3 - 6 Spring Place

Spring Place Ltd

Surface Water Drainage Statement

Heyne Tillett Steel

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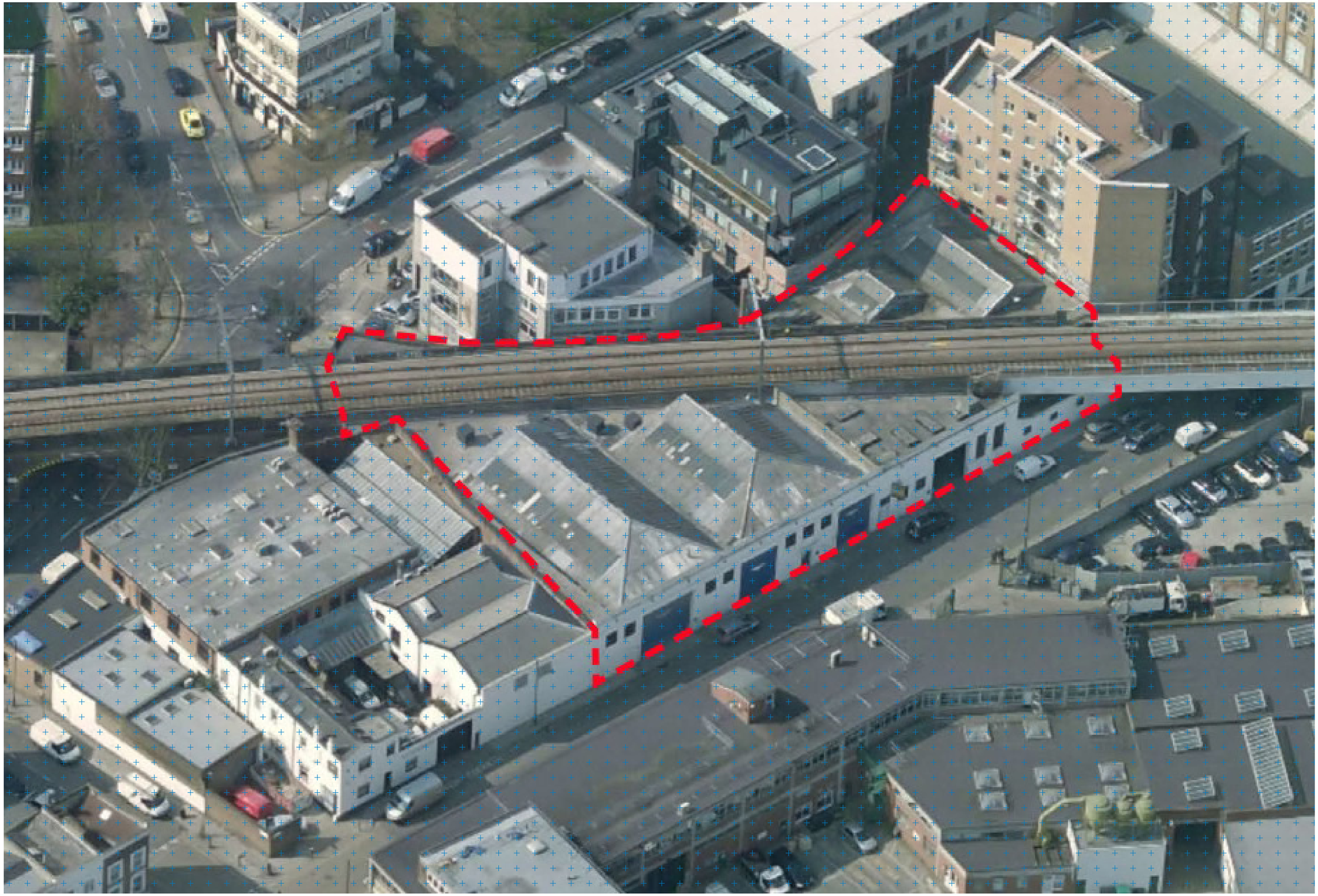
4 Pear Tree Ct
London EC1R 0DS

Telephone
+44 (0)20 7870 8050

mail@hts.uk.com
www.heynetillettsteel.com



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Appendices

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Approved by: Jamie Thompson

HEYNE TILLETT STEEL

1 Introduction

This Surface Water Management Report has been prepared by Heyne Tillett Steel Ltd (HTS) to support a detailed planning application for the redevelopment of 3-6 Spring Place, London NW5 3BA, which is in the London Borough of Camden (LBC).

This proposed surface water management analysis has been prepared to the requirements of the National Planning Policy Framework, 2012 (NPPF), and the National Planning Practice Guidance (NPPG), which sets out the guidance for reducing flood risk in general by using Sustainable drainage systems (SuDS),

The surface water management strategy will demonstrate a scheme of SuDS which will be achieved as part of the development in accordance with the Defra – Non-statutory technical standards for sustainable drainage, March 2015 which sets out the government policy to SuDS schemes.

The main purpose of this report is to analyse the pre and post development surface water run-off rates and volumes, where post development surface run-off rates are not to exceed the pre development run-off rates, and are to be reduced as much as practical (to adhere to current guidance), in order to reduce the risk of flooding to areas within and in the vicinity of the site.

The London Plan Paragraph 5.13 states that the preferred surface water run-off is to greenfield levels where practical and the PPG, Paragraph 051 states the drainage is to be designed to control surface water run-off close to where it falls and mimic natural drainage as closely as possible, provide opportunities to reduce the causes and impacts of flooding, and remove pollutants from urban run-off at source.

Supplementary Planning Guidance (SPG) produced by the Greater London Authority offers recommendations for developers. Clauses 3.4.2, 3.4.12 and 3.4.14 set out the expectation of SuDS to be incorporated into the design of new developments to prevent increasing volumes of surface water runoff and reduce flood risk. Clauses 3.4.8 -3.4.9 stipulate that:

"Most developments referred to the Mayor have been able to achieve at least 50% attenuation of the site's (prior to re-development) surface water runoff at peak times. This is the minimum expectation from development proposals".

Based on the above guidance, the proposed surface water drainage system will aim to restrict the surface water to greenfield run-off rate if practical, and to reduce the post development run-off rates to 50% of the pre development rates as a minimum.

2 Existing and Proposed Site

2.1 Site Location

The existing site is located at 3-6 Spring Place, London NW5 3BA, which is in the London Borough of Camden (LBC).

The proposed site is approximately 0.222 ha in area is triangular in shape and is located to the west of Spring Place, includes an existing Network Rail viaduct in the centre, and will be adjacent to existing commercial and residential buildings to the east that lead onto Grafton Road.

The OS coordinates for the centre of the site are - E: 528574, N: 184989.

2.2 Existing Site Description

The existing site currently comprises of commercial buildings that are 2 storeys in height with mezzanine levels on the first floor, and are located each site if the Network Rail viaduct.

Plans of the existing / topographical plan can be found in Appendix A.

2.3 Ground Conditions

The investigation generally encountered the expected ground conditions. Beneath a moderate to significant thickness of made ground, London Clay was encountered and proved to the maximum depth investigated of 24.00 m (11.51 m OD). The made ground generally comprised brown silty sandy clay with flint gravel, brick and concrete fragments and extended to depths of between 1.30 m and 2.10 m (33.92 m OD and 32.33 m OD), although extended to a depth of at least 2.50 m at a single location. The London Clay initially comprised firm becoming stiff fissured medium strength becoming high strength brown mottled grey silty clay, becoming brownish grey from a depth of about 6.00 m which extended to depths of 8.90 m and 9.00 m (25.48 m OD and 26.51 m OD). Below this depth, stiff becoming very stiff fissured high strength becoming very high strength grey silty clay was encountered. Claystones were encountered at various depths within the London Clay.

2.4 Thames Water Assets

The Thames Water asset records (Appendix B) indicates that there is a 300mm combined sewer within Spring Place that runs in a southerly direction towards the junction with Spring Place and Holmes Road. The sewer is approximately 3.40m deep, with the invert level being approximately 31.390m.

There is also a combined sewer that crosses the west corner of the site, which connects to a 450mm combined sewer that runs along the west site boundary and under the Network Rail viaduct. The depth of this sewer and the diameter of the sewer crossing the site is to be confirmed.

2.5 Existing Site Drainage

A CCTV drainage survey was carried out in August 2016 by JPD Technical Services. As shown on the drainage survey plan (Appendix C), there is an existing combined water drainage network and sewer within the site.

The main sewer details running across the site are unknown, but it assumed to be a 300mm – 450mm diameter combined sewer at an approximate depth of 1.60m. A combined water drainage network is located along Spring Place, which consists of 100mm pipes; is at an approximate / average depth of 1.300m; and is believed to discharge to the 300mm combined sewer within Spring Place.

As there a combined water drainage networks within the site, and no records of any SuDS features, it is believed that the surface water is currently positively drained off the site.

2.6 Proposed Development

In a brief summary, and in relation to this surface water management report, the proposed development is to demolish the existing single storey, double-height servicing garage and construct new office blocks to the east and west of the existing railway viaduct. These will be connected at ground floor level via an external communal area.

The building to the west of the Network Rail viaduct will be 2-storeys in height, and the building to the east of the Network Rail viaduct will be 6-storeys in height and will also include a single storey basement.

The ground floor will consist of public cafe, informal work and meeting spaces and an open courtyard2.7 with further office space being provided below the existing Network Rail viaduct.

2.7 Site Areas

The overall development site / site boundary area is approx. 0.222 ha.

In terms of permeable and impermeable areas of the existing / pre development site, it is deemed that all of the site (2222m²) is impermeable, as there is no evidence of landscaped / grassed / undeveloped areas.

In terms of permeable and impermeable areas of the proposed / post development site, it is deemed that all of the site (2222m²) is impermeable, but may be scope of having landscape terrace areas at roof levels of the buildings and new garden off Grafton Street.

The two areas of the development (each side of the viaduct) equate to approximately 760m² / 0.076 ha to the west of the viaduct, and approximately 1240m² / 0.124 ha to the east of the viaduct. The railway viaduct has not been taken into consideration for the surface water management analysis, as it does not form part of the new development.

3 Surface Water Run-Off Analysis

The post development surface water run-off is to be reduced to as low as feasible, in order to reduce the risk of flooding, with the preferred being the greenfield run-off rate, and the minimum requirement being a 50% betterment of the pre development rates.

In order to establish the required reduction / restriction for the post development surface water run-off rates, the pre development greenfield run-off rates and pre development positively drained surface water run-off rates, will be calculated.

The post development surface water run-off rates are then to be calculated to establish the impact of the development in terms of flood risk. The pre and post development figures are to be used to analyse the required SuDS methods to control the surface water, and to calculate the attenuation volumes required to prevent flooding for the 1 in 30-year storm, and controlled flooding for the 1 in 100-year storm including climate change.

4 Pre Development Surface Water Run-Off Rates

In order to minimise the surface water run-off from the new development areas of the site, it is preferred for the post development surface water run-off to be restricted to the greenfield run-off rate.

