SURFACE WATER DRAINAGE ASSESSMENT & OUTLINE SUDS STRATEGY

39 FITZJOHNS AVENUE

CAMDEN

LBH4498suds

September 2021

LBHGEO

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FOREWORD-GUIDANCE NOTES

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THIRD PARTY INFORMATION

The report may present an opinion based upon information received from third parties. However, no liability can be accepted for any inaccuracies or omissions in that information.

1. INTRODUCTION

1.1 BACKGROUND

It is proposed to re-build a large Victorian property at No. 39 Fitzjohn's Avenue, which will include the construction of a basement beneath the full extent of the building that will also extend into the rear garden.

LOCATION PLAN

A previous planning application for the development, submitted to the London Borough of Camden Council (Ref. 2018/2415/P), was accompanied by an Outline Suds Strategy.

The scheme was revised in 2019 to reduce the depth and area of basement excavation and later to increase the proposed number of housing units to thirty-five together with minor additions to the front and side lightwells and a rearrangement of the proposed basement level patio.

A planning application for the altered scheme has been submitted to London Borough of Camden Council and was registered on 4th of August 2020 (Planning Ref. 2020/2169/P).

Previous comments on the SuDS proposals provided by the LLFA and the Camden Sustainability Officer on 3rd December 2020 indicated that *'the appropriate runoff targets are greenfield rates (minimum of 2 l/s) for the new/rebuild parts (including any new impermeable area) and at least 50% betterment on existing for the retained parts'*. This was provided in recognition of the SuDS policy of requiring Major Development to achieve greenfield run-off rates wherever feasible (as referenced in Section 1.3 below).

The above comments were addressed in version 2.0 of this report, along with the changes to the proposals as explained above.

An additional set of comments was received from Camden's external LLFA consultants Metis in July 2021, including a requirement for the development to provide attenuation storage sufficient to reduce the run-off rate to the equivalent greenfield rate; following which version 3.0 of this report was issued to address these comments.

Metis have now (September 2021) requested additional clarification on three items and this report has been updated to address these. A comments tracker is appended to this report.

1.2 SUDS GUIDANCE

The government advice is that developers should seek opportunities to reduce the overall level of flood risk through the appropriate application of sustainable drainage systems.

Sustainable drainage systems are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible. They provide opportunities to:

- reduce the causes and impacts of flooding;
- remove pollutants from urban run-off at source;
- combine water management with green space with benefits for amenity, recreation and wildlife.

The aim is to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:

1. into the ground (infiltration);
2. to a surface water body;
3. to a surface water sewer, highway drain, or another drainage system;
4. to a combined sewer.

The London Borough of Camden requires drainage solutions to incorporate SuDS principles as laid out in the Non-Statutory Technical Standards[1] for Sustainable Drainage Systems and the London Plan[2].

For redevelopment sites where there is a net increase in impermeable area, development must include at least one 'source control' SuDS measure. Examples of potential Source Control measures include:

[1] DEFRA March 2015 Non-Statutory Technical Standards (NSTS) for sustainable drainage systems
[2] London Plan Chapter Five - London's Responses to Climate Change Policy 5.1.3 Sustainable Drainage

- blue/green roof
- rainwater harvesting
- bio-retention
- rain garden
- permeable paving

Underground storage/attenuation tanks are not encouraged and are to be used only as a last resort.

The Camden Local plan provides guidance for water and flooding under Policy CC3, where the council will seek to ensure a development reduces the risk of flooding where possible and will require a development to utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible.

Additionally, the Water and Flooding Camden Planning Guidance (CPG) (March 2019) states the following:

> *"A drainage report is required for all major applications, basement development, and vulnerable development in areas identified as at risk of flooding (details of what this should include can be found in paragraph 8.67 of the Local Plan). The Council will expect plans and application documents to describe how water will be managed within the development, including an explanation of the proposed SuDS, the reasons why certain SuDS have been ruled out and detailed information on materials and landscaping.*
>
> *The Council will expect developments to achieve a greenfield surface water run-off rate where feasible once SuDS have been installed.*
>
> *Greenfield run-off rates are defined as the run off rates from a site in its natural state prior to any development. Developers will be expected to show to the Council's satisfaction how all opportunities to reduce site run-off have been included"*

1.3 REPORT STRUCTURE

This report describes the site characteristics and the proposed development, following which consideration is given to the feasibility of different SuDS techniques for this site, in line with the SuDS hierarchy.

An analysis is then presented of surface water run-off and of the attenuation volume that will be required to achieve the required reduction in the predicted run-off rates, taking into account increased rainfall rates due to anticipated climatic change.

A SuDS strategy is then developed including information about the proposed SuDS types, with an aim to reduce the drainage discharge rates as far as can be reasonably achieved in the proposed post-development scenario.

The report is accompanied by detailed calculations and a summary sustainable drainage pro-forma.

2. THE SITE

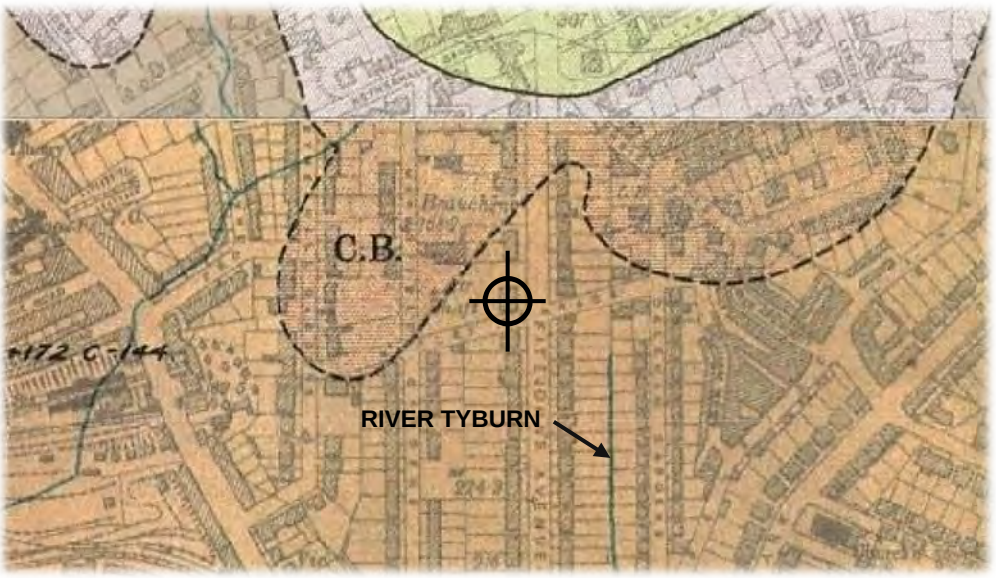
2.1 SITE LOCATION

The site is situated on the corner of Fitzjohn's Avenue and Nutley Terrace side of Kentish Town Road, approximately 400m to the northeast of Finchley Road underground station.

The site may be located approximately by postcode NW3 5JY or by National Grid Reference 526510, 185000.

2.2 TOPOGRAPHICAL SETTING

The area lies on the southern slopes of Hampstead Hill near the headwaters of the River Tyburn which are located approximately a short distance from the site.



2.3 GROUND CONDITIONS

The site is directly underlain by the London Clay Formation, which is essentially impermeable. This has been confirmed by a site specific ground investigation

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2.4 SITE DESCRIPTION

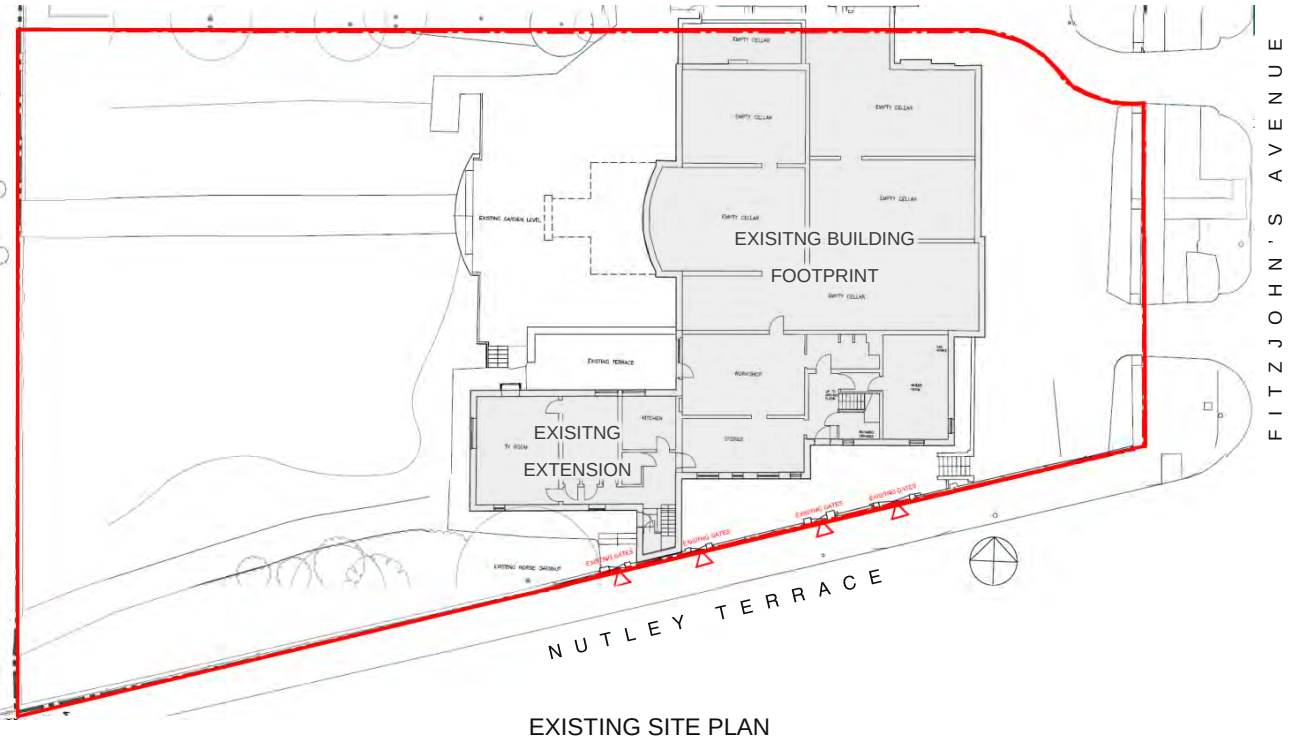
The site is occupied by a large three storey Victorian house with a lower ground floor.

A 1950s three storey building is connected to the northern side of the property via a three storey link corridor.

To the rear of the main house there is a 1970's extension.

The garden is situated to the rear of the Victorian house and gently slopes to the south where a row of trees is present along the boundary with Nutley Terrace.

