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Drainage Statement

19-37 Highgate Road

Project Name:	**19-37 Highgate Road**
Document Title:	**Drainage Statement**
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Contents

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Appendix

1. Introduction

1.1. Scope of Report

Engineeria have been commissioned by GM London to provide a Drainage Statement to support a planning application for 19-37 Highgate Road.

This report has been prepared in conjunction to a Flood Risk Assessment (Engineeria report E0751-EEE-R-C-001) in order to set out how the site will manage surface water run-off from the site.

2. Site Description

2.1. Existing Site Information

The site is located at 19 Highgate Road, NW5 1NS. It has approximate OS coordinates 528867, 185420. It is located in the London Borough of Camden.

The site is 0.12 ha in size and is bound by the following:

- East – Highgate Road runs immediately to the east of the site in parallel to the site. There is no access from Highgate Road into the development site.
- North – The site is accessed from Greenwood Place which runs across the north boundary
- West – The site abuts 19 Greenwood Place – a 2 storey commercial/ industrial building
- South – The site is immediately adjacent to the access into Christ Apostolic Church.

The existing site comprises a 2 storey community centre and a large parking area to the north of the site.

2.2. Development Proposals

The existing community centre will be demolished in order to give way to a new mixed-use development and associated landscape works.

The proposed development will be 7 storeys tall and will include a basement which houses plant equipment to support the functioning of the building.

2.3. Topography

The site falls from south to north and is generally set at a level beneath the adjacent highway.

The existing building has an approximate FFL of 36.68 OD, with a raised area to the south of 37.50 OD. The site rises to the north where it joins to Greenwood Place, where the level is 36.75 OD. Highgate Road to the east is set above the level of the existing site and falls from a level of 37.29 OD. to the north from a level of 37.9 OD to the south.

2.4. Geology and Hydrogeology

As set out in the ground investigation undertaken by GEA:

- The site is underlain by London Clay. London Clay is homogenous, slightly calcareous silty clay to very silty clay, with some beds of clayey silt grading to silty fine-grained sand.
- The site is understood to be located over the approximate route of a former tributary to the Fleet River.
- Alluvium and made grade may also be present beneath the site. This is likely to comprise a combination of clay, silt, sand and gravel.
- London Clay is material is classified by the Environment Agency as an unproductive stratum. This material is not capable of supporting a groundwater table, although pockets of perched groundwater do occur within fissures and partings. Horizontal permeability of London Clay is generally between 1 x 10^{-11} and 1 x 10^{-9} m/s with even lower vertical permeability. For the purposes of drainage, this is considered impermeable.
- A previous site investigation undertaken by Campbell Reith identified groundwater at depths of 2.56m (34.34m OD) and 3.75m (33.15m OD). It is likely that groundwater level measured in the standpipes does not represent a groundwater table and instead it is thought to reflect the accumulation of perched water from the made ground and Alluvium.

2.5. Existing Drainage Infrastructure

The existing site is served by a surface water drainage system and petrol interceptor which serves the existing car park and a combined drainage system serving the building (both rainwater and soil). The car park drainage joins the combined drainage system before discharging into the 305mm combined Thames Water sewer between TWMH 8403 and the 1549mm combined sewer in Highgate Road.

Thames Water records also show that combined manholes TWMH 84CI and 83AG, however upon investigation by Amber Group in November 2021, no such chambers were identified and it is considered that if these exist, they are likely on an adjacent site.

Thames Water records also indicate that a large Thames Water relief sewer which runs adjacent to the development. GM London have engaged Infotec to undertake a condition and line and level survey of this sewer which has confirmed exact alignment, and identified that the sewer is 11m deep to invert and is a 1219mm masonry sewer.

This section is supported by Appendix 2 which contains;

- Amber Group CCTV survey which validates the connectivity of on-site drainage
- Thames Water Asset records.
- Infotec drawing INF-5247-D01 dated 12.05.2022, “LONG RANGE GYROSCOPIC ALIGNMENT (LINE & LEVEL)& CONDITION SURVEY inc. FULL IN-PIPE LIDAR SCANNING”

3. Planning Context

3.1. Planning Background

The site has full planning approval under application reference 2013/5947/P, dated 18 June 2014. This initial approval entailed the proposed development site as well as various other properties on Greenwood Place.

The development is principally the same as the initial approval aside from minor alterations to the exact extent of the building and for the inclusion or a proposed basement to house plant serving the building.

The initial application included an FRA undertaken by Campbell Reith dated September 2013.

3.2. Regional and Local Planning Policy

London Plan

The site is in Greater London and therefore design has been prepared in consideration of the London Plan (adopted 2021) which states:

Policy SI13 Sustainable Drainage

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. Increases in surface water run-off outside these areas also need to be identified and addressed.*

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. There should also be a preference for green over grey features, in line with the following drainage hierarchy:*

   1. *rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)*
   2. *rainwater infiltration to ground at or close to source*
   3. *rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)*
   4. *rainwater discharge direct to a watercourse (unless not appropriate)*
   5. *controlled rainwater discharge to a surface water sewer or drain*
   6. *Controlled rainwater discharge to a combined sewer.*

C. *Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways*

D. *Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.*

Camden Local Plan

The site is located in Camden who adopted their Local Plan in 2017.

Policy CC3 of the Local Plan relates to Water and flooding, and is as follows:

The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible.

We will require development to:

A. *Incorporate water efficiency measures;*

B. *Avoid harm to the water environment and improve water quality;*

C. *Consider the impact of development in areas at risk of flooding (including drainage);*

D. *Incorporate flood resilient measures in areas prone to flooding;*

E. *Utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and not locate vulnerable development in flood-prone areas.*

F. *Where an assessment of flood risk is required, developments should consider surface water flooding in detail and groundwater flooding where applicable.*

4. Surface Water Drainage Strategy

4.1. Existing Site Drainage Regime

Existing Drainage Catchments

An existing catchment plan (E0751-EEE-00-DR-C-7500-P02) has been prepared and is shown **Appendix 1.**

This shows that the existing site is currently occupied by the following areas:

- Impermeable Surfacing = 1086 m^2
    - 418 m^2 Building roof
    - 668 m^2 Pavement
        - 375 m^2 Asphalt pavement
        - 150 m^2 Block pavement
        - 143 m^2 Walkway
- Permeable Surfacing = 136 m^2

Collectively this means that, of the site's 1189 m2 total area, it is 11.4% % permeable

Existing Drainage Connections

The existing and proposed drainage network is shown on the proposed drainage strategy drawing (E0751-EEE-00-DR-C-7599).

Information relating to the existing drainage system have been identified using the following data sources, and is found in **Appendix 2**:

- Thames Water asset records
- Drainage Survey (CCTV and Line and Level) undertaken by Amber Group.

This indicates that the site is currently served by the following drainage infrastructure:

- The existing drainage within the site drains into the existing EX MH1

As such, it can be concluded that the impermeable area associated with the entire site discharges in EX MH1.

The existing discharge rates have been calculated using the Modified Rational Method with the above impermeable areas, and the calculations are found in **Appendix 3**. These rates are as follows:

- 1 in 1 year: 5.16 l/s
- 1 in 30 year: 12.59 l/s
- 1 in 100 year: 16.49 l/s

4.2. Surface Water Drainage – Level of Service

Design Storm

The drainage system has been designed in accordance with the requirements for "Flood risk within the development" set out in "Sustainable Drainage Systems Non-statutory technical standards for sustainable drainage systems", published by Department for the Environment and Rural Affairs, March 2015.

These requirements are as follows:

- 1 in 30 year rainfall event – no flooding of any of the site (unless designated to hold and convey water as part of the design)
- 1 in 100 year rainfall event (the peak design storm) – no flooding of any part of a building or utility plant susceptible to water within the development (unless designated to hold and convey water as part of the design)
- > 1 in 100 year rainfall event – where reasonably practicable, flows are managed in exceedance routes that minimise the risk to people and property.

Climate Change Allowance

The Environment Agency's guidance note on Flood Risk Assessments: climate change allowances, updated 22 July 2020 States that developers should make allowances for climate change when considering flood risk.

Table 2 of this guidance notes sets the changes to peak rainfall intensity for small (less than 5km^2) or urbanised drainage catchments for different time horizons, as follows.

Table 1 peak rainfall intensity allowance in small catchments (less than 5km2) or urban drainage catchments (based on a 1961 to 1990 baseline)

	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)**
Upper End	10%	20%	40%
Central	5%	10%	20%

The design life of the proposed development shall be 100 years. As such, the allowances for the '2080s' are appropriate.

To provide a resilient design, the peak design rainfall event therefore includes an allowance of 40% above the peak rate for climate change (CC).

4.3. Surface Drainage Hierarchy

Disposal Method

The Sustainable Drainage Hierarchy requires that surface water run-off is controlled and preferably re-used where possible. Where it cannot be re-used, Building Regulations Part H identifies that surface water should be disposed of in the following order of preference:

- via infiltration
- to a watercourse
- to sewers

Discharge via infiltration

As identified in the section relating to ground conditions, the underlying soil is made of clay and impermeable and has an estimated hydraulic conductivity of under 1 x 10^{-9} m/s. As a result, infiltration is not considered a feasible method of surface water discharge.

Discharge to Watercourse

The closest watercourse is 1600m away and discharging here would be a disruptive and unsustainable approach given the adjacent sewerage network.

Discharge to Sewer

The proposed point of connection for drainage serving the site is proposed to be the combined sewer EX MH1.

Sustainable Drainage Hierarchy

The below table provides a summary of the sustainable drainage approach utilised to develop this drainage strategy.

Table 2 Sustainable Drainage Hierarchy

	Criteria	Included	Justification
1	Rainwater use as a resource (for example rainwater harvesting, blue roof for irrigation)	N	Rainwater harvesting is not considered a feasible option for this site as it would result in additional storage tanks being incorporated within the building and a duplication of sections of internal pipework.
2	Rainwater infiltration at ground or close to source	N	The sub-soil is impermeable as above which means infiltration is not feasible. Building regulations Part H (3.25) states that soakaways should not be built within 5m of a building or road. Given the dense urban nature of this site, infiltration for run-off from the building has been discounted.
3	Rainwater attenuation in green infrastructure features for gradual release (for example, green roofs, rain gardens)	Y	Blue roofs are being provided across the site in order to reduce run-off rate and to provide source control. Where feasible, permeable pavements will be introduced – however this will need to be coordinated alongside proposed utility services which generally are not compatible together.
4	Rainwater discharge direct to a watercourse (unless not appropriate)	N	As described above, there are no watercourses within close proximity of the development.
5	Controlled rainwater discharge to a surface water sewer or drain	N	There are no rainwater sewers in the immediate vicinity and the site and therefore discharge to a surface water drain has been discounted.

6	Controlled rainwater discharge to a combined sewer	Y	The site benefits from an existing point of connection to a combined water sewer and this will be retained.

4.4. Proposed Site Discharge Rate

Proposed Site Catchments

A proposed catchment plan has been prepared and is shown **Appendix 1.**

This identifies the following catchment on the site:

- Impermeable – 1142 m^2
- Permeable – 47 m^2

Greenfield Run-off Rate

Greenfield Run-off rates have been calculated for the site using the methodology set out within Institute of Hydrology Report 124. It is based on the total site area to estimate the rate of surface water run-off from the site prior to development. These calculations identify the following greenfield rates for the site:

Qbar: 0.52 l/s

1 in 1 year: 0.44 l/s

1 in 30 year: 1.19 l/s

1 in 100 year: 1.65 l/s

A printout of the calculations is found in **Appendix 4**.

Downstream Sewer Capacity

The existing on-site drainage connection is a 150mm surface water pipe. The level of the downstream point of connection is unknown, and it is assumed to fall at a grade of 1:100. Using the Colebrook White Equation and a friction coefficient of 1.5, this equates to a capacity of 15.6 l/s.

Proposed Discharge Rate

As set out London Plan policy SL13.B, developments should aim to achieve greenfield run-off rates.

Meeting a greenfield run-off rate would mean achieving a peak discharge rate of 0.44 l/s and 2.31 l/s in the 1 in 1 year and 1 in 100 year + CC storms respectively or 0.52 l/s for QBar.

