Davies Maguire

Castlewood House

15-21

Drainage Strategy Report

DMAG-1521-DSR

November 2019

Produced for Royal London Asset Management

20 Flaxman Terrace
London
WC1H 9AT

T +44 (0)20 7388 9406
E info@dmag.com
W dmag.com

Davies Maguire

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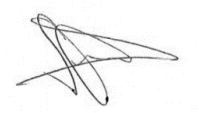
P01	25/08/16	Draft Issued for Comment	DMAG-1521-SDR-P01
P02	12/10/16	Issued for Planning	DMAG-1521-SDR-P02
P03	12/01/17	Updated Issue for Planning	DMAG-1521-SDR-P03
P04	17/01/17	Updated with comments	DMAG-1521-SDR-P04
P05	30/01/17	Final Planning Issue	DMAG-1521-SDR-P05
P06	29/11/19	Updated Issue for Planning Conditions Discharge	DMAG-1521-SDR-P06

QUALITY CONTROL:

Prepared by:



Sonia Cobo
Senior Civil Engineer

Approved by:

Benjamin Torrance
Associate Director

1 Executive Summary

The project comprises part of the redevelopment of the existing commercial properties on the Castlewood House and Medius House sites at numbers 77-91 and 63-69 New Oxford Street respectively. These are to be replaced with mixed use buildings providing predominantly commercial floor space in Castlewood House and residential accommodation in Medius House.

The site drainage for Castlewood House discharge into existing combined adopted sewers run adjacent to the site along Bucknall Street and Earnshaw Street, while the existing drainage for Medius House is discharging into the combined public sewer along New Oxford Street.

Existing peak drainage discharge rates have been calculated based upon established methods and the calculations are appended to this report. Due to site constraints, surface water discharge rates have been based upon a minimum 50% reduction of existing flow rates. This will be achieved through the provision of Sustainable Drainage Systems as discussed within this report.

2 Introduction

2.1 Existing Site Context

The main portion of the existing site comprises Castlewood House, which occupies 77-91 New Oxford Street, represents a post-war building comprising nine stories of commercial offices with a rooftop plant room and two stories of basement housing office space and plant rooms.

The existing building on the eastern part of the site, Medius House, which occupies 63-69 New Oxford Street, is a six-storey building plus basement with a retail ground floor and commercial offices above to level 6.

The building between Castlewood House and Medius House at 73-75 New Oxford Street is occupied by the Toni & Guy hairdressing business and comprises a four-storey Edwardian building with a highly decorative façade of stone and brickwork.

There are premises to the rear referenced the Bucknall Street Warehouses that occupies 12 Dyott Street and 2-4 Bucknall Street. These are mainly brick buildings dating from the 19th century.

The Castlewood House element of the site is proposed for redevelopment into Grade A commercial office space with new retail premises at ground floor/grade level and two stories of basement.

Requirements for inclusion of a residential element, as required in increased GEA is to be accommodated within the eastern element of the site through a conversion and extension of Medius House.

The site is located at National Grid reference 181400N-529950E and occupies an overall area of 0.30ha.

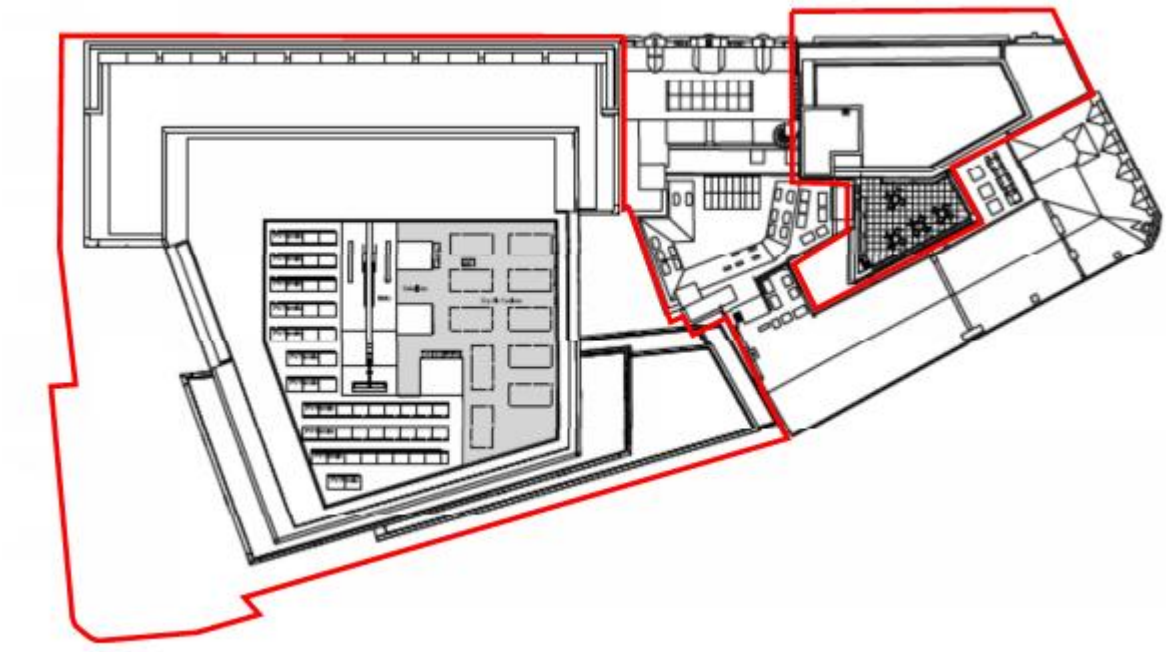


Figure 1: Site Plan

2.2 Existing Drainage Consideration

The existing foul and surface water drainage from the development site is assumed to discharge into below ground combined public sewers beneath Bucknall Street and Earnshaw Street; this assumption is based on the Thames Water asset records (Appendix A) for the area and a preliminary CCTV survey.

The existing peak surface water discharge rate into the public sewer from the site has been calculated based on Wallingford procedure "Modified Rational Method" using FSR Rainfall Data (Appendix B):

- The Castlewood House development site (Area = 0.260ha).
- The Medius House development site (Area = 0.044ha).

Table 1 - Existing Peak Surface Water Discharge Rate – Castlewood House

Storm Event	$Q_{1\ year}$	$Q_{30\ year}$	$Q_{100\ year}$
Discharge Rates (L/s)	21.83	53.61	89.99

- *without Climate Change*
- *hardstanding area of 3,830m² with peak runoff rates calculated for M5-15*

Table 2 - Existing Peak Surface Water Discharge Rate – Medius House

Storm Event	$Q_{1\ year}$	$Q_{30\ year}$	$Q_{100\ year}$
Discharge Rates (L/s)	3.7	9.07	15.23

- *without Climate Change*
- *hardstanding area of 430m² with peak runoff rates calculated for M5-15*

3 Design Standards and Criteria

It is proposed that all below ground surface and foul water drainage from the site is to be collected within separate networks. Self-cleansing velocity in the foul and surface water drainage networks will be achieved in all instances and flows will be kept above 0.75m/s and 1m/s respectively within the pipelines to ensure that self-cleansing velocities are achieved.

The development will be drained by dedicated and fully segregated surface and foul water systems designed in accordance with the following documents (where appropriate):

- Building Regulations - Approved document H
- BS EN 12056: Parts 1-5: Gravity Drainage Systems Inside Buildings
- BS EN 752: Drain and Sewer Systems outside buildings
- Sustainable Drainage Systems - Design manual for England and Wales (CIRIA)
- Sewers for Adoption - 7th edition
- BS 8000-14: Workmanship on Building Sites: Code of Practice For Below Ground Drainage
- The Local Authorities guidelines, rules and regulations (such as London Plan 2016)

To give a long design life, with minimum embodied energy, the buried pipe work will generally be vitrified clay where possible and cast iron when laid below or casting within or through new building foundations or the buildings structure.

Chambers will generally be either polypropylene inspection chambers (if less than 1.2m to invert) or pre-cast concrete manholes (deeper than 1.2m to invert and in vehicle access areas), this is subject to availability of space for safe means of access.

Foul drains will generally be DN150 in order to minimise the risk of blockage while connections from appliances and stacks will generally be DN100 in order to maintain self-cleansing flows.

It is envisaged that surface water related 4 credits will be targeted to achieve suitable BREEAM rating. This will be confirmed by BREEAM consultant.

4 Existing Site Constraints with Public Sewers

The use of infiltration systems is not viable due to the presence of shallow London Clay strata beds. Additionally, according to Building Regulations any infiltration techniques, such as the use of soakaways, will need to be minimum 5m away from any structure and road. These limitations lead to the requirement for a positive discharge of surface water into off-site surface water sewerage systems.

4.1 Castlewood House

The existing sewerage connections into the public sewers will be retained and utilised where possible. However, based on current records, the connection to Earnshaw Street will be clashing with proposed foundations, and therefore, it won't be able to be retained. The exact location of this connection should be confirmed on site.

If a new connection to the combined public sewer along Earnshaw Street is required it will have to cross existing buried services along the footpath so additional surveys may be required to confirm the location of these services to avoid clashes with the new sewer connection.

It is proposed to maintain and re-use the existing connection to the public sewer along Bucknall Street.

4.2 Medius House

It is proposed to maintain the existing connection into the combined public sewer along New Oxford Street. The existing pipe will be upgraded from a 100mm diameter to 150mm with bursting techniques to avoid a new connection to the public sewer along New Oxford Street.

This proposal has been based on a CCTV survey, and the exact level of this existing connection will be confirmed at demolition.

5 Proposed Drainage

5.1 Surface Water Drainage

The proposed surface water drainage strategy is based on an assumption of targeted minimum 50% net reduction in the peak discharge rate. This strategy has been accepted and planning permission has been granted by London Borough of Camden.

The peak discharge rate from the proposed development for 1 in 100 year return period will include a climate change allowance in accordance with the Environment Agency guidelines. Depending on the design life of the development 20% or 40% additional allowance in the rainfall intensity is required in the design. As a conservative approach, 40% allowance due to climate change has been considered in the design.

To achieve this surface water runoff rate, Sustainable Drainage Systems (SuDS) will be required.

