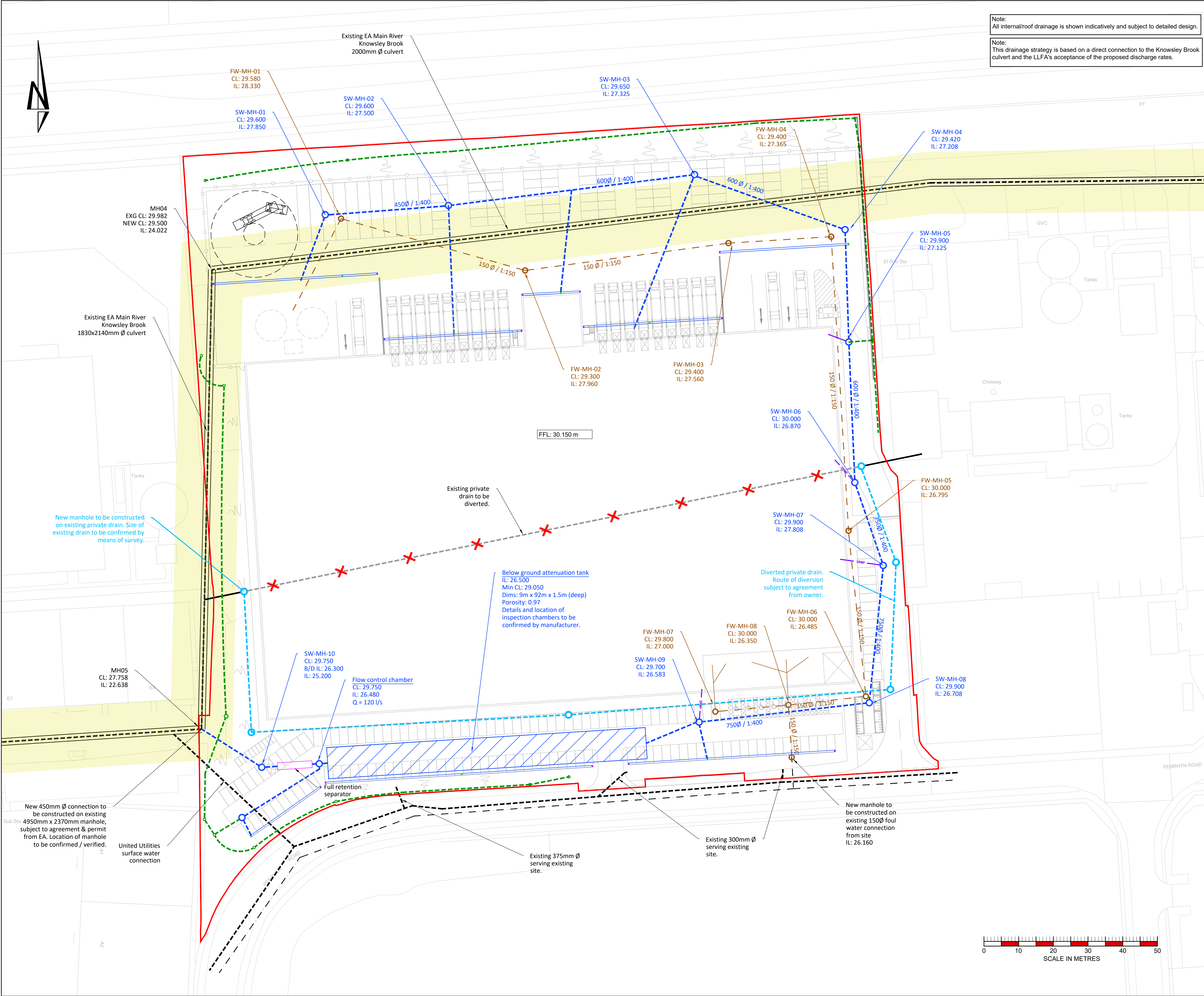




APPENDIX E – DRAINAGE STRATEGY DRAWINGS



Note:
All internal/roof drainage is shown indicatively and subject to detailed design.

Note:
This drainage strategy is based on a direct connection to the Knowsley Brook culvert and the LLFA's acceptance of the proposed discharge rates.

THIS DRAWING IS THE COPYRIGHT OF BURROWS GRAHAM LIMITED.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARD/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:

CONSTRUCTION

MAINTENANCE

DEMOLITION

IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT

GENERAL NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL THE RELEVANT ARCHITECTS, ENGINEERS' AND SERVICE ENGINEERS DRAWINGS & SPECIFICATIONS.