REAR ELEVATION



EXISTING SITE PLAN

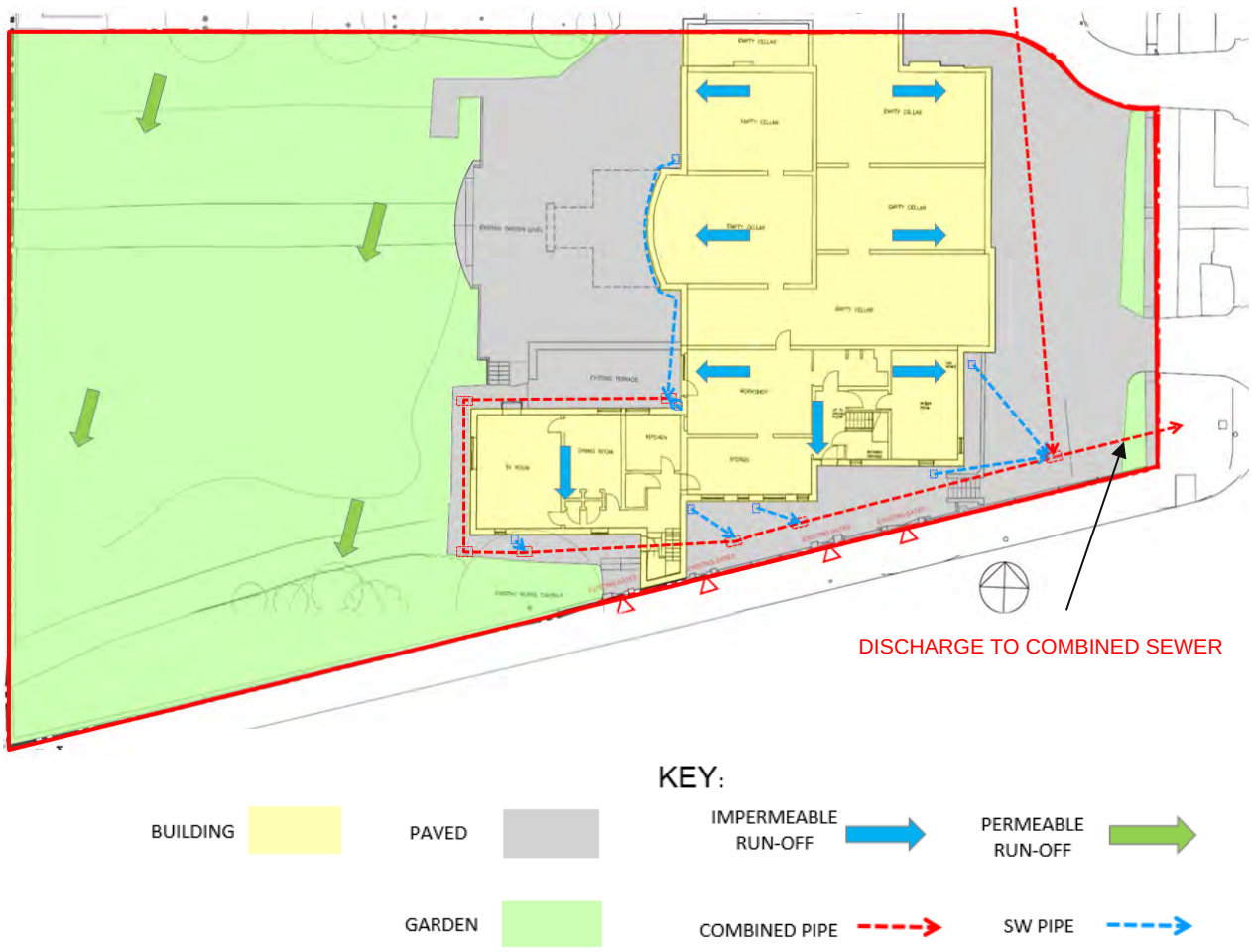
2.5 EXISTING SURFACE WATER DRAINAGE

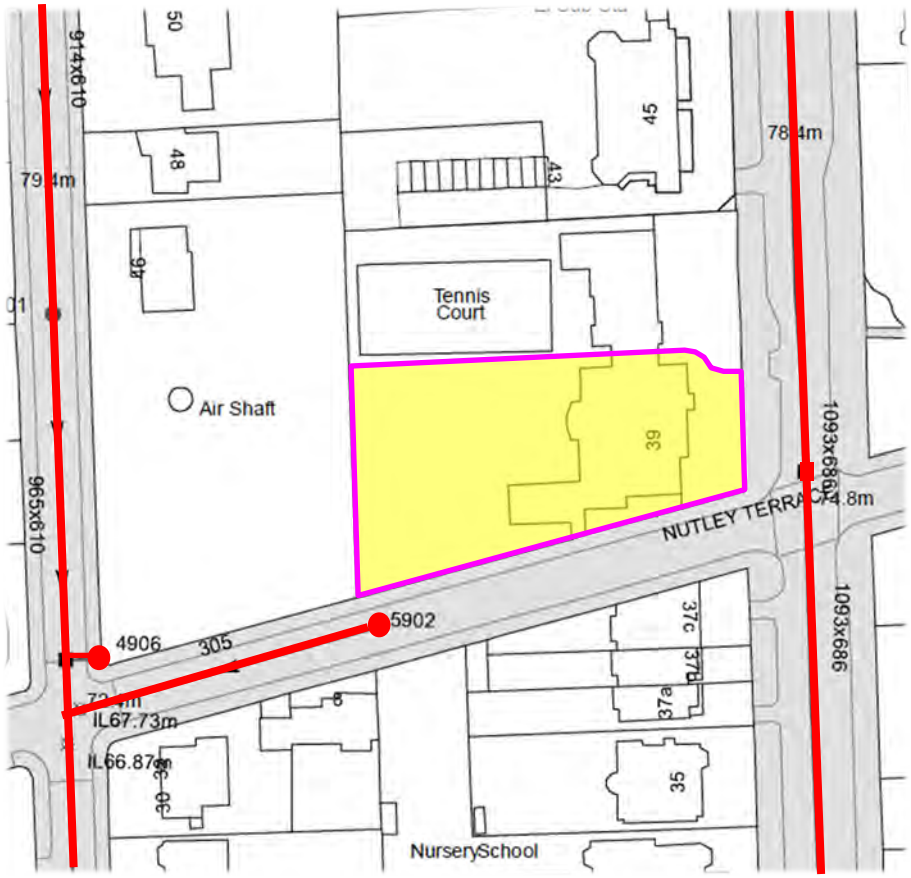
The rainfall incident on the buildings and hard surfacing on site is directed through a series of drains leading towards the front of the site. The drains collect both the surface water and foul water. The final

discharge manhole, located in the southeastern corner of the site, also collects combined runoff from the adjacent building to the north before discharging to the combined sewer.

The rear garden slopes away from the building and the front of the site so that rainfall incident on this garden area follows the slope and flows away from the existing drainage system on site.

The collected runoff from the site is ultimately discharged to a public combined sewer running southwards below Fitzjohn's Avenue.





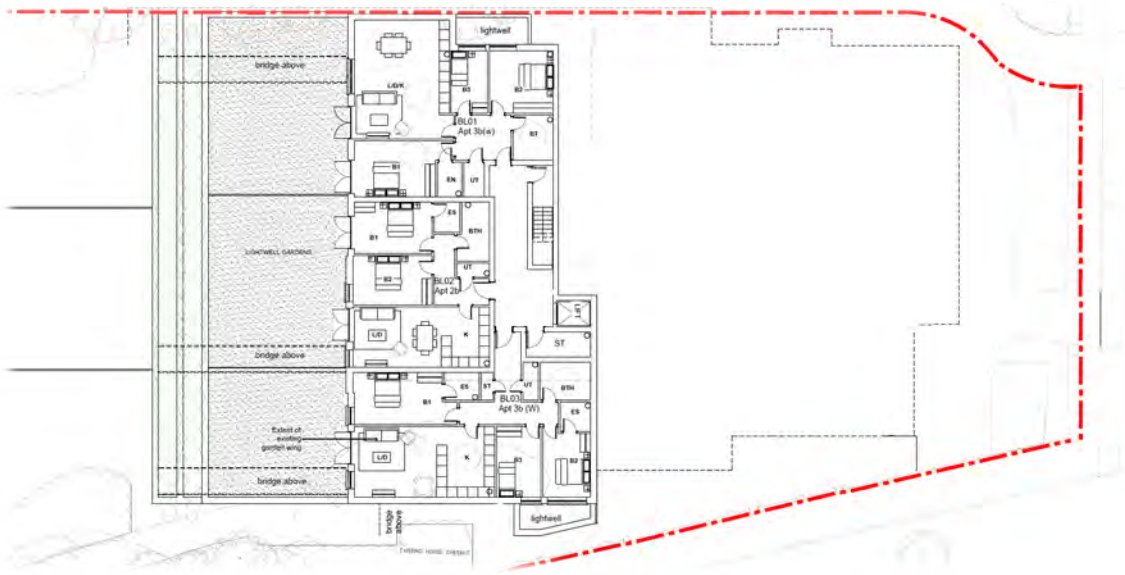
EXTRACT FROM A THAMES WATER ASSET LOCATION SEARCH SHOWING PUBLIC SEWER NETWORK IN THE VICINITY OF THE SITE

3. PROPOSED DEVELOPMENT

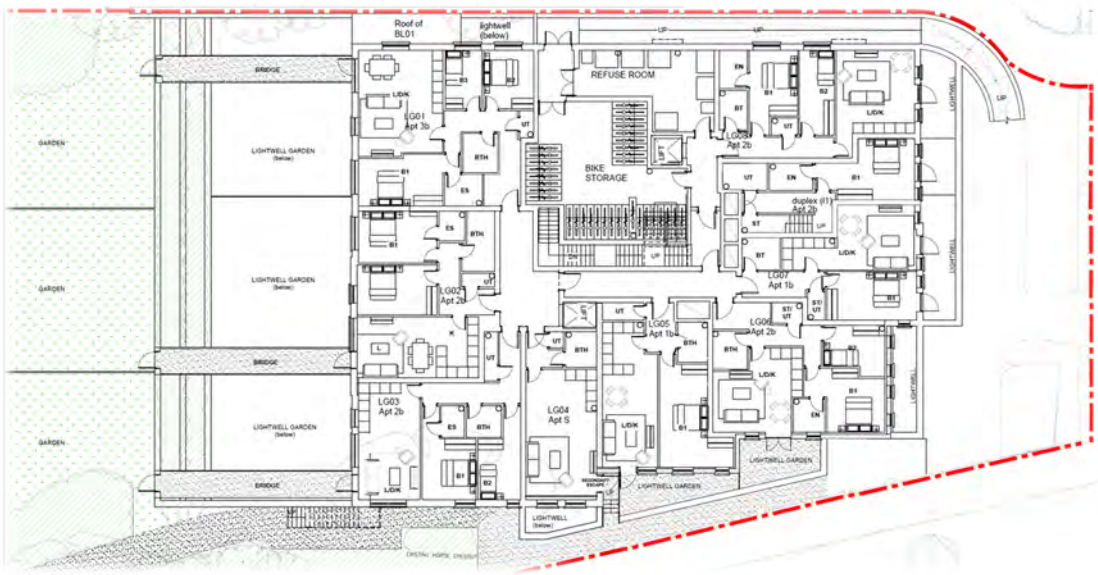
It is proposed to redevelop the site with a new four storey building with a basement while retaining the front and side facades to the existing Victorian property.

The new building will extend into the present rear garden with the new basement opening out onto a basement level patio that will link to the remaining rear garden by means of stepped planting.

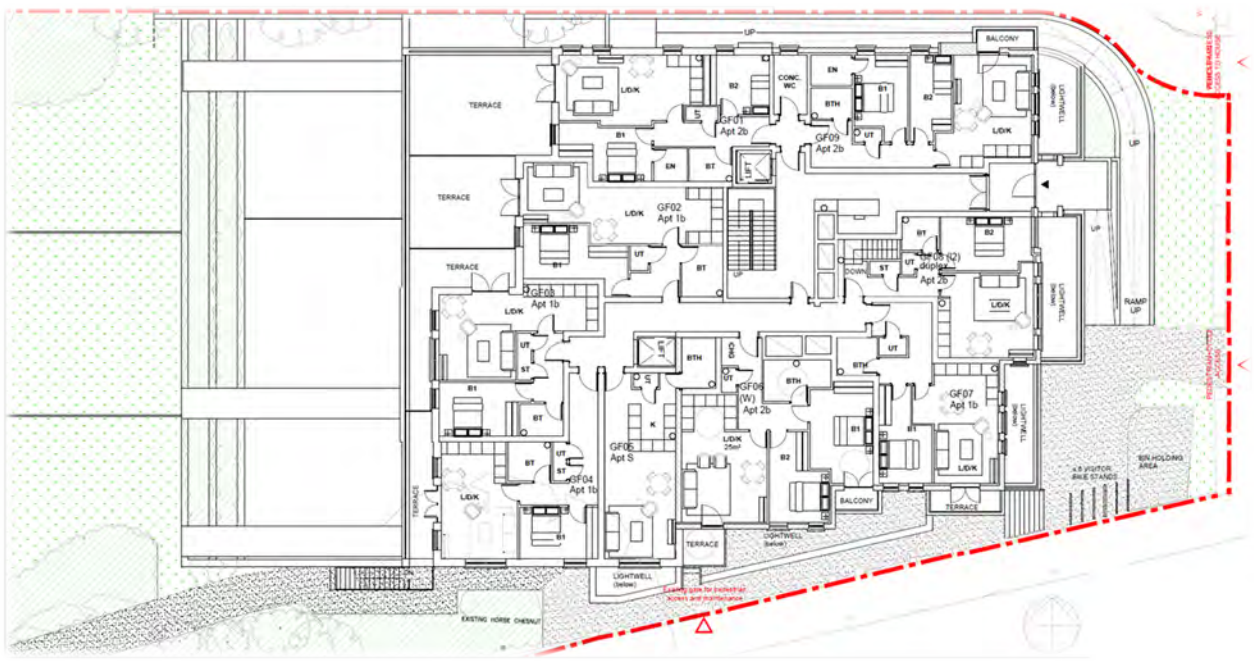
As part of the proposed development, the existing 1970s rear extension and the link corridor to the builing to the north will be removed.



PROPOSED BASEMENT PLAN



PROPOSED LOWER GROUND FLOOR PLAN



PROPOSED GROUND FLOOR LEVEL PLAN

SCHEDULE OF ESTIMATED AREAS										
	EXISTING					PROPOSED				
		Cv	%		%	Proposed	Cv	%		%
FRONT AREAS	310sqm	0.9	14.4%			270sqm	0.9	12.6%		
BUILDING	550sqm	0.9	25.6%	**%IMP**	**52.6%**	660sqm	0.9	30.7%	**%IMP**	**60.0%**
REAR PATIOS	270sqm	0.9	12.6%			360sqm	0.9	16.7%		
GARDENS	1020sqm	0.4	47.4%	**%PER**	**47.4%**	860sqm	0.4	40.0%	**%PER**	**40.0%**
TOTAL DEVELOPMENT AREA	2150sqm		100.0%		100.0%	2150sqm		100.0%		100.0%

4. SURFACE WATER MANAGEMENT

4.1 SURFACE WATER MANAGEMENT (SWM) OBJECTIVES

The drainage strategy follows the guidance set out in the 2015 CIRIA C753 SuDS Manual; the principle of SuDS design is that surface water runoff is managed for maximum benefit.

