A.5 Surface Water Calculations

- Greenfield runoff rates
- Predevelopment brownfield runoff rates
- MicroDrainage quick storage estimates
- MicroDrainage infiltration simulation results

FAIRHURST

Greenfield Runoff	Job No.	126782	Calculated	KFM
	Date	11/10/2019	Checked	AC
Project	Manor Road, Richmond			

Site Information

Site Location	TW9 1YB	
Site Area	1.842	ha
Impermeable Area	1.842	ha
% Impermeable	100	%

Hydrological Region	6	
SOIL Type	4	
SAAR	600	
SPR	0.3	
$A_{(50)}$	50	Minum 50 hectares
$Q_{BAR(50)}$	76.08	50 hectare equivelent
Q_{BAR}	2.80 l/s	Qbar for site
$Q_{BAR(site)}/A_{(site)}$	1.52 l/s/ha	Qbar per hectare of site
GC_1	0.85	Growth curves for Hydrological Region
GC_{30}	2.30	
GC_{100}	3.19	

Total Q_{1yr}	1.3	l/s/ha
Total Q_{30yr}	3.5	l/s/ha
Total Q_{100yr}	4.9	l/s/ha

Total Q_{1yr}	2.4	l/s
Total Q_{30yr}	6.4	l/s
Total Q_{100yr}	8.9	l/s

FAIRHURST

Brownfield Runoff		Job No.	126782	Calculated	KFM
		Date	11/10/2018	Checked	AC
Project	Manor Road, Richmond				

Site Information

Site Location	TW9 1YB	
Site Area	1.842	ha
Impermeable Area	1.842	ha
% Impermeable	100	%
Climate Change Allowance	35	%

Storm Information

M5 -60	20	mm
Ratio 'r'	0.4	
Storm Duration	5	Minutes
Z1	0.37	
M5-Dmin	7.4	mm

1 Year Runoff

Z2	0.62	
M1-Dmin	4.6	mm
i	55.1	mm/hr
Runoff	281.9	l/s

30 Year Runoff

Z2	1.46	
M30-Dmin	10.8	mm
i	129.6	mm/hr
Runoff	663.9	l/s

100 Year Runoff

Z2	1.85	
M100-Dmin	13.7	mm
i	164.28	mm/hr
Runoff	841.2	l/s

100 Year + Climate Change Runoff

Z2	1.85	
M100-Dmin	13.7	mm
i	221.8	mm/hr
Runoff	1135.7	l/s

Summary of Results for 100 year Return Period (+35%)

Half Drain Time : 68 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	5.950	0.350	3.6	17.3	O K
30 min Summer	6.020	0.420	3.6	20.8	O K
60 min Summer	6.045	0.445	3.6	22.0	O K
120 min Summer	6.022	0.422	3.6	20.9	O K
180 min Summer	5.986	0.386	3.6	19.0	O K
240 min Summer	5.946	0.346	3.6	17.1	O K
360 min Summer	5.872	0.272	3.6	13.5	O K
480 min Summer	5.809	0.209	3.6	10.3	O K
600 min Summer	5.756	0.156	3.6	7.7	O K
720 min Summer	5.715	0.115	3.6	5.7	O K
960 min Summer	5.663	0.063	3.6	3.1	O K
1440 min Summer	5.641	0.041	2.9	2.0	O K
2160 min Summer	5.630	0.030	2.1	1.5	O K
2880 min Summer	5.624	0.024	1.7	1.2	O K
4320 min Summer	5.617	0.017	1.2	0.8	O K
5760 min Summer	5.614	0.014	1.0	0.7	O K
7200 min Summer	5.611	0.011	0.8	0.5	O K
8640 min Summer	5.610	0.010	0.7	0.5	O K
10080 min Summer	5.609	0.009	0.6	0.4	O K
15 min Winter	5.998	0.398	3.6	19.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	134.830	0.0	17
30 min Summer	88.004	0.0	31
60 min Summer	54.688	0.0	54
120 min Summer	32.836	0.0	86
180 min Summer	24.046	0.0	120
240 min Summer	19.168	0.0	154
360 min Summer	13.875	0.0	218
480 min Summer	11.034	0.0	280
600 min Summer	9.231	0.0	338
720 min Summer	7.976	0.0	396
960 min Summer	6.328	0.0	502
1440 min Summer	4.560	0.0	734
2160 min Summer	3.281	0.0	1092
2880 min Summer	2.595	0.0	1468
4320 min Summer	1.863	0.0	2184
5760 min Summer	1.471	0.0	2904
7200 min Summer	1.224	0.0	3664
8640 min Summer	1.053	0.0	4328
10080 min Summer	0.927	0.0	4984
15 min Winter	134.830	0.0	17

Summary of Results for 100 year Return Period (+35%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	6.084	0.484	3.6	23.9	O K
60 min Winter	6.122	0.522	3.6	25.8	O K
120 min Winter	6.089	0.489	3.6	24.2	O K
180 min Winter	6.034	0.434	3.6	21.4	O K
240 min Winter	5.974	0.374	3.6	18.5	O K
360 min Winter	5.860	0.260	3.6	12.9	O K
480 min Winter	5.766	0.166	3.6	8.2	O K
600 min Winter	5.696	0.096	3.6	4.7	O K
720 min Winter	5.654	0.054	3.6	2.7	O K
960 min Winter	5.641	0.041	3.0	2.0	O K
1440 min Winter	5.630	0.030	2.1	1.5	O K
2160 min Winter	5.622	0.022	1.6	1.1	O K
2880 min Winter	5.617	0.017	1.2	0.8	O K
4320 min Winter	5.612	0.012	0.9	0.6	O K
5760 min Winter	5.610	0.010	0.7	0.5	O K
7200 min Winter	5.608	0.008	0.6	0.4	O K
8640 min Winter	5.607	0.007	0.5	0.3	O K
10080 min Winter	5.606	0.006	0.5	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	88.004	0.0	31
60 min Winter	54.688	0.0	58
120 min Winter	32.836	0.0	94
180 min Winter	24.046	0.0	130
240 min Winter	19.168	0.0	168
360 min Winter	13.875	0.0	234
480 min Winter	11.034	0.0	294
600 min Winter	9.231	0.0	344
720 min Winter	7.976	0.0	384
960 min Winter	6.328	0.0	490
1440 min Winter	4.560	0.0	734
2160 min Winter	3.281	0.0	1096
2880 min Winter	2.595	0.0	1452
4320 min Winter	1.863	0.0	2184
5760 min Winter	1.471	0.0	2848
7200 min Winter	1.224	0.0	3720
8640 min Winter	1.053	0.0	4304
10080 min Winter	0.927	0.0	5016

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.414	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+35