5.1.1 Castlewood House

There are two proposed surface water connections to the public sewer. The main connection to Earnshaw Street will be restricted to 32.6l/s. Based on the proposed scheme, to achieve this surface

water runoff rate, an attenuation tank will be installed at B1 basement level to achieve a gravity discharge into Thames Water network.

The second connection to Bucknall Street is only draining hard-landscaping areas and it will be restricted to 2l/s. Due to the small catchment area, no attenuation volume is required to achieve this runoff rate.

A flow control device, orifice plate or hydro-brake, will be incorporated at each surface water outlet to restrict the proposed discharge rate as appropriate.

Refer to below table for the proposed surface water flow rates (Appendix C).

Table 3 - Proposed Peak Surface Water Discharge Rates - Castlewood House

Storm Event	$Q_{1\ year}$	$Q_{30\ year}$	$Q_{100\ year}$
Discharge Rates (l/s)	21.8	53.6	69.2
50% REDUCTION (l/s)=	10.9	26.8	34.6
Quick Storage Estimate (m^3) =			76

5.1.2 Medius House

Medius House will have an attenuation tank at basement level to restrict flow rates to a maximum of 5.85l/s. Then, the restricted surface water network will discharge into Thames Water public sewer along New Oxford Street via an existing connection.

Refer to below table for the proposed surface water flow rates (Appendix D).

Table 4 - Proposed Peak Surface Water Discharge Rates - Medius House

Storm Event	$Q_{1\ year}$	$Q_{30\ year}$	$Q_{100\ year}$
Discharge Rates (l/s)	3.7	9.1	11.7
50% REDUCTION (l/s)=	1.85	4.55	5.85
Quick Storage Estimate (m^3) =			15

Proposed connection to Thames Water public sewer will be via a demarcation manhole and outfall systems located within the site boundary. Proposed connection applications into existing public sewers will be made to Thames Water under a Section 106 application of the Water Industry Act 1991.

5.2 SuDS Analysis

Surface water drainage systems has been developed in line with sustainable development collectively referred to as Sustainable Drainage Systems (SuDS). The objective of SuDS is to minimise the impact of the development on the quantity and quality of site runoff and maximise amenity and biodiversity opportunities.

5.2.1 Castlewood House

It has been calculated that the proposed attenuation system will require 76m^3 of storage, designed to contain a 1 in 100 year storm event (incl. 40% allowance for climate change) without causing any flooding on site.

The total impermeable area of the new-build Castlewood House is identified as being 0.260ha. The hydraulic modelling criteria used for the purpose of the initial hydraulic modelling and drainage design is as follows:

- FSR Rainfall Data
- M5-60(mm) – 20.5
- Ratio R – 0.435
- Climate Change (+40%) for 1 in 100 year return period
- Impermeable area: 0.260ha
- Maximum Allowable Discharge- 34.6 l/s

The attenuation volume is based on the proposed hardstanding area being drained at a minimum targeted 50% reduction of existing flow rate. Green roof areas and soft landscaping areas at ground level will be provided to improve biodiversity and amenity. However, these small areas won't be able to achieve the required attenuation volume. Therefore, an above ground attenuation tank will be installed at the upper basement level to achieve the required flow restriction.

The proposed SuDS solutions have been incorporated in the proposed drainage layout and architectural drawings (Appendix E).

5.2.2 Medius House

It has been calculated that the proposed attenuation system will require 15m^3 of storage designed to contain a 1 in 100 year storm event (incl. 40% allowance for climate change) without causing any flooding on site.

The total impermeable area of the new-build Medius House site is identified as being 0.044ha. The hydraulic modelling criteria used for the purpose of the initial hydraulic modelling and drainage design is as follows:

- FSR Rainfall Data
- M5-60(mm) – 20.7
- Ratio R – 0.437
- Climate Change (+40%) for 1 in 100 year return period
- Impermeable area: 0.044ha
- Maximum Allowable Discharge- 5.85 l/s

The attenuation volume of 15m^3 is based on the proposed roofs/hardstanding area being drained at a minimum targeted 50% reduction of existing flow rate. The storage volume will be provided within an above ground attenuation tank at basement level. Similarly to Castlewood House, green roof areas have been proposed to improve the sustainability of the project, however they are not suffice to achieve the required attenuation volume.

The proposed SuDS solutions have been incorporated in the proposed drainage layout and architectural drawings (Appendix F).

5.3 Foul Water Drainage

5.3.1 Castlewood House

The foul water drainage strategy is based on the unrestricted discharge rate from the development into existing Thames Water sewer assumed to be beneath Bucknall Street and Earnshaw Street.

The majority of the site will be discharging into the public sewer via gravity. However, where gravity connections are not viable package pumping stations will be required. As per Building Regulations, a 24h emergency storage volume within each pump needs to be provided in case of pump failure.

A separate cavity drainage system will be required at upper and lower basement level as a secondary form of waterproofing after the primary waterproof concrete slab and walls of the basement box. This system will be specified by a specialist and it is currently shown indicative only in Davies Maguire drawings.

5.3.2 Medius House

The foul water drainage strategy will discharge unrestricted from the development into existing Thames Water sewer along New Oxford Street.

All drainage will discharge by gravity into the sewer. It is proposed to reuse the existing sewer connection from basement level. A CCTV survey is required to confirm if existing levels work with the current proposal. If it is not possible to maintain this connection, a new direct connection into the public sewer will be required.

A separate cavity drainage system will be required at basement level as a form of waterproofing. This system will be specified by a specialist and it is currently shown indicative only in Davies Maguire drawings.

5.4 External Landscape Drainage

Where external public realm surface water drainage is required, gullies and linear slot-type channel drains will be provided. All drainage gullies and channel drains will comprise suitable silt traps and sumps to collect rainwater debris and prevent blockage of drainage pipelines. The discharge from these channels will be taken in to the common site surface water drainage network at high level basement and conveyed under gravity to the sewerage outfall systems.

Any works outside the project boundary within the public area will require a Section 278 Works application with the local authority.

6 SuDS Maintenance Manual

Maintenance regimes should be regularly assessed to make sure that the approach is still meeting the drainage, landscape and any other objectives. This may result in changes to the maintenance of a feature or area.

The function of the surface water management system should be understood by those responsible for maintenance.

Any proprietary system should be maintained as per the manufacturer's specifications.

6.1 Green Roof

Intensive green roofs are likely to require regular inspection and maintenance. Grassed areas may require mowing weekly or fortnightly, plant beds may require weeding on a weekly or fortnightly basis during the growing season, and wildflower meadows may require annual mowing with the cuttings removed.

Extensive green roofs should normally only require biannual or annual visits to remove litter, check fire breaks and drains and, in some cases, remove unwanted invasive plants. The most maintenance is generally required during the establishment stage (12 to 15 months), and this should usually be made the responsibility of the green roof provider. Maintenance contractors with specialist training in green roof care should be used, where possible.

Maintenance schedule	Required Action	Typical Frequency
Regular inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of water proofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify and sediment sources	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance of roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (ie year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
	Post establishment, replace dead plants as required (where>5%ofcoverage)	Annually (in autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly or as required

Remedial Actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

6.2 Attenuation Tank

The attenuation tank needs to be regularly inspected and maintained to make sure that long-term operation is effective. The table below gives some guidance on the types of maintenance that might be appropriate and a suggested frequency. Specific needs of the tank used should be adhered to and the schedule proposed below should be adjusted accordingly.

Maintenance schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risk to performance)	Monthly
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial Actions	Repair/rehabilitate inlets, outlets, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

6.3 Pipework and Catchpits

The pipes and the catchpits need to be checked regularly as well. This will need to be done to avoid any debris build-up. Specifications should be consulted to determine what maintenance needs to be conducted and how often this should be done.

7 Conclusions

It is proposed that the below ground drainage of the Castlewood House development will discharge into the existing Thames Water combined sewer beneath Bucknall Street and Earnshaw Street.

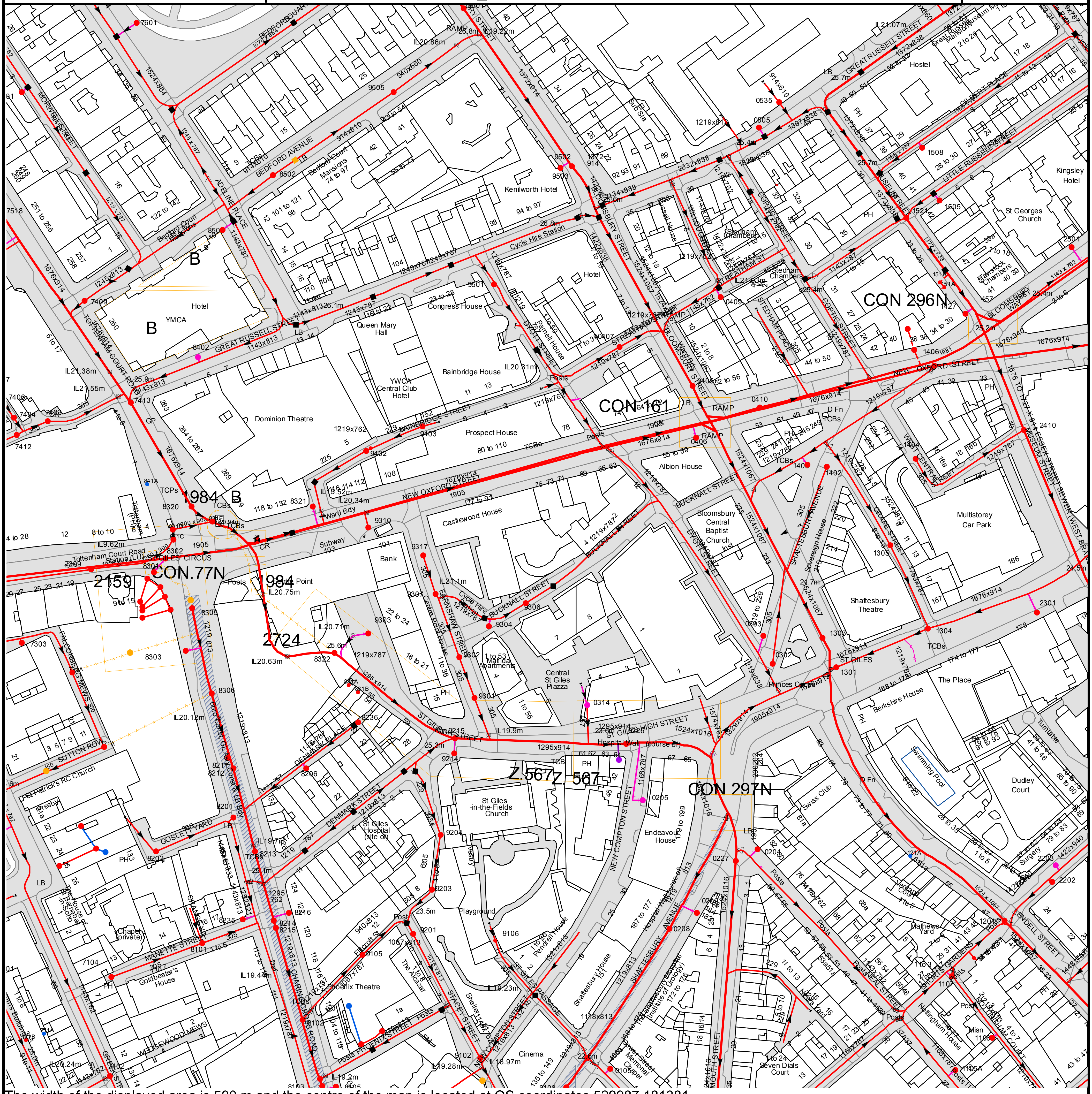
The proposed drainage network for Medius House will reuse the existing connection into the combined public sewer along New Oxford Street. Though this existing pipe will be increased to a 150mm diameter to avoid a new direct connection into the main sewer.

