



UK Flood Risk
Flood Risk Consultants

***Flood Risk Assessment (FRA) &
Site Drainage Strategy (Sustainable
Urban Drainage Systems SuDS)***

**139 North Hyde Road,
Hayes UB3 4NR**

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Executive Summary

UK Flood Risk Consultants has been commissioned to prepare this Flood Risk Assessment (FRA)/ Sustainable Urban Drainage Systems (SuDS) in support of a proposal consisting of a residential development with 2 no. two-bedroom and 2 no. one-bedroom flats along with basement as communal gymnasium with the demolition of existing bungalow located at 139 North Hyde Road, Hayes UB3 4NR.

The main sources of information to undertake flood risk assessment are the flood maps and data of the Environment Agency and the previous flood studies by the Local Authority.

The proposed development is categorised as ‘more vulnerable’.

The nearest main river from the site is the River Crane, however, the site is located outside the floodplain of this watercourse.

According to the information available from the SFRA and the Environment Agency, there were no records of flooding events at the site.

The Environment Agency’s Flood Maps show that the site lies within the Flood Zone 1 (low probability flooding). The Environment Agency’s flood risk map indicates that the site is located outside of the flood risk zone.

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

The flood risk from other sources including underground water, sewer and reservoir is low.

The surface runoff will be improved by implementing appropriate SuDS measures. An underground attenuation storage along with permeable paving in car parking area will be implemented in order to improve the surface runoff from the site. The outflow from the attenuation storage will be discharged into the existing SW sewer on North Hyde Road utilising the existing drainage system at the site. The outflow discharge will be limited by implementing Hydrobrake or similar so that the maximum discharge will not be more than 2 litres per second.

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

The 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.

Contents

1.0	BACKGROUND	1
2.0	FRA REQUIREMENTS AND OBJECTIVES.....	1
3.0	GENERAL DESCRIPTION OF THE SITE AND THE PROPOSALS.....	2
3.1.	Description of the site	2
3.2.	Proposed Development	2
4.0	DEVELOPMENT AND FLOOD RISK POLICY.....	3
4.1.	National Planning Policy Framework (NPPF).....	3
4.2.	Flood Zones.....	3
4.3.	Sequential and Exception Tests.....	3
4.4.	Vulnerability of Use and Flood Risk Assessment.....	4
4.5.	NPPF Flood Zones	4
4.6.	Flood and Water Management Act 2010.....	9
4.7.	Draft New London Plan	9
5.0	ASSESSMENT OF FLOOD RISK.....	10
5.1.	History of Flooding.....	10
5.2.	Risk of Fluvial Flooding	10
5.3.	Risk of Tidal Flooding	10
5.4.	Risk of Flooding From Artificial Water Bodies	11
5.5.	Risk of Groundwater Flooding	11
5.6.	Risk of Surface Water Flooding.....	11
5.7.	Risk of flooding from Reservoirs.....	11
5.8.	Flood Risk from Sewers	12
5.9.	Impact of Climate Change	12
6.0	SUSTAINABLE URBAN DRAINAGE SYSTEMS (SUDS)	15
6.1.	Existing Drainage	15
6.2.	Greenfield Runoff Estimation.....	16
6.3.	Estimation of Permeable and Impermeable Areas	17
6.4.	Estimation of peak surface runoff rates	17
6.5.	Hierarchy of SuDS Measures	19
6.6.	Proposed SuDS.....	20

7.0	OUTLINE DESIGN OF SUDS	21
7.1.	Proposed Surface Water Management	21
7.2.	SuDS Management and Maintenance Plan	23
7.3.	Foul Sewer Diversion	26
8.0	CONCLUSION	26

Appendices

APPENDIX A	COLLECTION OF FIGURES	I
APPENDIX B	EXISTING SITE AND PROPOSED PLANS	II
APPENDIX C	GREENFIELD RUNOFF RATES	III
APPENDIX D	PRE AND POST DEVELOPMENT RAINFALL RUNOFF SUMMARY	IV
APPENDIX E	PROPOSED SURFACE RUNOFF IMPROVEMENT MEASURES SUDS	V
APPENDIX F	ATTENUATION STORAGE MODELLING SUMMARY	VI
APPENDIX G	EXCEEDANCE FLOW ROUTES	VII
APPENDIX H	SEWER ASSET MAPS DATA	VIII
APPENDIX I	PROPOSED FOUL SEWER DIVERSION PLAN	IX

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 Flood Risk Assessment (FRA)/ Sustainable Urban Drainage Systems (SuDS) in support of a proposal consisting of a residential development with 2 no. two-bedroom and 2 no. one-bedroom flats along with basement as communal gymnasium with the demolition of existing bungalow located at 139 North Hyde Road, Hayes UB3 4NR.

