Highgate Road, Camden

Below Ground Drainage Strategy

Planning Submission Issue

Issue P1 – 7rd March 2016

AUDAX CONSULTANTS

MEINHARDT

HIGHGATE ROAD, CAMDEN

BELOW GROUND DRAINAGE STRATEGY

PLANNING SUBMISSION ISSUE

Quality Assurance Page

Issue	Date	Prepared By	Checked By	Approved By	Remarks
P01	07/03/2016	Mr. N. Gregory	Mr. A. O'Rourke	Mr. D. Sharp	Issued for Planning

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Executive Summary

Meinhardt UK Ltd has been appointed by Audax Consulatants to undertake the foul and surface water below ground drainage design for the proposed development at 19 Greenwood Place Highgate Road, Camden.

This report outlines the proposed drainage strategy to date and is subject to change as the design process evolves and further information becomes available.

The proposed development is located off Highgate Road in Camden. The two existing buildings are currently occupied by A&A Self Storage and Highgate Day centre.

The proposed scheme involves the demolition of the current structures and redevelopment of the site to provide a new commercial and residential space. The site area totals 0.273 hectares.

The proposed surface water drainage strategy for the site has been developed to utilise sustainable drainage techniques (SUDs) to attenuate surface water at source and reduce the risk of downstream flooding as far as possible. A scheme has been developed that utilises green roof technology to attenuate surface water and below ground cellular attenuation located in the basement of the proposed development. A flow control device will restrict discharge from the site to 35 l/s before discharging to the Thames Water combined water sewer located underneath Greenwood Place.

The MEP engineer will coordinate the superstructure foul water gravity drainage system up to the point that it exits the building envelope through the basement wall and under the suspended ground floor slab. A dedicated below ground foul water drainage network is proposed to collect the foul water once it has exited the basement and discharge it to the Thames Water combined public sewer located underneath Greenwood Place. Refer to drainage drawing 1763-C-100 for details of the proposed drainage scheme.

1 Existing Drainage

1.1 Existing Site

The existing site is located off Highgate Road in Camden. The site is bound by Greenwood Place to the north and west, Highgate Road to the east and Christ Apostolic Church to the south. The site area totals 0.273 hectares and is currently occupied by two existing buildings, Lensham House occupied by A&A Storage and Highgate Day Centre. The site is currently all hard standing and for the purposes of this report and drainage calculations, the site is considered to be 100% impermeable.

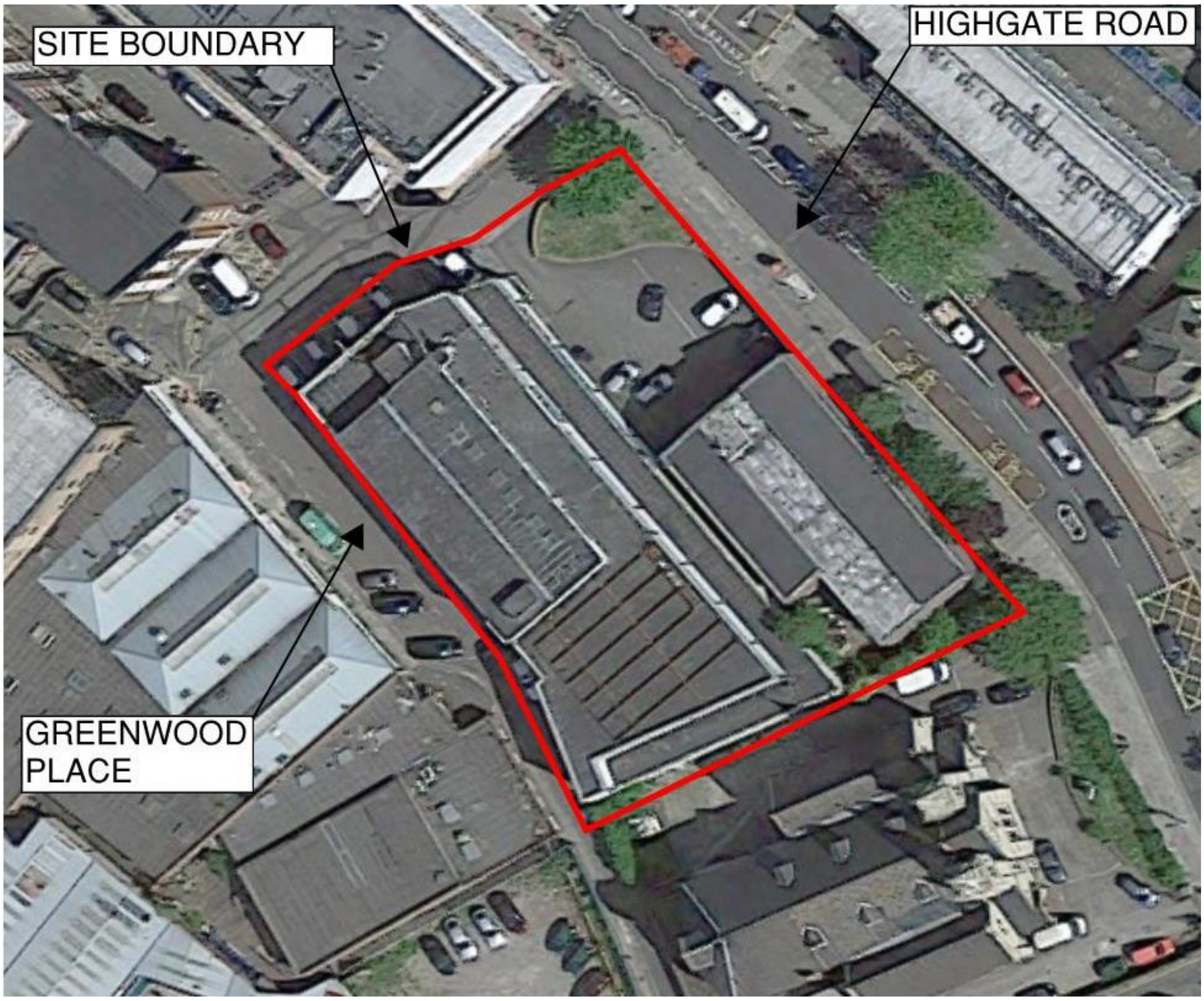


Figure 1.1: The Existing Site

1.2 Existing Drainage

The existing Thames Water public sewer network is outlined in Figure 1.2. There is a dedicated combined water public sewer located to the west of the site and is 300mm in diameter. The combined water sewer runs underneath Greenwood Place before turning 90 degrees at Thames Water manhole 8402 and continuing along Greenwood Place, it then connects to the 1549mm diameter trunk sewer located underneath Highgate Road.

The Thames Water combined trunk sewer runs underneath Highgate Road flowing in a south easterly direction. The asset records indicate that there are no access chambers to this sewer adjacent to the site therefore any connections will be through saddle connections directly to the trunk sewer. It is therefore more likely that the existing discharge locations from the subject site are connections to the public sewer in Greenwood Place. The exact layout of the existing drainage system should be confirmed through further site survey.

The Thames Water Asset records indicate that there is some public drainage infrastructure located onsite (Manholes 84CL and 83AC). These drainage runs do not appear connected to any of the surrounding sewers and will require further investigation to establish what this drain serves. If this drain serves the site only, this lateral drain may be abandoned and removed (subject to agreement from Thames Water). However, if this drain is shown to serve any adjacent properties then this sewer will need to be diverted and any existing connections maintained. This may have programme and cost implications.