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

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

The input variables to establish QBAR are:

Return Period (years)	Results based on a range of return periods and the specified RP;
Area	Catchment Area (ha) which is adjusted to km2 for use in the equation;
SAAR	Average annual rainfall in mm (1941-1970) from FSR figure II.3.1;
Soil	Soil index of the catchment from FSR figure I.4.18 and/or Wallingford Procedure Volume 3. Soil classes 1 to 5 have Soil Index values of 0.15, 0.3, 0.4, 0.45 and 0.5 respectively;
Region Number	Region number of the catchment based on FSR Figure I.2.4.
	QBAR(l/s)

The output variables to establish QBAR are calculated using the following formula (equation yields m³/s):

QBAR = 0.00108 x AREA0.89 x SAAR1.17 x SOIL2.17

The IH 124 Variables (taken from FSR) that are specific to the leisure facility site are as follows:

Area	=	0.222 ha
SAAR	=	600
Soil	=	0.300
Region Number	=	6

Based on the above variables and formula the QBAR for the site = 0.30 l/s

Now that the QBAR has been calculated the existing Greenfield run-off rates can be calculated for each of the storm events.

Ciria C753 Table 24.2 identifies the growth factors for each of the storm events, based on the known QBAR figure. The growth factors from the table vary depending on the site location. In this case hydrometric area (Region Number) is 6.

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

Storm Event	QBAR	Growth Factor (C753 Table 24.2)	Greenfield Run-off Rate
Q1	0.30 l/s	0.85	0.26 l/s
Q30	0.30 l/s	2.40	0.72 l/s
Q100	0.30 l/s	3.19	0.96 l/s

These calculations have been checked against XP Solution WinDes computer software and can be found in Appendix D. The area entered for the calculation to conform to the IH124 method is 50 ha. The results of this are to be pro rata to the actual area of the site (e.g. 0.20 / 50 = 0.0040, 0.0040 x 76.1 l/s = 0.30 l/s).

The greenfield run-off volume has also been calculated in the XP Solution WinDes software (Appendix D) for the 1 in 100-year, 6-hour storm event, which results in 30.23m³ for the pre development site.

5 Pre Development Surface Water Run-Off Rates – Positive Drainage

The pre development positively drained surface water run-off rates are based on the existing impermeable area of 0.222 ha, and also the data given by the Flood Studies Report (FSR) and Wallingford Procedure. The post development surface water run-off rates have also been simulated in a 'mock' network in the XP Solution WinDes software (Appendix E).

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

Existing Impermeable Area	=	0.222 ha
M5 – 60 (mm)	=	20.600
Ratio R	=	0.437
Cv (Summer)	=	0.750
Cv (Winter)	=	0.840
Time of Entry minutes	=	5
Climate Change	=	0

Based on the above variables and computer software results, the post development surface water run-off rates will be as follows:

Q1	=	30 l/s
Q30	=	70 l/s
Q100	=	90 l/s

Based on the above variables for and the results from the WinDes computer software the pre development surface water running volume for a 1 in 100-year 6-hour storm event has been calculated to be 104m³.

6 Post Development Surface Water Run-Off Rates – No Restrictions

The post development surface water run-off rates and volumes are to be calculated to assess the impact of the development in terms of surface water management.

The post development surface water run-off rates are based on the impermeable area of 2222m² / 0.222 ha. These areas are also to be used with the data given by the Flood Studies Report (FSR) and Wallingford Procedure. The post development surface water run-off rates have also been simulated in the XP Solution WinDes software (Appendix F).

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

Proposed Impermeable Area	=	0.222 ha
M5 – 60 (mm)	=	20.600
Ratio R	=	0.437
Cv (Summer)	=	0.750
Cv (Winter)	=	0.840
Time of Entry minutes	=	5
Climate Change	=	20%*

*NPPF states that the peak rainfall intensity will increase by 20% by the years 2055 to 2085 As the development is for office purposes the life span of the building (before further work takes place) will fall in to these years.

Based on the above variables and computer software results, the post development surface water run-off rates will be as follows:

Q1	=	30 l/s
Q30	=	70 l/s
Q100 + CC	=	105 l/s

Based on the above variables for and the results from the WinDes computer software the post development surface water running volume for a 1 in 100-year 6-hour storm event (including 20% climate change) has been calculated to be 125m³.

7 Surface Water SuDS Analysis

As the results from the above calculations show, the post development surface water run-off rates exceed the greenfield rates, and the positively drained rates for the 1 in 100-year storm event due to climate change. Therefore, in order to reduce the surface water run-off to the preferred rate of greenfield, or to 50% of the pre development rate as a minimum, further SuDS methods are to be introduced to the post development design.

HTS have considered a number of SuDS methods as per the Sustainable Drainage System (SuDS) hierarchy (NPPF Paragraph 080).

The various SuDS methods, their description and feasible or impractical use on this development are described below:

SuDS Methods	Description and Feasibility
Green Roofs and 'Blu-Roof' System	The Green and/or blu-roof systems are not feasible due to the shape of the roofs and limited space following introduction of the roof lighting and PVs.
Infiltration Devices	Infiltration devices cannot be built in made ground due to instability, and clay is not a porous material. Infiltration structures are also to be 5m from any structure and 2.5m from the development boundary, and won't be able to be built due to the nature of the site. Due to the ground conditions not being viable for infiltration and the nature of site not being suitable, infiltration devices are not a feasible SuDS method.
Basins and Ponds – Above Ground Storage	Given the nature of the development, where the majority of the site will comprise of the proposed building the use of basins and ponds is not a feasible SuDS method.
Filter Strips and Swales	Given the nature of the development, where the majority of the site will comprise of the proposed building the current ground conditions the use of filter strips and swales is not a feasible SuDS method.
Rainwater Harvesting Tanks	Rainwater harvesting tanks could potentially be used for the development to provide water to the toilet facilities within the new office buildings. This however will require a dual plumbing system where one will be from the water mains and the other being from the harvesting tank in the event of the harvesting tank being empty. The cost of the dual plumbing system is very expensive, and has not been considered as part of the overall development design. Therefore, at the time of writing this report, it is deemed that rainwater harvesting is not a feasible SuDS method.
Flow Control and Attenuation System	In order to ensure the surface water is restricted to the desired rate a flow control system can be incorporated into the proposed drainage network. There will also be a required to store the attenuated water which could be achieved by oversized pipes, oversized manholes or a cellular storage structure.
Discharge Rainwater directly to watercourse	There are no watercourses within the direct vicinity of the site for the network to connect / discharge to.
Discharge Rainwater to a surface water sewer	There are no surface water sewers within the direct vicinity of the site for the network to connect / discharge to.
Discharge Rainwater to a combined water sewer	As there are watercourses or surface water sewers within the direct vicinity of the site the only alternative would be to connect / discharge the surface water to the combined sewer within Spring Place to mimic existing.

8 Surface Water Management Analysis

8.1 SuDS Summary

As detailed in the above sections, the post development surface water run-off rate exceeds the required pre development greenfield run-off rates for each of the storm events.

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

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

Due to the layout and nature of the development, where the building is the majority of the site area, the use of wetlands, ponds or detention basins is not a SuDS option.

A full ground investigation is yet to take place at the development site. However, borehole logs found on the British Geological Survey website in a location approximately 100m to the north of the site location indicates that the ground consists of made ground over clay. Clay has a very low (if any) percolation and therefore infiltration of the surface water cannot be achieved.

Due to the ground condition the alternative would be to formally discharge the surface water run-off from the site via a vortex flow control to the existing combined water sewer in Spring Place.

8.2 Surface Water Run-Off Rate

Ciria document C753 – The SuDS Manual states that the flow controls / orifice design should be designed so that it has simplicity on operation, and has resistance to clogging, blocking or mechanical failure.

The previous Ciria SuDS Manual (C697) states that the limiting discharge rate is to take into account a minimum practical orifice size. The minimum size of opening in an orifice plate or vortex control to provide an acceptable risk of blockage is often accepted to be 75mm.

However, the surface water is to connect to a combined public sewer, and therefore the demarcation chamber, flow control and outfall pipe are to adhere to Sewers for Adoption 7th Edition. Sewer for Adoption 7th Edition states that the minimum diameter for an outfall pipe is to be 100mm.

Taking the above guidance into consideration, it is deemed that the orifice size to reduce the surface water run-off rates to greenfield will be too small, and therefore will be prone to blockage and subsequent flooding.

The surface water is therefore to be reduced to a maximum discharge through a 100mm flow control / orifice which is 5 l/s for all storm event including climate change.

The 5 l/s discharge rate is the equivalent to five times 1 in 100-year greenfield run-off rate, an 83% betterment of the pre development peak 1 in 1-year rate, an 93% betterment of the pre development peak 1 in 30-year rate, and an 94% betterment of the pre development peak 1 in 100-year rate.

The discharge rate of 5 l/s also adheres to the guidance in Supplementary Planning Guidance (SPG) produced by the Greater London Authority.

8.3 Surface Water Run-Off Volume

The above calculations also show that the post development surface water flood volume / volume of discharge from the site will exceeds the pre development greenfield volume during the 1 in 100 year 6-hour storm event.

The 'Non-Statutory Technical Standards for Sustainable Drainage Systems – March 2015' states that the post development surface water run-off rate should not exceed the pre development greenfield rate, but where this is not reasonably practical the surface water run-off volume must be discharged at a rate that does not adversely affect flood risk.

The most practical solution to prevent the exceedance in the run-off volume would be to discharge the water to ground. However, as stated previously, the ground condition is not feasible for infiltration, and therefore other SuDS methods are to be used. By reducing the surface water run-off to five times the greenfield and a minimum 83% betterment of the pre development rate, the development site will not adversely affect flood risk.

The surface water run-off volume for the 1 in 100 year, 6-hour storm event (including climate change), if restricted to a maximum rate of 5 l/s, will be 108m³ (5 x 60 x 60 x 6). This is 4m³ greater than the volume for pre development 1 in 100 year, 6-hour storm event, but 17m³ less than the volume for the pre development 1 in 100 year 6-hour storm event including climate change. Therefore, 9.2 the run-off volume will not adversely affect flood risk.

9 Surface Water Attenuation Calculations

As stated above the surface water run-off from the surface water catchment area of the site (east and west of viaduct) are to be restricted to 5 l/s, with the surface water catchment area equating to 0.222 ha.

The estimated required attenuation volumes to prevent / contain flooding for each storm event has been calculated via the XP Solutions software, using the variables and data set out previously in this report (refer Appendix G).

The WinDes output file indicates the maximum volume of attenuation required (highlighted in red), which is the equivalent required attenuation volume.

9.1 Note:

The flow control in the software is indicated as a pump, as this will ensure the results show a discharge rate (maximum outflow) of 5 l/s. The actual flow control will be via a hydrobrake / vortex control chamber, details of which will be required at detailed design stage.

The summary of the required attenuation volumes (including climate change) for the post development surface water catchment area, and for each of the storm events is as follows:

Q1	=	16m³
Q30	=	49m³
Q100	=	70m³

Ciria SuDS Manual 2015, Paragraph 10.2.4 states that: 'Exceedance flows (i.e. flows in excess of those for which the system is designed) should be managed safely in above-ground space such that risks to people and property are acceptable'.

