edge structures

45-46 Chesham Road, Bovingdon

Below Ground Drainage Report

Project No:
9279

Date:
March 2021

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Revision History

Rev	Date	Purpose/Status	Document Ref.
0	04/03/2021	Planning	9279-ES-BGD-0
1	22/03/2021	Planning – minor updates	9279-ES-BGD-1
2	26/03/2021	Planning – minor updates	9279-ES-BGD-2

	Name	Qualifications	Position
Prepared by	DdA	MEng.	Structural Design Engineer
Checked by:	RR	MSc. CEng. MIStructE	Associate

1.0 Introduction

Edge Structured Ltd have undertaken the below ground drainage strategy in respect of a planning application for the construction of eight new semi-detached houses.

The drainage design has been based on;

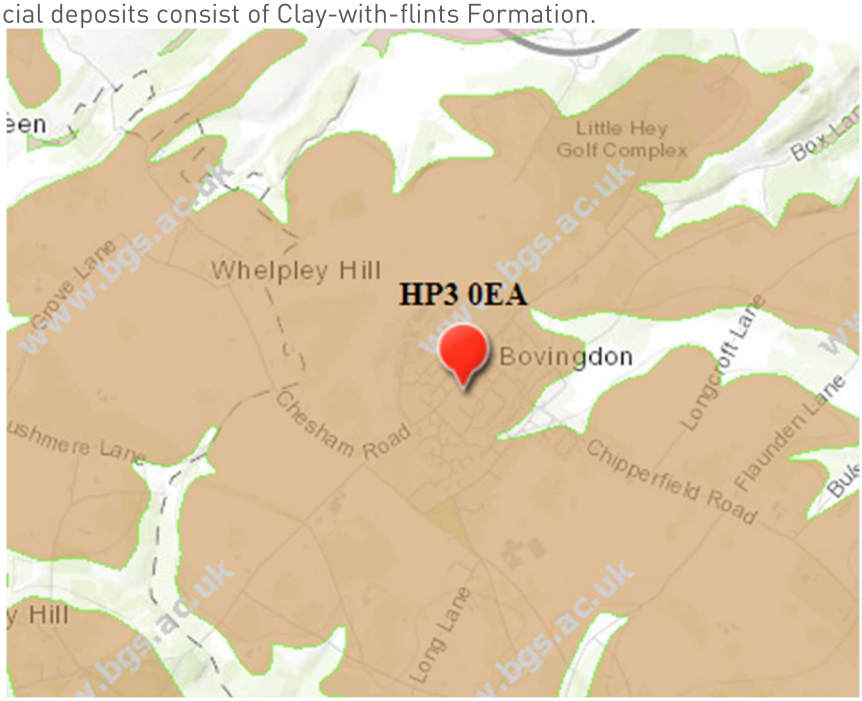
- Asset Survey - Thames Water Utilities Ltd, July 2020
- British Geological Survey Mapping
- Architectural drawings – Boast Architects, January 2021

1.1 Existing site

The site lies on the east side of Chesham Road, to the west of the village of Bovingdon and currently comprises a detached two storey chalet bungalow with a large garden to the rear.
The local area is largely residential with housing located adjacent to the development. The site is circa 2000m^2 in size.

1.2 Existing ground conditions

The site is relatively flat with limited changes in elevation.
The site's bedrock geology has been identified by the British Geological Survey's (BGS) online mapping as Lewes Nodular Chalk Formation and Seaford Chalk Formation. Superficial deposits consist of Clay-with-flints Formation.

