in line with the discharge hierarchy in the Buildings Regulations guidance, should be considered.

Flood Warnings/Flood Alert

3.15 The site does not fall within a Flood Warning Area, and so does not receive the Flood Warning Service from the Environment Agency.

4.0 PROPOSED DEVELOPMENT

- 4.1 The development proposals are for a residential development comprised of 49 dwellings. The main vehicular and pedestrian access will be off Beech Drive directly, with provision for accompanying car parking facilities that will serve each dwelling.
- 4.2 There are also areas of soft landscaping, with an area of shelter belt planting and an area near the north-west corner of the site that has been set aside for the provision of a surface water detention basin.
- 4.3 The masterplan for the site was prepared by BHB Architects has been provided and is included within Figure 3 below.



Figure 3 – The proposed site masterplan.

5.0 PLANNING CONTEXT

Flood and Water Management Act

- 5.1 In combination with the Flood Risk Regulations 2009 (which enact the EU Floods Directive in England and Wales), the Flood and Water Management Act places significantly greater responsibility on Local Authorities to manage and lead on local flooding issues. The Act and Regulations together raise the requirements and targets that Local Authorities need to meet; this includes:
- To play an active role in leading flood risk management in an area.
 - The development of a Local Flood Risk Management Strategy.
 - To prepare preliminary flood risk assessments (PFRAs), flood hazard and risk maps, and flood risk management plans (FRMPs);
 - To develop and implement drainage and flood risk management strategies.
 - To be responsible for the approval, adoption and subsequent maintenance of Sustainable Urban Drainage Systems (SuDS).
- 5.2 The Local Lead Flood Authority (LLFA) for the Thornton area is Leicestershire County Council (LCC), who have the responsibility for the management of flood risk for the local area. LCC have been consulted during the preparation of this flood risk assessment, and a copy of their response can be found in **Appendix E**.

The National Planning Policy Framework (NPPF)

- 5.3 The NPPF sets out the government's planning policies for England and the expectations of how these policies should be applied. It acts as guidance for local planning authorities and decision-makers, both in drawing up plans and making decisions about individual planning applications.
- 5.4 Section 14 of the NPPF sets out how the government intends decision-making authorities to meet the challenge of climate change plus flooding and coastal change. Paragraph 155 sets out how inappropriate development in areas at risk of flooding should be avoided by directing development away from these areas, but where development is necessary, making it safe for its lifetime without increasing the flood risk elsewhere.
- 5.5 Paragraph 159 advises:
- “If it is not possible for development to be in zones with a lower risk of flooding, the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in national planning guidance.”*
- 5.6 Paragraph 160 advises that:
- “The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. For the exception test to be passed it should be demonstrated that:*
- a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and*
 - b) the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.”*
- 5.7 Paragraph 163 continues to advise that:
- “When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-*

specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

- a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location.*
- b) the development is appropriately flood resistant and resilient.*
- c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate.*
- d) any residual risk can be safely managed; and*
- e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.”*

Planning Practice Guidance (PPG)

5.8 The PPG associated with the NPPF provides more detailed guidance on how the requirements of the NPPF can be met in practice. It includes recommendations on the allowances for climate change and for the application of the sequential and exception tests. Three critically important tables are included within the PPG that set the framework for discussion and analysis of site-specific flood risk.

5.9 Table 1 of the Planning Practice Guidance defines flood zones based upon event return probability and is used to steer development and classify land for development. The table is reproduced below.

Table 1 – Flood Zone Classification

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (shown as ‘clear’ on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (not separately distinguished from Zone 3a on the Flood Map)

5.10 Table 2 of the Planning Practice Guidance defines development type by associated vulnerability to flooding. The table is reproduced overleaf.

Table 2 – Development Vulnerability Classification

Vulnerability Classification	Definition
Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which must be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
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.
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.

5.11 Table 3 of the Planning Practice Guidance (Flood Risk Vulnerability and flood zone ‘compatibility’) outlines the circumstances in which development may or may not be appropriate and when an Exception Test will be required. The table is reproduced below.

Table 3 – Flood Risk Vulnerability and Flood Zone Compatibility

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test Required.	✓	✓	✓
Zone 3a	Exception Test Required †	✗	Exception Test Required	✓	✓
Zone 3b	Exception Test Required*	✗	✗	✗	✓*
† In Flood Zone 3a – essential infrastructure should be designed and constructed to remain operational and safe in times of flood. * In Flood Zone 3b (functional flood plain) essential infrastructure that must be there and has passed the Exception Test, and water- compatible uses, should be designed to: • remain operational and safe for users in times of flood • result in no net loss of flood plain storage • not impede water flows and not increase flood risk elsewhere.					

