



RAB

Flood Risk Assessment and Drainage Strategy

Land to rear of 34 Keats Lane, Earl Shilton

05/02/2024
Version 1.0
RAB: 3260_FRD



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Revision History

Version	Date	Amendments	Issued to
1.0	05/02/2024	First Issue	Mark Geraghty – HSSP Architects



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1.0 Introduction

RAB Consultants has prepared this Flood Risk Assessment (FRA) in support of the proposed development at Land to rear of 34 Keats Lane, Earl Shilton, LE9 7DQ.

The development site is located in Flood Zone 1 according to the Environment Agency's Flood Map for Planning (Rivers and Sea). A Flood Risk Assessment for this site is required under the Planning Practice Guidance for the National Planning Policy Framework (NPPF) as it is a major development. The site-specific FRA is required to ensure that the development is safe from flooding and will not increase the risk of flooding elsewhere.

2.0 Site details

2.1 Site location

TABLE 1: SITE LOCATION

Site address:	34 Keats Lane, Earl Shilton, LE9 7DG
Site area:	Approximately 0.9 ha
Existing land use:	Paddock with associated outbuilding and hardstanding yard area
OS NGR:	SP 46697 98253
Local Planning Authority:	Hinckley and Bosworth Borough Council





2.2 Site description

The proposed site is Land to the rear of 34 Keats Lane, Earl Shilton, located at the north extent of the town.

There is currently no public vehicular access, however there is a public right of way which passes from Keats Lane along the northeast extent of the site into the adjacent fields to the north.

Freely available LiDAR (1m-DTM-2022) and the topographic survey of the site (Appendix A) shows the site is relatively steep, falling from 120mAOD at the south extent by Keats Lane, down to 104mAOD at the north, with a general slope of 1 in 10.

The general surrounding area to the north is predominantly pasture and agricultural land with the town of Earl Shilton to the south.

It is understood that the fields to the north and west of the site (those which bound the site) are also under the ownership of the applicant and already benefit from outline planning permission for residential development.

2.3 Development proposal

Outline planning is sought for the construction of 10 residential bungalows on the site as well as associated parking and access road from Keats Lane.

The proposed layout plan with topographic survey is included in Appendix A.

3.0 Flood Risk

3.1 Sequential test

According to the Environment Agency's Flood Map for Planning the site lies in Flood Zone 1, which is described in the NPPF as land having a less than 1 in 1,000 annual probability of river or sea flooding (less than 0.1% AEP).

The NPPF follows a sequential risk-based approach in determining the suitability of land for development in flood risk areas, with the intention of steering all new development to the lowest flood risk areas. NPPF Planning Practice Guidance (PPG) Annex 3 confirms the 'Flood risk vulnerability classification' of a site, depending upon the proposed usage. This classification is subsequently applied to Table 2 'Flood risk vulnerability and flood zone incompatibility' to determine whether:

- The proposed development is suitable for the flood zone in which it is located; and
- Whether an Exception Test is required for the proposed development.

The proposed development is classed as a 'more vulnerable' development in accordance with NPPF PPG. The development is therefore appropriate for the Flood Zone. Both a Sequential Test and Exception Test are not required given the site is within Flood Zone 1.



3.2 Flood History

The Environment Agency's Recorded Flood Outlines GIS layer shows no record of flooding at the proposed site.

Leicestershire and Leicester City Level 1 Strategic Flood Risk Assessment (2017) makes no reference to any previous flood events around the site.

Internet searches reveal no evidence the site has previously flooded.

3.3 Fluvial (Rivers)

The site lies in Flood Zone 1 on the Environment Agency's Flood Map for Planning, indicating a risk less than 0.1% AEP.

The proposed development is more than 800m away from the nearest fluvial risk extent, north of the site.

3.3.1 Climate Change Impact on Fluvial Risk

The Environment Agency guidance document 'Flood risk assessments: climate change allowances' was released in February 2016 and last updated in May 2022. It includes statistical increases on peak fluvial flows by Management Catchment and allowance categories based on epochs and development vulnerability classification. Referring to the NPPF PPG, the development is classified as 'more vulnerable' and could have an expected lifetime of up to 100 years. In this case as the site is located in Flood Zone 1 the peak river flow allowances are not applicable.