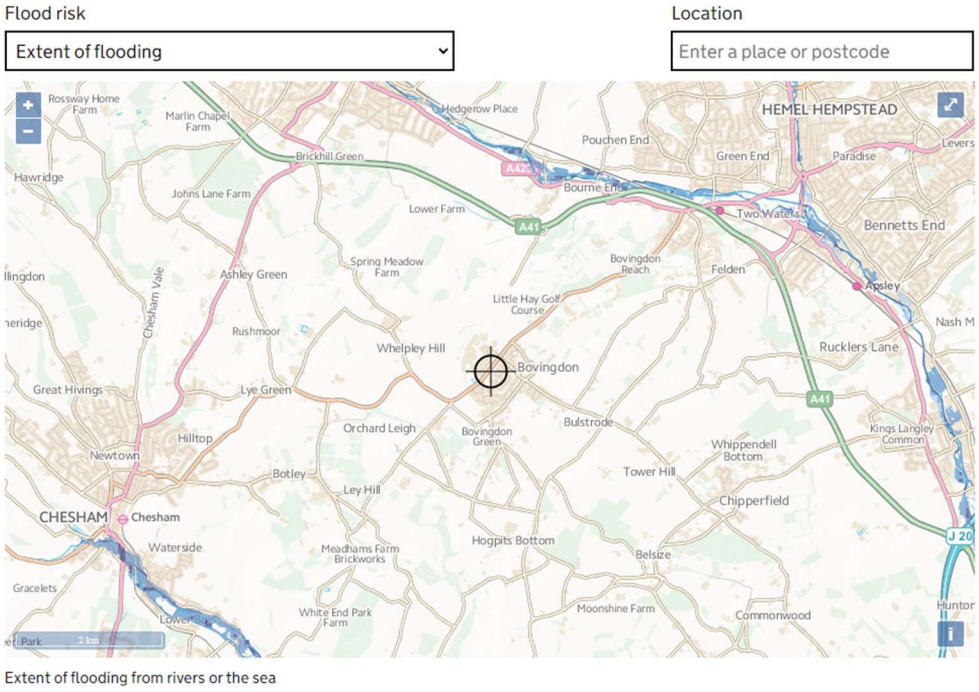


Extract from online BGS mapping (accessed 01/03/2021) showing extent of superficial clay-with-flints formation

The superficial clay-with-flints formations is typically considered a very poor drainage medium and soakage rates through this strata are expected to be minimal.

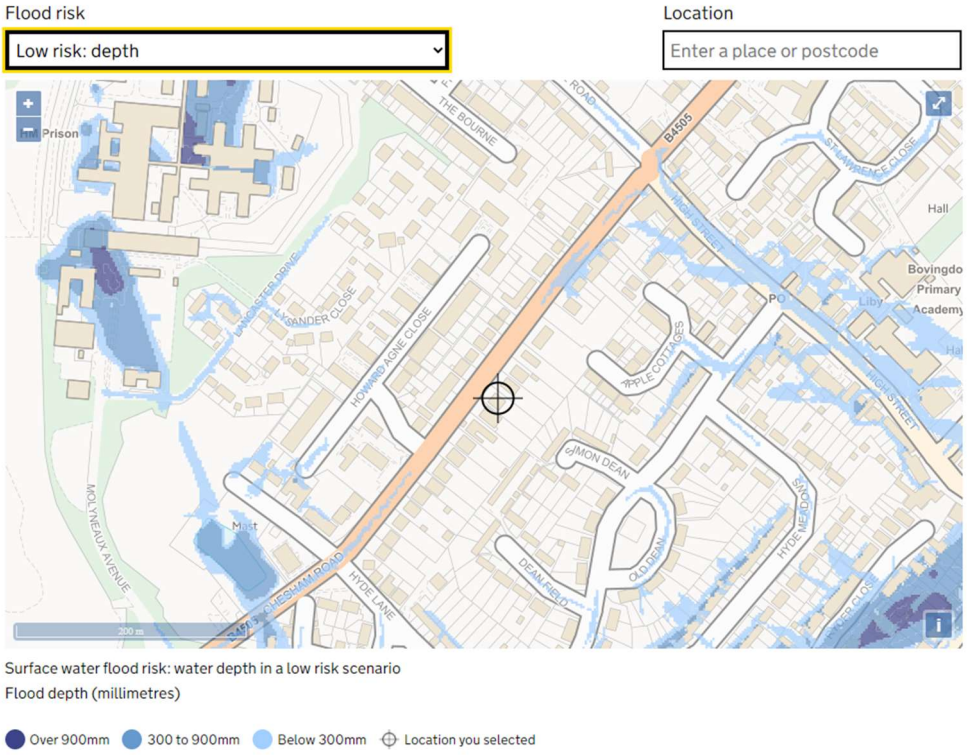
The Environmental Agency's Groundwater Source Protection Zone, as shown on the Defra Magic map, shows that the site is located over a 'Principle Aquifer' with 'High Vulnerability' and confirms that the site is located within groundwater Source Protection Zone III. These are layers of rock or drift deposits that provide a high level of water storage and may support water supply and/ or river base flow on a strategic scale.