Time Area Diagram

Total Area (ha) 0.080

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.080

Model Details

Storage is Online Cover Level (m) 7.000

Cellular Storage Structure

Invert Level (m) 5.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.50000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	52.0	52.0	0.900	0.0	79.2
0.800	52.0	79.2			

Summary of Results for 100 year Return Period (+35%)

Half Drain Time : 76 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	5.985	0.385	14.2	75.1	O K
30 min Summer	6.067	0.467	14.2	90.9	O K
60 min Summer	6.099	0.499	14.2	97.2	O K
120 min Summer	6.078	0.478	14.2	93.0	O K
180 min Summer	6.041	0.441	14.2	85.8	O K
240 min Summer	6.001	0.401	14.2	78.0	O K
360 min Summer	5.924	0.324	14.2	63.0	O K
480 min Summer	5.856	0.256	14.2	49.9	O K
600 min Summer	5.798	0.198	14.2	38.6	O K
720 min Summer	5.750	0.150	14.2	29.2	O K
960 min Summer	5.683	0.083	14.2	16.3	O K
1440 min Summer	5.645	0.045	12.7	8.7	O K
2160 min Summer	5.632	0.032	9.2	6.3	O K
2880 min Summer	5.626	0.026	7.3	5.0	O K
4320 min Summer	5.619	0.019	5.3	3.6	O K
5760 min Summer	5.615	0.015	4.2	2.8	O K
7200 min Summer	5.612	0.012	3.5	2.4	O K
8640 min Summer	5.611	0.011	3.1	2.1	O K
10080 min Summer	5.609	0.009	2.6	1.8	O K
15 min Winter	6.038	0.438	14.2	85.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	134.830	0.0	17
30 min Summer	88.004	0.0	31
60 min Summer	54.688	0.0	56
120 min Summer	32.836	0.0	88
180 min Summer	24.046	0.0	122
240 min Summer	19.168	0.0	156
360 min Summer	13.875	0.0	222
480 min Summer	11.034	0.0	284
600 min Summer	9.231	0.0	344
720 min Summer	7.976	0.0	402
960 min Summer	6.328	0.0	510
1440 min Summer	4.560	0.0	734
2160 min Summer	3.281	0.0	1100
2880 min Summer	2.595	0.0	1452
4320 min Summer	1.863	0.0	2200
5760 min Summer	1.471	0.0	2936
7200 min Summer	1.224	0.0	3568
8640 min Summer	1.053	0.0	4368
10080 min Summer	0.927	0.0	5112
15 min Winter	134.830	0.0	17

Summary of Results for 100 year Return Period (+35%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	6.137	0.537	14.2	104.6	O K
60 min Winter	6.186	0.586	14.2	114.0	O K
120 min Winter	6.156	0.556	14.2	108.2	O K
180 min Winter	6.102	0.502	14.2	97.7	O K
240 min Winter	6.041	0.441	14.2	85.8	O K
360 min Winter	5.923	0.323	14.2	62.8	O K
480 min Winter	5.821	0.221	14.2	43.0	O K
600 min Winter	5.739	0.139	14.2	27.0	O K
720 min Winter	5.679	0.079	14.2	15.4	O K
960 min Winter	5.645	0.045	12.7	8.7	O K
1440 min Winter	5.633	0.033	9.3	6.3	O K
2160 min Winter	5.624	0.024	6.8	4.6	O K
2880 min Winter	5.619	0.019	5.3	3.6	O K
4320 min Winter	5.613	0.013	3.8	2.6	O K
5760 min Winter	5.611	0.011	3.1	2.1	O K
7200 min Winter	5.609	0.009	2.5	1.7	O K
8640 min Winter	5.608	0.008	2.2	1.5	O K
10080 min Winter	5.607	0.007	1.9	1.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	88.004	0.0	31
60 min Winter	54.688	0.0	58
120 min Winter	32.836	0.0	94
180 min Winter	24.046	0.0	134
240 min Winter	19.168	0.0	170
360 min Winter	13.875	0.0	238
480 min Winter	11.034	0.0	300
600 min Winter	9.231	0.0	356
720 min Winter	7.976	0.0	404
960 min Winter	6.328	0.0	492
1440 min Winter	4.560	0.0	734
2160 min Winter	3.281	0.0	1096
2880 min Winter	2.595	0.0	1436
4320 min Winter	1.863	0.0	2204
5760 min Winter	1.471	0.0	2896
7200 min Winter	1.224	0.0	3632
8640 min Winter	1.053	0.0	4400
10080 min Winter	0.927	0.0	5008

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.414	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+35

Time Area Diagram

Total Area (ha) 0.344

Time (mins) From:	**To:**	**Area (ha)**
0	4	0.344

Model Details

Storage is Online Cover Level (m) 7.000

Cellular Storage Structure

Invert Level (m) 5.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.50000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	205.0	205.0	0.900	0.0	253.8
0.800	205.0	253.8			

Summary of Results for 100 year Return Period (+35%)

Half Drain Time : 75 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	6.379	0.379	8.2	42.5	O K
30 min Summer	6.458	0.458	8.2	51.4	O K
60 min Summer	6.489	0.489	8.2	54.8	O K
120 min Summer	6.467	0.467	8.2	52.4	O K
180 min Summer	6.430	0.430	8.2	48.2	O K
240 min Summer	6.390	0.390	8.2	43.8	O K
360 min Summer	6.314	0.314	8.2	35.2	O K
480 min Summer	6.247	0.247	8.2	27.7	O K
600 min Summer	6.190	0.190	8.2	21.3	O K
720 min Summer	6.143	0.143	8.2	16.0	O K
960 min Summer	6.079	0.079	8.2	8.9	O K
1440 min Summer	6.044	0.044	7.2	4.9	O K
2160 min Summer	6.032	0.032	5.2	3.6	O K
2880 min Summer	6.025	0.025	4.1	2.8	O K
4320 min Summer	6.018	0.018	3.0	2.0	O K
5760 min Summer	6.014	0.014	2.3	1.6	O K
7200 min Summer	6.012	0.012	2.0	1.4	O K
8640 min Summer	6.010	0.010	1.7	1.1	O K
10080 min Summer	6.009	0.009	1.5	1.0	O K
15 min Winter	6.431	0.431	8.2	48.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	134.830	0.0	17
30 min Summer	88.004	0.0	31
60 min Summer	54.688	0.0	56
120 min Summer	32.836	0.0	88
180 min Summer	24.046	0.0	122
240 min Summer	19.168	0.0	156
360 min Summer	13.875	0.0	222
480 min Summer	11.034	0.0	284
600 min Summer	9.231	0.0	344
720 min Summer	7.976	0.0	400
960 min Summer	6.328	0.0	510
1440 min Summer	4.560	0.0	734
2160 min Summer	3.281	0.0	1100
2880 min Summer	2.595	0.0	1440
4320 min Summer	1.863	0.0	2164
5760 min Summer	1.471	0.0	2936
7200 min Summer	1.224	0.0	3592
8640 min Summer	1.053	0.0	4312
10080 min Summer	0.927	0.0	5136
15 min Winter	134.830	0.0	17