Given the extent of development at ground-floor level relative to total site area, the extent of basement and the presence of residential units at ground-floor, below ground attenuation tanks have been discounted. As such, it is proposed that above ground attenuation will be provided by way of a blue roof. This provides source control at roof level and helps to improve water quality, however it is unable to provide attenuation for any run off emanating from surfaces beneath the roof (such as pavements and balconies).

Of the total roof area of 760 m^2, a total area of 566 m^2 shall be used for blue roofs. Due to the needs for level access from the internal areas to achieve usable podium decks, and due to the weight of a fully loaded blue roof system, the depth of blue roof attenuation unit has been limited to 100mm. This results in a combined volume of 53.8m^3 with a void ratio of 95%

Calculations have been undertaken to establish that a peak discharge rate of **4.1 l/s** can be achieved from the building roof area using this system during the 1 in 100 year design storm. This rate is achieved across 3 roof areas (2a, 2b and 2c) as shown in **Appendix 6** and the critical storm duration is 120 minutes for roof 2c and 660 minutes for 2a and 2b.

Modelling has also been undertaken to establish a peak discharge rate of 12.1 l/s from the site during the 1 in 100 year storm cc by making use of attenuation volume below ground in deep manholes and a 68mm orifice plate at the outlet (S.4). This rate assumes that the blue roof discharges at its peak rate for the duration of the storm event, irrespective of duration.

Consultation with Thames Water shall be undertaken prior to construction in order to validate that the discharge rate is acceptable, however given it is a substantial improvement from the existing condition, this is likely.

4.5. Water Quantity

The proposed scheme will increase the amount of impermeable area covering the site from 1053 m^2 to 1142 m^2. However a substantial proportion of the proposed site will be covered by blue roof (566 m^2). As a result, the quantity of water running off the site will be substantially reduced for rainfall events up to 5mm, and will be approximately the same during the design storm.

4.6. Water Quality

In accordance with Table 26.2 of the Ciria SuDS Manual (2015), the proposed development will have the pollution hazard indices as shown below.

Table 3 Summary of Pollution Indices for Mixed Use Development

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2	0.2	0.05
Low Traffic Roads	Low	0.5	0.4	0.4

Rainfall will land on these surfaces, and potentially carry pollution into the downstream drainage network. As such, all rainfall will go through a treatment train in order to mitigate the risk of pollution.

The following SuDS measures are proposed to provide mitigation against these pollution indices.

Table 4 Summary of Pollution Index

Land Use	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Other Roof	0.3	0.2-0.8	0.05

All drainage features will be designed in accordance with the SuDS manual (Ciria report 753), to ensure that they reach their total mitigation potential.

4.7. Hydraulic Modelling

The proposed controlled surface water discharge rate will be less than the incoming peak surface water run-off rate during events which exceed the 1 in 1 year return period. As a result surface water will build up behind the flow control device, and storage will be required.

This scenario has been modelled using Infodrainage with FEH and FSR rainfall data. FEH data has been used for the 1 in 30 and 1 in 100 + 40% cc design storms, whereas FSR has been used for the 1 year design storm.

The modelling has assumed the peak blue roof discharge rate, as confirmed by manufacturer calculations (refer to **Appendix 7)** will be represented as a constant base flow. The additional impermeable surface areas (balconies and pavements) have been assigned as impermeable surfaces and therefore reflect a peaking hydrograph, rather than a base rate.

The modelling is found in **Appendix 6**. A summary of core results from the modelling for each of the design return periods is identified in the table below. The hydraulic modelling includes a set discharge rate of 4.1 l/s for the blue roof, however based on a proportional reduction for the 1 in 30 year and 1 in 1 year storm, the blue roof discharge rate will be approximately 2.4 l/s and 1.6 l/s respectively, therefore the below table also includes an adjusted discharge rate considering these rate reductions.

Table 5 Indicative Storage Volumes for other design storms

Return Period	Critical Storm Duration by Depth	Discharge Rate – model (l/s)	Discharge Rate – adjusted (l/s)
1 in 1 year	FSR 30 mins Winter	5.5	3.0
1 in 30 year	FEH 60 mins Winter	9.4	7.7
1 in 100 year + CC	FEH 60 mins Winter	12.1	12.1

As shown the critical results are all of durations under the peak duration for the blue roof, and also reflect the discharge rate from the blue roof during the 1 in 100 year storm period. As a result these values represent over estimations.

4.8. Exceedance Routes

During storm events which exceed the peak design storm, flooding will occur from manholes and gully points.

The topography of the site has been designed to fall away from the building, so in the case of exceedance events, run-off will fall to the adjacent highway. This is shown on the proposed drainage strategy drawing

4.9. Maintenance Requirements

All drainage infrastructure on the site will be private and shall be maintained by the Management Team for the building.

Indicative maintenance requirements for the blue roof and flow control device are found in **Appendix 6**. These shall be updated as required depending on the ultimate manufacturer for the component.

5. Conclusion

A proposed drainage strategy has been presented on Engineeria drawing E0751-EEE-00-DR-C-7599-P01. This identifies that a blue roof will be provided to provide the principal source of source control, storm water attenuation and water quality enhancement. The blue roof will control the rate of run-off from the building to 4.1 l/s.

Water will then discharge from the roof into a below ground drainage system which will further control the discharge rate to a rate of 12.1 l/s during the 1 in 100 year + climate change design storm and 5.5 l/s during the 1 in 1 year event. As described this includes conservative assessments of the flow rate based on the modelling of the blue roof.

The below provides a summary of the modelled flow rates associated with the site.

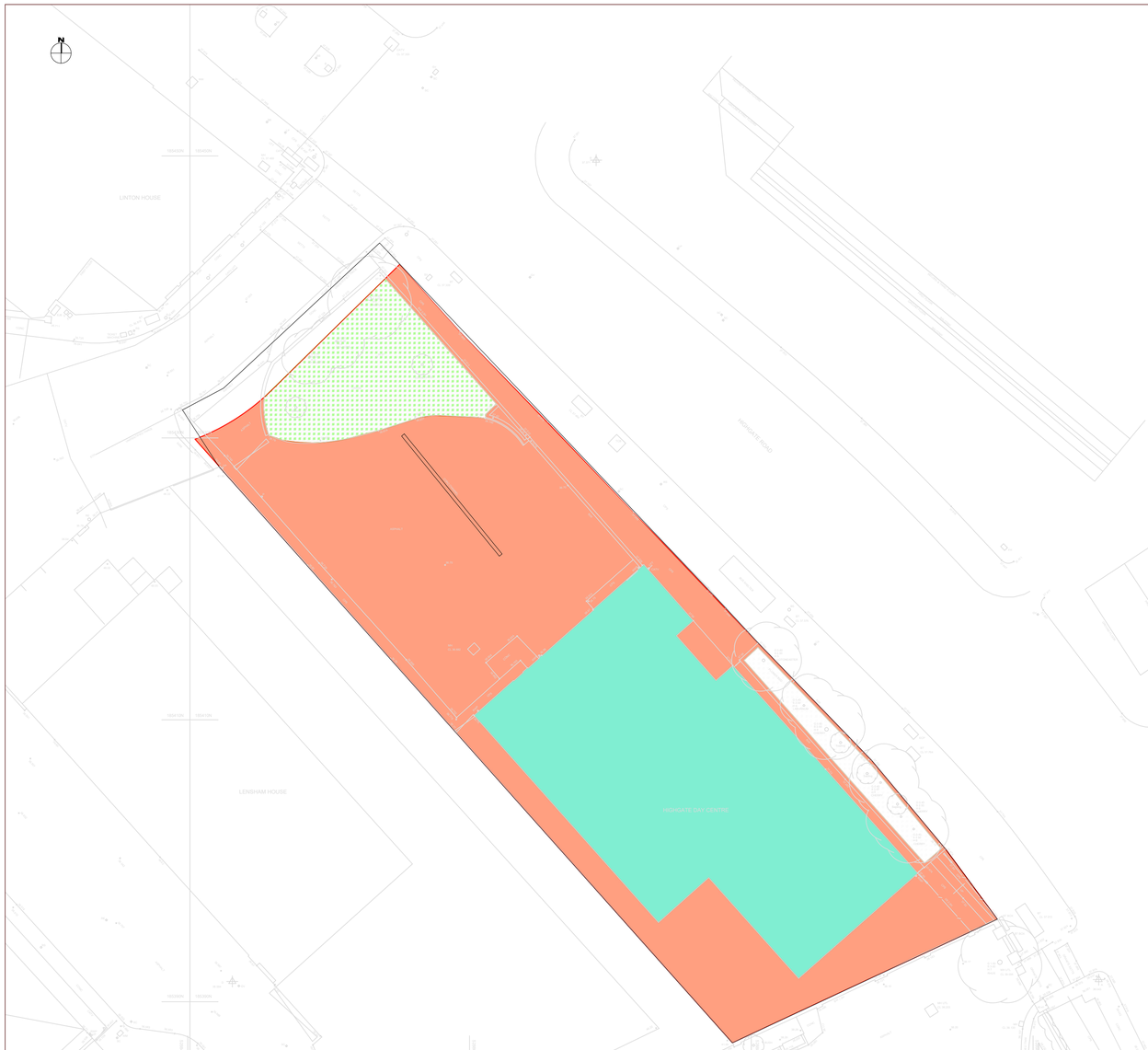
Table 6 Modelled site flow rates

Return Period	Existing Run-off		Greenfield (l/s)	Proposed (l/s)	Improvement to Existing Peak	Improvement to Greenfield	Discharge Volume Change (m^3)
	Duration	Q (l/s) - FSR					
Qbar			0.52				
1	30	5.2	0.44	3.0	**42%**	**-582%**	**1.72**
30	30	12.6	1.19	7.7	**39%**	**-547%**	**3.75**
100+40%	60	23.1	1.65	12.1	**48%**	**-633%**	**4.87**

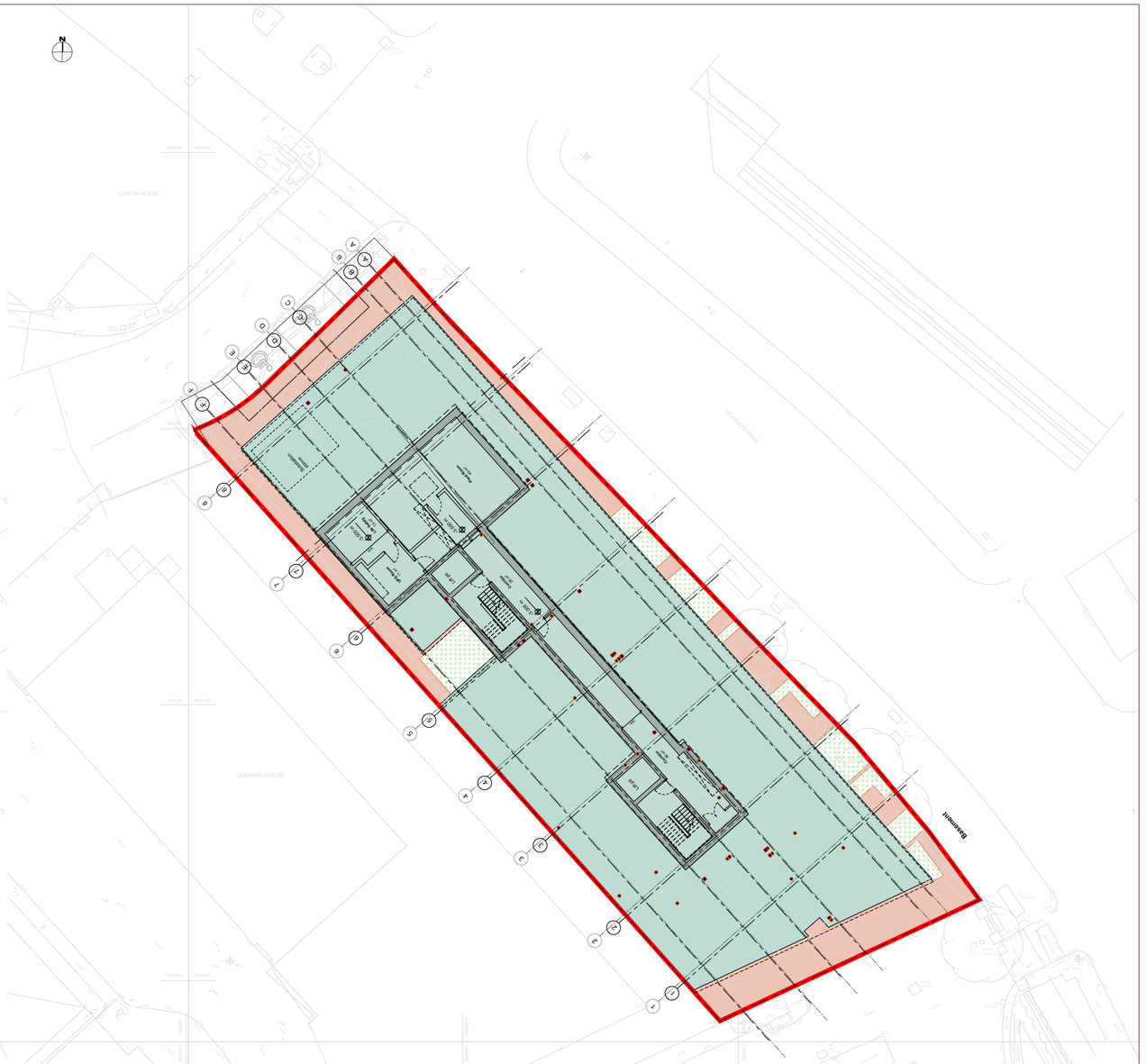
The report has also provided maintenance requirements for the blue roof such that the operator can keep it well maintained throughout the development lifetime.