Significant surface flooding is considered unlikely. The site lies within Flood Zone 1 (lowest risk) of flooding from rivers and the sea (fluvial).



Extent of fluvial flood risk (from flood-warning-information.service.gov.uk accessed 02/03/21)

The pluvial (surface water) flooding maps indicate the site is at low risk of pluvial flooding. Low risk is defined as 0.1% to 1% annual probability (equivalent to 1:1000 to 1:100 year return period).



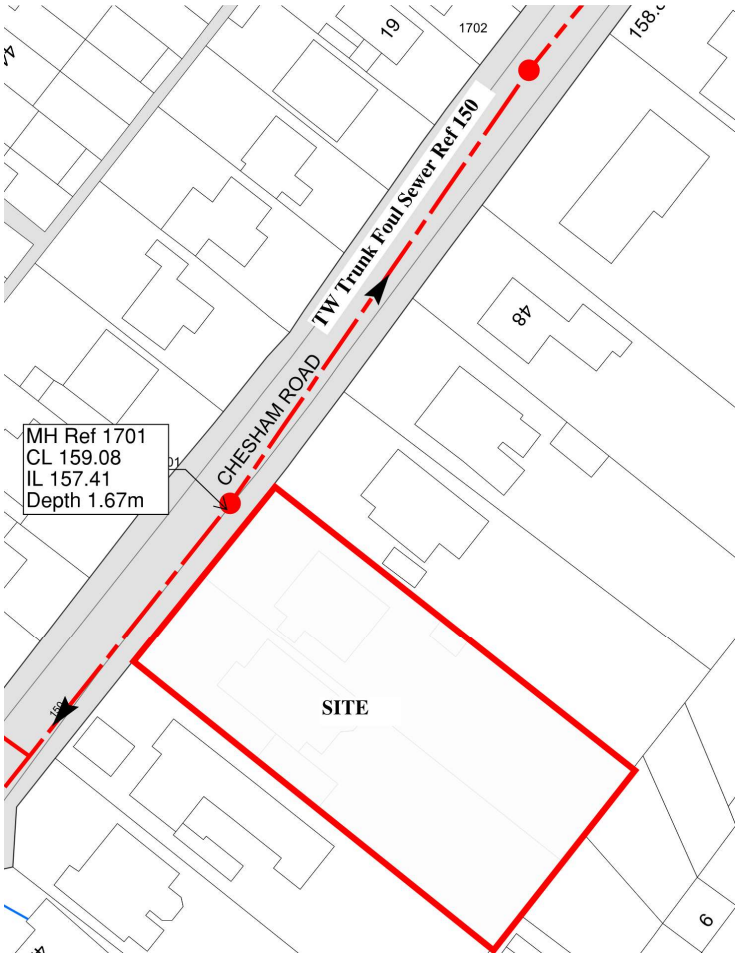
Extent of fluvial flood risk (from flood-warning-information.service.gov.uk accessed 02/03/21)

1.3 Proposals

The proposed development is for the redevelopment (demolition and new construction) of the existing bungalow and construction of eight new semi-detached houses, including access, turning and parking areas, landscape and plating and ancillary development.