Proposed Surface Water Drainage

Proposed Surface Water Drainage Manhole

Siphonic Roof Downpipe (by others)

Proposed Foul Water Drainage

Proposed Foul Water Drainage Manhole

Proposed Porous Paving

Existing foul water sewer

Existing surface water sewer

Existing private sewer to be retained

Proposed Attenuation Tank

Proposed Channel Drains

Proposed Diversion of the Private Sewer

Existing Private Sewer to be abandoned

EA 8m Easement

Outlet Unit

Access Unit

Proposed Petrol Interceptor / Separator

Proposed Filter Drain

This drawing is based on UMC Architect's drawing ref: 21002-P0102D

P03	04.02.2022	JAM	For planning	JW
P02	28.01.2022	JAM	FIRST ISSUE	JW
P01	25.01.2022	RO	FIRST ISSUE	JAM
REV.	DATE	BY	REVISION	CHK'D

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PROJECT
GRAFTONGATE, KNOWSLEY

DRAWING TITLE
FOUL & SURFACE WATER DRAINAGE STRATEGY

BGL PROJECT NUMBER 21065	DRAWING STATUS PRELIMINARY	DRAWN BY RO
SCALE @ A1 1:500	DATE 25.01.2022	CHECKED BY JAM
DRAWING No. 21065-BGL-XX-XX-DR-S-0250		REV. P3

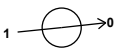
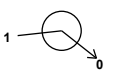
APPENDIX F – HYDRAULIC CALCULATIONS

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.009	7.000	400.0	450	Circular	29.000	26.500	2.050	29.750	26.482	2.818
1.010	13.423	394.8	450	Circular	29.750	26.482	2.818	28.280	26.448	1.382

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.009	Attenuation Tank		Junction		Flow control chamber 2	2100	Manhole	Adoptable
1.010	Flow control chamber 2	2100	Manhole	Adoptable	12	1350	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW-MH-01	-243.825	144.993	29.600	1.750	1350				
						0	1.000	27.850	450
SW-MH-02	-208.793	148.535	29.600	2.100	1500		1	1.000	27.650
						0	1.001	27.500	600
SW-MH-03	-139.113	156.135	29.650	2.325	1500		1	1.001	27.325
						0	1.002	27.325	600
SW-MH-04	-100.362	125.597	30.200	2.992	1500		1	1.002	27.208
						0	1.003	27.208	600
SW-MH-05	-97.431	100.422	30.600	3.475	1500		1	1.003	27.125
						0	1.004	27.125	600
SW-MH-06	-95.046	72.602	30.200	3.330	1800		1	1.004	27.020
						0	1.005	26.870	750
SW-MH-07	-85.791	47.288	29.900	3.092	1800		1	1.005	26.808
						0	1.006	26.808	750
SW-MH-08	-88.818	7.973	29.900	3.192	1800		1	1.006	26.708
						0	1.007	26.708	750
SW-MH-09	-137.072	2.407	29.750	3.167	1800		1	1.007	26.583
						0	1.008	26.583	750
Attenuation Tank	-181.195	0.386	29.000	2.500			1	1.008	26.500
						0	1.009	26.500	450
Flow control chamber 2	-230.663	-1.061	29.750	3.268	2100		1	1.009	26.482
						0	1.010	26.482	450
12	-261.115	11.447	28.280	1.832	1350		1	1.010	26.448
									450

Simulation Settings

Rainfall Methodology	FSR	Summer CV	0.750	Drain Down Time (mins)	240
FSR Region	England and Wales	Winter CV	0.840	Additional Storage (m³/ha)	20.0
M5-60 (mm)	20.000	Analysis Speed	Normal	Check Discharge Rate(s)	x
Ratio-R	0.400	Skip Steady State	x	Check Discharge Volume	x

Storm Durations

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	40	0	0
30	0	0	0				

Node Flow control chamber 2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	26.482	Product Number	CTL-SHE-0419-1200-1525-1200
Design Depth (m)	1.525	Min Outlet Diameter (m)	0.450
Design Flow (l/s)	120.0	Min Node Diameter (mm)	

Node Attenuation Tank Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	26.550
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	108