4.2 SUDS DISCHARGE HIERACHY

The surface water runoff should be managed using the following techniques, as outlined in order of priority by the following drainage hierarchy:

SuDS Drainage Hierarchy	Suitable for the site? (Y/N)	Comment
Store rainwater for later use	Y	There is limited space for rainwater harvesting. Small water butts are to be included within the proposed basement patio.
Use infiltration techniques	N	The London Clay is unsuitable for soakaway infiltration.
Attenuate rainwater in ponds or open water features for gradual release	Y	There may be space to introduce open water features in the form of swales or rain garden at the rear garden of the site
Attenuate rainwater by storing in tanks or sealed water features for gradual release	Y	There is scope for attenuation storage within a cellular storage layer underlying the proposed permeable paving. A larger underground attenuation storage tank can also be considered.
Discharge rainwater direct to a watercourse	N	There is no available watercourse.
Discharge rainwater to a surface water sewer/drain	N	There is no surface water sewer serving the site.
Discharge rainwater to the combined sewer	Y	The site currently discharges to the combined sewer beneath Fitzjohn's Avenue.

The objective is to control the quantity of runoff to support the management of flood risk and maintain and protect the natural water cycle. The hierarchy seeks to ensure that surface water runoff is controlled as near to its source as possible to mimic natural drainage systems and retain water on or near to the site.

Before disposal of surface water to the public sewer is considered, all other options set out in the above hierarchy need to be exhausted.

4.3 FEASIBLE SUDS COMPONENTS

SUDS Component	Description	Suitable for the site? (Y/N)	Comment
Rainwater harvesting	Collection of rainwater runoff from roofs or impermeable areas for reuse.	Y	Water butts are to be included within the basement level patio.
Green roofs	Vegetated areas installed on the top of buildings provide visual and ecological benefits in addition to surface water runoff reduction and enhanced building performance.	Y	The proposed development provides new areas of flat roof which may be repurposed with a green roof cover.
Blue roofs	Roof design intended to store water providing attenuation storage.	Y	There is a limited scope to install blue roof storage at the same flat roof areas.
Infiltration systems	Infiltration can contribute to reducing runoff rates and volumes while supporting base flow and groundwater recharge processes.	N	The London Clay is not suitable for infiltration.
Proprietary treatment systems	Proprietary treatment systems are manufactured products which remove specified pollutants from surface water runoff.	N	Not required.
Filter strips/drains	Filter strips are gently sloping strips of grass that provide treatment of runoff from adjacent impermeable areas. Filter drains are gravel or stone filled trenches which provide temporary subsurface storage for attenuation conveyance and filtration of surface water runoff.	Y	There is scope to introduce a form of filter strips at the proposed development site, potentially within the basement level patio.
Swales	Swales are shallow, flat bottomed, vegetated open channels designed to convey, treat, and attenuate surface water runoff.	Y	There is limited scope to introduce swales within the retained rear garden of the site.
Bioretention systems	Rain gardens or shallow landscaped depressions that may reduce surface water runoff rates and volumes and/or treat pollution using engineered soils and vegetation.	Y	There is limited scope to introduce rain gardens or similar within the retained rear garden of the site.

Trees	Trees aid surface water management through transpiration, inception, infiltration and phytoremediation.	Y	There is scope for new planting to be introduced in the retained rear garden.
Pervious Pavements	Pervious pavements facilitate the infiltration of surface water into a subsurface structure where filtration, adsorption, biodegradation or sedimentation may also provide treatment of the runoff.	Y	There is scope to introduce a significant area of permeable paving beneath the proposed hard surfacing at the southern part of the site. Such paving will only be feasible when underlain by a proprietary cellular storage layer.
Attenuation storage tanks	Attenuation storage tanks provide below-ground void space for the temporary storage of surface water before infiltration, controlled release or use.	Y	Construction of attenuation storage tanks is feasible within the front area of the site and below the stepped planter towards the rear of the basement patio.
Detention basins	Attenuation storage in the form of dry landscaped depressions.	N	There is a very limited scope to introduce such features in the retained rear garden.
Ponds and wetlands	Permanent water filled ponds or wetlands that provide attenuation storage or treatment of surface water runoff.	N	There is a very limited scope to introduce such features in the retained rear garden.

4.4 BENEFITS

The types of benefits that may be achieved by utilising SuDS are categorised by the design objectives outlined in the following section.

4.4.1 WATER QUANTITY

The proposed development will reduce the areas of soft landscaping on site and attenuation storage will be required in order to reduce the surface water discharge from the site into the public sewer.

In order to provide this attenuation, a majority of the proposed hard surfacing at ground level, at the southern part of the site, is to be constructed as permeable paving, with a proprietary, cellular storage layer underlying this for storage of surface water runoff. Storage is also planned under the stepped planters at the rear of the basement patio.

4.4.2 WATER QUALITY

The water quality design objective is to manage the quality of runoff to prevent pollution, supporting the management of water quality in the receiving surface waters and groundwater and design system resilience to cope with future change.

The permeable paving will provide an effective filter of larger particles before routing to the underlying storage. Petroleum interceptors will be installed at the front of the site, where vehicular access and parking will be provided.

Any additional areas of green roof and/or rear garden SuDS features will offer additional scope for filtering of the surface water.

4.4.3 AMENITY

The amenity design objective is to create and sustain better places for people by implementing the following criteria for the site:

- Maximise multi-functionality
- Enhance visual character
- Deliver safe surface water management systems
- Support development resilience/adaptability to future change
- Maximise legibility
- Support community environmental learning

There is limited scope to introduce further amenity objectives on site. It is expected that the proposed stepped planter leading towards the retained rear garden may provide the best opportunity for this.

4.4.4 BIODIVERSITY

The biodiversity design objective is to create and sustain better places for nature by implementing the following criteria for the site:

- Support and protect natural local habitats and species
- Contribute to the delivery of local biodiversity objectives
- Contribute to habitat connectivity
- Create diverse, self-sustaining and resilient ecosystems.

Similarly, there is limited scope to introduce further biodiversity features on site. It is expected that the proposed stepped planter leading towards the retained rear garden may provide the best opportunity for this.

4.5 SUDS CONSTRUCTION

It is proposed to provide sufficient attenuation storage to reduce the discharge rate to a greenfield rate.

The required storage volume is expected to be provided by cellular storage tanks underlying the stepped basement patio planters and beneath permeable paving in the southern part of the site.

An underground storage tank is likely to be required to be installed at the front of the site in order to capture the attenuated runoff and provide further attenuation volume itself, to fulfil the calculated requirement.

The basement patio will need to drain to a sump, from where water will be pumped up to either the storage underlying the permeable paving or directly to the attenuation tank situated beneath the front parking area.

The attenuated flow can then be discharged from the tank via an orifice flow control towards the combined sewer beneath Fitzjohn's Avenue.

4.6 MAINTENANCE

There is a need to introduce clear arrangements in place for on-going maintenance over the lifetime of the development.

The SuDS features will require some regular inspection and maintenance to clear any accumulated sediment or debris which may reduce the storage capacity as well as to ensure the inlets and outlets are clear and do not impede the water flow.

Maintenance activities can be broadly categorised as:

- Regular maintenance consists of inspections and basic tasks carried out to a frequent schedule (more frequently than once per year) including inspections, silt, litter or debris removal and vegetation management.
  Regular maintenance inspections are to be undertaken at least monthly (and following significant storm events) during the first year of operation of all SuDS components to ensure the system is functioning as designed.

- Occasional maintenance comprises tasks that are required on a much less frequent and predictable basis (e.g. annual checks)

- Remedial maintenance describes the intermittent tasks that may be required to rectify faults associated with the system such as inlet and outlet repairs, infiltration surface rehabilitation, replacement of blocked filter materials/fabrics, system rehabilitation immediately following a pollution event.

The maintenance activities envisaged for the proposed SuDS components at the site are detailed in the table below:

Suds Component	Maintenance Category	Minimum frequency	Maintenance activity details
Pervious Paving	Regular	Monthly	• Inspect for evidence of poor operation, weed growth or build-up of sediment– if required, take remedial action. • Monitor inspection chambers
	Occasional / Remedial following inspection	Annually	• Brush and clear sand joints of any vegetation or moss. • Remove sediment from silt traps • Remove litter and/or debris
Underground attenuation storage tanks	Regular	Monthly	• Inspect all components for proper operation • Inspect and check outfall flow controls. • Inspect drain inlets and outlets to ensure proper flow • Check the outer areas near the tanks for any signs of leaks

	Occasional / Remedial following inspection	Annually	• Brush and clear sand joints and inlets of any vegetation or moss. • Remove sediment from silt traps • Access the inspection chambers and check for internal obstructions or debris to be removed

The SuDS maintenance will be the responsibility of the site owner.

5. INITIAL DESIGN CONSIDERATIONS

An analysis has been undertaken of the pre- and post- development surface water run-off rates and volumes over a range of storm intensities and durations.

5.1 GREENFIELD RUNOFF RATE

The Greenfield runoff rates from the site have been calculated using the UK SuDS online tool and the Institute of Hydrology (IoH) 124 methodology.

Greenfield Rates:	
Qbar:	0.93 l/sec
1 in 1	0.79 l/sec
1 in 30	2.15 l/sec
1 in 100	2.98 l/sec
1 in 200	3.50 l/sec

5.2 EXISTING RUNOFF RATE

The site comprises a total area of approximately 2150m^2 of which approx. 52.6% is impermeably surfaced. The proposed development will increase the proportion of impermeable areas to an estimated approx. 60.0%. There is considered to be no SuDS features present at the existing site.

The existing peak storm runoff for the 1% (1 in 100 year) annual probability 15 min rainfall event on the site is estimated to be 51.1 l/sec. The calculation was based on the Wallingford Procedure and the resulting runoff was calculated using the Modified Rational Method with an M5-60 of 20mm, an 'r' value of 0.42 and a critical rainfall intensity of 99.3 mm/hr.

The rainfall runoff volume for the 1% (1 in 100 year) annual probability, 6 hour duration storm from the existing site is estimated to be 116.9 m^3.

6. PROPOSED SURFACE WATER DRAINAGE SCHEME

Attenuation storage is to be provided predominantly beneath the hard surfaced areas at the southern part of the site.

Calculations indicate that some 112m^3 of attenuation storage will be required for the 1 in 100 year rainfall event, in consideration of up to 40% climate change allowance, in order to reduce the proposed discharge rate to the equivalent of estimated greenfield runoff rate (2.98 l/s).

It is envisaged that this could potentially be provided as follows:

- 200mm thick storage layer, underlying 150m^2 permeable paving, providing 30m^3 of attenuation storage
- An underground attenuation tank at the front of the site providing 40m^3 of storage
- Two attenuation tanks within the stepped planter towards the rear of the basement patio, providing a combined 42m^3 of storage

Small rainwater harvesting butts are to be provided in the rear basement patios, although these are not expected to provide any significant storage volume for attenuation purposes.

Drainage pipes leading from the roof and other hard surfaced areas situated at a higher elevation towards the attenuation tanks underlying the stepped features at the rear of the basement patio can be provided leading through the proposed ground floor level bridges above the basement patio.

A schematic plan of the proposed SuDS features on site, which would provide the necessary attenuation storage, is presented overleaf.

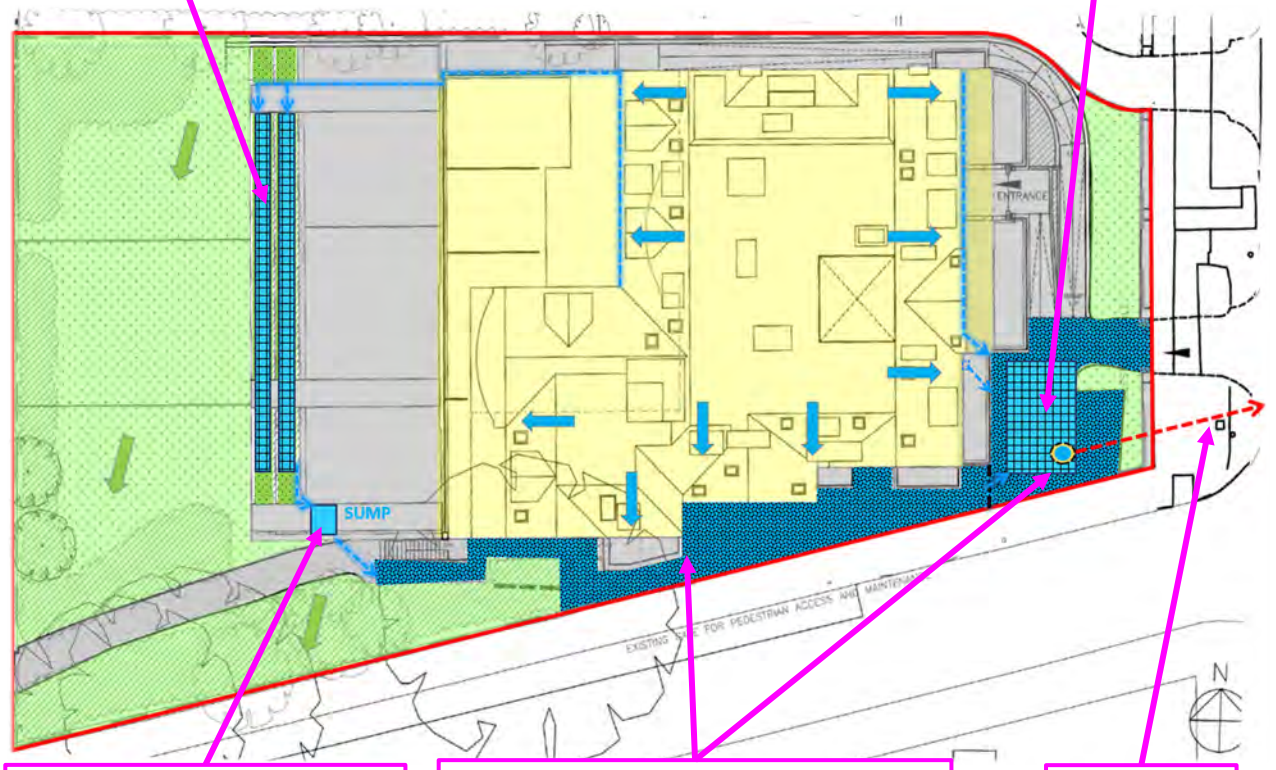
A schematic section of the proposed SuDS features is also provided, illustrating the envisaged required levels of the storage features in order to ensure feasibility of gravity drainage towards the final attenuation tank.

