18A FROGNAL GARDENS

DRAINAGE REPORT

SEPTEMBER 2019

EEP REF: 3849

ENVIRONMENTAL ENGINEERING PARTNERSHIP

CONSULTING ENGINEERS

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Registered in England
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BSRIA Member

Contents

Introduction

Where projects are proposing to incorporate a below ground level basement, in accordance with the Camden Local Plan these projects are required to submit a drainage report where the following information is required:

- Identification of flood risk (by Akera Engineers)
- Assessment of existing run-off rates
- Calculation of greenfield run-off rates
- Identification of measures, in line with the drainage hierarchy, to reduce run-off rates
- Calculation of proposed run-off rates

Existing Drainage Connection

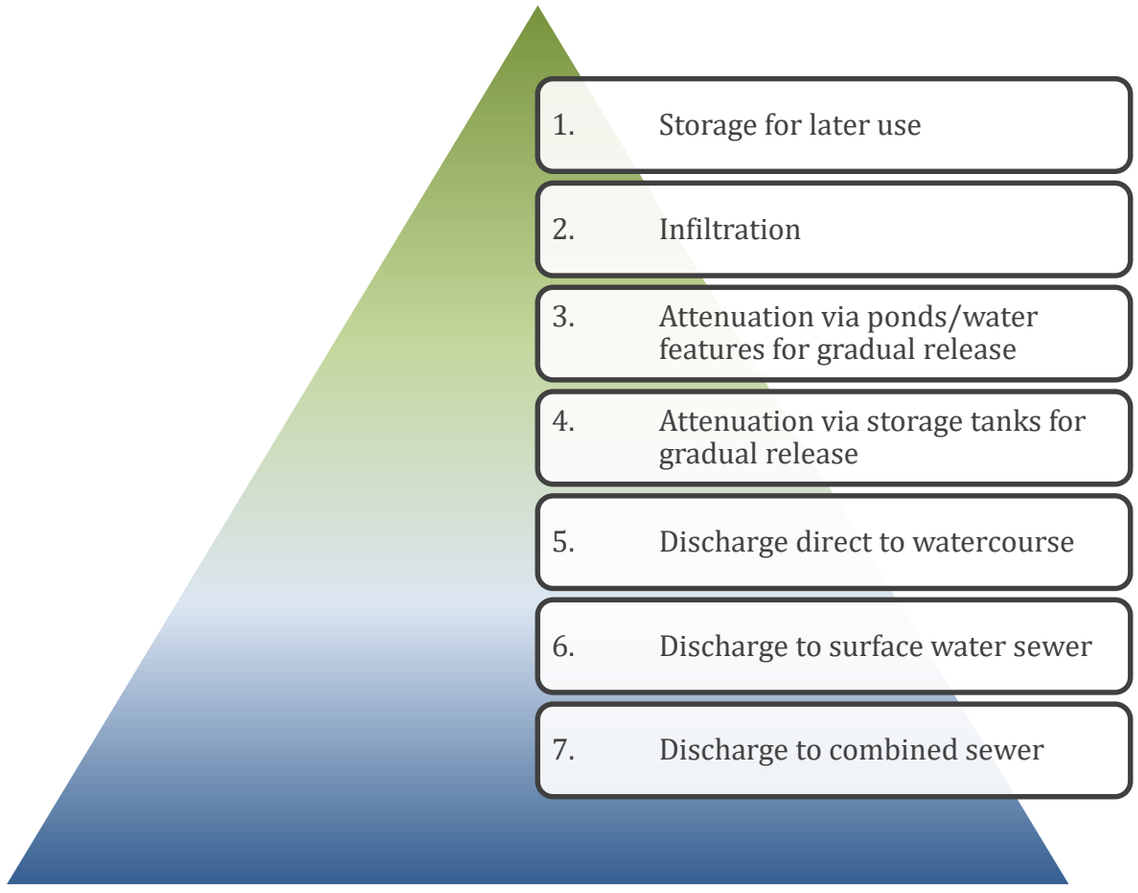
Currently, the rainwater drainage plus the soil and waste drainage from the building are combined and discharge directly to the Thames Water Sewer located beneath the Frognal Gardens road, the drainage combines within an existing manhole located within the front of house private drive/car parking area.

Accordingly, as it is known that the existing connection to the sewer is via a 'combined' drain, which has been confirmed to be Ø150 mm. However, the drainage connection from 18A connects to the drainage from 18B (Ø100 mm pipework) before connecting to the sewer. The connection between the two buildings can be seen at the manhole located on the property of 18B.

Please see a recent CCTV report of the existing drainage system in the Appendix of this report.

It is assumed that the existing rainwater drainage system would have been designed using a rainfall intensity of 75mm/hour.

