WE ARE SYMMETRYS

ADDENDUM TO DRAINAGE AND SUDS STRATEGY – RESPONSES TO LLFA

LAND TO THE WEST OF FROGHALL LANE
ESSEX
2015121

SYMMETRYS
STRUCTURAL / CIVIL ENGINEERS

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APPENDICES

ATTACHMENTS

REVISION HISTORY

Revision	Description	Date	By	Checked
00	First Issue	31/03/22	YP	AH

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1.0 Introduction

1.1 Symmetrys was previously appointed to carry out a Drainage and SuDS Strategy for the development at the Land to the West of Froghall Lane

1.2 The Objective of this Addendum is to provide responses to the queries raised by Essex County Council, on their role as the Lead Local Flood Authority, associated with the Drainage and SuDS Strategy.

2.0 LLFA Comments & Responses Summary

2.1 Following consultation with the Lead Local Flood Authority the following amendments have been introduced.

	LLFA Comment	Responses	Amendments
1	Rainwater harvesting should be utilised	Rainwater harvesting butts will be provided to re-use water for garden planting watering. Strategy is limited to above ground due to the relatively high environmental impact of below ground tanks	• Appendix A - Proposed Drainage Layout
2	Source control SuDS	Permeable paving is provided at parking spaces. Also, greenroof is proposed at the communal area building between Villas A and C	• Appendix A - Proposed Drainage Layout
3	Runoff calcs for the areas discharging through SuDS only	The proposed runoff has been calculated following LLFA comments to only account for the impermeable areas. New value is 3.43 l/s/ha, 3.6 l/s for the 1.036 Ha of impermeable surfaces	• Appendix B - Micro drainage Simulation Calculations 1 in 100 year + 40% and Greenfield Calculation.
4	Discharge from site restricted to 1 year GF, instead of 5 l//s	Drainage system has been re-calculated for the new proposed runoff rate of 3.7 l/s to match greenfield rates. This value is marginally higher than the calculated 3.6 l/s, to enable a half drain time of less than 24 hours for the 1 in 30 +40% storm event	• Appendix A - Proposed Drainage Layout • Appendix B - Micro drainage Simulation Calculations 1 in 100 year + 40% and Greenfield Calculation.
5	half empty in 24hrs for 1 in 30+40%	Calculations shown half drain time for the 1 in 30 + 40% climate change storm event is 1406 minutes (23.4 hours)	• Appendix B - Micro drainage Simulation Calculations 1 in 100 year + 40% and Greenfield Calculation.

2.2 Additionally, we have updated calculations for the 1 in 1000-year storm based to demonstrate no flooding occurs given the amended discharge rate. They can be found on Appendix C.

2.3 Original comments from LLFA can be found on Appendix D.

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APPENDIX A
PROPOSED DRAINAGE LAYOUT

QD A1

NOTE:

ALL GULLIES TO BE LAID WITHIN ACCESS ROADS AND CAR PARK AREAS ARE TO BE TRAPPED. MANHOLES S35 AND S13 ARE TO BE CATCH PIT MANHOLES WITH MINIMUM OF 450mm SUMP. GULLIES AND CATCH PITS ARE TO BE ANNUALLY CLEANED AND MAINTAINED TO ENSURE WATER QUALITY ENTERING THE DRY LAGOON IS OPTIMISED.

Footway to have porous paving with 2 layer of AquarCell Eco laid directly under paving. AquarCell Eco to be laid under whole area. Refer to soakaway design calculations for clarification of design. Calculation state a minimum of 2.1m wide x 0.8m deep x 78.275m length of crate type attenuation is required for the worst case 1 in 100 year storm event + 40% for climate change. It is proposed to provide 2.1m x 0.8m x 96.721m giving a betterment.

Orifice flow control 20mm

Orifice flow control 25mm

Orifice flow control 20mm

Attenuation lagoon designed not to flood in the worst case 1 in 100 year storm event + 40% for climate change. Refer to Micro Drainage simulations for clarification of design. Minimum attenuation to be provided is 850cum from a 1m deep lagoon with 300mm of free board.

