1247 - 73-75 Avenue Road Floor Risk Assessment

HEYNE TILLETT STEEL

Contents

Appendices

Status:	Flood Risk Assesment	
Date:	24/03/2016	~~18/02/2015~~
Revision:	B	~~A~~
Job no:	1247	
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Approved by:	Andy Heyne	

HEYNE TILLETT STEEL

1 Introduction

This FRA has been carried out in accordance with Planning Policy Statement (PPS) 25, along with advice and guidance from the Environment Agency (EA), London Borough of Camden Guidance and CIRIA documents.

PPS 25 states that an appropriate FRA will be required for all development proposals of 1Ha or greater in Flood Zone 1, or for any development within flood zones 2 or 3. The site is within flood zone 1 and is smaller than 1 Ha, but the proposals involve the construction of a basement in an area that is vulnerable to pluvial flooding. Therefore, the FRA must be focused on flood mitigation measures in order to prevent overland flows from entering the house.

2 Site Description and Location

The subject site location is shown in Figure 2. The site occupies an area of approximately 0.24 Ha at OSGR TQ 269838. The site falls to the northeast with a maximum level difference of approximately 1m and an average ground level of approximately 45.0m AOD.

The existing property, a swimming pool, with soft and hard landscaped areas currently occupies the site. The existing house is raised approximately 1m above existing ground levels. The site is bounded by Avenue Road to the northeast, Queen Grove to the southeast and existing residential developments to the northwest and east west.

The site co-ordinates are at grid ref OS 526930 / 183830.

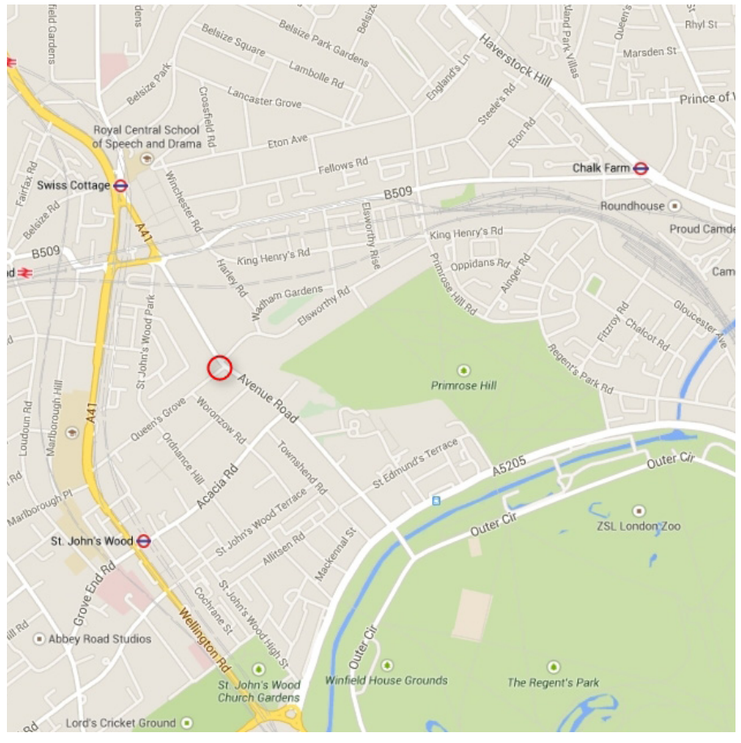
Access to the site is currently available to pedestrians and vehicles from Avenue Road.

The postcode is NW8 6JD, with Latitude North 526930 and Longitude West 01016

Images

1 Site Location Plan
2 Site Plan

1



2

3 Development Proposal

The proposed site is to be redeveloped for residential purposes. The proposals involve two residential properties with three storeys and two basement levels for each. A carpark will be provided at the lower basement level and a swimming pool at the upper basement level for both residential units. The proposal also involves modifications to the external areas of the site.

4 Flood Risk Assessment

4.1 Flood Risk from Watercourse

There is not a risk from flooding from Rivers as identified ion the Environment Agency (EA) indicative flood outline map. The map shows that the site lies within Flood Zone 1 (Figure 5).

4.2 Flood from Sewers and Overland Flows

The SFRA states that flood event on the 7th August 2002 was caused by excessive rainfall causing the main sewer system to become completely inundated. The surcharge pressure forced the water to back onto the streets through manholes and gully gratings and into residents' homes at basement and ground floor level. It was stated that blocked or otherwise deficient

Camden Council highway gullies could not have caused flooding on this scale "as the flood water could not drain to the trunk sewer". Floods in Camden report, prepared by London Borough of Camden in June 2003 provides a map that shows which roads and areas were flooded in 1975 and 2002 floods. Floods in Camden, Appendix 4 also names the roads that were flooded in these two storms. In accordance with this document Avenue Road was affected in 2002 flood event.

The topographical survey drawing shows that any overland flows from other developments upstream to the site will run from southwest to southeast alongside the site south boundary flooding Avenue Road and the areas downstream of the site.

Historical records confirm that the site and the surrounding areas were flooded in the past. The proposals include a new basement that is defined as vulnerable in table D.2 of PPS 25 because they are particularly vulnerable to all forms of flooding.