The guidance also relates to peak rainfall intensity allowance, which is relevant for surface water flooding. For development with a lifetime beyond 2100, the 'upper end' allowance for the 2070s epoch (2061 to 2125) should be used which is a 40% addition to rainfall intensity in the Soar Management Catchment.

3.4 Flood defence breach or overtopping

3.4.1 Breach Risk

The site does not benefit from flood defences, so there is no breach risk for the site.

3.4.2 Overtopping Risk

The site does not benefit from flood defences, so there is no overtopping risk for the site.

3.5 Coastal/Tidal

The site is not affected by coastal or tidal flood risk as it is located at a considerable distance from the sea.

3.6 Pluvial (Surface water)

Referring to the Environment Agency's surface water flood map (Figure 1), the entire site is identified as being at 'very low' risk.

The map also identifies a 'low' risk, shallow natural flow route which begins to the west of the site, travelling north through the fields down to a watercourse more than 800m from the site. A drainage ditch (highlighted in Figure 1 below) also flows north parallel to the natural flow path, towards the ordinary watercourse.

Part of Keats Lane to the south of the site is shown to be at 'low' risk of flooding to depths mainly less than 0.15m, with some small sections up to 0.30m deep.



FIGURE 1: ENVIRONMENT AGENCY SURFACE WATER FLOOD MAP (LOW RISK) WITH GOOGLE SATELLITE MAP

Inspection of freely available LiDAR data (DTM-1m-2022) shows the ditch is not a well-defined feature in the landscape, possibly due to the dense vegetation which lines the ditch. In reality, it is expected that the ditch would intercept some of this overland surface water flow.

A prior Flood Risk Assessment (from another consultant) supporting a planning approval for the development of the north and west fields recommends that to manage this surface water risk, the drainage ditch should be "made good so it can safely convey and intercept surface water flows through the site".



TABLE 2: ENVIRONMENT AGENCY SURFACE WATER RISK CATEGORIES

Surface Water Risk Category	Surface water flooding Annual Exceedance Probability
Very Low	< 0.1% (1 in 1000 years)
Low	Between 1% and 0.1% (1 in 100 years and 1 in 1000 years)
Medium	Between 1% and 3.3% (1 in 100 years and 1 in 30 years)
High	> 3.3% (1 in 30 years)

3.7 Artificial water bodies

The site is not shown as being at risk from reservoir flooding on the Environment Agency reservoir risk map.

There are no canals within the vicinity of the site that could pose a risk.

3.8 Groundwater

BGS online mapping reports the local bedrock to be Gunthorpe Member, Mudstone, with superficial deposits of Wigston Member - Sand and gravel.

Soilscapes describes the soil on the development as 'Freely draining slightly acid loamy soils'.

The 2017 SFRA makes no reference to groundwater issues in the area.

The site and land beyond slopes steeply down towards a brook which lies 800m to the north and more than 20m lower. It seems unlikely that the proposed site would be prone to groundwater flooding in this setting.

Based on the above information a more detailed analysis of groundwater flooding is not considered appropriate.

3.9 Sewers

The 2017 SRFA includes a 'Severn Trent Water internal flooding records' table in which the postcode 'LE9 7' has no recorded incidents.

Given the location of the site it is unlikely that a sewer passes through the site. Any emergence of water along Keats Lane to the south would flow west along the road away from the site.

Based on available data a more detailed analysis of sewer flooding risk is not considered appropriate.

4.0 Mitigation Methods

4.1 Risk to buildings

4.1.1 Finished floor levels



In order to afford a level of protection against flooding it is normally recommended that finished floor levels are set 0.3 - 0.6m above the modelled 1% AEP plus climate change design flood level.

No particular flood risk has been identified for the site therefore finished floor levels should be set at least 0.15m above surrounding ground levels in line with best practice.

4.1.2 Flood resistance

Flood resistance is a strategy of temporary or permanent measures taken to reduce the amount of flood water that will enter buildings. It is not considered appropriate to adopt a flood resistance strategy for the development given the assessed risk and proposed floor levels.