This FRA has been carried out in accordance with the requirements of the Revised National Planning Policy Framework (NPPF, July 2021) and the Environment Agency's Flood Risk Assessment (FRA) Guidance Notes and the best practices in flood risk management.

The National Planning Policy Framework sets out planning policy in order to avoid inappropriate development in areas at risk of flooding by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

2.0 FRA Requirements and Objectives

The site-specific FRA should address the following:

- how flood risk affects the proposed development,
- whether the development type is appropriate for the proposed location,
- whether the site's flood risk is too great for the development,
- whether the proposed development will increase flood risk elsewhere,
- carry out the Sequential Test and the Exception Test where necessary,
- meet the additional flood resistance and resilience requirements where necessary.

The objectives of this site-specific flood risk assessment are to establish:

- whether the proposed development is likely to be affected by current or future flooding from any source,
- whether it will increase flood risk elsewhere,
- whether the measures proposed to deal with these effects and risks are appropriate,

3.0 General Description of the Site and the Proposals

3.1. Description of the site

The proposal site is located at 139 North Hyde Road, Hayes UB3 4NR approximately centred on the OS NGR TQ 10132 78864 (**Appendix A Figure 1**). 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 442m². The area of building footprint is approximately 100m² and the area of hardstanding pavement is approximately 23m². Approximately 291m² area is covered by soft landscaping.

The access to the site is via North Hyde Road. The surrounding area consists of predominantly residential use (**Appendix A Figure 2**).

The British Geological Survey's geological maps show that the bedrock of the site comprises London Clay Formation with Clay, Silt and Sand which formed approximately 48 to 56 million years ago in the Palaeogene Period (**Appendix A Figure 3**). The superficial deposits consist of Lynch Hill Gravel Member with Sand and Gravel, which formed up to 2 million years ago in the Quaternary Period.

The nearest main river from the site is the River Crane, however, the site is located outside the floodplain of this watercourse.

The site topography is relatively flat and level with the general elevation of 30.50mAOD. Further details about the existing site are provided in **Appendix B**.

3.2. Proposed Development

The proposal consists a residential development with 2 no. two-bedroom and 2 no. one-bedroom flats along with basement as communal gymnasium with the demolition of existing bungalow. The footprint area of the proposed building is approximately 124.40m². Further details about the proposals have been provided in **Appendix B**.

4.0 Development and Flood Risk Policy

4.1. National Planning Policy Framework (NPPF)

The revised National Planning Policy Framework (NPPF, July 2021) 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.

4.2. Flood Zones

The Flood Zones refer to the probability of river and sea flooding which ignores the presence of defences. The national flood maps have been developed by the Environment Agency that shows the risk of tidal and/or fluvial flooding across England and Wales for different return period events. The Environment Agency's Flood Maps are the maps which have been developed using broad scale hydraulic modelling. It is therefore important to understand that the flood maps may not be very accurate at a site-specific level which may need further field observation and measurements. The Flood Zones do not take into account of the climate change impacts which must be considered in any flood risk assessment as required by the NPPF.

4.3. Sequential and Exception Tests

As set out in the NPPF, the overall aim of the Sequential Test should be to steer new development to Flood Zone 1 (Low Probability Flooding). Where there are no reasonably available sites in Flood Zone 1, the Local Authority should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2, applying the Exception Test if required. Where there are no reasonably available sites in Flood Zones 1 or 2, the suitability of sites in Flood Zone 3 should be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

As the site is located in Flood Zone 1, the Sequential Test will not be required.

The Exception Test, as set out in the NPPF Framework, is a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available. There are two requirements to meet for the Exception Tests. The proposed development will provide wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.