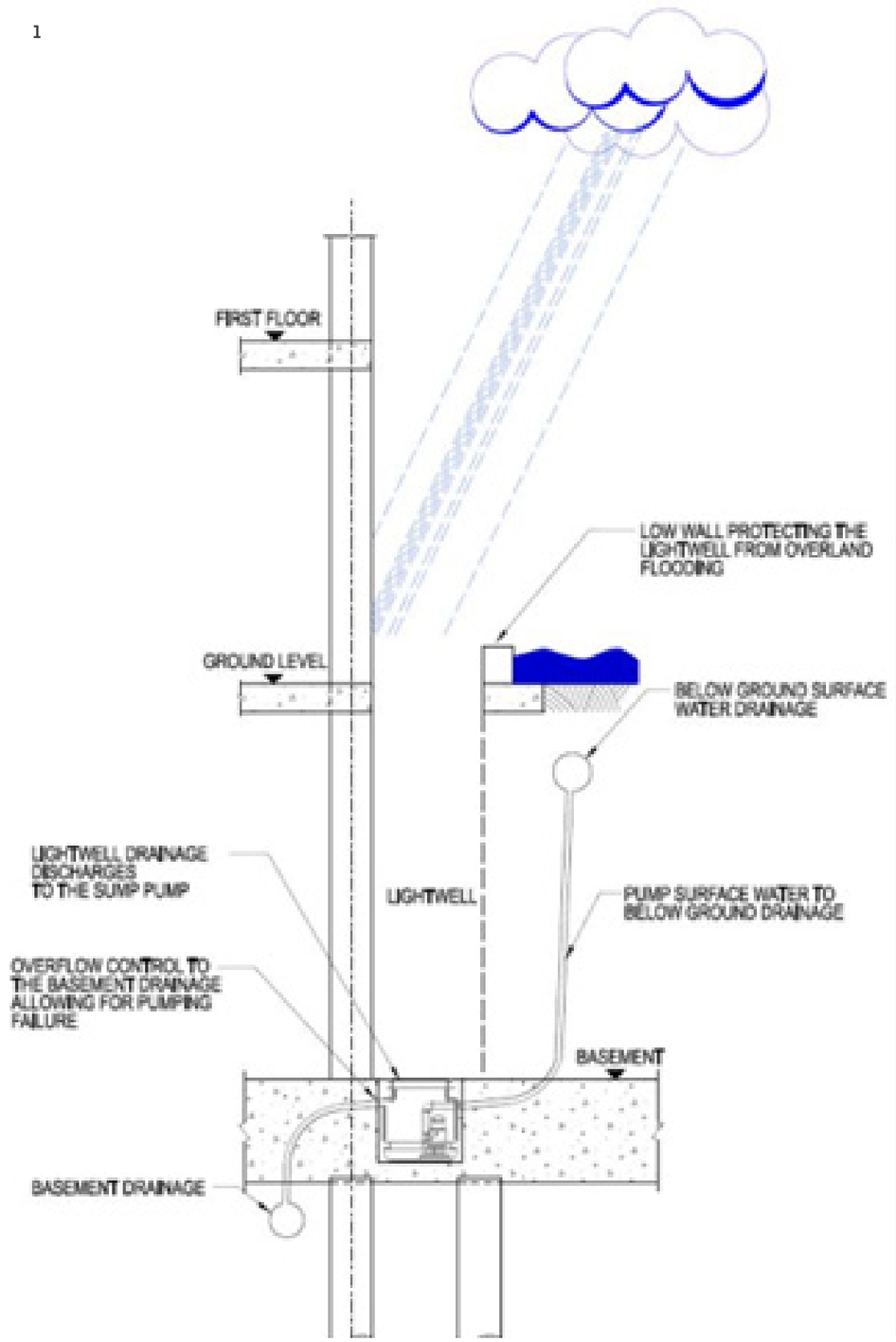
The proposals show that the ground floor level will be approximately 200mm above the surrounding ground levels. Therefore, the proposed raised levels will prevent water from flooded roads from entering the building.

The proposals also include two lightwells that extends to basement levels. The lightwells will be also constructed with a 200mm upstand wall at external level to protect it from (potential) overland flooding from the Avenue Road.

A drainage system will be constructed in the lightwells, pumping surface water to the below ground drainage. It is also proposed a wall to be constructed around the lightwell preventing overland flows from draining to the basement. This is a precautionary measure, as the lightwell is an external structure and will operate as a gully in an unpredictable flood incident (such as flooding from private sewers on site). It is also proposed that gravity drainage is constructed (where achievable) with backflow valves preventing flooding from surcharged sewers. Backflow prevention valves must be also provided for the pumped network that will serve the basement.