And PPS25 Practice Guidance Paragraph 5.51 previously stated that: 'For events with a return-period in excess of 30 years, surface flooding of open spaces such as landscaped areas or car parks is acceptable for short periods, but the layout and landscaping of the site should aim to route water away from any vulnerable property, and avoid creating hazards to access and egress routes. No flooding of property should occur as a result of a one in 100-year storm event (including an appropriate allowance for climate change)'.

The attenuation tank in the computer software matches the true tank area and depth shown on the outline drainage drawing (Appendix H). The proposed attenuation tank area is to be 64m², with a depth of 1.2m giving a total volume of 76.8m³.

As the computer software results show, with the tank volume of 76.8m³ is adequately sized so that there is no flood risk of the 1 in 30-year storm, and just a flood risk with no flooding occurring during the 1 in 100-year storm event (including climate change).

10 Maintenance Requirements

The maintenance of the SuDS features is required in order to ensure that the infiltration structure is working affectively, and subsequently reducing the risk of flooding on the site.

Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for 3 months, then six monthly
Debris removal from catchment surface (where may cause risk performance)	Monthly
Check manhole for blockage or silt, algae or other matter by jetting	As required, but at least 4 times a year.
Remove sediment from upstream drainage network, and sediment from within manhole by jetting	As required, but at least 4 times a year
Repair/check all inlets and flow control	As required
Inspect/check all inlets and flow control to ensure they are operating as designed	4 times a year as a minimum and after large storms

The maintenance for the Hydro brake / vortex control manhole is as follows:

The maintenance for the cellular storage is as follows:

Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for 3 months, then six monthly
Debris removal from catchment surface (where may cause risk performance)	Monthly
Where rainfall infiltration into cellular storage from above, check surface or filter for blockage or silt, algae or other matter by jetting	As required, but at least 5 times a year
Remove sediment from upstream surface water network by jetting.	Twice annually or as required
Repair/check all inlets, outlet, overflows and vents	As required
Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after large storms

11 Conclusion

The proposed / post development surface water drainage has aimed to meet the requirement of The London Plan Paragraph 5.13 that states that the preferred surface water run-off is to greenfield levels where practical.

All SuDS methods have been assessed to establish whether they are feasible for the development in order to reduce the surface water run-off to the preferred greenfield rate.

Due to the size and nature of the site, and as well as the ground conditions, the use of wetlands, ponds, detention basins or infiltration structures are not feasible SuDS options for the development site.

Therefore, the only alternative would be to formally restrict the surface water run-off via a vortex control chamber prior to formal discharge into an existing sewer network.

It has been calculated that the greenfield run-off rates for the site are very low and are deemed too low to be controlled by vortex and / or orifice. Therefore, the surface water is to be controlled by a suitable control diameter of 100mm for the surface water catchment area. This equates to the surface water run-off for the post development site being 5 l/s.

The 5 l/s discharge rate is the equivalent to five times 1 in 100-year greenfield run-off rate, an 83% betterment of the pre development peak 1 in 1-year rate, an 93% betterment of the pre development peak 1 in 30-year rate, and an 94% betterment of the pre development peak 1 in 100-year rate.

The discharge rate of 5 l/s also adheres to the guidance in Supplementary Planning Guidance (SPG) produced by the Greater London Authority.

The maximum restricted rate of 5 l/s for the 1 in 100 year, 6-hour storm event (including climate change) will equate to a maximum run-off rate of 108m³. This is 4m³ greater than the volume for pre development 1 in 100 year, 6-hour storm event, but 17m³ less than the volume for the pre development 1 in 100 year 6-hour storm event including climate change. Therefore, the run-off volume will not adversely affect flood risk.

9.3 As the surface water is restricted to 5 l/s for surface water catchment area there will be a requirement for attenuation. This is to be in the form below ground cellular storage for all storm events up to and including the 1 in 100-year (Including climate change), as no flooding can occur at surface level.

The required attenuation volume for the surface catchment area of 0.222 ha during a 1 in 100-year storm event (Inc. climate change) will be 70m³. The actual tank volume provided will be 76.8m³.

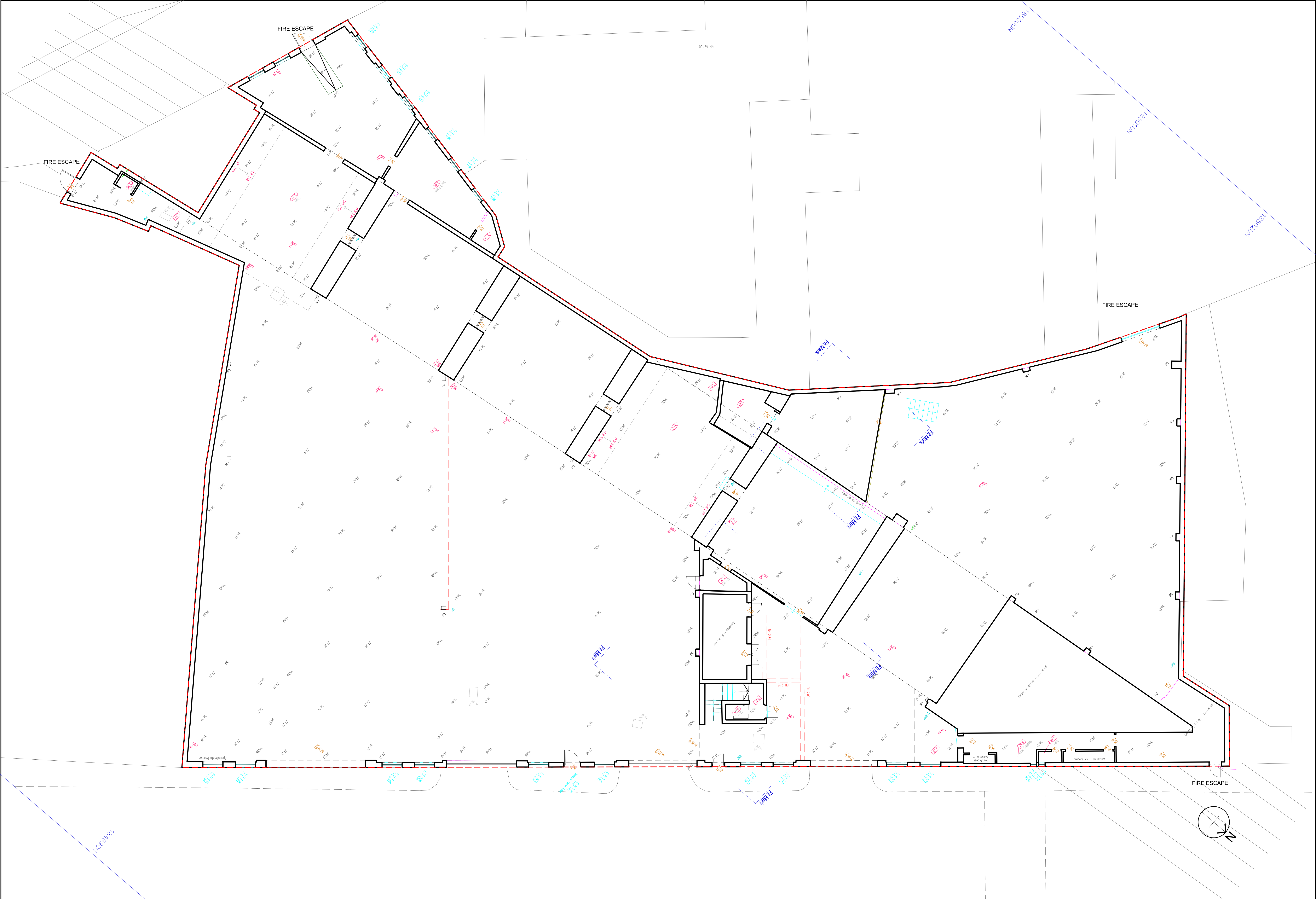
The surface water management of the post development site will reduce the flood risk for the site and areas within the vicinity of the site. The surface water management of the post development site adheres to all current regulations.

HEYNE TILLETT STEEL

Appendix A

Topographical / Existing Site Plan

HEYNE TILLETT STEEL



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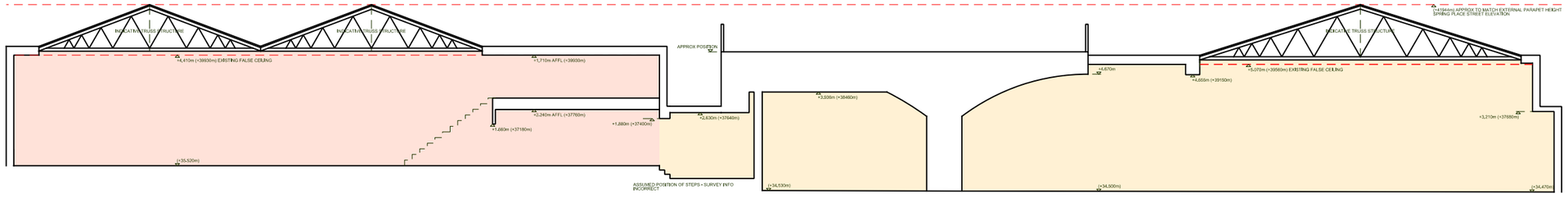

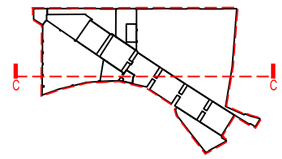

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Appendix B

Existing Drainage Survey Plan

NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH JPD TECHNICAL SERVICES REPORT DATED 8 AUG 2016 SURVEY CARRIED OUT 6 AUG 2016

2.