It is considered that given the comprehensive inclusion of SuDS by way of the blue roof that this development proposal complies with the necessary local planning policy, alongside the FRA.

Appendix 1 – Existing and Proposed catchment



PROPOSED PLANNING BOUNDARY (1,189 SQ.M)
EXISTING PERVIOUS SURFACE (136 SQ.M)
EXISTING IMPERVIOUS SURFACE (635 SQ.M)
EXISTING ROOF AREA (418 SQM)



PROPOSED PLANNING BOUNDARY (1,189 SQ.M)
PROPOSED PERVIOUS SURFACE (58 SQM)
PROPOSED IMPERVIOUS SURFACE (201 SQM)
PROPOSED ROOF AREA (931 SQM)

GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEER'S AND ARCHITECT'S DRAWINGS, SPECIFICATIONS AND RISK REGISTERS.
2. DO NOT SCALE FROM THIS DRAWING. USE ONLY DIMENSIONS AS INDICATED. CHECK ALL SITE DIMENSIONS PRIOR TO PLACING ANY ORDER OR FABRICATION. WHERE A CONFLICT OF INFORMATION EXISTS SEEK CONFIRMATION FROM CONSULTANTS PRIOR TO PROCEEDING FURTHER WITH THE WORKS.
3. THIS DRAWING IS TO BE PRINTED IN COLOUR.
4. TEMPORARY STABILITY OF THE EXISTING STRUCTURE AND ANY NEWLY CONSTRUCTED ELEMENTS OF PERMANENT WORKS DURING CONSTRUCTION IS SOLELY CONTRACTOR'S RESPONSIBILITY.
5. ONLY DRAWINGS AND SPECIFICATIONS ISSUED FOR **CONSTRUCTION** CAN BE USED FOR THE WORKS. IT IS CONTRACTOR'S RESPONSIBILITY TO SEEK THE INFORMATION FROM CONSULTANTS.
6. ALL PROPRIETARY ITEMS TO BE INSTALLED STRICTLY IN ACCORDANCE WITH MANUFACTURER'S REQUIREMENTS AND SPECIFICATIONS. ALL WATERPROOFING SUCH AS TANKING DETAILS, DAMP PROOF MEMBRANES, DAMP PROOF COURSES, CAVITY TRAYS ETC. ARE TO BE INSTALLED AS PER ARCHITECT'S DETAILS.
7. THE ACTUAL FORM, EXTENT AND CONDITION OF ANY ELEMENTS MARKED AS "TBC", IS TO BE CONFIRMED BY THE CONTRACTOR VIA LOCAL OPENING/TRIAL PIT PRIOR TO COMMENCEMENT OF ANY WORKS. EXACT DETAILS OF FINDINGS ARE TO BE IMMEDIATELY REPORTED TO ENGINEER.

rev	date	description	by	chkd
P02	05.07.2022	UPDATED FOR PLANNING	ON	KG
P01	08.12.2021	FIRST ISSUE	MA	KG

PROJECT TITLE:
19 - 37 HIGHGATE ROAD

CLIENT:
GM LONDON

SKETCH TITLE:
CATCHMENT PLAN

SKETCH No:
E0751-EEE-00-XX-DR-C-7500

SUITABILITY STATUS:
FOR INFORMATION

PROJECT No:	DRAWN:	CHECKED:	REV:	SCALE @ A1:
E0751	ON	KG	P01	1:200

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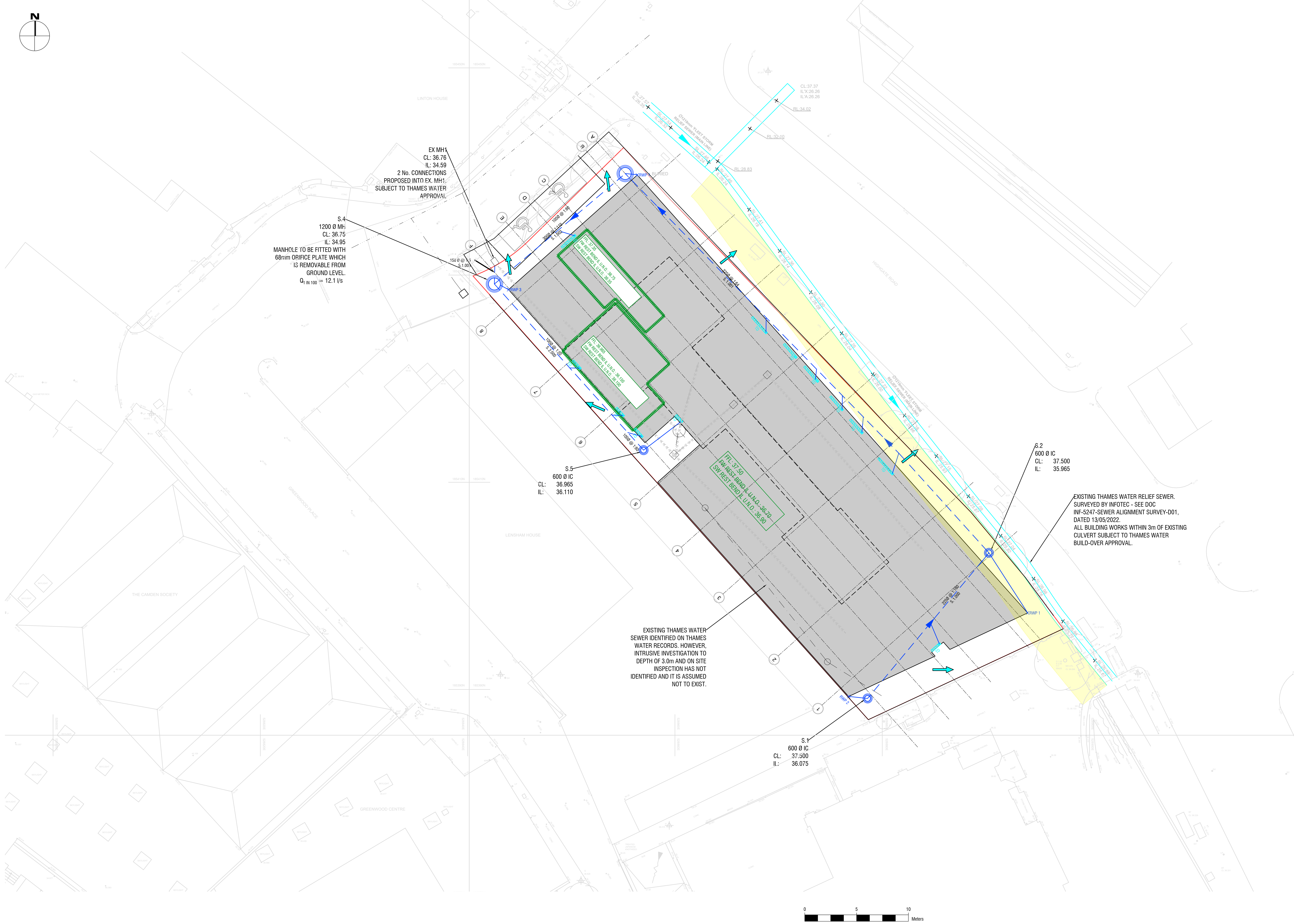
Appendix 2 – Drainage Strategy



KEY

- PLANNING BOUNDARY
- PROPOSED GROUND FLOOR EXTENT
- PROPOSED BASEMENT EXTENT
- PROPOSED SW DRAIN AND CHAMBER
- EXISTING THAMES WATER RELIEF SEWER
- EXISTING PRIVATE DRAIN
- AREA OF ALTERNATE FFL
- PROPOSED SURFACE WATER EXCEEDANCE ROUTE

GENERAL NOTES

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DRAINAGE NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERS AND ARCHITECTS DETAILS.
2. ALL PRIVATE ON-PLOT DRAINAGE WORK IS TO BE CARRIED OUT IN ACCORDANCE WITH BUILDING REGULATIONS PART H. ALL ADOPTABLE DRAINAGE TO BE CARRIED OUT IN ACCRDANCE WITH SEWERAGE SECTOR GUIDANCE, APPENDIX C - DESIGN AND CONSTRUCTION GUIDANCE (SSG)
3. THE CONTRACTOR IS RESPONSIBLE FOR VALIDATING ALL ASSUMPTIONS PRIOR TO THE COMMENCEMENT OF WORKS, INCLUDING THE POSITION, DEPTH AND SIZE OF ANY EXISTING EXISING DRAINAGE INFRASTRUCTURE. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER BEFORE WORKS ARE ADVANCED.
4. ALL WORKS ARE DESIGNED FOR THE FINAL CONSTRUCTED USE. TEMPORARY WORKS ARE THE RESPONSIBILITY OF THE PRINCIPAL CONTRACTOR.
5. ALL DRAINAGE WORKS ABOVE THE UNDERSIDE OF THE LOWEST STRUCTURAL SLAB BY OTHERS. DRAINAGE POINTS ARE SHOWN APPROXIMATELY ONLY. EXACT POSITION OF THESE ARE SET OUT AS FOLLOWS:
6. RAINWATER BY ARCHITECT
7. FOUL WATER AND ALL ASSOCIATED FITTINGS AND INTERNAL GULLIES - MEP
8. ANY STATED COVER LEVELS ARE FOR GUIDANCE ONLY AND SHALL BE SET TO THE FINISHED LEVELS SPECIFIED BY THE ARCHITECT.
9. THE CONTRACTOR SHALL ADJUST THE EXACT POSITION OF GULLIES AND DRAINS TO SUIT THE AS-BUILT SURFACE LEVELS. GULLIES SHALL BE PLACED AT LOWS SPOTS.
10. ALL PIPES TO CONNECT SOFFIT TO SOFFIT UNLESS OTHERWISE STATED.
11. ALL INTERNAL MANHOLES TO BE RECESSED, DOUBLE SEALED, AIRTIGHT TYPE IN ALUMINIUM OR STEEL. RECESS DEPTH TO THE SPECIFICATION OF THE ARCHITECT.
12. ALL INTERNAL MANHOLES SHALL BE SET OUT BY THE ARCHITECT. THE CONTRACTOR MUST ENSURE THE GRADIENT AND SIZE OF CONNECTING PIPE-WORK IS AS SHOWN ON THIS DRAWING.
13. ALL GROUND-FLOOR AND BASEMENT RWP'S AND SVP'S TO BE FITTED WITH ABOVE GROUND RODDABLE ACCESS PLATES TO ALLOW FOR JETTING/ CLEARANCE FROM THE INSIDE.
14. ALL BELOW SLAB RAINWATER PIPES TO BE 150MM Ø @ 1:80 AND FOUL WATER TO BE 100MM Ø @ 1:40 (DIA) UNLESS OTHERWISE STATED
15. THE CONTRACTOR SHALL CLEAN OUT AND REPAIR ALL RETAINED EXISTING DRAINAGE ON-SITE
16. SEALANT DETAIL THROUGH ALL WATERPROOFED STRUCTURAL ELEMENTS TO BE AGREED WITH TANKING SPECIALIST AND INSTALLED IN STRICT COMPLIANCE WITH THEIR INSTRUCTIONS.