Summary of Results for 100 year Return Period (+35%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	6.527	0.527	8.2	59.1	O K
60 min Winter	6.574	0.574	8.2	64.3	O K
120 min Winter	6.544	0.544	8.2	60.9	O K
180 min Winter	6.489	0.489	8.2	54.8	O K
240 min Winter	6.428	0.428	8.2	48.0	O K
360 min Winter	6.311	0.311	8.2	34.9	O K
480 min Winter	6.211	0.211	8.2	23.6	O K
600 min Winter	6.130	0.130	8.2	14.6	O K
720 min Winter	6.073	0.073	8.2	8.2	O K
960 min Winter	6.044	0.044	7.3	4.9	O K
1440 min Winter	6.032	0.032	5.3	3.6	O K
2160 min Winter	6.023	0.023	3.8	2.6	O K
2880 min Winter	6.018	0.018	3.0	2.0	O K
4320 min Winter	6.013	0.013	2.2	1.5	O K
5760 min Winter	6.011	0.011	1.8	1.2	O K
7200 min Winter	6.009	0.009	1.4	1.0	O K
8640 min Winter	6.008	0.008	1.3	0.8	O K
10080 min Winter	6.007	0.007	1.1	0.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	88.004	0.0	31
60 min Winter	54.688	0.0	58
120 min Winter	32.836	0.0	94
180 min Winter	24.046	0.0	132
240 min Winter	19.168	0.0	170
360 min Winter	13.875	0.0	238
480 min Winter	11.034	0.0	300
600 min Winter	9.231	0.0	354
720 min Winter	7.976	0.0	400
960 min Winter	6.328	0.0	490
1440 min Winter	4.560	0.0	734
2160 min Winter	3.281	0.0	1088
2880 min Winter	2.595	0.0	1420
4320 min Winter	1.863	0.0	2204
5760 min Winter	1.471	0.0	2944
7200 min Winter	1.224	0.0	3664
8640 min Winter	1.053	0.0	4240
10080 min Winter	0.927	0.0	5280

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.414	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+35

Time Area Diagram

Total Area (ha) 0.195

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.195

Model Details

Storage is Online Cover Level (m) 7.000

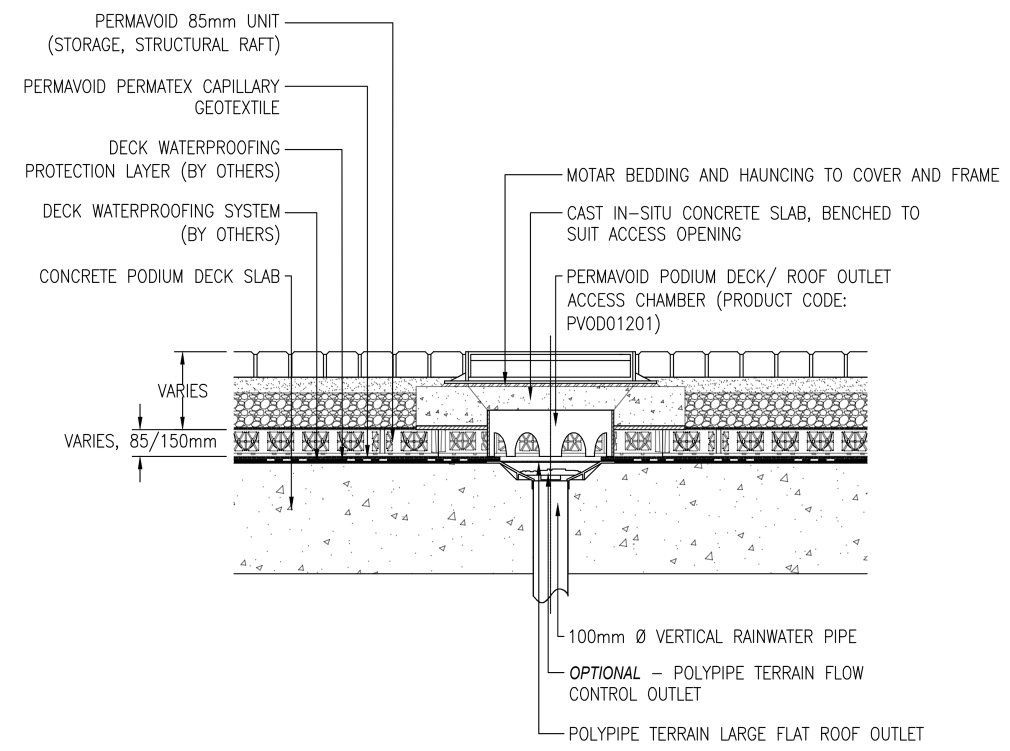
Cellular Storage Structure

Invert Level (m) 6.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.50000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

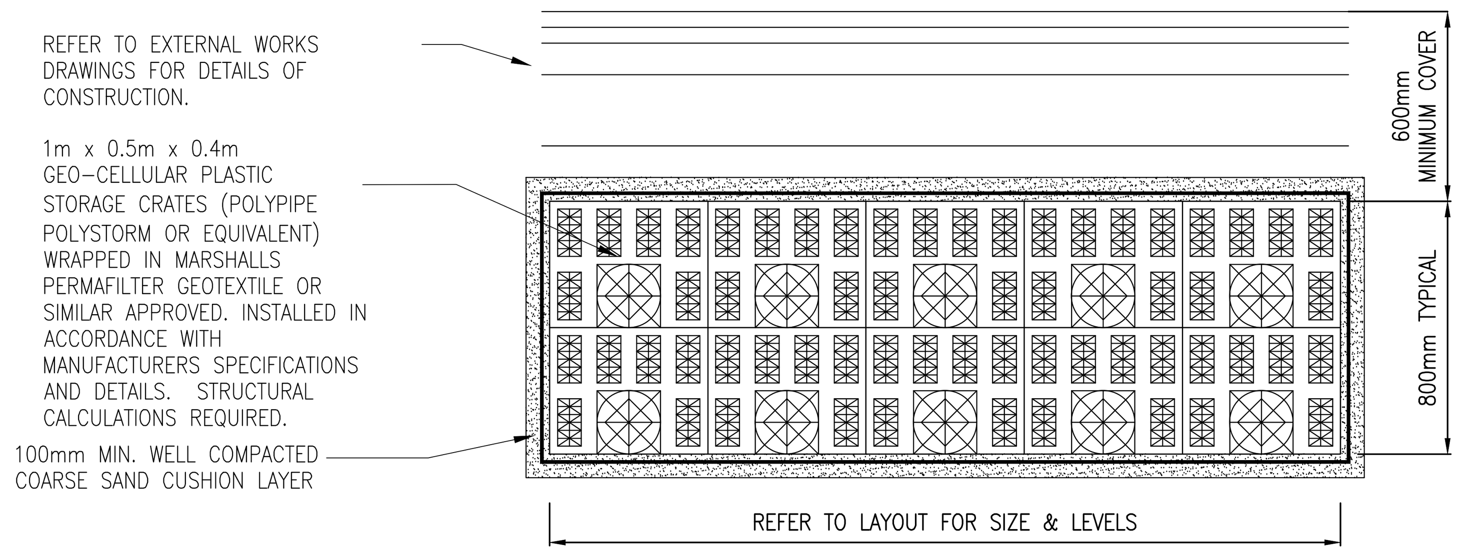
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	118.0	118.0	0.900	0.0	152.9
0.800	118.0	152.9			