Images
1 Lightwell flood protection design

1



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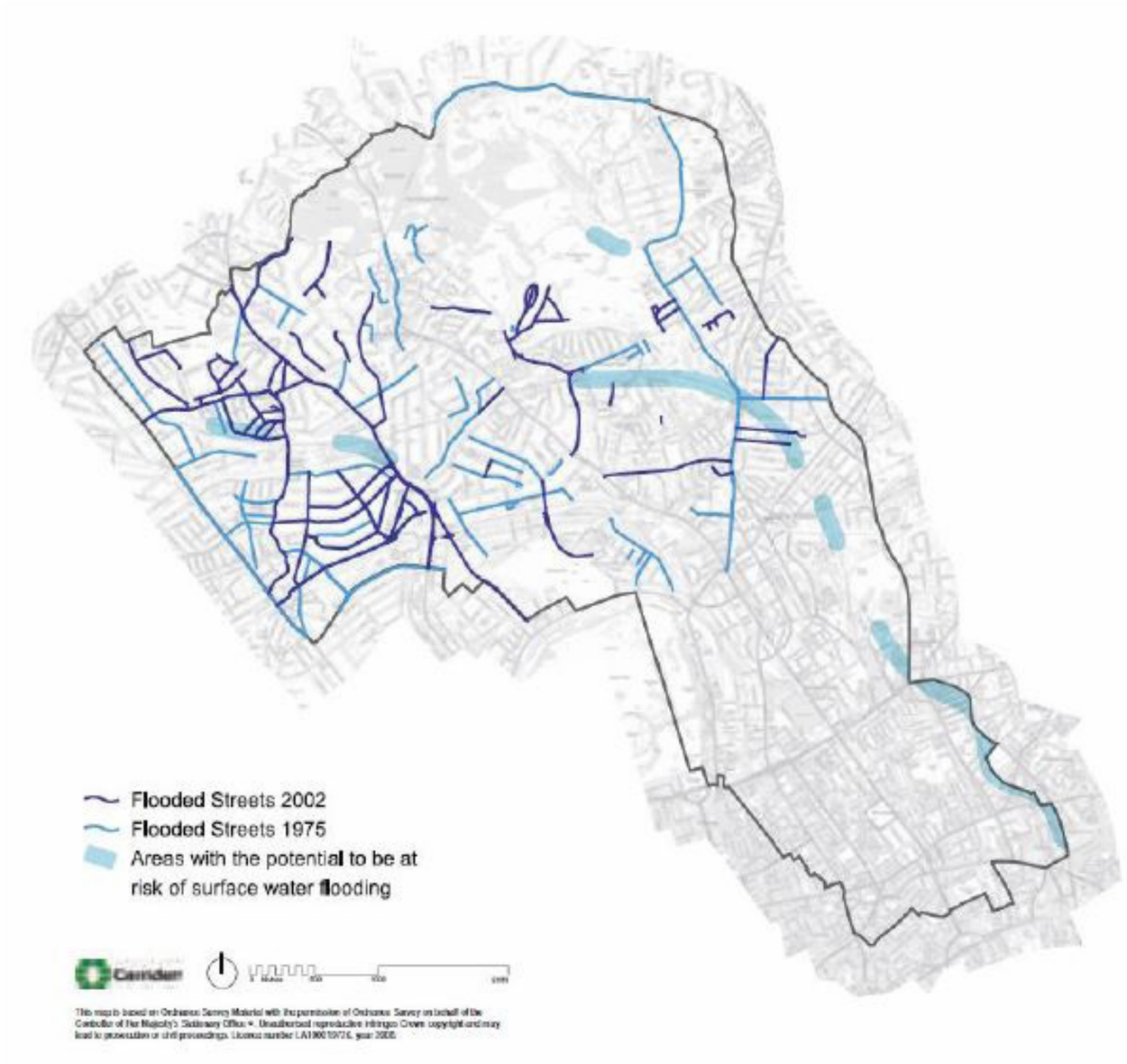


5 Surface Water Management Analysis

The surface water management analysis demonstrates that suitable sustainable drainage systems (SuDS) are incorporated into the post development drainage design so that the pre and post development surface water run-off rates are not exceeded, and to demonstrate that no sub-surface water flow regimes are interrupted because of the development.

The pre development site has an area of 2400m² and currently consists of an impermeable area of 840m² (roofs, paved areas etc), and a permeable area of 1560m² (lawn, flower beds, shrubs etc).

The post development site also has an area of 2400m² and will consist of an impermeable area of 1050m² (Inc area of basement), and a permeable are of 1350m².

Based on a topographical survey, there is an existing manhole and outfall pipe from the pre development site that connects to the public sewer within Avenue Road. It is proposed that the post development surface water run-off will re-use the existing outfall pipe to the public sewer.

The details of the pre development surface water network is unclear, and therefore is not accurately possible to calculate the pre development surface water run-off rates to the public sewer.

The post development surface water run-off rates are therefore to be restricted to `greenfield' to ensure that the pre development run-off rates are not exceeded.

5.1 Pre-development Surface Water Run-Off Rates – `Greenfield'

In order to know what the post development surface water run-off rates are to be, the pre development greenfield run-off rates are to be calculated.

Existing Greenfield Run-Off Rates

Relevant documents state that in order to calculate the greenfield run-off rates on small catchments less than 25km², the IH 124 QBAR equation (and the equation for the instantaneous time to peak for the unit hydrograph approach) is to be used.

The IH method is based on the Flood Studies Report (FSR) approach and is developed for use on catchments less than 25 km². It yields the Mean Annual Maximum Flood (QBAR). This reference also recommends the use of Ciria Book 14 to generate Growth Factors. These are used to convert QBAR to different return periods for different regions in the UK.

Images
7 Historical flood levels (Extract from floods in Camden)

The input variables to establish QBAR are:

- Return Period (years) — Results based on a range of return periods and the specified RP.
- Area — Catchment Area (ha) which is adjusted to km^2 for use in the equation.
- SAAR — Average annual rainfall in mm (1941-1970) from FSR figure II.3.1.
- Soil — Soil index of the catchment from FSR figure I.4.18 and/or Wallingford.
  Procedure Volume 3. Soil classes 1 to 5 have Soil Index values of 0.15, 0.3, 0.4, 0.45 and 0.5 respectively.
- Urban — Proportion of area urbanised expressed as a decimal
- Region Number — Region number of the catchment based on FSR Figure I.2.4.

$QBAR_{rural}$ (l/s)

The output variables to establish $QBAR_{rural}$ are calculated using the following formula (equation yields m^3/s):

$$QBAR_{rural} = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

The IH 124 Variables (taken from FSR) that are specific to this site are as follows:-