4.4. Vulnerability of Use and Flood Risk Assessment

The proposed development is categorised as ‘more vulnerable’ (**Table 2**). The site is located in Flood Zone 1 (low probability flooding). The proposed development is therefore considered appropriate at this location (**Table 3**). It should be ensured that all types of flood risk are considered as part of the Flood Risk Assessment: ‘A *site-specific Flood Risk Assessment must demonstrate that 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*’.

This FRA aims to demonstrate that the proposal will remain safe for its lifetime and will not increase flood risk elsewhere.

4.5. NPPF Flood Zones

Table 1 below shows the NPPF Flood Zones and the requirements and policy aims in terms of undertaking site-specific flood risk assessment.

Table 1 - NPPF Flood Zones and Requirements (NPPF Technical Guidance Table 1)

Zone 1: Low Probability Flood Zone	This is defined as the land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
Appropriate uses	All uses of land are appropriate in this zone.
FRA requirements	For development proposals on sites comprising 1 ha or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA.
Policy aims	Developers and local authorities should seek opportunities to reduce the overall level of flood risk through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

Zone 2: Medium Probability Flood Zone	This is defined as the land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.
Appropriate uses	The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table 2 are appropriate in this zone. Highly vulnerable uses in Table 2 are only appropriate in this zone if the Exception Test is passed.
FRA requirements	All proposals in this zone should be accompanied by a FRA.
Policy aims	Developers and local authorities should seek opportunities to reduce the overall level of flood risk through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
Zone 3a: High Probability Flood Zone	This is defined as the land assessed as having a 1 in 100 or greater annual probability of river flooding (<1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Appropriate uses	The water-compatible and less vulnerable uses of land in Table 2 are appropriate in this zone. The highly vulnerable uses (Table 2) should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table 2 should only be permitted in this zone if the Exception Test is passed. All proposals in this zone should be accompanied by a FRA.
FRA requirements	
Policy aims	Developers and local authorities should seek opportunities to: ❖ reduce the overall level of flood risk through the layout and form of the development and the

	appropriate application of sustainable drainage techniques; ❖ relocate existing development to land with a lower probability of flooding; ❖ create space for flooding to occur by allocating and safeguarding open space for flood storage.
Zone 3b: Functional Floodplain	This is the land where water has to flow or be stored in times of flood. This zone is generally defined as the land which would flood with an annual probability of 1 in 20 (5%AEP) or greater in any year. The Local Council may define the Functional Floodplain area with a different annual probability of event.
Appropriate uses	Only the water-compatible uses and the essential infrastructure listed in Table 2 that has to be there should be permitted. It should be designed and constructed to: ❖ remain operational and safe for users in times of flood; ❖ result in no net loss of floodplain storage; ❖ not impede water flows; ❖ not increase flood risk elsewhere.
FRA requirements	All proposals in this zone should be accompanied by a FRA.
Policy aims	In this zone, developers and local authorities should seek opportunities to: ❖ reduce the overall level of flood risk through the layout and form of the development and the appropriate application of sustainable drainage techniques; ❖ relocate existing development to land with a lower probability of flooding.

Table 2 - Flood Risk Vulnerability Classification (NPPF Technical Guidance Table 2)

Essential Infrastructure	Essential transport infrastructure and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
Highly Vulnerable	❖ Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations and emergency dispersal points. ❖ Basement dwellings, caravans, mobile homes and park homes intended for permanent residential use. ❖ Installations requiring hazardous substances consent.
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, hotels and sites used for holiday or short-let caravans and camping. ❖ Non-residential uses for health services, nurseries and education. ❖ Landfill and waste management facilities for hazardous waste.
Less Vulnerable	❖ Buildings used for shops, financial, professional and other services, restaurants and cafes, offices, industry, storage and distribution, 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). ❖ Water treatment plants and sewage treatment plants (if adequate pollution control measures are in place).