4.1.3 Flood resilience

Flood resilience measures are intended reduce damage to a building such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment. It is not considered appropriate to adopt a flood resilience strategy for the development given the assessed risk and proposed floor levels.

4.2 Risk to occupiers

4.2.1 Safe access/egress

Keats Lane, just south of the access to the site is shown to flood to depths no more than 0.15m according to the Environment Agency's surface water risk map.

In line with FD2320/TR2 this equates to a risk of low hazard, therefore, safe access and egress are considered achievable in all but the most extreme scenarios.

4.2.2 Flood warning and evacuation plan

The Environment Agency do not provide a flood warning or alert for the site. Given the assessed risk a bespoke flood warning and response plan is not required.

4.3 Risk to others

4.3.1 Floodplain compensation

Environment Agency guidance states there must be no loss of flood storage capacity for flooding up to the 1% AEP plus climate change event.

In this case, the proposed development is not affected by fluvial or surface water flooding therefore there will be no impact on flood flows or floodplain storage volume.

4.3.2 Surface water run-off

The existing site is largely grassland with a small hardstanding yard area with stable building. It is proposed to create new impermeable features into the site which, if not managed properly, has the potential to increase surface water runoff and degrade water quality leaving the site; therefore, a drainage strategy will be required in line with the principles of Sustainable Drainage Systems (SuDS).

The SuDS scheme should integrate surface water risk management within the site and provide water quality improvement to people and wildlife.



5.0 Drainage strategy

5.1 SuDS applicable policies

Leicestershire County Council SuDS guidance has been used to assist with this drainage strategy, along with CIRIA's SUDS Manual and LASOO Non-Statutory Technical Standards for Sustainable Drainage, Practice Guidance.

5.2 SuDS feasibility

The SuDS Manual (2015), discusses the SuDS approach to managing surface water runoff which is intended to mimic the natural catchment process as closely as is possible. The approach sets out the design objectives in respect of SuDS:

- Use of surface water runoff as a resource;
- Manage rainwater close to where it falls (at source);
- Manage runoff on the surface (above ground);
- Allow rainwater to soak into the ground (infiltration);
- Promote evapotranspiration;
- Slow and store runoff to mimic natural runoff rates and volumes;
- Reduce contamination of runoff through pollution prevention and by controlling the runoff at source; and
- Treat runoff to reduce the risk of urban contaminants causing environmental pollution.

Depending on the characteristics of the site and local requirements, these may be used in conjunction and to varying degrees. Table 3 presents the functions of the SuDS components (from which a management train can be created) and their feasibility in respect of the site.



TABLE 3: FEASIBILITY OF SuDS TECHNIQUES AT THE DEVELOPMENT SITE

Technique	Description	Feasibility Y / N / M (Maybe)
Good building design and rainwater harvesting	Components that capture rainwater and facilitate its use within the building or local environment.	Y – Water butts could be included to collect rainwater from building rooftops for re-use on the site.
Porous and pervious surface materials	Structural surfaces that allow water to penetrate, thus reducing the proportion of runoff that is conveyed to the drainage system (green roofs, pervious paving).	Y – Porous surfaces could be used on the proposed roads, car parking areas and building surrounds.
Infiltration Systems	Components that facilitate the infiltration of water into the ground. These often include temporary storage zones to accommodate runoff volumes before slow release to the soil.	M - Infiltration could feature to some extent via the utilisation of on-surface SuDS features subject to the results of ground testing.
Conveyance Systems	Components that convey flows to downstream storage systems (e.g. swales, watercourses).	Y - There is some scope within the proposal for surface conveyance.
Storage Systems	Components that control the flows and, where possible, volumes of runoff being discharged from the site, by storing water and releasing it slowly (attenuation). These systems may also provide further treatment of the runoff (e.g. ponds, wetlands, and detention basins).	Y – There is scope within the development to include on-site storage.
Treatment Systems	Components that remove or facilitate the degradation of contaminants present in the runoff.	Y – There is scope within the development to introduce a SuDS treatment train.