A.6 Surface Water Drainage Strategy

- Fairhurst drawing 126782-C-4000



TYPICAL BLUE ROOF DETAIL
PERMAVOID 85mm/150mm PODIUM DECK WITH ROOF ACCESS CHAMBER



CELLULAR SOAKAWAY TANK CONSTRUCTION DETAILS
(TRAFFICKED AREAS)
1:20

DETAILS SHOWN ARE INDICATIVE. REFER TO MANUFACTURER FOR FULL DETAILS AND SPECIFICATIONS. REFER TO MANUFACTURERS DETAILS FOR INLET & OUTLET MANIFOLDS AND INSPECTION ACCESS. (REFER TO LAYOUT FOR LOCATIONS).

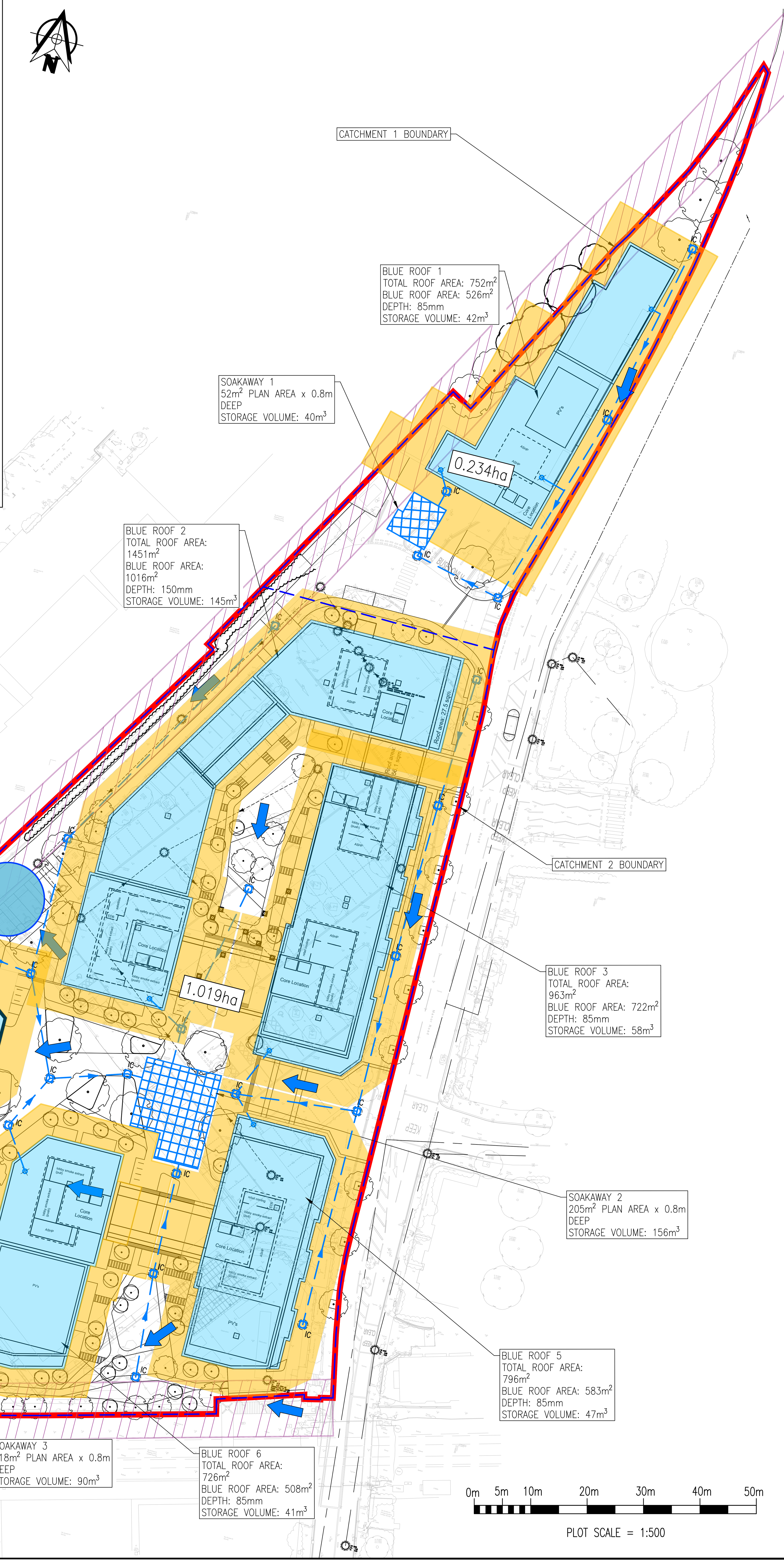
SURFACE WATER ATTENUATION CALCULATION

INFLOW		TYPICAL INFILTRATION RATE FOR SOIL CONDITIONS (m/hr)	REQUIRED STORAGE BASED ON SOURCE CONTROL DESIGN (m^3)	TANK No.	INDICATIVE TANK DIMENSIONS BASED ON CONTRIBUTING AREAS						NOTES
RAINFALL FROM IMPERMEABLE AREA (ha)	REDUCED FLOW FROM BLUE ROOF OUTLET (l/s)				LENGTH (m)	WIDTH (m)	DEPTH (m)	VOLUME (m^3)	STORAGE VOLUME (BASED ON 95% VOID RATIO)	TOTAL STORAGE VOLUME (BASED ON 95% VOID RATIO)	
0.53	5	0.50	272	1	SUBJECT TO DETAILED DESIGN			42	40	286	INFILTRATION RATE TO BE CONFIRMED FOLLOWING SOAKAGE TESTING. TANK VOLUMES TO BE CONFIRMED BASED ON DETAILED NETWORK LAYOUT DESIGN
				2	SUBJECT TO DETAILED DESIGN			164	156		
				3	SUBJECT TO DETAILED DESIGN			95	90		