DRAINAGE STRATEGY

THE BELOW GROUND DRAINAGE STRATEGY SHOWN IS BASED ON A 3 PART BLUE ROOF WITH A COMBINED DISCHARGE RATE OF 4.1 L/S AS PER BAUDER CALCULATIONS. REFER TO ARCHITECTURAL PLANS FOR THE EXACT EXTENT OF BLUE ROOF. THE BLUE ROOF COVERS AN AREA OF 566 M^2 AND COLLECTS RUN-OFF FROM A ROOF AREA OF 760 M^2.

ADDITIONAL BELOW GROUND ATTENUATION IS PROVIDED IN DEEP MANHOLES WHICH WILL ALLOW THE DISCHARGE RATE FROM THE SITE (INCLUDING RUN-OFF FROM IMPERMEABLE PAVEMENTS) TO BE LIMITED TO 12.1 L/S AS SHOWN FOR 1% ANNUAL EXCEEDANCE PROBABILITY RAINFALL EVENT.

rev	date	description	by	checked
P01	2022.07.05	FIRST ISSUE	ON	KG

PROJECT TITLE: 19-37 HIGHGATE ROAD

CLIENT: GM LONDON

PROJECT No: E0751 | DRAWN: ON | CHECKED: KG

DRAWING TITLE: PROPOSED DRAINAGE STRATEGY

DRAWING No: E0751-EEE-00-XX-DR-C-7599

SUITABILITY STATUS: SUITABLE FOR INFORMATION

REV: P01 | SCALE: 1:200@A1

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Appendix 3 – Run off rate

E0751 - XXXXX

By: ON

Dated: 05.07.2022

Site Run Off Rate Comparison

Calc-C-001

Data

Site Areas (m^2)

Total Site Area	1189
Existing Impermeable Area	1053
Proposed Impermeable Area	1142

Flood Studies Report Rainfall Data

M5-60 (mm)	20
R	0.4
Areal Reduction Factor	0.9

Modified Rational Method Data

Cv	0.75
Cr	1.3

Rainfall Intensity

Return Period (T)	Duration (D)	Z1	M5-D (mm)	Z2	MT-D (mm)	i (mm/hr)	i, catchment (mm/hr)
1	30	0.8	16	0.628	10.05	20.10	18.09
30	30	0.8	16	1.532	24.51	49.02	44.12
100	30	0.8	16	2.006	32.10	64.19	57.77
1	360	1.6	32	0.686	21.95	3.66	3.29
30	360	1.6	32	1.499233333	47.98	8.00	7.20
100	360	1.6	32	1.946	62.27	10.38	9.34

Modified Rational Method

Q=2.78 x Cv x Cr x i x A/10,000

Existing - Peak

Return Period (T)	Duration (D)	Q (l/s)
1	30	**5.16**
30	30	**12.59**
100 + 40%	30	**23.08**

Proposed - Peak

Return Period (T)	Duration (D)	Q (l/s)
1	30	**5.60**
30	30	**9.40**
100 + 40%	60	**12.10**

Existing - 6 Hour

Return Period (T)	Duration (D)	Q (l/s)
1	360	**0.94**
30	360	**2.05**
100	360	**2.67**

Proposed - 6 Hour

Return Period (T)	Duration (D)	Q (l/s)
1	360	**1.02**
30	360	**2.23**
100	360	**2.89**

Summary

Return Period	Existing Run-off		Greenfield (l/s)	Proposed (l/s)	Improvement to Existing Peak	Improvement to Greenfield	Discharge Volume Change (m^3)
	Duration	Q (l/s) - FSR					
Qbar			0.52				
1	30	5.2	0.44	3.0	**42%**	**-582%**	**1.72**
30	30	12.6	1.19	7.7	**39%**	**-547%**	**3.75**
100+40%	60	23.1	1.65	12.1	**48%**	**-633%**	**4.87**

Appendix 4 – Greenfield run off estimation

HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Oscar Ndisale
Site name:	19 highgate road
Site location:	london

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.55346° N
Longitude:	0.14334° W
Reference:	4256979821
Date:	Jul 05 2022 11:14

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 0.119

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	641	641
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	0.52	0.52
1 in 1 year (l/s):	0.44	0.44
1 in 30 years (l/s):	1.19	1.19
1 in 100 year (l/s):	1.65	1.65
1 in 200 years (l/s):	1.94	1.94

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix 5 – Hydraulic Modelling

E0751 - HIGHGATE: SURFACE WATER MODEL	Date: 05/07/2022		
	Designed by: KG	Checked by:	Approved By:
Report Details: Type: Inflows Storm Phase: Storm	Company Address:		

1 - TOC

Type : Catchment Area

Area (ha)	0.012

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	100

2 - TOC

Type : Catchment Area

Area (ha)	0.023

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	100

1/3 Roof C Outlet b Type : Base Flow

Flow (L/s)	0.89

2a - Roof Outlet Type : Base Flow

Flow (L/s)	0.69

2b - Roof Outlet + 1/3 2c - Roof Outlet Type : Base Flow

Flow (L/s)	1.6

1/3 Roof C Outlet - a Type : Base Flow

Flow (L/s)	0.89

E0751 - HIGHGATE: **SURFACE WATER MODEL**	**Date:** **05/07/2022**		
	Designed by: **KG**	**Checked by:**	**Approved By:**
Report Details: **Type: Junctions** **Storm Phase: Storm**	**Company Address:**		

Name	Junction Type	Easting (m)	Northing (m)	Cover Level (m)	Depth (m)
S.5	Manhole	528856.973	185413.075	37.410	1.300
S.1	Manhole	528878.813	185389.160	37.500	1.425
S.3	Manhole	528855.190	185439.825	37.330	2.230
S.4	Manhole	528842.605	185429.153	36.750	1.800
EX.MH.1	Manhole	528842.826	185431.009	36.760	2.170
S.2	Manhole	528890.338	185403.237	37.500	1.535

Name	Invert Level (m)	Chamber Shape	Diameter (m)	Manhole Locked
S.5	36.110	Circular	0.600	☑
S.1	36.075	Circular	0.600	☑
S.3	35.100	Circular	1.200	☑
S.4	34.950	Circular	1.200	☑
EX.MH.1	34.590	Circular	1.200	☐
S.2	35.965	Circular	0.600	☐

Name	Access Required	Easting (m)	Northing (m)
S.5	☑	528856.973	185413.075
S.1	☑	528878.813	185389.160
S.3	☑	528855.190	185439.825

Inlets

Junction	Inlet Name	Incoming Item(s)	Bypass Destination	Capacity Type
S.5	Inlet	1/3 Roof C Outlet b 1 - TOC	(None)	No Restriction
S.1	Inlet	2a - Roof Outlet 2 - TOC	(None)	No Restriction
S.3	Inlet	S.1.001 1/3 Roof C Outlet - a	(None)	No Restriction
S.4	Inlet	S.2.000 S.1.002	(None)	No Restriction
EX.MH.1	Inlet	S.1.003	(None)	No Restriction
S.2	Inlet	S.1.000 2b - Roof Outlet + 1/3 2c - Roof Outlet	(None)	No Restriction

Outlets

Junction	Outlet Name	Outgoing Connection	Outlet Type
S.5	Outlet	S.2.000	Free Discharge
S.1	Outlet	S.1.000	Free Discharge
S.3	Outlet	S.1.002	Free Discharge
S.4	Outlet	S.1.003	Orifice
	Diameter (m)	0.068	
	Coefficient of Discharge	0.600	
	Invert Level (m)	34.950	
S.2	Outlet	S.1.001	Free Discharge

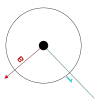
E0751 - HIGHGATE: **SURFACE WATER MODEL**	Date: **05/07/2022**		
	Designed by: **KG**	Checked by:	Approved By:
Report Details: **Type: Connections** **Storm Phase: Storm**	Company Address:		

Name	Length (m)	Connection Type	Slope (1:x)	Manning's n	Colebrook-White Roughness (mm)	Diameter / Base Width (mm)	Upstream Cover Level (m)	Upstream Invert Level (m)
S.1.003	1.869	Pipe	5.193		0.6	150	36.750	34.950
S.2.000	21.562	Pipe	19.425		0.6	100	37.410	36.110
S.1.002	16.501	Pipe	110.008		0.6	300	37.330	35.100
S.1.000	18.193	Pipe	165.000		0.6	225	37.500	36.075
S.1.001	50.734	Pipe	64.242		0.6	225	37.500	35.965

Name	Downstream Cover Level (m)	Downstream Invert Level (m)	Flow Restriction (L/s)
S.1.003	36.760	34.590	12.8
S.2.000	36.750	35.000	
S.1.002	36.750	34.950	
S.1.000	37.500	35.965	
S.1.001	37.330	35.175	

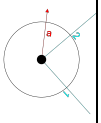
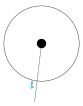
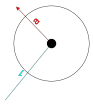
E0751 - HIGHGATE: **SURFACE WATER MODEL**	Date: **05/07/2022**		
	Designed by: **KG**	Checked by:	Approved By:
Report Details: **Type: Manhole Schedule** **Storm Phase: Storm**	Company Address:		

Setting Out Information	
Easting Origin (m)	0.000
Northing Origin (m)	0.000
Orientation (Degrees anticlockwise from North)	0

Name	Cover Level (m) Invert Level (m)	Manhole Schematic	Manhole Size (m)	Connection Details				Type		
Coordinates (m)	Depth (m)			Incoming Connections	Connection Type	Connection Invert (m)	Connection Size (mm)	Junction Type	Flow Control Type	Flow Control IL (m)
Intersection (m)				Outgoing Connections				Cover		
S.5	37.410 36.110		Diameter / Length: 0.600					Manhole - Access Required	{a} Free Discharge	
E:528856.972 N:185413.079	1.300									
IP E:528856.972 IP N:185413.079				{a} S.2.000	Pipe	36.110	Diam/Width: 100	Not Applicable		
S.1	37.500 36.075		Diameter / Length: 0.600					Manhole - Access Required	{a} Free Discharge	
E:528878.811 N:185389.164	1.425									
IP E:528878.811 IP N:185389.164				{a} S.1.000	Pipe	36.075	Diam/Width: 225	Not Applicable		
S.3	37.330 35.100		Diameter / Length: 1.200	{1} S.1.001	Pipe	35.175	Diam/Width: 225	Manhole - Access Required	{a} Free Discharge	
E:528855.189 N:185439.829	2.230									
IP E:528855.189 IP N:185439.829				{a} S.1.002	Pipe	35.100	Diam/Width: 300	Not Applicable		

E0751 - HIGHGATE: **SURFACE WATER MODEL**	Date: **05/07/2022**		
	Designed by: **KG**	Checked by:	Approved By:
Report Details: **Type: Manhole Schedule** **Storm Phase: Storm**	Company Address:		

Setting Out Information	
Easting Origin (m)	0.000
Northing Origin (m)	0.000
Orientation (Degrees anticlockwise from North)	0

Name	Cover Level (m) Invert Level (m)	Manhole Schematic	Manhole Size (m)	Connection Details				Type		
Coordinates (m)	Depth (m)			Incoming Connections	Connection Type	Connection Invert (m)	Connection Size (mm)	Junction Type	Flow Control Type	Flow Control IL (m)
Intersection (m)				Outgoing Connections				Cover		
S.4	36.750 34.950		Diameter / Length: 1.200	{1} S.2.000 {2} S.1.002	Pipe Pipe	35.000 34.950	Diam/Width: 100 Diam/Width: 300	Manhole - Access not Required	{a} Orifice	34.950
E:528842.604 N:185429.156	1.800									
IP E:528842.604 IP N:185429.156				{a} S.1.003	Pipe	34.950	Diam/Width: 150	Not Applicable		
EX.MH.1	36.760 34.590		Diameter / Length: 1.200	{1} S.1.003	Pipe	34.590	Diam/Width: 150	Manhole - Access not Required		
E:528842.825 N:185431.013	2.170									
IP E:528842.825 IP N:185431.013								Not Applicable		
S.2	37.500 35.965		Diameter / Length: 0.600	{1} S.1.000	Pipe	35.965	Diam/Width: 225	Manhole - Access not Required	{a} Free Discharge	
E:528890.336 N:185403.241	1.535									
IP E:528890.336 IP N:185403.241				{a} S.1.001	Pipe	35.965	Diam/Width: 225	Not Applicable		