5.3 Existing drainage

The site has a consistently steep slope of approximately 1 in 10 down to the north extent. Just beyond the site extent to the north lies a small pond where various historic maps note a spring to be located. In addition to the pond, a small drainage ditch flows through the fields to the north towards an unnamed ordinary watercourse more than 800m from the site. This drainage ditch flows parallel to natural flow route as discussed in Section 3.6.

Historic maps from the mid-1800s show the site has never been developed, other than the stable building and concrete yard area which stand in the southwest corner today. The remainder of the site is maintained grassland except for a small paddock in the northeast corner.

The topographic survey (Appendix A) identifies no drainage infrastructure across the site, so drainage arrangements of the stable and yard area are unknown – however, given the steep natural fall of the land, any drainage arrangements are ultimately expected to discharge north in line with the natural topography of the land as described above.

Greenfield runoff rates for the site have been calculated using the IH124 method (based on the interim Code of Practice of Sustainable Drainage Systems given the small site area).

IH124 parameters:

Area = 1ha unit area (to calculate l/s/ha)

SOIL = 0.450

SAAR = 700mm

Region = 4

TABLE 4: ESTIMATE OF PRE-DEVELOPMENT PEAK RUNOFF RATES

Annual Exceedance Probability (AEP)	Peak Runoff Rate (l/s/ha)
QBAR	4.4
100% (1 year)	3.6
3.33% (30 year)	8.6
1% (100 year)	11.3

The actual runoff from the site is expected to be higher than the values shown in the table above, given the steeply sloped site and existing impermeable yard and stable area.

5.4 Proposed drainage

It is proposed to construct 10 residential bungalows on the site, with access road and associated parking.

The recommended hierarchy for discharging surface water (ref. The SuDS Manual, CIRIA C753) is:

1. Infiltration to the maximum extent that is practical.
2. Discharge to surface waters.
3. Discharge to surface water sewer.
4. Discharge to combined sewers.



BGS online mapping reports the local bedrock to be Gunthorpe Member, Mudstone, with superficial deposits of Wigston Member - Sand and gravel. Soilscape describes the soil on the development as 'Freely draining slightly acid loamy soils', while MicroDrainage gives a SOIL value of 0.450 for the site. The site is steeply sloping, with a 1 in 10 slope, which can be problematic for drainage systems that rely on infiltration as the only discharge method. Drained water will often simply re-emerge further down the slope. Nonetheless, it would be viable to use a degree of infiltration for example to manage runoff for day-to-day rain events.

Given the above, the optimal strategy is simply to continue draining the site into the existing drainage ditch network at the north of the site. As mentioned previously, the land to the north and west is also under the ownership of the applicant. It is understood that in any future sale of the northern site, there will be a clause allowing the right to connect surface water (and foul) drainage from this site. Therefore, discharging surface water to the northern ditch is viable as a long-term solution.

The northern ditch bed lies at approximately 104.5mAOD, while the lowest section of the site to be drained is 107.5mAOD, as such there is ample fall available to create a gravity discharge into the ditch.

The drainage strategy should aim to create a SuDS treatment train. Any conceptual scheme is subject to the following constraints:

- **Limited space within the masterplan** – restricting the implementation of open surface SuDS features.
- **Flood Risk Management**
 - Designed to manage runoff from all rain events up to and including the 1% AEP +40% CC, plus a 10% urban creep allowance, with no flooding.
 - The incorporation of hardstanding roads within the steeply sloping site could lead to rapid runoff towards proposed dwellings if not suitably managed and designed.
 - Any flooding from the network in an exceedance event is safely managed such that it does not impact vulnerable receptors.
- **Four pillars of SuDS** – In addition to safely managing water quantity, a drainage scheme should aim to achieve water quality, amenity and biodiversity benefits.

The ability of the site to deliver a drainage strategy has been demonstrated by working up a conceptual scheme based on the outline masterplan and above constraints. The details will of course vary depending on the final scheme brought forward.