Not shown on plan:

- Rainwater harvesting butts in the basement patio

Attenuation storage tanks underlying stepped planting providing **approx. 42m^3 of storage**

Underground attenuation storage tank providing **approx. 40m^3 of storage**



Basement level sump & pump leading runoff from the basement patio area towards the attenuation storage underlying the permeable paving

Garden level and front street level permeable paving with an underlying, 200mm thick storage layer providing a total of **approx. 30m^3 of attenuation storage**

Final discharge to the public combined sewer

SUDS KEY :

BUILDING | PAVED | RUN-OFF

GARDEN | FLOW CONTROL | SEWER

DEVELOPMENT AREA | SW PIPE

PERMEABLE PAVING UNDERLAIN BY STORAGE LAYER | ATTENAUTION STORAGE TANK

Schematic section showing the approximate arrangement of the proposed attenuation storage SuDS features, showing the levels of the featerus in relation to each other.

7. CONCLUSION

This assessment has demonstrated that the developer has sought opportunities to reduce the overall level of flood risk through the appropriate application of sustainable drainage systems.

This assessment demonstrates that there is scope for various SuDS features that can restrain run-off, in accordance with Policy CC3 of the Camden Local Plan, to mitigate the risk of future surface water flooding, taking into account potential climate change.

APPENDIX

SUSTAINABLE DRAINAGE PRO-FORMA

PRELIMINARY DRAINAGE CALCULATIONS

SUDS ASSESSMENT COMMENT TRACKER

1. Project & Site Details	Project / Site Name (including sub-catchment / stage / phase where appropriate)	39 FITZJOHN'S AVENUE
	Address & post code	
	OS Grid ref. (Easting, Northing)	E 525585
		N 183920
	LPA reference (if applicable)	
	Brief description of proposed work	Construction of a new rear basement extension as well as a front basement level lightwell.
	Total site Area for Attenuation	2150 m^2
	Total existing impervious area	1130 m^2
	Total proposed impervious area	1290 m^2
	Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)?	No
	Existing drainage connection type and location	Combined Sewer beneath Fitzjohn's Avenue
	Designer Name	S R L B
	Designer Position	Principal
	Designer Company	LBHGEO

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility	
Superficial geology classification	N/A
Bedrock geology classification	London Clay
Site infiltration rate	1.E-09 m/s
Depth to groundwater level	No groundwater table present
Is infiltration feasible?	No

2b. Drainage Hierarchy	*Feasible (Y/N)*	*Proposed (Y/N)*
1 store rainwater for later use	Y	Y
2 use infiltration techniques, such as porous surfaces in non-clay areas	N	N
3 attenuate rainwater in ponds or open water features for gradual release	Y	N
4 attenuate rainwater by storing in tanks or sealed water features for gradual release	Y	Y
5 discharge rainwater direct to a watercourse	N	N
6 discharge rainwater to a surface water sewer/drain	N	N
7 discharge rainwater to the combined sewer.	Y	Y

2c. Proposed Discharge Details	
Proposed discharge location	Combined Sewer beneath Fitzjohn's Avenue
Has the owner/regulator of the discharge location been consulted?	No - as there will be a reduction in the volume and rate of water entering the TW sewer

3. Drainage Strategy

3a. Discharge Rates & Required Storage

	Greenfield (GF) runoff rate (l/s)	*Existing discharge rate (l/s)*	*Required storage for GF rate (m^3)*	*Proposed discharge rate (l/s)*
Qbar	0.93			
1 in 1	0.79	16.34	25.45	0.79
1 in 30	2.15	39.90	56.38	2.15
1 in 100	2.98	51.15	73.93	2.98
1 in 100 + CC			112.09	2.98
Climate change allowance used		40%		
3b. Principal Method of Flow Control		Orifice		

3c. Proposed SuDS Measures

	Catchment area (m^2)	*Plan area (m^2)*	*Storage vol. (m^3)*
Rainwater harvesting	0		0
Infiltration systems	0		0
Green roofs	0	0	0
Blue roofs	0	0	0
Filter strips	0	0	0
Filter drains	0	0	0
Bioretention / tree pits	0	0	0
Pervious pavements	1290	150	30
Swales	0	0	0
Basins/ponds	0	0	0
Attenuation tanks	1290		82
Total	2580	150	112

4. Supporting Information	4a. Discharge & Drainage Strategy	*Page/section of drainage report*
	Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	Appendix to the SuDS Assessment
	Drainage hierarchy (2b)	Section 4.2
	Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	Discharge is to be via existing manhole and existing sewer connection - there will be no new connection and a reduction in the volume and rate of water entering the TW sewer
	Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Appendix to the SuDS Assessment
	Proposed SuDS measures & specifications (3b)	Section 6
	4b. Other Supporting Details	*Page/section of drainage report*
	Detailed Development Layout	P12
	Detailed drainage design drawings, including exceedance flow routes	P23
	Detailed landscaping plans	P12
	Maintenance strategy	Section 4.6
	Demonstration of how the proposed SuDS measures improve:	SuDS Assessment report
	a) water quality of the runoff?	Section 4.4
	b) biodiversity?	
	c) amenity?	

GREENFIELD RUNOFF

Catchment Area:	2150sqm	0.215ha
PO Code :	0	
Hydrological Region:	6	*From Wallingford on-line tool*
SAAR:	650mm	*From Wallingford on-line tool*
SOIL type:	4	*From Wallingford on-line tool*
SPR:	0.47	*Derived as follows:*

SOIL	*Sand*	*Clayey Sand*	*Sandy Clay*	*Clay*	*Rock*
	1	*2*	*3*	*4*	*5*
SPR	*0.1*	*0.3*	*0.37*	*0.47*	*0.53*

From Wallingford on-line tool using IH 124 Method

Qbar: 217.37 *Calculated from SPR and SAAR*

Greenfield Peak Run-off Rate:		*Growth curve Factor*
1 in 1	*184.8 l/sec*	*0.85*
1 in 30	*500.0 l/sec*	*2.30*
1 in 100	*693.4 l/sec*	*3.19*
1 in 200	*813.0 l/sec*	*3.74*

Qbar:	**0.93 l/sec**
Greenfield Peak Run-off Rate:	
1 in 1	**0.79 l/sec**
1 in 30	**2.15 l/sec**
1 in 100	**2.98 l/sec**
1 in 200	**3.50 l/sec**

National Non-Statutory Guidance:

For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

SuDs CALCULATIONS	
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RAINFALL PEAK INTENSITY (i)

M5-60 :	20	*From Wallingford Fig A1*
r:	0.42	*From Wallingford Fig A2*

D Duration		**Z1**	**M5-D**
5min	5min	0.38	7.6mm
10min	10min	0.55	11.0mm
15min	15min	0.65	13.0mm
30min	30min	0.75	15.0mm
1hr	60min	1.00	20.0mm
2hr	120min	1.20	24.0mm
4hr	240min	1.40	28.0mm
6hr	360min	1.60	32.0mm
10hr	600min	1.70	34.0mm
24hr	1440min	2.20	44.0mm
48hr	2880min	2.50	50.0mm

Z2

D Duration		**M5-D**	**M1-D**	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	7.6mm	0.62	0.79	0.89	0.97	1.02	1.19	1.36	1.43	1.79
10min	10min	11.0mm	0.61	0.79	0.90	0.97	1.03	1.22	1.41	1.49	1.91
15min	15min	13.0mm	0.61	0.79	0.90	0.97	1.03	1.22	1.41	1.49	1.91
30min	30min	15.0mm	0.62	0.81	0.90	0.97	1.03	1.24	1.44	1.53	1.99
1hr	60min	20.0mm	0.64	0.81	0.90	0.97	1.03	1.24	1.45	1.54	2.03
2hr	120min	24.0mm	0.64	0.81	0.90	0.97	1.03	1.24	1.45	1.54	2.03
4hr	240min	28.0mm	0.66	0.82	0.91	0.97	1.03	1.24	1.44	1.53	2.01
6hr	360min	32.0mm	0.68	0.83	0.91	0.97	1.03	1.22	1.42	1.51	1.97
10hr	600min	34.0mm	0.68	0.83	0.91	0.97	1.03	1.22	1.42	1.51	1.97
24hr	1440min	44.0mm	0.70	0.84	0.92	0.97	1.02	1.19	1.38	1.47	1.89
48hr	2880min	50.0mm	0.72	0.85	0.93	0.98	1.02	1.17	1.34	1.42	1.81

MT-D

D Duration		**M5-D**	**M1-D**	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	7.6mm	4.7mm	6.0mm	6.8mm	7.4mm	7.8mm	9.0mm	10.3mm	10.8mm	13.6mm
10min	10min	11.0mm	6.7mm	8.7mm	9.9mm	10.7mm	11.3mm	13.4mm	15.5mm	16.4mm	21.0mm
15min	15min	13.0mm	7.9mm	10.3mm	11.7mm	12.6mm	13.4mm	15.9mm	18.3mm	19.4mm	24.8mm
30min	30min	15.0mm	9.3mm	12.2mm	13.5mm	14.6mm	15.5mm	18.6mm	21.6mm	22.9mm	29.9mm
1hr	60min	20.0mm	12.8mm	16.2mm	18.0mm	19.4mm	20.6mm	24.8mm	29.0mm	30.9mm	40.6mm
2hr	120min	24.0mm	15.4mm	19.4mm	21.6mm	23.3mm	24.7mm	29.8mm	34.8mm	37.0mm	48.7mm
4hr	240min	28.0mm	18.5mm	23.0mm	25.5mm	27.2mm	28.8mm	34.7mm	40.3mm	42.9mm	56.3mm
6hr	360min	32.0mm	21.8mm	26.6mm	29.1mm	31.0mm	33.0mm	39.0mm	45.4mm	48.4mm	63.0mm
10hr	600min	34.0mm	23.1mm	28.2mm	30.9mm	33.0mm	35.0mm	41.5mm	48.3mm	51.5mm	67.0mm
24hr	1440min	44.0mm	30.8mm	37.0mm	40.5mm	42.7mm	44.9mm	52.4mm	60.7mm	64.5mm	83.2mm
48hr	2880min	50.0mm	36.0mm	42.5mm	46.5mm	49.0mm	51.0mm	58.5mm	67.0mm	71.0mm	90.5mm

Intensity i

D Duration			**M1-D**	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	56.5mm/hr	72.0mm/hr	81.2mm/hr	88.5mm/hr	93.0mm/hr	108.5mm/hr	124.0mm/hr	130.1mm/hr	163.2mm/hr
10min	10min	0.17hr	40.3mm/hr	52.1mm/hr	59.4mm/hr	64.0mm/hr	68.0mm/hr	80.5mm/hr	93.1mm/hr	98.3mm/hr	126.1mm/hr
15min	15min	0.25hr	31.7mm/hr	41.1mm/hr	46.8mm/hr	50.4mm/hr	53.6mm/hr	63.4mm/hr	73.3mm/hr	77.5mm/hr	99.3mm/hr
30min	30min	0.50hr	18.6mm/hr	24.3mm/hr	27.0mm/hr	29.1mm/hr	30.9mm/hr	37.2mm/hr	43.2mm/hr	45.8mm/hr	59.7mm/hr
1hr	60min	1.00hr	12.8mm/hr	16.2mm/hr	18.0mm/hr	19.4mm/hr	20.6mm/hr	24.8mm/hr	29.0mm/hr	30.9mm/hr	40.6mm/hr
2hr	120min	2.00hr	7.7mm/hr	9.7mm/hr	10.8mm/hr	11.6mm/hr	12.4mm/hr	14.9mm/hr	17.4mm/hr	18.5mm/hr	24.4mm/hr
4hr	240min	4.00hr	4.6mm/hr	5.7mm/hr	6.4mm/hr	6.8mm/hr	7.2mm/hr	8.7mm/hr	10.1mm/hr	10.7mm/hr	14.1mm/hr
6hr	360min	6.00hr	3.6mm/hr	4.4mm/hr	4.9mm/hr	5.2mm/hr	5.5mm/hr	6.5mm/hr	7.6mm/hr	8.1mm/hr	10.5mm/hr
10hr	600min	10.00hr	2.3mm/hr	2.8mm/hr	3.1mm/hr	3.3mm/hr	3.5mm/hr	4.1mm/hr	4.8mm/hr	5.1mm/hr	6.7mm/hr
24hr	1440min	24.00hr	1.3mm/hr	1.5mm/hr	1.7mm/hr	1.8mm/hr	1.9mm/hr	2.2mm/hr	2.5mm/hr	2.7mm/hr	3.5mm/hr
48hr	2880min	48.00hr	0.6mm/hr	0.8mm/hr	0.8mm/hr	0.9mm/hr	0.9mm/hr	1.1mm/hr	1.3mm/hr	1.3mm/hr	1.7mm/hr
48hr	2880min	48.00hr	0.8mm/hr	0.9mm/hr	1.0mm/hr	1.0mm/hr	1.1mm/hr	1.2mm/hr	1.4mm/hr	1.5mm/hr	1.9mm/hr