MH	MANHOLE
DP	DRAIN POINT
RWP	RAINWATER PIPE
RWS	RAINWATER SHOE
WP	WASTE PIPE
WVP	WASTE VENT PIPE
VP	VENT PIPE
SVP	SOIL VENT PIPE
SP	SOIL PIPE
OTG	OPEN TRAPPED GULLY
OTBIG	OPEN TRAPPED BACK INLET GULLY
STBIG	SEALED TRAPPED BACK INLET GULLY
VC	VITRIFIED CLAY
I/T	INTERCEPTOR TRAP
RAI/T	REVERSE ARM INTERCEPTOR TRAP
PVC	PLASTIC PIPE
CI	CAST IRON
CID	CAST IRON DRAIN
G	GULLY
R/G	ROAD GULLY
B/D	BACKDROP
FA	FROM ABOVE
TB	TO BELOW
HL	HIGH LEVEL
FWD	FOUL WATER DRAIN
SWD	SURFACE WATER DRAIN
BAC	BOLTED ACCESS CHAMBER
PRM	PUMP RISING MAIN
SS	STUB STACK
AP	ACCESS POINT
CP	CATCHPIT
RE	RODDING EYE
UTL	UNABLE TO LIFT
UTS	UNABLE TO SURVEY
UTSF	UNABLE TO SURVEY FURTHER

3. ALL PIPEWORK IS 100ø UNLESS OTHERWISE STATED

4. BELOW GROUND DRAINAGE
   ABOVE GROUND DRAIN/WASTE PIPE
   ASSUMED DRAINAGE
   THAMES WATER AUTHORITY SEWER (TWA)
   BRANCH REF No (3)

REV.No	DATE	REVISION
.	.	.

jpd technical services
PUBLIC HEALTH ENGINEERS SURVEY:DESIGN:CONTRACT
14 Fairdene Road
Coulsdon, Surrey CR5 1RA
TEL: 01737 555054 WWW.JPDTECH.CO.UK

CLIENT: HEYNE TILLETT STEEL

PROJECT: 3–6 SPRING PLACE
LONDON NW5 3BA

TITLE: GROUND FLOOR PLAN
EXISTING DRAINAGE LAYOUT

DRAWN	SDS
CHECKED	TPG/JPD
SCALE	1:100 @ A1 DO NOT SCALE
DATE	9.8.2016
DRAWING. No	4561–1

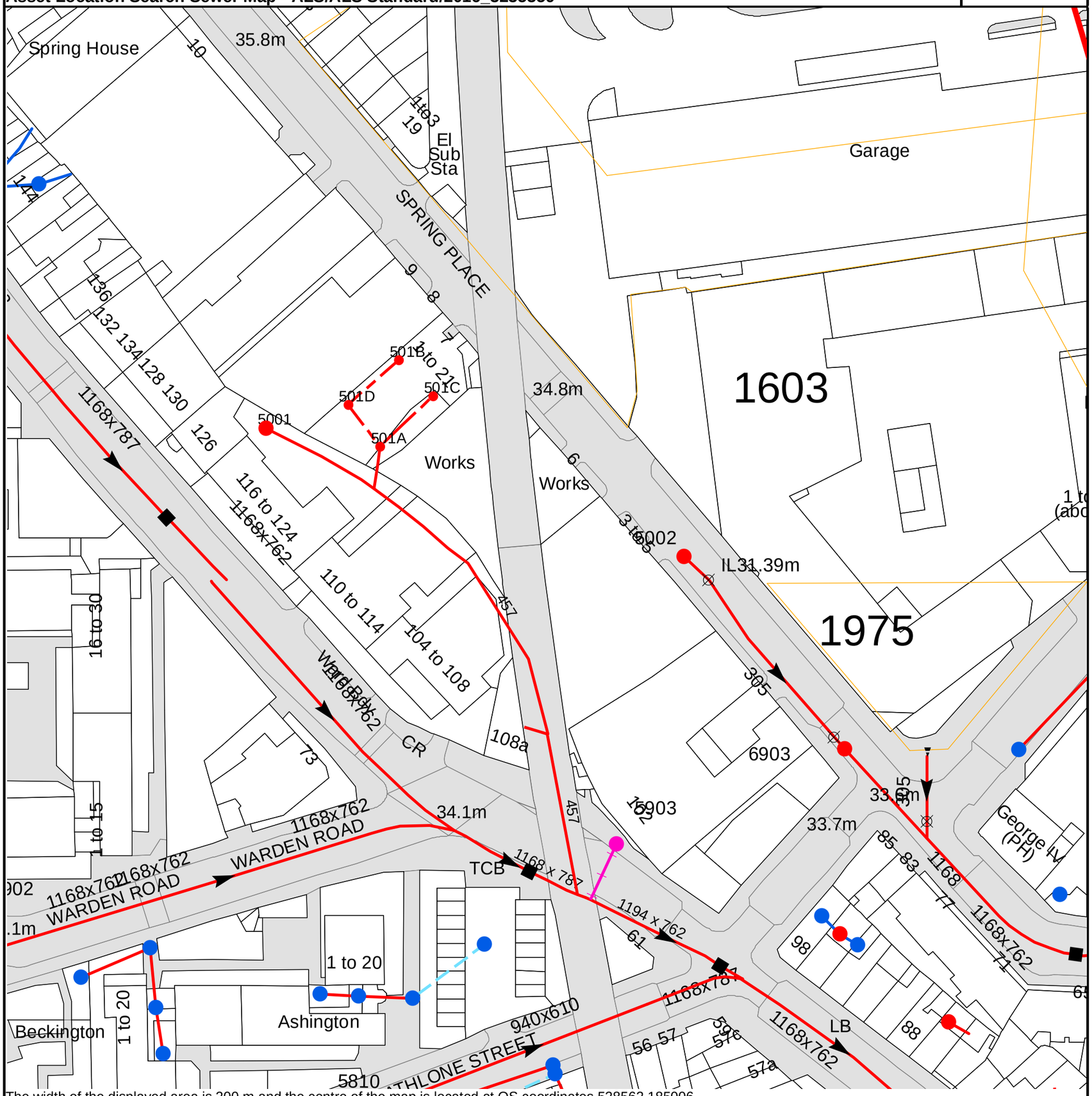
FIRE ESCAPE
100ø DP
100ø SVP
MH 8
820x610
880 DEEP
TWA SEWER
75ø FA
100ø @ HL
100ø FA/TB
100ø
WP (SINK)
100ø RWP
75ø FA
100ø FA/TB
TWA SEWER
450ø ?
SEWER MH 3
750x600
1680 DEEP
TWA SEWER
300ø ?
SEWER MH 2
UTL/TBC
100ø RWP
100ø RWP
ASSUMED
UTSF
100ø VC
75ø RWP
100ø PVC @ HL
RWP
RWP
RWP
UTSF
MH 3
600x450
1190 DEEP
MH 4
1500x500
1150 DEEP
RWP/STBIG
100ø VC
100ø VC
UTSF
100ø VC
FIRE ESCAPE
300ø
300ø
SEWER MH 1
750x600
1470 DEEP
100ø RWP
100ø ASSUMED
UTSF
MH 7
UTL
100ø VC
UTSF BLOCKED
100ø RWP
100ø PVC
SEALED
100ø VC
PIPE BLOCKED
MH 5
880x620
1580 DEEP
MH 1
600x450
1330 DEEP
100ø VC
100ø PVC
100ø VC
POSSIBLE OUTFALL MANHOLE IN CORNER OF BUILDING– ALTERNATIVELY PIPEWORK DISCHERGES TO ADJACENT BUILDING (AUTOGRAPH)
100ø RWP
MH 2
700x550
1470 DEEP
75ø RWP
100ø FA
100ø FA/TB
WP FA
SVP
WP
DP (WC)
DP ?
100ø DP (WP)
MH 6
600x600
1010 DEEP
FIRE ESCAPE
AUTOGRAPH
SPRING PLACE

Appendix C

Thames Water Asset Plan

HEYNE TILLETT STEEL

Asset Location Search Sewer Map - ALS/ALS Standard/2016_3235359



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 528562,185006

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.

Appendix D

Greenfield Run-Off Rates and Volumes

IH 124 Mean Annual Flood

Input

Return Period (years)	1	Soil	0.300
Area (ha)	50.000	Urban	0.000
SAAR (mm)	600	Region Number	Region 6

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

Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	20.600
Ratio R	0.437
Areal Reduction Factor	1.00
Area (ha)	0.200
SAAR (mm)	600
CWI	87.000
Urban	0.000
SPR	30.000

Results

Percentage Runoff (%)	24.41
Greenfield Runoff Volume (m^3)	30.230

Appendix E

Pre Development SW Run-Off Rates

HEYNE TILLETT STEEL

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)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.437	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.150	4-8	0.050

Total Area Contributing (ha) = 0.200

Total Pipe Volume (m³) = 0.795

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	10.000	0.100	100.0	0.200	5.00	0.0	0.600	o	225
1.001	10.000	0.100	100.0	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.13	10.000	0.200	0.0	0.0	0.0	1.31	52.0	27.1
1.001	50.00	5.25	9.900	0.200	0.0	0.0	0.0	1.31	52.0	27.1

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7 Bertal Road London SW17 0BX	3-6 Spring Place Pre Development SW Run-Off Rates	
Date 18.05.16 File	Designed by MDS Checked by MDS	
XP Solutions	Network 2015.1	

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.600	Storm Duration (mins)	15
Ratio R	0.437		

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Summary of Results for 15 minute 1 year Winter (Storm)

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	10.138	-0.087	0.000	0.68		29.4	OK
1.001	2	10.038	-0.087	0.000	0.68		29.5	OK

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model		FSR	Profile Type Winter
Return Period (years)		30	Cv (Summer) 0.750
Region	England and Wales		Cv (Winter) 0.840
M5-60 (mm)	20.600	Storm Duration (mins)	15
Ratio R	0.437		

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

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	10.543	0.318	0.000	1.62		70.0	SURCHARGED
1.001	2	10.275	0.150	0.000	1.61		69.9	SURCHARGED

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model		FSR	Profile Type Winter
Return Period (years)		100	Cv (Summer) 0.750
Region	England and Wales		Cv (Winter) 0.840
M5-60 (mm)	20.600	Storm Duration (mins)	15
Ratio R	0.437		

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

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	10.876	0.651	0.000	2.07		89.7	SURCHARGED
1.001	2	10.445	0.320	0.000	2.06		89.2	SURCHARGED

Appendix F

Post Development SW Run-Off Rates

HEYNE TILLETT STEEL

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)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.600	Minimum Backdrop Height (m)	0.200
Ratio R	0.437	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.150	4-8	0.050

Total Area Contributing (ha) = 0.200

Total Pipe Volume (m³) = 0.795

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	10.000	0.100	100.0	0.200	5.00	0.0	0.600	o	225
1.001	10.000	0.100	100.0	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.13	10.000	0.200	0.0	0.0	0.0	1.31	52.0	27.1
1.001	50.00	5.25	9.900	0.200	0.0	0.0	0.0	1.31	52.0	27.1

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7 Bertal Road London SW17 0BX	3-6 Spring Place Post Development SW Run-Off Rates	
Date 18.05.16 File	Designed by MDS Checked by MDS	
XP Solutions	Network 2015.1	

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.600	Storm Duration (mins)	15
Ratio R	0.437		

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Summary of Results for 15 minute 1 year Winter (Storm)

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	10.138	-0.087	0.000	0.68		29.4	OK
1.001	2	10.038	-0.087	0.000	0.68		29.5	OK

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model		FSR	Profile Type Winter
Return Period (years)		30	Cv (Summer) 0.750
Region	England and Wales		Cv (Winter) 0.840
M5-60 (mm)	20.600	Storm Duration (mins)	15
Ratio R	0.437		

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

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	10.543	0.318	0.000	1.62		70.0	SURCHARGED
1.001	2	10.275	0.150	0.000	1.61		69.9	SURCHARGED

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	20.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model		FSR	Profile Type Winter
Return Period (years)		100	Cv (Summer) 0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.600	Storm Duration (mins)	15
Ratio R	0.437		

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

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	11.230	1.005	0.000	2.45		106.0	SURCHARGED
1.001	2	10.620	0.495	0.000	2.42		105.0	SURCHARGED