Surface water drainage will be attenuated using SuDS. Though green roofs are proposed in both sites, an attenuation tank at basement level will be used to attenuate the majority of the surface water runoff from each development. Both sites will achieve a 50% reduction against existing estimated runoff rates.

Castlewood House below ground drainage will discharge under gravity with the exception of part of the upper basement drainage and the totality of the lower basement drainage where flows will be pumped. Each foul pump will incorporate a 24h emergency storage volume in case of pump failure.

8 Appendix A – Thames Water sewer records

Asset Location Search Sewer Map - ALS/ALS Standard/2015_3065629



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 529987,181381

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

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
9505	26.46	21.38
9601	26.8	18.78
0505	n/a	n/a
0535	n/a	n/a
1508	25.51	n/a
2202	23.02	n/a
2203	n/a	n/a
0208	n/a	18.37
0209	n/a	n/a
0227	22.93	18.89
0204	n/a	n/a
0303	n/a	n/a
0302	23.34	18.84
1303	23.59	17.34
1301	23.34	19.14
121A	n/a	n/a
1304	23.52	19.43
1107	n/a	n/a
1105A	-9999.9	-9999.9
111A	n/a	n/a
1106	22.43	17.94
1201	22.9	16.5
9307	25.41	20.44
9501	25.87	20.91
9306	24.82	20.86
9502	n/a	n/a
9503	25.9	18.52
0407	25.62	19.71
0405	25.58	17.91
0406	25.56	n/a
0409	n/a	n/a
0410	25.36	9.49
1403	n/a	n/a
1402	25.13	21.01
1305	24.15	20.1
1521	25.29	20.98
1429	n/a	n/a
1430	n/a	n/a
1404	25.2	21.73
1406	25.3	19.56
1505	n/a	n/a
151B	n/a	n/a
151A	n/a	n/a
1427	n/a	n/a
2410	25.15	20.6
2301	n/a	n/a
2501	n/a	n/a
8105	n/a	n/a
81AD	n/a	n/a
831A	n/a	n/a
8236	25.26	20.76
831B	n/a	n/a
81AC	n/a	n/a
9105	23.84	19.67
9303	25.56	n/a
91BI	n/a	n/a
9201	23.54	19.41
9203	23.81	19.67
9204	24.37	19.93
9214	n/a	n/a
9215	25.25	20.07
9302	25.27	20.39
9301	25.12	20.21
9102	23.34	18.98
9304	n/a	n/a
9106	24.64	23.3
0314	n/a	n/a
AUTO	n/a	n/a
0105	n/a	n/a
0268	n/a	n/a
0226	23.39	19.29
0205	n/a	n/a
7601	n/a	n/a
7403	26.24	21.66
7409	26.23	21.45
7309	n/a	n/a
7413	25.89	21.38
73BF	n/a	n/a
73BG	n/a	n/a
73BH	n/a	n/a
83AJ	n/a	n/a
841A	n/a	n/a
8301	n/a	n/a
83BC	n/a	n/a
83BD	n/a	n/a
8302	n/a	9.64
83BE	n/a	n/a
831D	n/a	n/a
831C	125.337	120.5
8320	25.55	20.98
8305	n/a	20.49

Manhole Reference	Manhole Cover Level	Manhole Invert Level
8402	n/a	n/a
831E	n/a	n/a
8501	n/a	n/a
8502	26.54	22.4
8321	25.63	n/a
9402	25.54	14.59
9310	25.35	21.26
9403	25.56	24.16
9317	25.47	20.71
711A	n/a	n/a
72BB	n/a	n/a
731A	n/a	n/a
72BD	n/a	n/a
72BA	n/a	n/a
721A	n/a	n/a
72BC	n/a	n/a
7102	24.51	20.01
7104	25.05	21.96
73BI	n/a	n/a
8202	25.02	22.3
8303	n/a	n/a
8101	25.12	20.31
8306	n/a	n/a
8211	n/a	19.97
8201	24.83	19.83
8212	n/a	n/a
8235	n/a	n/a
8213	n/a	19.7
8214	n/a	19.48
8215	n/a	n/a
8216	n/a	n/a
8102	n/a	n/a
8206	24.77	n/a
8103	n/a	18.89
8104	n/a	n/a
8322	25.54	20.55
7412	26.27	21.73
7303	24.8	23.04
711B	n/a	n/a
7404	n/a	n/a
7501	n/a	n/a

Appendix B – Existing Surface Water Runoff Rates

Sheet number	**01/01**
Date	**10/01/2017**
Eng	**PMG**
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Project Castlewood House

Estimation of Urban Realm Peak Flow Rate Runoff

The aim of this calculation is to determine the peak discharge runoff rate of the existing brownfield site for 1:30 and 1:100 year return period events based on The Wallingford Procedure 'Modified Rational Method'

Q = Proposed Runoff Rates
C = Dimensionless Coefficient
I = Rainfall Intensity mm/hr
A = Area (ha)

FSR M5-60 = 20.9
Ratio R = 0.438

A = 0.260

$$Q = 2.78 \times C \times I \times A$$

Z1 from Fig A.3b for 15 min duration= 0.625

M5-15 = 0.625 x 21 = 13.0625 mm

Z2 values taken from Table A1 of Volume 4 of Modified Rational Method for 13.063mm rainfall

Storm Event	**$Q_{1\ year}$**	**$Q_{2\ year}$**	**$Q_{10\ year}$**	**$Q_{20\ year}$**	**$Q_{30\ year}$**	**$Q_{100\ year}$**	**$Q_{100\ year + 30\%\ C/C}$**
Ratio Z2	8.03	10.38	16.07	18.65	19.72	25.47	33.11
Average Point Intensity	32.1338	41.5388	64.2675	74.59	78.8975	101.89	132.45
Areal Reduction Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94

Storm Event	**$Q_{1\ year}$**	**$Q_{2\ year}$**	**$Q_{10\ year}$**	**$Q_{20\ year}$**	**$Q_{30\ year}$**	**$Q_{100\ year}$**	**$Q_{100\ year + 30\%\ C/C}$**
Rainfall (mm/hr)	30.21	39.05	60.41	70.11	74.16	95.77	124.51
Discharge Rates (l/s)	21.83	28.22	43.67	50.68	53.61	69.23	89.99

Existing peak surface water runoff (100 year)= 69.2 l/s

Existing peak surface water runoff (30 year) = 53.6 l/s

Existing peak surface water runoff (20 year) = 50.7 l/s

Existing peak surface water runoff (10 year) = 43.7 l/s

Existing peak surface water runoff (1 year) = 21.8 l/s

Sheet number	**01/01**
Date	**10/01/2017**
Eng	**PMG**
Checked	**PC**

Project Medius House

Estimation of Urban Realm Peak Flow Rate Runoff

The aim of this calculation is to determine the peak discharge runoff rate of the existing brownfield site for 1:30 and 1:100 year return period events based on The Wallingford Procedure 'Modified Rational Method'

Q = Proposed Runoff Rates
C = Dimensionless Coefficient
I = Rainfall Intensity mm/hr
A = Area (ha)

FSR M5-60 = 20.9
Ratio R = 0.438

A = 0.044

$$Q = 2.78 \times C \times I \times A$$

Z1 from Fig A.3b for 15 min duration= 0.625

M5-15 = 0.625 x 21 = 13.0625 mm

Z2 values taken from Table A1 of Volume 4 of Modified Rational Method for 13.063mm rainfall

Storm Event	**$Q_{1\ year}$**	**$Q_{2\ year}$**	**$Q_{10\ year}$**	**$Q_{20\ year}$**	**$Q_{30\ year}$**	**$Q_{100\ year}$**	**$Q_{100\ year + 30\%\ C/C}$**
Ratio Z2	8.03	10.38	16.07	18.65	19.72	25.47	33.11
Average Point Intensity	32.1338	41.5388	64.2675	74.59	78.8975	101.89	132.45
Areal Reduction Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94

Storm Event	**$Q_{1\ year}$**	**$Q_{2\ year}$**	**$Q_{10\ year}$**	**$Q_{20\ year}$**	**$Q_{30\ year}$**	**$Q_{100\ year}$**	**$Q_{100\ year + 30\%\ C/C}$**
Rainfall (mm/hr)	30.21	39.05	60.41	70.11	74.16	95.77	124.51
Discharge Rates (l/s)	3.69	4.78	7.39	8.58	9.07	11.72	15.23