1.4 Existing Private and Public sewers

The Thames Water asset survey (July 2020) indicates there is a public foul water trunk sewer on Chesham Road. The nearest manhole is ref 1701, which has a cover level of 158.1m and invert level of 157.4m. A new existing connection will be made for both combined foul water and storm water. Storm water flows will be restricted to 2.0 l/s, subject to approval from Thames Water and the LLFA (Hertfordshire Council).
No surface water or combined sewers are recorded. There are no recorded watercourses on, or close to, the site.



Location of trunk sewer relative to site; extract from Thames Water asset survey (July 2020)

2.0 Surface Water Drainage Strategy

In order to mitigate flood risk posed by the proposed development, adequate control measures are required. This will ensure that surface water is dealt with at source and the flood risk off site is not increased.

2.1 SuDS Drainage Hierarchy and overview

In accordance with the SuDS management train approach, the use of various SuDS measures to reduce and control surface water flows have been considered in details for the development:

Order	Technique	Comment	Can be used? Yes or No
1	Store rainwater for later use.	The dwellings will have a relatively low use of non-potable water. We do not consider this to be an ideal project for the inclusion of rainwater harvesting for re-use within the Buildings.	No
2	Use infiltration techniques such as porous surfaces in non-clay.	The desk study suggests that the superficial clay-with-flints formation is not a suitable infiltration medium.	No
3	Attenuate rainwater in ponds or open water features for gradual release.	Limited available space in the development for open ponds	No
4	Attenuate rainwater by storing in tanks ore sealed water feature for gradual release.	Space available for below ground storage crates.	Yes
5	Discharge rainwater to water course.	None in local vicinity.	No
6	Discharge rainwater to public sewer.	There are no surface water or combined sewers close to the site. Discharge to foul water sewer to be agreed with Thames Water.	Yes

2.2 Infiltration Potential and Greenfield rates.

The results of the desk study indicate very poor infiltration properties of the clay-with-flints superficial deposits on site.

Local borehole data indicates these deposits are circa 10m deep, which is considered substantial and precludes the use of conventional soakaways into the underlying chalk bedrock.

Greenfield runoff rates for the site are tabulated below:

	IMPERMEABLE AREA (m^2)	**PEAK DISCHARGE RATES (l/s)**				
		1 year	**QBAR**	**30 year**	**100 year**	**100 year + 30% cc**
Greenfield	1440	0.03	1.2	0.08	0.11	0.15

2.3 Surface Water Runoff

The existing site classifies as Previously Developed Land (PDL). The guidance from the district and county councils is to use infiltration where possible and, if not, achieve Greenfield runoff rates where practical. Where this cannot be achieved, a "Betterment Rate" should be achieved. For calculation purposes, a peak intensity rainfall has been taken as 75mm/hour, as per Herefordshire Council guidance.

Greenfield runoff rates and peak runoff rates attributed to the site area have been calculated for the existing and proposed sites and tabulated below. Peak runoff has been calculated assuming 100% runoff from impermeable surfaces. Details of the existing site drainage system are not available, so an estimated value of 29.5% impermeable surfaces has been used, based on OS mapping and satellite imagery.

The existing peak flow rate for the 75mm/hour event is 12.3 l/s. It is proposed to use a flow control device to limit storm water discharge from the site to 2.0 l/s. This represents a Betterment (reduction) of 83.7%.

Additional performance markers are provided below, for a 30% increase in rainfall intensity due to Climate Change:

- The Greenfield volume of runoff for the 1 in 100 year 360 min (winter) rainfall event is 2m^3. The post-development volume of runoff for the 1 in 100 year 360 min (winter) rainfall event is 43m^3.
- The Long Term Storage Volume is the difference between the post-development and the Greenfield volume of runoff for the 1 in 100 year 360 min (winter) rainfall event. The Long Term Storage Volume for the site is 77m^3.
- The attenuation storage to be provided on site is 92m^3. This takes into account the discharge-head relationship through the flow control device.

