elliottwood

The Hall School

Flood Risk Assessment and Sustainable Drainage Statement

engineering a better **society**

		Remarks:	For Planning				
Revision:	P1	Prepared by:	K Trimmer	Checked by:	K Trimmer	Approved by:	T Kenning
Date:	01/03/2019	Signature:	KTr	Signature:	KTr	Signature:	TKe
Revision:	P2	Prepared by:	H Hunter	Checked by:	K Trimmer	Approved by:	K Trimmer
Date:	06/09/2022	Signature:	HHu	Signature:	KTr	Signature:	KTr

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Appendices

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One

Introduction

1.1

Elliott Wood Partnership Ltd have been appointed to produce a Sustainable Drainage Statement and Flood Risk Assessment to support a planning application for the development at The Hall School, 23 Crossfield Rd, London NW3 4NU.

Two

Existing Site

2.1

The Hall School is located in South Hampstead, London, and lies within the London Borough of Camden (LBC). The National Grid reference for the site is 526932E, 184533N. (Refer to Figure 1 for the site location map.)

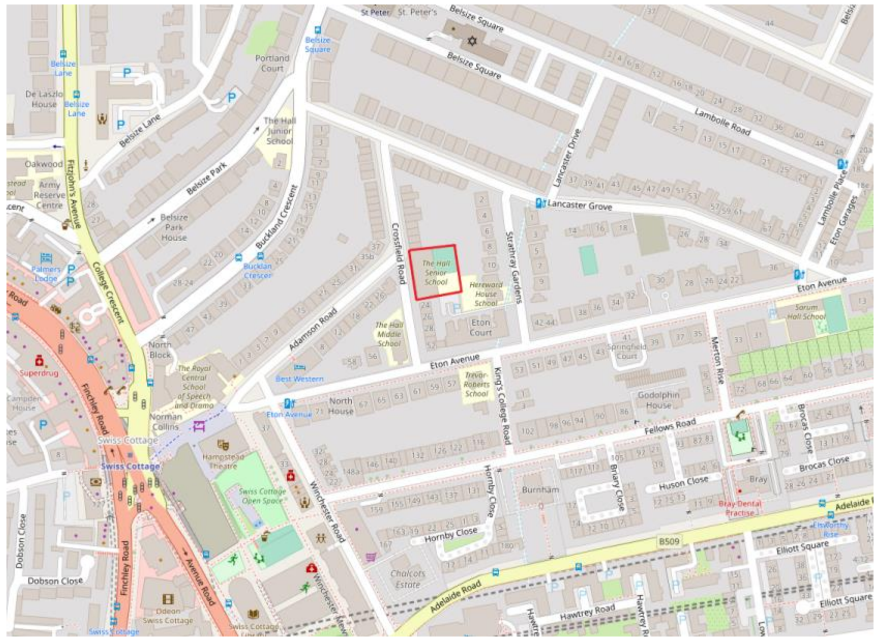

Figure 1 – Site Location Plan (Openstreetmap.org)

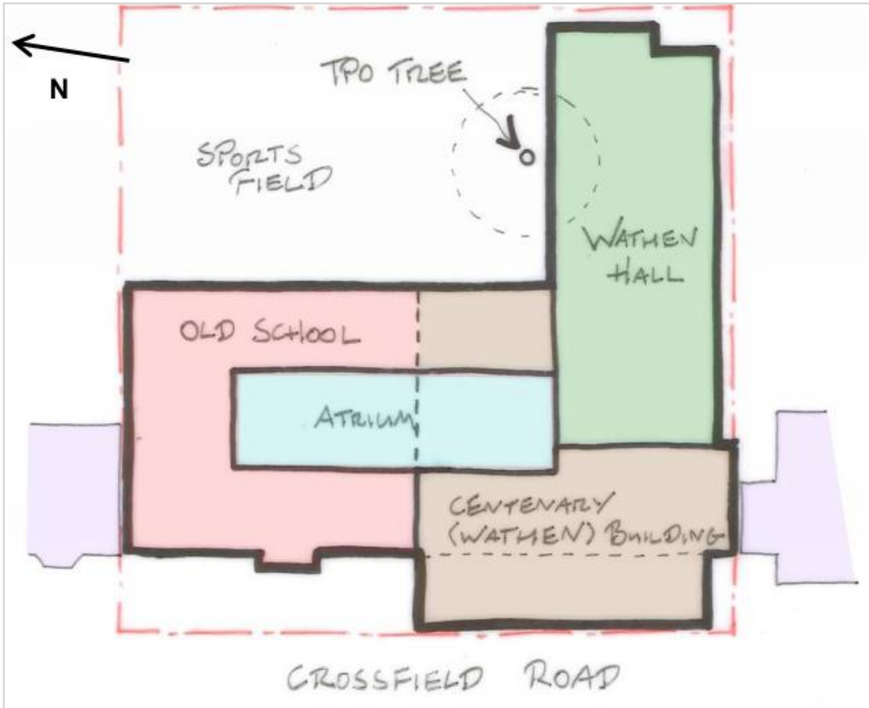

Figure 2 – Existing Buildings

2.2

The existing site comprises of existing school buildings (of varying ages). Namely the 'Old School', 'Wathen Hall', 'Centenary' (Wathen) Building' and the main 'Atrium'. Refer to Figure 2 above which shows the existing arrangement.

2.3

The existing site also comprises an external play space to the rear of the 'Old School' which is primarily covered by artificial grass and is used as a multi-use games area (MUGA). An existing London plane tree is located adjacent to the Wathen Hall building, which is subject to a Tree Preservation Order (TPO) and is to be retained as part of the proposed scheme.

2.4

Pedestrian access to the site is via Crossfield Road. The site redline boundary is approximately 2,180m^2 and is considered to be 100% impermeable in the existing state.

2.5

A topographic survey has been completed by Metrix Surveys Ltd in October 2015; this can be found in **Appendix A**. The site is broadly flat with a shallow slope from northwest to southeast with levels varying between 46.80 to 46.14 at the low point in the eastern corner of the site. The school building sits approximately 1.50m lower than Crossfield Road with the rest of site levels in keeping with the lower ground floor level.

2.6

A ground investigation report was been prepared by GEA Ltd in August 2016, refer to **Appendix B** for borehole log extracts. Boreholes between 5 & 25m below ground level (bgl) were undertaken as part of the survey works. These found ground conditions to be Made Ground (general depth of made ground was found to be 1-4m bgl) with underlying London Clay, which extended the full extent of the 25m deep boreholes. British Geological Survey (BGS) maps show that the clay may extend to a depth of up to 95m bgl.

Ground water seepage was encountered on site (approximately 1-4m bgl); however, this was thought to be perched water.

Three

Existing Drainage

3.1

Public sewer records have been obtained from Thames Water and are included in **Appendix C**. Sewer records show that the offsite sewer network is combined (sewers carry both foul and surface water flows). Records show that a 300mm diameter combined water sewer is located in Crossfield Road, which drains towards the 1143x787mm sewer which runs beneath Eton Avenue.

3.2

A CCTV survey of the existing below ground drainage has been conducted on the site which demonstrates the existing property drains via two existing combined water connections at lower ground floor level. One connection is for the existing older retained building and the other connection is for the more recently constructed building extensions. Refer to **Appendix D** for the CCTV survey report plan.

3.3

The surface water runoff rates for the existing site have been calculated using the Modified Rational Method equation below (based on CIRIA C697):

Q = 2.78.C.i.A

*Where Q = Existing peak runoff (l/s), C = non-dimensional runoff coefficient=1,
i = Rainfall intensity and A = total catchment area being drained*

If considering the whole site (which includes the existing old retained building and MUGA), the surface water runoff rate has been calculated as follows, based on an area of 2,180m^2 and a rainfall intensity of 50mm/hr.

Q = 2.78 x 1 x 50mm/hr x 0.218

<u>Q Total = 30.3 l/s</u>

The existing surface water run-off rate associated with the area of proposed green roof over the rooftop extension has been calculated as follows, based on an area of 269m^2 and modelled as a two-pipe network in MicroDrainage.

Table 1 – Existing Runoff Rates Associated with the area of proposed green roof

Return Period	Existing Runoff Rate (l/s)
1 in 1 year	4.4
1 in 30 years	10.7
1 in 100 years	14.0

Refer to **Appendix** F for the Microdrainage calculations for the site pre-development for the area that the green roof covers.

Four

Proposed Development

4.1

The project involves minor and extensive internal refurbishment of the existing school building comprising redecoration, replacement of floor and ceiling finishes, light fittings and the installation of new furniture. In addition to this, a single storey extension is proposed above the Wathen Hall which is to comprise 4 new classrooms, resource areas and an accessible WC.

Five

Proposed Drainage Strategy

5.1

The surface water drainage strategy for the site has been considered in line with London Plan Policies 5.12 (Flood Risk Management) and 5.13 (Sustainable Drainage). The following drainage hierarchy has therefore been considered:

1. Store rainwater for later use
2. Use infiltration techniques, such as porous surfaces in non-clay areas
3. Attenuate rainwater in ponds or open water features for gradual release
4. Attenuate rainwater by storing in tanks or sealed water features for gradual release
5. Discharge rainwater direct to a watercourse
6. Discharge rainwater to a surface water sewer/drain
7. Discharge rainwater to the combined sewer.