The proof of viability conceptual scheme comprises:

- Drain surface water from proposed impermeable areas via permeable paving and filter drains into underground conveyance pipes (specific arrangement to be set at detailed design stage).
 - The permeable paving should be suitably designed in order to reduce rapid runoff risk (due to steep slope), i.e. sufficient sub-base depth and sub-base check-dams.
 - The main access road should be set lower than adjacent dwellings, such that any exceedance event is contained and conveyed within the road by suitable kerbs, away from vulnerable receptors.



- Create an appropriate exceedance route (via a lowered public footpath relative to adjacent dwellings) from the access road towards the northern ditch.
- Convey water via underground pipes into an underground geocellular storage unit located beneath the road towards the north of the site (specific arrangement to be set at detailed design stage).
- Create 320m² geocellular storage with 1.5m available storage depth (specific arrangement to be set at detailed design stage).
- Control the flow rate leaving the storage to greenfield QBAR (0.63 ha x 4.4 l/s/ha = **2.8 l/s**) via a vortex flow controller.
- Controlled discharge into the northern ditch.

Runoff rates from the conceptual scheme have been calculated using MicroDrainage 2020.1.3¹ Source Control for the full range of storm events, with results summarised in Table 5, with all results included in Appendix B.

TABLE 5: SUMMARY OF MICRODRAINAGE RESULTS

Annual Exceedance Probability (AEP)	Critical Storm	Peak Water depth in geocellular	Total Final Peak Outflow Rate
1 in 1 (100%)	480-minute winter	0.273 m	2.3 l/s
1 in 30 (3.33%)	600-minute winter	0.737m	2.8 l/s
1 in 100 +CC (1% +40% CC)	960-minute winter	1.460 m	2.8 l/s

The above demonstrates that the site is capable of delivering a SuDS drainage scheme for the proposed development. This indicative proof of concept arrangement for the proposed drainage strategy is shown below in Figure 2.

¹ **Summary of MicroDrainage Source Control test parameters:**

320m² Geocellular storage – 1.5m available storage depth – No infiltration

Total drained area = 0.63 ha (Masterplan impermeable area + 10% urban creep).

5 min time of concentration

FSR Rainfall – M5-60 = 19.900mm – Ratio R = 0.400

Flow Control = 0.073m diameter Hydrobrake set at invert level of storage – Q_{max} = 2.8 l/s



FIGURE 2: PLAN SHOWING THE CONCEPTUAL SURFACE WATER DRAINAGE SCHEME

By developing a SuDS treatment train as set out above the following benefits can be released: **water quantity**, runoff rate and volume can be managed by utilising a SuDS treatment train, including attenuation storage to temporarily contain surface water while discharge is appropriately controlled. The scheme can also manage **flood risk**, such that no flooding occurs for events up to and including the 1% AEP +40% CC. The scheme has the potential to also safely manage **exceedance** and **system failure** scenarios as overflow routes can be created within the site that contain and direct water along the roads, through to the northern ditch away from vulnerable receptors.

The drainage scheme will control **water quality** by the use of a SuDS treatment train in line with The SuDS Manual. There will also be opportunity for water to naturally infiltrate into the ground as it passes through the system.

The drainage scheme will control **water quality**, in line with the SuDS Manual simple index approach (Section 26.7.1) for discharges to surface waters, as rainfall onto the site (low pollution hazard) will pass via filter drains and permeable paving prior to entering the northern ditch, which will provide a good level of filtration.



TABLE 6: SuDS MITIGATION INDICES FOR DISCHARGE TO SURFACE WATERS

SuDS Component train	Area drained	Hazard Index / Mitigation Index		
		TSS	Metals	Hydrocarbons
Filter drain > Permeable paving	Low risk	0.5 / 0.75	0.4 / 0.7	0.4 / 0.75

The mitigation indices for the treatment train are larger than the hazard indices, therefore the scheme is in line with the mitigation index approach of the SuDS Manual.

The proposed drainage system has potential to provide **amenity** and **biodiversity** enhancement within the local environment, complementing the local habitat.

6.0 Conclusion

Outline planning permission is sought for the construction of 10 residential bungalows to the rear of 34 Keats Lane, Earl Shilton

The site is within Flood Zone 1, the lowest risk zone, on the Environment Agency Flood map for planning.