E0751 - HIGHGATE: **SURFACE WATER MODEL**	Date: **05/07/2022**		
	Designed by: **KG**	Checked by:	Approved By:
Report Details: **Type: Inflow Summary** **Storm Phase: Storm**	Company Address:		

Inflow Label	Connected To	Flow (L/s)	Runoff Method	Area (ha)	Percentage Impervious (%)	Urban Creep (%)	Adjusted Percentage Impervious (%)	Area Analysed (ha)
1/3 Roof C Outlet - a	S.3	0.9						
1/3 Roof C Outlet b	S.5	0.9						
1 - TOC	S.5		Time of Concentration	0.012	100	0	100	0.012
2 - TOC	S.1		Time of Concentration	0.023	100	0	100	0.023
2a - Roof Outlet	S.1	0.7						
2b - Roof Outlet + 1/3 2c - Roof Outlet	S.2	1.6						
TOTAL		**4.1**		**0.035**				**0.035**

E0751 - HIGHGATE: **SURFACE WATER MODEL**	Date: **05/07/2022**		
	Designed by: **KG**	Checked by:	Approved By:
Report Details: **Type: Network Design Criteria** **Storm Phase: Storm**	Company Address:		

Flow Options

Peak Flow Calculation	(UK) Modified Rational Method
Min. Time of Entry (mins)	5
Max. Travel Time (mins)	30

SRP Wizard FEH

Type: FEH

Site Location	GB 528868 185421 TQ 28868 85421
Return Period (years)	2.0
Rainfall Version	2013
Data Type	Point

Pipe Options

Lock Slope Options	None
Design Level	Level Soffits
Min. Cover Depth (m)	1.200
Min. Slope (1:x)	225.00
Max. Slope (1:x)	10.00
Min. Velocity (m/s)	1.0
Max. Velocity (m/s)	3.0
Use Flow Restriction	☑
Reduce Channel Depths	☑

Pipe Size Library

STANDARD

Add. Increment (mm)	75

Diameter (mm)	Min. Slope (1:x)	Max. Slope (1:x)
100	100.00	0.00
150	150.00	0.00
225	225.00	0.00

Manhole Options

Apply Offset	☐
Synchronise Manhole Invert Levels	☑

Manhole Size Library

STANDARD

Diameter / Width

Connection (mm)	Diameter / Length (m)	Width (m)
150	0.450	0.000
225	0.600	0.000
300	1.200	0.000
375	1.350	0.000
500	1.500	0.000
750	1.800	0.000

Additional Sizing

Connection (mm)	900
Diameter / Length (m)	0.900
Width (m)	0.000

Depth

Depth (m)	Diameter / Length (m)	Width (m)
0.000	0.450	0.000
2.000	1.200	0.000

Access

Depth (m)	Ladder Protrusion (mm)
0.000	130
3.000	230

Benching Requirements

Landing Width (mm)	500
Benching Width (mm)	225

E0751 - HIGHGATE: **SURFACE WATER MODEL**	**Date:** **05/07/2022**		
	Designed by: **KG**	**Checked by:**	**Approved By:**
Report Details: **Type: Outfall Details** **Storm Phase: Storm**	**Company Address:**		

Outfalls

Outfall	Outfall Type	Fixed Surcharged Level (m)	Level Curve
EX.MH.1	Free Discharge		

E0751 - HIGHGATE: SURFACE WATER MODEL	Date: 05/07/2022		
	Designed by: KG	Checked by:	Approved By:
Report Details: Type: Audit Report Storm Phase: Storm	Company Address:		

Inflow Summary

Inflow Label	Connected To	Flow (L/s)	Runoff Method	Area (ha)	Percentage Impervious (%)	Urban Creep (%)	Adjusted Percentage Impervious (%)	Area Analysed (ha)
1/3 Roof C Outlet - a	S.3	0.9						
1/3 Roof C Outlet b	S.5	0.9						
1 - TOC	S.5		Time of Concentration	0.012	100	0	100	0.012
2 - TOC	S.1		Time of Concentration	0.023	100	0	100	0.023
2a - Roof Outlet	S.1	0.7						
2b - Roof Outlet + 1/3 2c - Roof Outlet	S.2	1.6						
TOTAL		**4.1**		**0.035**				**0.035**

Pipe Length

Audit Details

Range	Max. (m)
x ≤ Max.	45.000

Results

The following items have failed the audit:

Pipe	Length (m)
S.1.001	50.734

Cover Depth

Audit Details

Range	Min. (m)	Max. (m)
Min. ≤ x ≤ Max.	0.900	6.000

Results

All items pass

Backdrops

Audit Details

Range	Min. (m)	Max. (m)
Min. ≤ x ≤ Max.	0.000	1.500

Results

All items pass

Surcharge

Audit Details

Range	Max. (m)	Rainfall	Selected Rainfall	Return Period (years)	Increase Rainfall (%)
x ≤ Max.	0.000	Select Rainfall	FSR	1	0

Results

The following items have failed the audit:

Connection	US Item	Storm Name	Surcharge Depth (m)
S.1.003	S.4	1 years: +0 %: 30 mins: Winter	0.214

Flood Warnings

Junctions

No flood warnings are reported

Stormwater Controls

No flood warnings are reported

Discharge Rate

Audit Details

Selected Rainfall
SRP Wizard FEH

Results

Outfall	Rainfall	Audit Discharge Rate (L/s)	Actual Discharge Rate (L/s)	Pass/Fail
EX.MH.1	2 (years) + 0 (%)	13.0	5.6	Pass
	30 (years) + 0 (%)	13.0	9.4	Pass
	100 (years) + 40 (%)	13.0	12.1	Pass

E0751 - HIGHGATE: **SURFACE WATER MODEL**	Date: **05/07/2022**		
	Designed by: **KG**	Checked by:	Approved By:
Report Details: **Type: Audit Report** **Storm Phase: Storm**	Company Address:		

Discharge Volume

Details

Selected Rainfall	Storm
SRP Wizard FEH	100 years: +40 %: 360 mins: Summer

Results

Outfall	Audit Discharge Volume (m^3)	Actual Discharge Volume (m^3)	Pass/Fail
EX.MH.1	1.000	207.224	Fail

E0751 - HIGHGATE: SURFACE WATER MODEL	Date: 05/07/2022		
	Designed by: KG	Checked by:	Approved By:
Report Details: Type: Inflows Summary Storm Phase: Storm	Company Address:		

FSR: 1 years: Increase Rainfall (%): +0: Critical Storm Per Item

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow (m^3)
1/3 Roof C Outlet b	FSR: 1 years: +0 %: 15 mins: Summer		0.9	1.602
1 - TOC	FSR: 1 years: +0 %: 15 mins: Winter	0.01	1.7	0.782
2a - Roof Outlet	FSR: 1 years: +0 %: 15 mins: Summer		0.7	1.242
2 - TOC	FSR: 1 years: +0 %: 15 mins: Winter	0.02	3.2	1.493
2b - Roof Outlet + 1/3 2c - Roof Outlet	FSR: 1 years: +0 %: 15 mins: Summer		1.6	2.880
1/3 Roof C Outlet - a	FSR: 1 years: +0 %: 15 mins: Summer		0.9	1.602

SRP Wizard FEH: 30 years: Increase Rainfall (%): +0: Critical Storm Per Item

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow (m^3)
1/3 Roof C Outlet b	SRP Wizard FEH: 30 years: +0 %: 60 mins: Summer		0.9	6.408
1 - TOC	SRP Wizard FEH: 30 years: +0 %: 60 mins: Summer	0.01	2.7	3.395
2a - Roof Outlet	SRP Wizard FEH: 30 years: +0 %: 60 mins: Summer		0.7	4.968
2 - TOC	SRP Wizard FEH: 30 years: +0 %: 60 mins: Summer	0.02	5.2	6.521
2b - Roof Outlet + 1/3 2c - Roof Outlet	SRP Wizard FEH: 30 years: +0 %: 60 mins: Summer		1.6	11.520
1/3 Roof C Outlet - a	SRP Wizard FEH: 30 years: +0 %: 60 mins: Summer		0.9	6.408

SRP Wizard FEH: 100 years: Increase Rainfall (%): +40: Critical Storm Per Item

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow (m^3)
1/3 Roof C Outlet b	SRP Wizard FEH: 100 years: +40 %: 60 mins: Summer		0.9	6.408
1 - TOC	SRP Wizard FEH: 100 years: +40 %: 60 mins: Summer	0.01	5.1	6.389
2a - Roof Outlet	SRP Wizard FEH: 100 years: +40 %: 60 mins: Summer		0.7	4.968
2 - TOC	SRP Wizard FEH: 100 years: +40 %: 60 mins: Summer	0.02	9.8	12.244
2b - Roof Outlet + 1/3 2c - Roof Outlet	SRP Wizard FEH: 100 years: +40 %: 60 mins: Summer		1.6	11.520
1/3 Roof C Outlet - a	SRP Wizard FEH: 100 years: +40 %: 60 mins: Summer		0.9	6.408

E0751 - HIGHGATE: SURFACE WATER MODEL	Date: 05/07/2022		
	Designed by: KG	Checked by:	Approved By:
Report Details: Type: Junctions Summary Storm Phase: Storm	Company Address:		

FSR: 1 years: Increase Rainfall (%): +0: Critical Storm Per Item

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
S.5	FSR: 1 years: +0 %: 15 mins: Winter	37.410	36.110	36.139	0.029	2.6	0.008	0.000	2.5	2.362	OK
S.1	FSR: 1 years: +0 %: 15 mins: Winter	37.500	36.075	36.123	0.048	3.9	0.014	0.000	3.8	2.715	OK
S.3	FSR: 1 years: +0 %: 30 mins: Winter	37.330	35.100	35.314	0.214	5.3	0.242	0.000	4.2	12.971	OK
S.4	FSR: 1 years: +0 %: 30 mins: Winter	36.750	34.950	35.314	0.364	5.8	0.411	0.000	5.5	16.313	Surcharged
EX.MH.1	FSR: 1 years: +0 %: 30 mins: Winter	36.760	34.590	34.617	0.027	5.5	0.000	0.000	5.5	16.270	OK
S.2	FSR: 1 years: +0 %: 15 mins: Winter	37.500	35.965	36.008	0.043	5.4	0.012	0.000	5.2	5.355	OK

E0751 - HIGHGATE: SURFACE WATER MODEL	Date: 05/07/2022		
	Designed by: KG	Checked by:	Approved By:
Report Details: Type: Junctions Summary Storm Phase: Storm	Company Address:		

SRP Wizard FEH: 30 years: Increase Rainfall (%): +0: Critical Storm Per Item

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
S.5	SRP Wizard FEH: 30 years: +0 %: 60 mins: Summer	37.410	36.110	36.145	0.035	3.6	0.010	0.000	3.6	9.782	OK
S.1	SRP Wizard FEH: 30 years: +0 %: 60 mins: Summer	37.500	36.075	36.135	0.060	5.9	0.017	0.000	5.9	11.469	OK
S.3	SRP Wizard FEH: 30 years: +0 %: 60 mins: Winter	37.330	35.100	35.938	0.838	7.9	0.948	0.000	6.7	29.814	Surcharged
S.4	SRP Wizard FEH: 30 years: +0 %: 60 mins: Winter	36.750	34.950	35.937	0.987	9.9	1.116	0.000	9.4	39.223	Surcharged
EX.MH.1	SRP Wizard FEH: 30 years: +0 %: 60 mins: Winter	36.760	34.590	34.625	0.035	9.4	0.000	0.000	9.4	39.181	OK
S.2	SRP Wizard FEH: 30 years: +0 %: 60 mins: Summer	37.500	35.965	36.015	0.050	7.5	0.014	0.000	7.5	22.735	OK

E0751 - HIGHGATE: SURFACE WATER MODEL	Date: 05/07/2022		
	Designed by: KG	Checked by:	Approved By:
Report Details: Type: Junctions Summary Storm Phase: Storm	Company Address:		

