Drainage Strategy Report

J2740 373-375 Euston Road
Cambridge House, London

Ref: J2740-Doc-06
Revision: 01

Webb Yates Engineers Ltd
48-50 Scrutton Street
London. EC2A 4HH
020 3696 1550
info@webbyates.co.uk
www.webbyates.co.uk

CONTENTS

GENERAL NOTES

Only construction status documentation is to be constructed from. If you do not have a construction issue document and you are about to build something, please contact Webb Yates Engineers. Ensure that you have the latest revision prior to construction.

This document is strictly confidential to our client, or their other professional advisors to the specific purpose to which it refers. No responsibility whatsoever is accepted to any third parties for the whole or part of its contents. This document has been prepared for our client and does not entitle any third party to the benefit of the contents herein.

REVISION HISTORY

Revisions indicated with line in margin.

Revision status: P = Preliminary, T = Tender, C = Construction, X = For Information

Revision	Status	Date	Author	Reviewer	Description
00	Information	07/12/17	MJ	GP-D	Issued for Comment
01	Stage 3	15/12/17	GP-D	GP-D	Stage 3 issue

1 INTRODUCTION

Webb Yates Engineers have been appointed by Birkbeck College Cambridge house Ltd. to undertake civil and structural engineering design services for the proposed redevelopment at 373-375 Euston Road.

The proposal is a refurbishment and extension to the existing building. The site is currently occupied by a four storey building, plus basement. The development consists of a refurbishment of the existing building including new stair and lift cores as well as minor lowering of the existing basement floor level. The new extension is a 1-2 storey extension including a new lecture theatre, lounge area and plant areas internally and externally.

The purpose of this report is to consider the various drainage strategy options and determine the preferred option for the new development.

The site is bounded by; Euston Road to the North; Cleveland Street to the West and Warren Street to the South. An existing building occupies the site immediately to the East, sharing a party wall with the existing build on site.

This document has been prepared with reference to:

- London Borough of Camden Strategic Flood Risk Assessment (SFRA) July 2014.
- Camden Core Strategy November 2010
- National Planning Policy Framework (NPPF) March 2012.
- Sewers for Adoption 7th Edition (October 2012)
- Environment Agency Flood Maps (http://maps.environment-agency.gov.uk/)
- Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems April 2015.
- The London Plan (www.london.gov.uk) 2011.
- The London Supplementary Planning Guidance (SPG) – Sustainable Design and Construction (www.london.gov.uk) 2014.
- Sustainable Drainage Systems (SuDS) Manual, Ciria 2015.
- Rainfall Runnoff Management for Developments Report – SC030219, Environment Agency 2013

2 SITE DESCRIPTORS

373-375 Euston Road's approximate National Grid reference is TQ 28956 82178. Located in North West London, within the Borough of Camden. The site's postal code is NW1 3AR.

To the north of the site is Euston Road. Cleveland Street bounds the site to the west and Warren Street bounds the site to the south. An existing building occupies the site immediately to the east, which shares a party wall with the existing building.

A London Underground tunnel servicing the Circle, Metropolitan and Hammersmith & City lines is located beneath Euston Road, adjacent to the site. Great Portland Street Station is situated on Euston Road and the underground platform extends to the North-West corner of the site.

The proposed building occupies the entire footprint of the site. New piled foundations are to be set back a minimum of 3 m from the London Underground tunnel and platform in accordance with London Underground requirements.