Existing peak surface water runoff (100 year)= 11.7 l/s

Existing peak surface water runoff (30 year) = 9.1 l/s

Existing peak surface water runoff (20 year) = 8.6 l/s

Existing peak surface water runoff (10 year) = 7.4 l/s

Existing peak surface water runoff (1 year) = 3.7 l/s

Appendix C – Surface water calculations (Castlewood House)

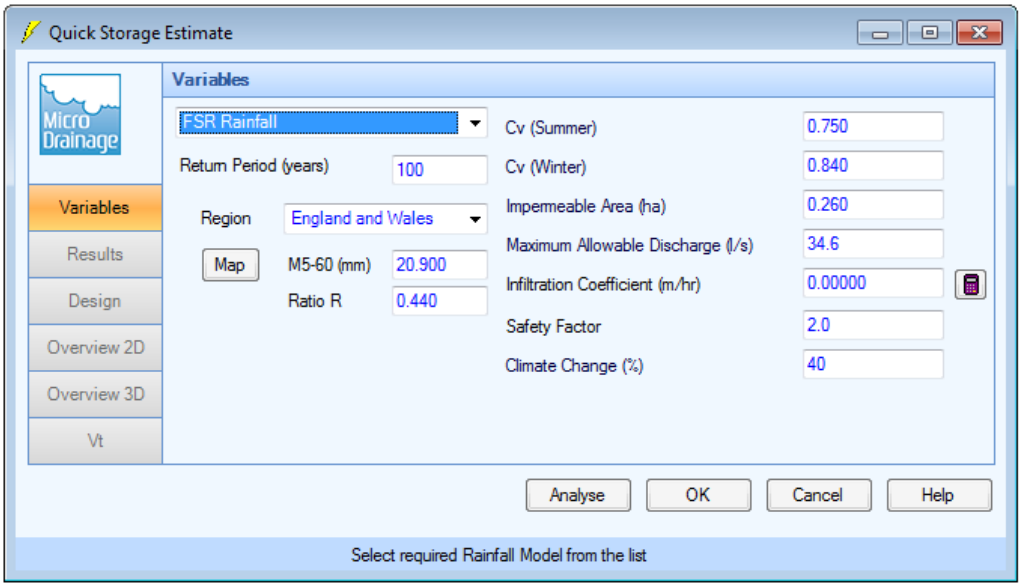
Castlewood House - Quick storage estimate

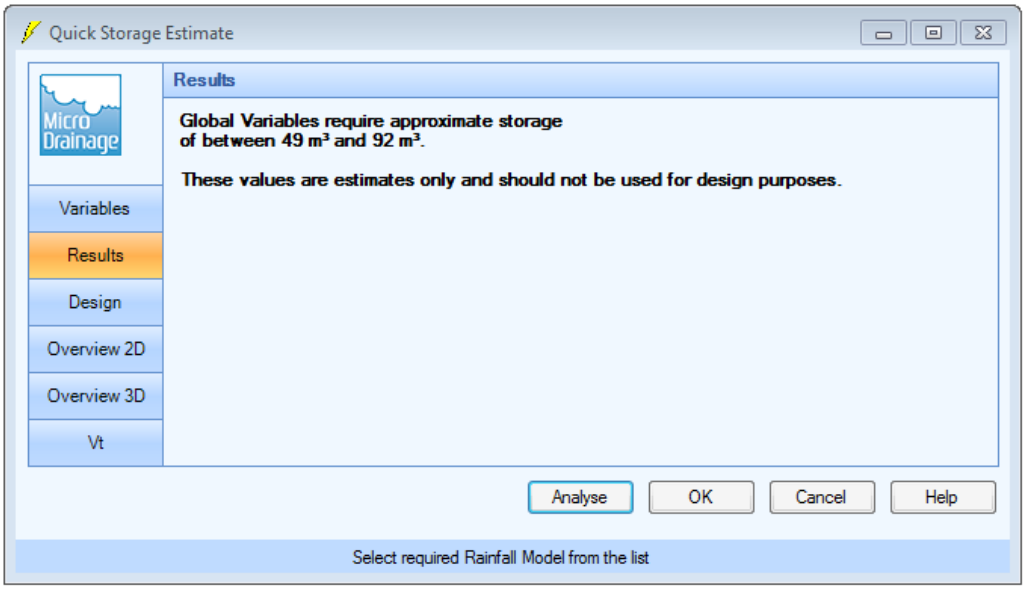
Site location: LONDON

Site area: 0.260ha

Existing discharge rate: 69.2 L/s

Proposed flow rate: 34.6 L/s





Results:

Volume required = 76 m^3

Appendix D – Surface water calculations (Medius House)