Return Periods 1 in 2, 1 in 30 and a 1 in 100 year storms

- Area — 0.240 ha
- SAAR — 600
- Soil — 0.300
- Urban — 0.00
- Region Number — 6

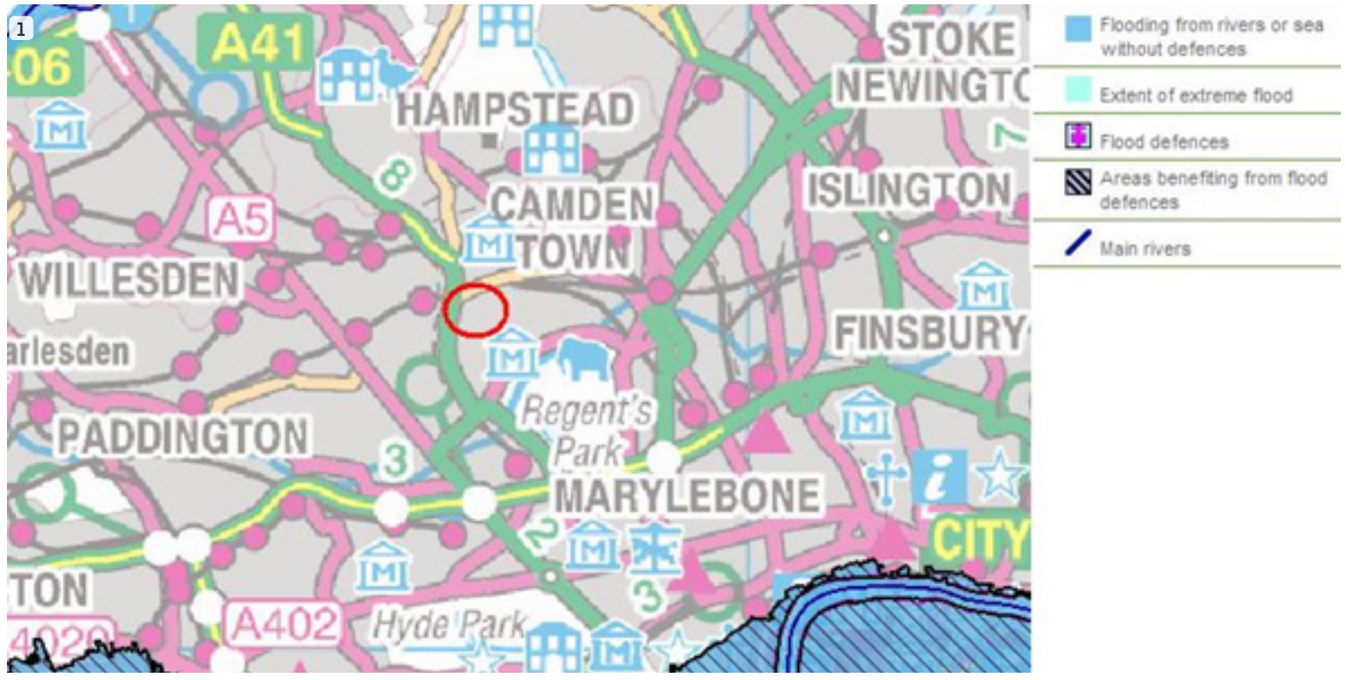
Based on the above variables and formula the $QBAR_{rural}$ for the existing site = 0.37 l/s

Now that the $QBAR_{rural}$ has been calculated the existing greenfield run-off rates can be calculated for each of the storm events.

Ciria C697 Table 4.2 identifies the growth factors for each of the storm events, based on the known $QBAR_{rural}$ figure. The growth factors from the table vary depending on the site location. In this case hydrometric area (Region Number) is 10.

Based on the figures derived from the table, the growth factors and the existing greenfield run-off rates for each of the storm events is as follows:-

Storm Event	$QBAR_{rural}$	Growth Factor (C697 Table 4.2)	Existing Greenfield Run-off Rate
Q_2	0.37 l/s	0.88	0.33 l/s
Q_{30}	0.37 l/s	2.67	0.99 l/s
Q_{100}	0.37 l/s	3.19	1.18 l/s



Images
1 Environment agency indicative floodplain map

These calculations have been checked against XP Solution WinDes computer software and can be found in Appendix A. The area entered for the calculation to conform to the IH method is 50 ha. The results of this are to be pro rata to the actual area of the site (e.g. 0.24 / 50 = 0.0048, 0.024 x 76.1 l/s = 0.37 l/s)

5.2 Post-development Surface Water Run-Off Calculations

As previously stated the post development site will consist of an impermeable area of 1500m² / 0.15ha.

The variables and calculations to determine the post development surface water run-off rates have been checked against XP Solution WinDes computer software and can be found in Appendix B.

The variables used to calculate the surface water run-off rates for the post development site are as follows:-

- Proposed Impermeable Area = 0.105 ha
- M5 – 60 (mm) = 20.600
- Ratio R = 0.438
- C_v (Summer) = 0.750
- C_v (Winter) = 0.840
- Time of Entry = 5 minutes
- Climate Change = 30%*[1] (1 in 100 year storm)

*[1] *PPS25 Table B.2 shows that the peak rainfall intensity will increase by 30% by the years 2085 to 2115. As the development is residential the life span of the building will fall in to these years.*

If no SuDS or flow controls were designed in the post development surface water drainage network then the free flowing surface water run-off rates would be:

- Q_2 = 20 l/s
- Q_{30} = 38 l/s
- Q_{100} + CC = 64 l/s

5.3 Post-development Surface Water Management – SuDS

As the details in Sections 2.0 and 3.0 the non-restricted post development surface water run-off rate exceed the required pre development greenfield run-off rates for each of the storm events.

Therefore, SuDS features are to be used in the post development design in order to reduce the post development surface water run-off and discharge volume to the required rates.

The preferred SuDS methods are to use retention ponds, wetlands and detentions basin. Where these cannot be used soakaways, swales and other infiltration rates are preferred. If none of the above a practical then green roofs, permeable paving (non-infiltration) and flow controls can be used.

Due to the layout of the new residential building; the proposed building having a basement, and the need for a garden space for the development to be viable the use of wetlands, ponds or detention basins is not a SuDS option.

Initial geotechnical survey show that the site is highly likely to be underlined by London Clay and therefore is classed as an impermeable material. This means the use of any infiltration for the post development site is not a viable option.

Due to the ground condition the alternative would be to discharge the surface water run-off from the site to the existing public sewer within Avenue Road via a flow control manhole.

As the surface water is to connect to a public sewer, the demarcation chamber, flow control an outfall pipe are to adhere to Sewers for Adoption 7th Edition.

Sewer for Adoption 7th Edition states that the minimum diameter for an outfall pipe is to be 100mm. This is to reduce the risk of blockage within the pipe and subsequently reduce the risk of flooding on or off the development site.

As the outfall pipe / flow control is to be minimum of 100mm, the pre development greenfield run-off rates shown in Table 1 cannot be achieved. The surface water run-off rates are therefore to be reduced to 5 l/s for all storm events.