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GREENFIELD PEAK RUNOFF

Hydrological Region: 6 *From Wallingford on-line tool* **Qbar: 0.93 l/sec**

Run-Off Q

D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	0.79 l/sec	0.82 l/sec	0.95 l/sec	1.07 l/sec	1.20 l/sec	1.51 l/sec	1.84 l/sec	2.24 l/sec	2.98 l/sec
10min	10min	0.17hr	0.79 l/sec	0.82 l/sec	0.95 l/sec	1.07 l/sec	1.20 l/sec	1.51 l/sec	1.84 l/sec	2.24 l/sec	2.98 l/sec
15min	15min	0.25hr	0.79 l/sec	0.82 l/sec	0.95 l/sec	1.07 l/sec	1.20 l/sec	1.51 l/sec	1.84 l/sec	2.24 l/sec	2.98 l/sec
30min	30min	0.50hr	0.79 l/sec	0.82 l/sec	0.95 l/sec	1.07 l/sec	1.20 l/sec	1.51 l/sec	1.84 l/sec	2.24 l/sec	2.98 l/sec
1hr	60min	1.00hr	0.79 l/sec	0.82 l/sec	0.95 l/sec	1.07 l/sec	1.20 l/sec	1.51 l/sec	1.84 l/sec	2.24 l/sec	2.98 l/sec
2hr	120min	2.00hr	0.79 l/sec	0.82 l/sec	0.95 l/sec	1.07 l/sec	1.20 l/sec	1.51 l/sec	1.84 l/sec	2.24 l/sec	2.98 l/sec
4hr	240min	4.00hr	0.79 l/sec	0.82 l/sec	0.95 l/sec	1.07 l/sec	1.20 l/sec	1.51 l/sec	1.84 l/sec	2.24 l/sec	2.98 l/sec
6hr	360min	6.00hr	0.79 l/sec	0.82 l/sec	0.95 l/sec	1.07 l/sec	1.20 l/sec	1.51 l/sec	1.84 l/sec	2.24 l/sec	2.98 l/sec
10hr	600min	10.00hr	0.79 l/sec	0.82 l/sec	0.95 l/sec	1.07 l/sec	1.20 l/sec	1.51 l/sec	1.84 l/sec	2.24 l/sec	2.98 l/sec
24hr	1440min	24.00hr	0.79 l/sec	0.82 l/sec	0.95 l/sec	1.07 l/sec	1.20 l/sec	1.51 l/sec	1.84 l/sec	2.24 l/sec	2.98 l/sec
48hr	2880min	48.00hr	0.79 l/sec	0.82 l/sec	0.95 l/sec	1.07 l/sec	1.20 l/sec	1.51 l/sec	1.84 l/sec	2.24 l/sec	2.98 l/sec

Run-Off Volume

D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	0.2 m3	0.2 m3	0.3 m3	0.3 m3	0.4 m3	0.5 m3	0.6 m3	0.7 m3	0.9 m3
10min	10min	0.17hr	0.5 m3	0.5 m3	0.6 m3	0.6 m3	0.7 m3	0.9 m3	1.1 m3	1.3 m3	1.8 m3
15min	15min	0.25hr	0.7 m3	0.7 m3	0.9 m3	1.0 m3	1.1 m3	1.4 m3	1.7 m3	2.0 m3	2.7 m3
30min	30min	0.50hr	1.4 m3	1.5 m3	1.7 m3	1.9 m3	2.2 m3	2.7 m3	3.3 m3	4.0 m3	5.4 m3
1hr	60min	1.00hr	2.9 m3	3.0 m3	3.4 m3	3.9 m3	4.3 m3	5.5 m3	6.6 m3	8.1 m3	10.7 m3
2hr	120min	2.00hr	5.7 m3	5.9 m3	6.8 m3	7.7 m3	8.6 m3	10.9 m3	13.2 m3	16.2 m3	21.5 m3
4hr	240min	4.00hr	11.4 m3	11.8 m3	13.6 m3	15.4 m3	17.2 m3	21.8 m3	26.5 m3	32.3 m3	42.9 m3
6hr	360min	6.00hr	17.2 m3	17.8 m3	20.5 m3	23.2 m3	25.8 m3	32.7 m3	39.7 m3	48.5 m3	64.4 m3
10hr	600min	10.00hr	28.6 m3	29.6 m3	34.1 m3	38.6 m3	43.1 m3	54.5 m3	66.2 m3	80.8 m3	107.3 m3
24hr	1440min	24.00hr	68.6 m3	71.1 m3	81.8 m3	92.6 m3	103.4 m3	130.8 m3	158.8 m3	193.8 m3	257.6 m3
48hr	2880min	48.00hr	137.3 m3	142.1 m3	163.7 m3	185.2 m3	206.7 m3	261.7 m3	317.6 m3	387.6 m3	515.2 m3

SuDs CALCULATIONS	
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GREENFIELD PEAK RUNOFF	
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EXISTING PEAK RUNOFF

C_V:	0.66	*Volumetric Run-Off Coefficient*
C_R:	1.3	*Routing Coefficient*

Run-Off Q

D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	29.1 l/sec	37.1 l/sec	41.8 l/sec	45.6 l/sec	47.9 l/sec	55.9 l/sec	63.9 l/sec	67.0 l/sec	84.1 l/sec
10min	10min	0.17hr	20.7 l/sec	26.9 l/sec	30.6 l/sec	33.0 l/sec	35.0 l/sec	41.5 l/sec	47.9 l/sec	50.6 l/sec	64.9 l/sec
15min	15min	0.25hr	16.3 l/sec	21.2 l/sec	24.1 l/sec	26.0 l/sec	27.6 l/sec	32.7 l/sec	37.8 l/sec	39.9 l/sec	51.1 l/sec
30min	30min	0.50hr	9.6 l/sec	12.5 l/sec	13.9 l/sec	15.0 l/sec	15.9 l/sec	19.2 l/sec	22.2 l/sec	23.6 l/sec	30.7 l/sec
1hr	60min	1.00hr	6.6 l/sec	8.3 l/sec	9.3 l/sec	10.0 l/sec	10.6 l/sec	12.8 l/sec	14.9 l/sec	15.9 l/sec	20.9 l/sec
2hr	120min	2.00hr	4.0 l/sec	5.0 l/sec	5.6 l/sec	6.0 l/sec	6.4 l/sec	7.7 l/sec	9.0 l/sec	9.5 l/sec	12.5 l/sec
4hr	240min	4.00hr	2.4 l/sec	3.0 l/sec	3.3 l/sec	3.5 l/sec	3.7 l/sec	4.5 l/sec	5.2 l/sec	5.5 l/sec	7.2 l/sec
6hr	360min	6.00hr	1.9 l/sec	2.3 l/sec	2.5 l/sec	2.7 l/sec	2.8 l/sec	3.4 l/sec	3.9 l/sec	4.2 l/sec	5.4 l/sec
10hr	600min	10.00hr	1.2 l/sec	1.5 l/sec	1.6 l/sec	1.7 l/sec	1.8 l/sec	2.1 l/sec	2.5 l/sec	2.6 l/sec	3.4 l/sec
24hr	1440min	24.00hr	0.7 l/sec	0.8 l/sec	0.9 l/sec	0.9 l/sec	1.0 l/sec	1.1 l/sec	1.3 l/sec	1.4 l/sec	1.8 l/sec
48hr	2880min	48.00hr	0.4 l/sec	0.5 l/sec	0.5 l/sec	0.5 l/sec	0.5 l/sec	0.6 l/sec	0.7 l/sec	0.8 l/sec	1.0 l/sec

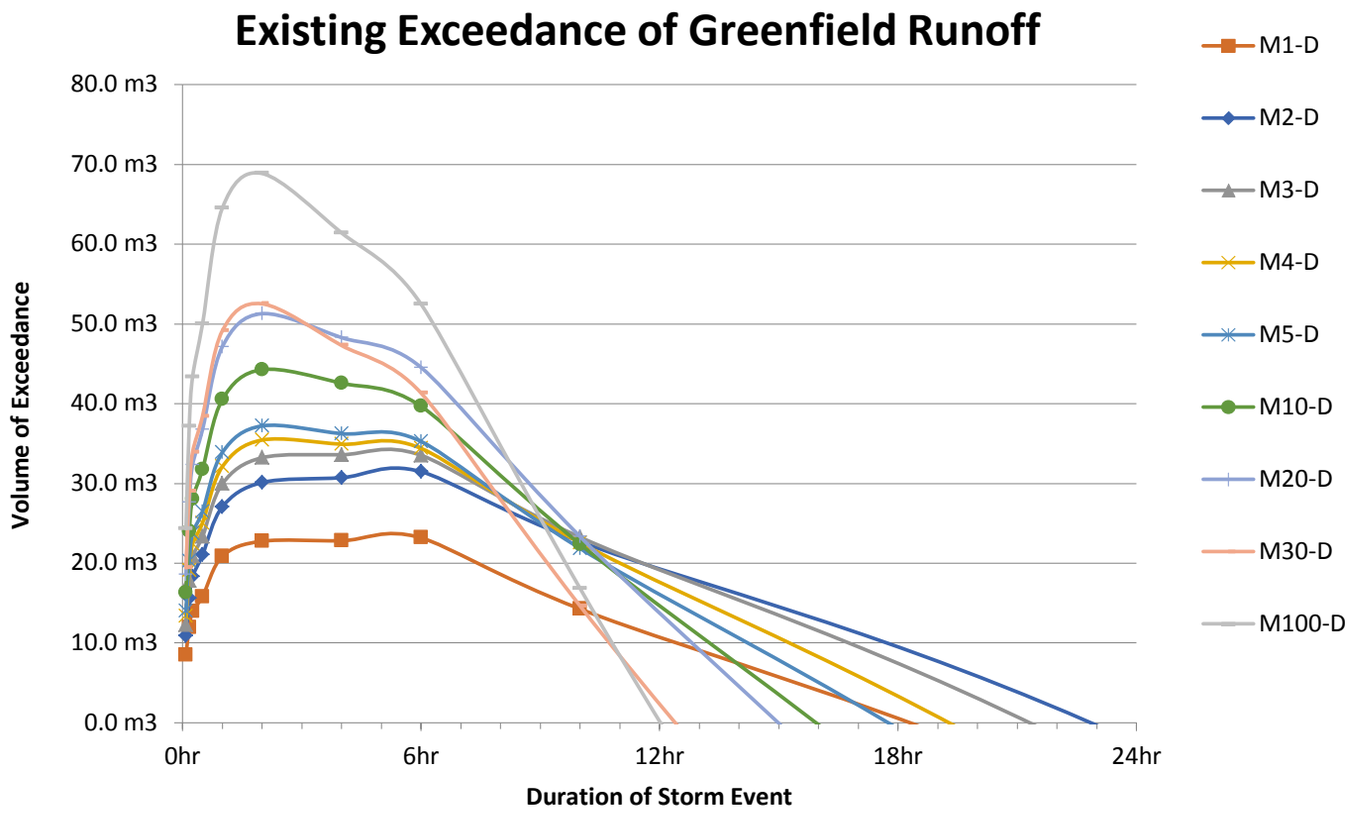
Run-Off Volume

D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	8.7 m3	11.1 m3	12.5 m3	13.7 m3	14.4 m3	16.8 m3	19.2 m3	20.1 m3	25.2 m3
10min	10min	0.17hr	12.4 m3	16.1 m3	18.4 m3	19.8 m3	21.0 m3	24.9 m3	28.8 m3	30.4 m3	39.0 m3
15min	15min	0.25hr	14.7 m3	19.0 m3	21.7 m3	23.4 m3	24.8 m3	29.4 m3	34.0 m3	35.9 m3	46.0 m3
30min	30min	0.50hr	17.2 m3	22.5 m3	25.0 m3	27.0 m3	28.6 m3	34.5 m3	40.0 m3	42.5 m3	55.3 m3
1hr	60min	1.00hr	23.7 m3	30.0 m3	33.4 m3	36.0 m3	38.2 m3	46.0 m3	53.8 m3	57.2 m3	75.3 m3
2hr	120min	2.00hr	28.5 m3	36.0 m3	40.0 m3	43.2 m3	45.8 m3	55.2 m3	64.5 m3	68.7 m3	90.3 m3
4hr	240min	4.00hr	34.3 m3	42.6 m3	47.2 m3	50.4 m3	53.5 m3	64.4 m3	74.8 m3	79.6 m3	104.3 m3
6hr	360min	6.00hr	40.3 m3	49.2 m3	54.0 m3	57.5 m3	61.1 m3	72.4 m3	84.2 m3	89.8 m3	116.9 m3
10hr	600min	10.00hr	42.9 m3	52.3 m3	57.4 m3	61.1 m3	64.9 m3	76.9 m3	89.5 m3	95.4 m3	124.2 m3
24hr	1440min	24.00hr	57.1 m3	68.5 m3	75.0 m3	79.1 m3	83.2 m3	97.1 m3	112.6 m3	119.6 m3	154.2 m3
48hr	2880min	48.00hr	66.7 m3	78.8 m3	86.2 m3	90.8 m3	94.6 m3	108.5 m3	124.2 m3	131.6 m3	167.8 m3