Hinckley and Bosworth Borough Council Local Plan

5.12 The site falls within the jurisdiction of Hinckley and Bosworth Borough Council and is subject to the policies and guidance specified within the Local Development Framework. The Core Strategy was adopted in December 2009 and covers the period up to 2026. The current Local Plan is due to be superseded by an updated plan that is currently being consulted on and is due to be adopted in 2021.

5.13 The Core Strategy does not contain any specific policies on flood risk or surface water management, but these are covered more broadly under Strategic Objective 10, which seeks to improve resource management across the Borough. Objective 10 notes that flooding is not a major issue for the Borough but does specify that sustainable urban drainage needs to be incorporated into the design of new development to mitigate against any increase in flood risk.

Hinckley and Bosworth Level 2 SFRA (2019)

5.14 Hinckley and Bosworth Borough Council commissioned JBA to undertake a Level 1 Strategic Flood Risk Assessment (SFRA), in order to inform and support the production of the updated Local Plan up to 2036. In addition to providing an update to the joint 2014 SFRA that covered Hinckley and Bosworth, Blaby, and Oadby and Wigston Borough Councils, as well as the later Leicestershire and Leicester City 2017 SFRA.

5.15 As part of the SFRA, there is guidance on flood risk for new developments across the Borough area, that also sets out the requirements for a site-specific FRA that establishes:

- whether a proposed development is likely to be affected by current or future flooding from any source.
- whether a proposed flood development will increase flood risk elsewhere.
- whether the measures proposed to deal with the effects and risk are appropriate.
- the evidence, if necessary, for the local planning authority to apply the Sequential Test; and
- whether, if applicable, the development will be safe and pass the Exception Test.

- 5.16 The SFRA goes onto to provide advice for site specific mitigation that includes modifying ground levels, finished floor levels and general resistance and resilience measures that can be used by future site users. These measures have been referenced in this report, from **Section 7.0** onwards, to provide suitable mitigation for the development and reduce the flood risk.

Flood Risk Status

- 5.17 The Environment Agency online flood mapping shows that the site lies within Flood Zone 1 (see Figure 4 below). A direct request was also made to the EA, to confirm the flood risk status of the site, as well as providing general guidance to inform the flood risk assessment but they have yet to provide a formal response.