An assessment of flood risk to the site from all other sources has been made from available data. No significant flood risk mechanism to the site has been identified.

Safe access and egress is expected in all but the most extreme flood scenario.

Viability has been shown for the use of SuDS to drain the proposed site and suitable components have been identified. A 'proof of viability' conceptual drainage scheme has been established and tested that would manage all runoff up to and including the 1% AEP plus climate change (40%) event.

It is concluded that the proposed development is appropriate for the flood risk and is not expected to increase the risk of flooding elsewhere.

7.0 Recommendations

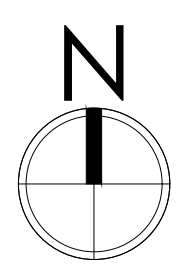
- Set finished floor level of all buildings at least 150mm above surrounding ground in line with normal building practice.
- Design a detailed SuDS drainage scheme in line with the drainage strategy set out in this report.
- Design the main access road such that it sits lower than adjacent dwellings with suitable kerbs, whereby exceedance flooding from the drainage system is contained and conveyed to the north of the site.
- Design the public footpath at the north of the site such that it can contain and convey exceedance from access road, towards the northern ditch.
- Consult with the Lead Local Flood Authority regarding the discharge of surface water into the northern ditch.



- Construction (Design and Management) Regulations 2015:
 - The revised CDM Regulations came into force in April 2015, which defines the duties for all parties involved in a construction project, including those promoting the development. One of the designer's responsibilities is to ensure that the client organisation, in this instance Paul Batson, is made aware of their duties (please see [link](#) for Commercial Client) under the CDM Regulations.



Appendix A – Proposed Plan & Topographic survey



Rev 8/28/09.23/Red and blue line revised
Rev A/27/09.23/Red and blue line revised

PLANNING

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Project:
Proposed residential development
on land to the rear of 34 Keats Lane,
Earl Shilton, Leicestershire, LE9 7DQ

-
Title, Proposed site plan

Scale, 1:200	Drawn, MG	Checked, JCB	Date, -
Drawing No. 8883-03-03			Revision, B



Appendix B – MicroDrainage Source Control Results

RAB Consultants Ltd							Page 2
Cathedral House Beacon Street Lichfield WS13 7AA							
Date 12/01/2024 13:53 File SC.SRCX			Designed by Micro Drainage Checked by				
Micro Drainage			Source Control 2020.1.3				
<u>Summary of Results for 1 year Return Period</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	0.081	0.081	0.0	1.6	1.6	24.7	O K
10080 min Summer	0.074	0.074	0.0	1.5	1.5	22.6	O K
15 min Winter	0.130	0.130	0.0	2.1	2.1	39.5	O K
30 min Winter	0.167	0.167	0.0	2.2	2.2	50.7	O K
60 min Winter	0.205	0.205	0.0	2.3	2.3	62.3	O K
120 min Winter	0.240	0.240	0.0	2.3	2.3	73.1	O K
180 min Winter	0.258	0.258	0.0	2.3	2.3	78.4	O K
240 min Winter	0.267	0.267	0.0	2.3	2.3	81.2	O K
360 min Winter	0.272	0.272	0.0	2.3	2.3	82.8	O K
480 min Winter	0.273	0.273	0.0	2.3	2.3	83.0	O K
600 min Winter	0.271	0.271	0.0	2.3	2.3	82.4	O K
720 min Winter	0.267	0.267	0.0	2.3	2.3	81.1	O K
960 min Winter	0.255	0.255	0.0	2.3	2.3	77.4	O K
1440 min Winter	0.225	0.225	0.0	2.3	2.3	68.5	O K
2160 min Winter	0.183	0.183	0.0	2.2	2.2	55.7	O K
2880 min Winter	0.149	0.149	0.0	2.1	2.1	45.2	O K
4320 min Winter	0.103	0.103	0.0	1.9	1.9	31.3	O K
5760 min Winter	0.083	0.083	0.0	1.7	1.7	25.4	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
8640 min Summer	0.357	0.0	242.3	4496			
10080 min Summer	0.320	0.0	252.2	5152			
15 min Winter	30.829	0.0	38.4	19			
30 min Winter	20.103	0.0	50.6	33			
60 min Winter	12.728	0.0	66.1	62			
120 min Winter	7.897	0.0	82.3	120			
180 min Winter	5.944	0.0	93.0	176			
240 min Winter	4.854	0.0	101.3	232			
360 min Winter	3.626	0.0	113.6	326			
480 min Winter	2.940	0.0	122.9	374			
600 min Winter	2.498	0.0	130.5	452			
720 min Winter	2.186	0.0	137.1	528			
960 min Winter	1.772	0.0	148.1	676			
1440 min Winter	1.319	0.0	165.2	964			
2160 min Winter	0.982	0.0	186.3	1360			
2880 min Winter	0.796	0.0	201.2	1732			
4320 min Winter	0.592	0.0	223.8	2420			
5760 min Winter	0.480	0.0	243.3	3112			
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Cathedral House Beacon Street Lichfield WS13 7AA		
Date 12/01/2024 13:53 File SC.SRCX	Designed by Micro Drainage Checked by	
Micro Drainage Source Control 2020.1.3		