5.2

Drainage via infiltration has been considered for the development however following a review of the ground conditions (i.e. underlying clay) it is considered that soakaways are not viable for this project.

5.3

External space on site is limited, as such, attenuation within ponds or open water features is not considered to be feasible.

5.4

There are no nearby accessible water courses and the existing Thames Water sewer network in the vicinity is combined use.

5.5

Considering the above, the foul and surface water generated by the development will aim to re-use the existing gravity connections from the development. Ultimately discharging to the Thames Water combined sewer beneath Crossfield Road.

5.6

For this development, 77% of the site consists of the existing old retained building and existing MUGA which drain via a separate combined water outlet. The remaining 23% of the site, comprising Wathan Hall, approximately half the Centenary Building and the proposed single storey extension discharges to a secondary combined water outlet.

5.7

When considering the existing buildings, it is not considered feasible to implement a restriction on surface water run-off, due to the extreme complexities associated with separating the existing drainage network on site (in order to install the appropriate flow controls and attenuation devices).

5.8

When considering the single-storey element of the development, it is again not considered feasible to restrict run-off via below ground attenuation devices. It is not considered viable to install a tank underneath the existing MUGA due to the damage it would cause, the implications with the TPO of the London Plane Tree and it is considered unlikely that drainage would be able to discharge via gravity this way. Surface water would therefore require pumping, which is not deemed feasible, as this would increase the flood risk to the building.

5.9

In light of the above, alternative solutions for restricting run-off from the development areas have been explored. Where possible, a green roof has been introduced (over the Wathen Hall building), covering 269m^2 of roof area, which is indicated in green on Figure 3 below). A green wall system is also proposed in areas shown in orange, which equates to approximately 262m^2. Refer to the Architects general arrangement drawings and building elevations for the extents of the green roof and green wall proposed.

Figure 3 – Proposed green roof and green wall extents

5.10

The proposed surface water run-off rates associated with the proposed green roof area only have been calculated using MicroDrainage software and are presented in Table 2.

Table 2 – Proposed Runoff Rates Associated with the area of proposed green roof

Return Period	Proposed Green Roof Runoff Rate (l/s)
1 in 1 year	1.0
1 in 30 years	3.1
1 in 100 years	3.9
1 in 100 years + 40% CC	5.5

5.11

The above proposals have been discussed previously with both Thames Water and the Lead Local Flood Authority who both previously approved the strategy (refer to **Appendix** E for previous correspondence with Thames Water).

5.12

In summary, Thames Water were previously satisfied with the surface water proposals at the development site and the run-off restrictions achieved by installing the green roof system. It should be noted that since the time of the discussions with Thames Water the green roof area has increased from 163m^2 to 269m^2. Refer to Appendix F for the Microdrainage calculations for the site pre-development and post-development for the area that the green roof covers.

5.13

In conjunction with the above, low flow water efficient appliances will be specified as part of the new development in order to reduce water consumption. These will be specified by the project M&E Engineer.

5.14

The evaluation of SuDS devices is summarised in the table below:

SuDS Technique	Y/N	Comment
Green Roofs	Y	Green roofs will be incorporated within the scheme. Refer to the Architect's drawings for location and extents. Run-off restrictions achieved from the green roof system have been reviewed with Thames Water who are satisfied with the proposals.
Basins and ponds	N	External space on site is limited, attenuation within ponds or open water features is not considered to be feasible.
Filter strips and swales	N	Filter strips and swales are not appropriate due to unsuitable ground conditions.
Infiltration devices	N	Infiltration is not deemed feasible for this site as the existing ground conditions are not conducive to infiltration techniques.
Tanked systems	N	When considering the existing buildings to be retained, it is not considered feasible to implement a restriction on surface water run-off – refer to section 5.8 of this report. When considering the new build element of the development, it is again not considered feasible to restrict run-off via below ground attenuation devices. It is not considered viable to install a tank underneath the existing MUGA due to the damage it would cause, the implications with the TPO of the London Plane Tree and it is considered unlikely that drainage would be able to discharge via gravity this way. Surface water would therefore require pumping, which is not deemed feasible, as this would increase the flood risk to the building. The green roof and green wall specified are deemed to be a more appropriate form of SuDS device in this instance.

5.15

The post-development runoff improvement against the existing runoff for the area covered by the new green roof has been provided in Table 4.

Return Period	Existing Runoff Rate (l/s)	Proposed Runoff Rate (l/s)	Percentage Betterment
1 in 1 year	4.4	1.0	77.3%
1 in 30 years	10.7	3.1	71.0%
1 in 100 years	14.0	3.9	72.1%
1 in 100 years + 40% Climate Change	N/A	5.5	>72.1%

Six

Maintenance Requirements

6.1

All SuDS devices will be maintained by the property owner for the lifetime of the development in accordance with the SuDS Manual as summarised below:

Green Roofs:

Maintenance Schedule	Required Action	Recommended Frequency
Regular Inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability.	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (i.e. year one), replace dead plants as required.	Monthly (but usually the responsibility of manufacturer)
	Post establishment, replace dead plants as required (where >5% of coverage)	Annually (in Autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation including weeds	Six monthly or as required
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and allowed to accumulate	Six monthly or as required
Remedial actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled.	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

Gullies:

Inspection and removal of debris from silt trap once a year; preferably after leaf fall in the autumn.

Drainage pipes, manholes & silt traps:

Inspect manholes & silt traps for build-up of silt and general debris (once a year, preferably after leaf fall in the autumn). If silt/debris is building up then clean with jetting lorry / gully sucker and inspect pipe – repeat cleaning if required. If the pipes to be jetted are plastic then a high flow, low pressure setting should be used so that the pipes are not damaged.

Unusual / unresolved problems:

If the drainage system is still holding water following cleaning with a jetter, or the jetting of the system removes excessive amounts of debris this may indicate greater issues within the system. A CCTV survey is likely to be required and further advice should be sought from a drainage engineer.

Seven

Flood Risk Policy

7.1

Camden Strategic Flood Risk Assessment - The LBC Strategic Flood Risk Assessment (SFRA) was completed by URS in July 2014. This report aims to provide a reference and policy document to inform the local development framework and any subsequent plans.

7.2

Sequential Test and Exception Test - The Sequential and Exception Tests should be applied when choosing the location of new development and the layout of the development site. The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. The Exception Test is utilised if no suitable development areas can be found in low risk areas. As the proposed development is located within Flood Zone 1, both the sequential test and the exception test are not required.

Eight

Flooding from Rivers and Sea

8.1

Flood Zone information published by GOV.uk shows that the proposed school site lies within Flood Risk Zone 1 (low risk). Sites within Flood Zone 1 have a chance of flooding of less than 1 in 1000 years (0.1%) due to coastal or river flooding. The flood risk in the surrounding area can be seen in Figure 4.

8.2

A review of the Flood Maps found within the LBC SFRA confirms that this site is located within Flood Zone 1, and as noted within the LBC SFRA, no historic flooding has occurred within the borough as a result of fluvial or tidal sources.

8.3

After review of the relevant information this development is considered to be at low risk of flooding from rivers and seas.

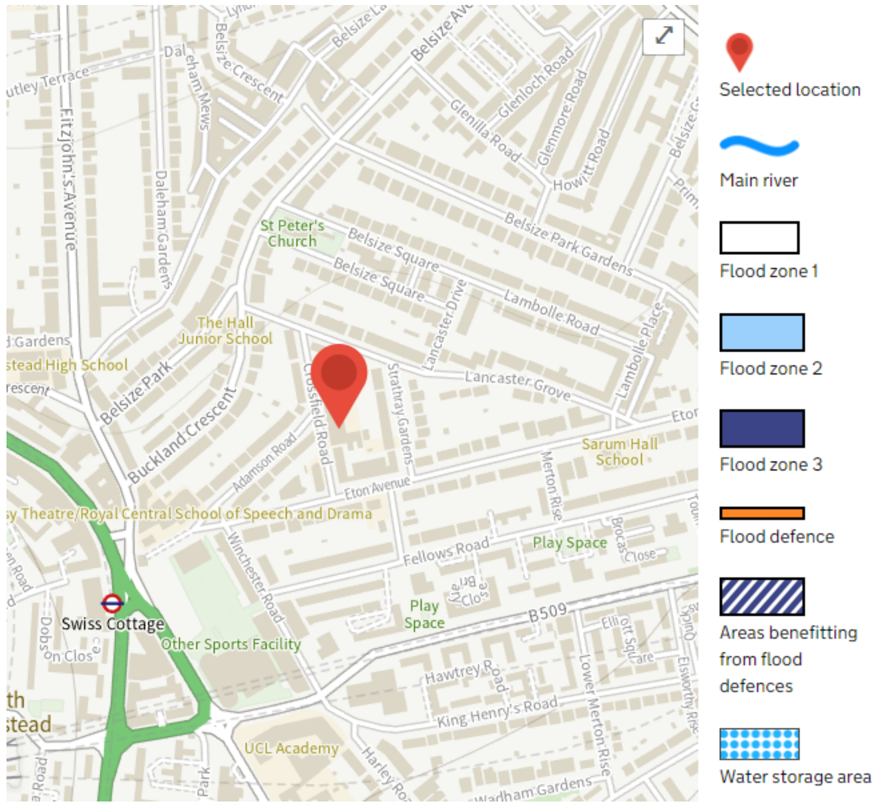

Figure 4 – Flood Zones in Surrounding Area (GOV.uk)

Flooding from Surface Water

8.4

Overland rainwater flows occur when the infiltration capacity of land or the drainage capacity of a local sewer network is exceeded. The extents of overland flooding will depend upon the rainfall event, the degree of saturation of the soil, the permeability of soils and the topography of the site.