STRATEGY NOTES

1. LOCAL BOREHOLES INDICATE SOIL TO BE SANDY GRAVEL WITH AN ASSUMED TYPICAL INFILTRATION RATE OF 0.1–1m/hr BASED ON DESIGN GUIDES. MID RANGE VALUE OF 0.5m/hr ASSUMED FOR STRATEGY ASSESSMENT. SITE SPECIFIC TESTING TO BE COMPLETED PRIOR TO DETAILED DESIGN.
2. ALL BUILDINGS (5No.) TO HAVE BLUE ROOFS LIMITED TO 1l/s/BUILDING AS INDICATED USING LOW FLOW OUTLET CONTROLS. BLUE ROOFS AREA ASSUMED TO BE 70% OF TOTAL ROOF AREA TO ALLOW FOR PLANT AND ACCESS REQUIREMENTS (TO BE COORDINATED AT DETAILED DESIGN)
3. MIRCRODRAINAGE ESTIMATE FOR NON-ROOF, NON LANDSCAPED AREAS (0.53ha) WITH 5.0l/s ADDITIONAL INFLOW REQUIRES APPROXIMATELY 222m^3 ATTENUATION (SUBJECT TO DETAILED DESIGN) FOR A TANK WITH 315m^2 BASE FOR INFILTRATION.
4. VOLUMES ASSESSMENT BASED ON INFILTRATION AREA STATED. TANKS DEEPER TANKS WITH REDUCED BASE SURFACE BASE AREA MAY INFILTRATE SLOWER AND THEREFORE VOLUME REQUIREMENTS WILL NEED TO BE REVIEWED.
5. THIS DRAWING TO BE READ IN CONJUNCTION WITH THE FAIRHURST FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY.

THIS DRAWING IS BASED ON THE FOLLOWING LAYOUTS:
1. GILLESPIES LANDSCAPING PLAN REFERENCE P11559-00-001-100_Rev04 RECEIVED 17/05/2019
2. ASSAEL SITE PLANS RECEIVED NOVEMBER 2019



NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION, INC. RISK ASSESSMENTS (SEE CDM NOTES) AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
2. DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY.
3. ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METRES UNLESS OTHERWISE STATED.
4. ALL DIMENSIONS, LEVELS AND SURVEY GRID CO-ORDINATES ARE TO BE CHECKED ON SITE AND THE ENGINEER NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF THE WORKS.
5. NO DEVIATION FROM THE DETAILS SHOWN ON THIS DRAWING IS PERMITTED WITHOUT PRIOR PERMISSION FROM THE ENGINEER.
6. ANY WORKS OUTSIDE SITE BOUNDARY ARE FOR INFORMATION PURPOSES ONLY. UNLESS SPECIFICALLY NOTED, ALL WORKS OUTSIDE THE SITE BOUNDARY WILL BE UNDERTAKEN BY OTHERS UNDER A SEPARATE CONTRACT.
7. THE CONTRACTOR SHALL UNDERTAKE SUCH MATERIALS TESTING AS INDICATED IN THE SPECIFICATIONS AND SHALL INCLUDE THE COST OF TESTING IN THE TENDER.
8. TOTAL SITE AREA = 1.842ha
TOTAL NON ROOF AREA = 1ha
TOTAL NON PERMEABLE NON ROOF AREA = 0.53ha

KEY

- SITE BOUNDARY
- 5m HOUSING EXCLUSION ZONE FOR INFILTRATION
- INFILTRATION CRATE
- BLUE ROOFS TYPICALLY 85–150mm THICK
- SURFACE WATER EXCEEDANCE ROUTES
- INDICATIVE AREA OF FLOODING
- EXISTING SW MANHOLE
- EXISTING SW PIPE
- PROPOSED SW MANHOLE
- PROPOSED SW PIPE
- RWP PROPOSED RAINWATER PIPE

Rev.	Date	Description	Drwn.	Chkd.	Appd.
P08	21/11/19	SITE LANDSCAPE LAYOUT UPDATED	KM	KM	AC
P07	22/10/19	SITE LANDSCAPE LAYOUT UPDATED AND ATTENUATION REPOSITIONED	KM	KM	AC
P06	10/10/19	SITE LAYOUT UPDATED	KM	KM	AC
P05	20/05/19	SITE LANDSCAPE LAYOUT UPDATED AND ATTENUATION UPDATED TO SUIT NEW LANDSCAPING AREAS	CD	AP	AC
P04	07/05/19	SURFACE WATER EXCEEDANCE ROUTE, FLOODING AREAS, GREEN ROOF AREAS AND TANK VOLUMES AND CALCS ADDED	HJ	AP	AC
P03	14/12/18	SITE LAYOUT UPDATED	CD	AP	AC
P02	21/11/18	KEY AMENDED	CD	AP	AC
P01	20/11/18	ISSUED FOR INFORMATION	CD	AP	AC

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Fairhurst.co.uk

Client:
AVANTON

Project Title:
FORMER HOMEBASE
MANOR ROAD
RICHMOND

Drawing Title:
PRELIMINARY SURFACE WATER DRAINAGE STRATEGY

Scale at A1: 1:500	Status: DISCUSSION	Fairhurst Project No: 126782
Drawn: AP	Checked: AP	Approved: AC
Date: NOV 18	Date: NOV 18	Date: NOV 18

Drawing No.: 126782-C-4000
Revision: P08

A.7 Typical Drainage Maintenance Schedules

Drainage Maintenance Schedules

DOCUMENT CONTROL

	Name	Signature	Date
Prepared by	A Prais		Nov 2018
Checked by	A Prais		Nov 2018
Approved by	A Chambers		Nov 2018

Rev.	Date	Status	Description	Signature		
				By	Chk	Aprv
1						
				By	Chk	Aprv
2						

FAIRHURST
consulting engineers

1 Overview

1.1.1 The following tables are taken from the SuDS Manual (CIRIA C753) where available or from manufacturers data and recommendations giving the operation and maintenance requirements for various surface water drainage components.

1.1.2 A brief description to be included in the maintenance strategy note / report is included.

1.1.3 This note is intended to be a live document and added to as different components are used at different sites and to be used as a resource for when producing schedules for future sites using the same / similar components.

1.2 Operation and Maintenance

1.2.1 There are three types of maintenance activities associated with surface water drainage systems. The SuDS Manual, CIRIA C753, defines these as:

- Regular Maintenance – 'basic tasks undertaken on a frequent and predictable schedule' including vegetation management, litter and debris removal, and inspections.'
- Occasional Maintenance – 'tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example.'
- Remedial Maintenance – 'intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.'