Drainage Hierarchy

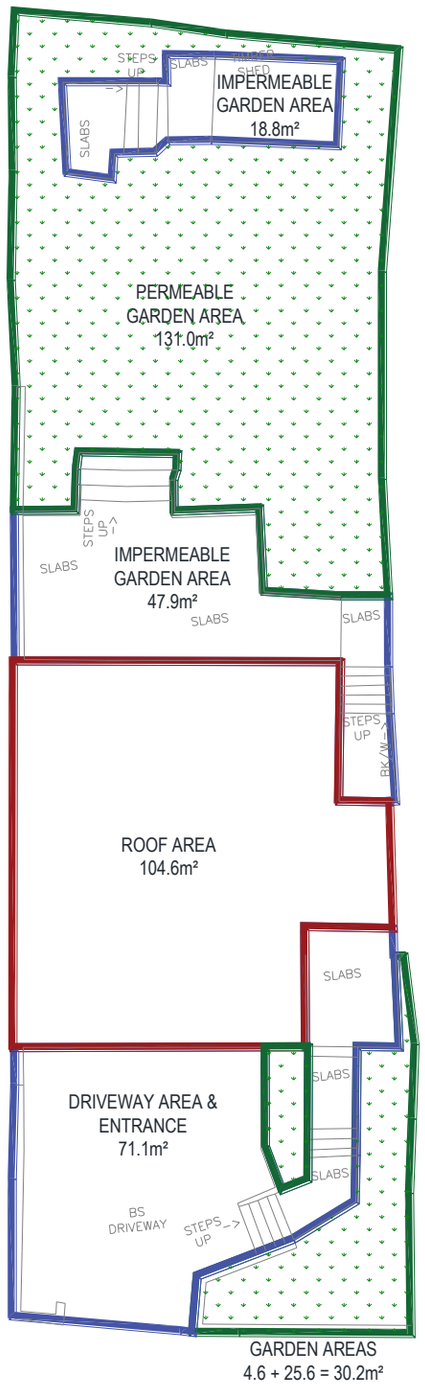


SURFACE AREA CALCULATION ñ EXISTING AND PROPOSED

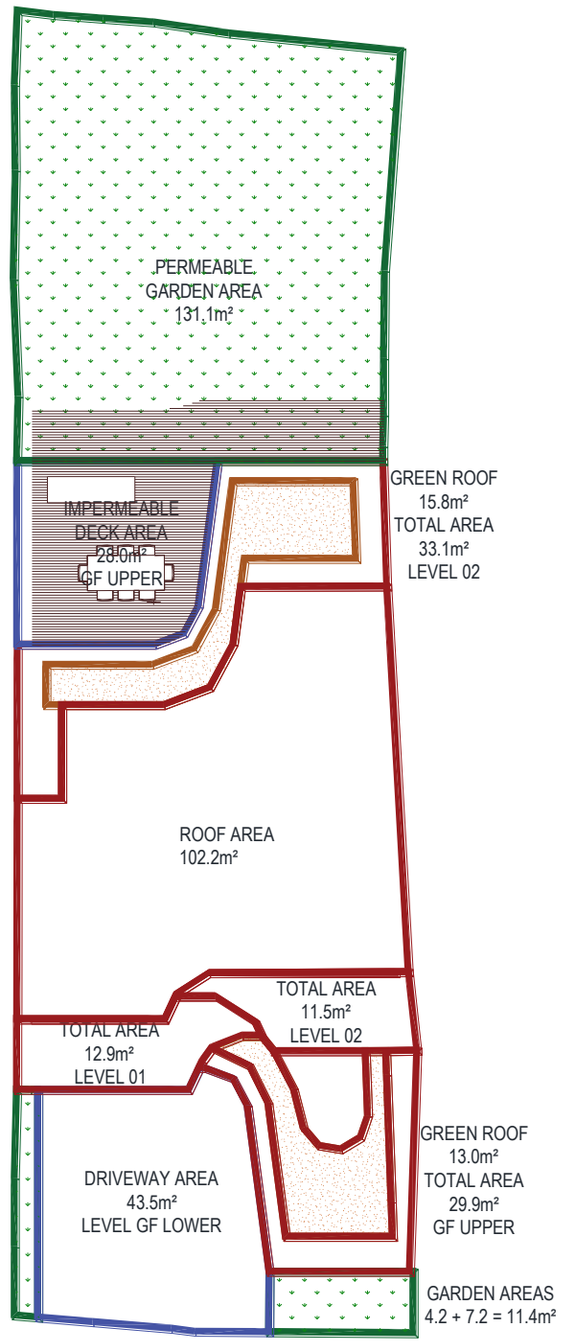
Existing Areas m²		
GF	18.8	Drains to garden
	131.0	Garden
	47.9	
	71.1	Drains to street
	30.2	Garden
Roof	104.6	
Total	403.6	
161.2m² Garden		
Impermeable	152.5	
Permeable	180.0	
To street	71.1	

Proposed Areas m²		
GF Lower	43.5	Drains to street
	11.4	Garden
GF Upper	131.1	Garden
	28.0	
	29.9	13.0m² Green Roof
01	12.9	
02	33.1	15.8m² Green Roof
	11.5	
Roof	102.2	
Total	403.6	
142.5m² Garden		
28.8m² Green Roof		
Impermeable	154.6	
Permeable	142.5	
Semi Permeable	63.0	
To street	43.5	

