

Appendix H: Impermeable Area Catchments



Legend

Site Boundary

Land Parcel

Buildings

Road

Private/shared driveways



Parcel	Total Area (ha)	Buildings (ha)	Roads (ha)	Driveways (ha)	Impermeable area total (ha)	Permeable area (ha)	Approx. % Impermeable
A	1.097	0.172	0.262	0.196	0.630	0.467	57%
B	0.559	0.126	0.101	0.092	0.320	0.239	57%
C	0.439	0.070	0.090	0.048	0.209	0.230	48%
D	0.817	0.093	0.117	0.084	0.294	0.523	36%
E	1.119	0.172	0.262	0.176	0.610	0.509	55%
F	1.151	0.206	0.242	0.200	0.648	0.503	56%



Land west of Bilsham Road

Client: Landlink Estates Ltd

Impermeable Areas

Scale: 1:1500@A3
CampbellReith OS Copyright: © Crown copyright. All rights reserved. Licence number 100020027
Boyle+Summers Proposed Site Layout, drg no BBY-BSL-ZZ-XX-DR-A-2001-DF Rev D (Dec 2021)
Job Number: 13684
Drawn by - Checked by: RP - AJH
Drg No - Status/Revision: 13684-CRH-XX-XX-FG-G-7039 - P2
File location: N:\13500 - 13749\13684 R - Lamb Field\Project_Workspaces (pdf in Outputs)
Date (Revision History): 20/12/2021 (P1, First Issue, 28/10/21, RP, P2, Proposed Development update, 20/12/21, RP)
ARUN DISTRICT COUNCIL Y/3/22/OUT

CampbellReith

consulting engineers

LONDON 020 7340 1700 ☐ MANCHESTER 0161 819 3060

REDHILL 01737 784 500 ☒ BIRMINGHAM 01675 467 484

BRISTOL 0117 916 1066 ☐ DUBAI 00 971 4453 4735

www.campbellreith.com

Appendix I: Proposed Drainage Strategy and Supporting Calculations

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by: Isabel Clements

Site name: Land West of Bilsham Road

Site location: Yapton

Site Details

Latitude: 50.81220° N

Longitude: 0.61639° W

Reference: 1923129922

Date: Nov 09 2021 09:54

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach: FEH Statistical

Site characteristics

Total site area (ha): 1

Methodology

Q_{MED} estimation method: Calculate from BFI and SAAR

BFI and SPR method: Calculate from dominant

HOST class: HOST 22

BFI / BFIHOST: 0.374

Q_{MED} (l/s): 4.58

Q_{BAR} / Q_{MED} factor: 1.14

Hydrological characteristics

	Default	Edited
SAAR (mm):	729	729
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

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

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

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

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	5.21	5.21
1 in 1 year (l/s):	4.43	4.43
1 in 30 years (l/s):	11.97	11.97
1 in 100 year (l/s):	16.61	16.61
1 in 200 years (l/s):	19.47	19.47

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Calculated by: Isabel Clements