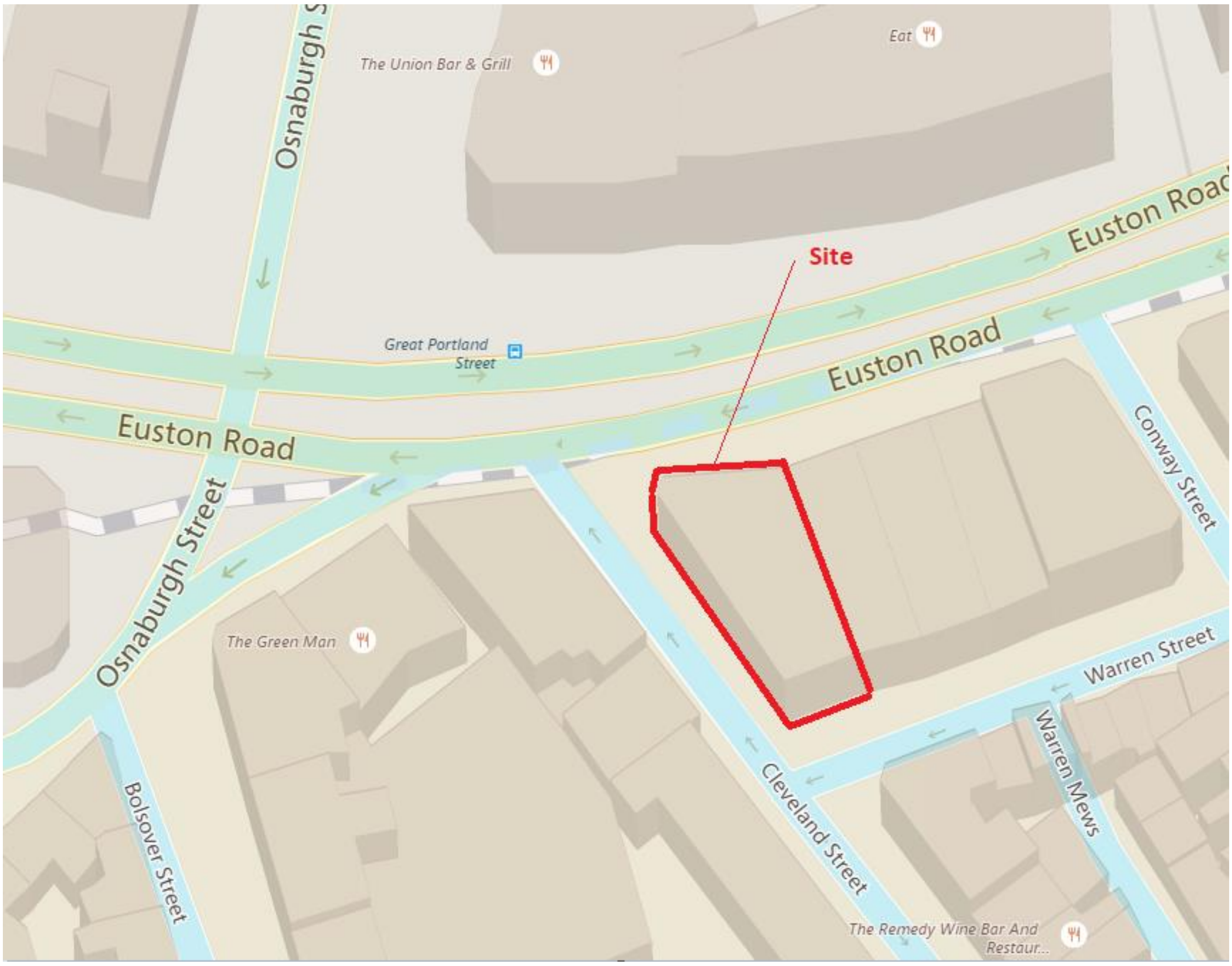


Figure 1: Map of Local Area with site boundary marked in red

Figure 2: Satellite view of local area with the site location marked in red

3 SITE CONTEXT

3.1 TOPOGRAPHY

The site topography is gently sloped from South to North in the upward direction. The highest topographic point, on site, is found on Euston Road at 10.13 mAOD. The lowest topographic point is found on the Southern along Warren Street and is 9.92mAOD. This gives a slope of 1 in 143.

3.2 GEOLOGY

British Geological Society maps and nearby boreholes indicate that the site is underlain by Lynch Hill Gravel over London Clay. A geotechnical investigation, Phase 1 and 2, was undertaken by BRD Environmental in September 2016. Geotechnical Reports from the Desk-Study and Site Investigation is found in Appendix B.

The typical ground stratum at the site, as identified during the Site Investigation is described in Table 1. Geotechnical boreholes and trial pits were carried out at basement level and ground strata is identified in depth below basement level. Basement level is located approximately 3.0m below ground level.

Table 1- Ground strata identified in the BRD Geo-Environmental Site Investigation Ref: BRD2742-OR2-B

Stratum	Depth Range (mBBL)	Strength/Consistency
Made Ground	0.5m-1.0m below basement level	Slightly gravelly, slightly sandy clay or clayey sand
Lynch Hill Gravel	3.40m-3.80m bbl.	Medium dense to dense, very sandy gravel of fine to coarse,
London Clay	Between 28.80m and >29.00m bbl.	Generally recorded as very stiff, fissured, dark grey silty clay.

3.3 GROUNDWATER

The Site Investigation identified ground water in both boreholes at approximately 2.8m below basement level in the Lynch Hill Gravel Formation. In borehole BH01, resting water was also struck in the London Clay formation at approximately 8.17m below existing basement level.

The ground water levels were recorded in one single visit at 01. September 2016.

3.4 HYDROLOGY

There are no nearby waterbodies which effect the site. The nearest water bodies include Boating Lake found in Regents Park (1km) and the Regents Canal (1.62km) which runs North of the site. The site lies within a Flood Risk Zone 1 (low risk). The site lies between two sub terrain rivers; the River Tyburn; and the River Fleet. These sub terrain Rivers do not affect the site. The River Thames lies South of the site 2.5 km away.

3.5 HYDROLOGEOLOGY

The bedrock geology (London Clay Formation) is an aquiclude. An aquiclude is a geological formation that absorbs and holds water but does not allow transmission of water. It is classified by the Environment Agency as "unproductive strata".

The Superficial Deposits (Lynch Hill Gravel Member) have an ability to act as a perched aquifer. It is classified by the Environment Agency as a "Secondary A" whereby permeable layers are capable of supporting water supplies at a local rather a strategic scale. These can also form an important source of base flow to rivers.

3.6 EXISTING SURFACE WATER DRAINAGE

The existing drainage within the local vicinity of the site includes a combined sewer for both surface water and foul water.

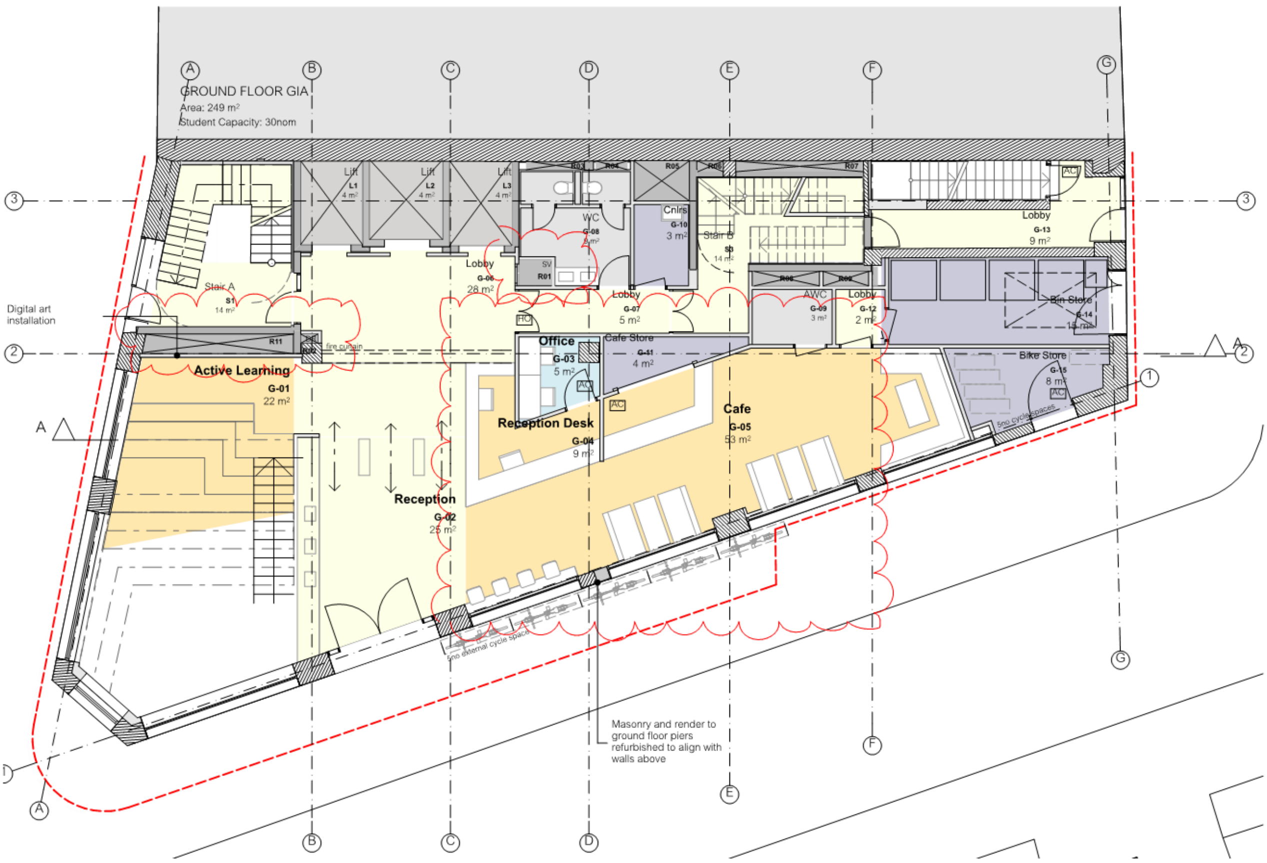


Figure 3: Layout of the proposed development Ground Floor.