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	820.0	0.0	1.500	820.0	0.0	1.501	0.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	109.521	30.991	30 year 360 minute summer	31.221	8.034
1 year 15 minute winter	76.857	30.991	30 year 360 minute winter	20.295	8.034
1 year 30 minute summer	71.439	20.215	30 year 480 minute summer	24.324	6.428
1 year 30 minute winter	50.133	20.215	30 year 480 minute winter	16.160	6.428
1 year 60 minute summer	48.435	12.800	30 year 600 minute summer	19.756	5.404
1 year 60 minute winter	32.179	12.800	30 year 600 minute winter	13.498	5.404
1 year 120 minute summer	30.053	7.942	30 year 720 minute summer	17.490	4.687
1 year 120 minute winter	19.966	7.942	30 year 720 minute winter	11.754	4.687
1 year 180 minute summer	23.233	5.979	30 year 960 minute summer	14.215	3.743
1 year 180 minute winter	15.102	5.979	30 year 960 minute winter	9.416	3.743
1 year 240 minute summer	18.475	4.882	30 year 1440 minute summer	10.161	2.723
1 year 240 minute winter	12.274	4.882	30 year 1440 minute winter	6.829	2.723
1 year 360 minute summer	14.169	3.646	100 year +40% CC 15 minute summer	488.233	138.153
1 year 360 minute winter	9.210	3.646	100 year +40% CC 15 minute winter	342.620	138.153
1 year 480 minute summer	11.185	2.956	100 year +40% CC 30 minute summer	320.551	90.705
1 year 480 minute winter	7.431	2.956	100 year +40% CC 30 minute winter	224.948	90.705
1 year 600 minute summer	9.182	2.511	100 year +40% CC 60 minute summer	214.603	56.713
1 year 600 minute winter	6.274	2.511	100 year +40% CC 60 minute winter	142.577	56.713
1 year 720 minute summer	8.203	2.199	100 year +40% CC 120 minute summer	129.587	34.246
1 year 720 minute winter	5.513	2.199	100 year +40% CC 120 minute winter	86.094	34.246
1 year 960 minute summer	6.768	1.782	100 year +40% CC 180 minute summer	97.729	25.149
1 year 960 minute winter	4.483	1.782	100 year +40% CC 180 minute winter	63.526	25.149
1 year 1440 minute summer	4.949	1.326	100 year +40% CC 240 minute summer	75.977	20.078
1 year 1440 minute winter	3.326	1.326	100 year +40% CC 240 minute winter	50.477	20.078
30 year 15 minute summer	268.706	76.035	100 year +40% CC 360 minute summer	56.677	14.585
30 year 15 minute winter	188.566	76.035	100 year +40% CC 360 minute winter	36.841	14.585
30 year 30 minute summer	174.929	49.499	100 year +40% CC 480 minute summer	43.979	11.622
30 year 30 minute winter	122.757	49.499	100 year +40% CC 480 minute winter	29.219	11.622
30 year 60 minute summer	116.589	30.811	100 year +40% CC 600 minute summer	35.604	9.738
30 year 60 minute winter	77.459	30.811	100 year +40% CC 600 minute winter	24.327	9.738
30 year 120 minute summer	70.438	18.615	100 year +40% CC 720 minute summer	31.433	8.424
30 year 120 minute winter	46.797	18.615	100 year +40% CC 720 minute winter	21.125	8.424
30 year 180 minute summer	53.298	13.715	100 year +40% CC 960 minute summer	25.432	6.697
30 year 180 minute winter	34.645	13.715	100 year +40% CC 960 minute winter	16.847	6.697
30 year 240 minute summer	41.604	10.995	100 year +40% CC 1440 minute summer	18.055	4.839
30 year 240 minute winter	27.641	10.995	100 year +40% CC 1440 minute winter	12.134	4.839

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW-MH-01	11	27.973	0.123	38.6	0.5983	0.0000	OK
15 minute winter	SW-MH-02	11	27.688	0.188	77.1	0.8704	0.0000	OK
15 minute winter	SW-MH-03	12	27.573	0.248	115.2	1.0762	0.0000	OK
15 minute winter	SW-MH-04	12	27.478	0.270	119.7	0.5905	0.0000	OK
15 minute winter	SW-MH-05	12	27.419	0.294	160.4	1.1263	0.0000	OK
15 minute winter	SW-MH-06	12	27.263	0.393	234.2	2.5486	0.0000	OK
15 minute winter	SW-MH-07	12	27.217	0.409	310.2	2.7767	0.0000	OK
15 minute winter	SW-MH-08	12	27.108	0.400	315.9	1.1762	0.0000	OK
15 minute winter	SW-MH-09	12	26.954	0.371	345.5	1.6372	0.0000	OK
60 minute winter	Attenuation Tank	48	26.808	0.308	227.6	202.3572	0.0000	OK
60 minute winter	Flow control chamber 2	48	26.796	0.314	85.4	1.0882	0.0000	OK
15 minute summer	12	1	26.448	0.000	56.2	0.0000	0.0000	OK