+56.3m MINIMUM TOP OF BANK LEVEL TO LAGOON

+55.0m LAGOON BASE LEVEL

Spel 215 C1/SC fuel By-pass interceptor or similar approved

Hydro-Brake chamber. Hydro-Brake with maximum permitted discharge rate of 3.7 l/s from 1.3m head.

Controlled discharge discharge to existing ditch course via head wall. Head wall to have none return flap valve at outfall.

Orifice flow control 30mm

Orifice flow control 40mm

Discharge location and demarcation chamber.

Orifice flow control 20mm

Proposed connection onto existing foul sewer
Ref:MHF1
Invert level confirmed to from site as 54.63m

FFL 62.442m
FFL 60.500m
FFL 57.882m
FFL 56.720m
FFL 57.612m
FFL 56.450m
FFL 59.037m
FFL 57.875m

90.000
6.721

35
33
28
26a
MOUNT PLEASANT ROAD

Storm Network 1

Pipe Code	Diameter (mm)	Gradient (1:)	Pipe Length (m)	Upstream Manhole Number	Upstream Manhole Cover	Upstream Manhole Invert	Downstream Manhole Number	Downstream Manhole Cover	Downstream Manhole Invert
1.000	225	15	37.366	S1	69.000	67.500	S2	67.000	65.000
1.001	225	15	61.182	S2	67.000	65.000	S3	63.000	60.925
1.002	300	22	25.157	S3	63.000	60.850	S8	62.042	59.719
2.000	300	99	17.974	S4	62.042	60.617	S7	62.042	60.435
3.000	100	56	4.520	S5	62.042	61.650	S6	62.000	61.569
3.001	100	60	3.283	S6	62.000	61.569	S7	62.042	61.514
2.001	300	56	20.154	S7	62.042	60.435	S8	62.042	60.077
1.003	300	100	40.012	S8	62.042	59.719	S9	61.681	59.319
1.004	300	100	17.866	S9	61.681	59.319	S10	61.681	59.140
1.005	300	22	28.851	S10	61.681	59.140	S12	60.100	57.851
4.000	450	100	71.711	S11	60.100	58.600	S12	60.100	57.883
1.006	450	39	16.525	S12	60.100	57.701	S15	58.868	57.274
5.000	100	48	4.304	S13	58.868	58.500	S14	58.868	58.410
5.001	100	81	3.648	S14	58.868	58.410	S15	58.868	58.365
1.007	450	76	38.833	S15	58.868	57.274	S16	58.710	56.763
1.008	450	28	23.806	S16	58.710	56.763	S22	56.850	55.900
6.000	150	150	31.451	S17	58.237	57.237	S18	58.237	57.027
6.001	150	38	34.138	S18	58.237	57.027	S20	57.075	56.127
7.000	225	201	22.321	S19	57.075	56.075	S20	57.075	55.964
6.002	225	197	7.295	S20	57.075	55.964	S21	57.075	55.927
6.003	225	197	7.295	S21	57.075	55.927	S22	56.850	55.890
1.009	500	202	7.893	S22	56.850	55.586	S23	56.842	55.547
1.010	500	201	38.900	S23	56.842	55.547	S24	56.842	55.353
1.011	500	250	23.263	S24	56.842	55.353	S29	56.842	55.260
8.000	225	201	11.628	S25	56.300	55.700	S26	56.300	55.642
8.001	225	201	11.628	S26	56.300	55.642	S27	56.300	55.584
8.002	225	199	31.507	S27	56.300	55.584	S28	56.300	55.426
8.003	225	199	10.065	S28	56.300	55.426	S29	56.842	55.375
1.012	450	100	15.049	S29	56.842	55.151	S41	56.300	55.001
9.000	150	426	14.149	S30	57.805	56.060	S31	57.800	56.027
9.001	150	170	5.640	S31	57.800	56.027	S32	56.662	55.994
9.002	300	203	25.320	S32	56.662	55.844	S33	57.732	55.719
9.003	300	100	20.490	S33	57.732	55.719	S34	57.732	55.514
9.004	300	201	34.291	S34	57.732	55.514	S35	57.732	55.343
9.005	300	200	33.985	S35	57.732	55.343	S36	56.570	55.173
9.006	300	202	10.199	S36	56.570	55.173	S40	56.570	55.122
10.000	300	249	10.968	S37	56.039	55.549	S38	56.000	55.505
10.001	300	243	10.695	S38	56.000	55.505	S39	56.189	55.461
10.002	300	302	21.954	S39	56.189	55.461	S40	56.570	55.388
9.007	300	314	17.585	S40	56.570	55.122	S41	56.300	55.066
1.013	150	750	21.846	S41	56.300	55.000	S42	56.300	54.971
1.014	150	1000	46.880	S42	56.300	54.971	S43	56.300	54.924
1.015	150	100	7.921	S43	56.300	54.924	S44	56.300	54.844
1.016	150	101	5.003	S44	56.300	54.788	S45	56.300	54.738