Water-compatible Development	❖ Flood control infrastructure, water transmission infrastructure and pumping stations. ❖ Sewage transmission infrastructure and pumping stations. ❖ Sand and gravel workings. ❖ Docks, marinas and wharves, navigation facilities. ❖ MOD 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. ❖ Essential sleeping or residential accommodation for staff required by uses in this category, subject to a warning and evacuation plan.
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Table 3 - Flood Risk Vulnerability and Flood Zone 'compatibility'

Vulnerability Classification (Refer Table 2)		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zones	Flood Zone 1	✓	✓	✓	✓	✓
	Flood Zone 2	✓	✓	Exception Test	✓	✓
	Flood Zone 3a	Exception Test	✓	✗	Exception Test	✓
	Flood Zone 3b	Exception Test	✓	✗	✗	✗

✓ Development is appropriate

✗ Development should not be permitted

4.6. 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.

4.7. 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.

5.0 Assessment of Flood Risk

5.1. History of Flooding

The west London boroughs of Brent, Barnet, Ealing, Harrow, Hillingdon and Hounslow have commissioned Strategic Flood Risk Assessment, SFRA (<https://westlondonsfra.london/>) has provided brief information about past flooding events in the area. The SFRA reported some past flooding incidents in the area, however, there were no records of any flooding event at the site.

Information on historic flood events was obtained from Environment Agency's online historic flood records. However, there were no information on any flooding events around the site.

Information on the past flooding event was also obtained from the landowner. They were not aware of any flooding issues at the site.

5.2. Risk of Fluvial Flooding

The nearest main river from the site is the River Crane, however, the site is located outside the floodplain of this watercourse. The Environment Agency's Flood Map around the site is shown in **Appendix A Figure 4** which shows that the site lies within the Flood Zone 1 (low probability flooding). Flood Zone 1 is an area where flooding from rivers and the sea is very unlikely. There is less than a 1 in 1000 chance of flooding occurring in any one given year (i.e. a less than 0.1% annual probability of flooding).

Figure 5 shows the Environment Agency's flood risk map which indicates that the site is located outside of the flood risk zone.

5.3. Risk of Tidal Flooding

The watercourses are not influenced by tidal waves at this location. The risk of tidal flooding is therefore low.

5.4. Risk of Flooding From Artificial Water Bodies

There were no known flood risks from any artificial water bodies near the site.

5.5. Risk of Groundwater Flooding

In recent years groundwater has been recognised as a significant source of flooding in the UK. According to the British Geological Survey, groundwater flooding occurs when the water table in permeable rocks rises to enter basements/cellars or comes up above the ground surface. Groundwater flooding is not necessarily linked directly to a specific rainfall event and is generally of longer duration than other causes of flooding (possibly lasting for weeks or even months).

Evidence of historical groundwater flooding within the SFRA is very limited, however it is important to recognise that the risk of groundwater flooding is highly variable and heavily dependent upon local conditions at any particular time.

According to the information available from the landowner, there were no records of any groundwater flooding incidents around the site. Based on these evidences and information, it is reasonable to consider that the risk of groundwater flooding to the site is low.

5.6. Risk of Surface Water Flooding

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 A Figure 6 and Figure 7** which indicate that the risk of surface water flooding to the site is 'low'.

5.7. Risk of flooding from Reservoirs

The Environment Agency's reservoir flood map in **Appendix A Figure 8** indicated that the proposal site is located outside of the maximum extent of flooding from reservoir. According to the Environment Agency, the reservoir flooding is extremely unlikely to happen and reservoirs in the UK have an extremely good safety record; indeed there has been no loss of life in the UK from reservoir flooding since 1925. The Environment Agency is the enforcement authority for the Reservoirs Act 1975 in England and

Wales. All large reservoirs must be inspected and supervised by reservoir panel engineers on a regular basis. It is therefore assumed that these reservoirs are regularly inspected and essential safety work is carried out. These reservoirs therefore present a managed residual risk.

5.8. Flood Risk from Sewers

Sewer flooding is often caused by excess surface water entering the drainage network causing sewers to surcharge. The SFRA has provided very limited information on sewer flooding within the area, however, there were no records of sewer flooding incidents at the site. It is important to note that previous sewer flood incidents or the lack thereof do not indicate the current or future risk to the site as upgrade work could have been carried out to alleviate any issues or conversely in areas that have not experienced sewer flooding incidents the local drainage infrastructure could deteriorate leading to future flooding.

According to the information obtained from the landowner, there were no records of sewer flooding incidents at the site in the past.