Refer to Appendix B for further surface water drainage calculations for the scheme.

2.4 Attenuation storage

Attenuation storage is needed to temporarily store water during periods where the runoff rates from the development site exceed the allowable discharge rates from the site.
Attenuation storage is provided plastic crates below the car park and garden area.
Refer to the drainage general arrangement in Appendix A for further details.

2.5 Exceedance events and overland flow routes

Below ground attenuation systems have been designed for the critical 1 in 100 year + climate change event. As such, no overland flows from exceedance of drainage systems within the site are anticipated for these events.

There is a small potential for overland flows to enter the site from Chesham Road through the road connection. This risk is to be mitigated by the provision of a localised high point in the access road and in the landscape along the boundary with Chesham Road. The risk of flooding from off-site overland is therefore considered minimal.

3.0 Foul Water Drainage Strategy

3.1 Overview

The site will require foul drainage provision for the eight proposed dwellings.

3.2 Proposed foul water calculations

Discharge units for appliances are taken as System III from Table 2 in BS EN 12056-2:2000 Section 6.2.2 p.16. Proposed discharge is calculated following the method described in Appendix C in BS EN 752-4:1997. Frequency factor of 0.5 is used for all domestic applications.

The existing output flow then becomes: 0.5 x square root of all discharge units = **4.8 l/s**. Refer to Appendix C for detailed calculation steps.

4.0 Summary & Conclusions

The local clayey soil conditions have poor permeability, which precludes the use of conventional soakaways and infiltration components.

Roof runoff will be directed to a geocellular system to store and manage runoff prior to outfall.

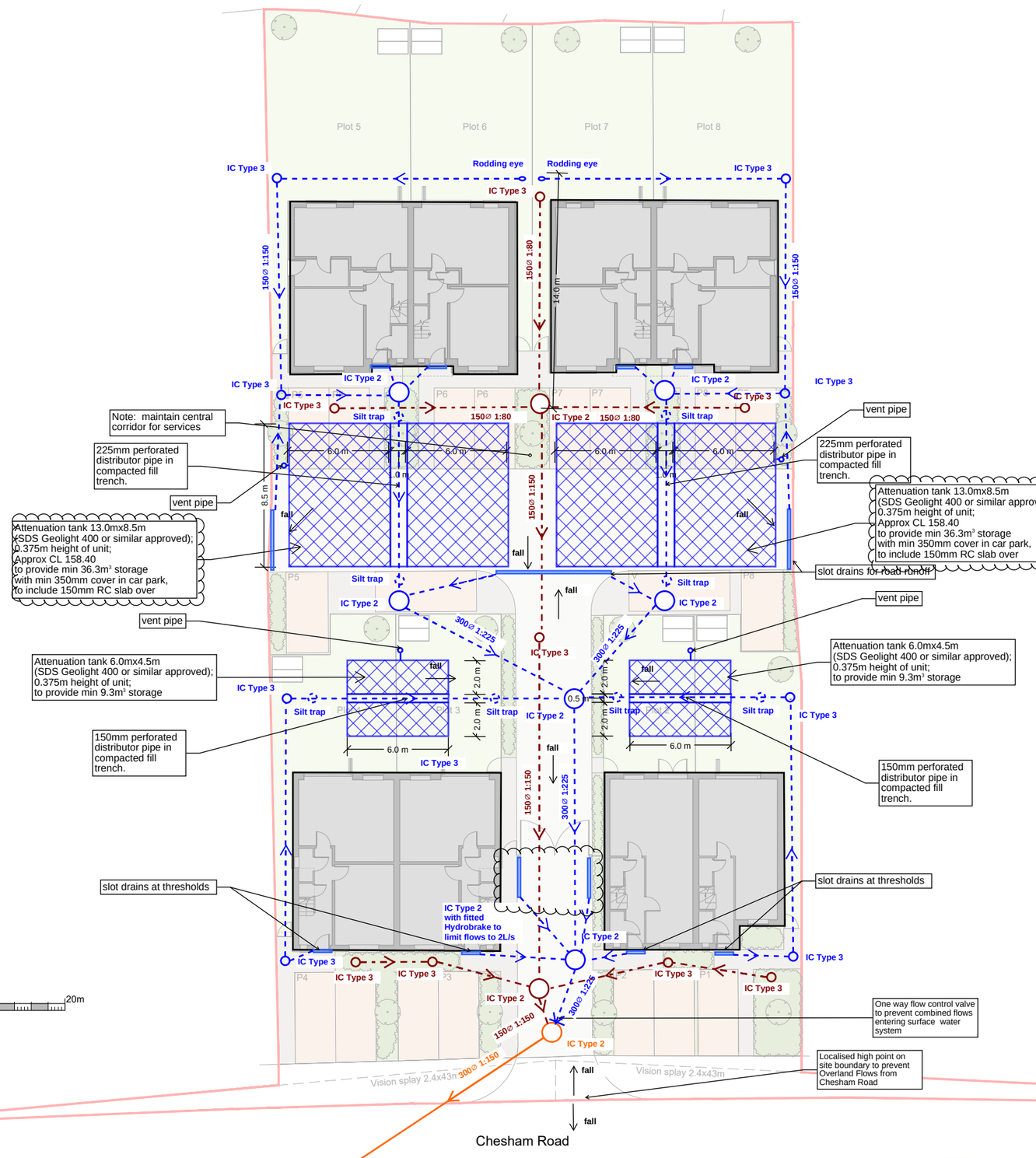
Both foul and storm water sewers connect to a public foul sewer via a manhole on Chesham Road. Storm water flows will be attenuated on site and flow restricted to 2.0 l/s. This constitutes a significant betterment (83.7% reduction) over existing peak flow.