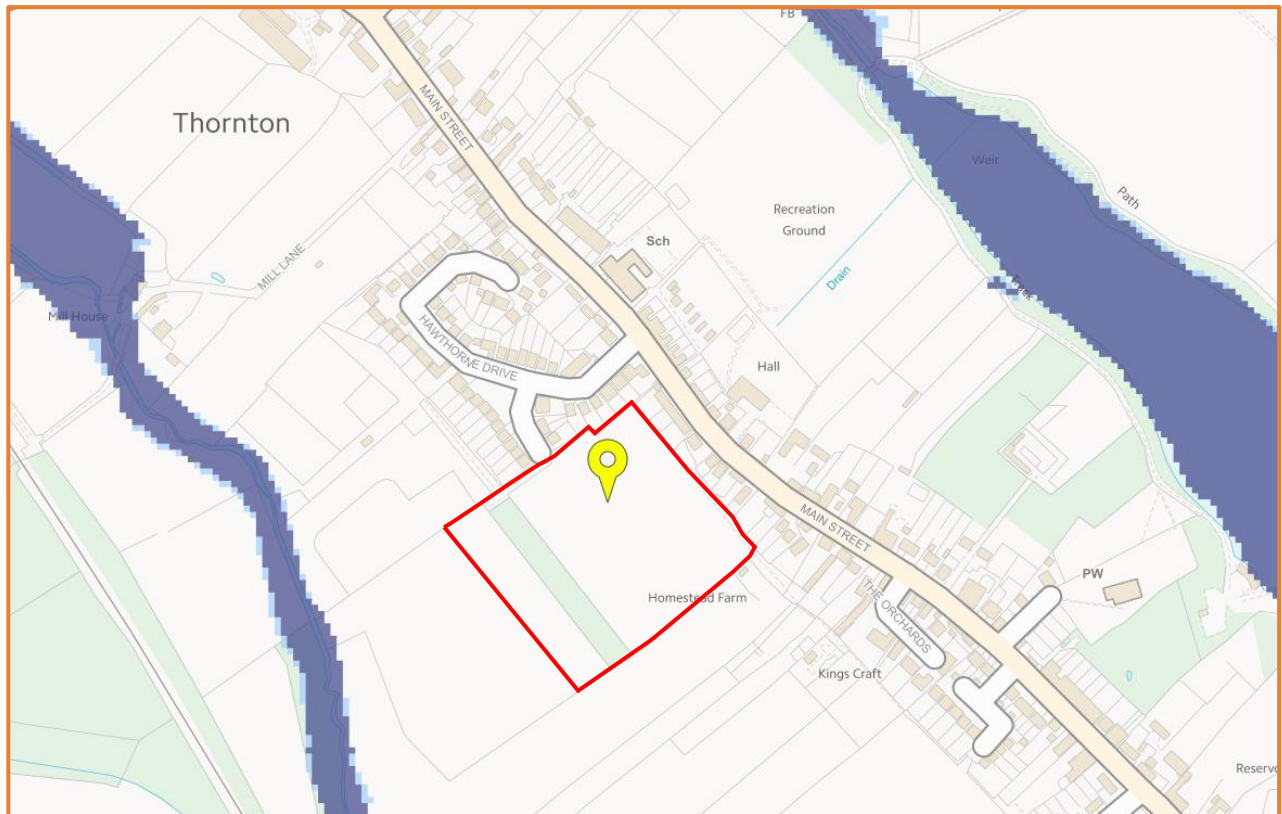


Figure 4 - EA Flood Map for Planning extract, showing the fluvial flood risk to the site.

- 5.18 In Table 2 of the PPG guidance, residential dwellings are categorised as a more vulnerable development type. In accordance with Table 3 of the PPG, the development is deemed appropriate. As such, there is no requirement for the Sequential and Exception Tests to be carried out. A summary of the flood risk status of the development proposals is provided in the table below.

Table 4 – Development Flood Risk Classification

Flood Zone	Flood Zone 1
Development Vulnerability Classification	More Vulnerable
Flood Zone Compatibility	Sequential and Exception Tests are not required

Flood history

- 5.19 The Environment Agency Recorded Flood Outlines mapping has been reviewed and showed that the site had not been affected by any recorded flood events. A similar search of the Chronology of British Hydrological Events database also confirmed that there are no historic flood events directly associated with Thornton.

6.0 FLOOD RISK ASSESSMENT

Existing risks

- 6.1 In accordance with the NPPF and local planning guidance, this Flood Risk Assessment considers the risk posed to the development from a range of flooding sources. This section of the report details the investigation of flood risk from all pertinent sources; a subsequent section provides recommended mitigation where the risk is deemed significant.
- 6.2 The flood risks that may be posed to any site are summarised in the table below. The degree of risk to the site is indicated in the table below and site-specific factors site are outlined and described in greater detail within the forthcoming sections.

Table 5 – Development Flood Risk Summary

Flooding Source	Degree of Risk	Source of Risk
Fluvial	Low	The site lies within Flood Zone 1 and is at a low risk of flooding from fluvial sources.
Tidal	None	Site is not in a tidally influenced area.
Canals	None	There are no canals within the immediate vicinity of the site.
Groundwater	Low	Based on the local topography and ground conditions, the risk is considered low.
Sewers	Low	Site is currently greenfield and is not served by an existing drainage network.
Pluvial (Surface Water) runoff	Low	The EA flood mapping shows that the majority of the site is not at risk of surface water flooding. The exceptions being an overland flow path that runs from the north-west site corner down to a nearby watercourse, following the natural gradient of the site.
Reservoirs and Waterbodies	None	The EA mapping shows that the site does not fall within an area deemed to be at risk of reservoir flooding.

Fluvial risk

- 6.3 The online Environment Agency mapping was reviewed and showed the site to be within Flood Zone 1. There are no main rivers within the vicinity of the site that could potentially pose a direct risk to the proposed development. Therefore, the fluvial flood risk to the site can be considered to be low.

Tidal flooding

- 6.4 The site is located within an area that is not tidally influenced, and as such there is no current risk of flooding from tidal sources.

Canal flooding

- 6.5 There are no canals within the immediate vicinity of the site, and therefore there is no risk posed to the site.

Groundwater flooding

- 6.6 Groundwater flooding occurs when the water table rises following a period of prolonged rainfall and emerges on the ground surface. It is most likely to occur in low-lying area that are underlain by permeable bedrock and superficial deposits.

- 6.7 A single trial pit was excavated in the northern section of the site in October 2014 to a depth of 0.6m below ground level (bgl), as part of onsite infiltration testing works. It was noted that groundwater was encountered at a depth of 0.47m bgl.
- 6.8 The subsequent infiltration testing showed that water levels remained constant throughout the duration of the test, and that there was no seepage from the surrounding soil stratum. This was deemed to be the result of the underlying geology of mudstone, which is described as being very dense with small fissures and would inhibit groundwater rising through the soil.
- 6.9 The 2019 SFRA for Hinckley and Bosworth includes mapping which shows the areas across the Borough that are susceptible to groundwater flooding. The mapping implies that the site falls within an area that is deemed to have a low susceptibility (<25%) to groundwater flooding. This is derived from the proportion of a 1km square within the map that is believed to be susceptible to groundwater flooding. A copy of the Areas Susceptible to Groundwater Flooding map can be found within **Appendix F**.
- 6.10 As such based on the findings from the onsite infiltration testing and the groundwater flood mapping, the residual risk from groundwater flooding is deemed to be low.