4 DESIGN ASSUMPTIONS, CONSTRAINTS AND PARAMETERS

4.1 SPATIAL CONSTRAINTS

Onsite above ground drainage storage options such as swales, ponds and detention basins are not considered a viable solution due to spatial constraints inhibiting for open water features with sufficient capacity.

4.2 CLIMATE CHANGE EFFECTS

In accordance with the National Planning Policy Framework (NPPF) 2012, the effects of climate change are included within the assessment to reduce future flood risk. Following the recommended contingency allowances from the 19th February 2016, the following allowances should be made for the proposed development:

- **Peak Rainfall Intensity**: +40% (Upper End Allowance) for 2070 to 2115
- **Peak Rainfall Intensity**: +20% (Central Allowance) for 2070 to 2115

The new surface water drainage systems for the site will include SUDS and will be designed to accommodate increases in peak rainfall intensity.

4.3 ASSUMED IMPERMEABLE AREAS

The table below identifies the total area of the site and the respective surface areas belonging to hard and soft landscaping.

Table 2: Table of impermeable areas

		Existing Area (m^2)	Proposed Area (m^2)	Difference (m^2)
Hard Landscaping	Building Footprint	340	367	0
	External Hardstanding	0	0	0
	Total	**340**	**367**	**0**
Soft Landscaping	Total	**0**	**0**	**0**
Site Area	Total	**340**	**367**	**+27**

The Building footprint has not changed and governs the entire site. Part of the building does cantilever over the existing street but as the existing street is impermeable there is no change to the overall hardstanding area.

4.4 INFILTRATION RATES

Borehole investigations taken on site have identified that the site is underlain by made ground, which sits on London Clay. Due to the presence of London Clay and the fact the existing building footprint occupies the entire site, soakaways and other infiltration approaches are not likely to be appropriate or sustainable methods to drain surface water runoff from the site.

4.5 HYDROLOGICAL PARAMETERS

The drainage design has assumed the following hydrological parameters found in table 3.

Table 3: Hydrological Parameters

Hydrological Character	Parameter	Unit	Value
Rainfall Model			FSR Rainfall
Hydrological Region		-	6
M5-60		mm	20.700
Ratio	R	-	0.438
Summer Volumetric Run-off Coefficient	-	-	0.750
Winter Volumetric Run-off Coefficient	-	-	0.840

5 DRAINAGE DESIGN CRITERIA AND PRINCIPLES

5.1 EXISTING DRAINAGE

Figure 5 below shows the surrounding Thames Water Public sewers that serve the site. From the extract below it appears the site is served by a combined sewer.

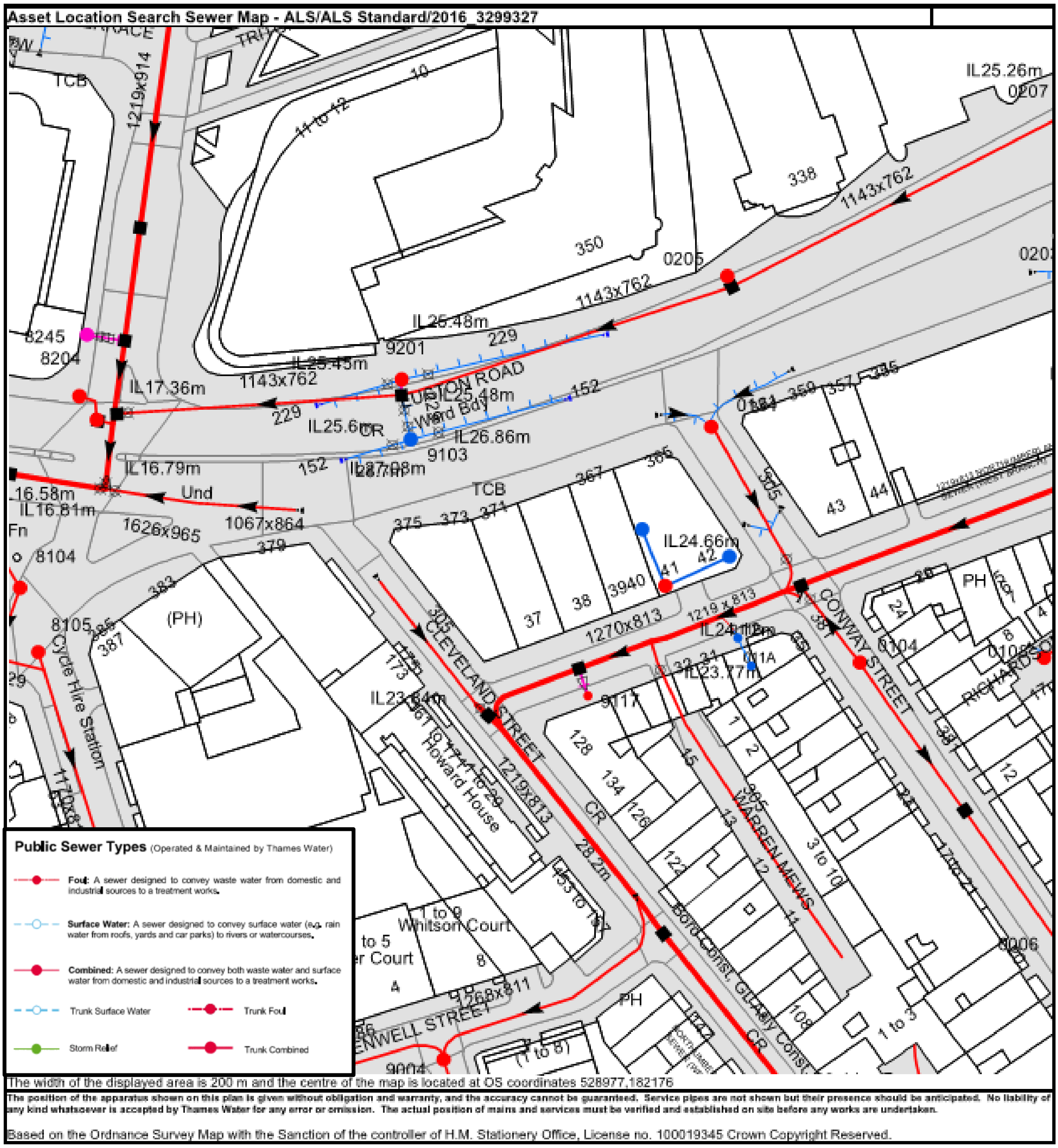


Figure 4: Thames Water Asset Search Map

The existing peak surface water flow draining into the Thames Water system has been calculated to be 20.9 l/s for the 100-year rainfall event plus 40% climate change.