The proposed surface water drainage network has been designed to contain runoff without flooding off-site or on-site for all rainfall events up to and including the 1 in 100 year + 40% climate change event.

The table below summarises the change foul and surface water discharge from the site.

Type	Existing	Proposed	Overall Change
Peak SW flow	12.3 l/s	2.0 l/s	-83.7%
Foul water	Previous unknown	4.8 l/s	N/A

Appendix A: Proposed Below Ground Drainage Plan



Inspection Chamber Schedule (typical)

Type 2 Precast concrete chambers (depth < 1.5m):
min 1050mm internal diamater,
approx. 1210mm external diameter

Type 3 Polypropylene chambers (depth < 1.5m):
min 460mm internal diameter,
approx, 480mm external diameter

Key & Notes

- Site boundary
- Proposed building outlines
- Proposed below ground SW storage crates, single-stacked (0.35m deep). Min 91m³ total attenuation volume to be provided.
- New FW inspection chamber / manhole
- 100mm SW pipe, with flow direction, min fall 1:40 U.N.O.
- Linear slot drain
- New SW inspection chamber / manhole
- 100mm SW pipe, with flow direction, min fall 1:80 U.N.O.
- 100mm Combined pipe, with flow direction, min fall 1:80 U.N.O.

RWP locations by others

Finish levels by others. Minimum recommended:
1:40 fall for tarmac
1:80 fall paved surfaces

Total site footprint to be drained: appr. 2000m²
Proposed permeable (soft landscaping): appr. 553m²
Proposed impermeable (buildings, paving and roads): appr. 1447m²

Note: Existing layout based on Boast Architects' drg 2600_SK007_Rev D Proposed Site Plan, December 2020

Site Plan

FOR INFORMATION

Project No. : 9279 - 45-46 Chesham Road, Bovingdon
Sheet No. : SK-001-RevC - Below Ground Drainage Scheme
Date: 10/03/21
Made by: DdA
Checked by: RR

edge structures
Phoenix Yard
69 Kings Cross Road
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Appendix B: Surface Water Drainage Calculations