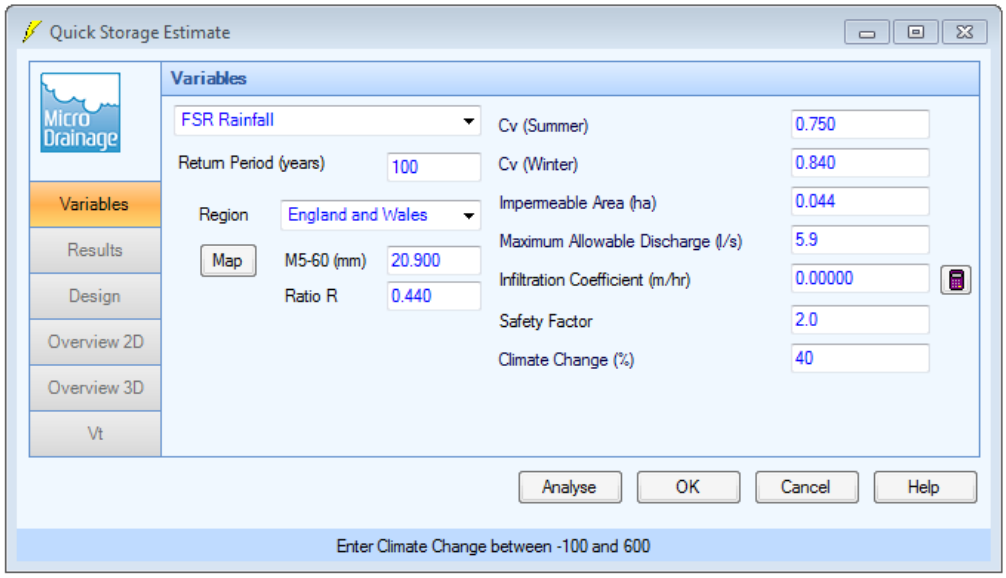
Medius House - Quick storage estimate

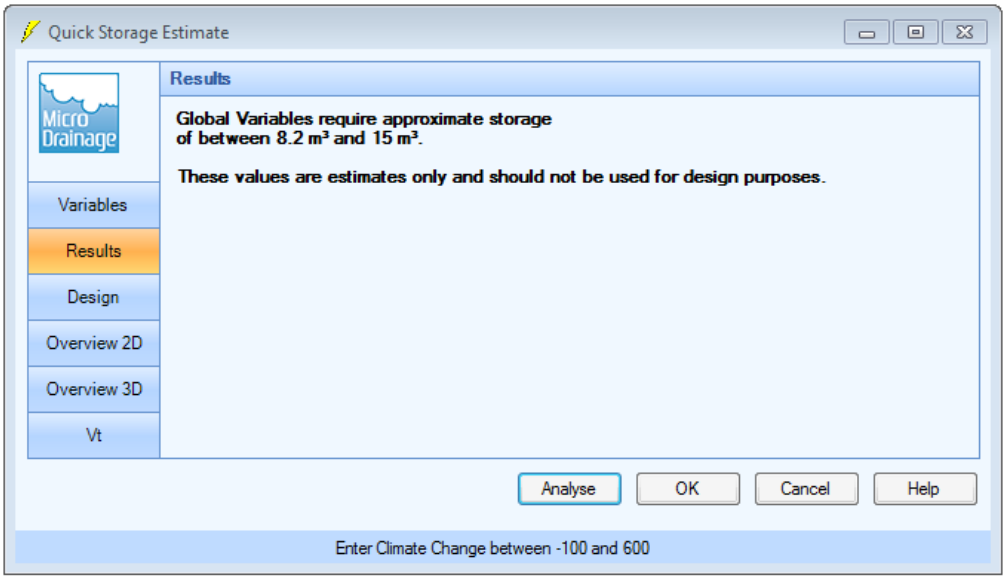
Site location: LONDON

Site area: 0.044ha

Existing discharge rate: 11.7 L/s

Proposed flow rate: 5.85 L/s

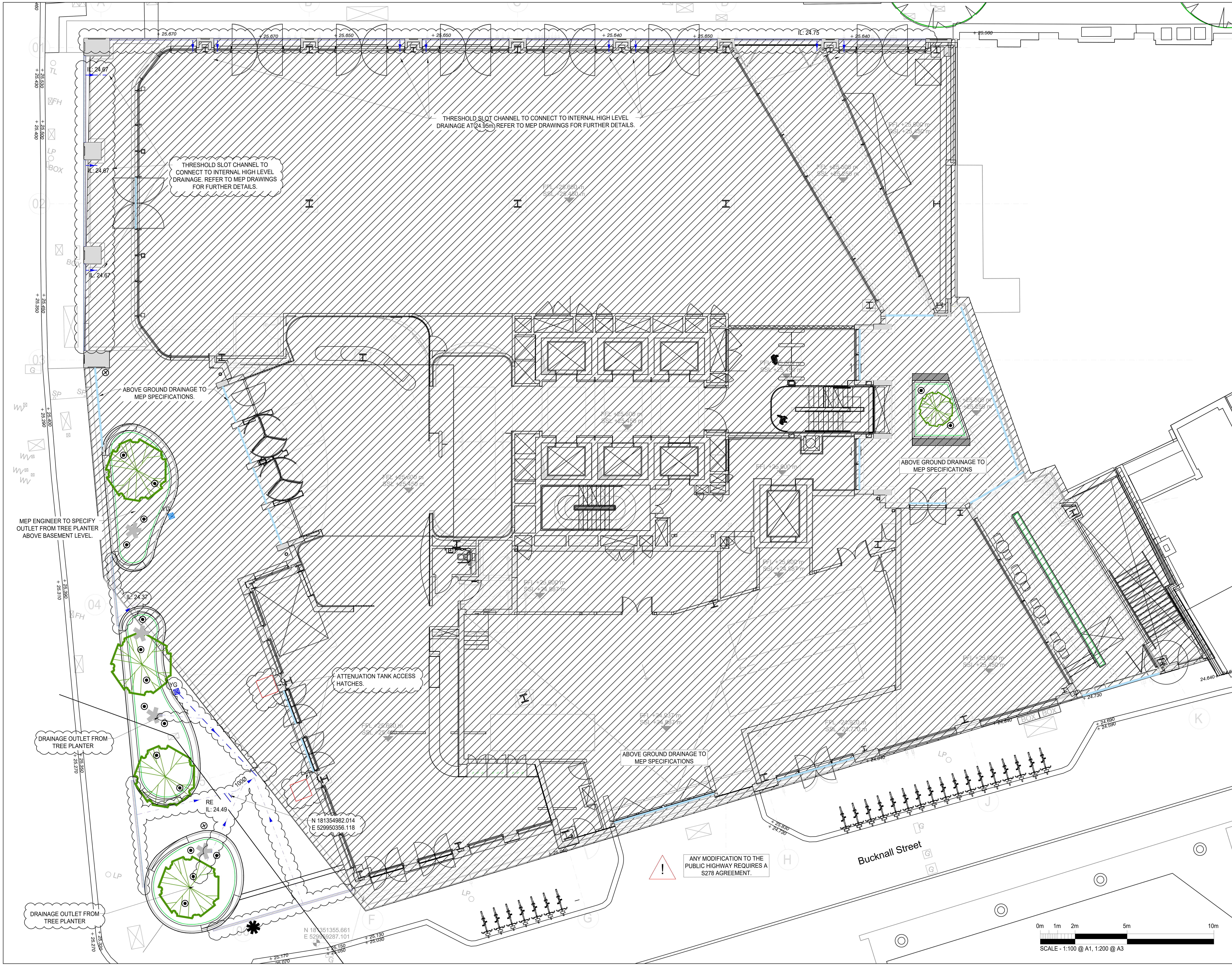




Results:

Volume required = 15 m^3

Appendix E – Drainage and architectural layouts (Castlewood House)



Notes:

1. DO NOT SCALE FROM THIS DRAWINGS.
2. ALL DIMENSIONS ARE IN MILLIMETRES U.N.O
3. ALL HEIGHTS ARE IN METRES ABOVE ORDNANCE DATUM U.N.O
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
5. ALL PIPES TO BE CAST IRON.
6. DRAINAGE DESIGN BASED ON INFORMATION AVAILABLE AT THE TIME.
7. LATERAL RUNS FROM INTERNAL POINTS TO MATCH ABOVE GROUND DESIGN, WITH MINIMUM SIZE OF Ø100mm.
8. ALL SOIL STACKS TO HAVE RODDING EYE ACCESS 1.2m ABOVE GROUND LEVEL.
9. ALLOWANCE TO BE MADE BY THE CONTRACTOR TO ABANDON/REMOVE EXISTING DRAINAGE WHERE NECESSARY.
10. EXTERNAL LEVELS TO BE CONFIRMED BY LANDSCAPE ARCHITECT.
11. ANY WORKS WITHIN THE PUBLIC AREA WILL REQUIRE A S278W AGREEMENT WITH THE LOCAL AUTHORITY.
12. ALL PIPES TO BE CONNECTED SOFFIT TO SOFFIT UNLESS SPECIFY OTHERWISE.
13. MANHOLE COVERS TO BS EN 124. CLASS D400 ON TRAFFICKED AREAS AND B125 ON PEDESTRIAN AREAS UNLESS NOTED OTHERWISE.
14. REFER TO DRAWING 15-21-DM-01-XX-DR-C-310, 311 AND 312 FOR TYPICAL DRAINAGE AND BUILD UPS DETAILS.

KEY

- SURFACE WATER DRAINAGE
- LINEAR SLOT-TYPE CHANNEL DRAIN WITH SUMP (TYPICAL)
- RE — SURFACE WATER RODDING EYE
- YG — YARD GULLY
- BASEMENT FOOTPRINT
- DRAINAGE ABOVE BASEMENT TO MEP DESIGN.

Rev	Description	Date	By	App
T02	STAGE 4 ER'S	13/09 2019	TD	SC
T01	STAGE 4 ISSUE	31/07 2019	MS	SC

Stage:
TENDER

Davies Maguire
20 Flaxman Terrace
London
WC1H 9AT
T +44 (0)20 7388 9406
E info@dmag.com
W dmag.com

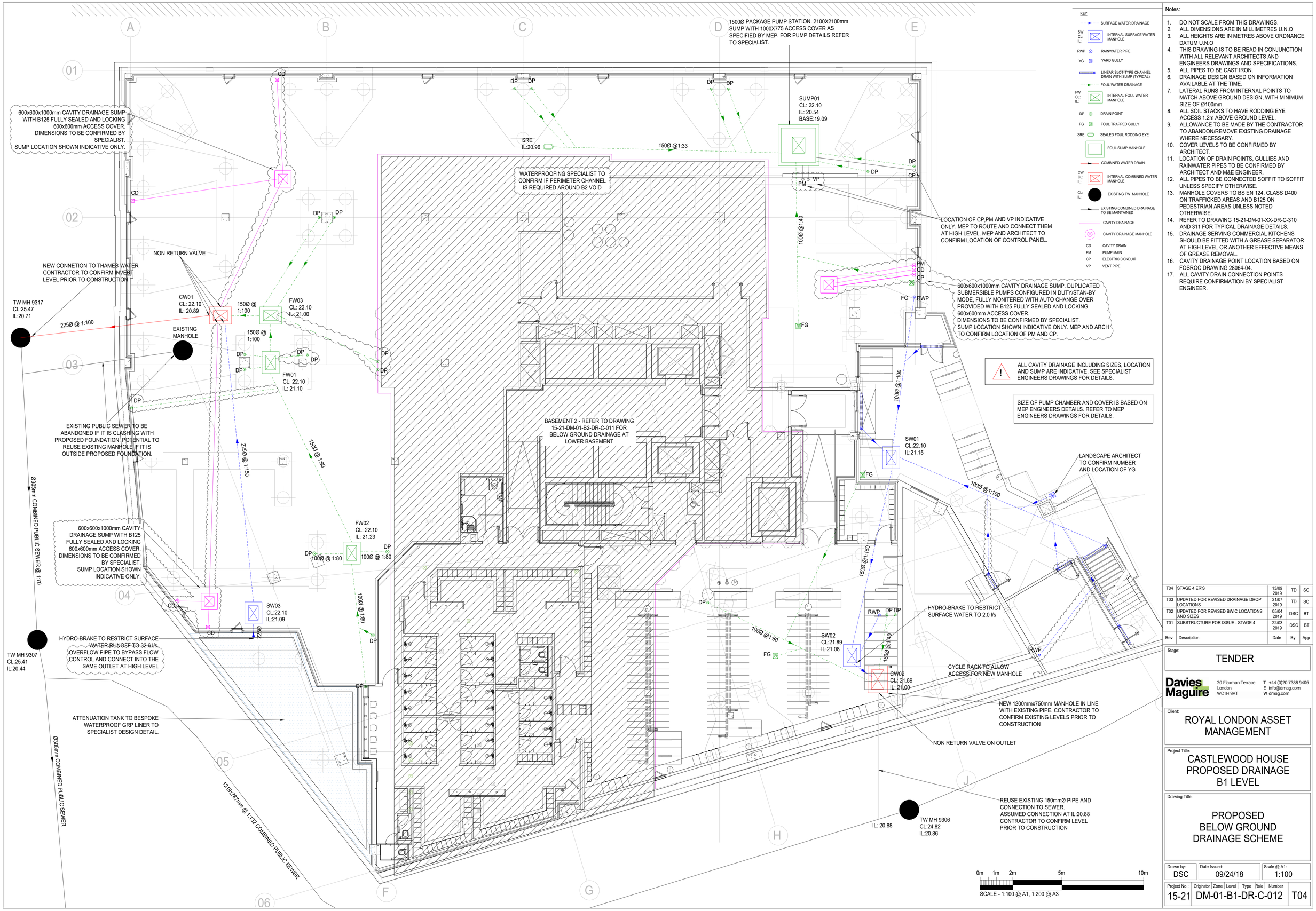
Client:
ROYAL LONDON ASSET MANAGEMENT

Project Title:
CASTLEWOOD HOUSE PROPOSED DRAINAGE GROUND FLOOR LEVEL

Drawing Title:
PROPOSED BELOW GROUND DRAINAGE SCHEME

Drawn by:	Date Issued:	Scale @ A1:
MS	31/07/2019	1:100

Project No.:	Originator Zone Level Type Role Number	Rev
15-21	DM-01-00-DR-C-013	T02



KEY

- SURFACE WATER DRAINAGE
- SW CL: IL: INTERNAL SURFACE WATER MANHOLE
- RWP RAINWATER PIPE
- YG YARD GULLY
- LINEAR SLOT-TYPE CHANNEL DRAIN WITH SUMP (TYPICAL)
- FOUL WATER DRAINAGE
- FW CL: IL: INTERNAL FOUL WATER MANHOLE
- DP DRAIN POINT
- FG FOUL TRAPPED GULLY
- SRE SEALED FOUL RODDING EYE
- FOUL SUMP MANHOLE
- COMBINED WATER DRAIN
- CW CL: IL: INTERNAL COMBINED WATER MANHOLE
- CL: IL: EXISTING TW MANHOLE
- EXISTING COMBINED DRAINAGE TO BE MAINTAINED
- CAVITY DRAINAGE
- CAVITY DRAINAGE MANHOLE
- CD CAVITY DRAIN
- PM PUMP MAIN
- CP ELECTRIC CONDUIT
- VP VENT PIPE

Notes:

1. DO NOT SCALE FROM THIS DRAWINGS.
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3. ALL HEIGHTS ARE IN METRES ABOVE ORDNANCE DATUM U.N.O
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
5. ALL PIPES TO BE CAST IRON.
6. DRAINAGE DESIGN BASED ON INFORMATION AVAILABLE AT THE TIME.
7. LATERAL RUNS FROM INTERNAL POINTS TO MATCH ABOVE GROUND DESIGN, WITH MINIMUM SIZE OF Ø100mm.
8. ALL SOIL STACKS TO HAVE RODDING EYE ACCESS 1.2m ABOVE GROUND LEVEL.
9. ALLOWANCE TO BE MADE BY THE CONTRACTOR TO ABANDON/REMOVE EXISTING DRAINAGE WHERE NECESSARY.
10. COVER LEVELS TO BE CONFIRMED BY ARCHITECT.
11. LOCATION OF DRAIN POINTS, GULLIES AND RAINWATER PIPES TO BE CONFIRMED BY ARCHITECT AND M&E ENGINEER.
12. ALL PIPES TO BE CONNECTED SOFFIT TO SOFFIT UNLESS SPECIFY OTHERWISE.
13. MANHOLE COVERS TO BS EN 124. CLASS D400 ON TRAFFICKED AREAS AND B125 ON PEDESTRIAN AREAS UNLESS NOTED OTHERWISE.
14. REFER TO DRAWING 15-21-DM-01-XX-DR-C-310 AND 311 FOR TYPICAL DRAINAGE DETAILS.
15. DRAINAGE SERVING COMMERCIAL KITCHENS SHOULD BE FITTED WITH A GREASE SEPARATOR AT HIGH LEVEL OR ANOTHER EFFECTIVE MEANS OF GREASE REMOVAL.
16. CAVITY DRAINAGE POINT LOCATION BASED ON FOSROC DRAWING 28064-04.
17. ALL CAVITY DRAIN CONNECTION POINTS REQUIRE CONFIRMATION BY SPECIALIST ENGINEER.

Rev	Description	Date	By	App
T04	STAGE 4 ER'S	13/09 2019	TD	SC
T03	UPDATED FOR REVISED DRAINAGE DROP LOCATIONS	31/07 2019	TD	SC
T02	UPDATED FOR REVISED BWIC LOCATIONS AND SIZES	05/04 2019	DSC	BT
T01	SUBSTRUCTURE FOR ISSUE - STAGE 4	22/03 2019	DSC	BT

Stage: TENDER

Davies Maguire
20 Flaxman Terrace
London
WC1H 9AT
T +44 (0)20 7388 9406
E info@dmag.com
W dmag.com

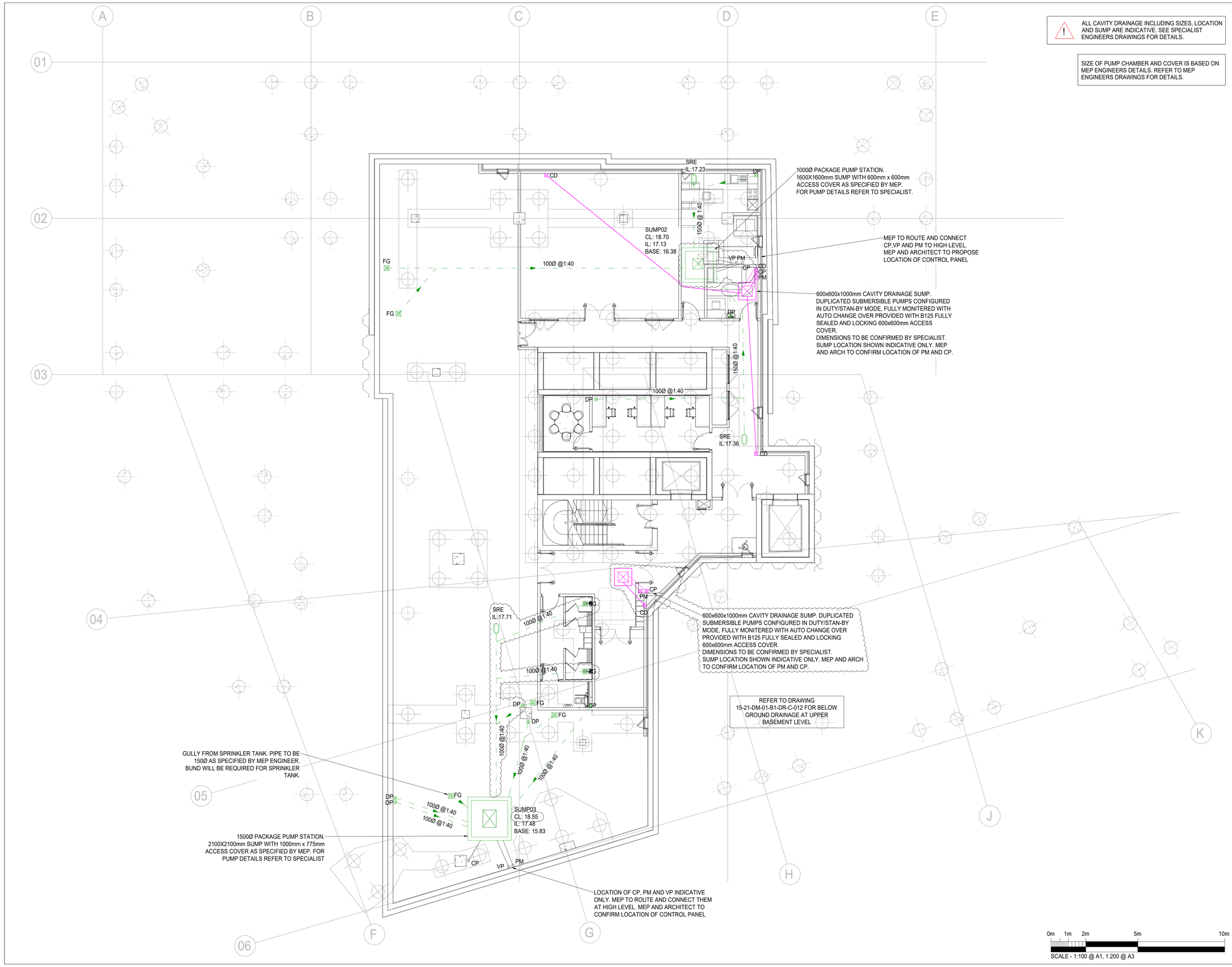
Client: ROYAL LONDON ASSET MANAGEMENT

Project Title: CASTLEWOOD HOUSE PROPOSED DRAINAGE B1 LEVEL

Drawing Title: PROPOSED BELOW GROUND DRAINAGE SCHEME

Drawn by:	Date Issued:	Scale @ A1:
DSC	09/24/18	1:100

Project No.:	Originator	Zone	Level	Type	Role	Number	
15-21	DM	01	B1	DR	C	012	T04



ALL CAVITY DRAINAGE INCLUDING SIZES, LOCATION AND SUMP ARE INDICATIVE. SEE SPECIALIST ENGINEERS DRAWINGS FOR DETAILS.

SIZE OF PUMP CHAMBER AND COVER IS BASED ON MEP ENGINEERS DETAILS. REFER TO MEP ENGINEERS DRAWINGS FOR DETAILS.

Notes:

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3. ALL HEIGHTS ARE IN METRES ABOVE ORDNANCE DATUM U.N.O
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
5. ALL PIPES TO BE CAST IRON.
6. DRAINAGE DESIGN BASED ON INFORMATION AVAILABLE AT THE TIME.
7. LATERAL RUNS FROM INTERNAL POINTS TO MATCH ABOVE GROUND DESIGN, WITH MINIMUM SIZE OF Ø100mm.
8. ALL SOIL STACKS TO HAVE RODDING EYE ACCESS 1.2m ABOVE GROUND LEVEL.
9. ALLOWANCE TO BE MADE BY THE CONTRACTOR TO ABANDON/REMOVE EXISTING DRAINAGE WHERE NECESSARY.
10. COVER LEVELS TO BE CONFIRMED BY ARCHITECT.
11. LOCATION OF DRAIN POINTS, GULLIES AND RAINWATER PIPES TO BE CONFIRMED BY ARCHITECT AND M&E ENGINEER.
12. ALL PIPES TO BE CONNECTED SOFFIT TO SOFFIT UNLESS SPECIFY OTHERWISE.
13. MANHOLE COVERS TO BS EN 124. CLASS D400 ON TRAFFICKED AREAS AND B125 ON PEDESTRIAN AREAS UNLESS NOTED OTHERWISE.
14. REFER TO DRAWING 15-21-DM-01-XX-DR-C-310 AND 311 FOR TYPICAL DRAINAGE DETAILS.
15. DRAINAGE SERVING COMMERCIAL KITCHENS SHOULD BE FITTED WITH A GREASE SEPARATOR AT HIGH LEVEL OR ANOTHER EFFECTIVE MEANS OF GREASE REMOVAL.
16. CAVITY DRAINAGE POINT LOCATION BASED ON FOSROC DRAWING 28064-04.
17. ALL CAVITY DRAIN CONNECTION POINTS REQUIRE CONFIRMATION BY SPECIALIST ENGINEER.