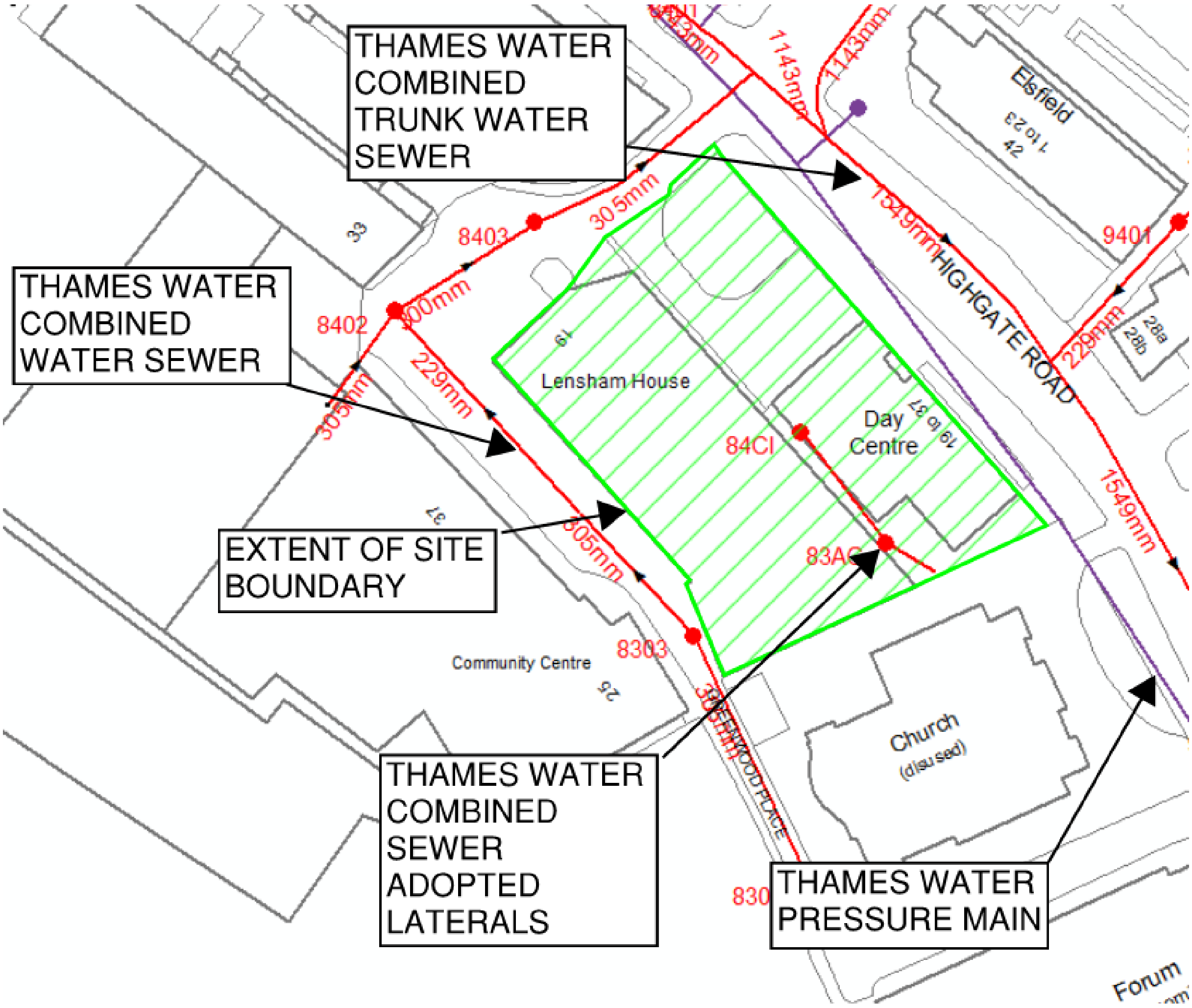


Figure 1.2: Thames Water Asset Record Plan Extract

The asset records also show a pressure main to the East of the site which appears to travel very close to the site boundary. Usually pressure mains are located within the road, however occasionally pressure mains may be located in footways. This pressure main will have an easement associated with it and any works within the vicinity of the main will need to be approved by Thames Water. It is therefore important to establish the exact location of this pressure main to avoid any potential delays or complications to the development.

It is recommended that a CCTV survey be undertaken to confirm the condition, line and level of any existing connections from the site as there may be potential to reuse the existing foul and surface water connections and avoid costly works adjacent to the site., and to establish the location of the pressure main.

A full extract of the public sewer record can be seen in Appendix A.

1.3 Existing Surface Water Discharge Rate

The existing site has a total area of 0.273 hectares. The surface of the site is primarily hard standing area with the surface materials primarily being concrete & asphalt.

The existing total site discharge rate has been calculated using hydraulic modelling software Micro Drainage WinDes. The existing site was hydraulically modelled to obtain the existing discharge rate from site for the following storm events, refer to Appendix C for existing drainage surface water calculations:

Storm Event	Contributing Area	Existing Discharge Rate
1 in 100 year	2,730m²	70 l/s
1 in 30 year	2,730m²	53.8 l/s
1 in 1 year	2,730m²	21.9 l/s

Table 1.1: Existing site discharge rates

1.4 Existing Foul Water Discharge Rate

The current foul water discharge rate from the site is unknown. As detailed in Section 1.2, there is a public combined water drainage sewer located just outside the site boundary underneath Greenwood Place, so it is assumed that the existing development discharges to the Thames Water combined public sewer network.

2 Proposed Drainage Strategy

2.1 Surface Water Drainage

2.1.1 Drainage Design Parameters

The industry standards along with the Environment Agency and Sewers for Adoption 7th Edition dictate for below ground surface water drainage that:

- There will be no surcharging of the drainage system for a 1 in 2 year storm;
- The drainage can be surcharged with no flooding for a 1 in 30 year storm; and
- The drainage can flood on-site for a 1 in 100 year storm with a 20% Climate Change allowance provided the flood water remains on site and does not flood habitable areas or affect safe ingress and egress to the site for occupiers.

All surface water drainage options outlined in this report adhere to these principles.

2.1.2 Proposed Surface Water Drainage Strategy

The proposed surface water strategy for the site has been developed to utilise sustainable drainage techniques (SUDs) to attenuate surface water at source and reduce the risk of downstream flooding as far as possible. It is proposed to attenuate the water within a cellular attenuation system. The tank is located below ground level in the basement of the development. The water stored in the attenuation tank will be discharged via gravity to the Thames Water manhole located within the public highway along Greenwood Place. The surface water will discharge via a flow control device into the Thames Water surface water sewer.

Hydraulic calculations indicate that the attenuation volume required on site for a 1 in 100 year + 20 % climate change storm event is $80m^3$ based on a proposed restricted discharge rate of 35 l/s.

2.1.3 Allowable Discharge Rates

The proposed surface water drainage design will incorporate a 20% climate change allowance as the proposed life of the building is less than 70 years. Refer to table 2.1 for proposed surface water calculations:

Storm Event + 30% CC	Contributing Area	Proposed Discharge Rate
1 in 100 year	0.273 ha	35 l/s

Table 2.1: Proposed surface water discharge rate

The proposed discharge rate offers a 50% reduction of the current surface water for a 1 in 100 year storm + 20% climate change, as per the London plan, NPPF and PPS25.

2.2 Foul Water Drainage

2.2.1 Design Parameters

The below ground foul drainage system will be designed to Sewers for Adoption 7th Edition, BS EN 752 Parts 3 and 4, and the Building Regulations Document H where appropriate.

2.2.2 Proposed Foul Water Drainage Strategy

It is proposed that the foul water will discharge from the site via two connections to the Thames Water combined sewer pending a CCTV survey.

Refer to drainage drawing 1763-C-100 for details of the proposed drainage scheme.

An approved discharge rate has yet to be agreed with Thames Water, a Section 106 application should be submitted at detailed design stage to Thames Water to agree the foul water discharge allowance.

2.2.2.1 Superstructure Foul Water Drainage

The proposed foul water drainage strategy for the superstructure of the proposed is to collect the internal foul water drainage, which is proposed to be suspended beneath the ground floor slab exiting the building through the basement wall, via a below ground piped gravity network. It is proposed that the internal foul water will be collected together at higher level to allow for an exit from each building.

The foul water will then be conveyed by gravity via a network of pipes and manholes which collect foul water discharge from the property. It will then be conveyed to the public sewer via a demarcation chamber.

The MEP engineer will coordinate the internal foul water system up to the point that it exits the building envelope through the basement wall. Meinhardt will design and detail the below ground drainage system once the drainage has exited the building.

Any requirements for grease traps within the building to serve kitchen facilities will be confirmed by the MEP engineer.

2.2.2.2 Substructure Foul Water Drainage

The proposed substructure foul water drainage which is located within the basement serving the car park and assorted plant rooms will be served by a pipe and gully system. This will discharge to pumping stations which will connect to the external gravity foul sewer prior to discharging into the Thames Water public combine water sewer located within Greenwood Place.