5.9. Impact of Climate Change

The Environment Agency released new climate change guidance for flood risk assessments on 19th February 2016 outlining the allowances for the impact of climate change on peak river flows, peak rainfall intensities, sea level rise, offshore wind speeds and extreme wave height. They are based on climate change projections and different scenarios of carbon dioxide (CO₂) emissions to the atmosphere. There are different allowances for different epochs or periods of time over the next century.

The range of allowances in **Table 4** below is based on percentiles. A percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for peak flows fall below it and half fall above it. The central allowance is based on the 50th percentile, higher central is based on the 70th percentile and the upper end is based on the 90th percentile.

Table 4 - Peak river flow allowances by river basin district (use 1961 to 1990 baseline)

River basin district	Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Northumbria	Upper end	20%	30%	50%
	Higher central	15%	20%	25%

	Central	10%	15%	20%
Humber	Upper end	20%	30%	50%
	Higher central	15%	20%	30%
	Central	10%	15%	20%
Anglian	Upper end	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%
South East	Upper end	25%	50%	105%
	Higher central	15%	30%	45%
	Central	10%	20%	35%
Thames	Upper end	25%	35%	70%
	Higher central	15%	25%	35%
	Central	10%	15%	25%
South West	Upper end	25%	40%	85%
	Higher central	20%	30%	40%
	Central	10%	20%	30%
Severn	Upper end	25%	40%	70%
	Higher central	15%	25%	35%
	Central	10%	20%	25%
Dee	Upper end	20%	30%	45%
	Higher central	15%	20%	25%
	Central	10%	15%	20%
North West	Upper end	20%	35%	70%
	Higher central	20%	30%	35%
	Central	15%	25%	30%
Solway	Upper end	20%	30%	60%
	Higher central	15%	25%	30%
	Central	10%	20%	25%
Tweed	Upper end	20%	25%	45%
	Higher central	15%	20%	25%
	Central	10%	15%	20%

Using peak river flow allowances for flood risk assessments

The guideline suggests to consider the flood zone and the appropriate flood risk vulnerability classification to decide which allowances applies to the development or plan.

In flood zone 2

Essential infrastructure – use the higher central and upper end to assess a range of allowances

Highly vulnerable – use the higher central and upper end to assess a range of allowances

More vulnerable – use the central and higher central to assess a range of allowances

Less vulnerable – use the central allowance

Water compatible – use none of the allowances

In flood zone 3a

Essential infrastructure – use the upper end allowance

Highly vulnerable – development should not be permitted

More vulnerable – use the higher central and upper end to assess a range of allowances

Less vulnerable – use the central and higher central to assess a range of allowances

Water compatible – use the central allowance

In flood zone 3b

Essential infrastructure – use the upper end allowance

Highly vulnerable – development should not be permitted

More vulnerable – development should not be permitted

Less vulnerable – development should not be permitted

Water compatible – use the central allowance

Assessment of Climate Change Impact for the Site

The site is located within the Thames River Basin District. However, as the site is located in Flood Zone 1, the climate change allowances are not directly relevant for the fluvial flood risk assessment for this site.

For the surface runoff management, a climate change factor of 40% has been considered.