8.5

Following review of the GOV.uk surface water map (refer to Figure 5), this site is considered to be at very low risk of flooding from overland flow i.e. less than 1 in 1000 chance of flooding any given year. The site is also shown to be located in a low risk area in the LBC SFRA 'Updated Flood Maps for Surface Water Flooding' map (uFMfSW) as shown in Figure 6.

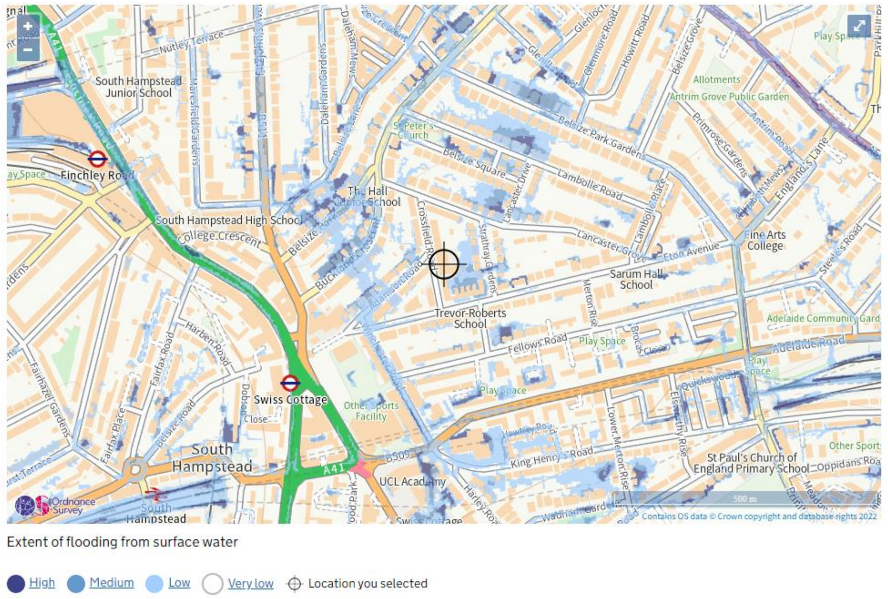

Figure 5 – Risk of surface water flooding (GOV.uk)

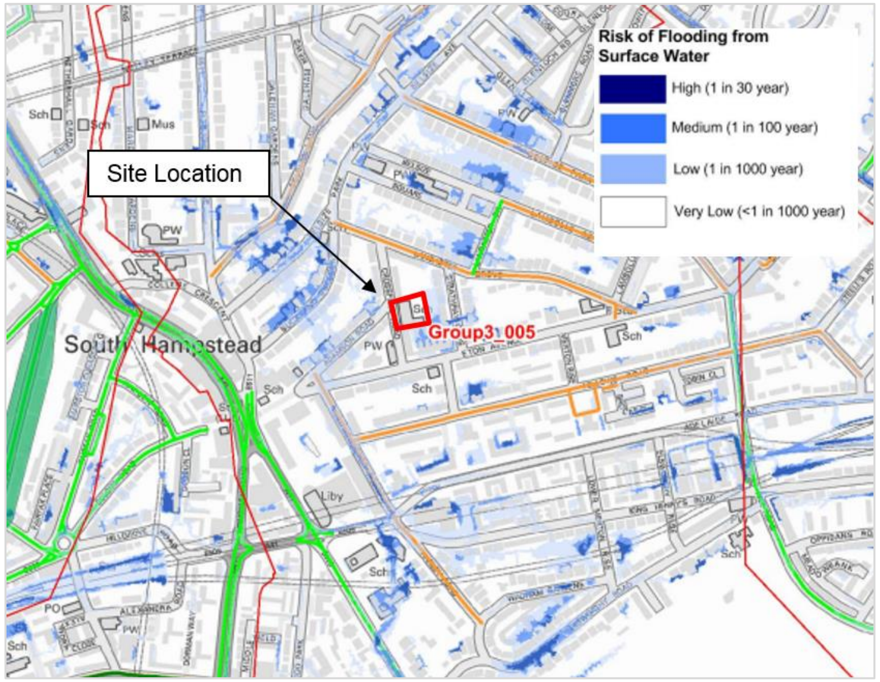

Figure 6 – LBC SFRA Figure 3v uFMfSW)

8.6

In general the levels along the western boundary of the site are above those along the pavement of Crossfield Road. Therefore, surface water within the road will ultimately flow away from the site, towards Eton Avenue, discharging into local highway gullies. Refer to Appendix A for the site topographical survey.

8.7

After review of the relevant information this development is considered to be at low risk of flooding from surface water.

Flooding from Sewers

8.8

Public sewer records have been obtained from Thames Water and are included in Appendix C. Sewer records show that the offsite sewer network is combined (sewers carry both foul and surface water flows). Records show that a 300mm diameter combined water sewer is located in Crossfield Road.

8.9

Thames Water are responsible for operating and maintaining their sewer infrastructure, therefore the likelihood of sewer surcharging is expected to be low.

8.10

The LBC SFRA shows that the site is located within an area which has had one reported incidence of internal sewer flooding. Refer to Figure 7 for an extract of the SFRA 'DG5 Internal Sewer Flooding' map.

8.11

The LBC SFRA also shows that the site is located outside of areas which have previously had reported issues as a result of external sewer flooding. Refer to Figure 8 for an extract of the SFRA 'DG5 External Sewer Flooding' map.

8.12

All new drainage on site will be designed to protect the local drainage network against public sewer surcharge.

8.13

After review of the relevant information this development is considered to be at low risk of flooding from sewers.

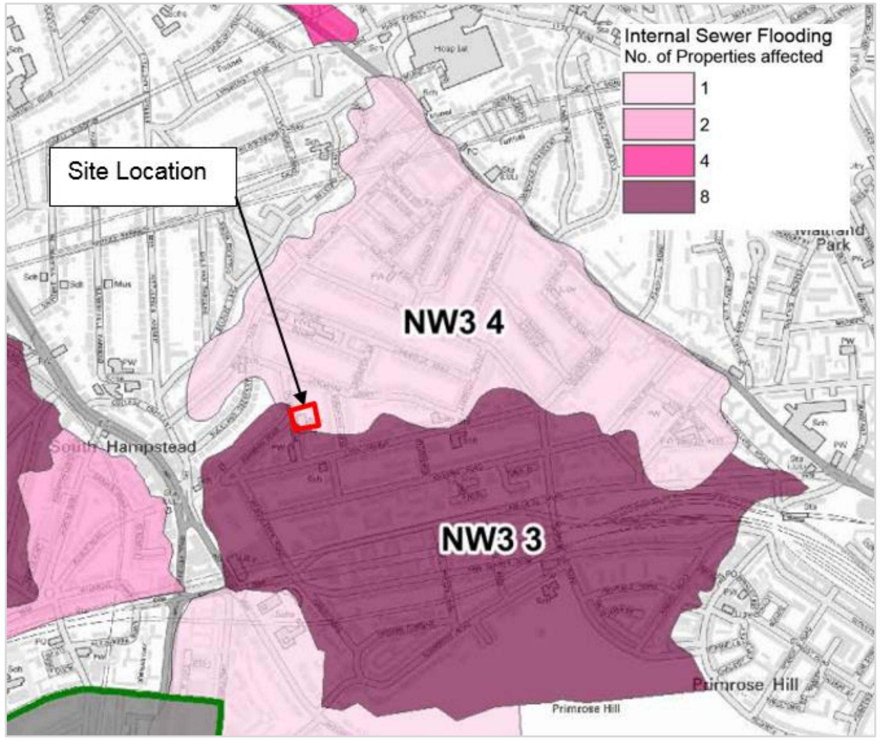

Figure 7 – LBC SFRA DG5 Internal Sewer Flooding Map

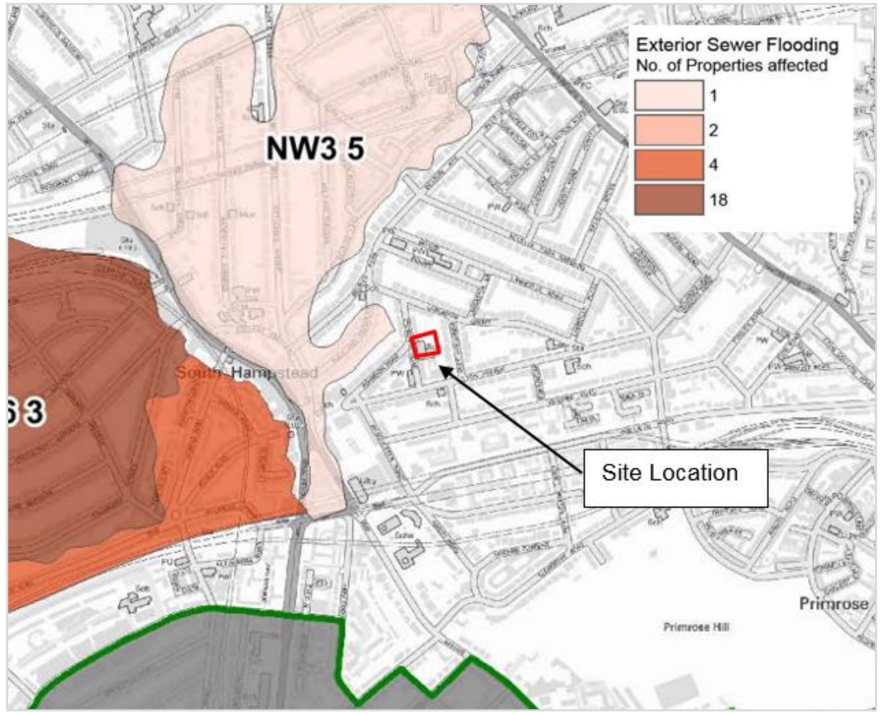

Figure 8 – LBC SFRA DG5 External Sewer Flooding Map

Flooding from Groundwater

8.14

Groundwater flooding can occur following an extended prolonged period of low intensity rainfall. The future risk from this source is more uncertain than surface water as the climate change predictions indicate that although sea levels will rise, thus possibly raising groundwater levels, overall summer rainfall will decrease, therefore having a long-term effect of lowering the groundwater levels. However, long periods of wet weather are predicted to increase, and these are the type of weather patterns that can cause groundwater flooding to occur.