Existing



Proposed



SURFACE AREA CALCULATION ñ EXISTING AND PROPOSED

Existing Building:

a)	Impermeable area	=	152.5m²
b)	Permeable area	=	180.0m²
c)	Discharges to street	=	71.1m²
Total			**403.6m²**

Proposed Building:

c)	Impermeable area	=	154.6m²
d)	Permeable area	=	142.5m²
e)	Semi-permeable Green Roof area	=	63.0m²
f)	Discharges to street	=	43.5m²
Total			**403.6m²**

Substrate depth / mm	Vegetation	Average annual water retention / %	Average annual rainfall run off / %
20–40	Moss, sedums	40	60
40–60	Sedums and moss	45	55
60–100	Sedums, moss and herbs	50	50
100–150	Sedums, herbs and grass	55	45
150–200	Grass and herbs	60	40

Water retention in extensive green roofs (based on 650–800 mm annual rainfall). CIBSE KS11 – Green Roofs, Table 6.

As can be seen from table 6 within the CIBSE Guide KS11 the rainfall water retention will be 50% (TBC) which affectively increases the “permeable area” by 38 m² (63 m² ÷ 2 = 31.5 m² or 50%), therefore the new site areas simplified for run-off calculation purposes we can adjust the areas as follows:-

Proposed Building (Simplified):

f)	Impermeable area	=	186.1m² (154.6 + 31.5)
g)	Permeable area	=	174m² (142.5 + 31.5)
h)	Discharges to street	=	43.5m²
Total			**403.6m²**

RUN-OFF RATE CALCULATIONS

The rainfall intensity stipulated within Clause 3.8 of the March 2019 version of the 'Camden Planning Guidance – Water & Flooding' for a residential development the required 'Protection Years' are for a 100 year return period, using BS EN 12056-3 this results in a design intensity of 250mm/hour (0.069 litres/second/metre^2).

Run-off Calculations

		Area m^2	Run-off l/s		
Existing	Impermeable	152.5	10.52		
	Permeable	180.0	12.42		
Proposed	Impermeable	186.1	12.84	22%	% Change
	Permeable	174	12.01		

Rainfall intensity calculations for **18a FROGNAL GARDENS, LONDON.**

Based on Category 2 values from BS EN 12056 part 3

BASIC DATA

Nearest geographical town	London	
Building life span required	100	years

Calculations data based on BS EN 12056 part 3 Category 2

Protection years (T) (1.5 x life span)	150	years				
Fig. NB.6 value (return period in years)	4.5	(based on 2min M5)				
From Table NB.1, fraction for 2 min. storm = 1.00						
Therefore 2 min. M5 rainfall =	4.5	X	1	=	4.5	
Factor from Fig. NB.7 using protection years	150	(M5=2)		=	1.9	
Using return period year factor for 2 min M5 =	1.85	X	4.5	=	8.325	

Calculated Flowrates

Rainfall intensity in mm/hour	30	X	8.325	=	250	mm/hour
Run off in litres per second	0.069	per square metre				

ATTENUATION TANK CAPACITY CALCULATIONS

In order to maintain the building's original rainwater discharge to the sewer any design for the attenuation and controlled release of rainwater shall not exceed the discharge rate of the original design. It is assumed that the rainfall intensity used for the original design was based on 75mm per hour/m^2.

Therefore, following the guidance from the Camden Planning Guidance documents and methodology provided in the BRE Digest 365 – Soakaway Design, and The Wallingford Procedure, the following equations can be used to size the rainwater attenuation tank:

Run-off Calculations Based on original building design (75mm/Hr/m^2)			
		Area m^2	Run-off l/s
	Impermeable	152.5	3.20

maximum allowable discharge to sewer

NOMENCLATURE

$MX\text{-}D_{min}$: $^{X=return\ \ period\ \ (years\ )}_{D=storm\ \ durat\ ion\ (min\ )}$

$Z1$: $rainfall\ factor\ taken\ from\ figure\ 1\ and\ table\ 1 - BRE\ Digest\ 365$

