



UK Flood Risk
Flood Risk Consultants

Site Drainage Strategy (Sustainable Drainage Systems SuDS)

**9 Chatsworth Avenue,
Prestwich M25 1LZ**

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Executive Summary

UK Flood Risk Consultants has been commissioned to prepare a Sustainable Drainage Systems (SuDS) Strategy in support of a proposal consisting of erection of two storey side and rear extensions to produce a larger two storey semi-detached residential building on the site with the creation of a new vehicular access to the northwest located at 9 Chatsworth Avenue, Prestwich M25 1LZ.

The main sources of information to develop the SuDS strategy are the guidelines of the National Planning Policy Framework (NPPF, December 2023) and the Environment Agency's Flood Risk Assessment (FRA) Guidance Notes along with the best practice guidance in flood risk and drainage including the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015).

The overall risk of surface water flooding to the site is low.

The surface runoff will be improved by implementing appropriate SuDS measures.

Due to underlying soil condition mostly composed of silt and clay with low infiltration capacity, the potential for a Soakaway to discharge the surface runoff from the site is low. Also, there are no watercourses in the vicinity of the site.

An open ground attenuation storage will not be feasible at the site due to the limited space available. Therefore, in line with the SuDS drainage hierarchy policy, an underground geo-cellular storage (Length = 4m, Width = 2m, Depth = 0.40m) will be implemented in order to temporarily store the runoff water from the site.

In line with the SuDS drainage hierarchy the controlled outflow from the attenuation storage will be discharged into the sewer on Chatsworth Avenue using a 150mm linear pipe. In order to minimise the risk of flooding, the maximum discharge rate will be controlled by using a discharge control unit such as hydrobrake, so that it is not more than 2.5 litres/sec.

In addition, permeable paving will be implemented in the front yard area to further improve the surface runoff from the site.

The landowners will be fully responsible for the repair and management of the implemented SuDS throughout the lifetime of the proposed development.

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Abbreviations

Abbreviation	Description
mAOD	Metres Above Ordnance Datum
DEFRA	Department for Environment, Food, and Rural Affairs
EA	Environment Agency
FRA	Flood Risk Assessment
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
SFRA	Strategic Flood Risk Assessment
PFRA	Preliminary Flood Risk Assessment
SuDS	Sustainable Drainage Systems

1.0 Background

UK Flood Risk Consultants has been commissioned to prepare a Sustainable Drainage Systems (SuDS) Strategy in support of a proposal consisting of erection of two storey side and rear extensions to produce a larger two storey semi-detached residential building on the site with the creation of a new vehicular access to the northwest located at 9 Chatsworth Avenue, Prestwich M25 1LZ.

This Sustainable Drainage Systems (SuDS) Strategy has been developed in accordance with the guidelines and the requirements of the National Planning Policy Framework (NPPF, December 2023) and the Environment Agency's Flood Risk Assessment (FRA) Guidance Notes along with the best practice guidance in flood risk and drainage including the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015).

2.0 Surface Water Drainage Requirements

A surface water drainage assessment should be undertaken to demonstrate that surface water runoff from the proposed development can be effectively managed without increasing flood risk elsewhere. A surface water drainage assessment should include the following:

- Assessment of whether the development will increase the overall discharge from the site by calculating the change in area covered by roofs and hard-standing.
- Details of how overland flow from the new development can be intercepted to prevent flooding of adjacent land.
- Details of how additional onsite surface water attenuation can be provided to mitigate against known flooding problems or as a result of incapacity on the drainage systems.
- Demonstration that overland flows will not increase flood risk to both existing development and receiving watercourses.

3.0 General Description of the Site and the Proposals

3.1. Description of the site

The proposal site is the residential dwelling located at 9 Chatsworth Avenue, Prestwich M25 1LZ approximately centred on the OS NGR (**Appendix A**). The site is located within the administrative boundary of Bury Metropolitan Borough Council which is also the Lead local flood authorities (LLFA) which is responsible for managing the flood risk from surface water in the area.