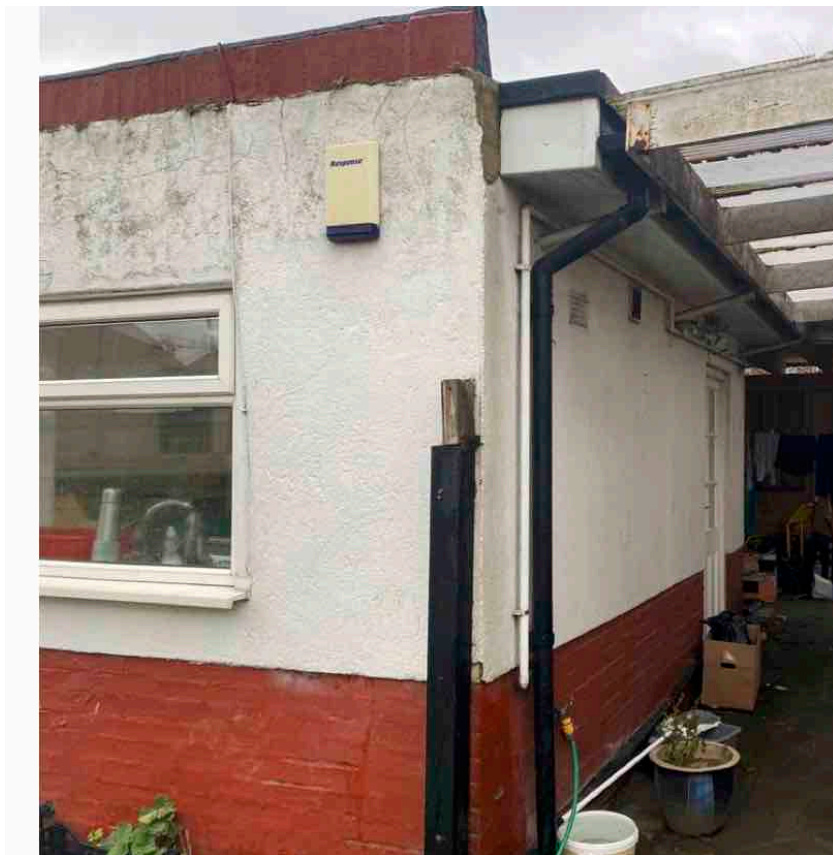
6.0 Sustainable Urban Drainage Systems (SuDS)

The London Borough of Hillingdon 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.

6.1. Existing Drainage

The roof runoff is disposed via a number of rainwater downpipes that discharge water into collection gullies which then discharge into the SW sewer located within the site (**Figure 1**). The surface runoff sewer discharges into the SW mains on North Hyde Road.

Figure 1 Existing Drainage on the site



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 C** and the results are summarised in **Table 5** below. The total site area of 0.10ha 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 will also be 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

6.3. Estimation of Permeable and Impermeable Areas

The changes in land cover have been summarised in **Table 6** below. It can be seen that the proposed development will lead an increase of impermeable area by 195m². This means the surface runoff will be increased as a result of the proposed development.

Table 6 Changes in Land Cover Areas

Land Cover	Pre-development, m ²	Post-development, m ²	Change, m ²
Impermeable Surface Area			
Hard standing	23	194	
Building footprint	100	124	
Total Impermeable	123	318	(+) 195
Permeable Surface Area			
Grass cover	319	124	
Total Permeable	319	124	(-) 195
Total Area	442	442	

6.4. Estimation of peak surface runoff rates

Pre-development Peak Runoff Rates

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, m²

P = Impermeability factor

R_i = Rainfall Intensity, mm/hr

Q = Peak surface runoff, m³/s

The peak surface runoff rates for the existing site condition are summarised in **Table 7** 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 MicroDrainage Model developed for the site which is provided in **Appendix D**. The

impermeable surface areas in Table 6 have been used as catchment for the calculations.

Table 7 Estimation of Peak Runoff Rates from the site (Pre-development condition)

Return Periods	Max Rainfall Intensity, Ri mm/hr	Catchment Area, A m ²	Impermeability factor, P	# Peak Runoff, Q, m ³ /sec	Peak Runoff, Q, litres/sec
1/ 1 year	32.3	123	0.9	0.00099	0.99
1/2 year	41.7	123	0.9	0.00128	1.28
1/5 year	53.6	123	0.9	0.00165	1.65
1/10 year	62.4	123	0.9	0.00192	1.92
1/30 year	79.3	123	0.9	0.00244	2.44
1/100 year	103	123	0.9	0.00317	3.17
1/100 year + 40% CC	103	123	0.9	0.00443	4.43

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

Ri taken from MicroDrainage model (**Appendix D**).

Post-development Peak Runoff Rates

The peak surface runoff from the post-development condition will be limited to 2 litres/sec with the implementation of the attenuation storage system. The surface runoff rates for the site are summarised in **Table 8** below.

Table 8 Summary of Peak Runoff Rates from the site (Post-development condition with the attenuation storage)

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

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 9** below.

Table 9 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 10 below presents the feasibility assessment of the SuDS measures for the site.