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.630

Time (mins) Area		
From:	To:	(ha)
0	5	0.630

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Cathedral House

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Micro Drainage

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Model Details

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m)0.000Safety Factor2.0

Infiltration Coefficient Base (m/hr)0.00000Porosity0.95

Infiltration Coefficient Side (m/hr)0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	320.0	0.0	1.501	0.0	0.0
1.500	320.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit ReferenceMD-SHE-0073-2800-1500-2800

Design Head (m)1.500

Design Flow (l/s)2.8

Flush-Flo™Calculated

ObjectiveMinimise upstream storage

ApplicationSurface

Sump AvailableYes

Diameter (mm)73

Invert Level (m)0.000

Minimum Outlet Pipe Diameter (mm)100

Suggested Manhole Diameter (mm)1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	2.8	Kick-Flo®	0.647	1.9
Flush-Flo™	0.319	2.4	Mean Flow over Head Range	-	2.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.9	1.200	2.5	3.000	3.9	7.000	5.7
0.200	2.3	1.400	2.7	3.500	4.1	7.500	5.9
0.300	2.4	1.600	2.9	4.000	4.4	8.000	6.1
0.400	2.3	1.800	3.0	4.500	4.7	8.500	6.3
0.500	2.3	2.000	3.2	5.000	4.9	9.000	6.5
0.600	2.1	2.200	3.3	5.500	5.1	9.500	6.6
0.800	2.1	2.400	3.5	6.000	5.3		
1.000	2.3	2.600	3.6	6.500	5.5		

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	0.210	0.210	0.0	2.3	2.3	63.7	O K
10080 min Summer	0.174	0.174	0.0	2.2	2.2	53.0	O K
15 min Winter	0.323	0.323	0.0	2.4	2.4	98.2	O K
30 min Winter	0.418	0.418	0.0	2.4	2.4	127.0	O K
60 min Winter	0.513	0.513	0.0	2.4	2.4	155.8	O K
120 min Winter	0.604	0.604	0.0	2.4	2.4	183.6	O K
180 min Winter	0.653	0.653	0.0	2.4	2.4	198.5	O K
240 min Winter	0.683	0.683	0.0	2.4	2.4	207.5	O K
360 min Winter	0.716	0.716	0.0	2.4	2.4	217.6	O K
480 min Winter	0.732	0.732	0.0	2.4	2.4	222.4	O K
600 min Winter	0.737	0.737	0.0	2.4	2.4	224.1	O K
720 min Winter	0.736	0.736	0.0	2.4	2.4	223.8	O K
960 min Winter	0.722	0.722	0.0	2.4	2.4	219.6	O K
1440 min Winter	0.678	0.678	0.0	2.4	2.4	206.2	O K
2160 min Winter	0.600	0.600	0.0	2.4	2.4	182.6	O K
2880 min Winter	0.520	0.520	0.0	2.4	2.4	158.2	O K
4320 min Winter	0.381	0.381	0.0	2.4	2.4	115.9	O K
5760 min Winter	0.274	0.274	0.0	2.3	2.3	83.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.656	0.0	445.4	4752
10080 min Summer	0.580	0.0	458.8	5448
15 min Winter	75.632	0.0	96.5	20
30 min Winter	49.240	0.0	125.6	34
60 min Winter	30.654	0.0	160.5	64
120 min Winter	18.524	0.0	194.1	122
180 min Winter	13.652	0.0	214.5	180
240 min Winter	10.945	0.0	229.2	240
360 min Winter	7.998	0.0	251.0	356
480 min Winter	6.399	0.0	267.4	470
600 min Winter	5.379	0.0	280.6	584
720 min Winter	4.666	0.0	291.6	694
960 min Winter	3.726	0.0	309.1	908
1440 min Winter	2.711	0.0	329.3	1144
2160 min Winter	1.970	0.0	374.1	1580
2880 min Winter	1.570	0.0	397.4	1992
4320 min Winter	1.139	0.0	431.9	2772
5760 min Winter	0.906	0.0	459.8	3512