SRP Wizard FEH: 100 years: Increase Rainfall (%): +40: Critical Storm Per Item

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
S.5	SRP Wizard FEH: 100 years: +40 %: 60 mins: Winter	37.410	36.110	36.656	0.546	5.5	0.155	0.000	4.3	13.543	Surcharged
S.1	SRP Wizard FEH: 100 years: +40 %: 60 mins: Winter	37.500	36.075	36.595	0.520	9.5	0.147	0.000	9.5	18.674	Surcharged
S.3	SRP Wizard FEH: 100 years: +40 %: 60 mins: Winter	37.330	35.100	36.580	1.480	9.6	1.673	0.000	8.5	36.223	Surcharged
S.4	SRP Wizard FEH: 100 years: +40 %: 60 mins: Winter	36.750	34.950	36.578	1.628	12.6	1.841	0.000	12.1	48.961	Surcharged
EX.MH.1	SRP Wizard FEH: 100 years: +40 %: 60 mins: Winter	36.760	34.590	34.630	0.040	12.1	0.000	0.000	12.1	48.918	OK
S.2	SRP Wizard FEH: 100 years: +40 %: 60 mins: Winter	37.500	35.965	36.592	0.627	11.1	0.177	0.000	8.7	29.902	Surcharged

E0751 - HIGHGATE: SURFACE WATER MODEL	Date: 05/07/2022		
	Designed by: KG	Checked by:	Approved By:
Report Details: Type: Connections Summary Storm Phase: Storm	Company Address:		

FSR: 1 years: Increase Rainfall (%): +0: Critical Storm Per Item

Connection	Storm Event	Connection Type	From	To	Upstream Cover Level (m)	Max. US Water Level (m)	Max. Flow Depth (m)	Discharge Volume (m³)	Max. Velocity (m/s)	Flow / Capacity	Max. Flow (L/s)	Status
S.1.003	FSR: 1 years: +0 %: 30 mins: Winter	Pipe	S.4	EX.MH.1	36.8	35.314	0.029	16.270	2.4	0.07	5.5	Surcharged
S.2.000	FSR: 1 years: +0 %: 15 mins: Winter	Pipe	S.5	S.4	37.4	36.139	0.100	2.362	0.3	0.18	2.5	OK
S.1.002	FSR: 1 years: +0 %: 30 mins: Winter	Pipe	S.3	S.4	37.3	35.314	0.289	12.971	0.2	0.04	4.2	OK
S.1.000	FSR: 1 years: +0 %: 15 mins: Winter	Pipe	S.1	S.2	37.5	36.123	0.046	2.715	0.7	0.09	3.8	OK
S.1.001	FSR: 1 years: +0 %: 15 mins: Winter	Pipe	S.2	S.3	37.5	36.008	0.076	5.355	0.9	0.08	5.2	OK

E0751 - HIGHGATE: SURFACE WATER MODEL	Date: 05/07/2022		
	Designed by: KG	Checked by:	Approved By:
Report Details: Type: Connections Summary Storm Phase: Storm	Company Address:		

SRP Wizard FEH: 30 years: Increase Rainfall (%): +0: Critical Storm Per Item

Connection	Storm Event	Connection Type	From	To	Upstream Cover Level (m)	Max. US Water Level (m)	Max. Flow Depth (m)	Discharge Volume (m³)	Max. Velocity (m/s)	Flow / Capacity	Max. Flow (L/s)	Status
S.1.003	SRP Wizard FEH: 30 years: +0 %: 60 mins: Winter	Pipe	S.4	EX.MH.1	36.8	35.937	0.038	39.181	2.7	0.12	9.4	Surcharged
S.2.000	SRP Wizard FEH: 30 years: +0 %: 60 mins: Summer	Pipe	S.5	S.4	37.4	36.145	0.100	9.782	0.5	0.26	3.6	OK
S.1.002	SRP Wizard FEH: 30 years: +0 %: 60 mins: Winter	Pipe	S.3	S.4	37.3	35.938	0.300	29.814	0.2	0.06	6.7	Surcharged
S.1.000	SRP Wizard FEH: 30 years: +0 %: 60 mins: Summer	Pipe	S.1	S.2	37.5	36.135	0.055	11.469	0.8	0.15	5.9	OK
S.1.001	SRP Wizard FEH: 30 years: +0 %: 60 mins: Summer	Pipe	S.2	S.3	37.5	36.015	0.225	22.735	0.8	0.12	7.5	OK

E0751 - HIGHGATE: SURFACE WATER MODEL	Date: 05/07/2022		
	Designed by: KG	Checked by:	Approved By:
Report Details: Type: Connections Summary Storm Phase: Storm	Company Address:		

SRP Wizard FEH: 100 years: Increase Rainfall (%): +40: Critical Storm Per Item

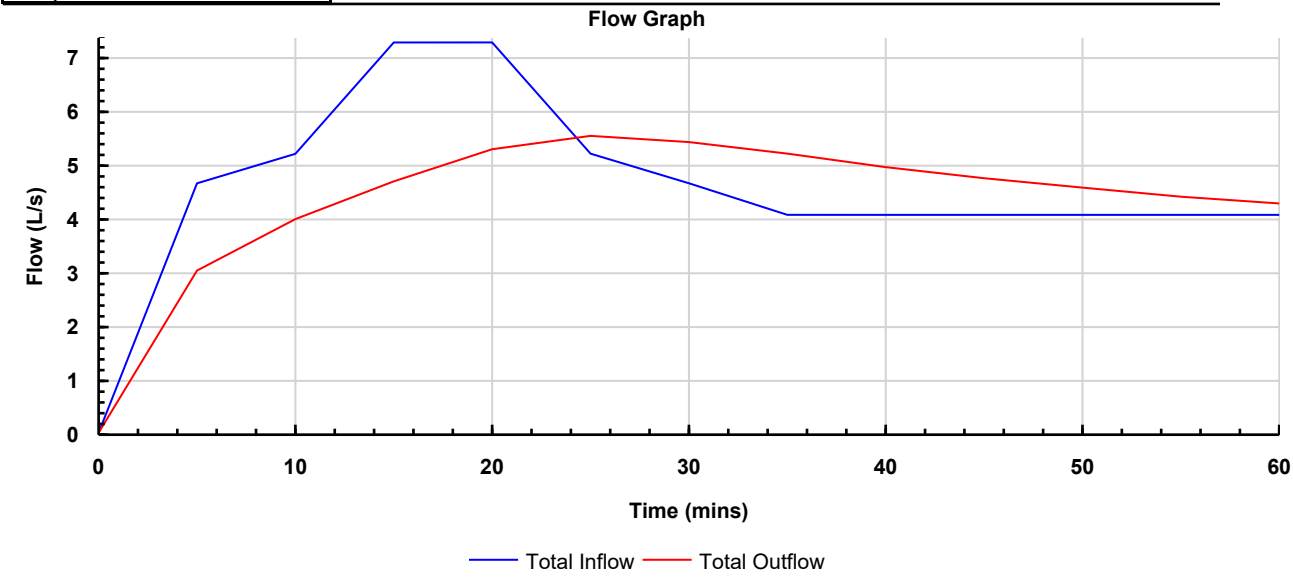
Connection	Storm Event	Connection Type	From	To	Upstream Cover Level (m)	Max. US Water Level (m)	Max. Flow Depth (m)	Discharge Volume (m³)	Max. Velocity (m/s)	Flow / Capacity	Max. Flow (L/s)	Status
S.1.003	SRP Wizard FEH: 100 years: +40 %: 60 mins: Winter	Pipe	S.4	EX.MH.1	36.8	36.578	0.043	48.918	2.9	0.15	12.1	Surcharged
S.2.000	SRP Wizard FEH: 100 years: +40 %: 60 mins: Summer	Pipe	S.5	S.4	37.4	36.601	0.100	12.775	0.7	0.39	5.3	Surcharged
S.1.002	SRP Wizard FEH: 100 years: +40 %: 60 mins: Winter	Pipe	S.3	S.4	37.3	36.580	0.300	36.223	0.2	0.08	8.5	Surcharged
S.1.000	SRP Wizard FEH: 100 years: +40 %: 60 mins: Summer	Pipe	S.1	S.2	37.5	36.549	0.225	17.197	0.9	0.26	10.3	Surcharged
S.1.001	SRP Wizard FEH: 100 years: +40 %: 60 mins: Summer	Pipe	S.2	S.3	37.5	36.547	0.225	28.431	0.9	0.16	10.6	Surcharged

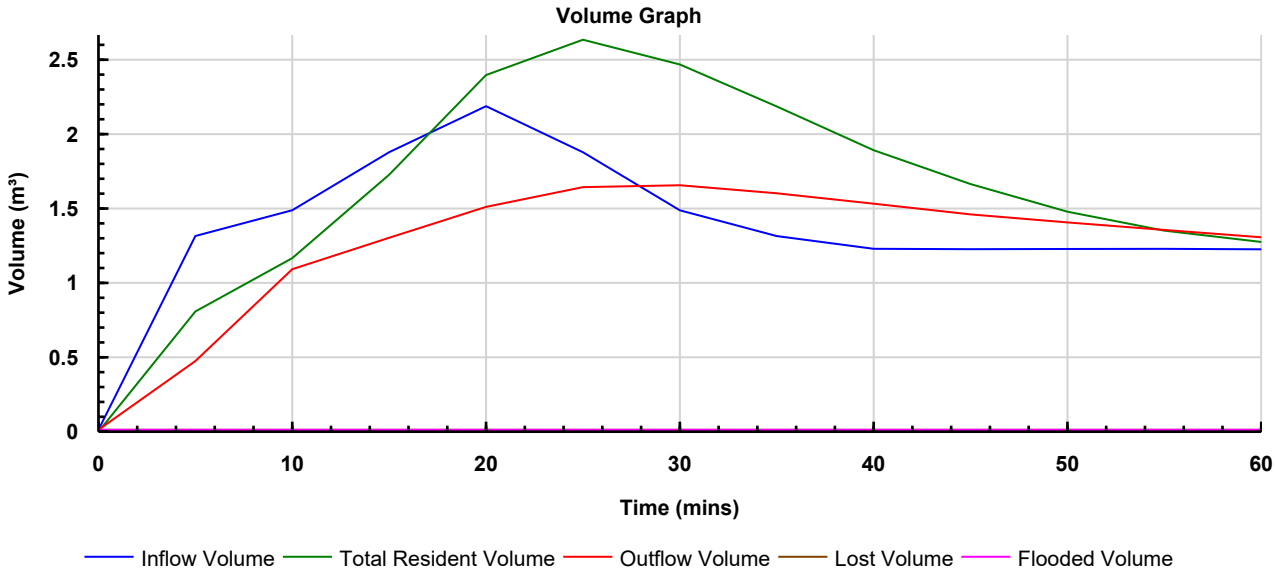
Storm
FSR: 1 years: Increase Rainfall (%): +0: 30 mins: Winter

Tables

Name	Max. Inflow (L/s)	Total Inflow Volume (m³)	Max. Outflow (L/s)	Total Outflow Volume (m³)
EX.MH.1			5.5	16.270
TOTAL	7.3	17.621	5.5	16.270

Graphs





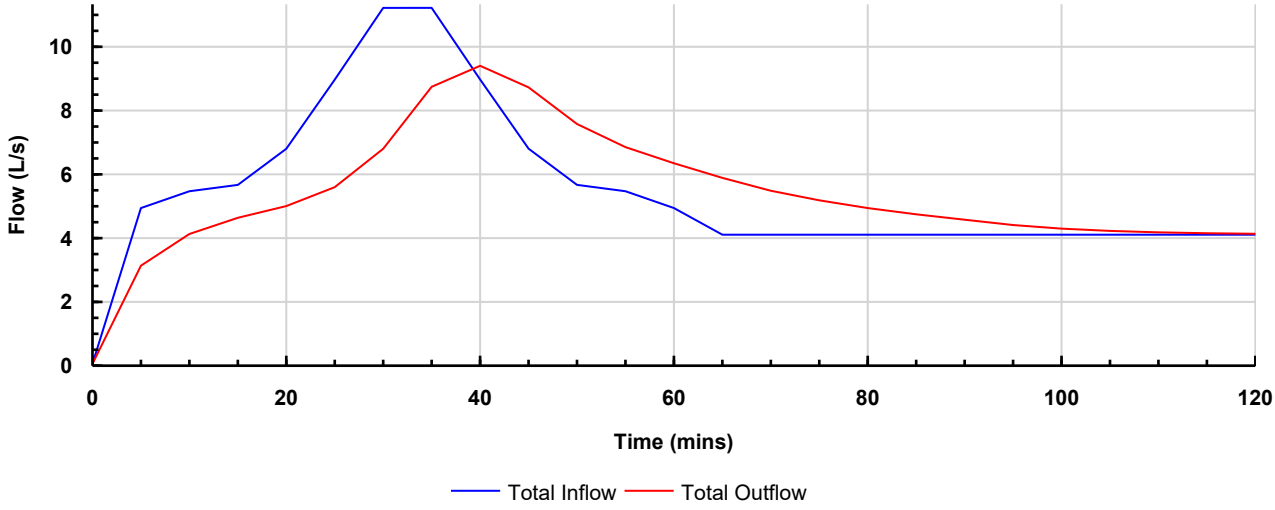
Storm
SRP Wizard FEH: 30 years: Increase Rainfall (%): +0: 60 mins: Winter