KEY

- FOUL WATER DRAINAGE
- FG FOUL TRAPPED GULLY
- DP DRAIN POINT
- FOUL PUMP STATION
- SRE SEALED FOUL RODDING EYE
- CAVITY DRAINAGE
- CAVITY SUMP WITH PUMP
- CD CAVITY DRAIN
- PM PUMP MAIN
- CP ELECTRIC CONDUIT
- VP VENT PIPE

Rev	Description	Date	By	App
T04	STAGE 4 ER'S	13/09 2019	TD	SC
T03	UPDATED FOR REVISED DRAINAGE DROP LOCATIONS	31/07 2019	TD	SC
T02	UPDATED FOR REVISED BWIC LOCATIONS AND SIZES	05/04 2019	DSC	BT
T01	SUBSTRUCTURE FOR ISSUE - STAGE 4	22/03 2019	DSC	BT

Stage: TENDER

Davies Maguire
20 Flaxman Terrace
London
WC1H 9AT
T +44 (0)20 7388 9406
E info@dmag.com
W dmag.com

Client: ROYAL LONDON ASSET MANAGEMENT

Project Title: CASTLEWOOD HOUSE LONDON W1A

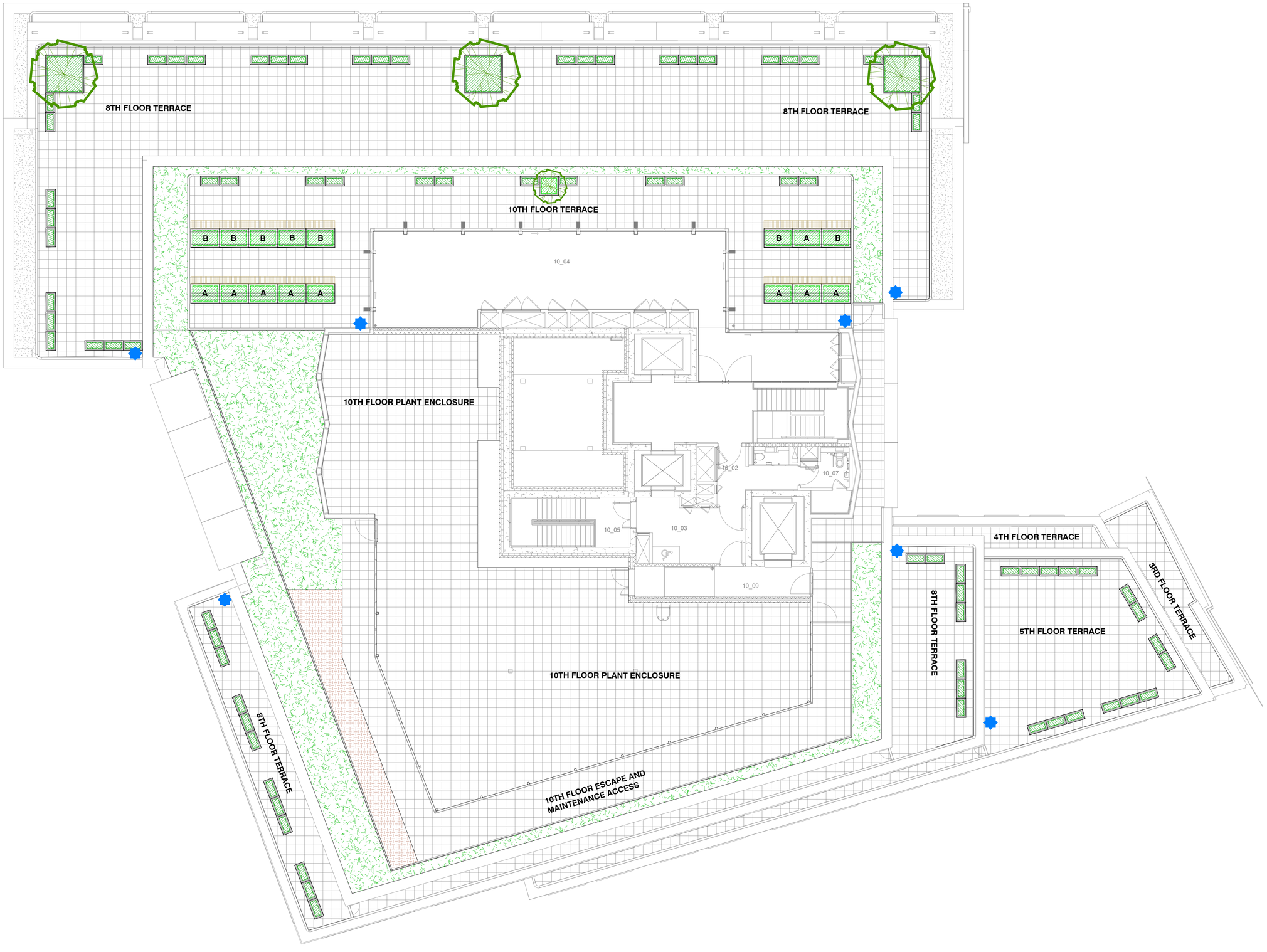
Drawing Title: CASTLEWOOD HOUSE PROPOSED DRAINAGE B2 LEVEL

Drawn by: DSC | Date Issued: JAN 2017 | Scale @ A1: 1 : 100

0m 1m 2m 5m 10m

SCALE - 1:100 @ A1, 1:200 @ A3

Project No.:	Originator	Zone	Level	Type	Role	Number	
15-21	DM	01	B2	DR	C	011	T04



0 2 4 8 12
METRES

NOTES:
1. THIS DRAWING IS BASED ON: APT DRAWING A_10_110_R06
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER LANDSCAPE DRAWINGS AND DOCUMENTS
3. THIS DRAWING IS NOT INTENDED FOR CONSTRUCTION
4. DO NOT SCALE FROM THIS DRAWING
5. ANY DISCREPANCIES WITHIN THIS DRAWING OR BETWEEN THIS DRAWING AND ANY OTHER INFORMATION IS TO BE REPORTED TO BMD FOR CLARIFICATION

PAVING
ROOF TERRACE PAVING AS ARCHITECTS SPECIFICATION AND DETAIL

PERIMETER PLANTERS FOR ORNAMENTAL PLANTING
0.5M X 1M X 0.5M POWDER COATED STEEL MOVEABLE PLANTER, COLOUR TBC TO MATCH BUILDING BALUSTRADES, SEE DETAIL 001/602 & CLAUSE Q50.202

TREE PLANTER FOR EDIBLE PLANTING
1M X 1M X 0.5M POWDER COATED STEEL MOVEABLE PLANTER, COLOUR TBC TO MATCH BUILDING BALUSTRADES, SEE DETAIL 002/602 & CLAUSE Q50.203

TREE PLANTER
2M X 2M X 1M POWDER COATED STEEL PLANTER, COLOUR TBC TO MATCH BUILDING BALUSTRADES, SEE DETAIL 005/602 & CLAUSE Q50.206

A
PLANTERS FOR EDIBLE PLANTING TYPE A
1.5M X 1M POWDER COATED STEEL MOVEABLE A FRAME TRELLIS PLANTER WITH SEATING, COLOUR TBC TO MATCH BUILDING BALUSTRADES, SEE DETAIL 006/602 & CLAUSE Q50.204

B
PLANTERS FOR EDIBLE PLANTING TYPE B
1.5M X 1M POWDER COATED STEEL MOVEABLE A FRAME PLANTER WITH SEATING AND TOOL STORAGE, COLOUR TBC TO MATCH BUILDING BALUSTRADES, SEE DETAIL 007/602 & CLAUSE Q50.205

BROWN ROOF
TO ARCHITECTS DETAIL AND SPECIFICATION

GREEN ROOF
TO ARCHITECTS DETAIL AND SPECIFICATION

TREE PLANTING
REFER TO PLATING PLANS FOR DETAILS

LOCATION OF WATER STANDPIPE
LOCKABLE TAP LOCATION FOR MANUAL IRRIGATION, REFER TO ELECTRICAL & MECHANICAL ENGINEERS WORK PACKAGE FOR DETAILS

Rev	Description	Date
--	--	--

Purpose of Issue
TENDER

Bradley Murphy Design Ltd
6 The Courtyard
Hatton Technology Park
Dark Lane
Hatton
Warwickshire
CV35 8XB

t: 01926 676496
e: info@bradleymurphydesign.co.uk
www.bradleymurphydesign.co.uk

Client
ROYAL LONDON ASSET MANAGEMENT

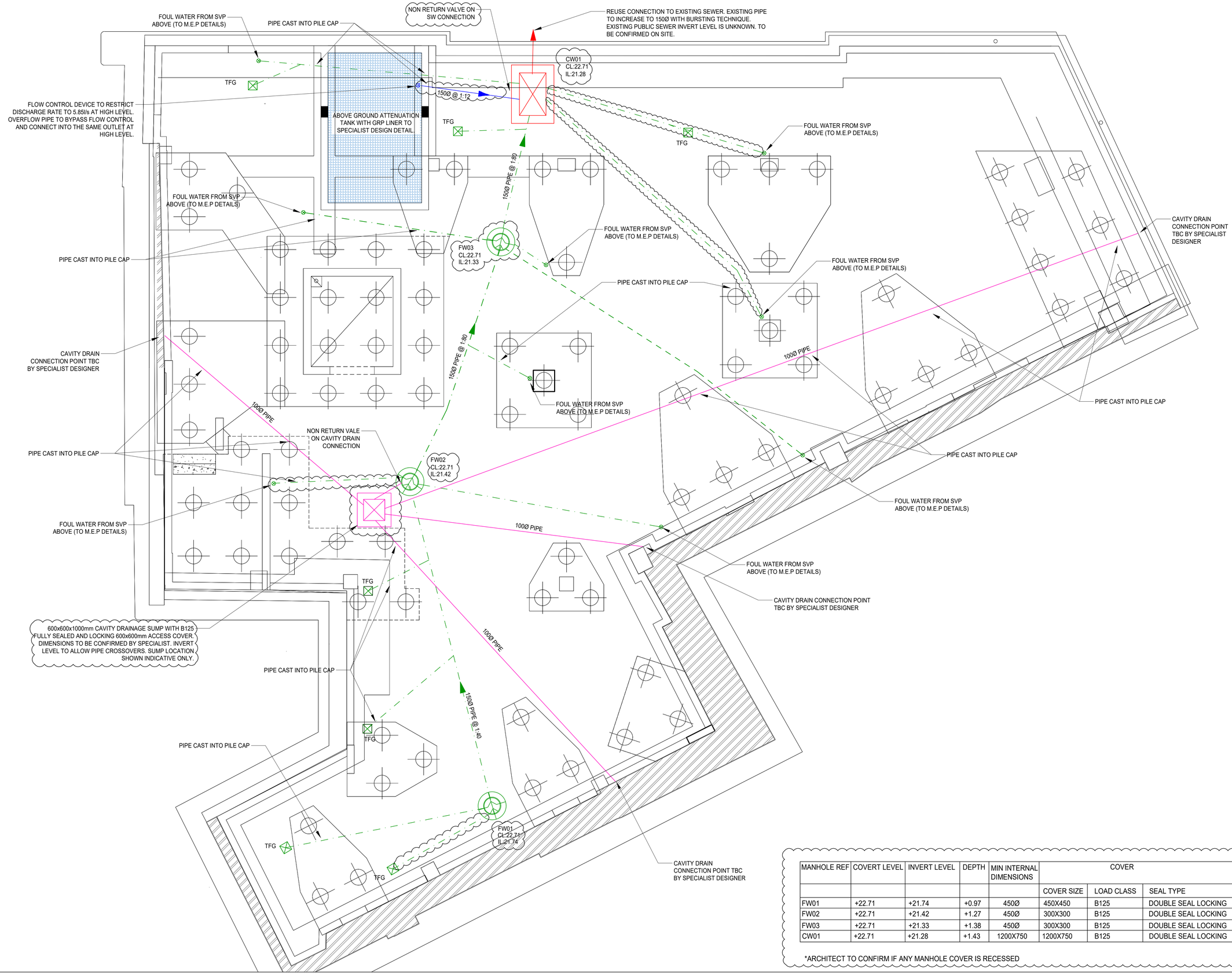
Project
CASTLEWOOD HOUSE

Drawing Title
LANDSCAPE GENERAL ARRANGEMENT ROOF TERRACES

Drawn	Checked	Approved	Date
DB	RW	RW	20/09/2019
Job No.	Scale	Sheet Size	Revision
19.003	1:100	A1	-