Exceedance of Greenfield Run-Off Volume

D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	8.5 m3	10.9 m3	12.3 m3	13.3 m3	14.0 m3	16.3 m3	18.6 m3	19.4 m3	24.3 m3
10min	10min	0.17hr	12.0 m3	15.6 m3	17.8 m3	19.1 m3	20.3 m3	24.0 m3	27.7 m3	29.0 m3	37.2 m3
15min	15min	0.25hr	14.0 m3	18.3 m3	20.8 m3	22.4 m3	23.7 m3	28.0 m3	32.3 m3	33.9 m3	43.4 m3
30min	30min	0.50hr	15.8 m3	21.0 m3	23.3 m3	25.0 m3	26.5 m3	31.8 m3	36.7 m3	38.4 m3	50.0 m3
1hr	60min	1.00hr	20.9 m3	27.1 m3	30.0 m3	32.1 m3	33.9 m3	40.5 m3	47.1 m3	49.2 m3	64.5 m3
2hr	120min	2.00hr	22.8 m3	30.1 m3	33.2 m3	35.4 m3	37.2 m3	44.3 m3	51.3 m3	52.5 m3	68.9 m3
4hr	240min	4.00hr	22.8 m3	30.7 m3	33.6 m3	34.9 m3	36.2 m3	42.6 m3	48.3 m3	47.3 m3	61.4 m3
6hr	360min	6.00hr	23.2 m3	31.5 m3	33.5 m3	34.4 m3	35.3 m3	39.7 m3	44.5 m3	41.3 m3	52.5 m3
10hr	600min	10.00hr	14.3 m3	22.7 m3	23.3 m3	22.6 m3	21.9 m3	22.4 m3	23.3 m3	14.6 m3	16.8 m3
24hr	1440min	24.00hr	-11.5 m3	-2.5 m3	-6.8 m3	-13.5 m3	-20.2 m3	-33.8 m3	-46.2 m3	-74.2 m3	-103.4 m3
48hr	2880min	48.00hr	-70.5 m3	-63.3 m3	-77.5 m3	-94.4 m3	-112.2 m3	-153.2 m3	-193.4 m3	-256.0 m3	-347.4 m3

			C_V:
Catchment Area:	2150sqm	100%	
Permeable:	1020sqm	47%	0.40
Impermeable:	1130sqm	53%	0.90
			0.66



SuDs CALCULATIONS	
Project: 39 FITZJOHN'S AVENUE	
EXISTING PEAK RUNOFF	
Sheet 4 of 7	
Project Reference: LBH4498	
Date: 21/09/2021	Rev: 1
Client: Godfrey London	

LBHGEO

POST- DEVELOPMENT PEAK RUNOFF

C_V: 0.70 *Volumetric Run-Off Coefficient* Climate Change Allowance: 0%

C_R: 1.3 *Routing Coefficient*

Run-Off Q

D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	30.8 l/sec	39.2 l/sec	44.1 l/sec	48.1 l/sec	50.6 l/sec	59.0 l/sec	67.5 l/sec	70.8 l/sec	88.8 l/sec
10min	10min	0.17hr	21.9 l/sec	28.4 l/sec	32.3 l/sec	34.8 l/sec	37.0 l/sec	43.8 l/sec	50.6 l/sec	53.5 l/sec	68.6 l/sec
15min	15min	0.25hr	17.3 l/sec	22.3 l/sec	25.5 l/sec	27.4 l/sec	29.1 l/sec	34.5 l/sec	39.9 l/sec	42.1 l/sec	54.0 l/sec
30min	30min	0.50hr	10.1 l/sec	13.2 l/sec	14.7 l/sec	15.8 l/sec	16.8 l/sec	20.2 l/sec	23.5 l/sec	24.9 l/sec	32.5 l/sec
1hr	60min	1.00hr	7.0 l/sec	8.8 l/sec	9.8 l/sec	10.6 l/sec	11.2 l/sec	13.5 l/sec	15.8 l/sec	16.8 l/sec	22.1 l/sec
2hr	120min	2.00hr	4.2 l/sec	5.3 l/sec	5.9 l/sec	6.3 l/sec	6.7 l/sec	8.1 l/sec	9.5 l/sec	10.1 l/sec	13.2 l/sec
4hr	240min	4.00hr	2.5 l/sec	3.1 l/sec	3.5 l/sec	3.7 l/sec	3.9 l/sec	4.7 l/sec	5.5 l/sec	5.8 l/sec	7.7 l/sec
6hr	360min	6.00hr	2.0 l/sec	2.4 l/sec	2.6 l/sec	2.8 l/sec	3.0 l/sec	3.5 l/sec	4.1 l/sec	4.4 l/sec	5.7 l/sec
10hr	600min	10.00hr	1.3 l/sec	1.5 l/sec	1.7 l/sec	1.8 l/sec	1.9 l/sec	2.3 l/sec	2.6 l/sec	2.8 l/sec	3.6 l/sec
24hr	1440min	24.00hr	0.7 l/sec	0.8 l/sec	0.9 l/sec	1.0 l/sec	1.0 l/sec	1.2 l/sec	1.4 l/sec	1.5 l/sec	1.9 l/sec
48hr	2880min	48.00hr	0.4 l/sec	0.5 l/sec	0.5 l/sec	0.6 l/sec	0.6 l/sec	0.7 l/sec	0.8 l/sec	0.8 l/sec	1.0 l/sec

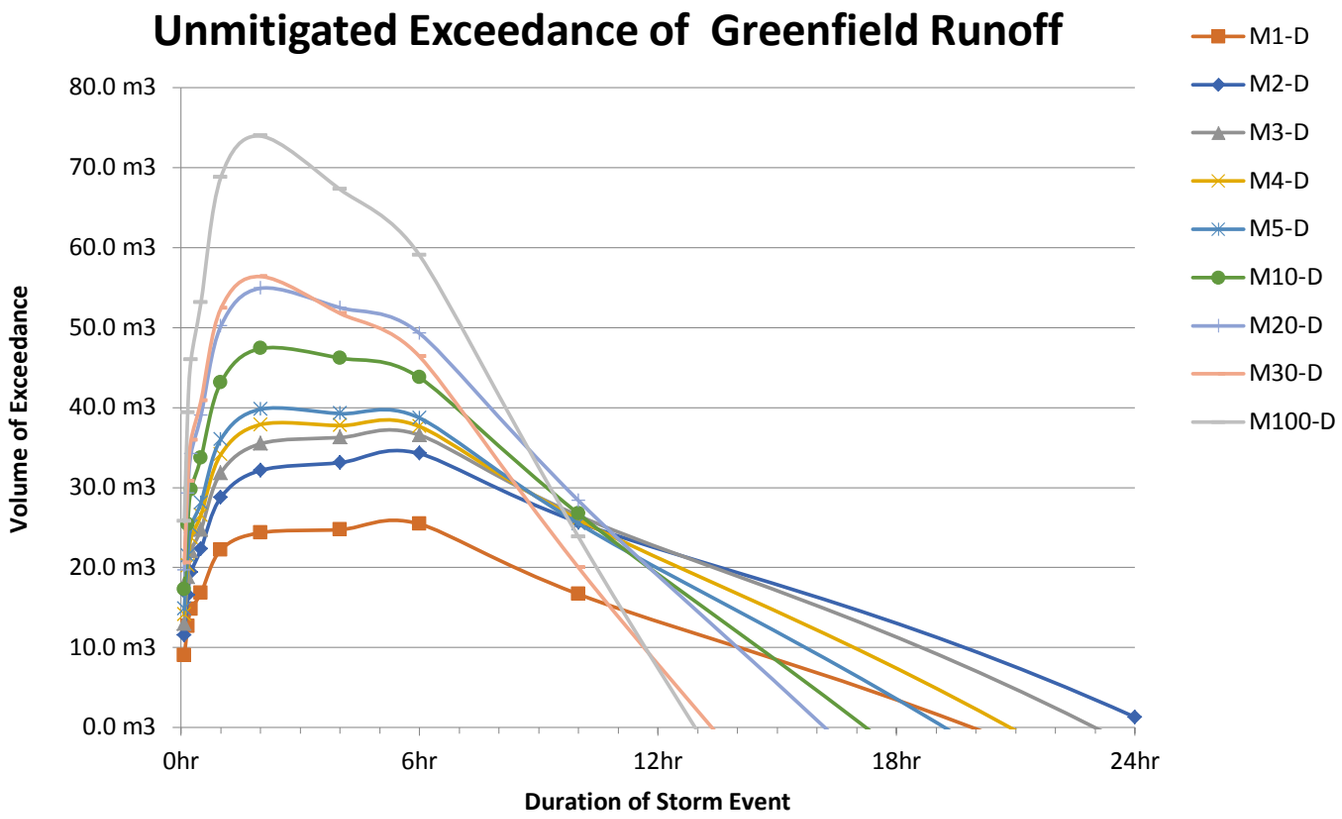
Run-Off Volume

D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	9.2 m3	11.8 m3	13.2 m3	14.4 m3	15.2 m3	17.7 m3	20.2 m3	21.2 m3	26.6 m3
10min	10min	0.17hr	13.1 m3	17.0 m3	19.4 m3	20.9 m3	22.2 m3	26.3 m3	30.4 m3	32.1 m3	41.1 m3
15min	15min	0.25hr	15.5 m3	20.1 m3	22.9 m3	24.7 m3	26.2 m3	31.1 m3	35.9 m3	37.9 m3	48.6 m3
30min	30min	0.50hr	18.2 m3	23.8 m3	26.4 m3	28.5 m3	30.3 m3	36.4 m3	42.3 m3	44.8 m3	58.4 m3
1hr	60min	1.00hr	25.1 m3	31.7 m3	35.2 m3	38.0 m3	40.3 m3	48.6 m3	56.8 m3	60.4 m3	79.5 m3
2hr	120min	2.00hr	30.1 m3	38.1 m3	42.3 m3	45.6 m3	48.4 m3	58.3 m3	68.1 m3	72.5 m3	95.4 m3
4hr	240min	4.00hr	36.2 m3	45.0 m3	49.9 m3	53.2 m3	56.5 m3	68.0 m3	78.9 m3	84.1 m3	110.2 m3
6hr	360min	6.00hr	42.6 m3	52.0 m3	57.0 m3	60.8 m3	64.5 m3	76.4 m3	89.0 m3	94.8 m3	123.4 m3
10hr	600min	10.00hr	45.3 m3	55.3 m3	60.6 m3	64.6 m3	68.6 m3	81.2 m3	94.5 m3	100.7 m3	131.2 m3
24hr	1440min	24.00hr	60.3 m3	72.4 m3	79.3 m3	83.6 m3	87.9 m3	102.5 m3	118.9 m3	126.4 m3	162.8 m3
48hr	2880min	48.00hr	70.5 m3	83.2 m3	91.1 m3	95.9 m3	99.9 m3	114.5 m3	131.2 m3	139.0 m3	177.2 m3