Notes

NOTES:

1.ALL DIMENSIONS IN METERS UNLESS STATED OTHERWISE.

2.ALL PRIVATE DRAINAGE WORKS ARE TO COMPLY WITH THE REQUIREMENTS OF BS 752 BUILDING DRAINAGE AND BUILDING REGULATIONS APPROVED DOCUMENT H 2010 EDITION.

3.ALL MATERIALS, UNLESS SPECIFIED OTHERWISE, SHALL COMPLY WITH THE RELEVANT BRITISH STANDARD. SOURCES OF MATERIALS ARE TO BE AGREED WITH THE EMPLOYER'S REPRESENTATIVE/ENGINEER IN ADVANCE OF THE WORKS.

4.ANY DISCREPANCIES IN THE DETAILS SHOWN TO BE REPORTED TO THE EMPLOYER'S REPRESENTATIVE/ENGINEER PRIOR TO CONSTRUCTION.

5.ALL EXISTING SERVICES TO BE LOCATED PRIOR TO THE COMMENCEMENT OF ANY DRAINAGE WORKS WHERE NECESSARY PROTECTION OR DIVERSIONS TO BE UNDERTAKEN TO AVOID CONFLICT WITH THE PROPOSED WORKS.

6.TYPE S PIPE BEDDING TO DRAINAGE WHERE DEPTH TO SOFFIT IS GREATER THAN 600mm IN LANDSCAPED AREAS (I.E. 10-14mm GRADED IMPORTED GRANULAR BED AND SURROUND FOR PIPES UP TO 525mm DIAM AND 20 - 40mm GRADED IMPORTED GRANULAR BED) TYPE Z BED AND SURROUND TO BE USED IN AREAS OF LESS COVER.

7.BACKFILL TO DRAINAGE TRENCHES UNDER CARRIAGEWAYS TO BE TYPE 1 SUB-BASE MATERIAL. ELSEWHERE BACKFILL TO BE FREE DRAINING READILY COMPATIBLE MATERIAL, FREE FROM RUBBISH AND ORGANIC MATTER, FROZEN SOIL CLAY LUMPS AND LARGE STONES. TO BE COMPACTED IN LAYERS NOT EXCEEDING 150mm THICK.

8.MANHOLE DIAMETERS SHOULD BE IN ACCORDANCE WITH THE TABLE BELOW:

DIAMETER OF LARGEST PIPE IN MANHOLE (mm)	INTERNAL DIAMETER OF MANHOLE (mm)
LESS THAN 375	1200*
375-450	1500
500-700	1500
750-900	1800
950-1200	2100

*1500 WHERE DEPTH TO SOFFIT IS 1350-1500mm

9.A FLEXIBLE JOINT SHALL BE PROVIDED AS CLOSE AS IS FEASIBLE TO OUTSIDE FACE OF ANY STRUCTURE INTO WHICH A PIPE IS BUILT, COMPATIBLE WITH THE SATISFACTORY COMPLETION AND SUBSEQUENT MOVEMENT OF THE JOINT. THE LENGTH OF THE NEXT PIPE (ROCKER PIPE) AWAY FROM THE STRUCTURE SHALL BE AS SHOWN IN THE TABLE BELOW.

NOMINAL DIAMETER (mm)	EFFECTIVE LENGTH (m)
150-600	0.6
675-750	1.0
825 AND OVER	1.25

KEY

S11 — 1.000 SWS — PRIVATE SURFACE WATER SEWER. REFER TO STORM NETWORK 1 TABLE FOR PIPE DETAILS AND MANHOLE COVER AND INVERT LEVELS.