The site occupies an area of approximately 280m². The area of building footprint is approximately 64m² and the area of hardstanding pavement is approximately 161m². Approximately 55m² area is covered by soft landscaping.

The access to the site is via Chatsworth Avenue. The surrounding area consists of predominantly residential use (**Appendix A**).

The British Geological Survey's geological maps are provided in **Appendix B**. The geological maps show that the bedrock of the site comprises Worsley Delf Rock-Sandstone that formed between 315.2 and 309.5 million years ago during the Carboniferous period. The superficial deposits comprise Hummocky (moundy) Glacial Deposits, Devensian - Sand and Gravel that formed between 116 and 11.8 thousand years ago during the Quaternary period.

There are no major watercourses in the vicinity of the site.

The site has a flat topography with the general elevations varying from 87.84mAOD to 88.70mAOD. Further details about the existing site are provided in **Appendix C**.

3.2. Proposed Development

The proposal comprises erection of two storey side and rear extensions to produce a larger two storey semi-detached residential building on the site with the creation of a new vehicular access to the northwest located. The footprint area of the proposed extensions including front bay extension is approximately 58m². Further details about the proposals have been provided in **Appendix C**.

4.0 Sustainable Urban Drainage Systems Policy

4.1. Flood and Water Management Act 2010

The method of drainage of surface water from the site is bound by the Flood and Water Management Act 2010. Schedule 3 Paragraph 5 of the Flood and Water Management Act 2010 states that the following hierarchy is to be applied to surface water runoff in the following order or priority:

- Discharge into the ground (infiltration)
- Discharge to a surface water body (lake, river, drain);
- Discharge to a surface water sewer, highway drain or another drainage system; or Discharge into a combined sewer.

4.2. Drainage Hierarchy

Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy as set out by the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015):

1. rainwater harvesting (including a combination of green and blue roofs),
2. infiltration techniques and green roofs,
3. rainwater attenuation in open water features for gradual release,
4. rainwater discharge direct to a watercourse (unless not appropriate),
5. rainwater attenuation above ground (including blue roofs),
6. rainwater attenuation below ground,
7. rainwater discharge to a surface water sewer or drain,
8. rainwater discharge to a combined sewer.

4.3. Preliminary Flood Risk Assessment (PFRA)

The Cumbria Council's Preliminary Flood Risk Assessment (PFRA, 2011, Addendum 2017) is a comprehensive study that assesses the potential risks and impacts of flooding in the borough. The PFRA provides important information to support land use planning, development control, emergency planning, and community resilience. The PFRA considers a range of potential flood risks, including those from rivers, surface water, and groundwater sources. The study includes detailed flood risk maps that identify areas at risk of flooding and the potential consequences of flooding, such as property damage, business disruption, and loss of life.

The PFRA also provides guidance on flood risk management strategies and measures that can be implemented to mitigate the potential impacts of flooding. The PFRA has provided SuDS a high priority. SuDS are designed to manage and reduce the impact of surface water runoff in urban areas. SuDS incorporate several measures to slow down and manage the flow of rainwater. By doing so, they help prevent surface water runoff overwhelming drainage systems and causing flooding downstream.

5.0 Assessment of Surface Runoff Flood Risk

The surface water flooding arises when the infiltration capacity of land or the drainage capacity of a local sewer network is exceeded and the excess rainwater flows overland. The severity of surface water flooding depends on several factors such as the degree of saturation of the soil before the event, the permeability of soils and geology, hill slope steepness and the intensity of land use.

Information on the risk of surface water flooding is held by the Environment Agency. The Environment Agency's Surface Water Flood Risk Maps are provided in **Appendix C Figure 1 and Figure 2** which indicate that the risk of surface water flooding to the site is 'low'.

6.0 Sustainable Urban Drainage Systems (SuDS)

The Cumbria Council strongly encourages the principles of SuDS on all forms of development. The developer should seek the most sustainable SuDS solution in order to reduce flood risk, improve water quality and improve the environment overall. The Local Authority encourages the developers to provide SuDS on major developments while paying due regard to the National Planning Policy Framework (NPPF), Planning

practice guidance, Non-statutory technical standards for sustainable drainage systems and the local plan policies.