Exceedance of Greenfield Run-Off Volume

D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	9.0 m3	11.5 m3	13.0 m3	14.1 m3	14.8 m3	17.3 m3	19.7 m3	20.6 m3	25.7 m3
10min	10min	0.17hr	12.7 m3	16.5 m3	18.8 m3	20.2 m3	21.5 m3	25.4 m3	29.3 m3	30.7 m3	39.3 m3
15min	15min	0.25hr	14.8 m3	19.4 m3	22.1 m3	23.7 m3	25.1 m3	29.7 m3	34.2 m3	35.9 m3	45.9 m3
30min	30min	0.50hr	16.8 m3	22.3 m3	24.7 m3	26.6 m3	28.1 m3	33.7 m3	39.0 m3	40.8 m3	53.1 m3
1hr	60min	1.00hr	22.2 m3	28.8 m3	31.8 m3	34.1 m3	36.0 m3	43.1 m3	50.2 m3	52.4 m3	68.8 m3
2hr	120min	2.00hr	24.4 m3	32.1 m3	35.5 m3	37.9 m3	39.8 m3	47.4 m3	54.9 m3	56.4 m3	73.9 m3
4hr	240min	4.00hr	24.7 m3	33.1 m3	36.3 m3	37.7 m3	39.2 m3	46.2 m3	52.5 m3	51.8 m3	67.3 m3
6hr	360min	6.00hr	25.4 m3	34.2 m3	36.6 m3	37.6 m3	38.7 m3	43.7 m3	49.3 m3	46.4 m3	59.0 m3
10hr	600min	10.00hr	16.7 m3	25.6 m3	26.5 m3	26.0 m3	25.5 m3	26.7 m3	28.4 m3	20.0 m3	23.8 m3
24hr	1440min	24.00hr	-8.3 m3	1.3 m3	-2.6 m3	-9.0 m3	-15.5 m3	-28.3 m3	-39.9 m3	-67.5 m3	-94.8 m3
48hr	2880min	48.00hr	-66.8 m3	-58.9 m3	-72.6 m3	-89.3 m3	-106.9 m3	-147.1 m3	-186.5 m3	-248.6 m3	-338.0 m3
			25.4 m3							**56.4 m3**	**73.9 m3**

			C_V:
Catchment Area:	2150sqm	100%	
Permeable Garden	860sqm	40%	0.40
Impermeable:	1290sqm	60%	0.90
			0.70



SuDs CALCULATIONS	
Project: 39 FITZJOHN'S AVENUE	
POST-DEV. PEAK RUNOFF	
Sheet 5 of 7	
Project Reference: LBH4498	
Date: 21/09/2021	Rev: 1
Client: Godfrey London	

LBHGEO

POST- DEVELOPMENT PEAK RUNOFF + CC

C_V: 0.70 *Volumetric Run-Off Coefficient* Climate Change Allowance: 40%

C_R: 1.3 *Routing Coefficient*

Run-Off Q

D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	43.1 l/sec	54.9 l/sec	61.8 l/sec	67.4 l/sec	70.8 l/sec	82.6 l/sec	94.4 l/sec	99.1 l/sec	124.3 l/sec
10min	10min	0.17hr	30.7 l/sec	39.7 l/sec	45.2 l/sec	48.7 l/sec	51.8 l/sec	61.3 l/sec	70.9 l/sec	74.9 l/sec	96.0 l/sec
15min	15min	0.25hr	24.2 l/sec	31.3 l/sec	35.6 l/sec	38.4 l/sec	40.8 l/sec	48.3 l/sec	55.8 l/sec	59.0 l/sec	75.6 l/sec
30min	30min	0.50hr	14.2 l/sec	18.5 l/sec	20.6 l/sec	22.2 l/sec	23.5 l/sec	28.3 l/sec	32.9 l/sec	34.9 l/sec	45.5 l/sec
1hr	60min	1.00hr	9.7 l/sec	12.3 l/sec	13.7 l/sec	14.8 l/sec	15.7 l/sec	18.9 l/sec	22.1 l/sec	23.5 l/sec	30.9 l/sec
2hr	120min	2.00hr	5.8 l/sec	7.4 l/sec	8.2 l/sec	8.9 l/sec	9.4 l/sec	11.3 l/sec	13.2 l/sec	14.1 l/sec	18.5 l/sec
4hr	240min	4.00hr	3.5 l/sec	4.4 l/sec	4.9 l/sec	5.2 l/sec	5.5 l/sec	6.6 l/sec	7.7 l/sec	8.2 l/sec	10.7 l/sec
6hr	360min	6.00hr	2.8 l/sec	3.4 l/sec	3.7 l/sec	3.9 l/sec	4.2 l/sec	5.0 l/sec	5.8 l/sec	6.1 l/sec	8.0 l/sec
10hr	600min	10.00hr	1.8 l/sec	2.1 l/sec	2.4 l/sec	2.5 l/sec	2.7 l/sec	3.2 l/sec	3.7 l/sec	3.9 l/sec	5.1 l/sec
24hr	1440min	24.00hr	1.0 l/sec	1.2 l/sec	1.3 l/sec	1.4 l/sec	1.4 l/sec	1.7 l/sec	1.9 l/sec	2.0 l/sec	2.6 l/sec
48hr	2880min	48.00hr	0.6 l/sec	0.7 l/sec	0.7 l/sec	0.8 l/sec	0.8 l/sec	0.9 l/sec	1.1 l/sec	1.1 l/sec	1.4 l/sec

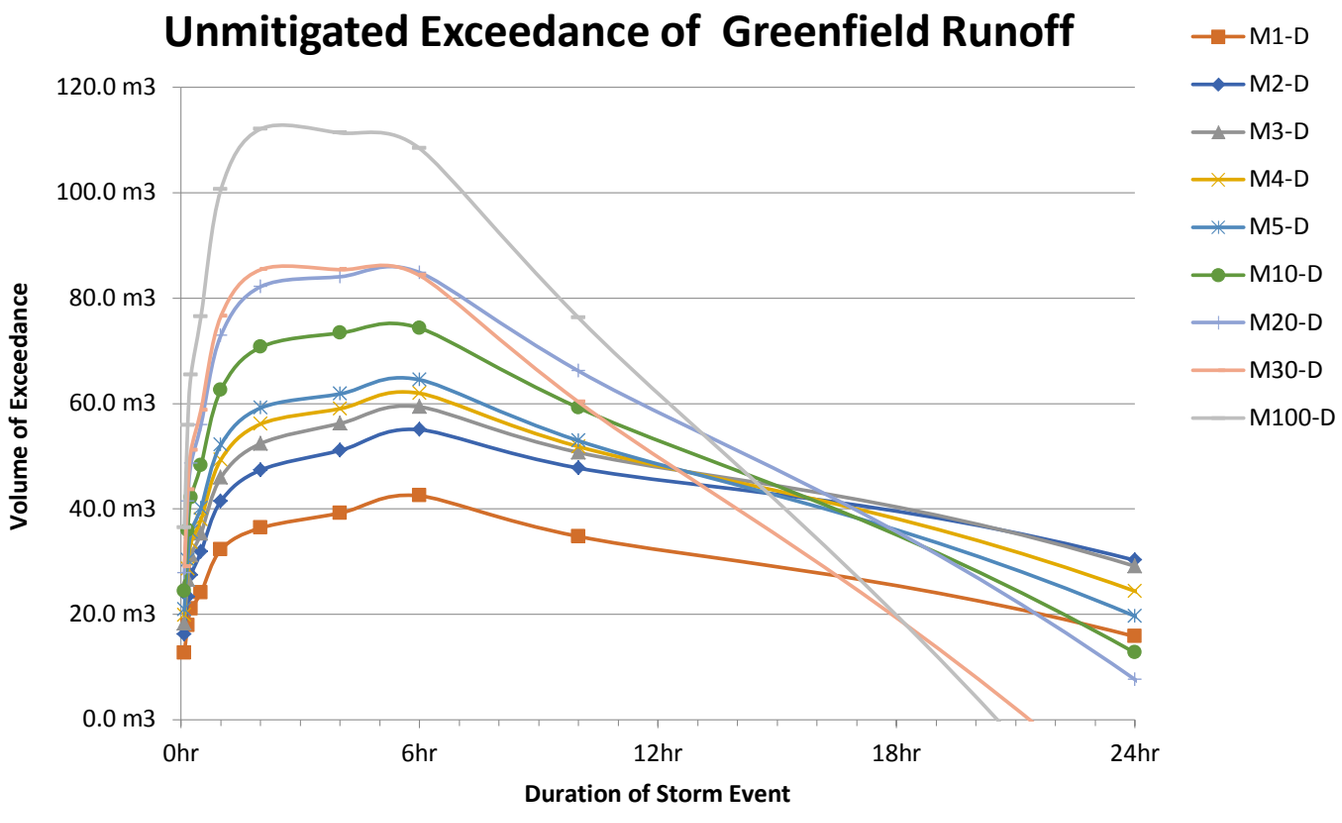
Run-Off Volume

D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	12.9 m3	16.5 m3	18.5 m3	20.2 m3	21.3 m3	24.8 m3	28.3 m3	29.7 m3	37.3 m3
10min	10min	0.17hr	18.4 m3	23.8 m3	27.1 m3	29.2 m3	31.1 m3	36.8 m3	42.5 m3	44.9 m3	57.6 m3
15min	15min	0.25hr	21.7 m3	28.2 m3	32.1 m3	34.6 m3	36.7 m3	43.5 m3	50.2 m3	53.1 m3	68.1 m3
30min	30min	0.50hr	25.5 m3	33.3 m3	37.0 m3	39.9 m3	42.4 m3	51.0 m3	59.2 m3	62.8 m3	81.8 m3
1hr	60min	1.00hr	35.1 m3	44.4 m3	49.3 m3	53.2 m3	56.5 m3	68.0 m3	79.5 m3	84.6 m3	111.3 m3
2hr	120min	2.00hr	42.1 m3	53.3 m3	59.2 m3	63.8 m3	67.8 m3	81.6 m3	95.4 m3	101.5 m3	133.6 m3
4hr	240min	4.00hr	50.7 m3	62.9 m3	69.8 m3	74.5 m3	79.1 m3	95.2 m3	110.5 m3	117.7 m3	154.3 m3
6hr	360min	6.00hr	59.7 m3	72.8 m3	79.8 m3	85.1 m3	90.4 m3	107.0 m3	124.6 m3	132.8 m3	172.8 m3
10hr	600min	10.00hr	63.4 m3	77.4 m3	84.8 m3	90.4 m3	96.0 m3	113.7 m3	132.3 m3	141.0 m3	183.6 m3
24hr	1440min	24.00hr	84.4 m3	101.3 m3	111.0 m3	117.0 m3	123.0 m3	143.5 m3	166.5 m3	176.9 m3	228.0 m3
48hr	2880min	48.00hr	98.7 m3	116.5 m3	127.5 m3	134.3 m3	139.8 m3	160.4 m3	183.7 m3	194.6 m3	248.1 m3

Exceedance of Greenfield Run-Off Volume

D Duration			M1-D	M2-D	M3-D	M4-D	M5-D	M10-D	M20-D	M30-D	M100-D
5min	5min	0.08hr	12.7 m3	16.2 m3	18.3 m3	19.9 m3	20.9 m3	24.3 m3	27.8 m3	29.0 m3	36.4 m3
10min	10min	0.17hr	17.9 m3	23.3 m3	26.6 m3	28.6 m3	30.3 m3	35.9 m3	41.4 m3	43.6 m3	55.8 m3
15min	15min	0.25hr	21.0 m3	27.4 m3	31.2 m3	33.6 m3	35.6 m3	42.1 m3	48.6 m3	51.1 m3	65.4 m3
30min	30min	0.50hr	24.1 m3	31.8 m3	35.3 m3	38.0 m3	40.2 m3	48.3 m3	55.9 m3	58.7 m3	76.5 m3
1hr	60min	1.00hr	32.2 m3	41.4 m3	45.9 m3	49.3 m3	52.2 m3	62.5 m3	72.9 m3	76.5 m3	100.6 m3
2hr	120min	2.00hr	36.4 m3	47.4 m3	52.4 m3	56.1 m3	59.2 m3	70.7 m3	82.2 m3	85.4 m3	112.1 m3
4hr	240min	4.00hr	39.2 m3	51.1 m3	56.2 m3	59.0 m3	61.8 m3	73.4 m3	84.1 m3	85.4 m3	111.3 m3
6hr	360min	6.00hr	42.5 m3	55.0 m3	59.4 m3	61.9 m3	64.5 m3	74.3 m3	84.9 m3	84.3 m3	108.4 m3
10hr	600min	10.00hr	34.8 m3	47.7 m3	50.7 m3	51.8 m3	52.9 m3	59.2 m3	66.2 m3	60.3 m3	76.3 m3
24hr	1440min	24.00hr	15.8 m3	30.3 m3	29.1 m3	24.4 m3	19.7 m3	12.7 m3	7.6 m3	-16.9 m3	-29.7 m3
48hr	2880min	48.00hr	-38.6 m3	-25.6 m3	-36.2 m3	-50.9 m3	-66.9 m3	-101.3 m3	-134.0 m3	-193.0 m3	-267.1 m3
											112.1 m3

			C_V:
Catchment Area:	2150sqm	100%	
Permeable Garden	860sqm	40%	0.40
Impermeable:	1290sqm	60%	0.90
			0.70



SuDs CALCULATIONS	
Project: 39 FITZJOHN'S AVENUE	
POST-DEV. PEAK RUNOFF+CC	
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Project Reference: LBH4498	
Date: 21/09/2021	Rev: 1
Client: Godfrey London	