FWS — PRIVATE FOUL SEWER

RAINWATER BUTTS TO COLLECT RUNOFF FROM RAINWATER DOWN PIPES. LOCATION SHOWN INDICATIVELY ONLY.

PERMEABLE PAVING WITH 350mm 30% VOIDS GRANULAR SUB-BASE

Rev	Date	By	Amendments
P9	29.03.21	YP	Updates to address LLFA comments
P8	03.07.17	JJM	Spel By-pass interceptor added to network.
P7	07.04.17	JJM	updated base layout and shown proposed drainage within cemetery.
P6	28.02.17	JJM	Revised climate change percentage
P5	16.02.17	JJM	Updated network table 1
P4	13.12.16	JJM	Drainage updated to suit new landscaping layout
P3	13.12.16	JJM	Drainage updated to suit new landscaping layout
P2	08.12.16	JJM	Added all drainage details
P1	02.12.16	JJM	PRELIMINARY ISSUE

Drawing Status

PRELIMINARY

Symmetrys Limited
Consulting Structural Engineers

6 The Courtyard, Lynton Road
London, N8 8SL
T: 020 8340 4041
W: www.symmetrys.com
E: info@symmetrys.com

Job Title

MONOR ROAD
CHIGWELL

Drawing Title

PROPOSED DRAINAGE LAYOUT

Job No.	Drawing No.	Revision
2015121	100	P9

Scales 1:500 @ A1 — Original Size A1

Drawn By JJM Date 29.10.16 Checked

Company No. 5873122
VAT Registration No. 894 2993 61
Registered In England And Wales

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APPENDIX B MICRO DRAINAGE SIMULATION CALCULATIONS 1 IN 100 YEAR + 40% AND GREENFIELD CALCULATION.

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	20.600	Add Flow / Climate Change (%)	0
Ratio R	0.436	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

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	37.366	2.500	14.9	0.020	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	61.182	4.075	15.0	0.033	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	25.157	1.131	22.2	0.112	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	17.974	0.182	98.8	0.092	5.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	4.520	0.081	55.5	0.018	5.00	0.0	0.600	o	100	Pipe/Conduit	
3.001	3.283	0.055	60.1	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
2.001	20.154	0.358	56.3	0.000	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	5.18	67.500	0.020	0.0	0.0	0.0	3.40	135.3	2.7
1.001	50.00	5.48	65.000	0.053	0.0	0.0	0.0	3.39	135.0	7.2
1.002	50.00	5.61	60.850	0.165	0.0	0.0	0.0	3.35	236.7	22.3
2.000	50.00	5.19	60.617	0.092	0.0	0.0	0.0	1.58	111.8	12.5
3.000	50.00	5.07	61.650	0.018	0.0	0.0	0.0	1.04	8.1	2.4
3.001	50.00	5.13	61.569	0.018	0.0	0.0	0.0	1.00	7.8	2.4
2.001	50.00	5.35	60.435	0.110	0.0	0.0	0.0	2.10	148.4	14.9