Appendix G

SW Attenuation Volumes

HEYNE TILLETT STEEL

Summary of Results for 1 year Return Period

Half Drain Time : 6 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	10.058	0.058	0.0	5.0	5.0	2.8	O K
30 min Summer	10.064	0.064	0.0	5.0	5.0	3.1	O K
60 min Summer	10.052	0.052	0.0	5.0	5.0	2.5	O K
120 min Summer	10.024	0.024	0.0	5.0	5.0	1.1	O K
180 min Summer	10.004	0.004	0.0	5.0	5.0	0.2	O K
240 min Summer	10.000	0.000	0.0	4.6	4.6	0.0	O K
360 min Summer	10.000	0.000	0.0	3.5	3.5	0.0	O K
480 min Summer	10.000	0.000	0.0	2.9	2.9	0.0	O K
600 min Summer	10.000	0.000	0.0	2.5	2.5	0.0	O K
720 min Summer	10.000	0.000	0.0	2.2	2.2	0.0	O K
960 min Summer	10.000	0.000	0.0	1.7	1.7	0.0	O K
1440 min Summer	10.000	0.000	0.0	1.3	1.3	0.0	O K
2160 min Summer	10.000	0.000	0.0	0.9	0.9	0.0	O K
2880 min Summer	10.000	0.000	0.0	0.8	0.8	0.0	O K
4320 min Summer	10.000	0.000	0.0	0.6	0.6	0.0	O K
5760 min Summer	10.000	0.000	0.0	0.5	0.5	0.0	O K
7200 min Summer	10.000	0.000	0.0	0.4	0.4	0.0	O K
8640 min Summer	10.000	0.000	0.0	0.3	0.3	0.0	O K
10080 min Summer	10.000	0.000	0.0	0.3	0.3	0.0	O K
15 min Winter	10.072	0.072	0.0	5.0	5.0	3.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	33.081	0.0	7.5	20
30 min Summer	21.343	0.0	9.9	28
60 min Summer	13.306	0.0	12.3	44
120 min Summer	8.118	0.0	15.1	74
180 min Summer	6.048	0.0	16.9	102
240 min Summer	4.901	0.0	18.2	0
360 min Summer	3.622	0.0	20.2	0
480 min Summer	2.915	0.0	21.7	0
600 min Summer	2.463	0.0	22.9	0
720 min Summer	2.146	0.0	23.9	0
960 min Summer	1.726	0.0	25.7	0
1440 min Summer	1.271	0.0	28.4	0
2160 min Summer	0.936	0.0	31.3	0
2880 min Summer	0.754	0.0	33.6	0
4320 min Summer	0.554	0.0	37.1	0
5760 min Summer	0.446	0.0	39.8	0
7200 min Summer	0.377	0.0	42.0	0
8640 min Summer	0.328	0.0	44.0	0
10080 min Summer	0.292	0.0	45.7	0
15 min Winter	33.081	0.0	8.6	20

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	10.078	0.078	0.0	5.0	5.0	3.7	O K
60 min Winter	10.055	0.055	0.0	5.0	5.0	2.6	O K
120 min Winter	10.009	0.009	0.0	5.0	5.0	0.4	O K
180 min Winter	10.000	0.000	0.0	4.3	4.3	0.0	O K
240 min Winter	10.000	0.000	0.0	3.5	3.5	0.0	O K
360 min Winter	10.000	0.000	0.0	2.6	2.6	0.0	O K
480 min Winter	10.000	0.000	0.0	2.1	2.1	0.0	O K
600 min Winter	10.000	0.000	0.0	1.8	1.8	0.0	O K
720 min Winter	10.000	0.000	0.0	1.6	1.6	0.0	O K
960 min Winter	10.000	0.000	0.0	1.3	1.3	0.0	O K
1440 min Winter	10.000	0.000	0.0	0.9	0.9	0.0	O K
2160 min Winter	10.000	0.000	0.0	0.7	0.7	0.0	O K
2880 min Winter	10.000	0.000	0.0	0.6	0.6	0.0	O K
4320 min Winter	10.000	0.000	0.0	0.4	0.4	0.0	O K
5760 min Winter	10.000	0.000	0.0	0.3	0.3	0.0	O K
7200 min Winter	10.000	0.000	0.0	0.3	0.3	0.0	O K
8640 min Winter	10.000	0.000	0.0	0.2	0.2	0.0	O K
10080 min Winter	10.000	0.000	0.0	0.2	0.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	21.343	0.0	11.0	29
60 min Winter	13.306	0.0	13.9	46
120 min Winter	8.118	0.0	16.9	74
180 min Winter	6.048	0.0	18.9	0
240 min Winter	4.901	0.0	20.4	0
360 min Winter	3.622	0.0	22.6	0
480 min Winter	2.915	0.0	24.3	0
600 min Winter	2.463	0.0	25.7	0
720 min Winter	2.146	0.0	26.8	0
960 min Winter	1.726	0.0	28.8	0
1440 min Winter	1.271	0.0	31.8	0
2160 min Winter	0.936	0.0	35.1	0
2880 min Winter	0.754	0.0	37.7	0
4320 min Winter	0.554	0.0	41.6	0
5760 min Winter	0.446	0.0	44.6	0
7200 min Winter	0.377	0.0	47.1	0
8640 min Winter	0.328	0.0	49.2	0
10080 min Winter	0.292	0.0	51.1	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	0.437	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.124

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.041	4	8	0.041	8	12	0.042

Model Details

Storage is Online Cover Level (m) 11.000

Cellular Storage Structure

Invert Level (m) 10.000 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	50.0	50.0	1.100	0.0	80.0
1.000	50.0	80.0			

Pump Outflow Control

Invert Level (m) 0.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0000	0.900	5.0000	1.700	5.0000	2.500	5.0000
0.200	5.0000	1.000	5.0000	1.800	5.0000	2.600	5.0000
0.300	5.0000	1.100	5.0000	1.900	5.0000	2.700	5.0000
0.400	5.0000	1.200	5.0000	2.000	5.0000	2.800	5.0000
0.500	5.0000	1.300	5.0000	2.100	5.0000	2.900	5.0000
0.600	5.0000	1.400	5.0000	2.200	5.0000	3.000	5.0000
0.700	5.0000	1.500	5.0000	2.300	5.0000		
0.800	5.0000	1.600	5.0000	2.400	5.0000		

Summary of Results for 30 year Return Period

Half Drain Time : 30 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	10.268	0.268	0.0	5.0	12.7	O K
30 min Summer	10.315	0.315	0.0	5.0	15.0	O K
60 min Summer	10.306	0.306	0.0	5.0	14.5	O K
120 min Summer	10.259	0.259	0.0	5.0	12.3	O K
180 min Summer	10.208	0.208	0.0	5.0	9.9	O K
240 min Summer	10.160	0.160	0.0	5.0	7.6	O K
360 min Summer	10.082	0.082	0.0	5.0	3.9	O K
480 min Summer	10.031	0.031	0.0	5.0	1.5	O K
600 min Summer	10.004	0.004	0.0	5.0	0.2	O K
720 min Summer	10.000	0.000	0.0	4.7	0.0	O K
960 min Summer	10.000	0.000	0.0	3.7	0.0	O K
1440 min Summer	10.000	0.000	0.0	2.7	0.0	O K
2160 min Summer	10.000	0.000	0.0	1.9	0.0	O K
2880 min Summer	10.000	0.000	0.0	1.5	0.0	O K
4320 min Summer	10.000	0.000	0.0	1.1	0.0	O K
5760 min Summer	10.000	0.000	0.0	0.9	0.0	O K
7200 min Summer	10.000	0.000	0.0	0.7	0.0	O K
8640 min Summer	10.000	0.000	0.0	0.6	0.0	O K
10080 min Summer	10.000	0.000	0.0	0.5	0.0	O K
15 min Winter	10.313	0.313	0.0	5.0	14.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	81.241	0.0	18.9	22
30 min Summer	52.101	0.0	24.3	32
60 min Summer	31.905	0.0	29.5	50
120 min Summer	18.960	0.0	35.2	84
180 min Summer	13.841	0.0	38.4	116
240 min Summer	11.027	0.0	41.2	148
360 min Summer	7.991	0.0	44.6	208
480 min Summer	6.355	0.0	47.3	262
600 min Summer	5.318	0.0	49.5	314
720 min Summer	4.596	0.0	51.3	0
960 min Summer	3.648	0.0	54.3	0
1440 min Summer	2.633	0.0	58.8	0
2160 min Summer	1.898	0.0	63.5	0
2880 min Summer	1.504	0.0	67.1	0
4320 min Summer	1.082	0.0	72.5	0
5760 min Summer	0.857	0.0	76.5	0
7200 min Summer	0.714	0.0	79.7	0
8640 min Summer	0.616	0.0	82.5	0
10080 min Summer	0.543	0.0	84.8	0
15 min Winter	81.241	0.0	21.1	22

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	10.371	0.371	0.0	5.0	17.6	O K
60 min Winter	10.363	0.363	0.0	5.0	17.2	O K
120 min Winter	10.290	0.290	0.0	5.0	13.8	O K
180 min Winter	10.210	0.210	0.0	5.0	10.0	O K
240 min Winter	10.137	0.137	0.0	5.0	6.5	O K
360 min Winter	10.030	0.030	0.0	5.0	1.4	O K
480 min Winter	10.000	0.000	0.0	4.6	0.0	O K
600 min Winter	10.000	0.000	0.0	3.9	0.0	O K
720 min Winter	10.000	0.000	0.0	3.4	0.0	O K
960 min Winter	10.000	0.000	0.0	2.7	0.0	O K
1440 min Winter	10.000	0.000	0.0	1.9	0.0	O K
2160 min Winter	10.000	0.000	0.0	1.4	0.0	O K
2880 min Winter	10.000	0.000	0.0	1.1	0.0	O K
4320 min Winter	10.000	0.000	0.0	0.8	0.0	O K
5760 min Winter	10.000	0.000	0.0	0.6	0.0	O K
7200 min Winter	10.000	0.000	0.0	0.5	0.0	O K
8640 min Winter	10.000	0.000	0.0	0.5	0.0	O K
10080 min Winter	10.000	0.000	0.0	0.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	52.101	0.0	27.1	33
60 min Winter	31.905	0.0	33.5	54
120 min Winter	18.960	0.0	39.5	90
180 min Winter	13.841	0.0	43.4	124
240 min Winter	11.027	0.0	45.8	156
360 min Winter	7.991	0.0	49.9	210
480 min Winter	6.355	0.0	53.0	0
600 min Winter	5.318	0.0	55.4	0
720 min Winter	4.596	0.0	57.4	0
960 min Winter	3.648	0.0	60.8	0
1440 min Winter	2.633	0.0	65.8	0
2160 min Winter	1.898	0.0	71.2	0
2880 min Winter	1.504	0.0	75.2	0
4320 min Winter	1.082	0.0	81.2	0
5760 min Winter	0.857	0.0	85.7	0
7200 min Winter	0.714	0.0	89.3	0
8640 min Winter	0.616	0.0	92.4	0
10080 min Winter	0.543	0.0	95.0	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	0.437	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.124