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POST- DEVELOPMENT & SOURCE MITIGATION PEAK RUN-OFF + CC STORAGE

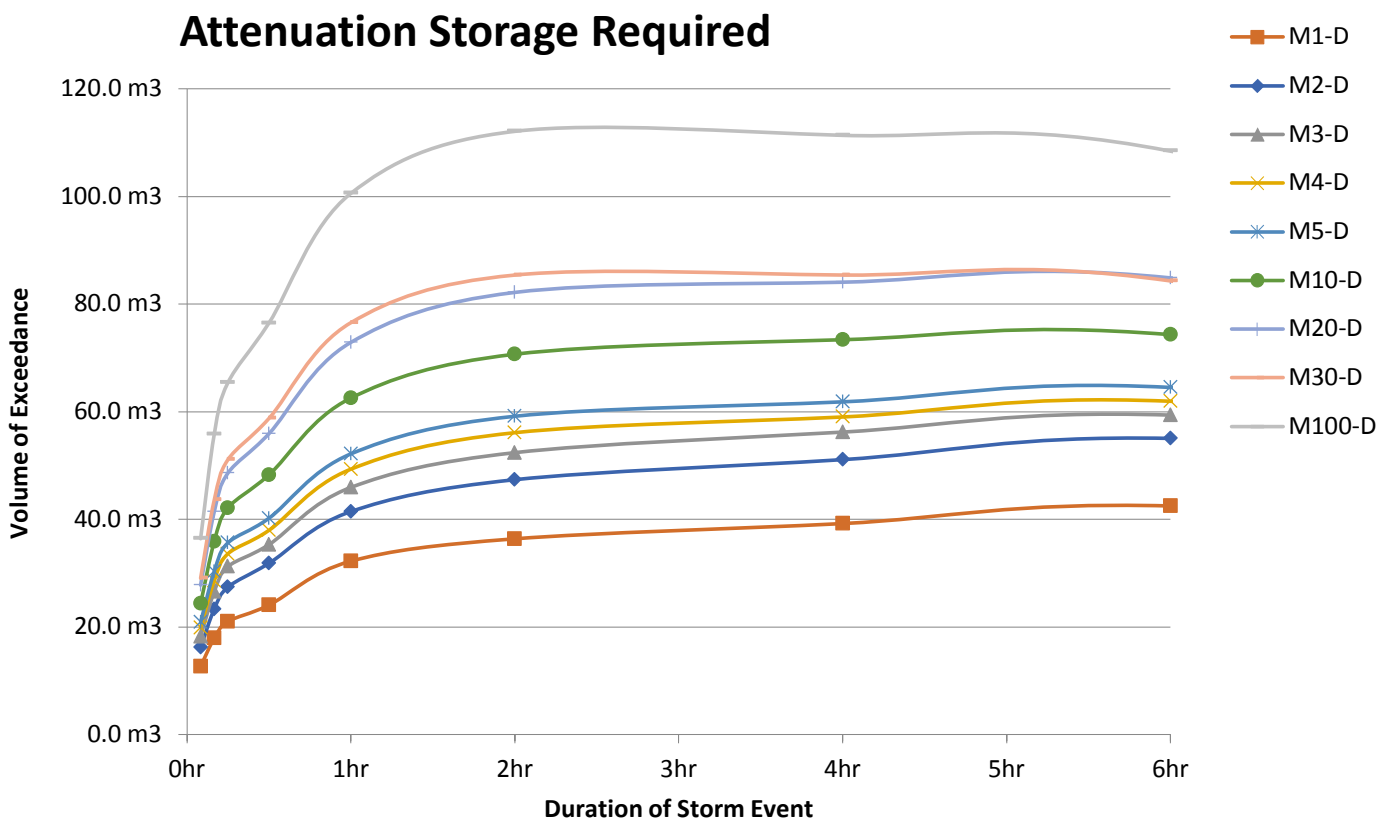
Proposed Discharge Rates: Greenfield x 1

			INFLOW								
	D Duration		**M1-D**	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	12.9 m3	16.5 m3	18.5 m3	20.2 m3	21.3 m3	24.8 m3	28.3 m3	29.7 m3	37.3 m3
10min	10min	0.17hr	18.4 m3	23.8 m3	27.1 m3	29.2 m3	31.1 m3	36.8 m3	42.5 m3	44.9 m3	57.6 m3
15min	15min	0.25hr	21.7 m3	28.2 m3	32.1 m3	34.6 m3	36.7 m3	43.5 m3	50.2 m3	53.1 m3	68.1 m3
30min	30min	0.50hr	25.5 m3	33.3 m3	37.0 m3	39.9 m3	42.4 m3	51.0 m3	59.2 m3	62.8 m3	81.8 m3
1hr	60min	1.00hr	35.1 m3	44.4 m3	49.3 m3	53.2 m3	56.5 m3	68.0 m3	79.5 m3	84.6 m3	111.3 m3
2hr	120min	2.00hr	42.1 m3	53.3 m3	59.2 m3	63.8 m3	67.8 m3	81.6 m3	95.4 m3	101.5 m3	133.6 m3
4hr	240min	4.00hr	50.7 m3	62.9 m3	69.8 m3	74.5 m3	79.1 m3	95.2 m3	110.5 m3	117.7 m3	154.3 m3
6hr	360min	6.00hr	59.7 m3	72.8 m3	79.8 m3	85.1 m3	90.4 m3	107.0 m3	124.6 m3	132.8 m3	172.8 m3
10hr	600min	10.00hr	63.4 m3	77.4 m3	84.8 m3	90.4 m3	96.0 m3	113.7 m3	132.3 m3	141.0 m3	183.6 m3
24hr	1440min	24.00hr	84.4 m3	101.3 m3	111.0 m3	117.0 m3	123.0 m3	143.5 m3	166.5 m3	176.9 m3	228.0 m3
48hr	2880min	48.00hr	98.7 m3	116.5 m3	127.5 m3	134.3 m3	139.8 m3	160.4 m3	183.7 m3	194.6 m3	248.1 m3

			OUTFLOW								
	D Duration		**M1-D**	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	0.2 m3	0.2 m3	0.3 m3	0.3 m3	0.4 m3	0.5 m3	0.6 m3	0.7 m3	0.9 m3
10min	10min	0.17hr	0.5 m3	0.5 m3	0.6 m3	0.6 m3	0.7 m3	0.9 m3	1.1 m3	1.3 m3	1.8 m3
15min	15min	0.25hr	0.7 m3	0.7 m3	0.9 m3	1.0 m3	1.1 m3	1.4 m3	1.7 m3	2.0 m3	2.7 m3
30min	30min	0.50hr	1.4 m3	1.5 m3	1.7 m3	1.9 m3	2.2 m3	2.7 m3	3.3 m3	4.0 m3	5.4 m3
1hr	60min	1.00hr	2.9 m3	3.0 m3	3.4 m3	3.9 m3	4.3 m3	5.5 m3	6.6 m3	8.1 m3	10.7 m3
2hr	120min	2.00hr	5.7 m3	5.9 m3	6.8 m3	7.7 m3	8.6 m3	10.9 m3	13.2 m3	16.2 m3	21.5 m3
4hr	240min	4.00hr	11.4 m3	11.8 m3	13.6 m3	15.4 m3	17.2 m3	21.8 m3	26.5 m3	32.3 m3	42.9 m3
6hr	360min	6.00hr	17.2 m3	17.8 m3	20.5 m3	23.2 m3	25.8 m3	32.7 m3	39.7 m3	48.5 m3	64.4 m3
10hr	600min	10.00hr	28.6 m3	29.6 m3	34.1 m3	38.6 m3	43.1 m3	54.5 m3	66.2 m3	80.8 m3	107.3 m3
24hr	1440min	24.00hr	68.6 m3	71.1 m3	81.8 m3	92.6 m3	103.4 m3	130.8 m3	158.8 m3	193.8 m3	257.6 m3
48hr	2880min	48.00hr	137.3 m3	142.1 m3	163.7 m3	185.2 m3	206.7 m3	261.7 m3	317.6 m3	387.6 m3	515.2 m3

			ATTENUATION STORAGE REQUIRED TO MEET PROPOSED DISCHARGE RATE								
	D Duration		**M1-D**	**M2-D**	**M3-D**	**M4-D**	**M5-D**	**M10-D**	**M20-D**	**M30-D**	**M100-D**
5min	5min	0.08hr	12.7 m3	16.2 m3	18.3 m3	19.9 m3	20.9 m3	24.3 m3	27.8 m3	29.0 m3	36.4 m3
10min	10min	0.17hr	17.9 m3	23.3 m3	26.6 m3	28.6 m3	30.3 m3	35.9 m3	41.4 m3	43.6 m3	55.8 m3
15min	15min	0.25hr	21.0 m3	27.4 m3	31.2 m3	33.6 m3	35.6 m3	42.1 m3	48.6 m3	51.1 m3	65.4 m3
30min	30min	0.50hr	24.1 m3	31.8 m3	35.3 m3	38.0 m3	40.2 m3	48.3 m3	55.9 m3	58.7 m3	76.5 m3
1hr	60min	1.00hr	32.2 m3	41.4 m3	45.9 m3	49.3 m3	52.2 m3	62.5 m3	72.9 m3	76.5 m3	100.6 m3
2hr	120min	2.00hr	36.4 m3	47.4 m3	52.4 m3	56.1 m3	59.2 m3	70.7 m3	82.2 m3	85.4 m3	112.1 m3
4hr	240min	4.00hr	39.2 m3	51.1 m3	56.2 m3	59.0 m3	61.8 m3	73.4 m3	84.1 m3	85.4 m3	111.3 m3
6hr	360min	6.00hr	42.5 m3	55.0 m3	59.4 m3	61.9 m3	64.5 m3	74.3 m3	84.9 m3	84.3 m3	108.4 m3
10hr	600min	10.00hr	34.8 m3	47.7 m3	50.7 m3	51.8 m3	52.9 m3	59.2 m3	66.2 m3	60.3 m3	76.3 m3
24hr	1440min	24.00hr	15.8 m3	30.3 m3	29.1 m3	24.4 m3	19.7 m3	12.7 m3	7.6 m3	-16.9 m3	-29.7 m3
48hr	2880min	48.00hr	-38.6 m3	-25.6 m3	-36.2 m3	-50.9 m3	-66.9 m3	-101.3 m3	-134.0 m3	-193.0 m3	-267.1 m3

ATTENUATION STORAGE REQUIRED:			42.5 m3	55.0 m3	59.4 m3	61.9 m3	64.5 m3	74.3 m3	84.9 m3	85.4 m3	**112.1 m3**



SuDs CALCULATIONS	
Project: 39 FITZJOHN'S AVENUE	
STORAGE REQUIREMENTS	
Sheet 7 of 7	
Project Reference: LBH4498	
Date: 21/09/2021	Rev: 1
Client: Godfrey London	

LBHGEO

SUDS COMMENTS TRACKER

REF.	LLFA COMMENT 26.07.2021	LBHGEO RESPONSE 03.08.2021	LLFA COMMENT 09.09.2021	LBHGEO RESPONSE 20.09.2021
1	Confirm if the water butts, rain gardens and green roof are proposed. If proposed, provide details of the green area and minimum 150mm substrate for storage.	There is no green roof proposed. Rain gardens and water butts have been suggested, but will be confirmed as part of the detailed design. It is noted that these features will not significantly impact the drainage strategy in terms of attenuation storage.	If they are found to be feasible then they should be implemented (purpose of hierarchy). Need to explicitly confirm that they are proposed at this stage. Need to demonstrate that green roof/ rain garden are either unfeasible or if not then provide information on proposals (areas need to be detailed and minimum storage capacity). Need to provide water butts – required under CC2/CC3 (water efficiency purposes). Minimise attenuation tanks (not in hierarchy of London Plan – not recommended, should only be catching final attenuation volume after green roof and bio-retention features) – should use green roofs and rain garden in first instance.	Section 6 of the report now confirms that water butts will be provided in the rear basement patios.
2	Clarify the correct proposed runoff rate.	The proposed runoff rate is now clarified in the report and the Pro-forma as equivalent to the calculated greenfield runoff rate.	Resolved.	

SUDS COMMENTS TRACKER

REF.	LLFA COMMENT 26.07.2021	LBHGEO RESPONSE 03.08.2021	LLFA COMMENT 09.09.2021	LBHGEO RESPONSE 20.09.2021
3	Increase the amount of attenuation storage so that the amount proposed is equal to or greater than that required.	The proposed storage volume has been increased to achieve runoff equivalent to the calculated greenfield runoff rate.	Resolved.	
4	Supply evidence for a Thames Water Asset Location Search.	An extract from a Thames Water Asset Location Search is included in the report for purposes of identifying the nearest sewers to the site.	Needs clarification – is it the plan on P12 of SuDs assessment? Include a simple reference such as …Extract from Thames Water Asset Location Search.	The extract from the Thames Water Asset Location Search is indeed presented on page 12 of the SuDS Assessment. A reference has been added for clarification.
5	Supply information detailing the management of Health and Safety risks related to the SuDS design.	There is no requirement to provide this information as part of the planning application, in accordance with the Camden Local Plan and the Water & Flooding Camden Planning Guidance (CPG).	We do not agree with this stance – but will not pursue these details in this instance in order to progress.	Noted.
6	Provide the maintenance tasks and frequencies for each drainage component proposed. The maintenance owner should also be provided.	The maintenance tasks are now specified in Section 4.6, including the recommended frequency of these.	Have not explicitly stated the frequency (too vague) – need to propose a minimum frequency for each maintenance task.	A minimum frequency has been added to the tasks outlined in Section 4.6.