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
1.003	40.012	0.400	100.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	17.866	0.179	99.8	0.029	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	28.851	1.289	22.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	71.711	0.717	100.0	0.122	5.00	0.0	0.600	o	450	Pipe/Conduit	
1.006	16.525	0.427	38.7	0.050	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.000	4.304	0.090	47.6	0.029	5.00	0.0	0.600	o	100	Pipe/Conduit	
5.001	3.648	0.045	81.4	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.007	38.833	0.511	76.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.008	23.806	0.863	27.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
6.000	31.451	0.210	149.8	0.040	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.001	34.138	0.900	37.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
7.000	22.321	0.111	201.1	0.039	5.00	0.0	0.600	o	225	Pipe/Conduit	
6.002	7.295	0.037	197.3	0.012	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.003	7.295	0.037	197.3	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)
1.003	50.00	6.03	59.719	0.275	0.0	0.0	0.0	1.57	111.1	37.2
1.004	50.00	6.22	59.319	0.304	0.0	0.0	0.0	1.57	111.2	41.2
1.005	50.00	6.37	59.140	0.304	0.0	0.0	0.0	3.34	235.9	41.2
4.000	50.00	5.59	58.600	0.122	0.0	0.0	0.0	2.03	323.4	16.5
1.006	50.00	6.45	57.701	0.476	0.0	0.0	0.0	3.28	521.0	64.5
5.000	50.00	5.06	58.500	0.029	0.0	0.0	0.0	1.12	8.8	3.9
5.001	50.00	5.14	58.410	0.029	0.0	0.0	0.0	0.85	6.7	3.9
1.007	50.00	6.73	57.274	0.505	0.0	0.0	0.0	2.33	371.2	68.4
1.008	50.00	6.83	56.763	0.505	0.0	0.0	0.0	3.88	617.5	68.4
6.000	50.00	5.64	57.237	0.040	0.0	0.0	0.0	0.82	14.5	5.4
6.001	50.00	5.99	57.027	0.040	0.0	0.0	0.0	1.64	29.0	5.4
7.000	50.00	5.41	56.075	0.039	0.0	0.0	0.0	0.92	36.5	5.3
6.002	50.00	6.12	55.964	0.091	0.0	0.0	0.0	0.93	36.9	12.3
6.003	50.00	6.25	55.927	0.091	0.0	0.0	0.0	0.93	36.9	12.3

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
1.009	7.893	0.039	202.4	0.050	0.00	0.0	0.600	o	500	Pipe/Conduit	
1.010	38.900	0.194	200.5	0.039	0.00	0.0	0.600	o	500	Pipe/Conduit	
1.011	23.263	0.093	250.0	0.000	0.00	0.0	0.600	o	500	Pipe/Conduit	
8.000	11.628	0.058	200.5	0.039	5.00	0.0	0.600	o	225	Pipe/Conduit	
8.001	11.628	0.058	200.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.002	31.507	0.158	199.4	0.044	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.003	10.065	0.051	199.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.012	15.049	0.150	100.3	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
9.000	14.149	0.033	425.5	0.041	5.00	0.0	0.600	o	150	Pipe/Conduit	
9.001	5.640	0.033	169.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
9.002	25.320	0.125	202.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
9.003	20.490	0.205	100.0	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	
9.004	34.291	0.171	200.5	0.040	0.00	0.0	0.600	o	300	Pipe/Conduit	
9.005	33.985	0.170	199.9	0.039	0.00	0.0	0.600	o	300	Pipe/Conduit	
9.006	10.199	0.051	201.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
10.000	10.968	0.044	248.9	0.073	5.00	0.0	0.600	o	300	Pipe/Conduit	
10.001	10.695	0.044	242.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
10.002	21.954	0.073	301.5	0.037	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)
1.009	50.00	6.92	55.586	0.646	0.0	0.0	0.0	1.52	299.1	87.5
1.010	50.00	7.34	55.547	0.685	0.0	0.0	0.0	1.53	300.5	92.8
1.011	50.00	7.62	55.353	0.685	0.0	0.0	0.0	1.37	268.9	92.8
8.000	50.00	5.21	55.700	0.039	0.0	0.0	0.0	0.92	36.6	5.3
8.001	50.00	5.42	55.642	0.039	0.0	0.0	0.0	0.92	36.6	5.3
8.002	50.00	5.99	55.584	0.083	0.0	0.0	0.0	0.92	36.7	11.2
8.003	50.00	6.17	55.426	0.083	0.0	0.0	0.0	0.92	36.7	11.2
1.012	50.00	7.75	55.151	0.768	0.0	0.0	0.0	2.03	322.8	104.0
9.000	50.00	5.49	56.060	0.041	0.0	0.0	0.0	0.48	8.5	5.6
9.001	50.00	5.61	56.027	0.041	0.0	0.0	0.0	0.77	13.6	5.6
9.002	50.00	6.00	55.844	0.041	0.0	0.0	0.0	1.10	77.8	5.6
9.003	50.00	6.21	55.719	0.082	0.0	0.0	0.0	1.57	111.2	11.1
9.004	50.00	6.73	55.514	0.122	0.0	0.0	0.0	1.11	78.2	16.5
9.005	50.00	7.24	55.343	0.161	0.0	0.0	0.0	1.11	78.3	21.8
9.006	50.00	7.39	55.173	0.161	0.0	0.0	0.0	1.10	78.0	21.8
10.000	50.00	5.18	55.549	0.073	0.0	0.0	0.0	0.99	70.1	9.9
10.001	50.00	5.36	55.505	0.073	0.0	0.0	0.0	1.00	71.0	9.9
10.002	50.00	5.77	55.461	0.110	0.0	0.0	0.0	0.90	63.6	14.9