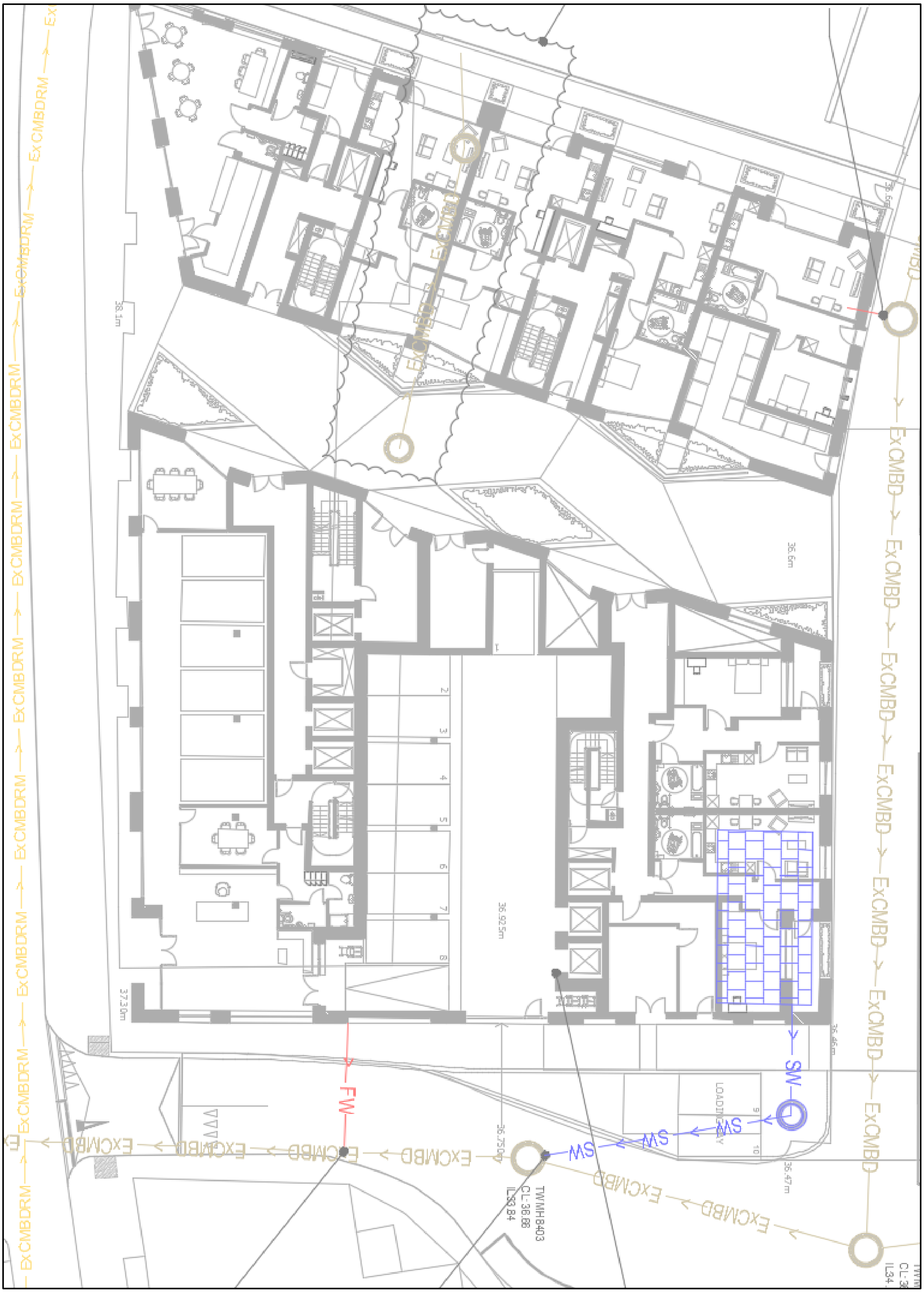


Figure 2.1: Proposed Drainage Strategy Layout

3 Sustainable Urban Drainage Solutions

Sustainable Urban drainage systems (SUDs) come in various shapes and sizes. They range from landscaping features to roof build ups and below ground attenuation. In urban areas, generally there are a large amount of site restrictions and space is constrained therefore the SUDs techniques applicable in these situations are limited.

Outlined below is the option for this site for surface water attenuation which is a below ground attenuation tank.

There are further potential options for discussion at the next design stage outlined in section 3.2; these are green and blue roofs.

3.1 Below Ground Cellular Attenuation

Cellular attenuation involves storing surface water within pipework or underground tanks prior to controlled discharge into the public sewer. Typically the cellular attenuation is formed with plastic "egg-crates" wrapped in impermeable geotextiles as indicated in figure 3.1.

Figure 3.1: A typical cellular attenuation tank

Advantages:	Effective storage of surface water, can be used below trafficked areas, can be used below public open areas, minimum maintenance.
Disadvantages	Cost of excavation. Sometimes complicated integration with foundations. No water quality treatment.

3.2 Potential Options

3.2.1 Green Roof

A green roof comprises a multi-layered system that covers the roof of a building or podium structures with vegetation cover/landscaping over a drainage layer. These systems are designed to intercept and retain precipitation, increasing the time of concentration and reducing the volume of runoff and attenuation peak flows. Green roofs can be anything from a thin growing layer of sedums and mosses to grass, plants, shrubs and large trees.

These roofs vary in specification and can be designed to attract bird and invertebrate species. Green and brown roofs also participate in attenuating rain water. This would reduce the requirement for below ground storage attenuation on the site.

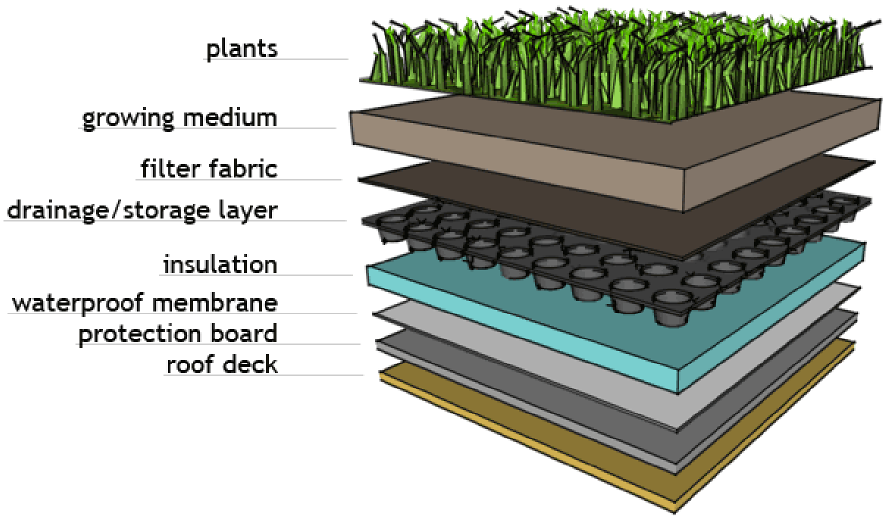


Figure 3.2: Typical section through a green roof build up

Advantages:	Mimic greenfield state of building footprint, good removal of pollutants, ecological and amenity benefits, improve air quality, insulates building.
Disadvantages	Cost, possible increase in structural loading, roof height, design and exposure may preclude use.

3.2.2 Blue Roof

A blue roof comprises a multi-layered system that covers the roof of a building or podium structures with a deep layer of attenuation along with various layers of insulation, water proofing and roofing material. These systems are designed to intercept and retain precipitation, increasing the time of concentration and reducing the volume of runoff and attenuating peak flows.

The system is designed to restrict the rainwater discharge from the roof to allow the surface water to build up on the roof for a period of time while slowly releasing the water down the drain pipe and into the below ground drainage system.

These roofs vary in specification and can be designed to accommodate any type of roof material which allows infiltration into the attenuation layer below.

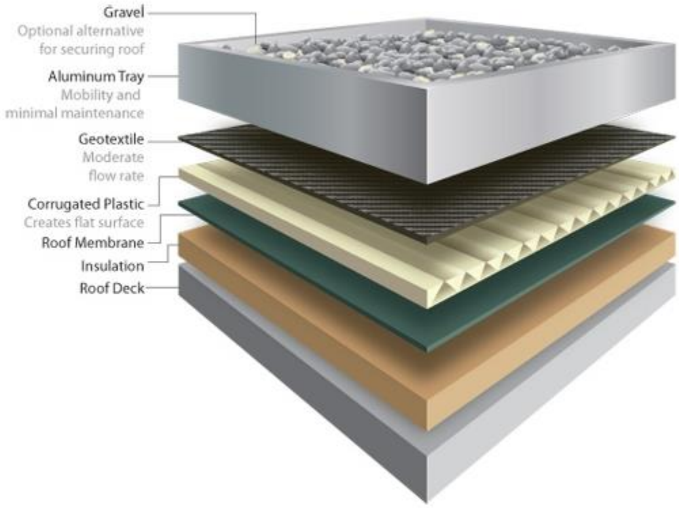


Figure 3.3: Typical section through a blue roof build up

Advantages:	Eliminates/reduces the requirement for below ground drainage attenuation and the cost of excavation for it; reduces the number of internal rainwater down points within the building; with the use of planting within the roof water quality can be improved; with systems of 85mm attenuation or lower, the structure is generally unaffected.
Disadvantages	Cost of the system itself may be more than the saving due to a reduction in down-pipes, with systems greater than 85mm there may be an implication to the structure, roof height is increased slightly, the roof design and exposure may preclude use.