6.1. Existing Drainage

The proposal site comprises existing building along with hardstanding and soft landscaping area. Most of the surface runoff from the soft landscaping area infiltrates into the ground. The surface runoff from the hardstanding also infiltrates into the nearby soft landscaping area. The roof runoff and the excess runoff is discharged into the road (i.e. Chatsworth Avenue) following general slope gradient towards the road.

6.2. Greenfield Runoff Estimation

The estimation of the Greenfield Runoff rate has been undertaken using the HR Wallingford's Greenfield Runoff Estimation tool available on the website: http://www.uksuds-.com/greenfieldrunoff_js.htm. The aim of the tool is to provide flow rate information based on a minimum amount of data so that anybody can use the tool. The methodology is built around the concept that a flow rate discharge constraint is needed for storm water runoff from a site, resulting in attenuation volume being needed. In addition, current drainage criteria include the requirement for the 100 year 6hr volume to be controlled. The tool is based on the results of simple model analysis and correlating the results against key known site parameters. As such the results need to be treated as providing indicative information only and should not be used to produce final designs of drainage systems without additional modelling being carried out.

The peak flow estimation can now be estimated using two different formulae.

- 1) The formula developed in IH124 (IH 1994) and use of the FSSR growth curve information for regions of the UK (FSSR 14),
- 2) The use of FEH statistical correlation equation revised in 2008.

However, only the IH124 method can be used without providing specific parameter values. Therefore, this method has been used for estimating greenfield runoff rate from the proposed development site.

Details about the parameters used in the estimation are provided in **Appendix D** and the results are summarised in **Table 1** below. A site area of 0.10ha has been used, which is the minimum site area required for this technique.

The proposed development has considered the greenfield runoff rates for addressing surface water discharge requirements from the developed site. The greenfield runoff rates have been utilised for developing the drainage strategy for the site.

Table 1 – Greenfield Runoff Rates

Events	Greenfield runoff rates (litres/sec) (Estimated)
Qbar	0.02
1 in 1 year	0.02
1 in 30 year	0.04
1 in 100 year	0.05

6.3. Estimation of Permeable and Impermeable Areas

The changes in land cover areas have been summarised in **Table 2** below. It can be seen that the proposed development will not lead an increase in the total impermeable area. This means the surface runoff will not be increased as a result of the proposed development.

Table 2 Changes in Land Cover Areas

Land Cover	Pre-development, m ²	Post-development, m ²	Change, m ²
Impermeable Surface Area			
Hard standing	161	103	
Building footprint	64	122	
Total Impermeable	225	225	0
Permeable Surface Area			
Grass cover	55	55	
Total Permeable	55	55	0
Total Area	280	280	

6.4. Estimation of peak surface runoff rates

Pre-development Peak Runoff Rates (based on land cover area)

The Rational Method has been used in order to estimate the peak surface runoff from the site.

The Rational Equation is given by:

$$Q = A_r \times P \times R_i$$

Where, A_r = Effective catchment area, m^2

P = Impermeability factor

R_i = Rainfall Intensity, mm/hr, Q = Peak surface runoff, m^3/s

The peak surface runoff rates for the existing site condition are summarised in **Table 3** below. An impermeability factor of 0.90 has been used for the site. Information on the maximum rainfall intensity for a range of return period events has been taken from the Micro Drainage Model developed for the site which is provided in **Appendix G**. The total site area in **Table 2** has been used as catchment for the calculations.

Table 3 Estimation of Peak Runoff Rates from the site (Pre-development condition) based on the land cover area

Return Periods	Max Rainfall Intensity, R_i mm/hr	Catchment Area, A m^2	Impermeability factor, P	# Peak Runoff, Q , m^3/sec	Peak Runoff, Q , litres/sec
1/ 1 year	26.98	280	0.9	0.00189	1.89
1/2 year	34.91	280	0.9	0.00244	2.44
1/5 year	45.12	280	0.9	0.00316	3.16
1/10 year	52.27	280	0.9	0.00366	3.66
1/30 year	66.01	280	0.9	0.00462	4.62
1/50 year	73.57	280	0.9	0.00515	5.15
1/100 year	85.24	280	0.9	0.00597	5.97
1/100 year + 40% CC	119.34	280	0.9	0.00835	8.35

$Q = (R_i/1000 \times A \times P)/3600$

R_i taken from MicroDrainage model (**Appendix G**).