8.15

A Ground investigation report has been prepared by GEA Ltd in August 2016. Boreholes between 5 & 25m below ground level (bgl) were undertaken as part of the survey works. The boreholes found the ground conditions to be Made Ground (general depth of made ground was found to be 1-4m bgl) with underlying London Clay, which extended the full extent of the 25m deep borehole. British Geological Survey (BGS) maps show that the clay may extend to a depth of up to 95m bgl.

8.16

Ground water seepage was encountered on site (approximately 1-4m bgl); however, this was thought to be perched water, refer to Appendix B for the

SI Borehole Logs. Data from BGS indicates that the continuous standing groundwater level is approximately 90m below ground level.

8.17

The EA does not have any historic evidence of flooding in the area arising from groundwater.

8.18

The LBC SFRA shows areas within the borough that are susceptible to elevated ground water (refer to Figure 9); the development site is not located within one of these areas.

8.19

The site itself and majority of the surrounding area is paved which reduces the risk of ground water at the surface. Flooding due to ground water elsewhere in the area would follow localised flow paths, similar to those shown on the GOV.uk surface water flood risk map, and would then discharge into the local sewer system.

8.20

After review of the relevant information this development is considered to be at **low risk** of flooding from groundwater.

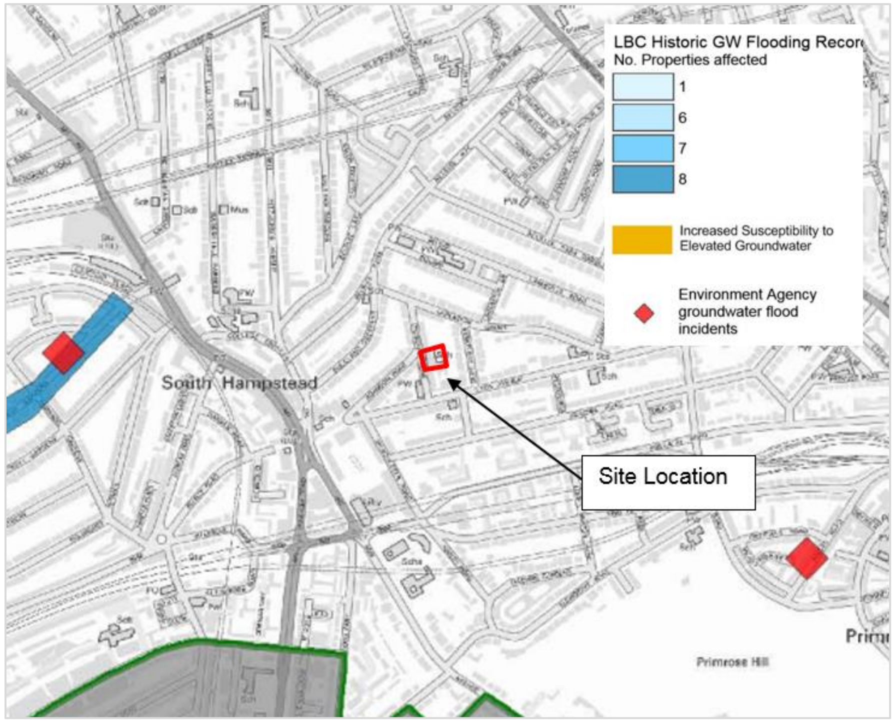

Figure 9 – LBC SFRA Increased Susceptibility to Elevated Groundwater Map

Flooding from Artificial Water Bodies

8.21

The closest watercourses to the site are the Hampstead Ponds (which are located approximately 1,250m north of the site) and the Regents Canal (which is located approximately 1,350m south of the site). Refer to Figure 10 which shows the 'Risk of Flooding from Reservoirs' map found on the EA website.

8.22

The LBC SFRA confirms that no flooding incidents associated with the Regents Canal have been recorded within the borough, and that the risk of flooding as a result of overtopping or breaching of the canal is considered to be low.

8.23

The LBC SFRA also notes that inspection of the Hampstead Ponds is carried out as required under the Reservoirs Act 1975, routine maintenance is carried out as and when required.

8.24

After review of the relevant information this development is considered to be at **low risk** of flooding from artificial water bodies.

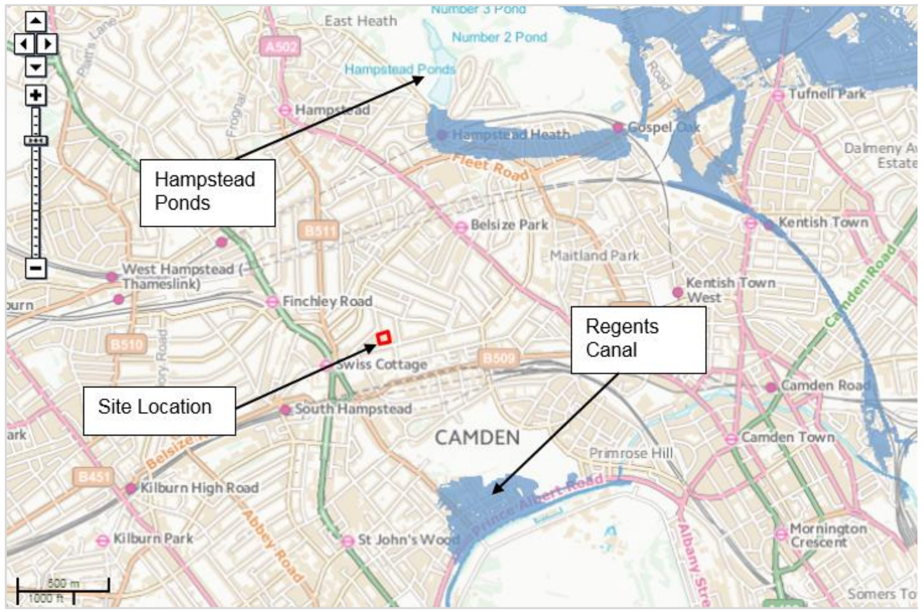

Figure 10 – Risk of Flooding from Reservoirs Map(Contains Environment Agency information © Environment Agency and/or database rights. Based on information © Local Authorities)

Flood Risk Summary

8.25

A review of all potential sources of flooding has found the site be at low. The new proposed drainage network should ensure that the building remains safe from flooding in the event of a localised drainage failure. In addition, levels across the site should ensure that surface water is directed away from building entrances.