3.3 Permeable Paving

Permeable pavement is an alternative to conventional paving in which water permeates through the paved structure rather than draining off it. The surface water will be held in a reservoir structure (high void content sub-base) under the pavement for subsequent delayed discharge or infiltration into the sub-strata below.

The porous paving can be materials such as gravel, reinforced grass, porous concrete, concrete blocks or porous asphalt. Pollutant removal rates have been shown to be high, as the majority of the removal occurs as a result of the filtration of the water through the aggregate sub-base.

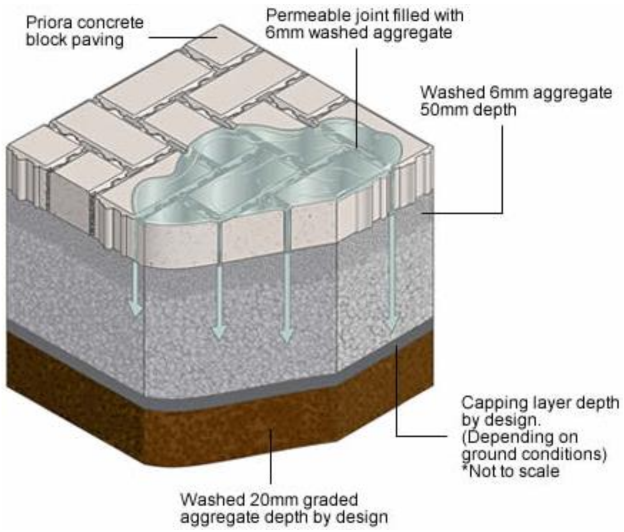


Figure 3 – Typical section through porous paving

Advantages:	Effective in removing pollutants, lined systems can be used to avoid infiltration, reduces attenuation volume and rate of surface water runoff, suitable for high density developments, reduces amount of gravity drainage required.
Disadvantages	Costs, used for low traffic volumes, low axel loads and speeds, risk of long term clogging due to poor maintenance.

4 Risks and Opportunities

4.1 Outstanding Risks

Risk	Implication	Action required
The current condition of the existing drainage on site.	The re-use of existing drainage without further investigation could lead to on site flooding and programme delays.	Client should commission CCTV survey works to establish the current condition of the drainage on the site and identify the conditions of all connections.
A decrease in the advised surface water discharge rate from 35 l/s (50% reduction from existing discharge rate).	Further surface water attenuation may be required within the development.	Client to instruct a pre-development Enquiry to be submitted to establish the sewer capacity to accepted proposed discharge rates.
The existing combined water public sewer may not have sufficient capacity to accept the proposed discharge rate	The sewerage undertaker may request upgrades to the existing public sewerage network or potential foul water attenuation tank may be required.	Client to instruct a pre-development Enquiry to be submitted to establish the sewer capacity to accepted proposed discharge rates.
The current levels and location of the existing drainage on site.	The re-use of existing drainage without further investigation could lead to the need for pumping on site.	Client to commission CCTV survey works to establish the current condition of the drainage on the site and identify the conditions of all connections.
Possible off site drainage entering the site and connecting to existing drainage which is to be removed	Removal of on-site drainage without further investigation could lead to additional drainage works, programme delays or litigation by the property owners which it serves.	Client to commission CCTV survey works to establish the current condition of the drainage on the site and identify the conditions of all connections.

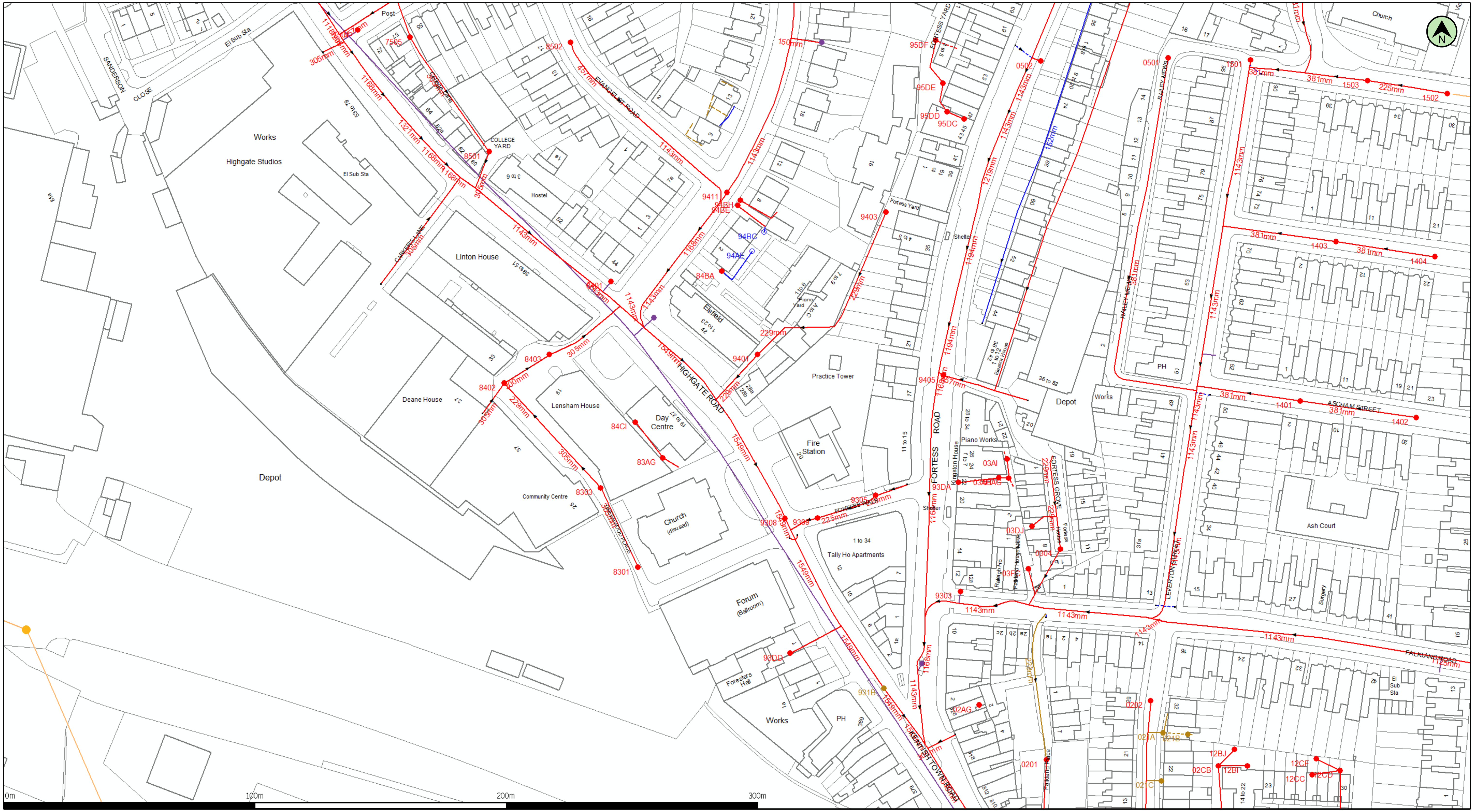
Table 4.1: Outstanding Risks

4.2 Potential Opportunities

Opportunities	Implication	Action required
Reusing the existing connection on site to the public sewers.	If feasible reuse of the connections would limit the amount of works required within the public realm.	CCTV works required to determine the exact line and level of onsite private drainage and connections to the public sewer.
The use of a blue/green roof build up on the terraces and roofs	A blue/green roof will reduce the amount of below ground cellular attenuation required, thus freeing up space below ground level.	The suitability of using blue/green roofs will be explored further during the detailed design process.
Acceptance of application to discharge foul water to Thames Water sewers at a preferred discharge rate.	There would be no requirement for foul water attenuation tanks for the development.	Client to instruct a pre-development Enquiry to be submitted to establish the sewer capacity to accepted proposed discharge rates.
An increase in the advised surface water discharge rate from 35 l/s (significant reduction from existing discharge rate).	Less surface water attenuation may be required within the development.	Pre-development Enquiry has been submitted to establish the sewer capacity to accepted proposed discharge rates.