Post-development Peak Runoff Rates (with attenuation storage)

An outflow control rate of 2.5 litres/sec has been used with the implementation of the attenuation storage system. The surface runoff rates for the site post-development are summarised in **Table 4** below.

Table 4 Summary of Peak Runoff Rates from the site (Post-development condition with the provision of attenuation storage)

Return Periods	Peak Runoff Rates, Q, litres/sec
1/ 1 year	2.5
1/2 year	2.5
1/5 year	2.5
1/10 year	2.5
1/30 year	2.5
1/100 year	2.5
1/100 year + 40% CC	2.5

6.5. Hierarchy of SuDS Measures

The surface runoff from the site will be improved by implementing appropriate SuDS. The requirements for SuDS will ensure that any redevelopment or new development does not negatively contribute to the surface water flood risk of other properties and instead provides a positive benefit to the level of risk in the area. It will also ensure that appropriate measures are taken to increase the flood resilience of new properties and developments in surface water flood risk areas, such as those identified as being locally important flood risk areas.

The SuDS hierarchy and management train has been discussed in the SuDS Manual (C753) which aims to mimic the natural catchment processes as closely as possible. The general hierarchy of the SuDS measures is provided in **Table 5** below.

Table 5 General Hierarchy of SuDS Measures

Measures	Definition/Description
Prevention	The use of good site design and housekeeping measures to prevent runoff and pollution (e.g. rainwater harvesting/reuse).
Source control	Control of runoff at or very near its source (e.g. soakaways, porous and pervious surfaces, green roofs).
Site control	Management of water in a local area on site (e.g. routing water to large soakaways, infiltration or detention basins)
Regional control	Management of runoff from a site or several sites (e.g. balancing ponds, wetlands).

6.6. Potential for Infiltration SuDS (Soakaway)

A Ground investigation survey was carried out at the site (**Appendix H**). The boreholes results indicated that the underlying soil approximately 1m from the surface mostly composed of sandy Silty Clay. Field observations indicated that the underlying soil is mostly composed of silt and clay which has a low permeability potential. This implies that Infiltration SuDS like a Soakaway would not be appropriate due to the underlying soil condition.

6.7. General Assessment of SuDS Measures for the site

Table 6 below presents the feasibility assessment of several SuDS measures for the site. The

Table 6 General Assessment of SuDS measures for the site

SuDS Measures	Issues/Description	Feasibility for the site
Source Control Porous and pervious materials/soakaways/green roof/infiltration trenches/disconnect downpipes to drain to lawns or infiltrate to soakaway.	Permeable paving improves the surface runoff from the site.	Yes. There is a potential for permeable paving in front yard area to improve the surface runoff.

Site and Regional Control Infiltration/detention basins/ balancing ponds/ wetlands/underground storage/swales/retention ponds.	Open surface Balancing pond will not be feasible due to limited space available.	No. The potential for balancing pond is low as there is very limited space available for open ground balancing pond.
	Geo-cellular underground storage will improve the surface runoff conditions by temporarily storing the surface runoff from extreme rainfall event (1 in 100 year plus climate change)	Yes. A Geo-cellular underground storage system can be implemented beneath the car park area in order to attenuate the surface runoff from the extreme event of 1 in 100 year plus climate change.

6.8. Proposed SuDS

Based on the general assessment of the potential SuDS measures above, an underground attenuation storage will be implemented in order to attenuate the surface runoff from the design 1 in 100-year 6-hour rainfall event plus 40% Climate Change. In addition, permeable paving will be implemented in the front yard area to further improve the surface runoff from the site.

7.0 Outline Drainage Design

7.1. Proposed Drainage System

Attenuation Storage

There are no open-surface watercourses near the site. Therefore, discharging the surface runoff to watercourses would not be a viable option.