Site name: Land West of Bilsham Road

Site location: Yapton

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site Details

Latitude: 50.81219° N

Longitude: 0.61695° W

Reference: 693580872

Date: Nov 09 2021 15:12

Site characteristics

Total site area (ha): 1

Significant public open space (ha): 0

Area positively drained (ha): 1

Impermeable area (ha): 1

Percentage of drained area that is impermeable (%): 100

Impervious area drained via infiltration (ha): 0

Return period for infiltration system design (year): 10

Impervious area drained to rainwater harvesting (ha): 0

Return period for rainwater harvesting system (year): 10

Compliance factor for rainwater harvesting system (%): 66

Net site area for storage volume design (ha): 1

Net impermeable area for storage volume design (ha): 1

Pervious area contribution to runoff (%): 30

Methodology

Q_{MED} estimation method: Calculate from BFI and SAAR

BFI and SPR method: Calculate from dominant HOST

Soil characteristics: Default Edited

HOST class: --

BFI HOST: -- 0.374

SPR HOST: -- 0.6

Default Edited

Hydrological characteristics

Q_{MED}: -- 4.58

Q_{BAR} / Q_{MED} conversion factor: -- 1.136

Rainfall 100 yrs 6 hrs: -- 63

Rainfall 100 yrs 12 hrs: -- 91.63

FEH / FSR conversion factor: 1.19 1.19

SAAR (mm): 729 729

M5-60 Rainfall Depth (mm): 20 20

'r' Ratio M5-60/M5-2 day: 0.4 0.4

Hydrological region: 7 7

Growth curve factor 1 year: 0.85 0.85

Growth curve factor 10 year: 1.62 1.62

Growth curve factor 30 year: 2.3 2.3

Growth curve factor 100 years: 3.19 3.19

Q_{BAR} for total site area (l/s): 5.21 5.21

Q_{BAR} for net site area (l/s): 5.21 5.21

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Design criteria

Climate change allowance factor: 1.4

Urban creep allowance factor: 1.1

Volume control approach: Flow control to max of 2 l/s/ha or

Interception rainfall depth (mm): Q_{bar} 5

Minimum flow rate (l/s): 2

Site discharge rates	Default	Edited	Estimated storage volumes	Default	Edited
1 in 1 year (l/s):	4.4	4.4	Attenuation storage 1/100 years (m³):	944	944
1 in 30 years (l/s):	5.2	5.2	Long term storage 1/100 years (m³):	0	0
1 in 100 year (l/s):	5.2	5.2	Total storage 1/100 years (m³):	944	944

This report was produced using the storage estimation tool developed by HRWallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at <http://uksuds.com/terms-and-conditions.htm>. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.



Parcel	Storage Requirement (m³)						
	Surface Treatment	Depth (m)	Area (m²)	Void Ratio	Length (m)	%	Volume (m³)
Parcel A	Permeable Pave	0.45	1555	30%		33%	210
	Attenuation Tank A1	1.00	263	95%		39%	250
	Attenuation Tank A2	1.30	141	95%		27%	174
	Total Provided					100%	634

Parcel	Storage Requirement (m³)						
	Surface Treatment	Depth (m)	Area (m²)	Void Ratio	Length (m)	%	Volume (m³)
Outline Area	Permeable Pave	0.45	4500	30%		31%	608
	Pond	0.60	1600			49%	960
	Swale (effective vol)	0.40			450	8%	153
	Residual Attenuation (Shallow Basin)	0.15	1630			12%	245
	Residual Attenuation (Attenuation Tanks)	1.00	260	95%		12%	245
	Total Provided					100%	1966
	Total Required						1964

Vortex Flow Control
Set at QBar (~3.3l/s
for Area A)
IL = 2.5m

Outfall 1
Approx. IL = 2.55 m
Subject to Ordinary
Watercourse Consent.

Attenuation Tank A1
Area = 8m x 33m = 264m²
Depth = 1.0m
Volume = 250m³
CL = 4.20 m (0.6 cover allowance)
Top of tank = 3.60m
IL = 2.60m
To be installed during Phase 1

Attenuation Tank A2
Area = 5m x 28m = 140m²
Depth = 1.3m
Volume = 170m³
CL = 4.2 m (0.6 cover allowance)
Top of tank = 3.60m
IL = 2.60m
To be installed during Phase 1.

Area A (Phase 1)
Impermeable area = 0.63 ha
+ 10% UC = 0.69 ha
All private and shared driveways within
Phase 1 to be permeable paving.
Assumed that 75% positively contribute
to the attenuation on site. Approx 210m³.

All pipes within Area A under
highways to be minimum
300mm diameter with cover
equal to or greater than 1.2m
and laid at minimum 1:200 to
achieve self cleansing velocity.

Outline Application Area
Areas B, C, D, E + F
Impermeable area = 1.76 ha (+ 10% UC = 2.29 ha)

Pond (SuDS/wildlife feature)
Permanent Water approx 0.9m deep.
0.6m deep temporary storage with 1:3 to 1:5 side
slopes to provide attenuation and treatment to run-off.
Area = approx 1600 m²
Depth = 0.60m
Volume = 960m³
Assumed TWL of permanent po

Roadside Swales
Assumed 0.4m deep swales running the length
of the highway to provide conveyance, treatment
and storage of runoff. Check dams to be
introduced periodically to control runoff an
maximise storage potential. Effective storage
volume assume

Outfall 2
Approx. IL = 1.45 m
Subject to Ordinary
Watercourse Consent.

Vortex Flow Control
Set at QBar (~9.8l/s
for Outline area)
IL = 1.70m

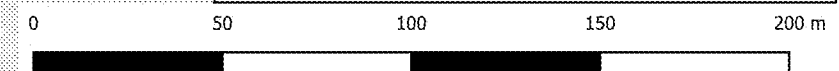
Optional Shallow Dry Basin/Exceedance Storage
(Around perimeter of pond)
To provide up to 245m³ additional exceedance attenuation
as alternative to attenuation tanks.
Max 0.15m deep basin over area of approx 1600m² with 1:5
side slope and flattened

Permeable Paving
All private and shared driveways within outline area
to be permeable paving. Average sub base depth
450mm, void ratio 30%.
Assumed that 75% positively contribute to the
attenuation on site. Total volume = approx 600 m³.