Table 4.2: Potential opportunities

Appendix A – Thames Water Asset Records



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Foul Sewer	Foul Manhole
Surface Sewer	Surface Manhole
Combined Sewer	Combined Manhole
Abandoned Sewer	Abandoned Manhole
Pressure Main	Other Manhole
Private Asset (Colour denotes effluent type)	End Item
Proposed Asset (Colour denotes effluent type)	S104 Boundary

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Thames Water

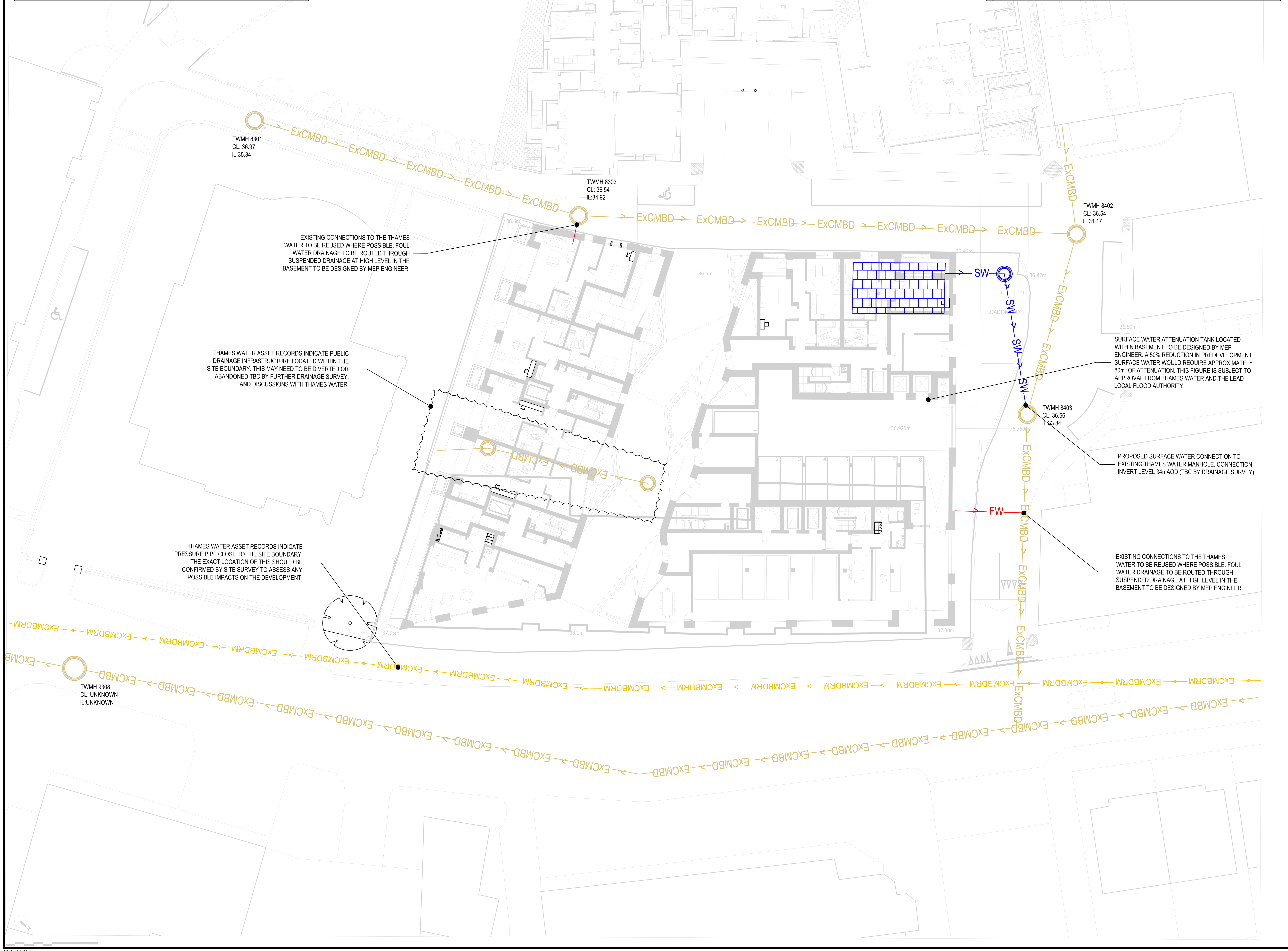
Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0201	C	38.47	36.57	1.9
0202	C	40.68	39.43	1.25
021A	F	-	-	-
021B	F	-	-	-
021C	F	-	-	-
02AG	C	-	-	-
02CB	C	-	-	-
0304	C	40.92	38.61	2.31
03AG	C	-	-	-
03AH	C	-	-	-
03AI	C	-	-	-
03DJ	C	-	-	-
03FC	C	-	-	-
0501	C	-	-	-
0502	C	-	-	-
12BI	C	-	-	-
12BJ	C	-	-	-
12CC	C	-	-	-
12CD	C	-	-	-
12CF	C	-	-	-
1401	C	43.93	40	3.93
1402	C	44.67	42.12	2.55
1403	C	47.1	43.38	3.72
1404	C	47.97	45.07	2.9
1501	C	-	44.38	-
1502	C	-	-	-
1503	C	50.98	46.31	4.67
7501	C	-	-	-
7505	C	-	-	-
8301	C	36.97	35.34	1.63
8303	C	36.54	34.92	1.62
83AG	C	-	-	-
8401	C	-	-	-
8402	C	36.54	34.17	2.37
8403	C	36.66	33.84	2.82
8404	A	37.24	-	-
84BA	C	-	-	-
84CI	C	-	-	-
8501	C	38.84	34.64	4.2
8502	C	39.57	37.62	1.95
9303	C	-	-	-
9305	C	39.67	37.42	2.25
9308	C	-	-	-
9309	C	-	-	-
931A	Z	38.9	-	-
931B	F	-	-	-
93DA	C	-	-	-
93DD	C	-	-	-
9401	C	38	34.26	3.74
9403	C	41.06	38.74	2.32
9405	C	-	-	-
9411	C	38.41	33.74	4.67
94AE	S	-	-	-
94BC	S	-	-	-
94BE	C	-	-	-
94BH	C	-	-	-
951A	J	-	-	-
95DC	C	-	-	-
95DD	C	-	-	-
95DE	C	-	-	-
95DF	C	-	-	-

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix B – Proposed Drainage Strategy Drawing

NOTE:
ALL FULL CCTV SURVEY IS RECOMMENDED TO ESTABLISH THE CURRENT CONDITION OF THE DRAINAGE ON THE SITE AND IDENTIFY THE CONDITION OF ALL CONNECTIONS.

NOTE:
ALL DRAINAGE SHOWN BASED ON THAMES WATER ASSET INFORMATION AND IS INDICATIVE ONLY. EXACT LOCATION AND DEPTH TO BE CONFIRMED THROUGH SITE SURVEY.



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P01	FOR PLANNING	AOR	07.03.16

NOTES:

1. DO NOT SCALE FROM THIS DRAWING
2. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES UNLESS NOTED OTHERWISE.
3. DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND CONSULTANTS DRAWINGS AND SPECIFICATIONS.
4. THIS DRAWING IS BASED ON:
   - PROPOSED SITE PLAN, GROUND FLOOR LEVEL BY SQUIRE AND PARTNERS REV J.
   - THAMES WATER ASSET RECORDS.
5. THIS DRAWING IS FOR CO-ORDINATION PURPOSES ONLY. IT IS NOT AN INSTALLATION DRAWING AND SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

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PROJECT
HIGHGATE ROAD
CAMDEN

CLIENT
AUDAX CONSULTANTS

TITLE
BELOW GROUND DRAINAGE
LAYOUT

CIVILS

PROJECT No	DESIGNED	DRAWN	SCALE @ A1
1763	AOR	AOR	1:200
		APPROVED: AP	

DRAWING No 1763-C-100
ISSUE/AMT P01

Appendix C – Existing Surface Water Calculations

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.500	0.000	21.9	0.0	O K
30 min Summer	1.500	0.000	22.5	0.0	O K
60 min Summer	1.500	0.000	20.4	0.0	O K
120 min Summer	1.500	0.000	15.2	0.0	O K
180 min Summer	1.500	0.000	12.1	0.0	O K
240 min Summer	1.500	0.000	10.2	0.0	O K
360 min Summer	1.500	0.000	7.8	0.0	O K
480 min Summer	1.500	0.000	6.4	0.0	O K
600 min Summer	1.500	0.000	5.5	0.0	O K
720 min Summer	1.500	0.000	4.8	0.0	O K
960 min Summer	1.500	0.000	3.8	0.0	O K
1440 min Summer	1.500	0.000	2.8	0.0	O K
2160 min Summer	1.500	0.000	2.1	0.0	O K
2880 min Summer	1.500	0.000	1.7	0.0	O K
4320 min Summer	1.500	0.000	1.2	0.0	O K
5760 min Summer	1.500	0.000	1.0	0.0	O K
7200 min Summer	1.500	0.000	0.8	0.0	O K
8640 min Summer	1.500	0.000	0.7	0.0	O K
10080 min Summer	1.500	0.000	0.6	0.0	O K
15 min Winter	1.500	0.000	24.8	0.0	O K
30 min Winter	1.500	0.000	24.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	33.106	0.0	16.9	0
30 min Summer	21.352	0.0	21.9	0
60 min Summer	13.306	0.0	27.2	0
120 min Summer	8.114	0.0	33.2	0
180 min Summer	6.043	0.0	37.1	0
240 min Summer	4.897	0.0	40.1	0
360 min Summer	3.618	0.0	44.4	0
480 min Summer	2.911	0.0	47.7	0
600 min Summer	2.459	0.0	50.4	0
720 min Summer	2.142	0.0	52.6	0
960 min Summer	1.723	0.0	56.5	0
1440 min Summer	1.268	0.0	62.3	0
2160 min Summer	0.934	0.0	68.8	0
2880 min Summer	0.752	0.0	73.9	0
4320 min Summer	0.553	0.0	81.5	0
5760 min Summer	0.444	0.0	87.4	0
7200 min Summer	0.375	0.0	92.2	0
8640 min Summer	0.327	0.0	96.5	0
10080 min Summer	0.291	0.0	100.2	0
15 min Winter	33.106	0.0	19.0	0
30 min Winter	21.352	0.0	24.5	0