$Z2$: $growth\ factor\ taken\ from\ table\ 2 - BRE\ Digest\ 365$

$d = discharge\ rate(l/s)$

$T = time\ (s)$

$I = inflow\ (m^3)$

$O = outflow\ (m^3)$

$S = storage\ (m^3)$

EQUATIONS

$M5\text{-}D_{min} = M5\text{-}60_{\min\ rainfall} \times Z1$

$M10\text{-}D_{min} = M5\text{-}D_{min} \times Z2$

$O = d \times M10\text{-}D_{min}$

$I = d \times T$

$I_{140\%} = I \times 1.4$

$S = I_{140\%} - O$

Area m^2	Duration	Rainfall factor Z1	M5 rainfalls mm	Growth factor Z2 (M10)	M10 year rainfall mm	Growth factor Z2 (M100)	M100 year rainfall mm	M100 year rainfall + 40% mm	Inflow m^3	Inflow (@140%) m^3	Outflow m^3	Storage required m^3
186.1	5 mins	0.38	7.6	1.19	9.0	1.96	14.9	20.9	2.8	3.9	1.0	2.9
	10 mins	0.53	10.6	1.22	12.9	2.00	21.2	29.7	3.9	5.5	1.9	3.6
	15 mins	0.64	12.8	1.24	15.9	1.96	25.1	35.1	4.7	6.5	2.9	3.7
	30 mins	0.81	16.2	1.24	20.1	2.00	32.4	45.4	6.0	8.4	5.8	2.7
	1 hour	1.00	20	1.24	24.8	2.03	40.6	56.8	7.6	10.6	11.5	0.0
	2 hours	1.20	24	1.22	29.3	2.01	48.2	67.5	9.0	12.6	23.1	0.0
	4 hours	1.42	28.4	1.19	33.8	1.97	55.9	78.3	10.4	14.6	46.1	0.0
	6 hours	1.57	31.4	1.17	36.7	1.96	61.5	86.2	11.5	16.0	69.2	0.0
	10 hours	1.74	34.8	1.14	39.7	1.92	66.8	93.5	12.4	17.4	115.3	0.0
	24 hours	2.16	43.2	1.13	48.8	1.86	80.4	112.5	15.0	20.9	276.7	0.0

Protected tree root zone

At 18A Frognal Gardens at the rear of the property are a number of fully established trees, a soakaway, if used, must be located outside of the root protection zone.

Building Regulations Part H and good practice requires that any soakaway be located not closer than 5m to the nearest building and section 3.20 within the 'Camden Planning Guidance – Water & Flooding' states any infiltration measures located within 5m must be designed to avoid harm to the building, in accordance with the Building Regulations.

A survey of the existing root area shows that distance of the building from the root protection zone varies from approximately 2.4m to 5.2m, this provides little or no room for the inclusion of a soakaway system of any meaningful size.

Therefore, rainwater run-off and drainage shall be addressed using a combination of solutions to be discussed in the sections to follow.

Rainwater Infiltration & Attenuation

The proposed architectural design shows extensive green roofing to be installed to some terrace and roof areas, however, it is noted that section 3.14 within the 'Camden Planning Guidance – Water & Flooding' states:

However, green roofs cannot be considered a permeable soil and should be assumed to be saturated at the point of intense storms (i.e. storms that are more intense than a 1 in 10 year storm). Due to the sporadic nature of water consumption, rainwater harvesting tanks should also be assumed to be full at the point of a storm event. Both of these systems are generally not intended to control peak run-off rate during critical events, and are mainly useful during medium and small events to capture run-off and thus reduce the volume of water entering the drainage system during these smaller events.

But section 3.15 also states:

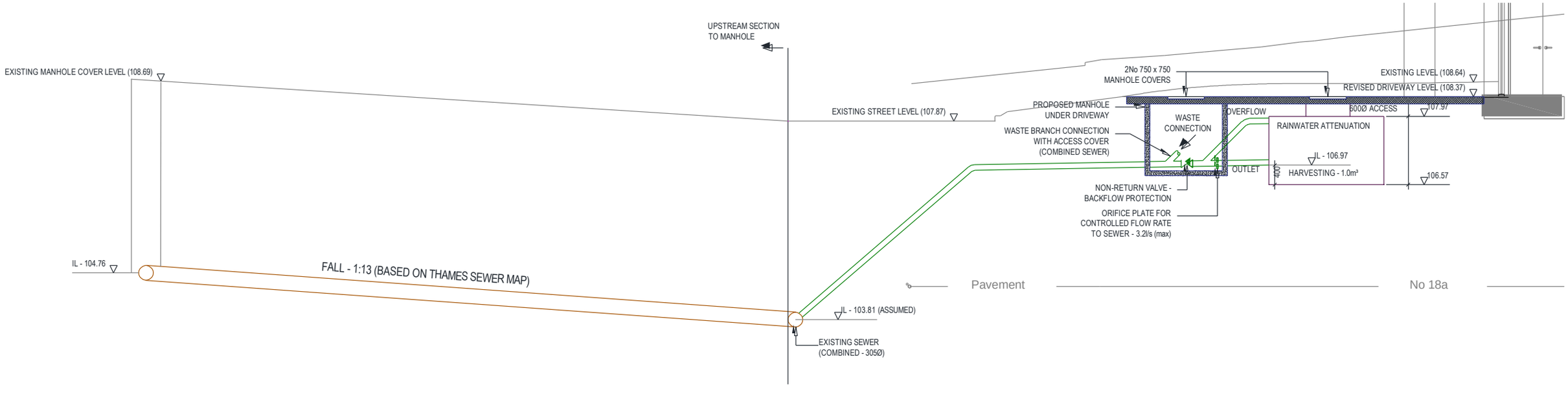
Some rainwater harvesting tanks can incorporate an attenuation chamber/ overflow with controlled release, and green roofs can incorporate an attenuation layer ("blue roof") or be designed to be substantially thick, allowing the associated attenuation volume to be included within the modelling. The Council will consider inclusion of these SuDS in developments favourably due to their additional environmental benefits.