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Appendices

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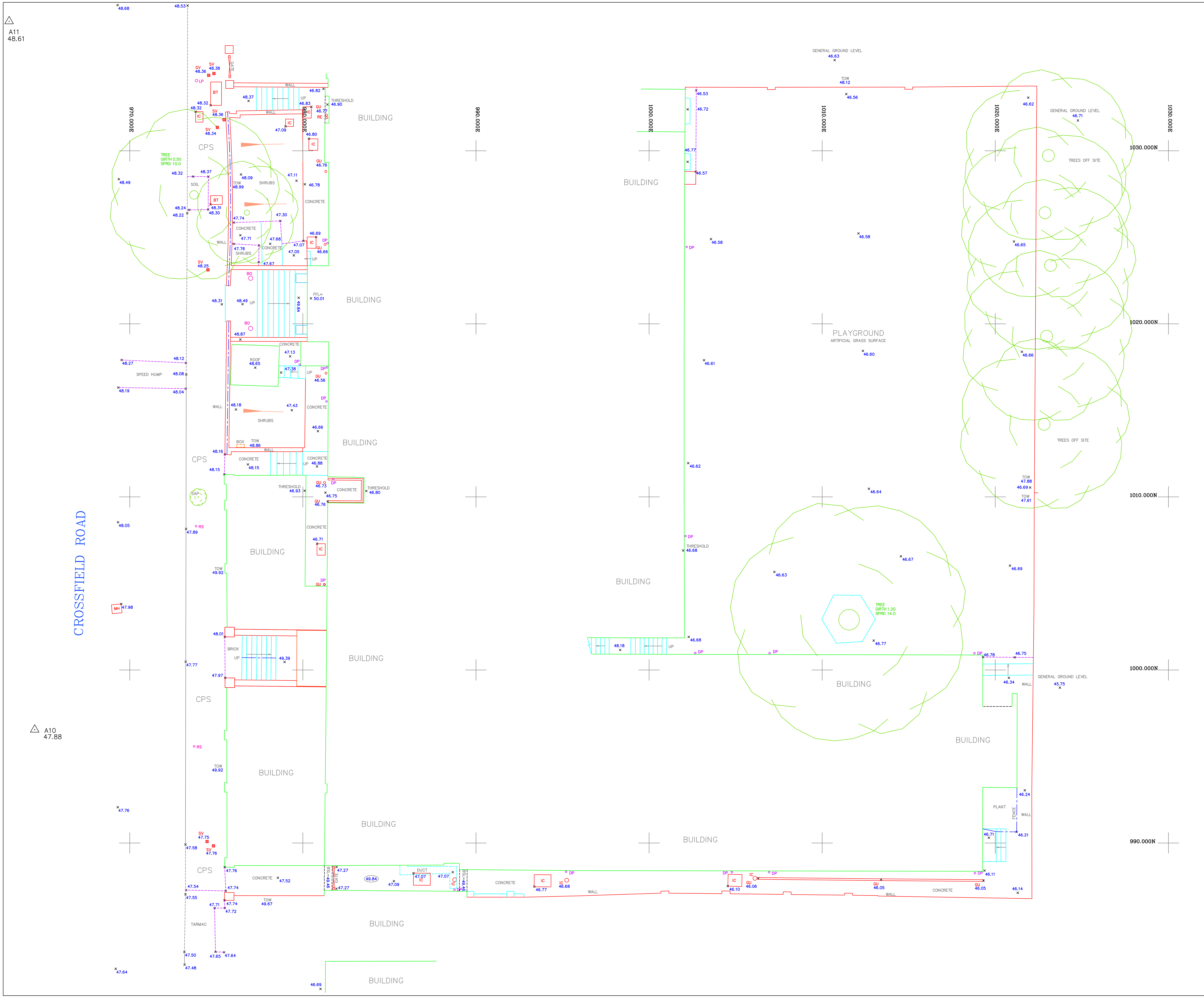
A Topographic Survey



INDICATIVE ONLY

Topographical Abbreviations

A/R	Assumed Route	MKR	Marker
BH	Borehole	MT	Mercury Telecom Cover
BOL	Bollard	OHC	Overhead Cable
BT	British Telecom Cover	OHP	Overhead Pipe
BW	Barbed Wire Fence	OSBM	Ordnance Survey Bench Mark
BWK	Brickwork	PB	Post Box
CATV	Cable TV Cover	PGM	Permanent Ground Marker
CB	Close Boarded Fence	PR	Post & Rail Fence
CCTV	Closed Circuit TV	PW	Post & Wire Fence
CHLK	Chainlink Fence	PWM	Post & Wire Mesh Fence
CHPL	Chestnut Paling Fence	RE	Rodding Eye
CL	Cover Level	RG	Road Gully
CM	Cable Marker	RN	Road Name
CP	Catch Pit	RS	Road Sign
CPL	Catch Pit Base Level	RW	Retaining Wall
DIA	Diameter	RWP	Rain Water Pipe
DK	Drop Kerb	SAP	Sapling
DP	Down Pipe	SC	Stop Cock
EJB	Electricity Junction Box	SPR	Spread
EC	Electricity Cover	STA	Traverse Station
EP	Electricity Pole	SV	Stop Valve
ER	Earthing Rod	SVP	Soil Vent Pipe
FH	Fire Hydrant	SW	Storm Water
FIG	Feed Into Ground	TB	Telephone Box
FW	Foul Water	TBM	Temporary Bench Mark
GU	Gully	TFR	Taken From Records
GV	Gas Valve	TJB	Telephone Junction Box
H	Height	TPT	Trial Pit
IC	Inspection Cover	TL	Traffic Light
IL	Invert Level	TP	Telephone Pole
IR	Iron Railing Fence	UTL	Unable To Lift
KO	Kerb Outlet	UTT	Unable To Trace
LB	Litter Bin	VP	Vent Pipe
LC	Lamp Column	WKH	Water Key Hole
LP	Lamp Post	WM	Water Meter
MH	Manhole	WV	Water Valve
		- - -	Approximate

Survey Station Information

STA No.	Easting	Northing	Level	Type
STN A10	964.512	996.550	47.88	Nail
STN A11	963.033	1037.480	48.61	Nail

Notes

The Grid is Arbitrary

All Levels are related to Station A1 given value 50.00m (Previous survey)

Rev	QA Check	Description	Date
5	-	-	-
4	-	-	-
3	-	-	-
2	-	-	-
1	-	-	-
0	GR	First Complete Issue	26-10-2015
Prelim	-	Preliminary - Not Complete	-

SURVEYED BY
METRIX SURVEYS LTD
7 WEST END
SHERBORNE ST JOHN
BASINGSTOKE
HAMPSHIRE
RG24 9LB

TEL 01256 851672
CELL 07734 233459
E-MAIL postbox@metrixsurveys.com
www.metrixsurveys.com

SURVEYED	SR	CLIENT: Archial NORR
DRAWN	SR	
SCALE	1:100	

TOPOGRAPHICAL SURVEY

ADDRESS:
THE HALL SCHOOL
CROSSFIELD ROAD
LONDON NW3

JOB No	DRAWING NUMBER
14064B / 15085T	15085T/100

A1 Sheet - 841mm X 594mm

B Site Investigation – Borehole Logs

GEA Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware SG12 7QE	**Site** The Hall School, 23 Crossfield Street, London NW3 4NU	**Borehole Number** **BH1**

Boring Method	**Casing Diameter**		**Ground Level (mOD)**	**Client**	**Job Number**
Dismantlable Cable Percussion Rig	Depth	Diameter		The Hall School	J15302
	2.00	150			
	Location		**Dates**	**Engineer**	**Sheet**
	526946.00E 184515.00N		28/10/2015	Elliott Wood	Sheet 1 of 3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.10) 0.10	Astro Turf surface over foam underlay and asphalt		
0.20	D1					(0.10) 0.20	Lean-mix concrete over stone chippings		
0.30	D2					(0.10) 0.30	Asphalt		
0.50	B3						Made Ground (brownish grey silty clay with rootlets, gravel, brick, coal and concrete fragments)		
0.75	D4					(1.05)			
1.20 - 1.65	B5								
1.20 - 1.65	SPT (C)N=11	1.00		N=11 (1,2/2,2,3,4)		1.35	Medium to firm fissured brown silty CLAY with pockets of orange-brown silt and fine sand and fine selenite, has blocky fissuring.		
1.75	D6								
2.00 - 2.45	U7					(1.65)			
2.75	D8								
3.00 - 3.45	D9					3.00	Stiff high strength locally fissured brown silty laminated CLAY with partings and pockets of orange-brown and grey silt and fine to coarse selenite crystals.		
3.00 - 3.45	SPT (S)N=15	2.00		N=15 (1,2/3,3,4,5)					
3.75	D10								
4.00 - 4.45	U11								
4.75	D12								
5.00 - 5.45	D13								
5.00 - 5.45	SPT (S)N=16	2.00		N=16 (1,2/3,3,4,6)					
6.00	D14								
6.50 - 6.95	U15					(6.50)			
7.50	D16								
8.00 - 8.45	D17								
8.00 - 8.45	SPT (S)N=19	2.00		N=19 (4,3/4,5,5,5)					
9.00	D18						*abundant partings of orange-brown silty sand.*		
9.50 - 9.95	U19					9.50	Very stiff high strength to very high strength dark grey silty CLAY, locally very laminated with fine selenite, occasional white shells, occasional pale grey veins and white		

Continued on Next Page

Remarks	**Scale (approx)**	**Logged By**
4 hrs spent moving rig and all equipment to borehole location. Services inspection pit excavated from GL to 1.2 m for 1 hr. Chiselling on claystone between 17.0 m to 17.30 m for 30 mins. 5hrs spent removing rig and equipment off of site. Groundwater monitoring standpipe installed in borehole to 8.00 m.	1:50	ML

GEA Geotechnical & Environmental Associates	Widbury Barn Widbury Hill Ware SG12 7QE	Site The Hall School, 23 Crossfield Street, London NW3 4NU	Borehole Number **BH1**

Boring Method	Casing Diameter		Ground Level (mOD)	Client	Job Number
Dismantlable Cable Percussion Rig	Depth	Diameter		The Hall School	J15302
	2.00	150			

Location	Dates	Engineer	Sheet
526946.00E 184515.00N	28/10/2015	Elliott Wood	Sheet 2 of 3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							foraminifera.		
10.50	D20								
11.00 - 11.45	D21								
11.00 - 11.45	SPT (S)N=24	2.00		N=24 (3,4/5,6,6,7)					
12.00	D22								
12.50 - 12.95	U23								
13.50	D24								
14.00 - 14.45	D25								
14.00 - 14.45	SPT (S)N=27	2.00		N=27 (3,5/5,6,7,9)					
15.00	D26					(15.50)			
15.50 - 15.95	U27								
16.50	D28								
17.00 - 17.45	D29						*claystone at 17.00 m*		
17.00 - 17.45	SPT (S)N=33	2.00		N=33 (14,15/11,8,6,8)					
18.00	D30								
18.50 - 18.95	U31								
19.50	D32								
20.00 - 20.45	D33								