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	1.500	0.000	19.1	0.0	O K
120 min Winter	1.500	0.000	12.6	0.0	O K
180 min Winter	1.500	0.000	9.5	0.0	O K
240 min Winter	1.500	0.000	7.8	0.0	O K
360 min Winter	1.500	0.000	5.8	0.0	O K
480 min Winter	1.500	0.000	4.7	0.0	O K
600 min Winter	1.500	0.000	4.0	0.0	O K
720 min Winter	1.500	0.000	3.5	0.0	O K
960 min Winter	1.500	0.000	2.8	0.0	O K
1440 min Winter	1.500	0.000	2.0	0.0	O K
2160 min Winter	1.500	0.000	1.5	0.0	O K
2880 min Winter	1.500	0.000	1.2	0.0	O K
4320 min Winter	1.500	0.000	0.9	0.0	O K
5760 min Winter	1.500	0.000	0.7	0.0	O K
7200 min Winter	1.500	0.000	0.6	0.0	O K
8640 min Winter	1.500	0.000	0.5	0.0	O K
10080 min Winter	1.500	0.000	0.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	13.306	0.0	30.5	0
120 min Winter	8.114	0.0	37.2	0
180 min Winter	6.043	0.0	41.6	0
240 min Winter	4.897	0.0	44.9	0
360 min Winter	3.618	0.0	49.8	0
480 min Winter	2.911	0.0	53.4	0
600 min Winter	2.459	0.0	56.4	0
720 min Winter	2.142	0.0	59.0	0
960 min Winter	1.723	0.0	63.2	0
1440 min Winter	1.268	0.0	69.8	0
2160 min Winter	0.934	0.0	77.1	0
2880 min Winter	0.752	0.0	82.7	0
4320 min Winter	0.553	0.0	91.2	0
5760 min Winter	0.444	0.0	97.8	0
7200 min Winter	0.375	0.0	103.3	0
8640 min Winter	0.327	0.0	108.0	0
10080 min Winter	0.291	0.0	112.2	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.700	Shortest Storm (mins)	15
Ratio R	0.438	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.273

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.091	4	8	0.091	8	12	0.091

Model Details

Storage is Online Cover Level (m) 2.500

Pipe Structure

Diameter (m)	0.225	Length (m)	10.000
Slope (1:X)	100.000	Invert Level (m)	1.500

Pipe Outflow Control

Diameter (m)	0.225	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	0.000
Roughness k (mm)	0.600		

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.500	0.000	53.8	0.0	O K
30 min Summer	1.500	0.000	55.0	0.0	O K
60 min Summer	1.500	0.000	48.9	0.0	O K
120 min Summer	1.500	0.000	35.6	0.0	O K
180 min Summer	1.500	0.000	27.8	0.0	O K
240 min Summer	1.500	0.000	22.9	0.0	O K
360 min Summer	1.500	0.000	17.2	0.0	O K
480 min Summer	1.500	0.000	13.9	0.0	O K
600 min Summer	1.500	0.000	11.8	0.0	O K
720 min Summer	1.500	0.000	10.2	0.0	O K
960 min Summer	1.500	0.000	8.1	0.0	O K
1440 min Summer	1.500	0.000	5.9	0.0	O K
2160 min Summer	1.500	0.000	4.2	0.0	O K
2880 min Summer	1.500	0.000	3.3	0.0	O K
4320 min Summer	1.500	0.000	2.4	0.0	O K
5760 min Summer	1.500	0.000	1.9	0.0	O K
7200 min Summer	1.500	0.000	1.6	0.0	O K
8640 min Summer	1.500	0.000	1.4	0.0	O K
10080 min Summer	1.500	0.000	1.2	0.0	O K
15 min Winter	1.500	0.000	60.8	0.0	O K
30 min Winter	1.500	0.000	59.8	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	81.304	0.0	41.6	0
30 min Summer	52.121	0.0	53.4	0
60 min Summer	31.905	0.0	65.3	0
120 min Summer	18.953	0.0	77.6	0
180 min Summer	13.833	0.0	85.0	0
240 min Summer	11.019	0.0	90.2	0
360 min Summer	7.983	0.0	98.1	0
480 min Summer	6.348	0.0	104.0	0
600 min Summer	5.311	0.0	108.7	0
720 min Summer	4.589	0.0	112.8	0
960 min Summer	3.643	0.0	119.3	0
1440 min Summer	2.628	0.0	129.2	0
2160 min Summer	1.894	0.0	139.6	0
2880 min Summer	1.501	0.0	147.5	0
4320 min Summer	1.080	0.0	159.2	0
5760 min Summer	0.855	0.0	168.0	0
7200 min Summer	0.713	0.0	175.1	0
8640 min Summer	0.614	0.0	181.1	0
10080 min Summer	0.542	0.0	186.3	0
15 min Winter	81.304	0.0	46.6	0
30 min Winter	52.121	0.0	59.8	0

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	1.500	0.000	45.7	0.0	O K
120 min Winter	1.500	0.000	29.4	0.0	O K
180 min Winter	1.500	0.000	21.9	0.0	O K
240 min Winter	1.500	0.000	17.5	0.0	O K
360 min Winter	1.500	0.000	12.8	0.0	O K
480 min Winter	1.500	0.000	10.2	0.0	O K
600 min Winter	1.500	0.000	8.6	0.0	O K
720 min Winter	1.500	0.000	7.4	0.0	O K
960 min Winter	1.500	0.000	5.9	0.0	O K
1440 min Winter	1.500	0.000	4.2	0.0	O K
2160 min Winter	1.500	0.000	3.1	0.0	O K
2880 min Winter	1.500	0.000	2.4	0.0	O K
4320 min Winter	1.500	0.000	1.7	0.0	O K
5760 min Winter	1.500	0.000	1.4	0.0	O K
7200 min Winter	1.500	0.000	1.1	0.0	O K
8640 min Winter	1.500	0.000	1.0	0.0	O K
10080 min Winter	1.500	0.000	0.9	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	31.905	0.0	73.2	0
120 min Winter	18.953	0.0	86.9	0
180 min Winter	13.833	0.0	95.2	0
240 min Winter	11.019	0.0	101.1	0
360 min Winter	7.983	0.0	109.8	0
480 min Winter	6.348	0.0	116.5	0
600 min Winter	5.311	0.0	121.8	0
720 min Winter	4.589	0.0	126.3	0
960 min Winter	3.643	0.0	133.7	0
1440 min Winter	2.628	0.0	144.7	0
2160 min Winter	1.894	0.0	156.4	0
2880 min Winter	1.501	0.0	165.2	0
4320 min Winter	1.080	0.0	178.3	0
5760 min Winter	0.855	0.0	188.2	0
7200 min Winter	0.713	0.0	196.1	0
8640 min Winter	0.614	0.0	202.8	0
10080 min Winter	0.542	0.0	208.7	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.700	Shortest Storm (mins)	15
Ratio R	0.438	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.273

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.091	4	8	0.091	8	12	0.091

Model Details

Storage is Online Cover Level (m) 2.500

Pipe Structure

Diameter (m)	0.225	Length (m)	10.000
Slope (1:X)	100.000	Invert Level (m)	1.500

Pipe Outflow Control

Diameter (m)	0.225	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	0.000
Roughness k (mm)	0.600		