PROJECT TITLE:	45-46 Chesham Road, Bovingden		PROJECT NO.	9279	edge structures	Purple Patch
ELEMENT:	Surface water SuDS calculations - 1 in 100 year storm	ENGINEER:	DdA	DATE:	03-Mar-21	14 Rosebery Avenue
		CHECKED:	RR	SHEET NO.	SW 1	Holborn
						London EC1R 4TD

KEY:

X		INPUT
X	★	DROP-DOWN INPUT
X		CALC
X		OUTPUT
X		REFERENCE

1 Site characteristics

Size of catchment area (total site) A_{catch} = 2000 m^2 = 0.20 ha

p = 72 % (proportion collected in system)

[from UKSuDS Report]

Standard percentage runoff (depends on SOIL)	SPR =	0.1	
Average annual rainfall	SAAR =	733	mm
5-year return period rainfall of 60 minutes duration	M_{5-60} =	20	mm
Ratio 60 min to 2 day rainfall of 5 year return period	r =	0.40	
Routing coefficient	c_r =	1.3	
Runoff coefficent	c_v =	1	
Increase of rainfall intensity due to Climate Change	$p_{climate}$ =	30 %	
Return period 1	=	2	years
Return period 2 (no flooding)	=	30	years
Return period 3 (no flooding on neighbouring sites)	=	100	years
Select return period:	=	100 ★	

2 Greenfield runoff rates

2.1 **Scaled Greenfield runoff rate, $QBAR_{catch\ Institute\ of\ Hydrology\ Rep}$** = A_{catch} x $QBAR_{rural}$ / AREA

= 0.04 L/s = 3.55E-05 m^3/s

2.2 **Growth rates and Scaled greenfield runoff [Flood Studies Supplementary Reports (FSSR) 2 & 14 (Institute of Hydrology)]**

Period	FSR growth rate	Scaled Greenfield runoff rates	
year(s)		L/s	m^3/s
1	0.85	0.03	3.01E-05
10	1.65	0.06	5.85E-05
30	2.3	0.08	8.16E-05
100	3.19	0.11	1.13E-04
100 + % CC	4.1	0.15	1.47E-04
1000 + % CC	10.7	0.38	3.78E-04

3 Soil infiltration (zero infiltration system)

Infiltation dims — Percentage of area that is permeable 0 % — A_eff 0 m^2

Use as storage? N ★

Assumed infiltration rate 1	i	0.00E+00 m/s	% highest	0.0	L/s
Assumed infiltration rate 2	i	0.00E+00 m/s	% mean	0.0	L/s
Assumed infiltration rate 3	i	0.00E+00 m/s	% lowest	0.0	L/s

Applied Factor of Safety (F.o.S.) against failure [Table 25.2 of CIRIA SuDS Manual 2015] 3.00

4 Discharge rate for modelling

Selected: ★ 2.00 l/s

1	Discharge to sewer - lowest	1.00	L/s
2	Discharge to sewer - mean	2.00	L/s
3	Discharge to sewer - highest	4.00	L/s

5 Infiltration + discharge rate for modelling

Selected: ★ 2.00 l/s

Case	Description	Value	
1	Greenfield (total site area)	0.11	L/s
2	Permeability 0x10^-4 m/s	2.00	L/s
3	Permeability 0x10^-4 m/s	2.00	L/s
4	Permeability 0x10^-4 m/s	2.00	L/s