5.2 PROPOSED DRAINAGE SYSTEM DESIGN

The proposed drainage system will provide separate foul and surface water systems that will confluence at the last manhole on-site within a demarcation chamber before entering the Thames Water Combined Sewer on Cleveland Street. This will allow ease to mutually exclude the surface water from the foul system if a separate surface water sewer was to be constructed by Thames Water within the vicinity of the site.

5.3 SURFACE WATER DESIGN

The surface water disposal system has been designed to ensure the drainage hierarchy has been implemented in the most practical and viable approach to benefit to the site; as per the SuDS Manual 2015. Furthermore, the design has considered the Non-Statutory Technical standards for sustainable drainage systems, and ensured these standards have been addressed.

Table 4: Discharge Rates

Return Period	Greenfield Runoff (l/s)	Existing Rates (l/s)	Proposed Unmitigated Rates (l/s)	Proposed Mitigated Rates (l/s)	Difference (l/s) (Proposed Mitigated – Existing)
Greenfield QBAR	0.14	N/A	N/A	N/A	N/A
1 in 1	0.12	4.7	4.9	4.9	0.2
1 in 30	0.32	11.5	12.2	12.2	0.7
1 in 100	0.44	15.0	15.8	15.8	0.8
1 in 100 plus Climate change (20%)	N/A	17.9	19.0	19.0	1.1
1 in 100 plus Climate change (40%)	N/A	20.9	22.2	22.2	1.3

As the existing site is currently all taken up by the building footprint and is 100% hardstanding and this is mainly a refurbishment of the existing building with a minor extension on the upper floors which cantilever over the public footpath (which is currently also all hardstanding).

As a result, there is no overall net increase in the surface water runoff being discharged into the public sewer because of this development. If one was to reduce the surface water runoff from the existing site it would result in having an attenuation tank below the basement slab (due to space constraints) which would result in the surface water discharge from the site needing to be pumped to reuse the existing drainage connection. This would add to the maintenance requirements and flood risk for the site.

As the only change to the external footprint of the building is the minor extension at the upper levels and the surface water discharge from the extension is due to be around 1l/s it is not possible to reduce the surface water runoff from this area. 1l/s is the minimum recommended flowrate for flow controls in the SuDS tool for maintenance and practical reasons

To mitigate the low risk of flooding drainage from the basement will be fitted with non-return valves to prevent any surcharge from the public sewer backing up into the building drainage.

An infiltration-based system has not been considered due to the sites geological restrains and spatial constraints. Surface water control bodies have not been considered due to the sites spatial limitations.

5.4 FOUL WATER DESIGN

It is proposed that the new foul drainage connects to the existing Thames Water combined sewer. The foul water system will provide for educational and office premises of Birbeck College. The foul system will require a pump chamber due to the depth of the double basement for the development and the positioning of the Thames Water combined sewer.

The waste water flow rate has been calculated using the Discharge Unit (DU) Method for both the existing site and the proposed development. The equation is as follow:

$$Q_{ww} = K\sqrt{\sum DU}$$

Q_{ww} = Waste Water flow rate (l/s)

K = Frequency Factor

$\sum DU$ = Sum of discharge units

A frequency factor (K) of 0.7 has been used to represent appliances in frequent use in places such as hospitals, schools, restaurants and hotels. Birkbeck College is an Academic Institution and therefore best fits under the "School" category.

	Existing	**Proposed**
Discharge Units (DU)	38	44.6
Waste Water Flow Rate (Q_{ww}) (l/s)	4.31	4.67

The results show that the Waste Water Flow Rate increases very slightly however the increase less than a 10% increase in the flow rate.

6 MAINTENANCE

The drainage system will be designed to minimise maintenance requirements; however, a full maintenance scheme will be established for those elements not being offered for adoption. The private storm and foul drains, attenuation tank and pump chamber will be maintained by Birkbeck College Cambridge house Ltd. to the manufacturer's recommendations as part of their property maintenance programme. The downstream public sewer will be maintained by Thames Water as part of their maintenance works.

6.1 BELOW GROUND DRAINAGE PIPED SYSTEMS

The below ground piped system (based on assessed flood risk) should be inspected every 10 years as a minimum and repaired and cleansed where necessary.

6.2 GULLIES AND CHANNEL DRAINS

Gullies and channel drains should be cleaned out very six months or when required.

7 DESIGN STANDARDS AND REFERENCES

The works are to be designed to the requirements of the following British Standards and documents:

- BS EN 752:2008 Drain and Sewer Systems Outside Buildings
- The Wallingford Procedure: Design and Analysis of Urban Storm Drainage
- Building Regulations 2010 Part H: Drainage and Waste Disposal.
- CIRIA Report C697: The SUDS Manual
- National Planning Policy Framework
- Volume 7 of Design Manual for Roads and Bridges.
- BS EN 1997 Eurocode 7- Geotechnical Design of Structures
- Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems April 2015.