Continued on Next Page

Remarks	Scale (approx)	Logged By
4 hrs spent moving rig and all equipment to borehole location. Services inspection pit excavated from GL to 1.2 m for 1 hr. Chiselling on claystone between 17.0 m to 17.30 m for 30 mins. 5hrs spent removing rig and equipment off of site. Groundwater monitoring standpipe installed in borehole to 8.00 m.	1:50	ML

GEA Geotechnical & Environmental Associates — Widbury Barn, Widbury Hill, Ware, SG12 7QE	**Site** The Hall School, 23 Crossfield Street, London NW3 4NU		**Borehole Number** BH1
Boring Method Dismantlable Cable Percussion Rig	**Casing Diameter** Depth 2.00, Diameter 150	**Ground Level (mOD)**	**Client** The Hall School	**Job Number** J15302
	Location 526946.00E 184515.00N	**Dates** 28/10/2015	**Engineer** Elliott Wood	**Sheet** Sheet 3 of 3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
20.00 - 20.45	SPT (S)N=34	2.00		N=34 (5,6/7,8,8,11)					
21.00	D34								
21.50 - 21.95	U35								
22.50	D36								
23.00 - 23.45	D37								
23.00 - 23.45	SPT (S)N=35	2.00		N=35 (5,6/8,8,9,10)					
							claystone at 23.70 m		
24.00	D38								
24.55 - 25.00	D40								
24.55 - 25.00	SPT (S)N=37	2.00		N=37 (7,6/7,8,9,13)					
24.55 - 25.00	U39					25.00	Complete at 25.000m		

Remarks

4 hrs spent moving rig and all equipment to borehole location.
Services inspection pit excavated from GL to 1.2 m for 1 hr.
Chiselling on claystone between 17.0 m to 17.30 m for 30 mins.
5hrs spent removing rig and equipment off of site.
Groundwater monitoring standpipe installed in borehole to 8.00 m.

Scale (approx) 1:50

Logged By ML

Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
SG12 7QE

Site	The Hall School, 23 Crossfield Street, London NW3 4NU
Borehole Number	BH2
Boring Method	Drive-in Window Sampler
Casing Diameter (Depth / Diameter)	
Ground Level (mOD)	
Client	The Hall School
Job Number	J15302
Location	526939.00E 184539.00N
Dates	30/10/2015
Engineer	Elliott Wood
Sheet	Sheet 1 of 1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
						(0.20) 0.20	Concrete
						(0.20) 0.40	Made Ground (dark brown and black silty sandy gravel with ash)
2.00	D1					(2.00) 2.40	Made Ground (brown silty clay with gravel and fine brick fragments)
				Seepage		(0.40) 2.80	Made Ground (crushed brick and gravel)
						(1.00) 3.80	Made Ground (greyish brown loosely cemented gravel and brick)
4.00	D2						Firm fissured locally very thinly laminated silty CLAY with partings of bluish grey silt occasional pockets of dark orange-brown fine sand, coarse selenite and fine white shells
4.50	D3						
5.00	D4					(1.50) 5.30	
							Complete at 5.300m

Remarks

Borehole advanced through the base of TRial Pit 1 at a depth of 1.80 m.
Groundwater monitoring standpipe installed in borehole to 5.00 m.

Scale (approx)	Logged By
1:50	ML

GEA Geotechnical & Environmental Associates Widbury Barn Widbury Hill Ware SG12 7QE	**Site** The Hall School, 23 Crossfield Street, London NW3 4NU	**Borehole Number** **BH3**

Boring Method	**Casing Diameter** (Depth / Diameter)	**Ground Level (mOD)**	**Client**	**Job Number**
Drive-in Window Sampler			The Hall School	J15302
	Location 526964.00E 184508.00N	**Dates** 30/10/2015	**Engineer** Elliott Wood	**Sheet** Sheet 1 of 1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
						0.15 (0.15)	Concrete with 6 mm reinforcement
0.90	D1					1.20 (1.05)	Made Ground (dark brown silty clay with gravel, decayed roots, brick and coal fragments)
				Seepage		1.40 (0.20)	Made Ground (brown silty clay with gravel)
1.60	D2						Soft rapidly becoming firm fissured brown CLAY with bluish grey veins, occasional small pockets of orange-brown fine sand and fine selenite
2.60	D3						
3.60	D4					(4.60)	
4.60	D5						*coarse selenite and pockets of pale grey silt below 4.50 m*
5.60	D6					6.00	
							Complete at 6.000m

Remarks	**Scale (approx)**	**Logged By**
Borehole advanced through the base of Trial Pit No 2 at a depth of 0.70 m.	1:50	ML

Geotechnical & Environmental Associates

Widbury Barn
Widbury Hill
Ware
SG12 7QE

Site	The Hall School, 23 Crossfield Street, London NW3 4NU	**Borehole Number** BH4
Boring Method: Drive-in Window Sampler	**Casing Diameter** (Depth / Diameter):	**Ground Level (mOD)**:
Client: The Hall School		**Job Number**: J15302
Location: 526920.00E 184520.00N	**Dates**: 30/10/2015	
Engineer: Elliott Wood		**Sheet**: Sheet 1 of 1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						0.20 (0.20)	Concrete		
						1.00 (0.80)	Made Ground (brown silty clay with gravel and brick fragments)		
						5.00 (4.00)	Firm fissured locally very thinly laminated silty CLAY with partings of bluish grey silt occasional pockets of dark orange-brown fine sand, coarse selenite and fine white shells		
							Complete at 5.000m		

Remarks

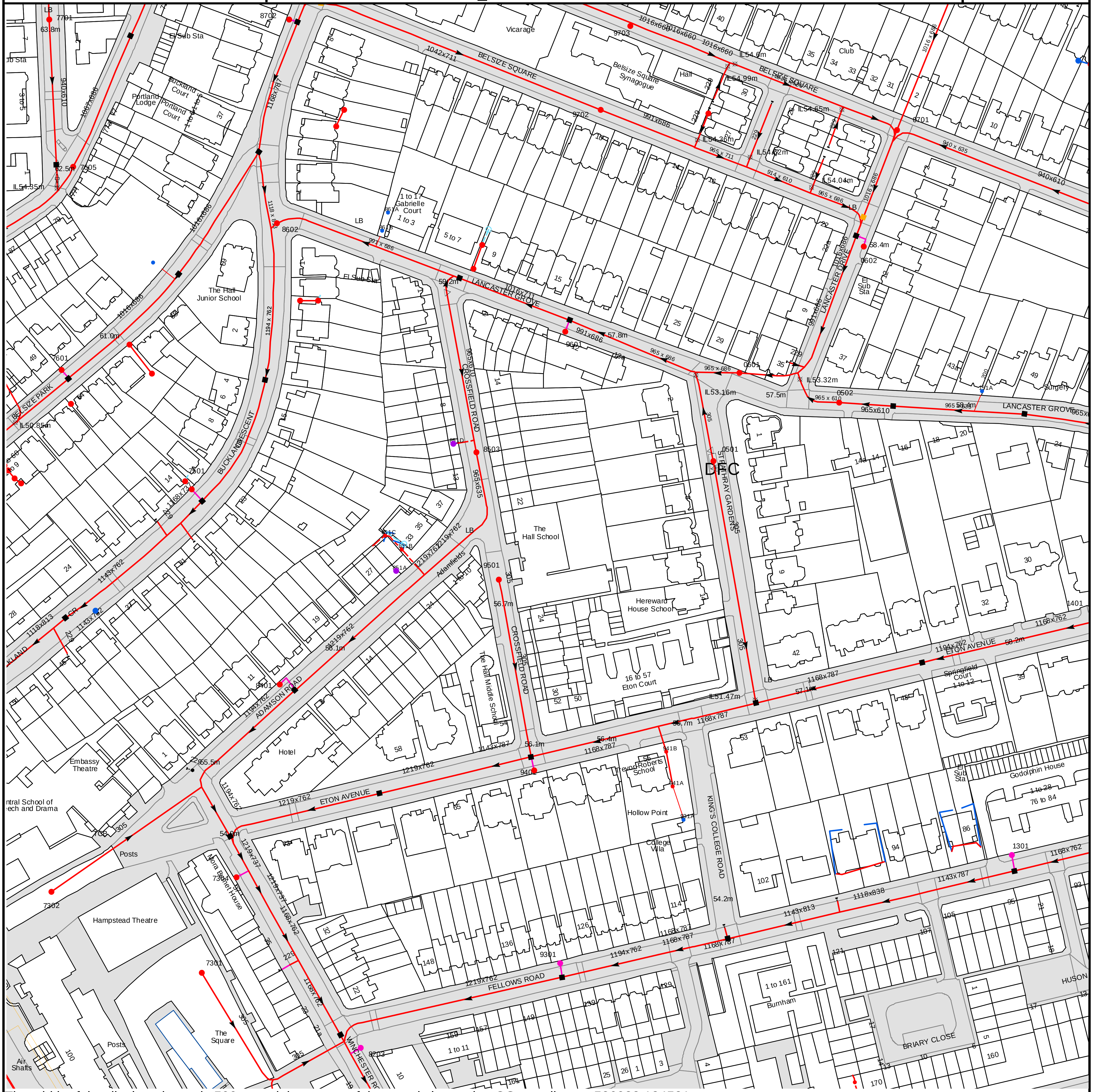
Groundwater monitoring standpipe installed in borehole to a depth of 5.00 m.