1.2.2 Specific maintenance needs should be monitored and maintenance schedules adjusted to suit the location and condition of the drainage feature in question.

1.2.3 The table below gives an overview of the maintenance required for each of the SuDS elements used on the site.

1.2.4 Not all drainage features which require maintenance are SuDS devices and are therefore not all in the table below. This includes the following;

- Flow controls including orifice plates, vortex controls etc

Details of the maintenance of these are given in later sections alongside the full details of the SuDS device maintenance requirements.

Operation & maintenance requirement	Piped Network / Inspection Chambers	Porous Pavement	Petrol Interceptor	Modular Storage Tank	Soakaway	Green Roof	Detention / infiltration Basin	Swale
Regular Maintenance								
Inspection	■	■	□	■	■	■	■	■
Litter and debris removal	■	■	□	□	□	■	■	■
Grass Cutting		□	□	□	□	■	■	■
Weed / invasive plant control		□				□	□	□
Shrub management		□				□	□	□
Shoreline vegetation management							□	
Aquatic vegetation management							□	
Occasional Maintenance								
Sediment management[1]	■	■	■	■	■	■	■	■
Vegetation/plant replacement						□	□	□
Vacuum sweeping and		■						

Operation & maintenance requirement	Piped Network / Inspection Chambers	Porous Pavement	Petrol Interceptor	Modular Storage Tank	Soakaway	Green Roof	Detention / infiltration Basin	Swale
brushing								
Remedial Maintenance								
Structure rehabilitation / repair	□		□		□	□	□	□
Infiltration surface reconditioning	□	□	□	□	□	□	□	□
■ Will be required □ May be required [1]Sediment should be collected and managed in pre-treatment systems, upstream of the main device.								

Table 1 - Extracted and adapted from The SuDS Manual (C697, 2007[1]) Table 22.1: Typical key SuDS components operation and maintenance activities.

[1] CIRIA C697 SuDS Manual was superseded in 2015 by the updated SuDS Manual, C753. This table is still relevant however was not included in this format in the later edition.

2 Schedules

2.1 Attenuation Storage Tanks

Source: CIRIA C753 - Table 21.3

2.1.1 Attenuation tanks, in various forms, are used to store runoff on site to limit the peak discharge into the adopted surface water network. On this site, this storage has been achieved through the provision of a below ground cellular storage tank. This tank has a high void ratio allowing large volumes of surface waters to be stored during storm events which is discharged at a controlled flow rate into the sewer network.

2.1.2 Tanks require regular inspection to ensure they operate as designed and do not become blocked, preventing flows entering / exiting the tank or reducing their storage capacity.

2.1.3 During storm events, surface water may be attenuated for long periods of time in the tank. This time may result in any silts suspended in the runoff to settle out and gather at the base of the tank. Failing to take action to remove this can result in reducing the capacity of the tank and the deposited silt causing blockage.

2.1.4 Table 2 outlines the maintenance required for the effective operation of the cellular storage tank.

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 risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair / rehabilitate inlets, outlet, 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

Table 2 - Attenuation storage tank maintenance requirements (CIRIA C753 Table 21.3)

2.2 Permeable Pavements

Source: CIRIA C753 - Table 20.15

2.2.1 Permeable pavements have higher voids than regular pavements to allow surface water to drain through them either directly into the ground, reducing the flow into the surface water drainage network, or through an outlet into the surface water drainage network. Where an outlet is provided, the peak flow rate into the network is reduced as infiltration through the pavement takes longer than flowing over hard surfaces.

2.2.2 Table 3 outlines the maintenance required for the effective operation of the permeable pavements.

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 3 – Permeable pavement maintenance requirements (CIRIA C753 Table 20.15).

2.3 Outflow Controls – Vortex Control / Hydrobrake

Source: Various manufacturers literature.

2.3.1 A vortex flow control device is a complex control used to limit the discharge rate. Where a simple orifice will limit the discharge by a fixed amount, a vortex control device can vary the discharge rate depending on the head driving the flow. This allows low flow rates to pass during smaller storms, but larger flow rates to pass up to the maximum designed rate during larger storms to prevent the network flooding.

2.3.2 Vortex flow control devices have no moving parts and therefore require little maintenance. Inspections should be completed routinely, or if a blockage is suspected to check for litter and potential blockage risks as detailed in Table 4.

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	None required	n/a
Remedial actions	Remove debris and silt build up	As required
	Repair / replace flow control device	As required
Monitoring	Open manhole and visually inspect device and sump for blockages and debris.	Every 3 – 6 months and if evidence of poor performance
	Inspect flow control device for visible signs of damage	Annually or if evidence of poor performance.

Table 4 – Vortex Control / Hydrobrake maintenance requirements

2.4 Other Components - Manholes (including catchpits), Gullies and Channels

Source: Various guidance

2.4.1 In addition to the aforementioned SuDS components of the network, the network also consists of gullies, channels and other components to collect the flow into the network. It is at these locations that silt is most likely to enter the system.

2.4.2 Table 5 outlines the maintenance required for the effective operation of the other surface water drainage network components.

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove debris from catchment surface / gratings (where may cause risks to performance)	Monthly (and after large storms)
Remedial actions	Remove sediment from manholes and catchpits	Annually or as required
	Repair / rehabilitation of gratings, inlets and outlets	As required
Monitoring	Inspect / check all gratings, manholes and	Annually and after large

Maintenance Schedule	Required Action	Typical Frequency
	catchpits to ensure that they are in good condition and operating as designed.	storm events
	Inspect and identify any features that are not operating correctly. If required take remedial action	Monthly for three months, then six monthly

Table 5 - Other drainage components maintenance requirements

2.5 Green Roofs

Source: CIRIA C753 - Table 12.5

2.5.1 Green roofs are areas of living vegetation, installed on the top of buildings, for a range of reasons including visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff. There are two main types of green roofs

(i) Extensive – low substrate depths and loadings with low maintenance requirements. These are generally inaccessible.

(ii) Intensive – deeper substrates and loadings which can support a variety of plants but require more intensive maintenance. These are usually accessible.

2.5.2 It is important to note that although they are useful in the control and management of surface water runoff, they are constructed over impermeable bases and therefore do not act in the same way as an equivalent greenfield area. The Green Roof Organisation has guidance on the equivalent impermeability of the area, expected volumes that may discharge to evaporation, and runoff rates used to design downstream elements of the surface water network.

2.5.3 Table 7 outlines the maintenance required for green roofs. Where available, manufacturer specific information should take precedence over this.