Table 10 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 will improve the surface runoff from the site.	Yes. There is potential for Permeable paving in the front yard/car parking area.
Site and Regional Control Infiltration/detention basins/ balancing 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

wetlands/underground storage/swales/retention ponds.	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)	space available for open ground balancing pond. Yes. A Geo-cellular underground storage system can be implemented beneath the access drive in order to attenuate the surface runoff from the extreme event of 1 in 100 year plus climate change.
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6.6. Proposed SuDS

Based on the general assessment of the potential SuDS measures above, an underground 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.

7.0 Outline Design of SUDS

7.1. Proposed Surface Water Management

Attenuation Storage

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 = 5m, Width = 3m, Depth = 0.50m

Therefore, the total storage volume = 7.50m³

The maximum flow control of 2 litres per second has been adopted for all events up to and including 1% AEP + 40%CC with no flooding. The controlled outflow will be discharged into the SW sewer on North Hyde Road via the existing drainage system. The proposed drainage layout plan has been provided in **Appendix E**.

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 site area considered for the modelling is 0.044ha. 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 F**. The summary of the model output for the 1 in 100 year plus 40% climate change event is provided in **Table 11** below.

It can be seen from **Table 11** that for the maximum volume of 157m³ will be generated by the 600 minutes Winter event, and there will be no overflow and 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 11 – Summary of Model Output (1 in 100 year plus 40% climate change)

Events	Rainfall mm/hr	Max Volume m ³	Discharge Volume M ³	Max Overflow M ³	Flooded Volume M ³
60 min (Winter)	57.87	12.4	21.3	4.3	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 the attenuation storage volume will not be less than 7.50m³.

Thames Water's sewer asset maps data indicate that a SW sewer runs along North Hyde Road (**Appendix G**). The outflow from the attenuation storage will be discharged into the existing SW sewer on North Hyde Road utilising the existing drainage system at the site.

Permeable Paving

Permeable paving will be provided on the front yard and car parking area as shown in **Appendix E**.

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 front of the building will naturally follow towards North Hyde Road, as this will be the only open area for the floodwater to flow across the site. The flow routes from the access/car parking area to the east of the site will flow towards Wyre Grove. The exceedance flow routes are shown in **Appendix H**.

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

Table 12 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 13** provides further details on the regular maintenance of the flow control structures/devices.

Table 13 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 14** provides further details on the regular maintenance of the proposed Permeable Paving.

Table 14 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

7.3. Foul Sewer Diversion

The site gets benefit from the foul sewer that runs across the site. In order to allow the erection of the new building, the foul sewer will be diverted towards the norther eastern corner of the site as shown in **Appendix I**.

8.0 Conclusion

The proposal consists of a residential development with 2 no. two-bedroom and 2 no. one-bedroom flats along with basement as communal gymnasium with the demolition of existing bungalow located at 139 North Hyde Road, Hayes UB3 4NR.

The proposed development is categorised as ‘more vulnerable’.

The nearest main river from the site is the River Crane, however, the site is located outside the floodplain of this watercourse.

According to the information available from the SFRA and the Environment Agency, there were no records of flooding events at the site.

The Environment Agency’s Flood Maps show that the site lies within the Flood Zone 1 (low probability flooding). The Environment Agency’s flood risk map indicates that the site is located outside of the flood risk zone.

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

The flood risk from other sources including underground water, sewer and reservoir is low.

The surface runoff will be improved by implementing appropriate SuDS measures. An underground attenuation storage along with permeable paving in car parking area will be implemented in order to improve the surface runoff from the site. The outflow from the attenuation storage will be discharged into the existing SW sewer on North Hyde Road utilising the existing drainage system at the site. The outflow discharge will be limited by implementing Hydrobrake or similar so that the maximum discharge will not be more than 2 litres per second.

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

The 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.

Appendix A Collection of Figures

Appendix B Existing Site and Proposed Plans

Appendix C Greenfield Runoff Rates

Appendix D Pre and Post-Development Runoff Rates

Appendix E Proposed Surface Water Improvement (SuDS) Measures

Appendix F Attenuation Storage Modelling Output Summary

Appendix G Exceedance Flow Routes

Appendix H Sewer Asset Maps Data

Appendix I Proposed Foul Sewer Diversion