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.630

Time (mins)	Area
From:	To: (ha)
0	5 0.630

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Model Details

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m)0.000

Safety Factor2.0

Infiltration Coefficient Base (m/hr)0.00000

Porosity0.95

Infiltration Coefficient Side (m/hr)0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	320.0	0.0	1.501	0.0	0.0
1.500	320.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit ReferenceMD-SHE-0073-2800-1500-2800

Design Head (m)1.500

Design Flow (l/s)2.8

Flush-Flo™Calculated

ObjectiveMinimise upstream storage

ApplicationSurface

Sump AvailableYes

Diameter (mm)73

Invert Level (m)0.000

Minimum Outlet Pipe Diameter (mm)100

Suggested Manhole Diameter (mm)1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	2.8	Kick-Flo®	0.647	1.9
Flush-Flo™	0.319	2.4	Mean Flow over Head Range	-	2.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.9	1.200	2.5	3.000	3.9	7.000	5.7
0.200	2.3	1.400	2.7	3.500	4.1	7.500	5.9
0.300	2.4	1.600	2.9	4.000	4.4	8.000	6.1
0.400	2.3	1.800	3.0	4.500	4.7	8.500	6.3
0.500	2.3	2.000	3.2	5.000	4.9	9.000	6.5
0.600	2.1	2.200	3.3	5.500	5.1	9.500	6.6
0.800	2.1	2.400	3.5	6.000	5.3		
1.000	2.3	2.600	3.6	6.500	5.5		

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Micro Drainage Source Control 2020.1.3		

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.630

Time (mins) Area		
From:	To:	(ha)
0	5	0.630

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Model Details

Storage is Online Cover Level (m) 2.000

Cellular Storage Structure

Invert Level (m)0.000Safety Factor2.0

Infiltration Coefficient Base (m/hr)0.00000Porosity0.95

Infiltration Coefficient Side (m/hr)0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	320.0	0.0	1.501	0.0	0.0
1.500	320.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit ReferenceMD-SHE-0073-2800-1500-2800

Design Head (m)1.500

Design Flow (l/s)2.8

Flush-Flo™Calculated

ObjectiveMinimise upstream storage

ApplicationSurface

Sump AvailableYes

Diameter (mm)73

Invert Level (m)0.000

Minimum Outlet Pipe Diameter (mm)100

Suggested Manhole Diameter (mm)1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	2.8	Kick-Flo®	0.647	1.9
Flush-Flo™	0.319	2.4	Mean Flow over Head Range	-	2.2

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Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
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0.300	2.4	1.600	2.9	4.000	4.4	8.000	6.1
0.400	2.3	1.800	3.0	4.500	4.7	8.500	6.3
0.500	2.3	2.000	3.2	5.000	4.9	9.000	6.5
0.600	2.1	2.200	3.3	5.500	5.1	9.500	6.6
0.800	2.1	2.400	3.5	6.000	5.3		
1.000	2.3	2.600	3.6	6.500	5.5		

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