Tables

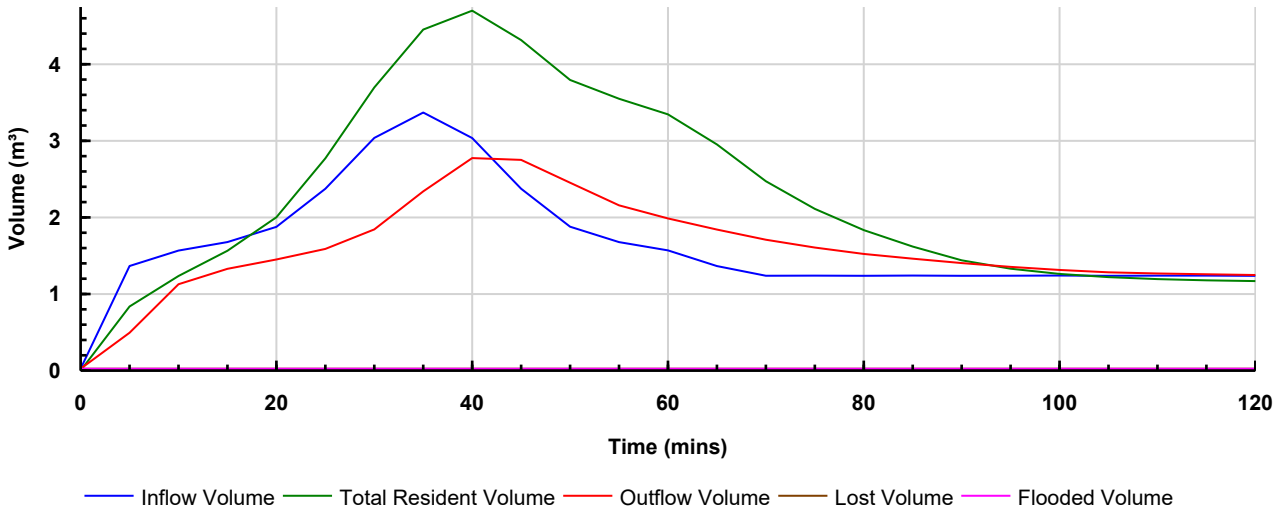
Name	Max. Inflow (L/s)	Total Inflow Volume (m³)	Max. Outflow (L/s)	Total Outflow Volume (m³)
EX.MH.1			9.4	39.181
TOTAL	11.2	40.421	9.4	39.181

Graphs

Flow Graph



Volume Graph



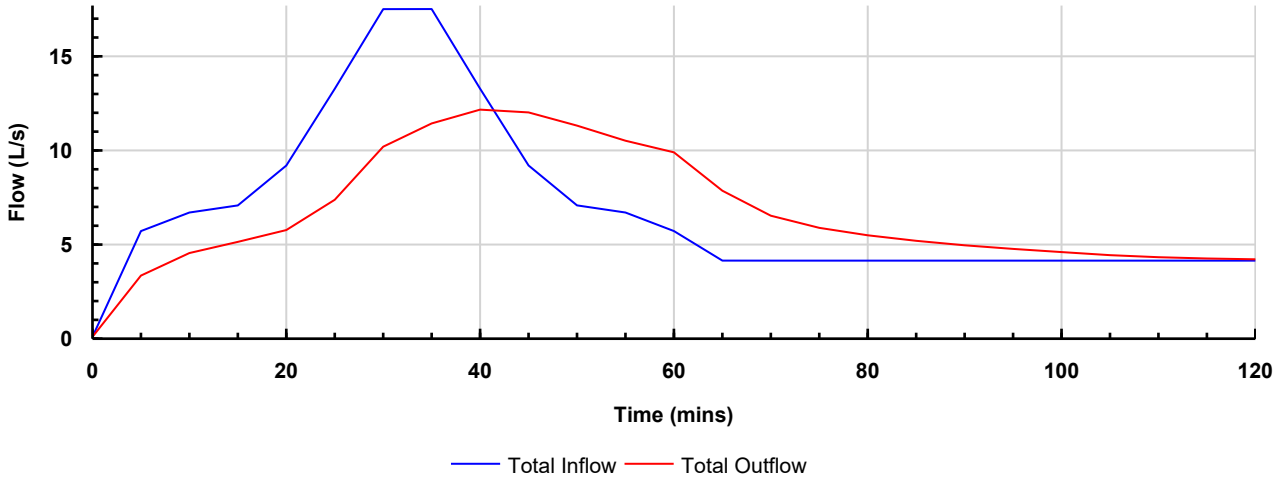
Storm
SRP Wizard FEH: 100 years: Increase Rainfall (%): +40: 60 mins: Winter

Tables

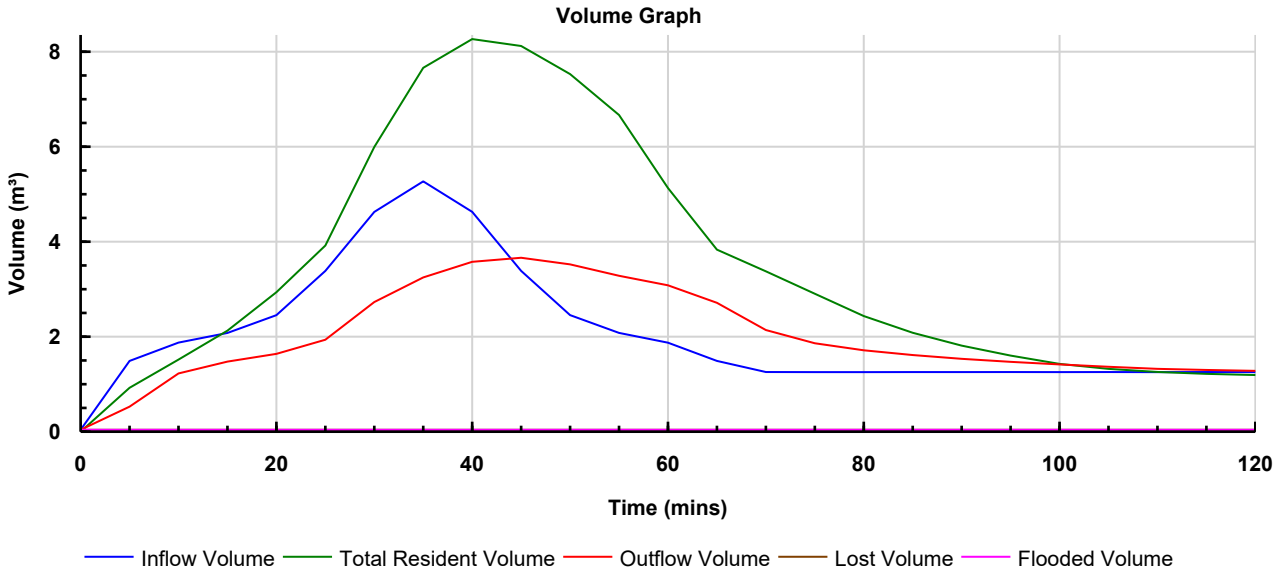
Name	Max. Inflow (L/s)	Total Inflow Volume (m³)	Max. Outflow (L/s)	Total Outflow Volume (m³)
EX.MH.1			12.1	48.918
TOTAL	17.5	50.181	12.1	48.918

Graphs

Flow Graph



Volume Graph



Appendix 6 – Blue Roof area and flow control

Bauder Ltd, 70 Landseer Road, Ipswich, IP3 0DH. T: +44 (0)1473 257671 e: info@bauder.co.uk

Date: 11/11/2021 **Revision:** A

Client:

Project: Highgate Road

Location: London

Roof Location: 2 l/s Option 2a

Roof Details:

BlueRoof	191 m²	x 100 %
Additional Area	28 m²	x 100 %
Effective Area	219 m²	

Storage Details:

Length	191 m
Width	1 m
Depth	100 mm
Porosity	95 %

Rainfall Details - FEH Method:

Return Period	100 years
Climate Change Factor	40 %

Summer Storm Profile

Duration	Intensity mm	mm/h	Required storage(m³)
5 min	26.0	312.3	5.6
10 min	37.0	221.9	7.9
15 min	45.4	181.7	9.6
30 min	58.2	116.4	11.9
45 min	65.7	87.6	13.1
60 min	71.0	71.0	13.8
2 hours	91.0	45.5	16.3
6 hours	124.2	20.7	17.1
24 hours	153.4	6.4	10.9

Outflow Details:

Attenuation Control	BlueRoof Outlet
Control	7 holes
Sump Depth	80 mm
Discharge rate	0.69 l/s
Outlet	1 No

Result:

Outcome	**Pass**
Critical Storm Duration	4 hrs
Hmax	96 mm
Required Volume	17.4 m³
Time to half empty	3.5 hrs
Roof Loading	91.1 Kg/m²

All results based on input data. Please check that input data has been correctly interpreted.

The Bauder Blue Flat Roof Rainwater Calculation Software will perform calculations in accordance with industry best practice for blue roof design based upon provided data relating to a specific building's dimensions geographical location and the flow rate performance of the selected Bauder rainwater outlet product.

Whilst the information contained herein is to the best of our knowledge true and accurate we specifically exclude any liability for errors omissions or otherwise arising therefrom.

Details practices principles values and calculations should be verified for accuracy and suitability for the required purpose for use.

NOTE: These calculations are valid for a zero fall roof with minimal variation in levels. Any significant variation will affect the volume of water stored and the roofs ability to attenuate extreme rain events. Typically variations in roof level should be less than 0 to +30mm with no back falls. The H-Max is measured from the mean roof level

Bauder Ltd, 70 Landseer Road, Ipswich, IP3 0DH. T: +44 (0)1473 257671 e: info@bauder.co.uk

Date: 11/11/2021 **Revision:** A

Client:

Project: Highgate Road

Location: London

Roof Location: 2 l/s Option 2b

Roof Details:

BlueRoof	187 m²	x 100 %
Additional Area	28 m²	x 100 %
Effective Area	215 m²	

Storage Details:

Length	187 m
Width	1 m
Depth	100 mm
Porosity	95 %

Rainfall Details - FEH Method:

Return Period	100 years
Climate Change Factor	40 %

Summer Storm Profile

Duration	Intensity mm	mm/h	Required storage(m³)
5 min	26.0	312.3	5.5
10 min	37.0	221.9	7.7
15 min	45.4	181.7	9.4
30 min	58.2	116.4	11.7
45 min	65.7	87.6	12.9
60 min	71.0	71.0	13.6
2 hours	91.0	45.5	16.0
6 hours	124.2	20.7	16.7
24 hours	153.4	6.4	10.6

Outflow Details:

Attenuation Control	BlueRoof Outlet
Control	7 holes
Sump Depth	80 mm
Discharge rate	0.69 l/s
Outlet	1 No

Result:

Outcome	**Pass**
Critical Storm Duration	4 hrs
Hmax	96 mm
Required Volume	17 m³
Time to half empty	3.4 hrs
Roof Loading	90.91 Kg/m²

All results based on input data. Please check that input data has been correctly interpreted.

The Bauder Blue Flat Roof Rainwater Calculation Software will perform calculations in accordance with industry best practice for blue roof design based upon provided data relating to a specific building's dimensions geographical location and the flow rate performance of the selected Bauder rainwater outlet product.