Link Event (Velocity)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW-MH-01	1.000	SW-MH-02	38.6	1.133	0.155	1.1444	
15 minute winter	SW-MH-02	1.001	SW-MH-03	76.6	0.835	0.224	6.4437	
15 minute winter	SW-MH-03	1.002	SW-MH-04	112.3	0.974	0.325	5.3471	
15 minute winter	SW-MH-04	1.003	SW-MH-05	118.3	0.913	0.339	4.1604	
15 minute winter	SW-MH-05	1.004	SW-MH-06	157.9	1.264	0.456	5.1496	
15 minute winter	SW-MH-06	1.005	SW-MH-07	233.3	0.973	0.381	5.9959	
15 minute winter	SW-MH-07	1.006	SW-MH-08	308.5	1.273	0.489	9.2105	
15 minute winter	SW-MH-08	1.007	SW-MH-09	315.2	1.394	0.505	11.0749	
15 minute winter	SW-MH-09	1.008	Attenuation Tank	349.9	2.600	0.540	4.4180	
60 minute winter	Attenuation Tank	1.009	Flow control chamber 2	85.4	0.730	0.531	0.8190	
60 minute winter	Flow control chamber 2	Hydro-Brake®	12	85.3				348.3

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW-MH-01	11	28.053	0.203	94.7	0.9844	0.0000	OK
15 minute winter	SW-MH-02	13	27.989	0.489	189.3	2.2606	0.0000	OK
15 minute winter	SW-MH-03	13	27.963	0.638	272.5	2.7739	0.0000	SURCHARGED
15 minute winter	SW-MH-04	12	27.872	0.664	271.3	1.4521	0.0000	SURCHARGED
15 minute winter	SW-MH-05	12	27.829	0.704	350.2	2.6981	0.0000	SURCHARGED
15 minute winter	SW-MH-06	12	27.708	0.838	522.0	5.4301	0.0000	SURCHARGED
15 minute winter	SW-MH-07	12	27.626	0.818	709.6	5.5448	0.0000	SURCHARGED
15 minute winter	SW-MH-08	12	27.434	0.726	727.7	2.1330	0.0000	OK
60 minute winter	SW-MH-09	52	27.216	0.633	504.7	2.7958	0.0000	OK
60 minute winter	Attenuation Tank	52	27.215	0.715	537.3	519.7841	0.0000	SURCHARGED
60 minute winter	Flow control chamber 2	52	27.198	0.716	120.9	2.4801	0.0000	SURCHARGED
15 minute summer	12	1	26.448	0.000	118.2	0.0000	0.0000	OK

Link Event (Velocity)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW-MH-01	1.000	SW-MH-02	94.6	1.412	0.380	3.0463	
15 minute summer	SW-MH-02	1.001	SW-MH-03	170.8	0.960	0.499	15.3179	
15 minute summer	SW-MH-03	1.002	SW-MH-04	227.7	1.077	0.659	12.2833	
15 minute winter	SW-MH-04	1.003	SW-MH-05	284.6	1.041	0.816	9.0137	
15 minute summer	SW-MH-05	1.004	SW-MH-06	333.5	1.449	0.962	11.5488	
15 minute winter	SW-MH-06	1.005	SW-MH-07	519.8	1.181	0.848	11.0030	
15 minute winter	SW-MH-07	1.006	SW-MH-08	709.5	1.612	1.124	16.6473	
15 minute winter	SW-MH-08	1.007	SW-MH-09	724.4	1.747	1.160	19.9374	
15 minute winter	SW-MH-09	1.008	Attenuation Tank	885.6	3.521	1.368	9.6390	
15 minute summer	Attenuation Tank	1.009	Flow control chamber 2	118.7	0.791	0.739	1.1091	
60 minute winter	Flow control chamber 2	Hydro-Brake®	12	119.7				838.0