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
9.007	17.585	0.056	314.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.013	21.846	0.029	750.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.014	46.880	0.047	1000.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.015	7.921	0.080	99.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.016	5.003	0.050	100.8	0.000	0.00	0.0	0.600	o	150	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)
9.007	50.00	7.73	55.122	0.271	0.0	0.0	0.0	0.88	62.3	36.7
1.013	50.00	8.76	55.000	1.039	0.0	0.0	0.0	0.36	6.4«	140.7
1.014	50.00	11.28	54.971	1.039	0.0	0.0	0.0	0.31	5.5«	140.7
1.015	50.00	11.41	54.924	1.039	0.0	0.0	0.0	1.01	17.8«	140.7
1.016	50.00	11.49	54.788	1.039	0.0	0.0	0.0	1.00	17.7«	140.7

Storage Structures for Storm

Porous Car Park Manhole: 5, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	18.0
Max Percolation (l/s)	50.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	61.650	Membrane Depth (mm)	0

Porous Car Park Manhole: 13, DS/PN: 5.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	29.0
Max Percolation (l/s)	80.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	58.500	Membrane Depth (mm)	0

Porous Car Park Manhole: 20, DS/PN: 6.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	24.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	66.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	56.700	Membrane Depth (mm)	0

Porous Car Park Manhole: 25, DS/PN: 8.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	12.5
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)	56.000	Membrane Depth (mm)	0

Porous Car Park Manhole: 30, DS/PN: 9.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	15.0
Max Percolation (l/s)	41.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	57.450	Membrane Depth (mm)	0

Porous Car Park Manhole: 37, DS/PN: 10.000

Infiltration Coefficient Base (m/hr)	0.00000	Max Percolation (l/s)	105.6
Membrane Percolation (mm/hr)	1000	Safety Factor	2.0

Porous Car Park Manhole: 37, DS/PN: 10.000

Porosity	0.30	Slope (1:X)	0.0
Invert Level (m)	55.650	Depression Storage (mm)	5
Width (m)	10.0	Evaporation (mm/day)	3
Length (m)	38.0	Membrane Depth (mm)	0

Cellular Storage Manhole: 41, DS/PN: 1.013

Invert Level (m)	55.000	Safety Factor	1.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	850.0	800.0	1.000	850.0	913.1

1 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 Coeffiecient	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 Storage Structures	7
Number of Online Controls	7	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.437
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
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)	1, 30, 100
Climate Change (%)	0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	1	+0%					67.523
1.001	2	15 Winter	1	+0%					65.033
1.002	3	15 Winter	1	+0%					60.913
2.000	4	15 Winter	1	+0%	100/15 Summer				60.691
3.000	5	240 Winter	1	+0%	100/60 Summer				61.665
3.001	6	240 Winter	1	+0%	30/15 Summer				61.659
2.001	7	15 Winter	1	+0%	100/15 Summer				60.499
1.003	8	15 Winter	1	+0%	30/15 Summer				59.837
1.004	9	15 Winter	1	+0%	30/15 Summer				59.448
1.005	10	15 Winter	1	+0%					59.223
4.000	11	15 Winter	1	+0%					58.670
1.006	12	15 Winter	1	+0%					57.822
5.000	13	240 Winter	1	+0%	30/120 Winter				58.519
5.001	14	240 Winter	1	+0%	1/120 Winter				58.516
1.007	15	15 Winter	1	+0%					57.403
1.008	16	15 Winter	1	+0%					56.865
6.000	17	15 Winter	1	+0%	30/15 Summer				57.304
6.001	18	15 Winter	1	+0%	100/15 Summer				57.072
7.000	19	30 Winter	1	+0%	1/15 Summer				56.593