Also, discharging the surface runoff via infiltration such as a Soakaway will also not viable due to underlying soil condition as discussed above.

An open ground attenuation storage will not be feasible at the site due to the limited space available. Therefore, an underground geo-cellular storage will be implemented in order to temporarily store storm water from the site.

The proposed scheme will therefore include an underground Geo-cellular attenuation storage with the controlled outflow discharge by using a Hydrobrake. The size of the proposed attenuation storage is as follows:

Length = 4m, Width = 2m, Depth = 0.40m

The Greenfield Runoff rate for the site is 0.02 litres/sec (**Table 1**). However, this is a very small discharge rate that may lead to blockage issue within the drainage system. Therefore, a maximum flow control of 2.5 litres per second has been adopted for all events up to and including 1% AEP + 40%CC with no flooding. The proposed SuDS drainage layout plan has been provided in **Appendix I**. In line with the SuDS drainage hierarchy the controlled outflow from the attenuation storage will be discharged into existing sewer on the road (i.e. Chatsworth Avenue) using a 150mm linear pipe as shown in **Appendix I**.

Hydraulic Modelling

The proposed drainage scheme has been modelled by using Micro Drainage Source Control to understand the evolving flow regime under flood conditions and the potential for flooding. The catchment area used for the modelling is 0.023ha which is the total impermeable area post-development (**Table 2**). The attenuation storage has been modelled considering the 1 in 100 year (1%AEP) plus 40% climate change event. Both summer and winter profiles of the storm events have been considered for a range of duration, from 15 minutes to 8640 minutes. All input parameters (i.e. rainfall and model details) have been provided in **Appendix J**. The summary of the model output for the 1 in 100 year plus 40% climate change event is provided in **Table 7** below.

It can be seen from **Table 7** that for the maximum volume of 3.90m³ will be generated by the 120 minutes Winter event, and there will be no flooding for this event. Therefore, the adopted attenuation storage will provide full storage for the surface runoff generated from the design event of 1 in 100 year plus 40% climate change event.

Table 7 – Summary of Model Output (1 in 100 year plus 40% climate change)

Events	Rainfall mm/hr	Max Volume M ³	Discharge Volume M ³	Flooded Volume M ³
30 min (Winter) 1 in 100 year plus 40% CC	79.89	3.90	7.70	0.0

The location and layout of the proposed storage and its dimensions (area and depth) can be changed to suit the site conditions. This will be to the client's discretion ensuring that the required attenuation storage volume is provided within the site. In line with the SuDS drainage hierarchy the controlled outflow from the attenuation storage will be discharged into existing sewer on the road (i.e. Chatsworth Avenue) using a 150mm linear pipe as shown in **Appendix I**.

Exceedance Flow Paths

It is inevitable that as a result of heavy or extreme rainfall, the capacities of sewers and other drainage systems will be exceeded on occasion. Drainage exceedance will occur when the rate of surface water runoff exceeds the inlet capacity of the drainage system, when the receiving water or pipe system becomes overloaded, when the outfall becomes restricted due to flood levels in the receiving water, or due to poor maintenance of the SuDS features.

The proposed attenuation storage has been designed for the 1 in 100 year plus 40% climate change event. Any extreme event greater than this design event may lead to the situation where the rate of surface water runoff exceeds the inlet capacity of the drainage system. In such circumstances, the flow routes from the site will naturally follow to the east towards the road (i.e. Chatsworth Avenue) following the general slope gradient to this direction, as this will be the only open area for the floodwater to flow across the site. The exceedance flow routes are shown in **Appendix K**.

7.2. SuDS Management and Maintenance Plan

The owners will be fully responsible for regular repair and maintenance of the proposed SuDS measures as required for the lifetime of the development. The SuDS at this site have been designed for easy maintenance to comprise:

Geo-cellular Storage System

Remedial work for repairing damage will be carried out whenever necessary. The repair and maintenance will include regular inspection of silt traps, manholes, pipework and pre-treatment devices, with removal of sediment and debris as required. **Table 8** provides further details on the regular maintenance of the Geo-cellular storage system.