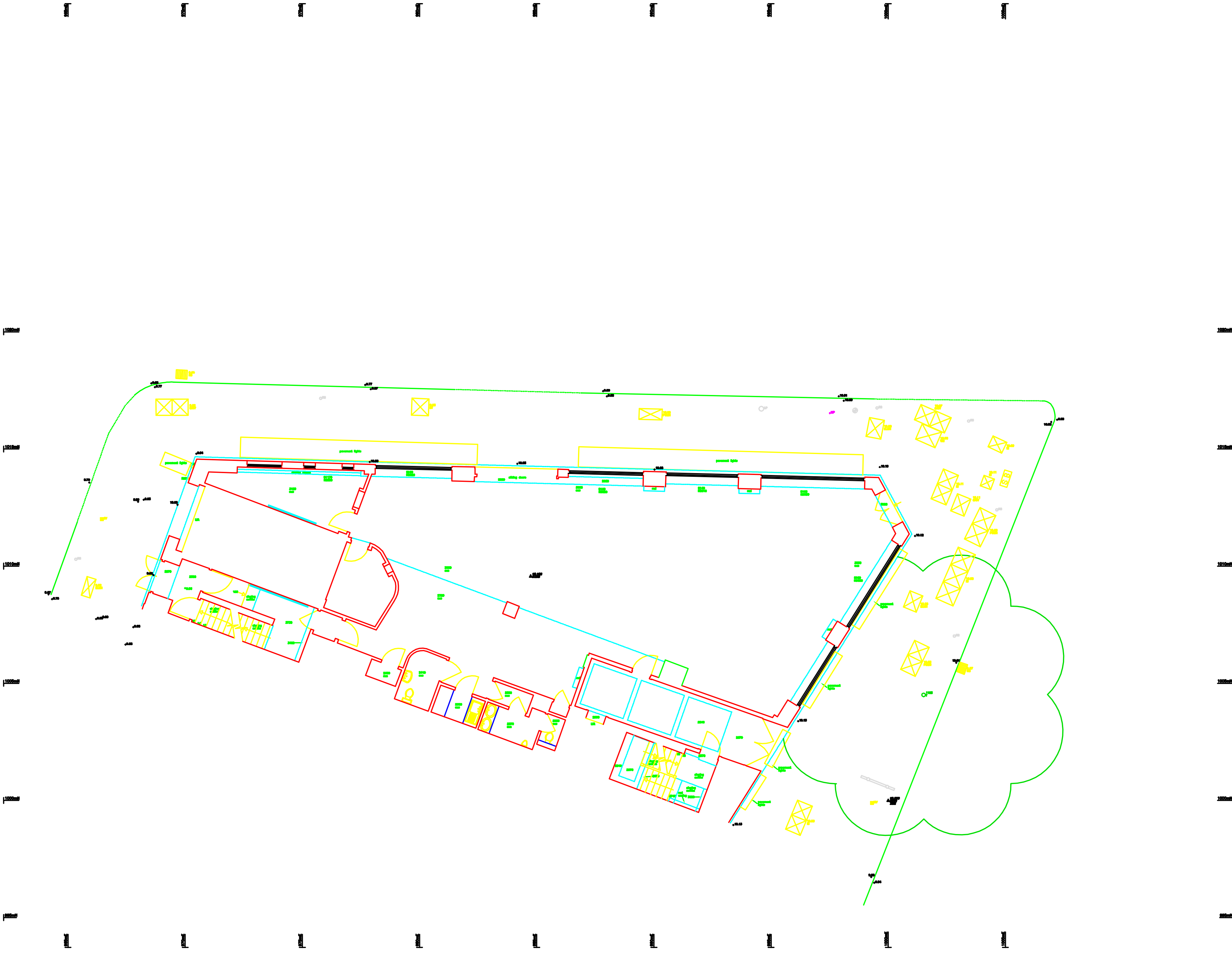
8 CONCULSION

To conclude the designed proposal is for a separated surface water and foul system that confluences at the ultimate manhole on site before entering the Thames Water combined sewer found on Cleveland Street.

As this is mainly a refurbishment of an existing building with a minor extension of 27metres squared at the upper levels it is not practical to reduce the runoff from the extension to 50% of the existing as this is already at the minimum recommended flowrate of 1l/s (as recommended on the SuDS tool).

To mitigate the low risk of flooding drainage from the basement will be fitted with non-return valves to prevent any surcharge from the public sewer backing up into the building drainage. There will also be a building maintenance schedule put in place for the below ground drainage system. Surrounding proposed ground levels will also be made to slope away from the building to prevent surface water flows entering the building due to the the unlikely event of the drainage system failing.

9 APPENDIX A: EXISTING TOPOGRAPHIC SURVEY



NOTES

All dimensions are to be checked on site by the contractor before any work is commenced.
In the case of apparent discrepancy refer immediately to surveyors.
The accuracy and completeness of this survey is dependent on the original survey brief including the scale intended.
The type and extent of information and the survey accuracy will have been matched to the client's original requirements.
Twickenham Surveys accepts no responsibility or liability to later users without prior consent.
The detail of this survey was established for a brief requiring a 1:50 plot. It is therefore suitable for plotting or planning/designing at scales of 1:50 or smaller.
The survey grid is not related to Ordnance Survey National Grid.
Level positions are indicated by a cross.
Levels relate to TBM 10.00m STN1 nailhead as shown on this plan.
This survey did not include locating underground services and equipment.
Tree girths are representative only and reference should be made to the tree schedule if included in the survey brief.
Levels are taken on b/s kerb unless otherwise indicated.
Window cill and head heights indicate t/s window board and u/s soffite measured internally.