NOTES
1.Attenuation Requirement = 944m³/ha
2.No infiltration assumed.
3.Assumed that 75% of private/shared driveways as usable as
permeable paving due to levels across parcels A and B.
4.Detailed Area - Phase 1 (Area A) to provide sufficient attenuation to
be self sufficient with no reliance on other parcels.
5.Assumed that swale running the length of the main highway through
the site as shown in green provides adequate storage for highway run-
off.
Therefore:
Total storage volume required for Phase 1 (Area A) = approx 860 m³
Permeable Paving = 315 m³
Attenuation tank in POS = 390 m³

Legend

- Site Boundary
- Land Parcel
- Phase 1 Surface Water Manhole
- Phase 1 Flow Control Manhole
- Phase 1 Surface Water
- Phase 1 Attenuation Tank
- Surface Water Manhole
- Flow Control Manhole
- Surface Water
- Permeable Paving
- Swale
- Optional Exceedance Storage Area
- Approximate Location of Gas Main
- Gas Main Easement (assumed 3m each side)



Land west of Bilsham Road

Client: Landlink Estates Ltd

Surface Water Drainage Strategy

Scale: 1:2000@A3
CampbellReith OS Copyright: © Crown copyright. All rights reserved. Licence number 100020027
Indigo Landscape Architects Ltd, Illustrative Landscape Masterplan, drg no 964-MP-01 Rev B (Dec 2021)
Job Number: 13684
Drawn by - Checked by: RP/RLF - AJH
Drg No - Status/Revision: 13684-CRH-XX-XX-FG-G-7040 - P2
File location: \\rad-data1\gis-data\13500 - 13749\13684 R - Lamb Field\Project_Workspaces (pdf in Outputs)
Date (Revision History): 23/12/2021 (P1, First Issue, 20/12/21, RP; P2, Minor Amendments, 23/12/21, PLF)
ARUN DISTRICT COUNCIL 13/12/2021

CampbellReith
consulting engineers
LONDON 020 7340 1700 □ MANCHESTER 0161 619 3060
REDHILL 01737 784 500 □ BIRMINGHAM 01675 467 484
BRISTOL 0117 916 1066 □ DUBAI 00 971 4453 4735
www.campbellreith.com

Land West of Bilsham Road

Design Calculations

13684 - Proposed Surface Water Network
Rev P2

Date: 20/12/21

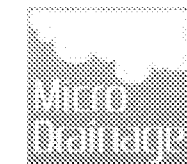
Project No: 13684

Engineer: I. Clements

Checked: A. Higgins

Campbell Reith Hill LLP
Raven House
29 Linkfield Lane
Redhill
Surrey RH1 1SS



CampbellReith		Page 1
Raven House 29 Linkfield Lane Surrey RH1 1SS	13684 Lamb Field Proposed SW	
Date 15/12/2021 14:11	Designed by IC	
File 13684 - PROPOSED SW - REV B.MDX	Checked by AJH	
XP Solutions	Network 2020.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model	
Return Period (years)	100
FEH Rainfall Version	1999
Site Location GB 497500 102350 SU 97500 02350	
C (1km)	-0.025
D1 (1km)	0.390
D2 (1km)	0.245
D3 (1km)	0.403
E (1km)	0.310
F (1km)	2.321
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.222	4-8	0.391	8-12	0.017

Total Area Contributing (ha) = 0.630

Total Pipe Volume (m³) = 23.993

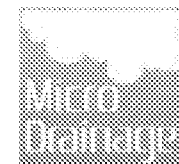
Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	40.000	0.450	88.9	0.063	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	53.000	0.260	203.8	0.021	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.40	4.810	0.063	0.0	0.0	0.0	1.67	117.9	8.5
1.001	50.00	6.20	4.360	0.084	0.0	0.0	0.0	1.10	77.6	11.4

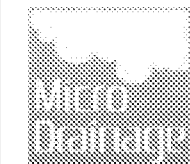
CampbellReith		Page 2
Raven House	13684	
29 Linkfield Lane	Lamb Field	
Surrey RH1 1SS	Proposed SW	
Date 15/12/2021 14:11	Designed by IC	
File 13684 - PROPOSED SW - REV B.MDX	Checked by AJH	
XP Solutions	Network 2020.1	

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.000	45.000	0.300	150.0	0.126	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	51.000	0.250	204.0	0.189	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	29.000	0.145	200.0	0.147	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	34.000	0.170	200.0	0.042	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	5.000	0.050	100.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	20.000	1.360	14.7	0.035	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	26.000	0.130	200.0	0.007	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	49.000	0.810	60.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	11.000	0.100	110.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.000	50.00	5.59	4.400	0.126	0.0	0.0	0.0	1.28	90.6	17.1
1.002	50.00	6.98	4.100	0.399	0.0	0.0	0.0	1.10	77.5	54.0
1.003	50.00	7.42	3.850	0.546	0.0	0.0	0.0	1.11	78.3	73.9
1.004	50.00	7.93	3.710	0.588	0.0	0.0	0.0	1.11	78.3	79.6
3.000	50.00	5.08	5.100	0.000	0.0	0.0	0.0	1.00	17.8	0.0
3.001	50.00	5.21	5.050	0.035	0.0	0.0	0.0	2.64	46.7	4.7
1.005	50.00	8.32	3.540	0.630	0.0	0.0	0.0	1.11	78.3	85.3
1.006	50.00	8.72	3.410	0.630	0.0	0.0	0.0	2.03	143.1	85.3
1.007	50.00	8.87	2.600	0.630	0.0	0.0	0.0	1.25	49.5	85.3