6 The Wallingford Procedure

3.1

	Duration, D	Growth factor Z1	M5-D	Growth factor Z2	M100-D	M100-D +30%	i_max	Peak flow	Runoff volume	Allowable disch	Attenuation volume
	min		mm		mm	mm	mm/hr	m^3/s	m^3	m^3	m^3
	5	0.38	7.6	1.84	14.0	18.2	218.2	1.1E-01	26.2	0.6	25.6
	10	0.53	10.6	1.91	20.2	26.3	157.9	8.2E-02	37.9	1.2	36.7
	15	0.64	12.8	1.95	25.0	32.4	129.8	6.7E-02	46.7	1.8	44.9
	30	0.81	16.2	2	32.4	42.1	84.2	4.4E-02	60.7	3.6	57.1
	60	1.00	20.0	2.03	40.6	52.8	52.8	2.7E-02	76.0	7.2	68.8
	120	1.20	24.0	2.01	48.2	62.7	31.4	1.6E-02	90.3	14.4	75.9
critical duration	240	1.43	28.6	1.97	56.3	73.2	18.3	9.5E-03	105.5	28.8	76.7
	360	1.59	31.8	1.94	61.7	80.2	13.4	7.0E-03	115.5	43.2	72.3
	600	1.77	35.4	1.9	67.3	87.4	8.7	4.5E-03	125.9	72.0	53.9
	1440	2.20	44.0	1.81	79.6	103.5	4.3	2.2E-03	149.1	172.8	0.0

3.2 Gross storage requirement = 77 m^3

7 Storage sizing

Pipe, soakaway and manhole storage available (optional) = = 4.3 m^3

Factor to account for future silting up (of below ground attenuation crates, swales, infiltration or detention basins) = 1.00 % x1.1 general practice where siltation is likely

Factor for discharge-head relationship = 1.25 % conservatively applied to both infiltration and to sewer discharge

3.3 **Attenuation storage required** = 91.5 m^3

Conclusion

- **The storm event producing the greatest attenuation volume for the 1 in 100 year storm +30% climate change has been calculated, using the Wallingford procedure**
- **The Greenfield Run-off rates have been calculated for the whole site**
-
- **The req. attenuation value is : 92 m^3**

Appendix C: Foul Water Drainage Calculations

PROJECT TITLE: 430-432 Uxbridge Road		PROJECT NO. 9191	edge structures Pheonix Yard 69 Kings Cross Road London WC1X 9LN tel: +44 (020) 7239 4950
ELEMENT: **Foul Water - Proposed**	ENGINEER: DdA	DATE: 03-Mar-21	
	CHECKED:	SHEET NO. FW 1	

1 Appliance list

	Appl .1	DU	Appl. 2	DU	Appl. 3	DU	Appl. 4	DU	Appl. 5	DU	Appl. 6	DU	total DU	K	(DU x K)
1 Guest WC	WC, 7.5L cist	1.8	Wash basin	0.3	---		---		---		---		2.1	0.5	1.05
2 Bathroom	WC, 7.5L cist	1.8	Wash basin	0.3	Bath	1.3	---		---		---		3.4	0.5	1.7
3 Ensuite	WC, 7.5L cist	1.8	Wash basin	0.3	Shower (no pl	0.4	---		---		---		2.5	0.5	1.25
3 Kichen	Kitchen sink	1.3	Dishwasher (h	0.2	Washing mac	1.2	---		---		---		2.7	0.5	1.35
3 Utility	Kitchen sink	1.3	---		---		---		---		---		1.3	0.5	0.65
	---		---		---		---		---		---				
	---		---		---		---		---		---				
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2 Proposed accomodation schedule

	Plot 1+2	Plot 3+4	Plot 5+6	Plot 7+8				n	n.DU	K	n.K.DU
1 Guest WC	2	2	0	2				6	12.6	0.5	6.3
2 Bathroom	2	2	2	2				8	27.2	0.5	13.6
3 Ensuite	2	2	3	3				10	25	0.5	12.5
3 Kichen	2	2	2	2				8	21.6	0.5	10.8
3 Utility	0	0	1	1				2	2.6	0.5	1.3

3 Wastewater flowrate

K_eff = 0.52 weighted proportionally according to sum of DU at each frequency factor

1.4) **ΣDU** = 86

Q_{ww} = 4.79 l/s

Conclusion

- **Drainage units for different applicances are listed according to BS EN 12056-2:2000.**
- **DU per room is calculated**
- **Nuber of rooms of each type are calculated**
- **Effective frequency factor is calculated**
- **From this the wastewater flowrate is calculated as 4.79l/s**