



UK Flood Risk
Flood Risk Consultants

Sustainable Urban Drainage Systems (SuDS)

20 Frays Avenue, West Drayton UB7 7AF

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Executive Summary

UK Flood Risk Consultants has been commissioned to prepare this Sustainable Urban Drainage Systems (SuDS) Assessment in support of a proposal consisting of replacement of existing house with 2 no. new houses located at 20 Frays Avenue, West Drayton UB7 7AF.

The main sources of information to undertake this SuDS assessment are the flood maps and data of the Environment Agency and the previous flood studies by the Local Authority along with the guidance and best practices in surface water management such as the guidelines of the National Planning Policy Framework (NPPF), Sewers for Adoption, SuDS Manual (C753) and other technical design documents.

The site is located in close proximity to the Fray's River, however, the site is located outside of its floodplain.

The proposed development will lead an increase of impermeable area by 163m². It is estimated that the peak runoff rates from the site in the pre and post-development conditions are 6.1 litre/sec and 10.2 litre/sec respectively. Therefore, the proposed development will lead to an increase of peak surface runoff by 4.1litres/sec.

The surface runoff will be improved by implementing appropriate SuDS measures. A site-specific Sustainable Urban Drainage Systems (SuDS) Strategy has been developed for the site. It is proposed that permeable paving will be implemented in order to improve the surface runoff from the site. Also, an underground Geo-cellular attenuation storage will be provided in order to attenuate the surface runoff from the design 1 in 100-year 6-hour rainfall event plus 40% Climate Change.

It is estimated that a total attenuation storage of 12m³ will be required to store the surface runoff from the 6-hour 1 in 100 year plus 40% climate change design event. Therefore, for the proposed two buildings, attenuation storage of 6m³ each will be implemented at each site.

In accordance with the SuDS hierarchy, the stored water from the storage will be discharged into the Fray's River at a controlled rate. The discharge rate into the river will be limited to the greenfield rate of 0.16 litres/sec by using flow controlling devices such as hydro-brake or vortex control device.

The owners will be fully responsible for regular repair and maintenance of the proposed SuDS measures as required for the lifetime of the development (i.e. 100 year).

With the adoption of appropriate SuDS measures, overall surface runoff condition will be significantly improved, and the proposed development will not give rise to backwater affects or divert water towards other properties.

This report demonstrates that the proposal will be safe, in terms of flood risk, for its design life and will not increase the flood risk elsewhere.

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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 this Sustainable Urban Drainage Systems (SuDS) Assessment in support of a proposal consisting of replacement of existing house with 2 no. new houses located at 20 Frays Avenue, West Drayton UB7 7AF.

This SuDS has been carried out in accordance with the guidance and best practices in surface water management. Particularly, the guidelines of the National Planning Policy Framework (NPPF), Sewers for Adoption, SuDS Manual (C753) and other technical design documents have been closely followed.

2.0 Surface Water Drainage Requirements

The Environment Agency suggests that the developers should demonstrate that the disposal of surface water from the site will not exacerbate existing flooding from new development within Flood Zones 3 and 2, development greater than 1ha in Flood Zone 1 and within areas that are known to suffer from surface water drainage or sewer flooding.

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.
- Agreement that the rates of discharge from the development are acceptable to the Environment Agency and utilities authorities.

3.0 General Description of the Site and the Proposals

3.1. Description of the site

The proposal site is located at 20 Frays Avenue, West Drayton UB7 7AF approximately centred on the OS NGR TQ 05717 79847 (**Appendix A**). The site is located on the western side of Frays Avenue with the Fray's River as the western boundary. The site is currently occupied by a single-storey detached house and a small outbuilding. The site is located within the administrative boundary of London Borough of Hillingdon, which is the Local Planning Authority.

The site occupies an area of approximately 751m². The area of building footprint along with the outbuilding is approximately 155m² and the area of hardstanding pavement is approximately 90m². Approximately 506m² area is covered by soft landscaping.

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

The site is located in close proximity to the Fray's River, however, it is located outside of its floodplain.

The site has a gently sloping topography with the general elevation varying from 25.10mAOD to 25.80mAOD. Further details about the existing site are provided in **Appendix A**.

3.2. Proposed Development

The proposal consists of replacement of existing house with 2 no. new two-storey detached houses and associated car parking and landscaping. The total footprint area of the proposed two buildings is approximately 231m². Further details about the proposals have been provided in **Appendix A**.