Pluvial risk

- 6.11 The EA publish pluvial (surface water) flood maps which show the route of surface water runoff across the ground. Typically, these flood maps identify overland drainage paths that are often part of a historic natural land drainage system.
- 6.12 In the mapping, the site is shown to have a low risk of surface water flooding. The exception being an overland flow path that runs from the north-west site corner down towards the minor watercourse to the west, following the natural gradient of the land. An extract of the mapping can be found below in Figure 5.

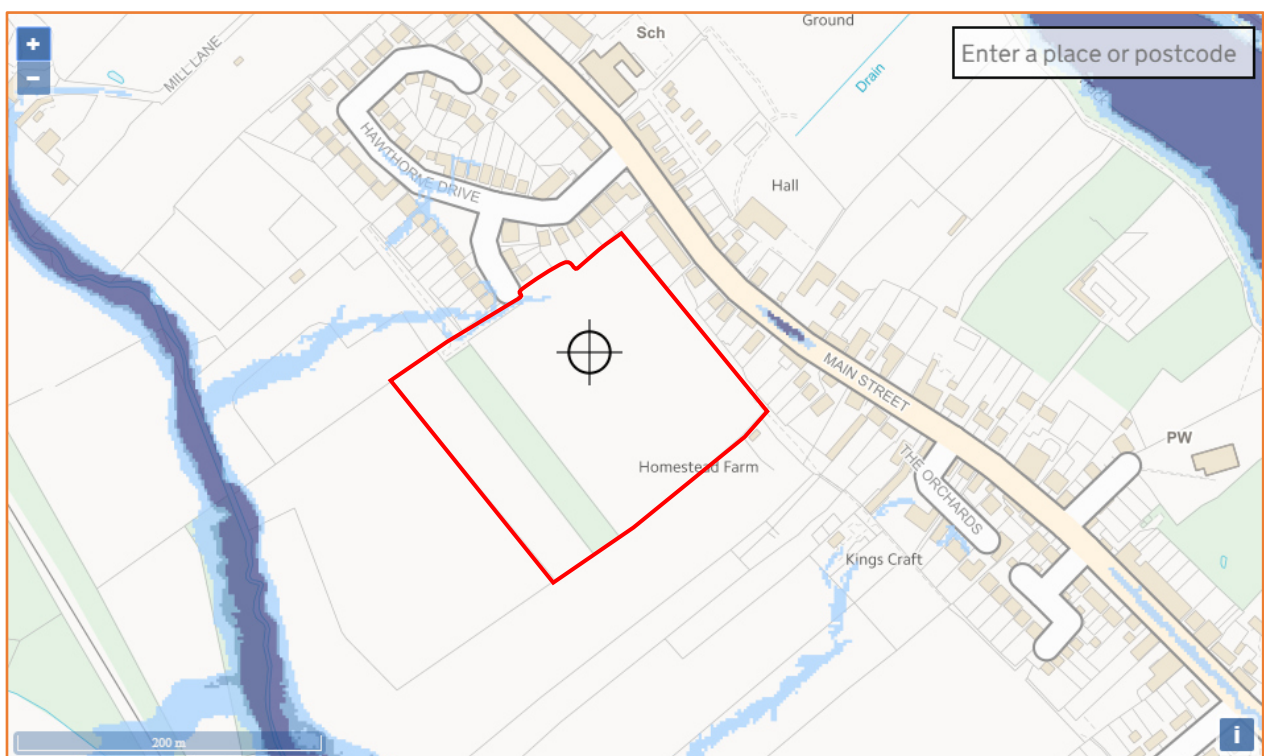


Figure 5 - The pluvial flood risk to the site.

- 6.13 The overland flow path is only shown to only occur following a low risk (1 in 100 year to 1 in 1000 year) storm event and will likely have a negligible impact upon the development.
- 6.14 It should be noted that surface water flooding is difficult to predict, as rainfall location and volume are difficult to forecast. Furthermore, local topographic features can greatly impact on the probability and severity of any flooding.
- 6.15 The development proposals will see an increase in the impermeable surface are onsite. However, provided that careful mitigation is included within the development design, it is anticipated that the risk of surface water flooding can be adequately managed onsite.

Sewer flooding

- 6.16 The adopted sewer network for the Thornton area is currently managed by Severn Trent Water. As mentioned previously, there is no extensive drainage network within the site at present, with the closest adopted assets being within Beech Drive to the south. Furthermore, the existing levels for the site and the surrounding area fall away from the site, any foul water flows from the existing drainage network would preferentially be directed away from the development.
- 6.17 The Asset Protection team from Severn Trent Water were contacted directly to see if they held any record of sewer flooding to have affected the site and its immediate vicinity. A response from Severn Trent is currently awaited.