Scale (approx) 1:50

Logged By ML

C Thames Water Sewer Records

Asset Location Search Sewer Map - ALS/ALS Standard/2015_3055369



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 526933,184521

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
17CC	n/a	n/a
17CB	n/a	n/a
7701	64.11	59.55
7601	n/a	n/a
75AI	n/a	n/a
7605	62.39	54.49
76CB	n/a	n/a
75BC	n/a	n/a
761A	n/a	n/a
8602	60.58	52.1
8702	n/a	n/a
86BD	n/a	n/a
86BC	n/a	n/a
87BB	n/a	n/a
87AJ	n/a	n/a
861B	n/a	n/a
861A	n/a	n/a
851D	n/a	n/a
86AB	n/a	n/a
8503	58.09	52.29
96AF	n/a	n/a
96AE	n/a	n/a
9601	n/a	n/a
9702	60.11	54.16
9703	60.69	54.89
07BJ	n/a	n/a
0601	n/a	n/a
0502	n/a	n/a
0602	n/a	n/a
0701	59.18	54.13
151A	n/a	n/a
941A	n/a	n/a
9401	n/a	n/a
941B	n/a	n/a
8401	n/a	n/a
74BA	0	0
9501	57.16	52.81
851A	n/a	n/a
851B	n/a	n/a
85BA	n/a	n/a
851C	n/a	n/a
7501	n/a	n/a
65CG	n/a	n/a
75BI	n/a	n/a
65CH	n/a	n/a
65CI	n/a	n/a
0501	57.19	n/a
8203	n/a	n/a
7301	54.25	52.42
7302	57.15	54.52
7304	n/a	n/a
9301	n/a	n/a
931A	n/a	n/a
021A	50.62	49.35
1301	n/a	n/a

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ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

- Trunk Surface Water
- Trunk Foul
- Storm Relief
- Trunk Combined
- Vent Pipe
- Bio-solids (Sludge)
- Proposed Thames Surface Water Sewer
- Proposed Thames Water Foul Sewer
- Gallery
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Sludge Rising Main
- Proposed Thames Water Rising Main
- Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

- Air Valve
- Dam Chase
- Fitting
- Meter
- Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

- Control Valve
- Drop Pipe
- Ancillary
- Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

- Outfall
- Undefined End
- Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

- Public/Private Pumping Station
- Change of characteristic indicator (C.O.C.I.)
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Operational Site
- Chamber
- Tunnel
- Conduit Bridge

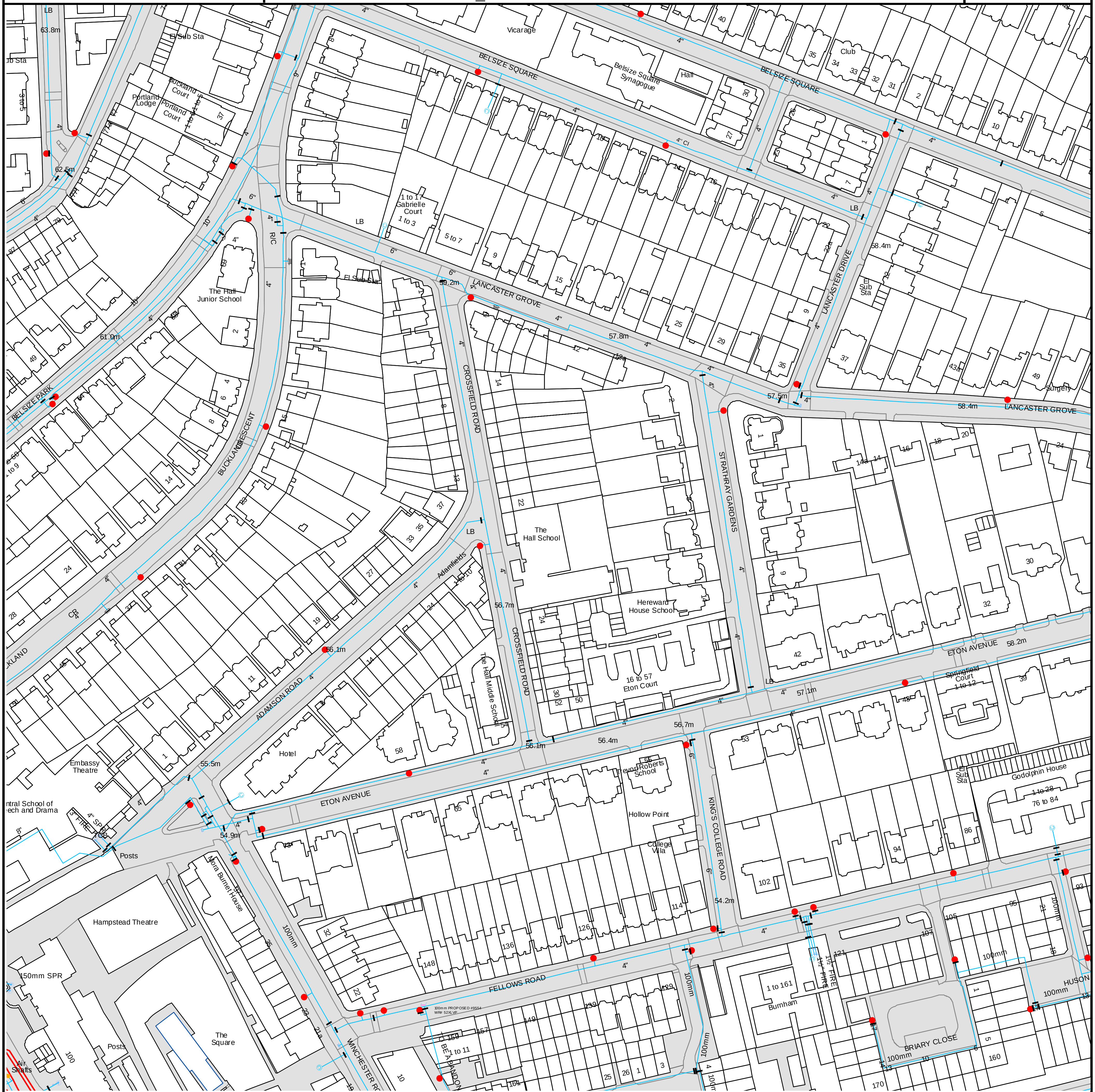
Other Sewer Types (Not Operated or Maintained by Thames Water)

- Foul Sewer
- Surface Water Sewer
- Combined Sewer
- Gulley
- Culverted Watercourse
- Proposed
- Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Asset Location Search Water Map - ALS/ALS Standard/2015_3055369



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 526933, 184521.

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ALS Water Map Key

Water Pipes (Operated & Maintained by Thames Water)

4" — **Distribution Main:** The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

16" — **Trunk Main:** A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

3" SUPPLY — **Supply Main:** A supply main indicates that the water main is used as a supply for a single property or group of properties.

3" FIRE — **Fire Main:** Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

3" METERED — **Metered Pipe:** A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