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.041	4	8	0.041	8	12	0.042

Model Details

Storage is Online Cover Level (m) 11.000

Cellular Storage Structure

Invert Level (m) 10.000 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	50.0	50.0	1.100	0.0	80.0
1.000	50.0	80.0			

Pump Outflow Control

Invert Level (m) 0.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0000	0.900	5.0000	1.700	5.0000	2.500	5.0000
0.200	5.0000	1.000	5.0000	1.800	5.0000	2.600	5.0000
0.300	5.0000	1.100	5.0000	1.900	5.0000	2.700	5.0000
0.400	5.0000	1.200	5.0000	2.000	5.0000	2.800	5.0000
0.500	5.0000	1.300	5.0000	2.100	5.0000	2.900	5.0000
0.600	5.0000	1.400	5.0000	2.200	5.0000	3.000	5.0000
0.700	5.0000	1.500	5.0000	2.300	5.0000		
0.800	5.0000	1.600	5.0000	2.400	5.0000		

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

Half Drain Time : 58 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	10.480	0.480	0.0	5.0	5.0	22.8	O K
30 min Summer	10.586	0.586	0.0	5.0	5.0	27.8	O K
60 min Summer	10.613	0.613	0.0	5.0	5.0	29.1	O K
120 min Summer	10.561	0.561	0.0	5.0	5.0	26.7	O K
180 min Summer	10.502	0.502	0.0	5.0	5.0	23.9	O K
240 min Summer	10.442	0.442	0.0	5.0	5.0	21.0	O K
360 min Summer	10.330	0.330	0.0	5.0	5.0	15.7	O K
480 min Summer	10.235	0.235	0.0	5.0	5.0	11.1	O K
600 min Summer	10.156	0.156	0.0	5.0	5.0	7.4	O K
720 min Summer	10.095	0.095	0.0	5.0	5.0	4.5	O K
960 min Summer	10.019	0.019	0.0	5.0	5.0	0.9	O K
1440 min Summer	10.000	0.000	0.0	4.1	4.1	0.0	O K
2160 min Summer	10.000	0.000	0.0	2.9	2.9	0.0	O K
2880 min Summer	10.000	0.000	0.0	2.3	2.3	0.0	O K
4320 min Summer	10.000	0.000	0.0	1.6	1.6	0.0	O K
5760 min Summer	10.000	0.000	0.0	1.3	1.3	0.0	O K
7200 min Summer	10.000	0.000	0.0	1.1	1.1	0.0	O K
8640 min Summer	10.000	0.000	0.0	0.9	0.9	0.0	O K
10080 min Summer	10.000	0.000	0.0	0.8	0.8	0.0	O K
15 min Winter	10.553	0.553	0.0	5.0	5.0	26.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	126.816	0.0	29.4	23
30 min Summer	81.944	0.0	38.0	35
60 min Summer	50.353	0.0	46.9	60
120 min Summer	29.886	0.0	55.5	92
180 min Summer	21.744	0.0	60.7	126
240 min Summer	17.257	0.0	63.9	158
360 min Summer	12.437	0.0	69.5	224
480 min Summer	9.856	0.0	73.3	284
600 min Summer	8.223	0.0	76.5	344
720 min Summer	7.089	0.0	79.0	398
960 min Summer	5.606	0.0	83.4	504
1440 min Summer	4.021	0.0	89.7	0
2160 min Summer	2.880	0.0	96.4	0
2880 min Summer	2.271	0.0	101.4	0
4320 min Summer	1.623	0.0	108.7	0
5760 min Summer	1.278	0.0	114.1	0
7200 min Summer	1.061	0.0	118.4	0
8640 min Summer	0.911	0.0	122.0	0
10080 min Summer	0.801	0.0	125.1	0
15 min Winter	126.816	0.0	33.1	23

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	10.680	0.680	0.0	5.0	5.0	32.3	O K
60 min Winter	10.730	0.730	0.0	5.0	5.0	34.7	Flood Risk
120 min Winter	10.661	0.661	0.0	5.0	5.0	31.4	O K
180 min Winter	10.575	0.575	0.0	5.0	5.0	27.3	O K
240 min Winter	10.482	0.482	0.0	5.0	5.0	22.9	O K
360 min Winter	10.312	0.312	0.0	5.0	5.0	14.8	O K
480 min Winter	10.172	0.172	0.0	5.0	5.0	8.1	O K
600 min Winter	10.067	0.067	0.0	5.0	5.0	3.2	O K
720 min Winter	10.006	0.006	0.0	5.0	5.0	0.3	O K
960 min Winter	10.000	0.000	0.0	4.1	4.1	0.0	O K
1440 min Winter	10.000	0.000	0.0	2.9	2.9	0.0	O K
2160 min Winter	10.000	0.000	0.0	2.1	2.1	0.0	O K
2880 min Winter	10.000	0.000	0.0	1.7	1.7	0.0	O K
4320 min Winter	10.000	0.000	0.0	1.2	1.2	0.0	O K
5760 min Winter	10.000	0.000	0.0	0.9	0.9	0.0	O K
7200 min Winter	10.000	0.000	0.0	0.8	0.8	0.0	O K
8640 min Winter	10.000	0.000	0.0	0.7	0.7	0.0	O K
10080 min Winter	10.000	0.000	0.0	0.6	0.6	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	81.944	0.0	42.5	36
60 min Winter	50.353	0.0	52.3	60
120 min Winter	29.886	0.0	62.5	98
180 min Winter	21.744	0.0	68.0	136
240 min Winter	17.257	0.0	71.6	172
360 min Winter	12.437	0.0	77.6	238
480 min Winter	9.856	0.0	82.0	298
600 min Winter	8.223	0.0	85.6	348
720 min Winter	7.089	0.0	88.6	384
960 min Winter	5.606	0.0	93.4	0
1440 min Winter	4.021	0.0	100.5	0
2160 min Winter	2.880	0.0	108.0	0
2880 min Winter	2.271	0.0	113.5	0
4320 min Winter	1.623	0.0	121.7	0
5760 min Winter	1.278	0.0	127.8	0
7200 min Winter	1.061	0.0	132.6	0
8640 min Winter	0.911	0.0	136.7	0
10080 min Winter	0.801	0.0	140.1	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	0.437	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.124

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.041	4	8	0.041	8	12	0.042

Model Details

Storage is Online Cover Level (m) 11.000

Cellular Storage Structure

Invert Level (m) 10.000 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	50.0	50.0	1.100	0.0	80.0
1.000	50.0	80.0			

Pump Outflow Control

Invert Level (m) 0.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0000	0.900	5.0000	1.700	5.0000	2.500	5.0000
0.200	5.0000	1.000	5.0000	1.800	5.0000	2.600	5.0000
0.300	5.0000	1.100	5.0000	1.900	5.0000	2.700	5.0000
0.400	5.0000	1.200	5.0000	2.000	5.0000	2.800	5.0000
0.500	5.0000	1.300	5.0000	2.100	5.0000	2.900	5.0000
0.600	5.0000	1.400	5.0000	2.200	5.0000	3.000	5.0000
0.700	5.0000	1.500	5.0000	2.300	5.0000		
0.800	5.0000	1.600	5.0000	2.400	5.0000		

Summary of Results for 1 year Return Period

Half Drain Time : 1 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	10.022	0.022	0.0	5.0	0.4	O K
30 min Summer	10.027	0.027	0.0	5.0	0.5	O K
60 min Summer	10.010	0.010	0.0	5.0	0.2	O K
120 min Summer	10.000	0.000	0.0	4.2	0.0	O K
180 min Summer	10.000	0.000	0.0	3.4	0.0	O K
240 min Summer	10.000	0.000	0.0	2.8	0.0	O K
360 min Summer	10.000	0.000	0.0	2.2	0.0	O K
480 min Summer	10.000	0.000	0.0	1.8	0.0	O K
600 min Summer	10.000	0.000	0.0	1.5	0.0	O K
720 min Summer	10.000	0.000	0.0	1.3	0.0	O K
960 min Summer	10.000	0.000	0.0	1.1	0.0	O K
1440 min Summer	10.000	0.000	0.0	0.8	0.0	O K
2160 min Summer	10.000	0.000	0.0	0.6	0.0	O K
2880 min Summer	10.000	0.000	0.0	0.5	0.0	O K
4320 min Summer	10.000	0.000	0.0	0.3	0.0	O K
5760 min Summer	10.000	0.000	0.0	0.3	0.0	O K
7200 min Summer	10.000	0.000	0.0	0.2	0.0	O K
8640 min Summer	10.000	0.000	0.0	0.2	0.0	O K
10080 min Summer	10.000	0.000	0.0	0.2	0.0	O K
15 min Winter	10.040	0.040	0.0	5.0	0.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	33.081	0.0	4.7	18
30 min Summer	21.343	0.0	6.1	26
60 min Summer	13.306	0.0	7.5	40
120 min Summer	8.118	0.0	9.3	0
180 min Summer	6.048	0.0	10.3	0
240 min Summer	4.901	0.0	11.2	0
360 min Summer	3.622	0.0	12.4	0
480 min Summer	2.915	0.0	13.3	0
600 min Summer	2.463	0.0	14.0	0
720 min Summer	2.146	0.0	14.7	0
960 min Summer	1.726	0.0	15.7	0
1440 min Summer	1.271	0.0	17.4	0
2160 min Summer	0.936	0.0	19.2	0
2880 min Summer	0.754	0.0	20.6	0
4320 min Summer	0.554	0.0	22.7	0
5760 min Summer	0.446	0.0	24.4	0
7200 min Summer	0.377	0.0	25.8	0
8640 min Summer	0.328	0.0	26.9	0
10080 min Summer	0.292	0.0	28.0	0
15 min Winter	33.081	0.0	5.3	18

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	10.038	0.038	0.0	5.0	0.7	O K
60 min Winter	10.003	0.003	0.0	5.0	0.1	O K
120 min Winter	10.000	0.000	0.0	3.5	0.0	O K
180 min Winter	10.000	0.000	0.0	2.7	0.0	O K
240 min Winter	10.000	0.000	0.0	2.2	0.0	O K
360 min Winter	10.000	0.000	0.0	1.6	0.0	O K
480 min Winter	10.000	0.000	0.0	1.3	0.0	O K
600 min Winter	10.000	0.000	0.0	1.1	0.0	O K
720 min Winter	10.000	0.000	0.0	1.0	0.0	O K
960 min Winter	10.000	0.000	0.0	0.8	0.0	O K
1440 min Winter	10.000	0.000	0.0	0.6	0.0	O K
2160 min Winter	10.000	0.000	0.0	0.4	0.0	O K
2880 min Winter	10.000	0.000	0.0	0.3	0.0	O K
4320 min Winter	10.000	0.000	0.0	0.2	0.0	O K
5760 min Winter	10.000	0.000	0.0	0.2	0.0	O K
7200 min Winter	10.000	0.000	0.0	0.2	0.0	O K
8640 min Winter	10.000	0.000	0.0	0.1	0.0	O K
10080 min Winter	10.000	0.000	0.0	0.1	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	21.343	0.0	6.8	26
60 min Winter	13.306	0.0	8.5	40
120 min Winter	8.118	0.0	10.4	0
180 min Winter	6.048	0.0	11.6	0
240 min Winter	4.901	0.0	12.5	0
360 min Winter	3.622	0.0	13.9	0
480 min Winter	2.915	0.0	14.9	0
600 min Winter	2.463	0.0	15.7	0
720 min Winter	2.146	0.0	16.4	0
960 min Winter	1.726	0.0	17.6	0
1440 min Winter	1.271	0.0	19.5	0
2160 min Winter	0.936	0.0	21.5	0
2880 min Winter	0.754	0.0	23.1	0
4320 min Winter	0.554	0.0	25.5	0
5760 min Winter	0.446	0.0	27.3	0
7200 min Winter	0.377	0.0	28.9	0
8640 min Winter	0.328	0.0	30.2	0
10080 min Winter	0.292	0.0	31.3	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	0.437	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.076