CampbellReith		Page 3
Raven House 29 Linkfield Lane Surrey RH1 1SS	13684 Lamb Field Proposed SW	
Date 15/12/2021 14:11	Designed by IC	
File 13684 - PROPOSED SW - REV B.MDX	Checked by AJH	
XP Solutions	Network 2020.1	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.063	0.063	0.063
1.001	-	-	100	0.021	0.021	0.021
2.000	-	-	100	0.126	0.126	0.126
1.002	-	-	100	0.189	0.189	0.189
1.003	-	-	100	0.147	0.147	0.147
1.004	-	-	100	0.042	0.042	0.042
3.000	-	-	100	0.000	0.000	0.000
3.001	-	-	100	0.035	0.035	0.035
1.005	-	-	100	0.007	0.007	0.007
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.630	0.630	0.630

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
---------------------	--------------	--------------	--------------	------------------	----------	--------

1.007		4.200	2.500	0.000	0	0
-------	--	-------	-------	-------	---	---

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 3 Number of Storage Structures 8 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	E (1km)	0.310
Return Period (years)	100	F (1km)	2.321
FEH Rainfall Version	1999	Summer Storms	Yes
Site Location	GB 497500 102350 SU 97500 02350	Winter Storms	No
C (1km)	-0.025	Cv (Summer)	0.750
D1 (1km)	0.390	Cv (Winter)	0.840
D2 (1km)	0.245	Storm Duration (mins)	30
D3 (1km)	0.403		

CampbellReith		Page 4
Raven House 29 Linkfield Lane Surrey RH1 1SS	13684 Lamb Field Proposed SW	
Date 15/12/2021 14:11	Designed by IC	
File 13684 - PROPOSED SW - REV B.MDX	Checked by AJH	
XP Solutions	Network 2020.1	

Online Controls for Storm

Orifice Manhole: 5, DS/PN: 1.003, Volume (m³): 9.0

Diameter (m) 0.045 Discharge Coefficient 0.600 Invert Level (m) 3.850

Complex Manhole: 10, DS/PN: 3.001, Volume (m³): 0.7

Orifice

Diameter (m) 0.018 Discharge Coefficient 0.600 Invert Level (m) 5.050

Weir

Discharge Coef 0.544 Width (m) 0.500 Invert Level (m) 5.500

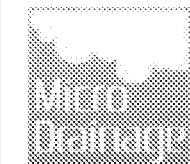
Hydro-Brake® Optimum Manhole: 9, DS/PN: 1.007, Volume (m³): 8.9

Unit Reference	MD-SHE-0086-3300-1000-3300
Design Head (m)	1.000
Design Flow (l/s)	3.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	86
Invert Level (m)	2.600
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.3	Kick-Flo®	0.624	2.7
Flush-Flo™	0.296	3.3	Mean Flow over Head Range	-	2.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6	0.800	3.0	2.000	4.5	4.000	6.3	7.000	8.2
0.200	3.2	1.000	3.3	2.200	4.8	4.500	6.6	7.500	8.5
0.300	3.3	1.200	3.6	2.400	4.9	5.000	7.0	8.000	8.7
0.400	3.2	1.400	3.9	2.600	5.1	5.500	7.3	8.500	9.0
0.500	3.1	1.600	4.1	3.000	5.5	6.000	7.6	9.000	9.2
0.600	2.8	1.800	4.3	3.500	5.9	6.500	7.9	9.500	9.5

CampbellReith		Page 5
Raven House 29 Linkfield Lane Surrey RH1 1SS	13684 Lamb Field Proposed SW	
Date 15/12/2021 14:11	Designed by IC	
File 13684 - PROPOSED SW - REV B.MDX	Checked by AJH	
XP Solutions	Network 2020.1	

Storage Structures for Storm

Porous Car Park Manhole: 1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	22.0
Max Percolation (l/s)	61.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.680	Cap Volume Depth (m)	0.450

Porous Car Park Manhole: 2, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	25.0
Max Percolation (l/s)	34.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.600	Cap Volume Depth (m)	0.450

Porous Car Park Manhole: 3, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	23.0
Max Percolation (l/s)	63.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.700	Cap Volume Depth (m)	0.450