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 or roof drain system	Annually and after severe storms
	Inspect the underside of the 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	6 monthly and annually or as required
	During establishment (ie year one), replace dead plants as required (where >5% coverage)	Monthly (but usually responsibility of manufacturer)
	Post establishment replace dead plants as required (where >5% coverage)	Annually (in autumn)

Maintenance Schedule	Required Action	Typical Frequency
	Remove fallen leaves and debris from deciduous foliage	6 monthly or as required
	Remove nuisance and invasive vegetation including weeds	6 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	6 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

Table 6 – Green Roof maintenance requirements

2.6 Soakaways

Source: CIRIA C753 - Table 13.1

2.6.1 There are many types of infiltration systems of which soakaways area one. These are excavations filled with granular material to allow voids to form for temporary storage of water whilst is soaks into the ground.

2.6.2 Historically these were rubble filled excavations; however more recently similar devices can be constructed using geotextile lines cellular crates. Alternatively, lined soakaways can be created using perforated precast concrete manhole rings surrounded with a geotextile and backfill. Concrete manhole rings have the advantage (over cellular crates) of being more accessible for cleaning and maintenance. Cellular crates have the advantage of being able to achieve larger volumes of storage.

2.6.3 Soakaways are not appropriate for all sites depending on the soil type and other site constraints. Where they are used, they should be designed by an engineer for the specific site for which they are to be used

2.6.4 Table 7 outlines the maintenance required for soakaways[2]

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspect for any sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)

[2] Note, this is for concrete manhole ring soakaways. For other types, refer to the appropriate tables.

Maintenance Schedule	Required Action	Typical Frequency
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect all silt traps and note rate of sediment accumulation	Monthly in first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

Table 7 - Soakaway maintenance requirements

2.7 Detention Basins

Source: CIRIA C753 - Table 22.1

2.7.1 Detention basins are landscaped depressions that are normally dry except during and immediately following storm events. They can be online components to manage runoff from regular events or offline to manage exceedance events only. They can be used for infiltration, where the underlying ground conditions are suitable or to attenuate flows until downstream capacity becomes available for controlled discharge. Due to their vegetated bases, they can also be used to provide treatment to flows. Depending on their design, they can also be used as recreational facility.

Detention basins differ from ponds as they are designed to be dry under normal conditions whereas ponds are designed to maintain a constant presence of water.

2.7.2 Table 8 outlines the maintenance required for detention basins.

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season) or as required
	Cut grass – meadow grass in and around basin	Half-yearly (spring- before nesting season and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at stare then as required)
	Inspect inlets, outlets and overflows for blockages and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Monthly (for first year) then annually or as required

Maintenance Schedule	Required Action	Typical Frequency
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	
	Remove sediments from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and cuttings	Every 2 years, or as required
	Remove sediments from inlets, outlets forebay and main based when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or returfing	As required
	Realignment of rip-rap	
	Repair/rehabilitation of inlets, outlets and overflows	
	Relevel uneven surfaces and reinstate design levels	

Table 8 – Detention Basin maintenance requirements

2.8 Swales

Source: CIRIA C753 - Table 17.1

2.8.1 Swales are shallow, flat bottomed, vegetated open channels designed to convey, treat and often attenuate surface water runoff. They can be incorporated into site design to enhance the natural landscape and provide biodiversity benefits. Swales can have a variety of profiles and designed to be usually dry (other than during and immediately after rainfall events) or permanently withhold some water. They can be used as surface water conveyance, or if ground conditions allow, infiltration direct to ground.

2.8.2 Table 9 outlines the maintenance required for swales.

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain height within specified design range	Monthly (during growing season or as required)
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months,

Maintenance Schedule	Required Action	Typical Frequency
		quarterly for 2 years, then half yearly
	Inspect inlets and fascility surface for silt accumulation, establish appropriate silt removal frequencies.	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required.	As required or if bare soil is exposed over 10% of swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	
	Remove and dispose of oils or petrol residues using safe standard practices	

Table 9 - Swale maintenance requirements

3 Health, Safety and Welfare

3.1.1 All those responsible for maintenance should take appropriate health, safety and welfare precautions for all activities including lone working, if relevant. Risk assessments should always be undertaken before carrying out any works either inside or outside of the site.

3.1.2 The requirements of the Health and Safety at Work Act 1974 and The Construction (Design and Management) Regulations 2015 should be adhered to and any residual risks identified in the Health and Safety File should be managed and information passed on to maintenance operatives through task specific risk assessments.

A.8 Local Authority Drainage Assessment Form

Treatment – Improving the quality of water by physical, chemical and/or biological means.

Watercourse – A term including all rivers, streams, ditches, drains, cuts, culverts, dykes, sluices, and passages through which water flows.

Water table (or groundwater table) – The point where the surface of groundwater can be detected. The water table may change with the seasons and the annual rainfall.

Appendix I:

DESIGN ASSESSMENT CHECKLIST: SCHEME

Table 1: Scheme Design Assessment Checklist

Requirements			
Site ID	MANOR RD, RICHMOND		
Site Location and co-ordinates	MANOR RD, TW9 1YB | 518901, 175426		
Site description	BROWNFIELD	Drawing Reference(s)	126782/C/4000
Date of assessment	14/12/2018	Specification Reference	
Type of development	MIXED USE	Site Area	1.65ha

	SuDS Manual Page Ref*	Y	N	Summary of details	Comments / Remedial actions
PRINCIPLES					
Is the runoff managed at or close to its source, wherever possible? If not, give reasons.		✓		INFILTRATION PROPOSED	
Is the runoff managed at or close to the surface, wherever possible? If not, give reasons e.g. infiltration systems are being used to manage the runoff.		✓		INFILTRATION. NO SPACE FOR ON-SURFACE SUDS	
Where the drainage system serves more than one property, is public space used and integrated with the drainage system in an appropriate and beneficial way ? If not, give reasons.		✓		PERMEABLE AREAS, INFILTRATION TANKS	
Have the opportunities afforded by the drainage system in terms of green infrastructure, biodiversity, urban design, climate adaptation and amenity provision been maximised?		✓		GREEN ROOFS ALLOWANCE FOR CLIMATE CHANGE	
Has an appropriate SuDS Management train been provided?					AT DETAILED DESIGN
Are the operating and maintenance requirements of the drainage system adequately defined?					"
Is operation and maintenance achievable at an acceptable cost?				PRIVATE MANAGEMENT COMPANY	
POINT OF DISCHARGE					
Does the design meet the following discharge hierarchy 1. Infiltration is preferred where it is safe and acceptable to do so; 2. If infiltration is not possible discharge to water course; 3. Discharge to sewer as last resort.		✓		INFILTRATION	
If infiltration is used: Confirm that an acceptable infiltration assessment has been undertaken and submitted?				IN PROGRESS	