Drawing Number
BMD.19.003.DR.T103

Appendix F – Drainage and architectural layouts (Medius House)



Notes:

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5. ALL PIPES TO BE CAST IRON.
6. DRAINAGE DESIGN BASED ON INFORMATION AVAILABLE AT THE TIME.
7. LATERAL RUNS FROM INTERNAL POINT TO MATCH ABOVE GROUND DESIGN, WITH MINIMUM SIZE OF Ø100mm.
8. ALL SOIL STACKS TO HAVE RODDING EYE ACCESS 1.2m ABOVE GROUND LEVEL.
9. ALLOWANCE TO BE MADE BY THE CONTRACTOR TO ABANDON/REMOVE EXISTING DRAINAGE WHERE NECESSARY.
10. COVER LEVELS TO BE CONFIRMED BY ARCHITECT.
11. LOCATION OF DRAIN POINTS, GULLIES AND RAINWATER PIPES TO BE CONFIRMED BY ARCHITECT AND M&E ENGINEER.
12. ALL PIPES TO BE CONNECTED SOFFIT TO SOFFIT UNLESS SPECIFY OTHERWISE.
13. MANHOLE COVERS TO BS EN 124. CLASS D400 ON TRAFFICKED AREAS AND B125 ON PEDESTRIAN AREAS UNLESS NOTED OTHERWISE.
14. REFER TO DRAWING DM-02-ZZ-DR-S-355 AND 356 FOR DRAINAGE DETAILS.
15. DRAINAGE SERVING COMMERCIAL KITCHENS SHOULD BE FITTED WITH A GREASE SEPARATOR AT HIGH LEVEL OR ANOTHER EFFECTIVE MEANS OF GREASE REMOVAL.
16. CAVITY DRAINAGE SYSTEM TO BE DESIGNED BY SPECIALIST.
17. CONTRACTOR TO CONFIRM INVERT LEVEL OF THE PUBLIC SEWER PRIOR TO CONSTRUCTION.
18. NON-RETURN VALVE TO BE PROVIDED AT ALL CONNECTIONS INTO EXISTING NETWORK.
19. ALL FLOOR GULLIES TO BE RODDABLE.

KEY

- SURFACE WATER PIPE
- ABOVE GROUND ATTENUATION TANK TO SPECIALIST DETAILS
- FOUL WATER PIPE
- FW CL: IL: FOUL WATER PPIC CHAMBER
- TFG FOUL TRAPPED GULLY
- DP DRAIN POINT
- COMBINED DRAINAGE
- CW CL: IL: INTERNAL COMBINED MANHOLE
- CAVITY DRAINAGE
- CAVITY DRAIN SUMP

CAVITY DRAINAGE IN ABEYANCE. TO BE CONFIRMED BY SPECIALIST

MANHOLE REF	COVERT LEVEL	INVERT LEVEL	DEPTH	MIN INTERNAL DIMENSIONS	COVER		
					COVER SIZE	LOAD CLASS	SEAL TYPE
FW01	+22.71	+21.74	+0.97	450Ø	450X450	B125	DOUBLE SEAL LOCKING
FW02	+22.71	+21.42	+1.27	450Ø	300X300	B125	DOUBLE SEAL LOCKING
FW03	+22.71	+21.33	+1.38	450Ø	300X300	B125	DOUBLE SEAL LOCKING
CW01	+22.71	+21.28	+1.43	1200X750	1200X750	B125	DOUBLE SEAL LOCKING

*ARCHITECT TO CONFIRM IF ANY MANHOLE COVER IS RECESSED

WORK IN PROGRESS

Rev	Description	Date	By	App
	WIP			
T02	STAGE 4 ISSUE	30/05 2019	DSC	JD
T01	INTERIM STAGE 3	03/05 2019	DSC	JD

Stage: TENDER

Davies Maguire
20 Flaxman Terrace
London
WC1H 9AT
T +44 (0)20 7388 9406
E info@dmag.com
W dmag.com

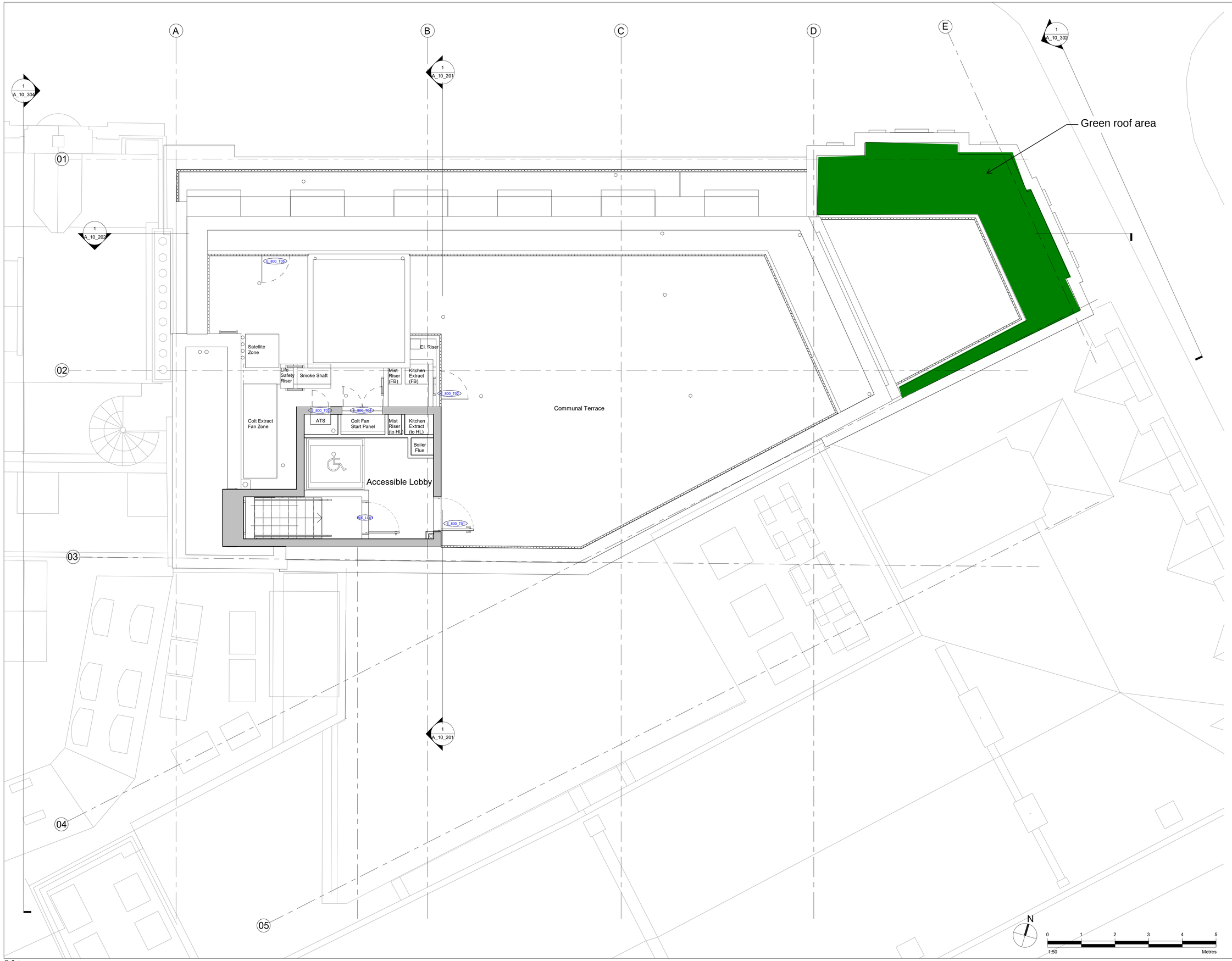
Client: ROYAL LONDON ASSET MANAGEMENT

Project Title: CASTLEWOOD HOUSE LONDON W1A

Drawing Title: MEDIUS HOUSE BELOW GROUND DRAINAGE

Drawn by:	Date Issued:	Scale @ A1:
DSC	SEP 2018	1 : 50

Project No.:	Originator	Zone	Level	Type	Role	Number	
15-21	DM-02-XX-DR-C-010						T02



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Notes

Not all revision notes appear on all sheets. Refer to tagged clouds.

Key

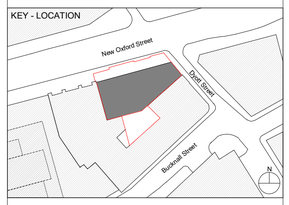
- Structure
- New Facade
- Retained Facade
- Boundary Line

Rev	Reason for Issue	Date	Iss
T00	TENDER	17/09/2019	Apt

Consultants

Structural Engineer:	Davies Maguire
MEP Engineer:	GDM Partnership
Project Manager:	CBRE

KEY - LOCATION



Apt

235 St John Street London EC1V 4NG www.apt.london

Client
Royal London Asset Management

Project
Medius House

Drawing Title
General Arrangement
Level 08 Roof Terrace Plan

Scale	Drawn By	Issued By
1 : 50 @ A1	Apt	Apt

Tender

Project No.	Drawing No.	Revision
18013	A_10_108	T00