Porous Car Park Manhole: 4, DS/PN: 1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.5
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	12.5	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.650	Cap Volume Depth (m)	0.450

Complex Manhole: 5, DS/PN: 1.003

Tank or Pond

Invert Level (m) 3.850

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	140.0	1.300	140.0	1.301	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	40.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	111.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.320	Cap Volume Depth (m)	0.600

CampbellReith		Page 6
Raven House 29 Linkfield Lane Surrey RH1 1SS	13684 Lamb Field Proposed SW	
Date 15/12/2021 14:11	Designed by IC	
File 13684 - PROPOSED SW - REV B.MDX	Checked by AJH	
XP Solutions	Network 2020.1	

Porous Car Park Manhole: 6, DS/PN: 1.004

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	22.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.290	Cap Volume Depth (m)	0.450

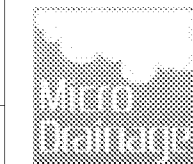
Porous Car Park Manhole: 10, DS/PN: 3.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	25.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	69.4	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.050	Cap Volume Depth (m)	0.450

Cellular Storage Manhole: 9, DS/PN: 1.007

Invert Level (m)	2.600	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	264.0	0.0	1.000	264.0	0.0	1.001	0.0	0.0

CampbellReith		Page 7
Raven House 29 Linkfield Lane Surrey RH1 1SS	13684 Lamb Field Proposed SW	
Date 15/12/2021 14:11	Designed by IC	
File 13684 - PROPOSED SW - REV B.MDX	Checked by AJH	
XP Solutions	Network 2020.1	

2 year Return Period Summary of Critical Results by Maximum Level (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 Coefficient 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 Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 3 Number of Storage Structures 8 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.403
 FEH Rainfall Version 1999 E (1km) 0.310
 Site Location GB 497500 102350 SU 97500 02350 F (1km) 2.321
 C (1km) -0.025 Cv (Summer) 0.750
 D1 (1km) 0.390 Cv (Winter) 0.840
 D2 (1km) 0.245

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status OFF
 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) 2, 30, 100
 Climate Change (%) 0, 0, 40

				Water Surcharged Flooded					
PN	US/MH Name	Event		Level (m)	Depth (m)	Volume (m³)	Overflow (l/s)	Infil. Vol (m³)	Maximum Discharge Vol (m³)
1.000	1	15 minute 2 year Winter I+0%		4.866	-0.244	0.000		0.000	0.090
1.001	2	15 minute 2 year Winter I+0%		4.435	-0.225	0.000		0.000	0.176
2.000	3	15 minute 2 year Winter I+0%		4.491	-0.209	0.000		0.000	0.153
1.002	4	480 minute 2 year Winter I+0%		4.343	-0.057	0.000		0.000	2.731
1.003	5	480 minute 2 year Winter I+0%		4.340	0.190	0.000		0.000	73.197
1.004	6	15 minute 2 year Winter I+0%		3.764	-0.246	0.000		0.000	0.223
3.000	dummy	960 minute 2 year Winter I+0%		5.114	-0.136	0.000			0.011
3.001	10	960 minute 2 year Winter I+0%		5.114	-0.086	0.000		0.000	4.920
1.005	7	15 minute 2 year Winter I+0%		3.598	-0.242	0.000			0.222
1.006	8	15 minute 2 year Winter I+0%		3.450	-0.260	0.000			0.145
1.007	9	960 minute 2 year Winter I+0%		2.716	-0.109	0.000		0.000	29.574

		Half Drain Pipe			
PN	US/MH Name	Time (mins)	Flow (l/s)	Status	
1.000	1	6	8.4	OK	
1.001	2	6	9.7	OK	
2.000	3	6	16.7	OK	
1.002	4	155	7.9	OK	
1.003	5	353	2.9	SURCHARGED	
1.004	6		5.2	OK	
3.000	dummy		0.0	OK	
3.001	10	475	0.2	OK	
1.005	7		5.9	OK	
1.006	8		5.9	OK	

CampbellReith		Page 8
Raven House 29 Linkfield Lane Surrey RH1 1SS	13684 Lamb Field Proposed SW	
Date 15/12/2021 14:11 File 13684 - PROPOSED SW - REV B.MDX	Designed by IC Checked by AJH	
XP Solutions	Network 2020.1	

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

		Half Drain Pipe			
		US/MH	Time	Flow	Status
PN	Name		(mins)	(l/s)	
1.007		9	568	2.9	OK

CampbellReith		Page 9
Raven House 29 Linkfield Lane Surrey RH1 1SS	13684 Lamb Field Proposed SW	
Date 15/12/2021 14:11	Designed by IC	
File 13684 - PROPOSED SW - REV B.MDX	Checked by AJH	
XP Solutions	Network 2020.1	