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW-MH-01	11	29.600	1.750	172.1	8.5050	19.3200	FLOOD
15 minute winter	SW-MH-02	11	29.600	2.100	273.0	9.7104	9.6152	FLOOD
15 minute winter	SW-MH-03	11	29.599	2.274	411.6	9.8861	0.0000	FLOOD RISK
15 minute winter	SW-MH-04	11	29.507	2.299	403.0	5.0300	0.0000	SURCHARGED
15 minute winter	SW-MH-05	11	29.415	2.290	559.6	8.7788	0.0000	SURCHARGED
15 minute winter	SW-MH-06	11	29.088	2.218	920.9	14.3672	0.0000	SURCHARGED
15 minute winter	SW-MH-07	11	28.850	2.042	1277.4	13.8468	0.0000	SURCHARGED
15 minute winter	SW-MH-08	12	28.259	1.551	1286.8	4.5577	0.0000	SURCHARGED
120 minute winter	SW-MH-09	102	27.975	1.392	531.8	6.1453	0.0000	SURCHARGED
120 minute winter	Attenuation Tank	102	27.972	1.472	578.9	1111.3170	0.0000	SURCHARGED
120 minute winter	Flow control chamber 2	102	27.956	1.474	121.5	5.1051	0.0000	SURCHARGED
15 minute summer	12	1	26.448	0.000	119.7	0.0000	0.0000	OK

Link Event (Velocity)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW-MH-01	1.000	SW-MH-02	130.6	1.437	0.525	5.3254	
15 minute winter	SW-MH-02	1.001	SW-MH-03	257.7	1.001	0.753	19.7436	
15 minute summer	SW-MH-03	1.002	SW-MH-04	385.7	1.369	1.117	12.9572	
15 minute summer	SW-MH-04	1.003	SW-MH-05	423.4	1.503	1.214	9.0137	
15 minute summer	SW-MH-05	1.004	SW-MH-06	555.8	1.973	1.603	11.5488	
15 minute winter	SW-MH-06	1.005	SW-MH-07	901.7	2.049	1.471	11.0030	
15 minute winter	SW-MH-07	1.006	SW-MH-08	1250.7	2.842	1.981	16.7246	
15 minute winter	SW-MH-08	1.007	SW-MH-09	1278.4	2.905	2.048	21.3784	
15 minute summer	SW-MH-09	1.008	Attenuation Tank	1382.2	4.015	2.134	13.2036	
15 minute summer	Attenuation Tank	1.009	Flow control chamber 2	124.9	0.816	0.778	1.1091	
120 minute winter	Flow control chamber 2	Hydro-Brake®	12	119.7				1828.4

APPENDIX G – DRAINAGE INSPECTION & MAINTENANCE SCHEDULE

GRAFTONGATE, KNOWSLEY – DRAINAGE INSPECTION & MAINTENANCE SCHEDULE

Maintenance schedule (It is the responsibility of the client/tenant or nominated management company to carry out the maintenance outlined in this table)	Required action	Typical frequency
Below Ground Drainage Pipes, Manholes, etc		
Regular maintenance	Lift covers and inspect manholes for evidence of debris and silt deposits and evidence of blockages (standing water). Carry out CCTV survey if required	Quarterly
Remedial actions	High pressure jetting and/or remove minor blockages and silt build up	As required – 20% loss of pipe cross-section
	Replace broken access covers, remove major blockages, repair structurally defective pipework	As required
Flow control chamber		
Regular maintenance	Lift covers and inspect chamber for evidence of debris and silt deposits and evidence of blockages. Test bypass door operating correctly.	Quarterly
Remedial actions	High pressure jetting and or remove minor blockages and silt build up	As required
	Replace broken access covers, remove major blockages, repair/replace defective flow control devices	As required
Linear channel drains and gullies		
Regular maintenance	Lift access covers and inspect for silt/debris accumulation	Quarterly
Remedial actions	Replace broken access covers, gratings	Annually
	High pressure jetting and/or remove minor blockages and silt build up	As required
Rainwater pipes		
Regular maintenance	Inspect rainwater goods for evidence of leaking pipework	Monthly (or as required)
Occasional maintenance	Remove rodding eyes and carry out high pressure jetting to remove any debris	Quarterly
Remedial actions	Replace cracked / leaking pipework	As required
Attenuation tank		
Regular maintenance	The majority of inspection and maintenance requirements are in the flow control downstream of the system.	See above
	Internal inspection and debris removal can be achieved via entry into the attenuation structure.	As required
Proprietary treatment systems		
Regular maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation.	Six monthly
	Change the filter media	As recommended by manufacturer
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor performance	Six monthly
	Inspect sediment accumulation rates and filter media, and establish appropriate replacement frequencies.	Monthly during first half of the year, then every six months