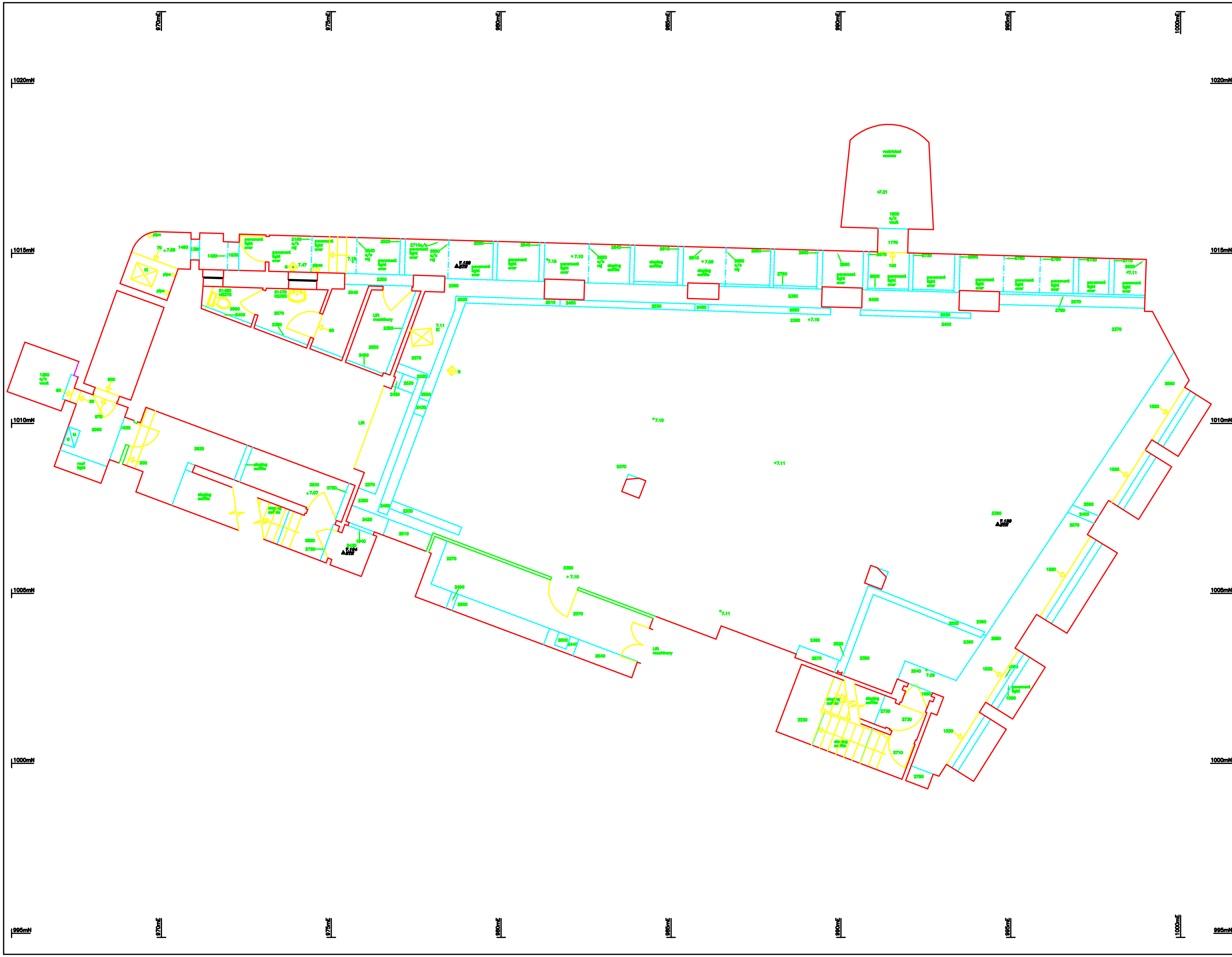
INDICATIVE

GROUND FLOOR PLAN

CAMBRIDGE HOUSE
373-375 EUSTON ROAD
LONDON NW1

Drawing No. : 1357G
Scale : refer grid
Date : May 2013
Drawn by : ACF
Checked by : NHS

TWICKENHAM SURVEYS
LAND AND BUILDING SURVEYORS
CENTRAL HOUSE
124 HIGH STREET
HAMPTON HILL
MIDDLESEX TW12 1NS
T-020 8614 4480 F-020 8977 6579
mail@twickenhamsurveys.co.uk
www.twickenhamsurveys.co.uk



NOTES

All dimensions are to be checked on site by the contractor before any work is commenced.
In the case of apparent discrepancy refer immediately to surveyors.
The accuracy and completeness of this survey is dependent on the original survey brief including the scale intended.
The type and extent of information and the survey accuracy will have been matched to the client's original requirements.
Twickenham Surveys accepts no responsibility or liability to later users without prior consent.
The detail of this survey was established for a brief requiring a 1:50 plot. It is therefore suitable for plotting or planning/designing at scales of 1:50 or smaller.
The survey grid is not related to Ordnance Survey National Grid.
Level positions are indicated by a cross.
Levels relate to TBM 10.00m STN1 nailhead as shown on ground floor plan.
This survey did not include locating underground services and equipment.
Tree girths are representative only and reference should be made to the tree schedule if included in the survey brief.
Levels are taken on b/s kerb unless otherwise indicated.
Window cill and head heights indicate t/s window board and u/s soffite measured internally.

INDICATIVE

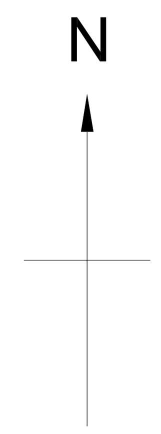
BASEMENT PLAN

CAMBRIDGE HOUSE
373-375 EUSTON ROAD
LONDON NW1

Drawing No.	:	13578
Scale	:	refer grid
Date	:	May 2013
Drawn by	:	ACF
Checked by	:	XX

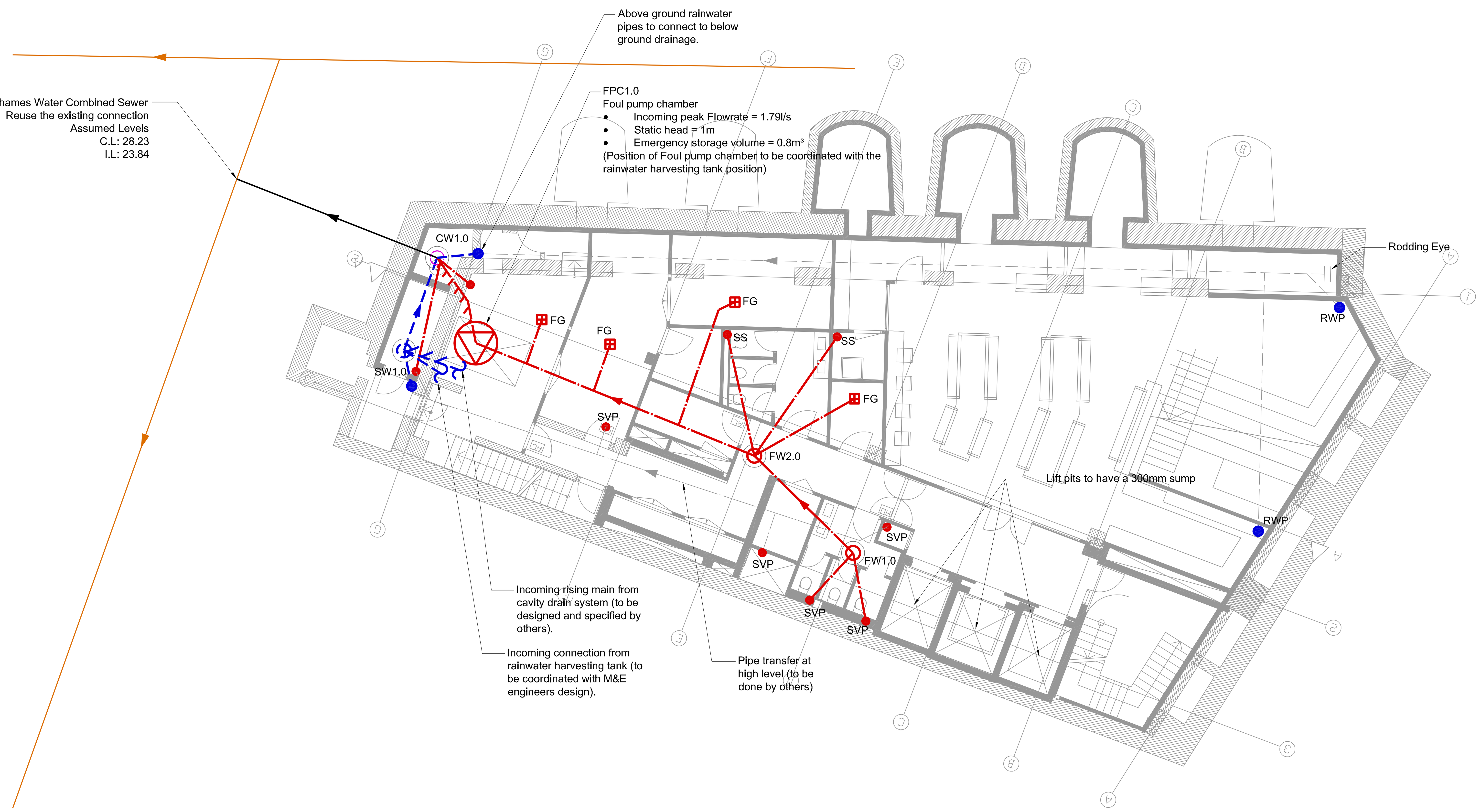
TWICKENHAM SURVEYS
LAND AND BUILDING SURVEYORS
CENTRAL HOUSE
124 HIGH STREET
HAMPTON HILL
MIDDLESEX TW12 1NS
T-020 8614 4480 F-020 8977 6579
mail@twickenhamsurveys.co.uk
www.twickenhamsurveys.co.uk