The run-off rates of 5 l/s also adheres to the requirements of Code for Sustainable Homes where is states that the post development run-off rates cannot exceed the pre development, and that if the post development discharge volume exceeds the pre development then the surface water is to be restricted to either QBAR, peak 1 in 1 year run-off rate, 2 l/s/ha, or 5 l/s whichever is the greater.

As the surface water is to be restricted there will be a requirement for below ground attenuation. This is to be achieved in the sub-base of permeable paving within the drive-way and car parking area, the sub-base of the permeable paving in the terrace area, and a granular base below a lawn are for the development site.

5.4 Post-development Surface Water Management – Sub-Surface Water Flow

Historical information and maps show that there could be a potential sub-surface water flow at a depth of between 0.6 – 1.7m below ground.

As the proposed building has a basement the surface water flow may be interrupted.

In order to prevent the interruption of flow it is proposed that a 500mm wide granular filled trench is built around the basement wall at a depth of 1.80m.

The trench will be filled with 20mm no fines gravel which has a 30%v void ratio and will be wrapped in a permeable geotextile to stop fines and maintain the voids.

This will be built for the entire length of the basement wall and will convey the sub-surface water around the basement structure without interrupting the flow.

5.5 Surface Water Attenuation Requirements and Locations

The required surface water attenuation volumes for the development when restricted to 5 l/s are as follows:-

Storm Event	Restricted Discharge Rate	Flow Control Type	*[1]Attenuation Range	Approximate Attenuation Required (Max)
Q_2	5 l/s	Hydro-Brake	4.4m³ - 9.5m³	7m³
Q_{30}	5 l/s	Hydro-Brake	14m³ - 23m³	19m³
Q_{100} + 30% CC	5 l/s	Hydro-Brake	30m³ - 46m³	38m³

**1 Attenuation ranges shown in table are estimated volume for a storage structure. The required storage structure volume will vary depending upon the drainage network design, i.e. if a network consists of large pipes and manholes the storage structure required will be lower, and if the network consists of smaller pipes and manholes the storage structure required will be higher. The volume is also estimated as the critical storm duration for the proposed surface water network is not yet known.*

These results have been calculated by the XP Solutions WinDes computer software where extracts of the results can be found in Appendix C.

It is proposed that the surface water attenuation is stroed within the sub-base of the driveways of the new residential buildings. The area and volume achieved from the sub-base is:-

5.5.1 Resin Bound Material – Driveway Area

- Driveway area - 215m²
- Sub-base depth - 500mm
- Sub-base material - 20mm no fines aggregate
- Material void ration - 30%
- Volume in sub-base - (215 x 0.3) x 0.5 - 32m³

As the above calculation show the total below ground attenuation volume achieved within the sub-base of the driveway is 32m³, which is adequate for the storms up to the 1 in 30 year event.

The required attenuation volume for the 1 in 100 year storm is approximately 38m³ which equates to an additional 6m³ of water that is to be attenuated. This additional volume of water is to be stored so that it does not flood any building on site, and does not discharge off the site.

The drainage network can be designed so that the additional volume of water can disperse onto the driveway area. The depth of the water on the lawn in a 1 in 100 year storm event will be:

5.5.2 Additional Attenuation - Lawn Area

- Lawn area - 215m²
- Additional Volume - 6.0m³
- Depth of Water - 6.0 / 215 - 28mm

As the above calculation shows the depth of the water during the 1 in 100 year storm event will be 17mm which can be easily retained on site without increasing the risk of flood to the building.

Appendix A

Pre -development 'Greenfield' surface water run-off rates

IH 124 Mean Annual Flood

Input

Return Period (years)	2	Soil	0.300
Area (ha)	50.000	Urban	0.000
SAAR (mm)	600	Region Number	Region 6

Results	l/s
QBAR Rural	76.1
QBAR Urban	76.1
Q2 years	67.0
Q1 year	64.7
Q2 years	67.0
Q5 years	97.4
Q10 years	123.3
Q20 years	152.4
Q25 years	163.4
Q30 years	172.4
Q50 years	199.3
Q100 years	242.7
Q200 years	285.3
Q250 years	299.0
Q1000 years	392.6

Appendix B

Post-development 'mock ' surface water run-off rates

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.438	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.080	4-8	0.025

Total Area Contributing (ha) = 0.105

Total Pipe Volume (m³) = 1.414

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	10.000	0.100	100.0	0.105	5.00	0.0	0.600	o	300
1.001	10.000	0.100	100.0	0.000	0.00	0.0	0.600	o	300

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.11	10.000	0.105	0.0	0.0	0.0	1.57	111.1	14.2
1.001	50.00	5.21	9.900	0.105	0.0	0.0	0.0	1.57	111.1	14.2

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0		

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.600	Storm Duration (mins)	30
Ratio R	0.438		

Summary of Results for 15 minute 2 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	10.103	-0.197	0.000	0.26	0.0	20.2	OK
1.001	2	10.003	-0.197	0.000	0.25	0.0	19.9	OK

Flo_Consult UK Ltd		Page 1
7 Bertal Road London SW17 0BX	73-75 Avenue Road Post Development Mock Network Unrestricted SW Run-Off Rates	
Date 12.02.15 File	Designed by MDS Checked by MDS	
XP Solutions	Network 2014.1.1	

Summary of Results for 15 minute 30 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	10.148	-0.152	0.000	0.48	0.0	38.1	OK
1.001	2	10.048	-0.152	0.000	0.48	0.0	37.9	OK