30 year Return Period Summary of Critical Results by Maximum Level (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 Coefficient 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 Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 3 Number of Storage Structures 8 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.403
 FEH Rainfall Version 1999 E (1km) 0.310
 Site Location GB 497500 102350 SU 97500 02350 F (1km) 2.321
 C (1km) -0.025 Cv (Summer) 0.750
 D1 (1km) 0.390 Cv (Winter) 0.840
 D2 (1km) 0.245

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status OFF
 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) 2, 30, 100
 Climate Change (%) 0, 0, 40

Water Surcharged Flooded

PN	US/MH Name	Event	Level (m)	Depth (m)	Volume (m³)	Overflow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)
1.000	1	480 minute 30 year Winter I+0%	4.926	-0.184	0.000		0.000	0.196	27.943
1.001	2	480 minute 30 year Winter I+0%	4.926	0.266	0.000		0.000	3.354	37.004
2.000	3	480 minute 30 year Winter I+0%	4.926	0.226	0.000		0.000	0.921	56.928
1.002	4	480 minute 30 year Winter I+0%	4.925	0.525	0.000		0.000	8.164	180.827
1.003	5	480 minute 30 year Winter I+0%	4.920	0.770	0.000		0.000	155.989	233.778
1.004	6	15 minute 30 year Winter I+0%	3.808	-0.202	0.000		0.000	0.408	14.718
3.000	dummy	960 minute 30 year Winter I+0%	5.191	-0.059	0.000			0.097	0.000
3.001	10	960 minute 30 year Winter I+0%	5.191	-0.009	0.000		0.000	10.785	17.771
1.005	7	15 minute 30 year Winter I+0%	3.646	-0.194	0.000			0.423	16.039
1.006	8	15 minute 30 year Winter I+0%	3.484	-0.226	0.000			0.285	15.863
1.007	9	960 minute 30 year Winter I+0%	2.904	0.079	0.000		0.000	77.963	336.392

Half Drain Pipe

PN	US/MH Name	Time (mins)	Flow (l/s)	Status
1.000	1	113	2.6	OK
1.001	2	229	3.2	SURCHARGED
2.000	3	251	4.9	SURCHARGED
1.002	4	467	14.7	SURCHARGED
1.003	5	492	4.3	SURCHARGED
1.004	6	8	16.3	OK
3.000	dummy		0.0	OK
3.001	10	606	0.2	OK
1.005	7		18.7	OK
1.006	8		18.5	OK

CampbellReith		Page 10
Raven House 29 Linkfield Lane Surrey RH1 1SS	13684 Lamb Field Proposed SW	
Date 15/12/2021 14:11 File 13684 - PROPOSED SW - REV B.MDX	Designed by IC Checked by AJH	
XP Solutions	Network 2020.1	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Half Drain Pipe				
PN	US/MH Name	Time (mins)	Flow (l/s)	Status
1.007	9	628	3.3	SURCHARGED

CampbellReith		Page 11
Raven House 29 Linkfield Lane Surrey RH1 1SS	13684 Lamb Field Proposed SW	
Date 15/12/2021 14:11	Designed by IC	
File 13684 - PROPOSED SW - REV B.MDX	Checked by AJH	
XP Solutions	Network 2020.1	

100 year Return Period Summary of Critical Results by Maximum Level (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 Coefficient 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 Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 3 Number of Storage Structures 8 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.403
 FEH Rainfall Version 1999 E (1km) 0.310
 Site Location GB 497500 102350 SU 97500 02350 F (1km) 2.321
 C (1km) -0.025 Cv (Summer) 0.750
 D1 (1km) 0.390 Cv (Winter) 0.840
 D2 (1km) 0.245

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status OFF
 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) 2, 30, 100
 Climate Change (%) 0, 0, 40

Water Surcharged Flooded

PN	US/MH Name	Event	Level (m)	Depth (m)	Volume (m³)	Overflow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)
1.000	1	480 minute 100 year Winter I+40%	6.028	0.918	0.000		0.000	25.079	54.554
1.001	2	480 minute 100 year Winter I+40%	6.027	1.367	0.000		0.000	21.667	72.370
2.000	3	480 minute 100 year Winter I+40%	6.028	1.328	0.000		0.000	25.506	110.129
1.002	4	480 minute 100 year Winter I+40%	6.026	1.626	0.000		0.000	15.185	344.308
1.003	5	480 minute 100 year Winter I+40%	6.019	1.869	0.000		0.000	265.252	388.239
1.004	6	15 minute 100 year Winter I+40%	3.857	-0.153	0.000		0.000	0.828	26.515
3.000	dummy	480 minute 100 year Winter I+40%	5.349	0.099	0.000			0.276	-0.043
3.001	10	480 minute 100 year Winter I+40%	5.349	0.149	0.000		0.000	22.858	22.350
1.005	7	15 minute 100 year Winter I+40%	3.700	-0.140	0.000			0.924	29.317
1.006	8	1440 minute 100 year Winter I+40%	3.600	-0.110	0.000			1.130	673.487
1.007	9	1440 minute 100 year Winter I+40%	3.595	0.770	0.000		0.000	256.178	672.285