Table 8 Regular Maintenance and remedial measures for Geo-cellular storage system

Regular Maintenance	Actions/Remedial measures
Monthly	- Inspect and identify any areas that are not operating correctly. If required, take remedial action. (for 3 months following installation) - Debris removal from catchment surface (where may cause risks to performance) - Inspect systems as specified by the manufacturer - Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.
Six monthly	Inspect and identify any areas that are not operating correctly. If required, take remedial action (following initial 3 month period).
Annually	Remove sediment from pre-treatment structures (e.g. upstream silt- traps or Vortex flow control upstream) and

	geocellular system where required (High pressure water jetting) Inspect and document the presence of wildlife.
Following all significant storms	Inspect and carry out essential recovery works to return the feature to full working order.

Flow control structures

Remedial work for repairing any damage to flow control structures/devices will be carried out whenever necessary. **Table 9** provides further details on the regular maintenance of the flow control structures/devices.

Table 9 Regular Maintenance and remedial measures for flow control structures

Regular Maintenance	Actions/Remedial measures
Monthly	Inspect and identify any areas that are not operating correctly. If required, take remedial action (for 3 months following installation).
Six monthly	- Inspect and identify any areas that are not operating correctly. If required, take remedial action. - Remove sediment from pre-treatment structures.
Following all significant storms	Inspect and carry out essential recovery works to return the feature to full working order.

Permeable Paving

The landowners will be fully responsible for regular maintenance of the proposed permeable paving. **Table 10** provides further details on the regular maintenance of the proposed Permeable Paving.

Table 10 Regular Maintenance and remedial measures for permeable paving

Regular Maintenance	Actions/Remedial measures
Monthly	- Refer to manufacturer specifications, - For sealed systems, inspection of outfalls should be undertaken.
Six Monthly	Brushing and vacuuming to manufacturer requirements. Re-grit where necessary after brushing.
As Required	- Inspect/check all inlets, outlets, inspection chambers, surface and overflows (where required) to ensure that they are in good condition, free from blockages and operating as designed. Take action where required (for 3 months following installation) - Removal of weeds where required, - Stabilizing and mowing of contributing areas where required.
Following all significant storm events	Inspect and carry out essential recovery works to return the feature to full working order

8.0 Conclusion

The proposals comprise erection of two storey side and rear extensions to produce a larger two storey semi-detached residential building on the site with the creation of a new vehicular access to the northwest located at 9 Chatsworth Avenue, Prestwich M25 1LZ.

The overall risk of surface water flooding to the site is low.

The surface runoff will be improved by implementing appropriate SuDS measures.

Due to underlying soil condition mostly composed of silt and clay with low infiltration capacity, the potential for a Soakaway to discharge the surface runoff from the site is low. Also, there are no watercourses in the vicinity of the site.

An open ground attenuation storage will not be feasible at the site due to the limited space available. Therefore, in line with the SuDS drainage hierarchy policy, an underground geo-cellular storage (Length = 4m, Width = 2m, Depth = 0.40m) will be implemented in order to temporarily store the runoff water from the site.

In line with the SuDS drainage hierarchy the controlled outflow from the attenuation storage will be discharged into the sewer on Chatsworth Avenue using a 150mm linear pipe. In order to minimise the risk of flooding, the maximum discharge rate will be controlled by using a discharge control unit such as hydrobrake, so that it is not more than 2.5 litres/sec.

In addition, permeable paving will be implemented in the front yard area to further improve the surface runoff from the site.

The landowners will be fully responsible for the repair and management of the implemented SuDS throughout the lifetime of the proposed development.

Appendix A Collection of Maps and Figures

Appendix B Geological Map of the Site

Appendix C Existing Site and Proposed Plans

Appendix D Topographic Map

Appendix E Surface Water Flood Maps

Appendix F Greenfield Runoff Rates Estimation

Appendix G Rainfall Runoff Summary

Appendix H Ground Investigation Report

Appendix I Outline Drainage Plan

Appendix J Attenuation Storage Modelling Summary

Appendix K Exceedance Flow Routes