Reservoirs and waterbodies

- 6.18 The EA has prepared reservoir flood risk mapping to show the largest area that might be flooded if a reservoir were to fail. The mapping displays a worst-case scenario and is only intended to act as a guide.
- 6.19 The mapping indicates that the site does not fall within an area that would be flooded in the event of the failure of a reservoir retention structure, see Figure 6 below for an extract of the EA mapping, and as such there is deemed to be no residual risk to the site.

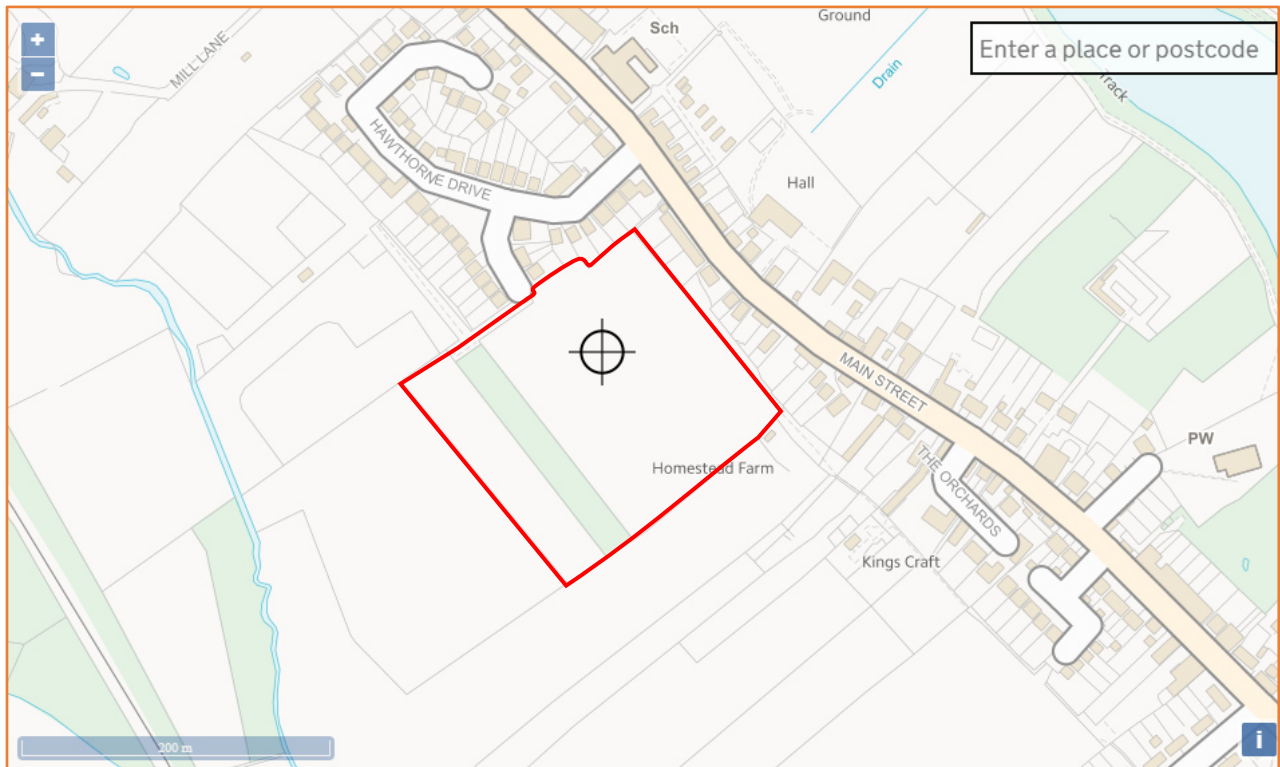


Figure 6 - The flood risk from reservoirs to the site.

Proposed Mitigation

- 6.20 The risk of flooding to the site from a variety of sources has been investigated, and there is a low overall risk of flooding from both fluvial and pluvial (surface water) flooding. The development site is located within Flood Zone 1 and is not at significant flood risk.
- 6.21 There is some minor surface water flood risk shown for the site, following the natural gradient down towards the adjacent land which falls away from the site. However, the provision of a formal drainage system and minor ground reprofiling will reduce the residual risk of surface water flooding.
- 6.22 A detailed surface water drainage strategy for the site is discussed in further detail in Section 7.0 and presents a management strategy that will seek to reduce the surface water flood risk to the development and the surrounding area. The following mitigation measures that are applicable to all new developments should be implemented.