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.025	4	8	0.025	8	12	0.026

Model Details

Storage is Online Cover Level (m) 11.000

Cellular Storage Structure

Invert Level (m) 10.000 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	20.0	20.0	1.100	0.0	44.0
1.000	20.0	44.0			

Pump Outflow Control

Invert Level (m) 0.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0000	0.900	5.0000	1.700	5.0000	2.500	5.0000
0.200	5.0000	1.000	5.0000	1.800	5.0000	2.600	5.0000
0.300	5.0000	1.100	5.0000	1.900	5.0000	2.700	5.0000
0.400	5.0000	1.200	5.0000	2.000	5.0000	2.800	5.0000
0.500	5.0000	1.300	5.0000	2.100	5.0000	2.900	5.0000
0.600	5.0000	1.400	5.0000	2.200	5.0000	3.000	5.0000
0.700	5.0000	1.500	5.0000	2.300	5.0000		
0.800	5.0000	1.600	5.0000	2.400	5.0000		

Summary of Results for 30 year Return Period

Half Drain Time : 14 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	10.320	0.320	0.0	5.0	6.1	O K
30 min Summer	10.363	0.363	0.0	5.0	6.9	O K
60 min Summer	10.322	0.322	0.0	5.0	6.1	O K
120 min Summer	10.217	0.217	0.0	5.0	4.1	O K
180 min Summer	10.123	0.123	0.0	5.0	2.3	O K
240 min Summer	10.054	0.054	0.0	5.0	1.0	O K
360 min Summer	10.000	0.000	0.0	4.8	0.0	O K
480 min Summer	10.000	0.000	0.0	3.9	0.0	O K
600 min Summer	10.000	0.000	0.0	3.3	0.0	O K
720 min Summer	10.000	0.000	0.0	2.9	0.0	O K
960 min Summer	10.000	0.000	0.0	2.3	0.0	O K
1440 min Summer	10.000	0.000	0.0	1.6	0.0	O K
2160 min Summer	10.000	0.000	0.0	1.2	0.0	O K
2880 min Summer	10.000	0.000	0.0	0.9	0.0	O K
4320 min Summer	10.000	0.000	0.0	0.7	0.0	O K
5760 min Summer	10.000	0.000	0.0	0.5	0.0	O K
7200 min Summer	10.000	0.000	0.0	0.4	0.0	O K
8640 min Summer	10.000	0.000	0.0	0.4	0.0	O K
10080 min Summer	10.000	0.000	0.0	0.3	0.0	O K
15 min Winter	10.382	0.382	0.0	5.0	7.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	81.241	0.0	11.4	21
30 min Summer	52.101	0.0	14.9	30
60 min Summer	31.905	0.0	18.3	46
120 min Summer	18.960	0.0	21.4	78
180 min Summer	13.841	0.0	23.5	108
240 min Summer	11.027	0.0	25.2	136
360 min Summer	7.991	0.0	27.3	0
480 min Summer	6.355	0.0	29.0	0
600 min Summer	5.318	0.0	30.3	0
720 min Summer	4.596	0.0	31.4	0
960 min Summer	3.648	0.0	33.3	0
1440 min Summer	2.633	0.0	36.0	0
2160 min Summer	1.898	0.0	38.9	0
2880 min Summer	1.504	0.0	41.1	0
4320 min Summer	1.082	0.0	44.4	0
5760 min Summer	0.857	0.0	46.9	0
7200 min Summer	0.714	0.0	48.9	0
8640 min Summer	0.616	0.0	50.5	0
10080 min Summer	0.543	0.0	52.0	0
15 min Winter	81.241	0.0	13.0	21

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	10.434	0.434	0.0	5.0	8.2	O K
60 min Winter	10.369	0.369	0.0	5.0	7.0	O K
120 min Winter	10.198	0.198	0.0	5.0	3.8	O K
180 min Winter	10.060	0.060	0.0	5.0	1.1	O K
240 min Winter	10.000	0.000	0.0	4.9	0.0	O K
360 min Winter	10.000	0.000	0.0	3.6	0.0	O K
480 min Winter	10.000	0.000	0.0	2.8	0.0	O K
600 min Winter	10.000	0.000	0.0	2.4	0.0	O K
720 min Winter	10.000	0.000	0.0	2.1	0.0	O K
960 min Winter	10.000	0.000	0.0	1.6	0.0	O K
1440 min Winter	10.000	0.000	0.0	1.2	0.0	O K
2160 min Winter	10.000	0.000	0.0	0.9	0.0	O K
2880 min Winter	10.000	0.000	0.0	0.7	0.0	O K
4320 min Winter	10.000	0.000	0.0	0.5	0.0	O K
5760 min Winter	10.000	0.000	0.0	0.4	0.0	O K
7200 min Winter	10.000	0.000	0.0	0.3	0.0	O K
8640 min Winter	10.000	0.000	0.0	0.3	0.0	O K
10080 min Winter	10.000	0.000	0.0	0.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	52.101	0.0	16.6	31
60 min Winter	31.905	0.0	20.2	50
120 min Winter	18.960	0.0	24.3	82
180 min Winter	13.841	0.0	26.5	110
240 min Winter	11.027	0.0	28.2	0
360 min Winter	7.991	0.0	30.6	0
480 min Winter	6.355	0.0	32.5	0
600 min Winter	5.318	0.0	33.9	0
720 min Winter	4.596	0.0	35.2	0
960 min Winter	3.648	0.0	37.3	0
1440 min Winter	2.633	0.0	40.3	0
2160 min Winter	1.898	0.0	43.6	0
2880 min Winter	1.504	0.0	46.1	0
4320 min Winter	1.082	0.0	49.8	0
5760 min Winter	0.857	0.0	52.5	0
7200 min Winter	0.714	0.0	54.7	0
8640 min Winter	0.616	0.0	56.6	0
10080 min Winter	0.543	0.0	58.2	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	0.437	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.076

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.025	4	8	0.025	8	12	0.026

Model Details

Storage is Online Cover Level (m) 11.000

Cellular Storage Structure

Invert Level (m) 10.000 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	20.0	20.0	1.100	0.0	44.0
1.000	20.0	44.0			

Pump Outflow Control

Invert Level (m) 0.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0000	0.900	5.0000	1.700	5.0000	2.500	5.0000
0.200	5.0000	1.000	5.0000	1.800	5.0000	2.600	5.0000
0.300	5.0000	1.100	5.0000	1.900	5.0000	2.700	5.0000
0.400	5.0000	1.200	5.0000	2.000	5.0000	2.800	5.0000
0.500	5.0000	1.300	5.0000	2.100	5.0000	2.900	5.0000
0.600	5.0000	1.400	5.0000	2.200	5.0000	3.000	5.0000
0.700	5.0000	1.500	5.0000	2.300	5.0000		
0.800	5.0000	1.600	5.0000	2.400	5.0000		

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

Half Drain Time : 28 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	10.631	0.631	0.0	5.0	5.0	12.0	O K
30 min Summer	10.747	0.747	0.0	5.0	5.0	14.2	Flood Risk
60 min Summer	10.725	0.725	0.0	5.0	5.0	13.8	Flood Risk
120 min Summer	10.607	0.607	0.0	5.0	5.0	11.5	O K
180 min Summer	10.477	0.477	0.0	5.0	5.0	9.1	O K
240 min Summer	10.355	0.355	0.0	5.0	5.0	6.8	O K
360 min Summer	10.166	0.166	0.0	5.0	5.0	3.2	O K
480 min Summer	10.051	0.051	0.0	5.0	5.0	1.0	O K
600 min Summer	10.001	0.001	0.0	5.0	5.0	0.0	O K
720 min Summer	10.000	0.000	0.0	4.4	4.4	0.0	O K
960 min Summer	10.000	0.000	0.0	3.5	3.5	0.0	O K
1440 min Summer	10.000	0.000	0.0	2.5	2.5	0.0	O K
2160 min Summer	10.000	0.000	0.0	1.8	1.8	0.0	O K
2880 min Summer	10.000	0.000	0.0	1.4	1.4	0.0	O K
4320 min Summer	10.000	0.000	0.0	1.0	1.0	0.0	O K
5760 min Summer	10.000	0.000	0.0	0.8	0.8	0.0	O K
7200 min Summer	10.000	0.000	0.0	0.7	0.7	0.0	O K
8640 min Summer	10.000	0.000	0.0	0.6	0.6	0.0	O K
10080 min Summer	10.000	0.000	0.0	0.5	0.5	0.0	O K
15 min Winter	10.737	0.737	0.0	5.0	5.0	14.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	126.816	0.0	18.0	21
30 min Summer	81.944	0.0	23.3	32
60 min Summer	50.353	0.0	28.7	50
120 min Summer	29.886	0.0	34.3	84
180 min Summer	21.744	0.0	37.2	116
240 min Summer	17.257	0.0	39.3	148
360 min Summer	12.437	0.0	42.5	206
480 min Summer	9.856	0.0	44.9	260
600 min Summer	8.223	0.0	46.9	308
720 min Summer	7.089	0.0	48.5	0
960 min Summer	5.606	0.0	51.1	0
1440 min Summer	4.021	0.0	55.0	0
2160 min Summer	2.880	0.0	59.1	0
2880 min Summer	2.271	0.0	62.1	0
4320 min Summer	1.623	0.0	66.6	0
5760 min Summer	1.278	0.0	69.9	0
7200 min Summer	1.061	0.0	72.6	0
8640 min Summer	0.911	0.0	74.8	0
10080 min Summer	0.801	0.0	76.7	0
15 min Winter	126.816	0.0	20.2	22