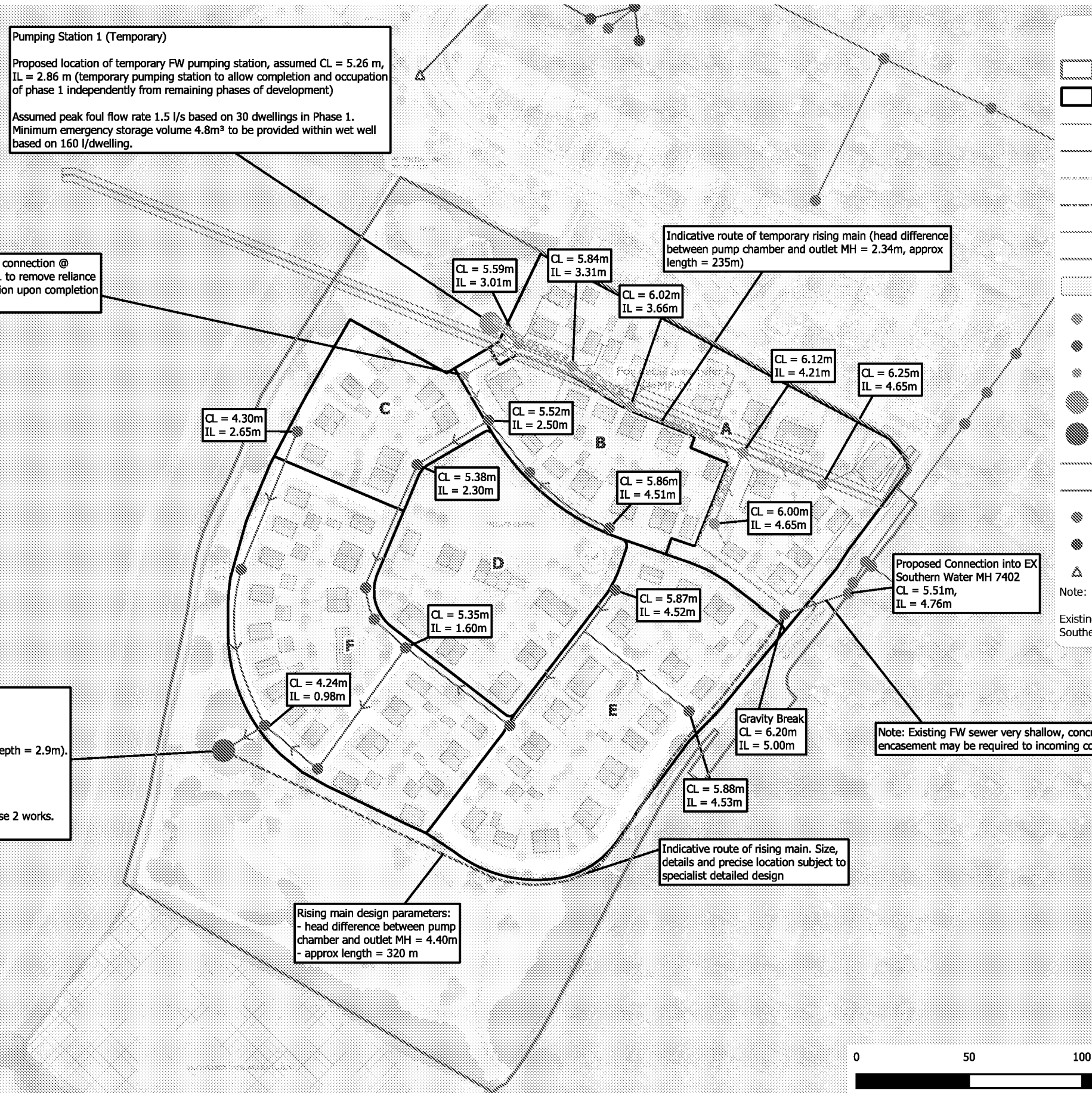
Half Drain Pipe

PN	US/MH Name	Time (mins)	Flow (l/s)	Status
1.000	1	149	4.3	FLOOD RISK
1.001	2	237	5.3	FLOOD RISK
2.000	3	148	8.9	FLOOD RISK
1.002	4	787	28.0	FLOOD RISK
1.003	5	717	6.2	FLOOD RISK
1.004	6	5	33.5	OK
3.000	dummy		0.0	FLOOD RISK*
3.001	10	653	0.4	FLOOD RISK
1.005	7		38.6	OK
1.006	8		7.3	OK