Therefore, the proposal for mitigating the impact of the proposed development to the local sewer network shall be through the attenuation and controlled release of surface water to the sewer. The discharge to the sewer shall be designed to meet the criteria used for the original building, therefore, any additional impact due to climate and increased surface run-off shall be dealt with on site.

The inclusion of several areas of "green roofing" shall serve to provide additional attenuation to the sewer, with the guidance provided in CIBSE Guide KS11, 50% of these areas have been included in the sizing of the attenuation tank.

In order to facilitate the sustainability ambitions of the project, and in line with the drainage hierarchy, it is proposed to maintain a level of water at the bottom of the tank for the provision of harvested rainwater to be reused for irrigation of the green roofs and landscape gardens.

This will require the addition of submersible pumps to the tank that will be serviceable from the manhole cover provided. The tank shall not include a mains water backup, therefore, at times when the tank is empty irrigation will need to come from a Category 5 protected mains water supply.



Conclusions

Due to the revised layout of 18A Frognal Gardens the surface water run-off is expected to increase by 22% when compared with the volume currently coming from the building.

Due to this increase and in order to meet the expectations of the Camden Policy Guidance documents the following measures are proposed to relieve pressure on the local drainage system:

- Green roof attenuation – to control the flow of rainwater from the building

- Rainwater attenuation and controlled release – a hybrid underground system located to the front of the building that will be used to control the flow discharging to the combined sewer with additional harvesting capacity for reuse through irrigation.

With these measures in place we expect to mitigate the impact of any changes to the impermeable run-off surfaces whilst also addressing the future demands owing to climate change. The discharge rate from the attenuation tank shall be designed to be no worse than the original peak discharge for the current building's original design (based on 75mm/Hr/m^2).

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CONSULTING ENGINEERS

APPENDIX ñ CCTV SURVEY REPORT

Aqua-Jet Specialist Drainage Contractors Ltd
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Table of Contents

Project Name	Project Number	Project Date
04.09.19 18A Frognal Gardens, London		04/09/2019

Aqua-Jet Specialist Drainage Contractors Ltd
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Project Information

Project Name	Project Number	Project Date
04.09.19 18A Frognal Gardens, London		04/09/2019

Client

Company: Environmental Engineering Partnership
Street: The Chapel House, High Street
Town or City: West Wycombe, HP14 3AG

Site

Company: EEP
Street: 18A Frognal Gardens
Town or City: London, NW3 6XA

Contractor

Company: Aqua-Jet Specialist Drainage Contractors Ltd
Contact: Rob Wilkinson
Street: Yard 21 Hilton Ind Est, Sutton Lane
Town or City: Hilton, Derbyshire, DE65 5FE
Phone: 01283 730333
Email: aquajetltd@aol.com

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Section Inspection - 04/09/2019 - MH1X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
1	1	04/09/19		Not Specified	No Rain Or Snow	Y	MH1X

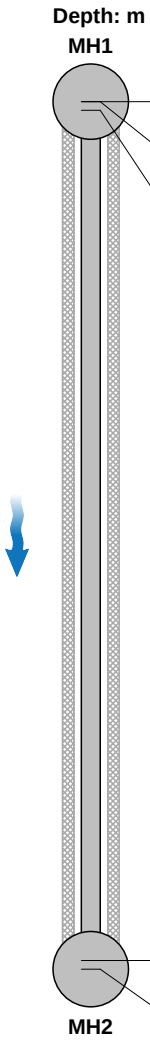
Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
RR/MD	FJ17 ZDS	Flexi	Not Specified	Not Specified	Not Specified

Town or Village:	London	**Inspection Direction:**	Downstream	**Upstream Node:**	MH1
Road:	18A Frognal Gardens	**Inspected Length:**	10.00 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	10.00 m	**Downstream Node:**	MH2
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Combined	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	100 mm
Year Constructed:		**Pipe Material:**	Cast iron
Flow Control:	No flow control	**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:87



Position [m]		Code	Observation	MPEG	Photo	Grade
0.00		MH	Start node type, manhole, reference number: MH1	00:00:00		
0.00		WL	Water level, 0% of the vertical dimension	00:00:01		
0.10	S01	DEE	Attached deposits, encrustation from 12 o'clock to 12 o'clock, 5% cross-sectional area loss, start: RUST / CORROSION	00:00:06		
9.90	F01	DEE	Attached deposits, encrustation from 12 o'clock to 12 o'clock, 5% cross-sectional area loss, finish: RUST / CORROSION	00:01:22		2
10.00		MHF	Finish node type, manhole, reference number: MH2	00:01:23		

Structural Defects					Construction Features				
Service & Operational Observations					Miscellaneous Features				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	1	1.0	1.0	10.0	2.0

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Section Pictures - 04/09/2019 - MH1X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
1	Downstream	MH1X		