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.500	0.000	70.0	0.0	O K
30 min Summer	1.500	0.000	72.1	0.0	O K
60 min Summer	1.500	0.000	64.3	0.0	O K
120 min Summer	1.500	0.000	46.8	0.0	O K
180 min Summer	1.500	0.000	36.4	0.0	O K
240 min Summer	1.500	0.000	29.9	0.0	O K
360 min Summer	1.500	0.000	22.3	0.0	O K
480 min Summer	1.500	0.000	18.0	0.0	O K
600 min Summer	1.500	0.000	15.3	0.0	O K
720 min Summer	1.500	0.000	13.2	0.0	O K
960 min Summer	1.500	0.000	10.4	0.0	O K
1440 min Summer	1.500	0.000	7.5	0.0	O K
2160 min Summer	1.500	0.000	5.3	0.0	O K
2880 min Summer	1.500	0.000	4.2	0.0	O K
4320 min Summer	1.500	0.000	3.0	0.0	O K
5760 min Summer	1.500	0.000	2.4	0.0	O K
7200 min Summer	1.500	0.000	2.0	0.0	O K
8640 min Summer	1.500	0.000	1.7	0.0	O K
10080 min Summer	1.500	0.000	1.5	0.0	O K
15 min Winter	1.500	0.000	79.1	0.0	O K
30 min Winter	1.500	0.000	78.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	105.764	0.0	54.1	0
30 min Summer	68.314	0.0	69.9	0
60 min Summer	41.961	0.0	85.9	0
120 min Summer	24.896	0.0	101.9	0
180 min Summer	18.110	0.0	111.2	0
240 min Summer	14.371	0.0	117.7	0
360 min Summer	10.355	0.0	127.2	0
480 min Summer	8.205	0.0	134.4	0
600 min Summer	6.845	0.0	140.1	0
720 min Summer	5.900	0.0	145.0	0
960 min Summer	4.665	0.0	152.8	0
1440 min Summer	3.346	0.0	164.4	0
2160 min Summer	2.396	0.0	176.6	0
2880 min Summer	1.889	0.0	185.7	0
4320 min Summer	1.350	0.0	199.0	0
5760 min Summer	1.063	0.0	208.9	0
7200 min Summer	0.882	0.0	216.8	0
8640 min Summer	0.758	0.0	223.4	0
10080 min Summer	0.666	0.0	229.1	0
15 min Winter	105.764	0.0	60.6	0
30 min Winter	68.314	0.0	78.3	0

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	1.500	0.000	60.1	0.0	O K
120 min Winter	1.500	0.000	38.6	0.0	O K
180 min Winter	1.500	0.000	28.6	0.0	O K
240 min Winter	1.500	0.000	22.9	0.0	O K
360 min Winter	1.500	0.000	16.6	0.0	O K
480 min Winter	1.500	0.000	13.2	0.0	O K
600 min Winter	1.500	0.000	11.0	0.0	O K
720 min Winter	1.500	0.000	9.5	0.0	O K
960 min Winter	1.500	0.000	7.5	0.0	O K
1440 min Winter	1.500	0.000	5.4	0.0	O K
2160 min Winter	1.500	0.000	3.9	0.0	O K
2880 min Winter	1.500	0.000	3.0	0.0	O K
4320 min Winter	1.500	0.000	2.2	0.0	O K
5760 min Winter	1.500	0.000	1.7	0.0	O K
7200 min Winter	1.500	0.000	1.4	0.0	O K
8640 min Winter	1.500	0.000	1.2	0.0	O K
10080 min Winter	1.500	0.000	1.1	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	41.961	0.0	96.2	0
120 min Winter	24.896	0.0	114.2	0
180 min Winter	18.110	0.0	124.6	0
240 min Winter	14.371	0.0	131.8	0
360 min Winter	10.355	0.0	142.5	0
480 min Winter	8.205	0.0	150.5	0
600 min Winter	6.845	0.0	157.0	0
720 min Winter	5.900	0.0	162.4	0
960 min Winter	4.665	0.0	171.2	0
1440 min Winter	3.346	0.0	184.1	0
2160 min Winter	2.396	0.0	197.8	0
2880 min Winter	1.889	0.0	207.9	0
4320 min Winter	1.350	0.0	222.9	0
5760 min Winter	1.063	0.0	233.9	0
7200 min Winter	0.882	0.0	242.8	0
8640 min Winter	0.758	0.0	250.2	0
10080 min Winter	0.666	0.0	256.5	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.700	Shortest Storm (mins)	15
Ratio R	0.438	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.273

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.091	4	8	0.091	8	12	0.091

Model Details

Storage is Online Cover Level (m) 2.500

Pipe Structure

Diameter (m)	0.225	Length (m)	10.000
Slope (1:X)	100.000	Invert Level (m)	1.500

Pipe Outflow Control

Diameter (m)	0.225	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	0.000
Roughness k (mm)	0.600		

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 9 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.878	0.378	0.0	35.0	35.0	28.7	O K
30 min Summer	1.925	0.425	0.0	35.0	35.0	32.3	O K
60 min Summer	1.854	0.354	0.0	35.0	35.0	26.9	O K
120 min Summer	1.695	0.195	0.0	35.0	35.0	14.8	O K
180 min Summer	1.568	0.068	0.0	35.0	35.0	5.2	O K
240 min Summer	1.502	0.002	0.0	35.0	35.0	0.2	O K
360 min Summer	1.500	0.000	0.0	26.7	26.7	0.0	O K
480 min Summer	1.500	0.000	0.0	21.6	21.6	0.0	O K
600 min Summer	1.500	0.000	0.0	18.3	18.3	0.0	O K
720 min Summer	1.500	0.000	0.0	15.8	15.8	0.0	O K
960 min Summer	1.500	0.000	0.0	12.5	12.5	0.0	O K
1440 min Summer	1.500	0.000	0.0	9.0	9.0	0.0	O K
2160 min Summer	1.500	0.000	0.0	6.4	6.4	0.0	O K
2880 min Summer	1.500	0.000	0.0	5.1	5.1	0.0	O K
4320 min Summer	1.500	0.000	0.0	3.6	3.6	0.0	O K
5760 min Summer	1.500	0.000	0.0	2.8	2.8	0.0	O K
7200 min Summer	1.500	0.000	0.0	2.4	2.4	0.0	O K
8640 min Summer	1.500	0.000	0.0	2.0	2.0	0.0	O K
10080 min Summer	1.500	0.000	0.0	1.8	1.8	0.0	O K
15 min Winter	1.953	0.453	0.0	35.0	35.0	34.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	126.917	0.0	64.3	20
30 min Summer	81.977	0.0	83.5	29
60 min Summer	50.353	0.0	103.5	44
120 min Summer	29.875	0.0	121.5	76
180 min Summer	21.732	0.0	134.1	104
240 min Summer	17.246	0.0	141.1	128
360 min Summer	12.426	0.0	152.7	0
480 min Summer	9.846	0.0	161.3	0
600 min Summer	8.214	0.0	168.2	0
720 min Summer	7.080	0.0	174.0	0
960 min Summer	5.598	0.0	183.4	0
1440 min Summer	4.015	0.0	197.3	0
2160 min Summer	2.875	0.0	211.9	0
2880 min Summer	2.267	0.0	222.8	0
4320 min Summer	1.620	0.0	238.8	0
5760 min Summer	1.275	0.0	250.6	0
7200 min Summer	1.059	0.0	260.1	0
8640 min Summer	0.909	0.0	268.0	0
10080 min Summer	0.799	0.0	274.9	0
15 min Winter	126.917	0.0	73.5	20

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.011	0.511	0.0	35.0	35.0	38.8	O K
60 min Winter	1.895	0.395	0.0	35.0	35.0	30.0	O K
120 min Winter	1.633	0.133	0.0	35.0	35.0	10.1	O K
180 min Winter	1.500	0.000	0.0	34.3	34.3	0.0	O K
240 min Winter	1.500	0.000	0.0	27.5	27.5	0.0	O K
360 min Winter	1.500	0.000	0.0	19.9	19.9	0.0	O K
480 min Winter	1.500	0.000	0.0	15.8	15.8	0.0	O K
600 min Winter	1.500	0.000	0.0	13.2	13.2	0.0	O K
720 min Winter	1.500	0.000	0.0	11.4	11.4	0.0	O K
960 min Winter	1.500	0.000	0.0	9.0	9.0	0.0	O K
1440 min Winter	1.500	0.000	0.0	6.5	6.5	0.0	O K
2160 min Winter	1.500	0.000	0.0	4.6	4.6	0.0	O K
2880 min Winter	1.500	0.000	0.0	3.7	3.7	0.0	O K
4320 min Winter	1.500	0.000	0.0	2.6	2.6	0.0	O K
5760 min Winter	1.500	0.000	0.0	2.1	2.1	0.0	O K
7200 min Winter	1.500	0.000	0.0	1.7	1.7	0.0	O K
8640 min Winter	1.500	0.000	0.0	1.5	1.5	0.0	O K
10080 min Winter	1.500	0.000	0.0	1.3	1.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	81.977	0.0	93.7	30
60 min Winter	50.353	0.0	116.1	48
120 min Winter	29.875	0.0	136.8	78
180 min Winter	21.732	0.0	149.5	0
240 min Winter	17.246	0.0	158.2	0
360 min Winter	12.426	0.0	171.0	0
480 min Winter	9.846	0.0	180.6	0
600 min Winter	8.214	0.0	188.4	0
720 min Winter	7.080	0.0	194.8	0
960 min Winter	5.598	0.0	205.4	0
1440 min Winter	4.015	0.0	221.0	0
2160 min Winter	2.875	0.0	237.4	0
2880 min Winter	2.267	0.0	249.5	0
4320 min Winter	1.620	0.0	267.5	0
5760 min Winter	1.275	0.0	280.7	0
7200 min Winter	1.059	0.0	291.3	0
8640 min Winter	0.909	0.0	300.2	0
10080 min Winter	0.799	0.0	307.8	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.700	Shortest Storm (mins)	15
Ratio R	0.438	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.273