Drainage System Design

- 6.23 The Non-statutory Technical Standard for SuDS has a series of recommendations in relation to the design of the prospective drainage system that will serve the development. These are to ensure that the drainage system on site is designed to a standard to negate the additional flood risk that may arise from the development. The recommendations are as follows:
- *"The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30-year (3.3% AEP) event."*
 - *"The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year (1% AEP) rainfall event in any part of: a building (including basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development."*

Finished Floor Levels

6.24 To manage the potential risk from pluvial flooding, the finished floor levels should be nominally lifted above external ground levels where possible. The NPPF guidance specifies that ground floor levels should be a minimum of whichever is higher:

- 300mm above the general ground level of the site;
- 600mm above the estimated river or sea flood level.

As the site is located within Flood Zone 1, and is at minimal risk from flooding, it is recommended that finished floor levels for all buildings on site are set to 300mm above the local ground level.

External Site Levels

6.25 External levels should be shaped to direct any exceedance flow from the drainage system or external surfaces away from building entrances. The local SFRA also highlights that any raising of levels onsite should be tested to ensure that there is no increase in surface water runoff onto neighbouring third party land.

Resistance and resilience measures

6.26 The local SFRA also provides advice on generic resistance and resilience measures that could be considered following the completion of the proposed development. However, in view of the site's location and low risk of flooding it is not proposed to implement any additional flood resistance or resilience measures.

7.0 SURFACE WATER DRAINAGE STATEMENT

Existing Discharge Rate

- 7.1 The existing site is greenfield and is entirely permeable in nature, for the purposes of this assessment it has been assumed that the site drains naturally.
- 7.2 The rate of greenfield runoff from the area of the site that is proposed for development was estimated using the ICP SuDS implementation of the IH124 method. A full print out of the results is included within **Appendix G**, and the results have been summarised in the table below. The figures give a realistic estimate of the likely discharge associated with the development.

Table 6 – Existing Site Discharge Rates

Return Period	Site Area (ha)	Runoff Rate (l/s)
QBar	2.15	9.5
1 in 1 Year	2.15	7.9
1 in 30 Year	2.15	18.5
1 in 100 Year	2.15	24.3

Discharge Options

- 7.3 In accordance with the Building Regulations Part H, the newly published Non-Statutory Technical Standards for SuDS and prevailing best practice, surface water should look to be discharged according to the following preferential hierarchy:
- Infiltration drainage techniques, such as swales and soakaways.
 - An open watercourse, river or ditch.
 - A surface water sewer.
 - A combined sewer.
- 7.4 The British Geological Survey (BGS) mapping, the Soilsmap mapping and the initial onsite infiltration testing were all reviewed to give an indication of the underlying ground conditions. These suggest that the site is underlain by impermeable soils, which may limit the viability of the use of infiltration on site.
- 7.5 As it appears that infiltration drainage techniques will not be able to provide a solution for discharge of the site's total runoff volume, preference should be given to the disposal of surface water runoff into the nearest open watercourse/drainage ditch. The drainage strategy for the previous proposals recommended that runoff should look to be discharged into the local drainage network, at a rate that is restricted to the existing greenfield runoff (QBAR) rate.
- 7.6 It was also noted that discussions with Leicestershire County Council (LCC), as the LLFA, that the drainage ditch could be used as an effective method of draining runoff from the site, at the existing QBar rate of 9.5l/s. In the latest consultation response, it was proposed to limit surface water flows to the existing greenfield runoff rate off, in line with local guidance specified by LCC.
- 7.7 The site walkover inspection confirmed the presence of the drainage ditch along the north-west boundary, and that it appeared to be of sufficient depth to be able to accommodate surface water flows from the development. Although it is recommended that additional survey work is undertaken to confirm the invert level at the base of the ditch.

Onsite Surface Water Strategy

- 7.8 The strategy for the onsite development involves the use of a below ground, gravity conveyed surface water drainage network that will collect surface water from impermeable surfaces (roofs and highways) onsite and drain down towards a detention basin located near in the north-west corner. A restricted discharge will be made into the drainage ditch, at the existing greenfield runoff rate of 9.5l/s.
- 7.9 The developable area of the site is estimated to consist of approximately 42% impermeable surfaces that cover a total area of 0.9ha. An additional 10% to account for urban creep, as specified in the LLFA guidance, was also included within the total impermeable surface area for the development.
- 7.10 The detention basin feature was designed for the site using the Micro Drainage Source Control module to a standard of a 1 in 100 year (1% AEP) plus 40% climate change storm event, in line with the guidance specified by the LLFA in their consultation response.
- 7.11 To provide the required onsite attenuation for the site, that includes the provision of 300mm of freeboard, a basin with a depth of 1.2m and approximate surface area of 890m² is required, the details of which can be found within **Appendix H**.
- 7.12 The public surface water drainage network within the development shall be put forward for adoption under a Section 104 agreement with Severn Trent, to maintain on an ongoing basis. Whilst the private lateral connections that will serve the individual properties shall be maintained by the private homeowners as part of the long-term maintenance of their individual properties.