MH1X_697d6ba7-1a86-43ea-9b00-4985f68a1723_20190906_095824_558.jpg, 00:00:06, 0.10 m
Attached deposits, encrustation from 12 o'clock to 12 o'clock, 5% cross-sectional area loss, start

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Section Inspection - 04/09/2019 - A/MH1X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
2	2	04/09/19		Not Specified	No Rain Or Snow	Y	A/MH1X

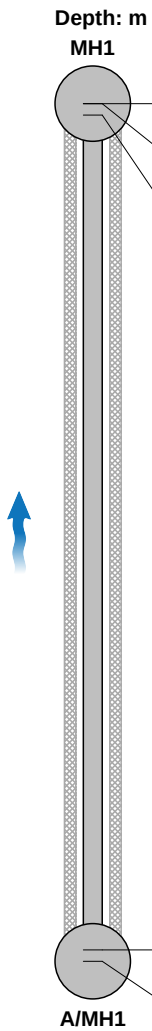
Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
RR/MD	FJ17 ZDS	Flexi	Not Specified	Not Specified	Not Specified

Town or Village:	London	**Inspection Direction:**	Upstream	**Upstream Node:**	A/MH1
Road:	18A Frognal Gardens	**Inspected Length:**	7.50 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	7.50 m	**Downstream Node:**	MH1
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Combined	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	100 mm
Year Constructed:		**Pipe Material:**	Cast iron
Flow Control:	No flow control	**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:66



Position [m]		Code	Observation	MPEG	Photo	Grade
0.00		MH	Start node type, manhole, reference number: MH1	00:00:00		
0.00		WL	Water level, 5% of the vertical dimension	00:00:01		
0.10	S01	DEE	Attached deposits, encrustation from 12 o'clock to 12 o'clock, 5% cross-sectional area loss, start: RUST / CORROSION	00:00:03		
7.40	F01	DEE	Attached deposits, encrustation from 12 o'clock to 12 o'clock, 5% cross-sectional area loss, finish: RUST / CORROSION	00:01:22		2
7.50		MHF	Finish node type, manhole, reference number: A/MH1	00:01:22		

Structural Defects					Construction Features				
Service & Operational Observations					Miscellaneous Features				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	1	1.0	1.1	8.0	2.0

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Section Pictures - 04/09/2019 - A/MH1X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
2	Upstream	A/MH1X		

A_MH1X_7069cf84-8557-4d21-aaf6-a844871a4e0a_20190906_100331_033.jpg, 00:00:03, 0.10 m
Attached deposits, encrustation from 12 o'clock to 12 o'clock, 5% cross-sectional area loss, start

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Section Inspection - 04/09/2019 - MH2X

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
3	3	04/09/19		Not Specified	No Rain Or Snow	Y	MH2X

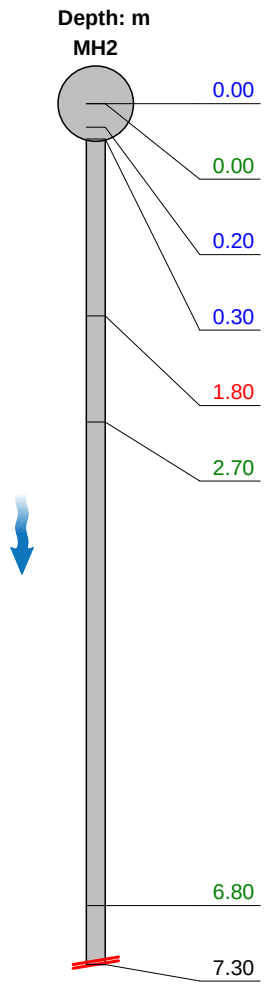
Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
RR/MD	FJ17 ZDS	Flexi	Not Specified	Not Specified	Not Specified

Town or Village:	London	**Inspection Direction:**	Downstream	**Upstream Node:**	MH2
Road:	18A Frognal Gardens	**Inspected Length:**	7.30 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	7.30 m	**Downstream Node:**	D/S MH2
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Combined	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	100 mm
Year Constructed:		**Pipe Material:**	Vitrified clay pipe (i.e. all clayware)
Flow Control:	No flow control	**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:64



Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node type, manhole, reference number: MH2: SURVEY THROUGH TOP ACCESS HOLE OF TRAP	00:00:00		
0.00	WL	Water level, 5% of the vertical dimension	00:00:01		
0.20	JN	Junction at 6 o'clock, diameter: 100mm: BOTTOM OUTLET OF TRAP	00:00:09		
0.30	SC	Size changes, new size(s), 150mm high	00:00:15		
1.80	CCJ	Crack, circumferential at joint from 8 o'clock to 3 o'clock	00:00:33		2
2.70	LD	Line deviates down	00:00:41		
6.80	LR	Line deviates right	00:01:23		
7.30	SA	Survey abandoned: JOINS MAIN BLIND	00:01:28		

Structural Defects					Construction Features				
Service & Operational Observations					Miscellaneous Features				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
1	10.0	1.4	10.0	2.0	0	0.0	0.0	0.0	1.0