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	10.882	0.882	0.0	5.0	5.0	16.7	Flood Risk
60 min Winter	10.859	0.859	0.0	5.0	5.0	16.3	Flood Risk
120 min Winter	10.675	0.675	0.0	5.0	5.0	12.8	O K
180 min Winter	10.472	0.472	0.0	5.0	5.0	9.0	O K
240 min Winter	10.289	0.289	0.0	5.0	5.0	5.5	O K
360 min Winter	10.040	0.040	0.0	5.0	5.0	0.8	O K
480 min Winter	10.000	0.000	0.0	4.4	4.4	0.0	O K
600 min Winter	10.000	0.000	0.0	3.7	3.7	0.0	O K
720 min Winter	10.000	0.000	0.0	3.2	3.2	0.0	O K
960 min Winter	10.000	0.000	0.0	2.5	2.5	0.0	O K
1440 min Winter	10.000	0.000	0.0	1.8	1.8	0.0	O K
2160 min Winter	10.000	0.000	0.0	1.3	1.3	0.0	O K
2880 min Winter	10.000	0.000	0.0	1.0	1.0	0.0	O K
4320 min Winter	10.000	0.000	0.0	0.7	0.7	0.0	O K
5760 min Winter	10.000	0.000	0.0	0.6	0.6	0.0	O K
7200 min Winter	10.000	0.000	0.0	0.5	0.5	0.0	O K
8640 min Winter	10.000	0.000	0.0	0.4	0.4	0.0	O K
10080 min Winter	10.000	0.000	0.0	0.4	0.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	81.944	0.0	26.1	33
60 min Winter	50.353	0.0	32.2	54
120 min Winter	29.886	0.0	38.1	90
180 min Winter	21.744	0.0	41.5	124
240 min Winter	17.257	0.0	44.0	154
360 min Winter	12.437	0.0	47.7	204
480 min Winter	9.856	0.0	50.3	0
600 min Winter	8.223	0.0	52.5	0
720 min Winter	7.089	0.0	54.3	0
960 min Winter	5.606	0.0	57.3	0
1440 min Winter	4.021	0.0	61.6	0
2160 min Winter	2.880	0.0	66.2	0
2880 min Winter	2.271	0.0	69.6	0
4320 min Winter	1.623	0.0	74.6	0
5760 min Winter	1.278	0.0	78.3	0
7200 min Winter	1.061	0.0	81.3	0
8640 min Winter	0.911	0.0	83.8	0
10080 min Winter	0.801	0.0	85.9	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	0.437	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.076

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.025	4	8	0.025	8	12	0.026

Model Details

Storage is Online Cover Level (m) 11.000

Cellular Storage Structure

Invert Level (m) 10.000 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	20.0	20.0	1.100	0.0	44.0
1.000	20.0	44.0			

Pump Outflow Control

Invert Level (m) 0.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0000	0.900	5.0000	1.700	5.0000	2.500	5.0000
0.200	5.0000	1.000	5.0000	1.800	5.0000	2.600	5.0000
0.300	5.0000	1.100	5.0000	1.900	5.0000	2.700	5.0000
0.400	5.0000	1.200	5.0000	2.000	5.0000	2.800	5.0000
0.500	5.0000	1.300	5.0000	2.100	5.0000	2.900	5.0000
0.600	5.0000	1.400	5.0000	2.200	5.0000	3.000	5.0000
0.700	5.0000	1.500	5.0000	2.300	5.0000		
0.800	5.0000	1.600	5.0000	2.400	5.0000		

Appendix H

Outline Drainage Layout Plan

HEYNE TILLETT STEEL

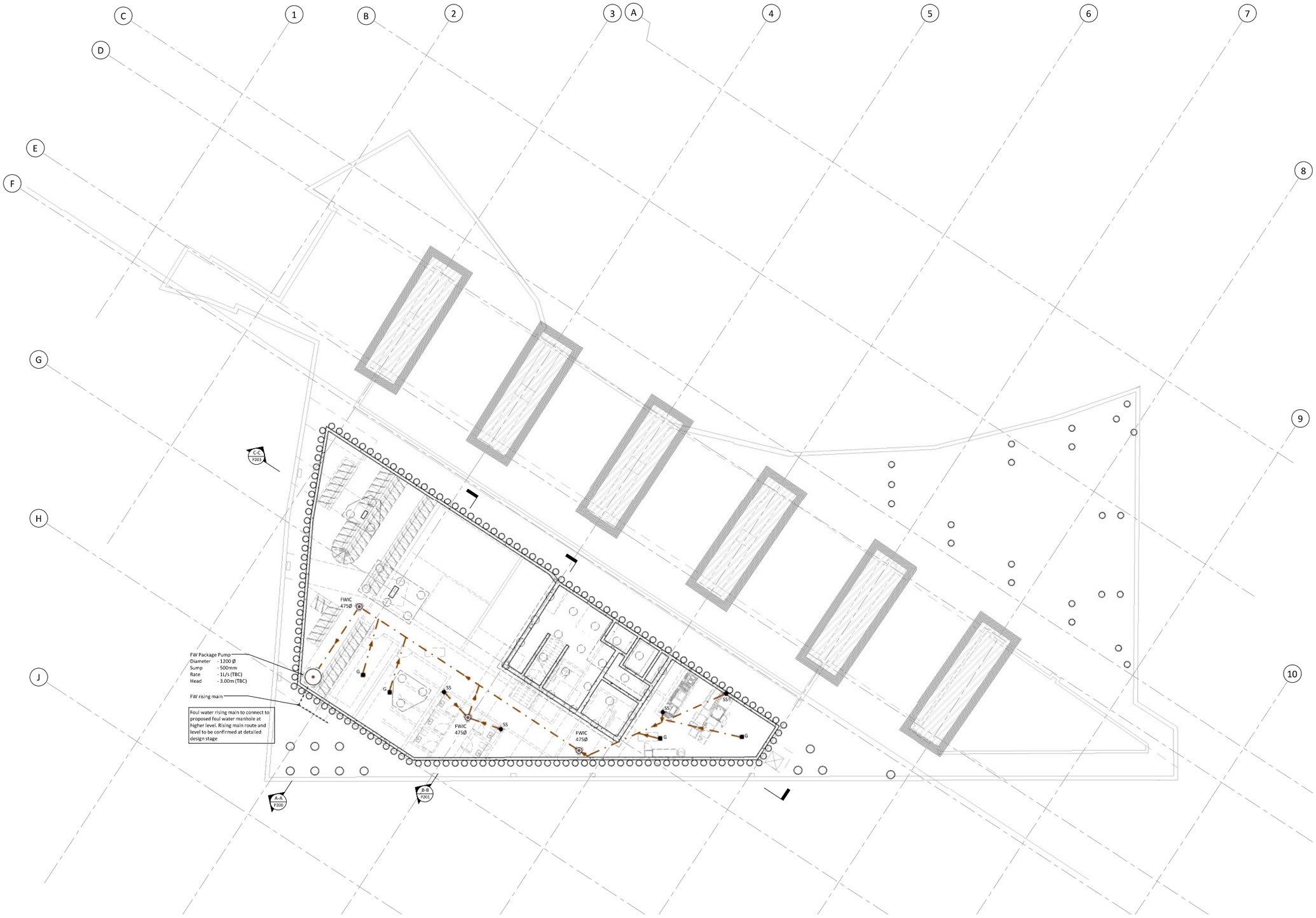
100mm @ A0 /50mm @ A01

1 This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

3 Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm

3 Abbreviations:-

CL	- Cover Level
IL	- Invert Level
MH	- Manhole
OD	- Outer Diameter
RWP	- Rainwater Pipe
SVP	- Soil Vent Pipe



Drainage Key

- Proposed SW drain run
- Proposed FW drain run
- Proposed CW drain run
- Proposed Pumped Rising Main
- Existing SW drain run
- Existing FW drain run
- Existing CW drain run
- Existing Pumped Rising Main
- Public sewer
- Unspecified drain run
- Proposed Channel Drain
- Redundant drain run
- RWP Proposed / Existing Rain Water Pipe
- SVP Proposed / Existing Soil Vent Pipe
- RE Proposed / Existing Rodding Eye
- DP Proposed / Existing Drainage Point
- SS Proposed / Existing Stub Stack
- G Proposed / Existing Gully
- Proposed SW Manhole
- Proposed FW Manhole
- Proposed CW Manhole
- Proposed Public Sewer Manhole
- Existing Manhole

Rev	Date	By	Eng	Amendments
P1	13.09.16	JGS	SL	STAGE 2 ISSUE

HEYNE TILLETT STEEL
STRUCTURAL ENGINEERS
hts.uk.com

Job Name
3 - 6 Spring Place, London

Drawing Title
Proposed Basement Drainage Strategy

Purpose of Issue **Stage 2 Issue** Scale at A0 **As indicated**

Drawing No **1399 / DR600** Rev **P1**

100mm @ A0 /50mm @ A01

1 This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.

3 Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale the above bar should be 100mm

3 Abbreviations:-

CL	- Cover Level
IL	- Invert Level
MH	- Manhole
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SVP	- Soil Vent Pipe

Drainage Key

- Proposed SW drain run
- Proposed FW drain run
- Proposed CW drain run
- Proposed Pumped Rising Main
- Existing SW drain run
- Existing FW drain run
- Existing CW drain run
- Existing Pumped Rising Main
- Public sewer
- Unspecified drain run
- Proposed Channel Drain
- Redundant drain run
- RWP Proposed / Existing Rain Water Pipe
- SVP Proposed / Existing Soil Vent Pipe
- RE Proposed / Existing Rodding Eye
- DP Proposed / Existing Drainage Point
- SS Proposed / Existing Stub Stack
- G Proposed / Existing Gully
- Proposed SW Manhole
- Proposed FW Manhole
- Proposed CW Manhole
- Proposed Public Sewer Manhole
- Existing Manhole

Connects to large brick sewer at 35.05

Thames water CW MH 750x600x1680

SWIC 450Ø

C-C P203

300Ø TW CW Pipe

SWMH 1200 Ø

Thames Water CW MH

SWMH 1200 Ø

Flow Control Chamber Maximum discharge 5 l/s

SWMH 1200 Ø

Thames Water CW MH 750x600x1470

Assumed connection from flats

Surface Water Attenuation Tank

Tank Area	64.00m²
Tank Depth	1.20m
Tank Volume	76.80m³
Approx. IL	32.800m
Approx. CL	34.000m
Tank Cover	0.500m

Exact tank location, size and depth to be confirmed at detailed design stage.

FWIC 450 Ø

FWIC 450 Ø

Surface water to discharge from roof areas on viaduct side of proposed building

Foul water rising main from basement level

FWIC 450 Ø

SWIC 450 Ø

FWIC 450 Ø

SWIC 450 Ø

FWIC 450 Ø

A-A P200

B-B P201

300 Ø TW CW Pipe

Thames water CW MH 5002 CL TBC IL 31.390

SPRING PLACE

Rev	Date	By	Eng	Amendments
P1	13.09.16	JGS	SL	STAGE 2 ISSUE

HEYNE TILLETT STEEL

STRUCTURAL ENGINEERS

hts.uk.com

Job Name
3 - 6 Spring Place, London

Drawing Title
Proposed Ground Floor Drainage Strategy

Purpose of Issue **Stage 2 Issue** Scale at A0 **As indicated**

Drawing No 1399 / DR601 Rev P1

4 Pear Tree Court, London EC1R 0DS +44 (0) 20 7870 8050