4.0 Relevant Planning Policies (Flood Risk and Drainage)

4.1. National Planning Policy Framework (NPPF)

The revised National Planning Policy Framework was published on 24 July 2018 and sets out the government's planning policies for England. The NPPF sets out planning and policies related to development planning and flood risk using a sequential characterisation of risk based on planning zones and the Environment Agency's Flood Maps. The aim of the flood risk assessment is to identify which Flood Zones the site is located in and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions. The policy also encourages the developers to incorporate appropriate Sustainable Drainage Systems (SuDS) to address the surface runoff/drainage issues.

4.2. 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.

4.3. Draft New London Plan

The Policy SI13 Sustainable Drainage of the Draft New London Plan has set out the following in order to address the surface runoff issues resulting from the development proposals:

- A. Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks.

- B. 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:
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[136]
 7. rainwater discharge to a surface water sewer or drain
 8. rainwater discharge to a combined sewer.
- C. Development proposals for impermeable paving should be refused where appropriate, including on small surfaces such as front gardens and driveways.
- D. Drainage should be designed and implemented in ways that address issues of water use efficiency, river water quality, biodiversity, amenity and recreation.

4.4. Local Flood Risk Management Strategy (2015)

The London Borough of Hillingdon's Local Flood Risk Management Strategy (LFRM, 2015) defines the approach within the London Borough of Hillingdon to the management of flood risk from local sources, with proposals for measures and actions to help manage that risk. This Local Flood Risk Management Strategy provides an overview of the assessment of flood risks already undertaken in other documents and sets out a framework for the management of local flood risk in the London Borough of Hillingdon, by the Council and other relevant bodies. The LFRM Strategy is supported by the already published Flood Risk Management Portfolio of documentation which contains other critical legal documents such as the Preliminary Flood Risk Assessment, Strategic Flood Risk Assessment and Surface Water Management Plan. These provide the evidence base for this strategy with more detailed information on the flood risks in Hillingdon and actions.

5.0 Surface Water Management Strategy

5.1. Surface Water Runoff Management

The London Borough of Hillingdon strongly encourages the principles of SuDS on all forms of development. This is particularly important for development sites that lie within flood risk zones, including minor development and building extensions. The developer should seek the most sustainable SuDS solution in order to reduce flood risk, improve water quality and improve the environment overall.

5.1.1. Estimation of Permeable and Impermeable Areas

The changes in land cover have been summarised in **Table 1** below. It can be seen that the proposed development will lead an increase of impermeable area by 163m². This means the surface runoff will be increased as a result of the proposed development.

Table 1 Changes in Land Cover

Land Cover	Pre-development, m ²	Post-development (with SuDS), m ²	Change, m ²
Impermeable Surface Area			
Building footprint	155	231	
Hardstanding area	90	177	
Total Impermeable	245	408	(+) 163
Permeable Surface Area			
Grass cover	506	343	
Total Permeable	506	343	(-) 163
Total Area	751	751	

5.2. Surface Water Runoff (SuDS)

5.2.1. Estimation of flows

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

The Rational Equation is given by:

$$Q = Ar \times P \times Ri$$

Where, Ar = Effective catchment area, m²

P= Impermeability factor

Ri= Rainfall Intensity, mm/hr

Q= Peak surface runoff, m³/s

The peak surface runoff for the existing and proposed site conditions are summarised in **Table 2** below. An impermeability factor of 0.90 has been used for the site. A rainfall intensity of 100 mm per hour has been utilised. The impermeable areas in **Table 1** have been used as effective catchment area. **Table 2** shows that the peak runoff rates from the site in the pre and post-development conditions are 6.1 litre/sec and 10.2 litre/sec respectively. Therefore, the proposed development will lead to an increase of peak surface runoff by 4.1 litres/sec.

Table 2 Estimation of Peak Runoff Rates from the site

SuDS Measures	Pre-development	Post-development (with SuDS)
# Rainfall intensity Ri, mm/hr	100	100
Effective catchment area, Ar m ²	245	408
Impermeability factor, P	0.90	0.90
Peak Runoff, m ³ /s	$(Ar \times P \times Ri/1000)/3600$ $= (245 \times 0.90 \times 100/1000) / 3600$ $= 0.0061 \text{ m}^3/\text{s}$ $= 6.1 \text{ litre/sec}$	$(Ar \times P \times Ri/1000)/3600$ $= (408 \times 0.90 \times 100/1000) / 3600$ $= 0.0102 \text{ m}^3/\text{s}$ $= 10.2 \text{ litre/sec}$

The rule of thumb is to use a constant rainfall intensity of 35mm/hr for initial sizing of conveyance system. 100mm/hr has been used and provides a more conservative solution (see Environment Agency 2003, Rainfall runoff management for developments, Report-SC030219).