	SuDS Manual Page Ref*	Y	N	Summary of details	Comments / Remedial actions
If discharge is to sewer, rather than a surface water body, provide justification.				N/a, possible	
If discharge to a sewerage asset is proposed, has evidence been provided that the design criteria have been agreed with the sewerage undertaker and that an appropriate connection detail has been agreed?				overflow connection dependant on infiltration results TBC	
Have adequate and appropriate exceedance routes been provided and are they protected from future development?					
INTERCEPTION					
Does the scheme design demonstrate on-site retention of approximately the first 5mm of runoff from impermeable surfaces for most events? How is Interception to be delivered (e.g. infiltration, green roofs, permeable pavements, vegetated surfaces, bespoke design - provide details)?		✓		- GREEN ROOFS - SOFT LANDSCAPING	
PEAK FLOW RATE CONTROL					
Does the design demonstrate control of the 1 year, critical duration site event to the equivalent 1 year greenfield peak flow rate or below?				N/A INFILTRATION DISCHARGE	
Does the design demonstrate control of the 100 year, critical duration site event to the equivalent 100 year greenfield peak flow rate or below?					
Do the design calculations take account of future development (urban creep) and climate change?					
VOLUMETRIC CONTROL (FOR THE 100 YEAR, 6 HOUR EVENT)					
Does the design demonstrate that, for the 100 year 6 hour event: *Either:* The discharged site runoff volume is not greater than the equivalent greenfield runoff volume? *Or:* The discharged site runoff volume over and above the equivalent greenfield runoff volume (i.e. the Long Term Storage Volume) is discharged at a rate < 2 l/s/ha (or another rate that is considered acceptable in not negatively impacting flood risk of the receiving water body) *Or:* Peak flow rates from the site are restricted to 2 l/s/ha or Qbar, whichever is the greater ha (or another rate that is considered acceptable in not negatively impacting flood risk of the receiving water body).				N/A INFILTRATION DISCHARGE	
WATER QUALITY TREATMENT					
Is the receiving water body (surface or groundwater) environmentally sensitive (E.g. Groundwater Source Protection Zone? What is its designation? Are any implications for drainage design clearly defined?				~~N/A~~ NOT IN GROUND WATER PROTECTION ZONE	

	SuDS Manual Page Ref*	Y	N	Summary of details	Comments / Remedial actions
Does the design include an appropriate treatment strategy that ensures: 1. Sediment is trapped and retained on site in accessible and maintainable areas? 2. Has a sufficient number of drainage components been provided in series prior to discharge? 3. Suitable pollution removal capability e.g. % TSS removal (where this is a requirement of the SAB)		✓		CATCHPITS USED, SOFT LANDSCAPING	
FUNCTIONALITY					
Are the design features sufficiently durable to ensure structural integrity over the system design life (residential 100 years and commercial 60 years), with reasonable maintenance requirements?		✓			
Are all parts of the SuDS system outside any areas of flood risk? If not, provide justification and evidence that performance will not be adversely affected.		✓			
Is pumping a requirement for operation of the system? If yes, provide justification and set out operation and maintenance/adoption arrangements.			✓		
Has runoff and flooding from all sources (both on and off site) been considered and taken into account in the design?		✓			
Are 1 in 30 year flows fully conveyed within the SuD system ?		✓			
Are 1 in 100 year flows contained or stored on-site within safe exceedance storage areas and flow paths? Note some approving authorities may require greater return periods.		✓			
CONSTRUCTABILITY					
Has an acceptable construction method statement been submitted and approved?				AT DETAILED DESIGN/ CONSTRUCTION	
MAINTAINABILITY					
Has an acceptable Maintenance Plan been submitted and approved?				AT DETAILED DESIGN/ CONSTRUCTION	
INFORMATION PROVISION					
Do the design proposals include sufficient provision for community engagement and awareness raising?					

(*) to be added on completion of SuDS Manual update

SYSTEM DESIGN ACCEPTABILITY	Summary details including any changes required	Acceptable (Y/N)	Date changes made
Acceptable: Minor changes required: Major changes required / re-design:			

A.9 Local Authority Planning Checklist

Requirement	Comment / Evidence location
A diagram of the proposed scheme showing the outline design of SuDS for the site. This should show where areas drain to, the flow routes for water through the system, where water will be stored and the volume of storage provided for the design rainfall event, the location, capacity and details of flow controls and the discharge point. Exceedance routes should also be indicated or explained.	Fairhurst Drawing 136782-C-4000
Description of likely geology below the site	Geo-Environmental and Geotechnical Preliminary Risk Assessment, Report Fairhurst 126782-R1
Description of existing topography of the site and natural or existing surface water drainage flows and how these have been allowed for in the design;	Statements in FRA
The proposed destination for the surface water	Statements in FRA & drainage strategy
If discharging surface water to a public sewer, developers will be required to provide evidence with the application that capacity exists in the public sewerage network to serve their development in the form of written confirmation. If discharging to infiltration then the developer will need to provide evidence that the site is suitable. This will require a site investigation including infiltration tests (see the 'SuDS Manual');	Infiltration tests commissioned, awaiting results.
Landscaping plans for any open surface features showing how they are integrated into the overall landscape design for the development;	n/a
Health and safety checklist for the scheme	To be completed during detailed design
Demonstrate how interception losses are provided through the provision of SuDS techniques, which absorb water or allow small volumes to soak into the ground. This means that there should be no runoff for the majority of rainfall events up to 5mm depth (i.e. around 50% of all rainfall events). This is achieved by using systems that allow water to soak into the ground, soil or stone layers and allowing for evapotranspiration. Interception losses occur in the top parts of the system or only require low infiltration rates in the soil below, and therefore can be provided even if the ground is not suitable for full infiltration. This is only a small volume of water so is achievable on most if not all sites in Richmond.	n/a Site to discharge via infiltration
Supporting calculations to demonstrate the system has sufficient capacity.	Pipe capacity to be confirmed at detailed design. Quick storage estimates (see FRA) show preliminary attenuation volumes.

Supporting justification for the treatment provision within the system (see the 'SuDS Manual');	n/a
Explanation of the amenity and biodiversity provision within the system and the basis for the design of these aspects. Whilst these are one of the benefits of SuDS, they may not be provided on all smaller developments (especially single houses). However, providing these aspects can create much more pleasant places to live.	Refer to landscape architect plans
Explanation of the maintenance requirements for the system (what to do and the frequency) along with an indication of how lack of maintenance affects the performance of the system (hydraulic and water quality). Indication of the likely annual cost of maintenance.	See FRA / drainage strategy
Drainage Assessment Checklist	See FRA / drainage strategy

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