10 APPENDIX B –CIVIL DRAINAGE DRAWING



DRAINAGE KEY

- Proposed Surface Water Drain
- Proposed Foul Drain
- Proposed Above Ground Surface Water Drain (to be designed by others)
- Proposed Above Ground Foul Drain (to be designed by others)
- Proposed Combined Drain
- Existing Combined Drain
- S#.# F#.# Proposed Manhole Surface Water / Foul
- FPC#.# Proposed Pumping Chamber Surface Water / Foul
- RWP Proposed Rainwater Pipe (With Roddable access)
- SVP Proposed Soil Vent Pipe (With Roddable Access)
- FG Proposed Foul Gully
- Proposed Pressurised Main



IMPORTANT NOTE: IT IS ASSUMED THE REMAINDER OF THE RAINWATER PIPES ARE PICKED UP ABOVE GROUND AND CONNECTED TO THE RAINWATER HARVESTING TANK. PLEASE REFER TO M&E ENGINEERS DRAWINGS FOR MORE DETAILS.

IMPORTANT NOTE: ALLOWANCES TO BE MADE FOR A CAVITY DRAIN SYSTEM (TO BE DESIGNED BY OTHERS).

IMPORTANT NOTE: ARCHITECT TO CONFIRM POSITION OF RAINWATER PIPES, CHANNELS AND GULLIES.

IMPORTANT NOTE: DRAINAGE SCHEME IS SUBJECT TO CONFIRMATION THAT THE EXISTING SYSTEM AT THE POSITION OF THE PROPOSED CONNECTION IS FUNCTIONAL.

IMPORTANT H&S NOTE: BURIED SERVICES - REFER TO SURVEYS & STATS DRAWINGS FOR DETAILS. ALWAYS FOLLOW GOOD PRACTICE TO AVOID STRIKING BURIED SERVICES.

Notes

1. Do not scale the drawing
2. All dimensions are in millimetres unless noted otherwise
3. Any discrepancies between structural and architectural setting out dimensions must be brought to the attention of the Architect and Engineers
4. This drawing is to be read in conjunction with the drainage details and other relevant Architects and Engineers drawings and specifications.
5. Design and setting out of above ground drainage by Architect/M&E engineer. All soil pipes, rainwater downpipes, channels and gullies are shown indicatively.
6. Any part of the existing drainage system retained as part of the new scheme shall be cleaned and inspected. Any defects shall be reported to the Engineer.
7. Existing drainage connectivity & condition to be confirmed by Contractor. Before starting work, check invert levels & positions of existing drains, sewers, inspection chambers & manholes against drawings. Report discrepancies.
8. Any drains proposed to be removed, the Contractor is to confirm the drain is no longer live prior to removal/capping.
9. Existing drainage to be removed is to be broken out to bed level and void backfilled with granular material, compacted in layers not exceeding 250mm.
10. Private foul water and surface water drainage is to be constructed in accordance with the building regulations part H (2002), BS EN 12056-2:2002 (inside buildings), BS EN 752:2008 (outside buildings) and all relevant agreement certificates.
11. Any Statutory Authority (eg Section 106 Water Industry Act) connection approvals or new drain adoption approvals to be undertaken by Client / Contractor.
12. Relevant drains to be built to adoptable standard as per "Sewers for Adoption, 7th Edition".
13. Drain connections to be soffit to soffit unless noted otherwise.
14. UNO Gravity drains up to and including DN300 are to be constructed using flexibly jointed vitrified clay pipes to BS EN 295-1:1995 (Hepworth "Supersleve" or similar approved), drains bedded and back filled in accordance with the manufacturer's instructions. all tested in accordance with BS EN 1610:1998.
15. UNO Gravity drains over DN300 jointed concrete pipes to BS EN 5911-1:2002 & BS EN 1916:2002 (Stanton-Bonna Integrated Gasket or similar approved), drains bedded and back filled in accordance with the manufacturer's instructions. all tested in accordance with BS EN 1610:1998.
16. Where drains run at shallow depths under basements and foundations, allow for Cast Iron pipes to BS EN 877 (Saint-Gobain "Timesaver" or similar approved).
17. All Foul Drains are DN100mm at 1:40 gradient UNO.
18. All Storm Drains are DN100mm at 1:100 gradient UNO.
19. Pipes with cover less than 1200mm under paved areas and 900mm under soft areas to be laid with concrete surround (Class Z or similar).
20. Concrete surround to pipes below slab to be monolithic with slab, allow for nominal re-bar to be cast into surround and tie into slab. Double-rocker detail required at all interfaces.
21. All pipes passing through foundations to be fitted with double rocker pipe connections on each side and/or sleeved through ground beams/walls subject to confirmation with structural engineer.
22. Surface water from private areas is not to be discharged onto public highway.
23. All internal manhole covers and rodding eyes shall be of 'double-seal' type. All external foul drainage manholes shall have double seal covers and all storm drainage manholes shall have single seal cover as a minimum.
24. Manhole covers and frames shall be BS EN 124 and shall be Kitemarked. Covers and frames shall be heavy duty C250 in carriageways and vehicular areas and medium duty B125 in footways and soft landscaping. In blocked/concrete paved areas covers shall be recessed fabricated steel. All recessed covers shall be in accordance with the FACTA association gradings and shall match the Architects finishes.
25. Cover levels are to be adjusted locally to suit finished ground levels.
26. Access panels are to be provided to all rainwater pipes, max 600 above finished ground level.
27. All drains to be tested before backfilling the trench and again after back filling - this may need to be witnessed by the local building control officer - contractor to confirm. Contractor to agree preferred method of testing (Water or Air test) with building control/engineer.
28. HEALTH AND SAFETY: The works shall be carried out by specialist competent and experienced contractors who are members of a recognised national organisation. Operatives shall have received full and appropriate training for the operations they are to undertake. All work shall be carried out in accordance with all pertinent Health and Safety Regulations.
29. HEALTH AND SAFETY: Care should be taken to locate services prior to any excavation.