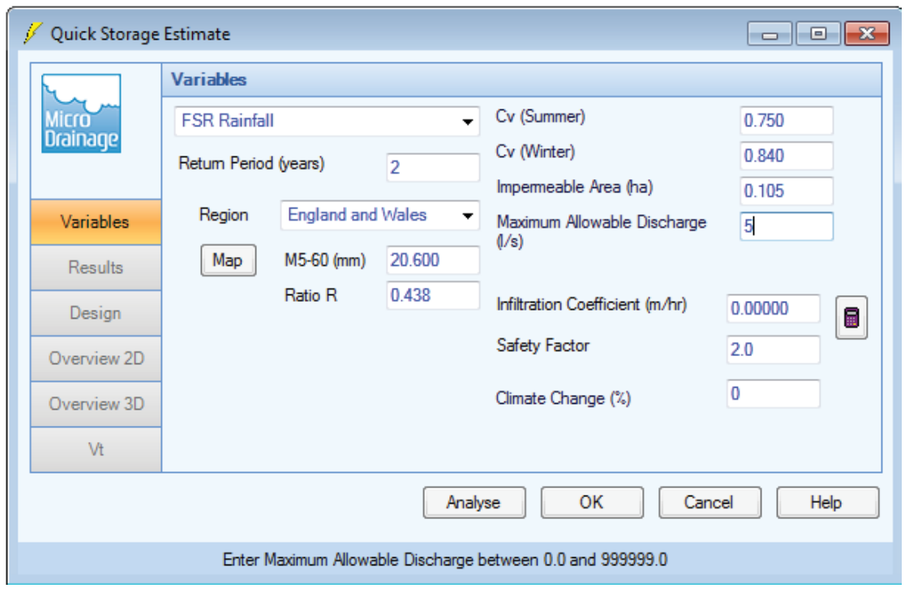
Summary of Results for 15 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

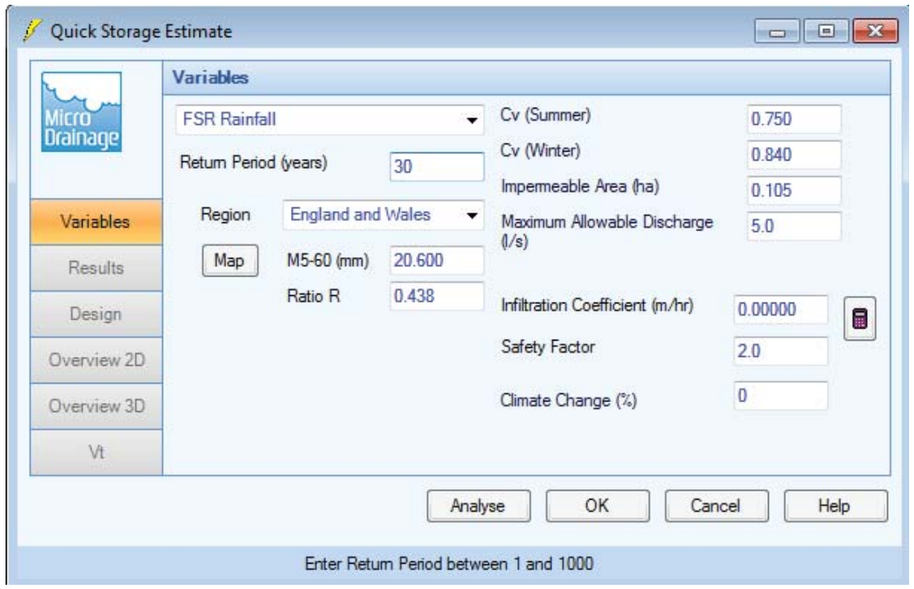
PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	10.208	-0.092	0.000	0.81	0.0	64.3	OK
1.001	2	10.109	-0.091	0.000	0.81	0.0	64.1	OK