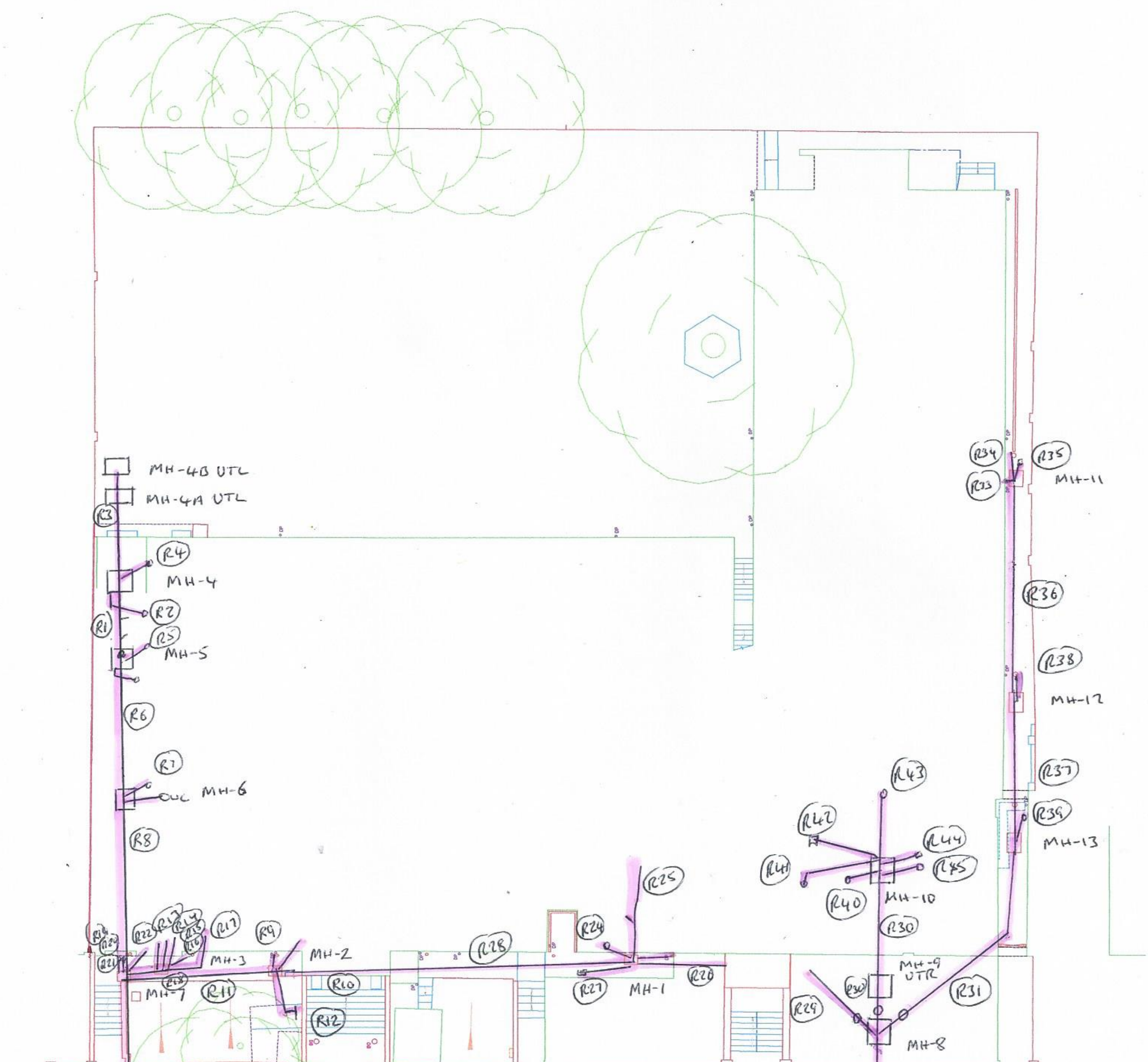
- Data Logger

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

D CCTV Drainage Survey Plan



MH-4B UTL
MH-4A UTL
R3
R4
MH-4
R2
R1
R5
MH-5
R6
R7
MH-6
R8
R9
MH-2
MH-3
MH-7
R11
R10
R12
R28
R24
R25
R27
MH-1
R26
R23
R29
MH-9 UTR
R31
MH-8
R32
R30
R43
R42
R44
R41
R45
R40
MH-10
R34
R35
R33
MH-11
R36
R38
MH-12
R37
R39
MH-13
CROSSFIELD ROAD
A11 48.61
A10 47.88

E Previous Correspondence with Thames Water

Hi Keri,

Please find below our formal response sent to the Local Authority on 27th March 2018.

London Borough of Camden Camden Town Hall Argyle Street Euston Road London WC1H 8EQ 27 March 2018	Our DTS Ref: 53960 Your Ref: 2016/6319/P - Disc of surface water

Dear Sir/Madam

Re: THE HALL SCHOOL, 23 CROSSFIELD ROAD, LONDON, NW3 4NT

Waste Comments
Thank you for consulting Thames Water for the discharge of matters relating to surface water. Thames Water confirm they are happy for the surface water condition referenced to be discharged based on the information submitted

Water Comments

Supplementary Comments
Further to discussions with Keri Trimmer from the Elliot Wood Partnership, Thames Water confirms that we are happy with the surface water proposals and as such agree to the discharge of the related condition.

Yours faithfully

Development Planning Department

Development Planning, Thames Water, Maple Lodge STW,
Denham Way, Rickmansworth, WD3 9SQ Tel:020 3577 9998
Email: devcon.team@thameswater.co.uk

Kind regards

John Georgoulias
Developer Services – Thames Valley Regional Development Planning Lead
Mobile 07747 645428 Landline 020 3577 9959
john.georgoulias@thameswater.co.uk

Maple Lodge Sewage Treatment Works, Denham Way, Rickamsworth, WD3 9SQ
Find us online at developers.thameswater.co.uk

F MicroDrainage Calculations

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)	100	PIMP (%)	100
M5-60 (mm)	21.000	Add Flow / Climate Change (%)	0
Ratio R	0.434	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	10.000	2.000	Open Manhole	1200	S1.000	8.000	150				
S2	10.000	2.100	Open Manhole	1200	S1.001	7.900	150	S1.000	7.900	150	
S	10.000	2.200	Open Manhole	0		OUTFALL		S1.001	7.800	150	

No coordinates have been specified, layout information cannot be produced.

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	150	S1	10.000	8.000	1.850	Open Manhole	1200
S1.001	o	150	S2	10.000	7.900	1.950	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	10.000	100.0	S2	10.000	7.900	1.950	Open Manhole	1200
S1.001	10.000	100.0	S	10.000	7.800	2.050	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.027	0.027	0.027
1.001	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.027	0.027	0.027

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
S1.000	S1	150	1.850	1.950	Unclassified	1200	0	1.850	Unclassified
S1.001	S2	150	1.950	2.050	Unclassified	1200	0	1.950	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.001	S	10.000	7.800	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	21.000	Storm Duration (mins)	30
Ratio R	0.434		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.436 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Summer	1	+0%	100/15 Summer				8.053	-0.097
S1.001	S2	15 Summer	1	+0%	100/15 Summer				7.954	-0.096

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.28			4.4	OK	
S1.001	S2	0.000	0.28			4.4	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.436 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Summer	30	+0%	100/15 Summer				8.091	-0.059
S1.001	S2	15 Summer	30	+0%	100/15 Summer				7.992	-0.058

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.68			10.7	OK	
S1.001	S2	0.000	0.68			10.7	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.436 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.000	S1	15 Summer	100	+0%					8.109	-0.041	0.000
S1.001	S2	15 Summer	100	+0%					8.010	-0.040	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.88			13.9	OK	
S1.001	S2	0.88			14.0	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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 Inlet Coeffecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.436 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	100	+40%	100/15 Summer				8.232	0.082
S1.001	S2	15 Winter	100	+40%	100/15 Summer				8.085	0.035

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	1.19			18.8	SURCHARGED	
S1.001	S2	0.000	1.18			18.7	SURCHARGED	

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)	100	PIMP (%)	100
M5-60 (mm)	21.000	Add Flow / Climate Change (%)	0
Ratio R	0.434	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

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)	Section Type	Auto Design
S1.000	10.000	0.100	100.0	0.027	4.00	0.0	0.600	o	150	Pipe/Conduit	🔒
S1.001	10.000	0.100	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	🔒

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)
S1.000	50.00	4.17	8.000	0.027	0.0	0.0	0.0	1.00	17.8	3.7
S1.001	50.00	4.33	7.900	0.027	0.0	0.0	0.0	1.00	17.8	3.7

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	10.000	2.000	Open Manhole	1200	S1.000	8.000	150				
S2	10.000	2.100	Open Manhole	1200	S1.001	7.900	150	S1.000	7.900	150	
S	10.000	2.200	Open Manhole	0		OUTFALL		S1.001	7.800	150	

No coordinates have been specified, layout information cannot be produced.

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	150	S1	10.000	8.000	1.850	Open Manhole	1200
S1.001	o	150	S2	10.000	7.900	1.950	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	10.000	100.0	S2	10.000	7.900	1.950	Open Manhole	1200
S1.001	10.000	100.0	S	10.000	7.800	2.050	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.027	0.027	0.027
1.001	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.027	0.027	0.027

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
S1.000	S1	150	1.850	1.950	Unclassified	1200	0	1.850	Unclassified
S1.001	S2	150	1.950	2.050	Unclassified	1200	0	1.950	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.001	S	10.000	7.800	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	1
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	21.000	Storm Duration (mins)	30
Ratio R	0.434		

Time Area Diagram for Green Roof at Pipe Number S1.000 (Storm)

Area (m³)	269	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.004888	32	36	0.000987	64	68	0.000199	96	100	0.000040
4	8	0.004002	36	40	0.000808	68	72	0.000163	100	104	0.000033
8	12	0.003277	40	44	0.000662	72	76	0.000134	104	108	0.000027
12	16	0.002683	44	48	0.000542	76	80	0.000109	108	112	0.000022
16	20	0.002196	48	52	0.000443	80	84	0.000090	112	116	0.000018
20	24	0.001798	52	56	0.000363	84	88	0.000073	116	120	0.000015
24	28	0.001472	56	60	0.000297	88	92	0.000060			
28	32	0.001205	60	64	0.000243	92	96	0.000049			

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 1
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.436 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.000	S1	60 Winter	1	+0%					8.026	-0.124	0.000
S1.001	S2	60 Winter	1	+0%					7.925	-0.125	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.07			1.0	OK	
S1.001	S2	0.06			1.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 1
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.436 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.000	S1	30 Winter	30	+0%					8.044	-0.106	0.000
S1.001	S2	30 Winter	30	+0%					7.946	-0.104	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.19			3.0	OK	
S1.001	S2	0.19			3.1	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 1
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.436 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.000	S1	30 Winter	100	+0%					8.051	-0.099	0.000
S1.001	S2	30 Winter	100	+0%					7.951	-0.099	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.25			3.9	OK	
S1.001	S2	0.25			3.9	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

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 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 1
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.436 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
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Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
S1.000	S1	30 Winter	100	+40%					8.061	-0.089	0.000
S1.001	S2	30 Winter	100	+40%					7.961	-0.089	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.35			5.5	OK	
S1.001	S2	0.35			5.5	OK	

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