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Section Pictures - 04/09/2019 - MH2X

Section	Inspection Direction	PLR	Client`s Job Ref	Contractor`s Job Ref
3	Downstream	MH2X		

MH2X_99a95e93-e9bd-4658-b633-a5a8b0b76c35_20190906_101510_209.jpg, 00:00:33, 1.80 m
Crack, circumferential at joint from 8 o'clock to 3 o'clock

Aqua-Jet Specialist Drainage Contractors Ltd
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Section Inspection - 04/09/2019 - JUNCTIONX

Section	Inspection	Date	Time	Client`s Job Ref	Weather	Pre Cleaned	PLR
4	4	04/09/19		Not Specified	No Rain Or Snow	N	JUNCTIONX

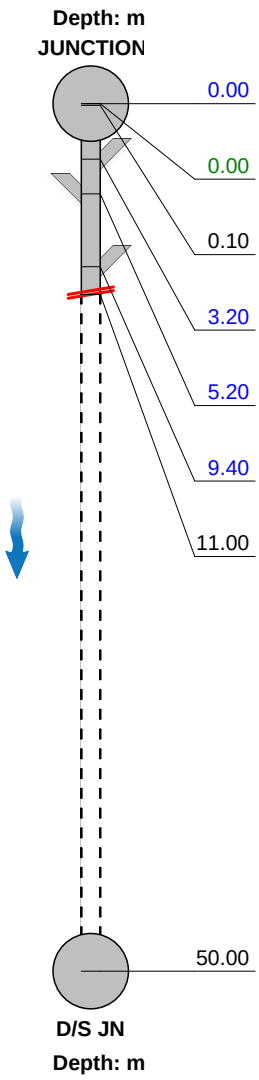
Operator	Vehicle	Camera	Preset Length	Legal Status	Alternative ID
RR/MD	FJ17 ZDS	Flexi	Not Specified	Not Specified	Not Specified

Town or Village:	London	**Inspection Direction:**	Downstream	**Upstream Node:**	JUNCTION
Road:	18A Frognal Gardens	**Inspected Length:**	11.00 m	**Upstream Pipe Depth:**	
Location:		**Total Length:**	50.00 m	**Downstream Node:**	D/S JN
Surface Type:		**Joint Length:**	0.00 m	**Downstream Pipe Depth:**	

Use:	Combined	**Pipe Shape:**	Circular
Type of Pipe:	Gravity drain/sewer	**Dia/Height:**	300 mm
Year Constructed:		**Pipe Material:**	Vitrified clay pipe (i.e. all clayware)
Flow Control:	No flow control	**Lining Type:**	No Lining
Inspection Purpose:		**Lining Material:**	No Lining

Comments:
Recommendations:

Scale: 1:435



Position [m]	Code	Observation	MPEG	Photo	Grade
0.00	MH	Start node type, manhole, reference number: JUNCTION	00:00:00		
0.00	WL	Water level, 5% of the vertical dimension	00:00:01		
0.10	REM	General remark: POOR VIEW OF PIPE DUE TO SIZE	00:00:07		
3.20	JN	Junction at 9 o'clock, diameter: 150mm	00:00:31		
5.20	JN	Junction at 3 o'clock, diameter: 150mm	00:00:42		
9.40	CN	Connection other than junction at 10 o'clock, diameter: 150mm	00:01:07		
11.00	SA	Survey abandoned: LIMIT OF SURVEY	00:01:17		
50.00		End of pipe			

Structural Defects					Construction Features				
Service & Operational Observations					Miscellaneous Features				
STR No. Def	**STR Peak**	**STR Mean**	**STR Total**	**STR Grade**	**SER No. Def**	**SER Peak**	**SER Mean**	**SER Total**	**SER Grade**
0	0.0	0.0	0.0	1.0	0	0.0	0.0	0.0	1.0

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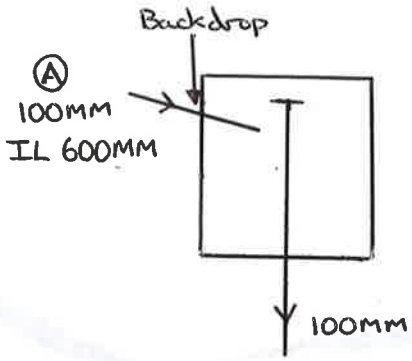
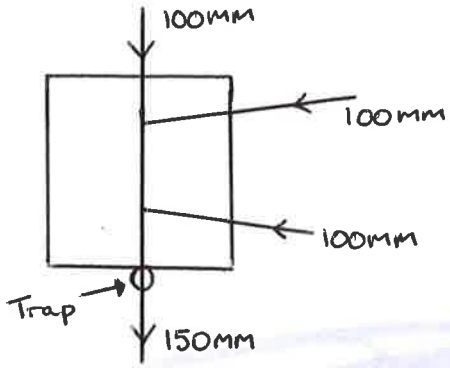
Manhole Information