Drainage Layout

- 7.13 An outline drainage layout plan, drawing ADC1092-DR-050, has been prepared by ADC Infrastructure, a copy of which can be found within **Appendix I**. The plan shows a surface water drainage network for the site, details of the onsite detention basin, and the proposed discharge location into the watercourse to the south-west.

8.0 FOUL WATER DRAINAGE STATEMENT

Proposed discharge rate

- 8.1 Based on the masterplan, there will be 49 residential dwellings are to be built as part of the development proposals, see Figure 3.
- 8.2 In line with the guidance within Section B5.1 of the Sewers for Adoption (SFA) 7th Edition, an average daily discharge rate of 4000l/s per residential unit has been used to calculate the anticipated peak foul water flow.
- 8.3 The peak flow has been calculated as follows:

$$49 \times 4000 = 196,000 \text{ l/day}$$
$$196,000 / (24 \times 60 \times 60) = \underline{\underline{2.26\text{l/s}}}$$

Proposed discharge strategy

- 8.4 In accordance with the guidance specified within the Building Regulations Part H, foul water effluent should look to be discharged according to the following preferential hierarchy:
- A foul water sewer;
 - A combined sewer;
 - A septic tank;
 - A cesspool.
- 8.5 The site is greenfield by nature and has no foul water discharge at present. Sewer asset record plans provided by Severn Trent confirm that there are no adopted sewers within the site, with the closest sewer assets being a foul network within Beech Drive and Hawthorne Drive to the north-west. A copy of the plans can be found in **Appendix C**.
- 8.6 A Developer Enquiry was submitted to Severn Trent for the previous development proposals. In their response, Severn Trent confirmed that a gravity foul connection could be made into the sewer network within Beech Drive, with the connection being made at manhole 3702 or downstream.
- 8.7 Severn Trent also confirmed that the network was transferred into their ownership following the Private Sewers Transfer Regulations in October 2011, and a Section 106 application would have to be made to Severn Trent in order to make the connection.
- 8.8 A new Developer Enquiry application for the new development proposals was submitted to Severn Trent, but a formal response has yet to be received.
- 8.9 Foul water effluent shall drain via a gravity conveyed drainage network that will discharge into the adopted foul sewer in Beech Drive, via a new connection that will outfall into manhole 3702 at an unrestricted rate. A Section 106 agreement shall be sought with Severn Trent to make the connection prior to the commencement of onsite work.
- 8.10 The proposed onsite foul drainage network shall be put forward for adoption under a Section 104 agreement with Severn Trent to be maintained on an ongoing basis. The private lateral connections that will serve the residential dwellings shall be maintained by the private homeowners as part of the ongoing maintenance of each individual property.

- 8.11 The outline drainage strategy, drawing ADC1092/DR/50, shows the layout of the proposed foul drainage network, and the details of the proposed connection into the foul network in Beech Drive. A copy of the outline drainage layout plan can be found in **Appendix I**.

9.0 SUSTAINABLE DRAINAGE ASSESSMENT

- 9.1 The proposed development will require approximately 655m³ of attenuation to balance flows from the site and ensure that there is no increase in flood risk elsewhere due to the development.
- 9.2 The anticipated ground conditions onsite comprising soils with low permeability are likely to mean that SuDS features utilising infiltration will not be viable, however appropriate ground investigation is recommended to confirm this.
- 9.3 Proposed impermeable areas on the Site are currently divided into private driveways, roads, shared car parks and buildings. In accordance with the 'CIRIA SuDS Manual C753 (2015)', the attributed pollution 'hazard' levels associated with these classifications of hardstanding are typically 'low'. Roofed areas, car parking and access roads are all classified as 'low' risk.
- 9.4 Due to the underlying ground conditions and significant slope on the site, the proposed SuDS will comprise a detention basin.

Table 7 – Land Use Pollution Risk Classification (CIRIA SuDS Manual Table 26.2 extract)

Land Use	Pollution Hazard Level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Private driveways	Low	0.5	0.4	0.4
Low traffic road	Low	0.5	0.4	0.4
Car park low usage	Low	0.5	0.4	0.4

- 9.5 The selected SuDS components and the associated total pollution mitigation indexes are outlined in Table 8 below. The proposed SuDS treatment train is designed to exceed the pollution values/risk occurring from proposed land uses highlighted in Table 7.

Table 8 – Indicative SuDS mitigation indices for discharges to surface waters (CIRIA SuDS Manual Table 26.3 extract)

Type of SuDS component	TSS	Metals	Hydrocarbons
Detention basin	0.5	0.5	0.6
Conventional gully and pipe drainage	1.0	1.0	1.0

- 9.6 In this instance it is anticipated that the bulk of the storage volume will be provided by a detention basin that will be sized appropriately. Furthermore, to provide an additional surface water treatment train the basin feature could be designed to include a forebay, and a small permanent pool near the outlet.