Rev	Date	Description	Drn	App
01	15.12.17	Issued for Stage 3	GP-D	GP-D
00	06.12.17	Issued for comments	GP-D	GP-D

WEBB YATES ENGINEERS
48-50 Scrutton Street
London EC2A 4HH
020 3696 1550
www.webbyates.co.uk
info@webbyates.co.uk

Project
Cambridge House

Drawing Title
Below Ground Drainage Layout

Drawing Status
Detailed Design

Drawn by	Checked by	Sheet size	Scale	REV
MJ	GP-D	A1	1:50	S3

Drawing Number	Revision
J2740-C-100	01

11 APPENDIX C –SUPPORTING CALCULATIONS

Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Guy Parker-Dennison
Site name:	Cambridge House
Site location:	Euston

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude:	51.52348° N
Longitude:	0.14215° W
Reference:	6195390
Date:	2017-12-06T12:40:39

Methodology	IH124

Site characteristics

Total site area (ha)	0.1

Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	4	4
HOST class	---	---
SPR/SPRHOST	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm)	619	619
Hydrological region	6	6
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 30 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Notes:

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

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

Where flow rates are less than 5.0 l/s consents are usually set at 5.0l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is SPR/SPRHOST ≤ 0.3?

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	0.42	0.42
1 in 1 year (l/s)	0.36	0.36
1 in 30 years (l/s)	0.96	0.96
1 in 100 years (l/s)	1.33	1.33

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)	5	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.700	Minimum Backdrop Height (m)	0.200
Ratio R	0.438	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.034	0.034	0.034
1.001	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.034	0.034	0.034

1 year Return Period Summary of Critical Results by Maximum Outflow (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 Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.438
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.700 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)
1.000	1	15 Winter	1	+0%					99.048
1.001	2	15 Winter	1	+0%					98.335

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.177	0.000	0.10		4.9	OK	
1.001	2	-0.178	0.000	0.09		4.7	OK	

30 year Return Period Summary of Critical Results by Maximum Outflow (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 Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.438
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.700	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)
1.000	1	15 Winter	30	+0%					99.076
1.001	2	15 Winter	30	+0%					98.362

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.149	0.000	0.24		12.0	OK	
1.001	2	-0.151	0.000	0.23		11.5	OK	

100 year Return Period Summary of Critical Results by Maximum Outflow (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 Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.438
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.700	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)
1.000	1	15 Winter	100	+0%					99.088
1.001	2	15 Winter	100	+0%					98.373

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.137	0.000	0.31		15.6	OK	
1.001	2	-0.140	0.000	0.30		15.0	OK	

Summary of Critical Results by Maximum Outflow (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 Storage Structures 0
Number of Online Controls 0
Number of Time/Area Diagrams 0
Number of Offline Controls 0
Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR
Ratio R 0.438
Region England and Wales
Cv (Summer) 0.750
M5-60 (mm) 20.700
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) 100
Climate Change (%) 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+20%					99.097
1.001	2	15 Winter	100	+20%					98.382

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.128	0.000	0.37		18.7	OK	
1.001	2	-0.131	0.000	0.35		17.9	OK	

Summary of Critical Results by Maximum Outflow (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 Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.438
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.700	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)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+40%					99.106
1.001	2	15 Winter	100	+40%					98.391

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.119	0.000	0.43		21.8	OK	
1.001	2	-0.122	0.000	0.41		20.9	OK	

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)	5	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.700	Minimum Backdrop Height (m)	0.200
Ratio R	0.438	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.036	0.036	0.036
1.001	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.036	0.036	0.036

1 year Return Period Summary of Critical Results by Maximum Outflow (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 Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.438
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.700 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)
1.000	1	15 Winter	1	+0%					99.049
1.001	2	15 Winter	1	+0%					98.336

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.176	0.000	0.10		5.2	OK	
1.001	2	-0.177	0.000	0.10		4.9	OK	

30 year Return Period Summary of Critical Results by Maximum Outflow (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 Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.438
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.700	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)
1.000	1	15 Winter	30	+0%					99.078
1.001	2	15 Winter	30	+0%					98.364

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.147	0.000	0.25		12.7	OK	
1.001	2	-0.149	0.000	0.24		12.2	OK	

100 year Return Period Summary of Critical Results by Maximum Outflow (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 Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.438
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.700	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)
1.000	1	15 Winter	100	+0%					99.091
1.001	2	15 Winter	100	+0%					98.376

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.134	0.000	0.33		16.5	OK	
1.001	2	-0.137	0.000	0.31		15.8	OK	

100 year Return Period Summary of Critical Results by Maximum Outflow (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 Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.438
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.700	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)	100
Climate Change (%)	20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+20%					99.100
1.001	2	15 Winter	100	+20%					98.385

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.125	0.000	0.39		19.8	OK	
1.001	2	-0.128	0.000	0.38		19.0	OK	

Summary of Critical Results by Maximum Outflow (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 Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.438
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status ON
Inertia Status ON

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+40%					99.110
1.001	2	15 Winter	100	+40%					98.394

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.115	0.000	0.46		23.1	OK	
1.001	2	-0.119	0.000	0.44		22.2	OK	