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.091	4	8	0.091	8	12	0.091

Model Details

Storage is Online Cover Level (m) 2.500

Cellular Storage Structure

Invert Level (m) 1.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	80.0	80.0	1.001	0.0	115.8
1.000	80.0	115.8			

Hydroslide Outflow Control

Design Head (m) 1.500 Invert Level (m) 1.000
Design Flow (l/s) 35.0 Maximum Head (m) 4.000
Range Combi Minimum Pipe Diameter (mm) 200
Application Stormwater Minimum Manhole Diameter (mm) 1200
Model DR 200 C

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.6	1.200	35.0	3.000	35.0	7.000	41.7
0.200	21.2	1.400	35.0	3.500	35.0	7.500	43.1
0.300	35.0	1.600	35.0	4.000	31.5	8.000	44.5
0.400	35.0	1.800	35.0	4.500	33.4	8.500	45.9
0.500	35.0	2.000	35.0	5.000	35.2	9.000	47.3
0.600	35.0	2.200	35.0	5.500	36.9	9.500	48.5
0.800	35.0	2.400	35.0	6.000	38.6		
1.000	35.0	2.600	35.0	6.500	40.2		

Appendix D – Proposed Surface Water Calculations

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 9 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.878	0.378	0.0	35.0	35.0	28.7	O K
30 min Summer	1.925	0.425	0.0	35.0	35.0	32.3	O K
60 min Summer	1.854	0.354	0.0	35.0	35.0	26.9	O K
120 min Summer	1.695	0.195	0.0	35.0	35.0	14.8	O K
180 min Summer	1.568	0.068	0.0	35.0	35.0	5.2	O K
240 min Summer	1.502	0.002	0.0	35.0	35.0	0.2	O K
360 min Summer	1.500	0.000	0.0	26.7	26.7	0.0	O K
480 min Summer	1.500	0.000	0.0	21.6	21.6	0.0	O K
600 min Summer	1.500	0.000	0.0	18.3	18.3	0.0	O K
720 min Summer	1.500	0.000	0.0	15.8	15.8	0.0	O K
960 min Summer	1.500	0.000	0.0	12.5	12.5	0.0	O K
1440 min Summer	1.500	0.000	0.0	9.0	9.0	0.0	O K
2160 min Summer	1.500	0.000	0.0	6.4	6.4	0.0	O K
2880 min Summer	1.500	0.000	0.0	5.1	5.1	0.0	O K
4320 min Summer	1.500	0.000	0.0	3.6	3.6	0.0	O K
5760 min Summer	1.500	0.000	0.0	2.8	2.8	0.0	O K
7200 min Summer	1.500	0.000	0.0	2.4	2.4	0.0	O K
8640 min Summer	1.500	0.000	0.0	2.0	2.0	0.0	O K
10080 min Summer	1.500	0.000	0.0	1.8	1.8	0.0	O K
15 min Winter	1.953	0.453	0.0	35.0	35.0	34.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	126.917	0.0	64.3	20
30 min Summer	81.977	0.0	83.5	29
60 min Summer	50.353	0.0	103.5	44
120 min Summer	29.875	0.0	121.5	76
180 min Summer	21.732	0.0	134.1	104
240 min Summer	17.246	0.0	141.1	128
360 min Summer	12.426	0.0	152.7	0
480 min Summer	9.846	0.0	161.3	0
600 min Summer	8.214	0.0	168.2	0
720 min Summer	7.080	0.0	174.0	0
960 min Summer	5.598	0.0	183.4	0
1440 min Summer	4.015	0.0	197.3	0
2160 min Summer	2.875	0.0	211.9	0
2880 min Summer	2.267	0.0	222.8	0
4320 min Summer	1.620	0.0	238.8	0
5760 min Summer	1.275	0.0	250.6	0
7200 min Summer	1.059	0.0	260.1	0
8640 min Summer	0.909	0.0	268.0	0
10080 min Summer	0.799	0.0	274.9	0
15 min Winter	126.917	0.0	73.5	20

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.011	0.511	0.0	35.0	35.0	38.8	O K
60 min Winter	1.895	0.395	0.0	35.0	35.0	30.0	O K
120 min Winter	1.633	0.133	0.0	35.0	35.0	10.1	O K
180 min Winter	1.500	0.000	0.0	34.3	34.3	0.0	O K
240 min Winter	1.500	0.000	0.0	27.5	27.5	0.0	O K
360 min Winter	1.500	0.000	0.0	19.9	19.9	0.0	O K
480 min Winter	1.500	0.000	0.0	15.8	15.8	0.0	O K
600 min Winter	1.500	0.000	0.0	13.2	13.2	0.0	O K
720 min Winter	1.500	0.000	0.0	11.4	11.4	0.0	O K
960 min Winter	1.500	0.000	0.0	9.0	9.0	0.0	O K
1440 min Winter	1.500	0.000	0.0	6.5	6.5	0.0	O K
2160 min Winter	1.500	0.000	0.0	4.6	4.6	0.0	O K
2880 min Winter	1.500	0.000	0.0	3.7	3.7	0.0	O K
4320 min Winter	1.500	0.000	0.0	2.6	2.6	0.0	O K
5760 min Winter	1.500	0.000	0.0	2.1	2.1	0.0	O K
7200 min Winter	1.500	0.000	0.0	1.7	1.7	0.0	O K
8640 min Winter	1.500	0.000	0.0	1.5	1.5	0.0	O K
10080 min Winter	1.500	0.000	0.0	1.3	1.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	81.977	0.0	93.7	30
60 min Winter	50.353	0.0	116.1	48
120 min Winter	29.875	0.0	136.8	78
180 min Winter	21.732	0.0	149.5	0
240 min Winter	17.246	0.0	158.2	0
360 min Winter	12.426	0.0	171.0	0
480 min Winter	9.846	0.0	180.6	0
600 min Winter	8.214	0.0	188.4	0
720 min Winter	7.080	0.0	194.8	0
960 min Winter	5.598	0.0	205.4	0
1440 min Winter	4.015	0.0	221.0	0
2160 min Winter	2.875	0.0	237.4	0
2880 min Winter	2.267	0.0	249.5	0
4320 min Winter	1.620	0.0	267.5	0
5760 min Winter	1.275	0.0	280.7	0
7200 min Winter	1.059	0.0	291.3	0
8640 min Winter	0.909	0.0	300.2	0
10080 min Winter	0.799	0.0	307.8	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.700	Shortest Storm (mins)	15
Ratio R	0.438	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.273

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.091	4	8	0.091	8	12	0.091

Model Details

Storage is Online Cover Level (m) 2.500

Cellular Storage Structure

Invert Level (m) 1.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	80.0	80.0	1.001	0.0	115.8
1.000	80.0	115.8			

Hydroslide Outflow Control

Design Head (m) 1.500 Invert Level (m) 1.000
Design Flow (l/s) 35.0 Maximum Head (m) 4.000
Range Combi Minimum Pipe Diameter (mm) 200
Application Stormwater Minimum Manhole Diameter (mm) 1200
Model DR 200 C

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.6	1.200	35.0	3.000	35.0	7.000	41.7
0.200	21.2	1.400	35.0	3.500	35.0	7.500	43.1
0.300	35.0	1.600	35.0	4.000	31.5	8.000	44.5
0.400	35.0	1.800	35.0	4.500	33.4	8.500	45.9
0.500	35.0	2.000	35.0	5.000	35.2	9.000	47.3
0.600	35.0	2.200	35.0	5.500	36.9	9.500	48.5
0.800	35.0	2.400	35.0	6.000	38.6		
1.000	35.0	2.600	35.0	6.500	40.2		

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