10.0 MAINTENANCE AND ADOPTION

- 10.1 The proposed attenuation systems are entirely contained within the site and maintenance of the drainage system will be the responsibility of the landowners to maintain on an ongoing basis
- 10.2 The maintenance of the recommended features is expected to be dictated by the general maintenance associated with the externals and drainage of the proposed development.
- 10.3 The table below has been prepared from the recommendations contained in the CIRIA SuDS Manual and should be set the minimum standards for inspection and maintenance, as per the table below.

Table 9 – Drainage maintenance recommendations

Drainage Component	Maintenance Task	Frequency
Drainage Network	Inspect for blockages to ensure network is free running	Every 3 months and after any significant storm event
Surface water gullies/ Linear drainage features	Inspect for blockages and ensure that the drainage feature is free running Jet or vacuum as appropriate	Every 3 months and after any significant storm event
Catchpits	Inspect for and remove silt	Every 6 months and after any significant storm event
Detention Basin	Inspect all areas for litter build up and remove litter as required.	Every month and after any significant storm event
	Cut grass and vegetation	Every 6 months and more frequently near outfalls
	Inspect inlets, outlets for blockages and remove as necessary	Every month and after any significant storm event
Soft Landscaping	Remove litter and debris	Monthly
	Manage vegetation and remove nuisance plants	As and when required
Discharge Control	Inspect for blockage and correct operation	Every 3 months and after any significant storm event

11.0 CONCLUSIONS AND RECOMMENDATIONS

- 11.1 This Flood Risk Assessment and Drainage Strategy report has been carried out on behalf of Barwood Homes in respect of a proposed residential development of 49 dwellings off Beech Drive in Thornton, Leicestershire. It has been conducted in accordance with the requirements of the NPPF and associated Planning Practice Guidance.
- 11.2 The site has been found not to be at any direct flood risk from flooding associated with fluvial, sewer or groundwater sources. The development site is entirely within Flood Zone 1 and there are no established sources of flood risk.
- 11.3 The EA mapping highlights that there are areas of minor surface water flood risk in the west. This will be mitigated by the proposed surface water strategy as well as general design considerations such as the raising of floor levels above existing ground levels and the arrangement of external levels to preferentially divert any exceedance flows away from building thresholds.
- 11.4 The surface water drainage strategy has been considered and a calculation of the anticipated discharge rates and attenuation volumes has been carried out. The proposed development shall look to discharge surface water runoff into the existing land drainage network at the current greenfield runoff rate of 9.5l/s.
- 11.5 Attenuation is proposed via the use of a detention basin feature that will be located in the west of the development in order to suit the onsite topography and development proposals. The basin feature has been designed to attenuate surface water runoff for all storm events up to and including a 1 in 100 year plus 40% climate change event, in line with local planning guidance. The provisional design is for a basin feature that is 1.2m deep, and with a total surface area of approximately 890m².
- 11.6 The detention basin will serve as the primary SuDS feature to serve the development and will be designed to incorporate the required treatment trains to ensure there is no detriment in water quality for the offsite flows into the drainage network.
- 11.7 Foul effluent shall look to be conveyed via a gravity foul sewer network that will discharge via a new connection into the adopted Severn Trent sewer network in Beech Drive adjacent to the proposed site entrance. The connection point to the network in Beech Drive is subject to approval from Severn Trent via a S106 application.
- 11.8 The proposed onsite foul and surface water drainage networks shall be put forward for adoption by Severn Trent under a Section 104 agreement to maintain on an ongoing basis.
- 11.9 The private drainage network and lateral connections shall be the responsibility of the private homeowners to maintain as part of the overall maintenance of each individual dwelling.
- 11.10 Provided that the recommendations of this report are followed, then the development can proceed without being at any significant flood risk and without increasing flood risk elsewhere. The development proposals are considered sustainable from a flood risk and drainage perspective.

APPENDIX A SITE WALKOVER PHOTOS



Photo of manhole 3702 within Beech Drive, which forms the head of the existing Severn Trent foul sewer.



Photo of manhole 3703 within Beech Drive, which is a continuation of the existing Severn Trent surface water sewer.



Photo looking west across the site, taken from the site entrance on Beech Drive.



Photo looking south across the site, taken from the site entrance on Beech Drive.

Note the relatively steep gradient of the site, as elevation fall towards the site entrance.



Photo looking south-east across the site, taken from the site entrance on Beech Drive.



Photo looking west across the site, looking back towards the site entrance, and the existing access track from Beech Drive.