CampbellReith		Page 12
Raven House 29 Linkfield Lane Surrey RH1 1SS	13684 Lamb Field Proposed SW	
Date 15/12/2021 14:11 File 13684 - PROPOSED SW - REV B.MDX	Designed by IC Checked by AJH	
XP Solutions	Network 2020.1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

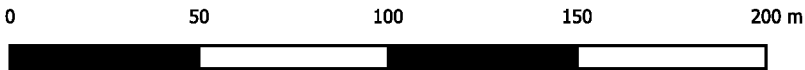
Half Drain Pipe				
US/MH		Time	Flow	Status
PN	Name	(mins)	(l/s)	
1.007	9	1223	3.3	SURCHARGED



Legend

- Site Boundary
- Land Parcel
- Phase 1 Foul Water
- Outline Foul Water
- Phase 1 / Temporary Rising Main
- Foul Water Rising Main
- Future Foul Water
- Approximate location of Gas Main
- Gas Main Easement (assumed 3m each side)
- Indicative Phase 1 Foul Water Manhole
- Indicative Outline Foul Water Manhole
- Future Foul Water Manhole
- Phase 1 Pumping Station
- Pumping Station
- Exsiting Foul Water Sewer
- Exsiting Surface Water Sewer
- Exsiting Foul Water Sewer Manhole
- Exsiting Surface Water Sewer Manhole
- Exsiting Surface Water Sewer Outfall

Note:
Existing foul and surface water drainage taken from Southern Water asset record plans



Land west of Bilsham Road
Client: Landlink Estates Ltd

Foul Water Drainage Strategy

Scale: 1:2000@A3
CampbellReith OS Copyright: © Crown copyright. All rights reserved. Licence number 100020027
Indigo Landscape Architects Ltd, Illustrative Landscape Masterplan, drg no 964-MP-01 Rev B (Dec 2021)
Job Number: 13684
Drawn by - Checked by: RLF - IC/AH
Drg No - Status/Revision: 13684-CRH-XX-XX-FG-G-7041 - P2
File location: \\red-data1\gis-data\13500 - 13749\13684 R - Lamb Field\Project_Workspaces (pdf in Outputs)
Date (Revision History): 23/12/2021 (P1, First Issue, 22/12/21, RLF; P2, Minor Amendments, 23/12/21, RLF)
ARUN DISTRICT COUNCIL Y/3/22/OUT

CampbellReith
consulting engineers

LONDON 020 7340 1700
REDHILL 01737 784 500
BRISTOL 0117 916 1066

MANCHESTER 0161 819 3060
BIRMINGHAM 01675 467 484
DUBAI 00 971 4453 4735

www.campbellreith.com

CALCULATION & DESIGN NOTES SHEET

CampbellReith
consulting engineers

Project Title:	Land West of Bilsham Road		
Calculations by:	I.Clements	Date:	09/12/2021
Checked by:	A.Higgins	Date:	09/12/2021

Project Number	CR Office and Code	Volume / System	Level / Area	Document Type	Role	Number	Status	Revision
13684	Surrey (CRH)	XX	XX	CA	C	0001	S1	P1
Description	Foul Water Flow Rates							

Foul flows calculated in accordance with section B3.1 of Design and Construction Guidance (DCG):

B3 HYDRAULIC DESIGN

B3.1 Foul Sewers and Lateral Drains

1. The peak design flow rates for dwellings should, at the discretion of the designer, be either:

- calculated in accordance with BS EN 12056-2 System II (this method is recommended for this application in BS EN 16933-2); or
- 4000 litres per dwelling per day (0.05 litres per second per dwelling). Note: This is a design peak flow rate not a daily average water usage, and represents the peak flow rate from a number of appliances. Reducing daily water usage does not necessarily reduce the peak flow rate.

Proposed residential units: 140

Proposed non-residential units: n/a

Assumed daily flow: 4000 l/dwelling/day

Total flow = 140 x 4000
= 560000 l/day

Peak flow = **6.48** l/s

*Should a pumped connection be required, a minimum flow rate of 5 l/s has been assumed.
Pumping stations to be designed by specialist.

London

15 Bermondsey Square
London
SE1 3UN

Birmingham

Chantry House
High Street, Coleshill
Birmingham B46 3BP

Surrey

Raven House
29 Linkfield Lane, Redhill
Surrey RH1 1SS

Manchester

No. 1 Marsden Street
Manchester
M2 1HW

Bristol

Unit 5.03,
HERE,
470 Bath Road,
Bristol BS4 3AP

Campbell Smith Hill LLP Registered in England & Wales, Limited Liability Partnership No OC360086
A list of Members is available at our Registered Office at 15 Bermondsey Square, London, SE1 3UN
VAT No 874 889240