Appendix C

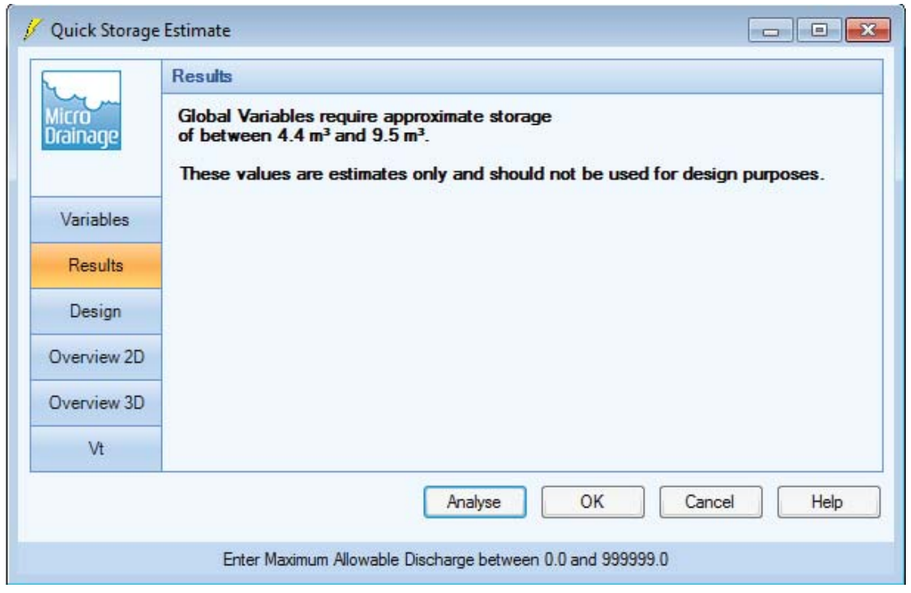
Approximate Attenuation Volumes



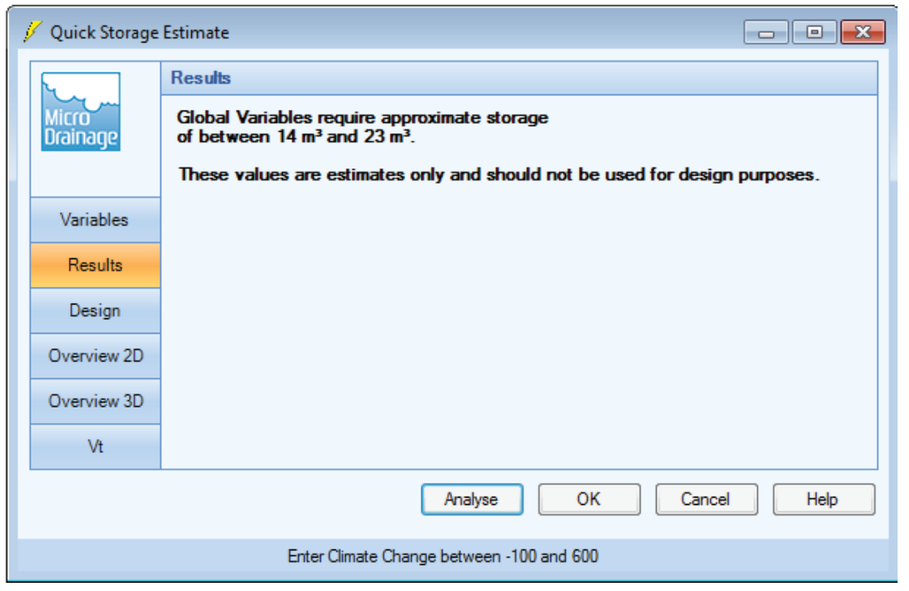
1 in 2 Year Storm Variables



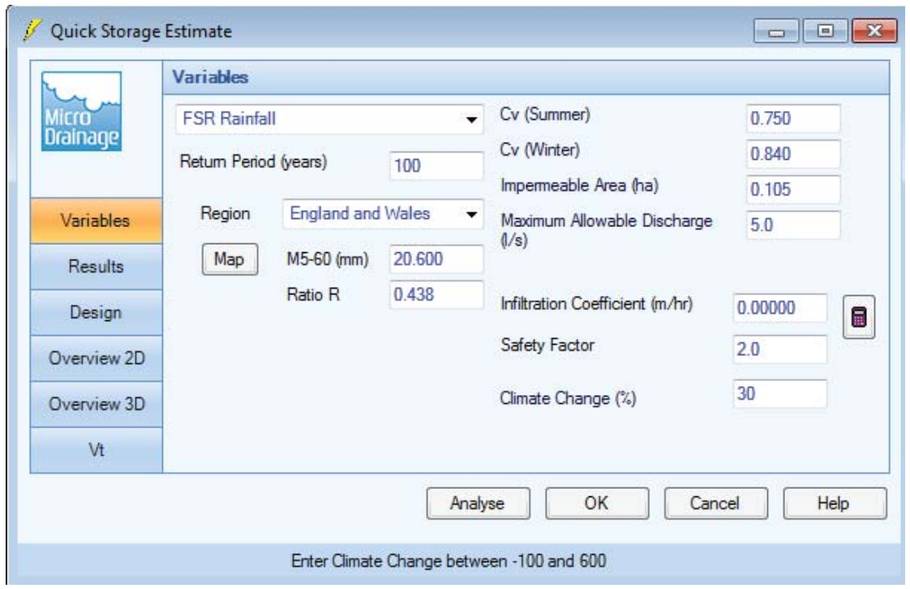
1 in 30 Year Storm Variables



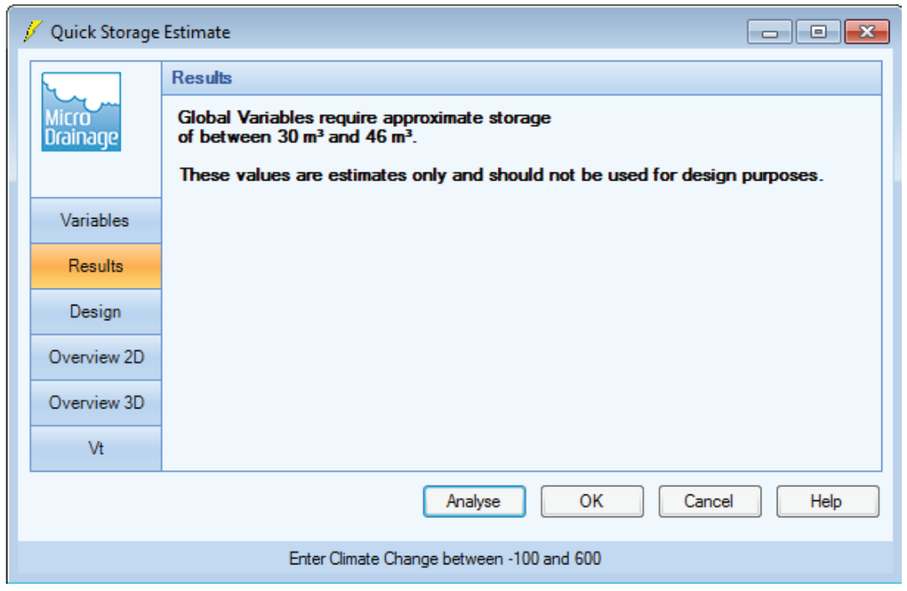
1 in 2 Year Storm Approximate Attenuation Range



1 in 30 Year Storm Approximate Attenuation Range



1 in 100 Year Storm Variables



1 in 100 Year Storm + Climate Change Approximate Attenuation Range

Appendix D

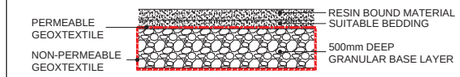
Surface water management analysis drawings SK01 & SK02

OUTLINE DRAINAGE DESIGN SHOWN ONLY

FINAL MANHOLE AND RAINWATER PIPE LOCATIONS TO BE CONFIRMED.

EXISTING SEWER DEPTH TO BE CONFIRMED.