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Bauder Ltd, 70 Landseer Road, Ipswich, IP3 0DH. T: +44 (0)1473 257671 e: info@bauder.co.uk

Date: 11/11/2021 **Revision:** A

Client:

Project: Highgate Road

Location: London

Roof Location: 2 l/s Option 2c

Roof Details:

BlueRoof	188 m²	x 100 %
Additional Area	138 m²	x 100 %
Effective Area	326 m²	

Storage Details:

Length	188 m
Width	1 m
Depth	100 mm
Porosity	95 %

Rainfall Details - FEH Method:

Return Period	100 years
Climate Change Factor	40 %

Summer Storm Profile

Duration	Intensity		Required storage(m³)
	mm	mm/h	
5 min	26.0	312.3	8.0
10 min	37.0	221.9	11.0
15 min	45.4	181.7	13.2
30 min	58.2	116.4	15.5
45 min	65.7	87.6	16.2
60 min	71.0	71.0	16.3
2 hours	91.0	45.5	17.3
6 hours	124.2	20.7	14.8
24 hours	153.4	6.4	4.3

Outflow Details:

Attenuation Control	BlueRoof Outlet
Control	9 holes
Sump Depth	80 mm
Discharge rate	2.68 l/s
Outlet	3 No
Flow Per Outlet	0.89 l/s

Result:

Outcome	**Pass**
Critical Storm Duration	2 hrs
Hmax	97 mm
Required Volume	17.3 m³
Time to half empty	53.7 min
Roof Loading	92.02 Kg/m²

All results based on input data. Please check that input data has been correctly interpreted.

The Bauder Blue Flat Roof Rainwater Calculation Software will perform calculations in accordance with industry best practice for blue roof design based upon provided data relating to a specific building's dimensions geographical location and the flow rate performance of the selected Bauder rainwater outlet product.

Whilst the information contained herein is to the best of our knowledge true and accurate we specifically exclude any liability for errors omissions or otherwise arising therefrom.

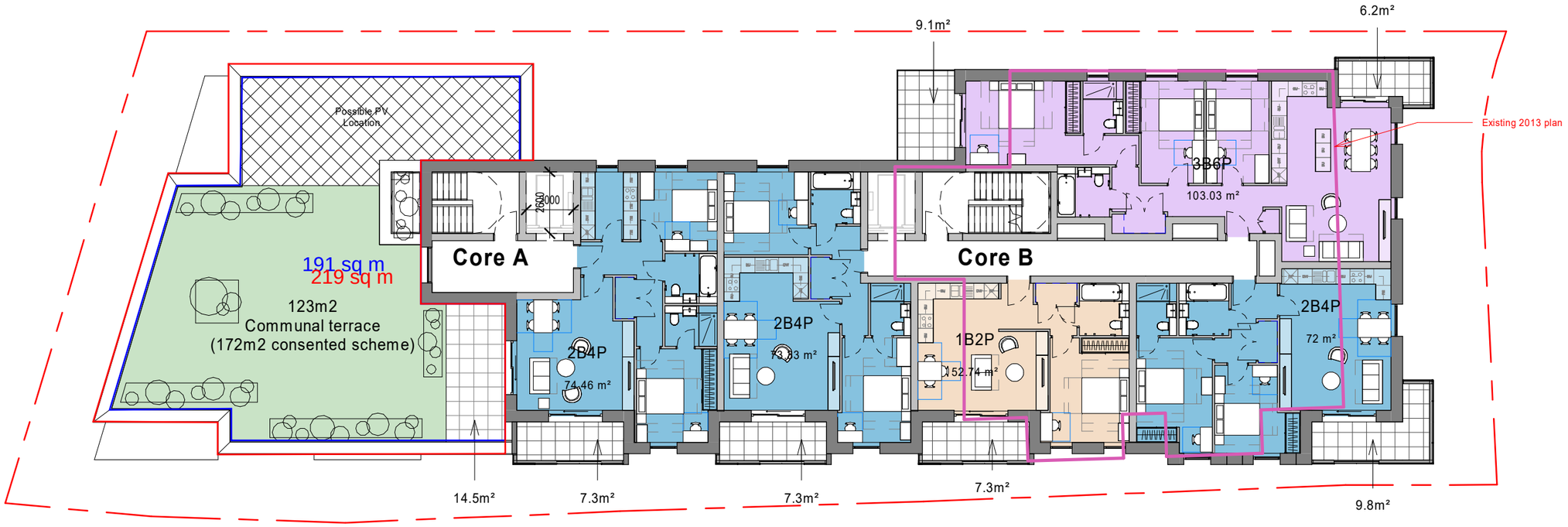
Details practices principles values and calculations should be verified for accuracy and suitability for the required purpose for use.

NOTE: These calculations are valid for a zero fall roof with minimal variation in levels. Any significant variation will affect the volume of water stored and the roofs ability to attenuate extreme rain events. Typically variations in roof level should be less than 0 to +30mm with no back falls. The H-Max is measured from the mean roof level

2a

Blue text denotes blue roof area

Red text denotes total catchment area



Level 5

Rev	Description	Date	Dr by	App by
3	First Issue	05.11.21	MAG	KL
2	Issue for Pre Application	16.06.21	TS	WLH
1	Draft Issue	25.05.21	TS	WLH

original by	date created	approved by
TS	06.06.20	KL

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5-8 Hardwick Street
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United Kingdom

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E london@ahr.co.uk
www.ahr.co.uk

client name: GM London

project: 19-37 Highgate Road

drawing: 5th Floor Plan

computer file: C:\Revit Projects\HR-AHR-B1-ZZ-M3-A-001-option2_maria.georgieva.rvt

plot date: 07.06.21

project number: 2019.00386.001

scale: 1 : 200 @A3

drawing number: HR-AHR-B1-05-DR-A-20-105

rev: 3

issue status: P01

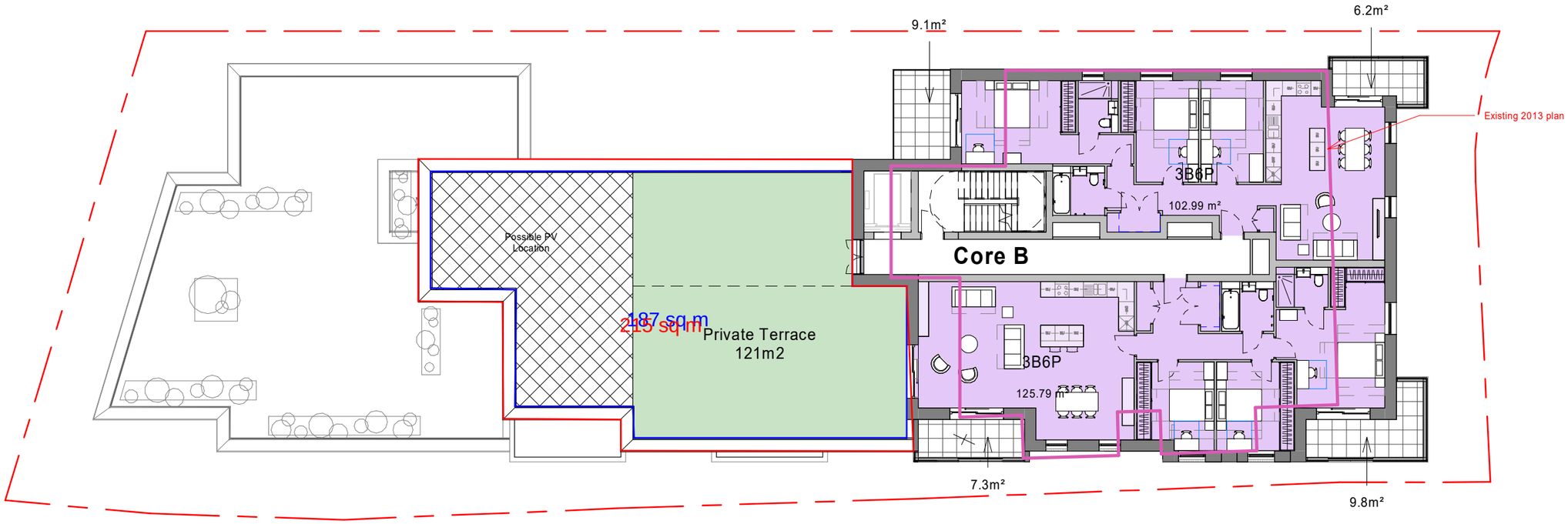
SCALE 1 : 200

0 4 8 12

2b

Blue text denotes blue roof area

Red text denotes total catchment area



Level 6

Rev	Description	Date	Dr by	App by
3	First Issue	05.11.21	MAG	KL
2	Issue for Pre Application	16.06.21	TS	WLH
1	Draft Issue	25.05.21	TS	WLH

original by	date created	approved by
TS	06.06.20	KL

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client name: GM London

project: 19-37 Highgate Road

drawing: 6th Floor Plan

computer file: C:\Revit Projects\HR-AHR-B1-ZZ-M3-A-001-option2_maria.georgieva.rvt

plot date: 07.06.21

project number: 2019.00386.001

scale: 1 : 200 @A3

drawing number: HR-AHR-B1-06-DR-A-20-106

rev: 3

issue status: P01

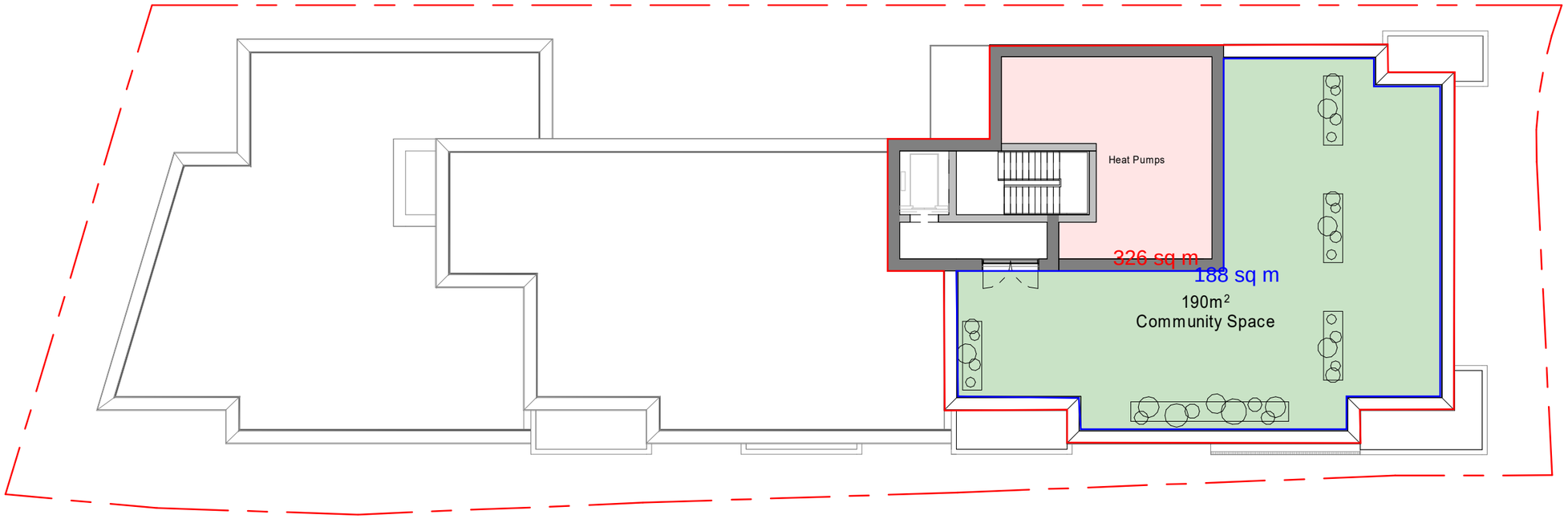
SCALE 1 : 200

0 4 8 12

2c

Blue text denotes blue roof area

Red text denotes total catchment area



Roof

Rev	Description	Date	Dr by	App by
3	First Issue	05.11.21	MAG	KL
2	Issue for Pre Application	16.06.21	TS	WLH
1	Draft Issue	25.05.21	TS	WLH

original by	date created	approved by
TS	06.06.20	KL

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www.ahr.co.uk

client name: GM London

project: 19-37 Highgate Road

drawing: Roof Level

computer file: C:\Revit Projects\HR-AHR-B1-ZZ-M3-A-001-option2_maria.georgieva.rvt

plot date: 07.06.21

project number: 2019.00386.001

scale: 1 : 200 @A3

drawing number: HR-AHR-B1-07-DR-A-20-107

rev: 3

issue status: P01

SCALE 1 : 200

0 4 8 12