5.3. SuDS Hierarchy

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 3** below.

Table 3 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).

Table 4 below presents the feasibility assessment of the SuDS measures for the site.

Table 4 General Assessment of SuDS measures for the site

SuDS Measures	Feasibility for the site	Issues/Description
Prevention Good site design and housekeeping/rainwater harvesting/infiltration devices/education.	Rainwater butt- Yes	Rainwater butt can be implemented in order to improve the surface runoff from 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-Yes	Permeable paving will improve the surface runoff from the site.

Site and Regional Control Infiltration/detention basins/ balancing ponds/ wetlands/underground storage/swales/retention ponds.	Balancing pond/wetland- No Geo-cellular storage- Yes	Balancing pond/wetland will not be feasible due to limited space. Geo-cellular underground storage will be feasible to attenuate the surface runoff from the extreme events
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5.4. Proposed SuDS

From the general assessment of the potential SuDS measures above, it is proposed that permeable paving will be implemented in order to improve the surface runoff from the site. Also, an underground Geo-cellular attenuation storage will be provided in order to attenuate the surface runoff from the design 1 in 100-year 6-hour rainfall event plus 40% Climate Change.

6.0 Outline Design of SUDS

6.1. 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 B** and the results are summarised in **Table 5** below. The total site area of 0.10 ha has been used which is the minimum site area required for this technique. The proposed development will consider 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 5 – Greenfield Runoff Rates

Events	Greenfield runoff rates (l/s) (Estimated)
Qbar	0.16
1 in 1 year	0.13
1 in 30 year	0.36
1 in 100 year	0.50

6.2. Surface Runoff Water Storage Estimation

Surface water runoff storage requirement has been estimated using the HR Wallingford's Storm water Storage Analysis tool. The aim of the tool is to provide flow rate and storage volume information for a site based on a minimum amount of data so that anybody can use the tool. A flow rate discharge constraint is usually required for storm water runoff from a site, resulting in attenuation volume being needed.

A climate change allowance factor of 1.40 (i.e. 40%) has been used. The estimated attenuation storage volumes are summarised in **Table 6** below. Input information and further details about the calculations have been provided in **Appendix C**.

Table 6 Estimated Surface Water Runoff Storage Volumes

Storage	Long-term storage (m ³)
Attenuation Storage	12
Long-term Storage	0
Total Storage	12

From **Table 6** above, it is estimated that a total attenuation storage of 12m³ will be required to store the surface runoff from the 6-hour 1 in 100 year plus 40% climate change design event. Therefore, for the proposed two buildings, attenuation storage of 6m³ each will be implemented at each site.

6.3. Proposed SuDS

Following SuDS measures will be implemented:

Permeable Paving

Permeable paving will be provided in car parking areas as shown in **Appendix D**.

Underground Attenuation Storage

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

Based on the estimate in **Table 6**, an attenuation storage with the total storage volume of 6m³ will be provided for each of the building plots as shown in **Appendix D**.

The location and layout of the storage and its dimensions (area and depth) can be changed to suit the site conditions. This will be to the client's discretion ensuring 6m³ of attenuation storage is provided at each site.

Disposal of surface runoff

Thames Water's Sewer Asset Map data are provided in Appendix E. There are no surface water sewer along Frays Avenue. In accordance with the SuDS hierarchy, the stored water from the storage will be discharged into the Fray's River as shown in **Appendix D**. The discharge rate into the river will be limited to the greenfield rate of

0.16 litres/sec by using flow controlling devices such as hydro-brake or vortex control device (**Table 5**).

7.0 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 7** provides further details on the regular maintenance of the Geo-cellular storage system.

Table 7 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 8** provides further details on the regular maintenance of the flow control structures/devices.

Table 8 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 9** provides further details on the regular maintenance of the proposed Permeable Paving.

Table 9 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

Appendix A Existing Site and Proposed Plans

Appendix B Greenfield Runoff Rates Estimation

Appendix C Surface Water Storage Volume Estimation

Appendix D Proposed Surface Water Improvement (SuDS) Measures

Appendix E Thames Water's Sewer Asset Map Data