REFER TO SURFACE WATER MANAGEMENT REPORT FOR ATTENUATION VOLUME DETAILS



DRIVEWAY AREA SECTION

LEGEND

- PERMEABLE RESIN BOUND DRIVEWAY
- SW MANHOLE
- SW FLOW CONTROL MANHOLE
- PERFORATED PIPE
- CONVENTIONAL PIPE
- BASEMENT OUTLINE

SURFACE WATER MANHOLE

RWP

PERFORATED PIPE

FLOW CONTROL CHAMBER - 5l/s

100Ø OUTFALL PIPE

EXISTING PUBLIC SEWER MANHOLE

RWP

SURFACE WATER MANHOLE

RWP

PERFORATED PIPE

RWP

SURFACE WATER MANHOLE

100mm @ A1 (50mm @ A3)

NOTES

Rev	Date	Drawn	Eng	Amendments
C1	12.02.15	MS	NC	CONSTRUCTION ISSUE

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STRUCTURAL ENGINEERS

Job Name:
73 - 75 AVENUE ROAD
LONDON

Drawing Title:
SURFACE WATER MANAGEMENT STRATEGY LAYOUIT

Scale: 1:100 @ A1, 1:200 @ A3

Purpose of Issue: INFORMATION

Drawing No. 1247 / SK01

Rev. P1

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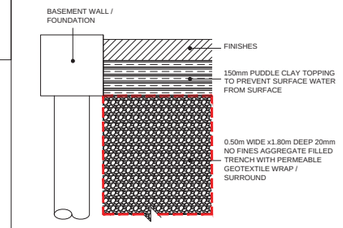
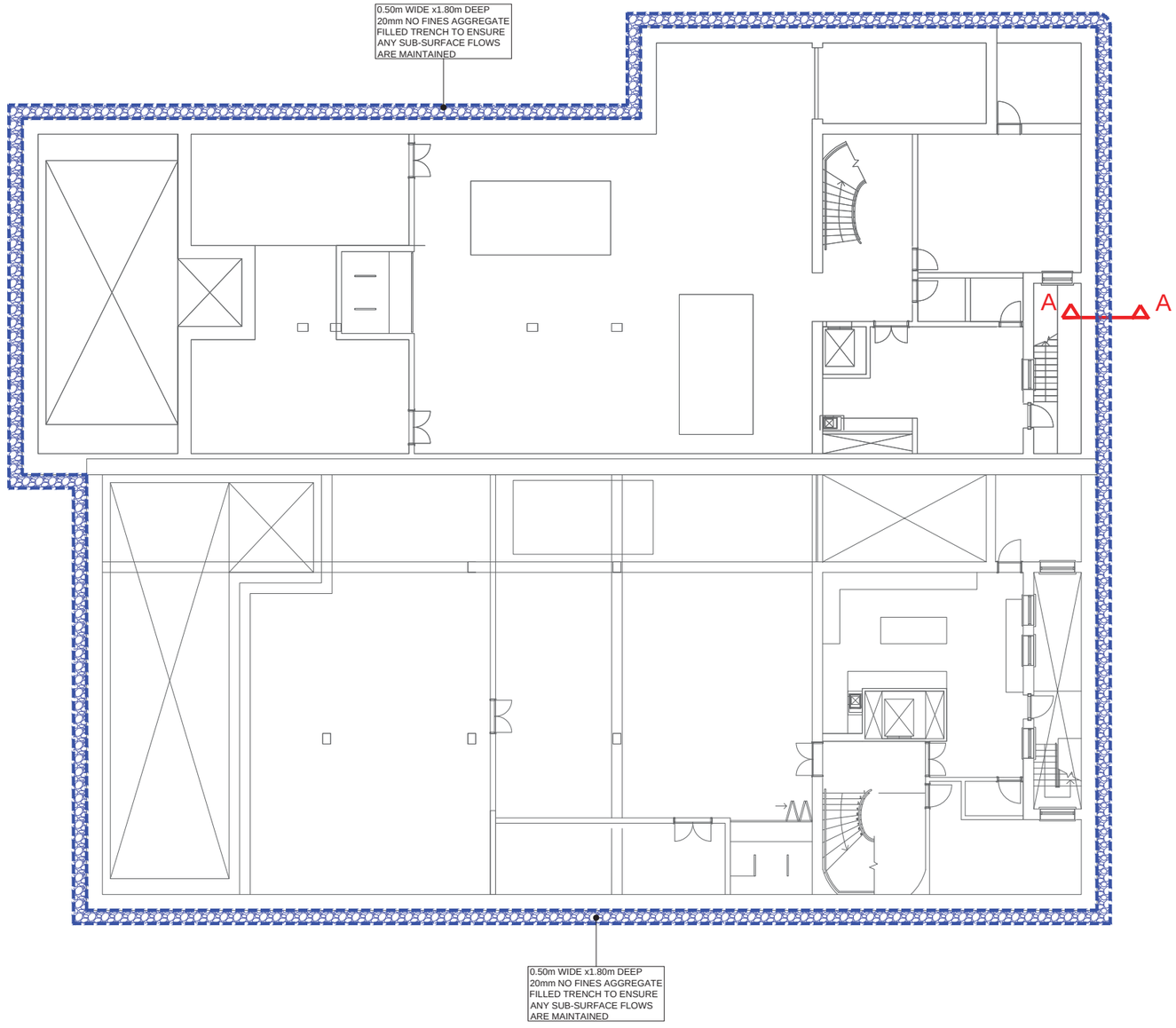
LEGEND

TRENCH ALONG BASEMENT WALL / FOUNDATIONS



SECTION A - A



100mm @ A1 (50mm @ A3)

NOTES

Rev	Date	Drawn	Eng	Amendments
C1	12.02.15	MS	NC	CONSTRUCTION ISSUE

HEYNE|TILLETT|STEEL
STRUCTURAL ENGINEERS

Job Name:
73 - 75 AVENUE ROAD
LONDON

Drawing Title:
SURFACE WATER MANAGEMENT STRATEGY BASEMENT LAYOUIT

Scale: 1:100 @ A1, 1:200 @ A3

Purpose of Issue: INFORMATION

Drawing No. 1247 / SK02

Rev. P1

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