REFERENCE: MH 1	DUTY: CB	REFERENCE: MH2	DUTY: CB
DIAGRAM: 		DIAGRAM: 	
DEPTH AT OUTLET: 1740MM		DEPTH AT OUTLET: 1400MM	
MH SIZE 900MM x 500MM		MH SIZE 950MM x 600MM	
MH MATERIAL Brick / Render		MH MATERIAL Brick	
OBSERVATIONS/ COMMENTS:		OBSERVATIONS/ COMMENTS:	
REFERENCE:	DUTY:	REFERENCE:	DUTY:
DIAGRAM:		DIAGRAM:	
DEPTH AT OUTLET:		DEPTH AT OUTLET:	
MH SIZE		MH SIZE	
MH MATERIAL		MH MATERIAL	
OBSERVATIONS/ COMMENTS:		OBSERVATIONS/ COMMENTS:	

Jetting • Vacuumation • Camera Inspection • Excavation & Repairs • Septic Tanks

Tel 01283 730333 Fax 01283 730444 www.aquajetltd.co.uk aquajetltd@aol.com

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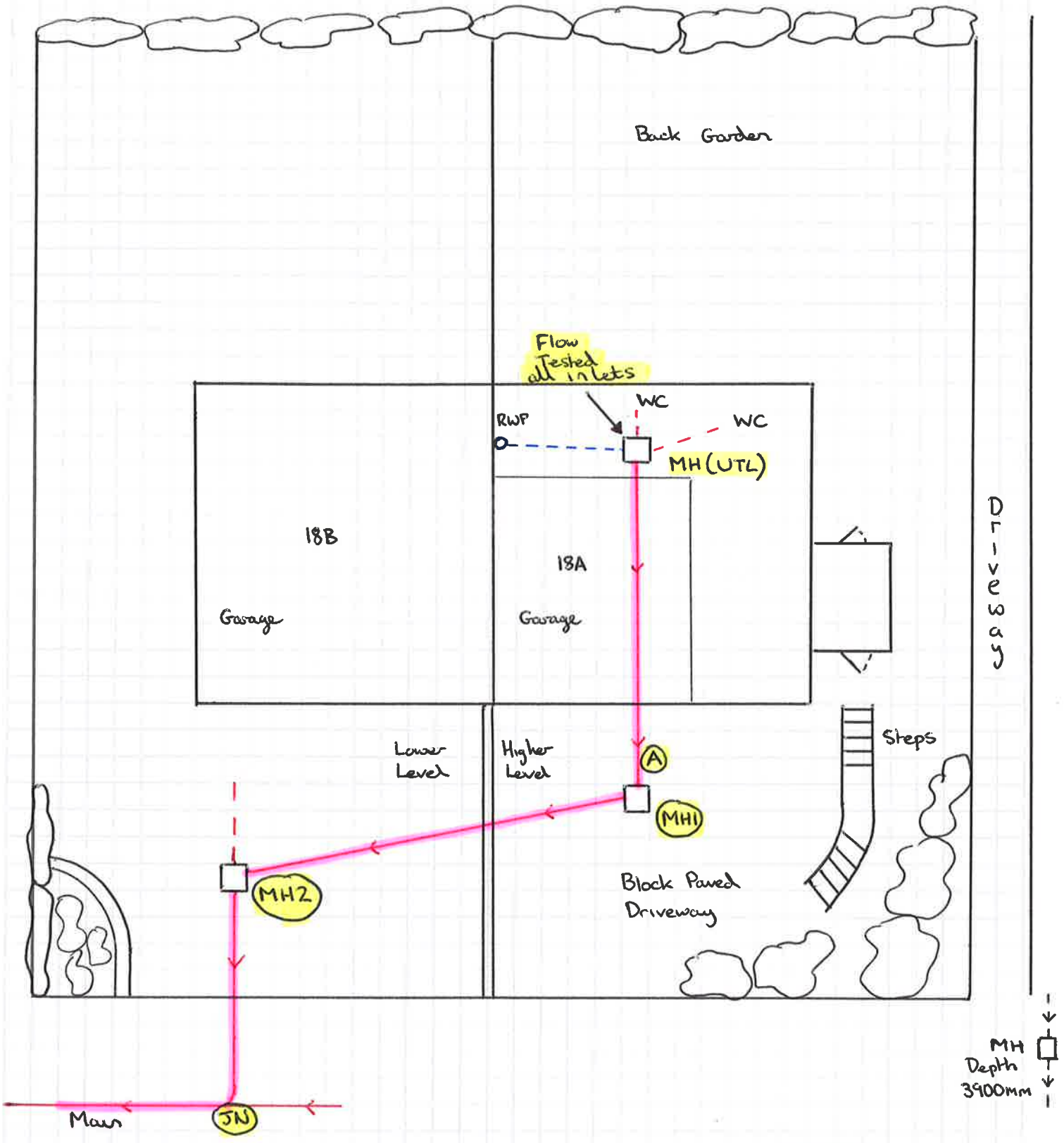

Sketch not to scale

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