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.202	0.000	0.02			2.9	OK	
1.001	2	-0.192	0.000	0.05			6.8	OK	
1.002	3	-0.237	0.000	0.10			20.4	OK	
2.000	4	-0.226	0.000	0.14			13.1	OK	
3.000	5	-0.085	0.000	0.04		85	0.3	OK	
3.001	6	-0.010	0.000	0.04			0.2	OK	
2.001	7	-0.236	0.000	0.10			13.0	OK	
1.003	8	-0.182	0.000	0.33			33.6	OK	
1.004	9	-0.171	0.000	0.39			37.0	OK	
1.005	10	-0.217	0.000	0.17			36.8	OK	
4.000	11	-0.380	0.000	0.06			17.4	OK	
1.006	12	-0.329	0.000	0.16			60.0	OK	
5.000	13	-0.081	0.000	0.05		102	0.4	OK	
5.001	14	0.006	0.000	0.05			0.3	SURCHARGED	
1.007	15	-0.321	0.000	0.18			59.5	OK	
1.008	16	-0.348	0.000	0.12			59.8	OK	
6.000	17	-0.083	0.000	0.40			5.6	OK	
6.001	18	-0.105	0.000	0.20			5.5	OK	
7.000	19	0.293	0.000	0.08			2.8	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.002	20	30 Winter	1	+0%	1/15 Summer				56.590
6.003	21	30 Winter	1	+0%	1/15 Summer				56.588
1.009	22	15 Winter	1	+0%	30/15 Summer				55.794
1.010	23	15 Winter	1	+0%	100/15 Summer				55.724
1.011	24	15 Winter	1	+0%	30/15 Winter				55.548
8.000	25	60 Winter	1	+0%	1/15 Winter				56.005
8.001	26	60 Winter	1	+0%	1/15 Summer				56.004
8.002	27	15 Winter	1	+0%	100/15 Winter				55.647
8.003	28	15 Winter	1	+0%	100/15 Summer				55.493
1.012	29	15 Winter	1	+0%	30/15 Winter				55.333
9.000	30	60 Winter	1	+0%	1/15 Summer				56.698
9.001	31	60 Winter	1	+0%	1/15 Summer				56.694
9.002	32	60 Winter	1	+0%					55.865
9.003	33	15 Winter	1	+0%					55.764
9.004	34	15 Winter	1	+0%	100/15 Winter				55.588
9.005	35	15 Winter	1	+0%	100/15 Summer				55.434
9.006	36	15 Winter	1	+0%	30/15 Summer				55.274
10.000	37	360 Winter	1	+0%	30/120 Winter				55.697
10.001	38	240 Winter	1	+0%	30/60 Summer				55.698
10.002	39	15 Winter	1	+0%					55.518
9.007	40	15 Winter	1	+0%	30/15 Summer				55.245
1.013	41	480 Winter	1	+0%	30/15 Summer				55.145
1.014	42	480 Winter	1	+0%	1/360 Winter				55.127
1.015	43	480 Winter	1	+0%	1/240 Winter				55.094
1.016	44	480 Winter	1	+0%	1/60 Summer				55.083

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.002	20	0.401	0.000	0.12		25	3.5	SURCHARGED	
6.003	21	0.436	0.000	0.09			2.7	SURCHARGED	
1.009	22	-0.292	0.000	0.36			67.5	OK	
1.010	23	-0.323	0.000	0.27			70.6	OK	
1.011	24	-0.305	0.000	0.32			70.6	OK	
8.000	25	0.080	0.000	0.06		17	1.9	FLOOD RISK	
8.001	26	0.137	0.000	0.04			1.1	FLOOD RISK	
8.002	27	-0.162	0.000	0.17			5.8	OK	
8.003	28	-0.158	0.000	0.19			5.9	OK	
1.012	29	-0.267	0.000	0.35			75.9	OK	
9.000	30	0.488	0.000	0.22		27	1.7	SURCHARGED	
9.001	31	0.517	0.000	0.09			1.1	SURCHARGED	
9.002	32	-0.278	0.000	0.02			1.1	OK	
9.003	33	-0.255	0.000	0.06			5.3	OK	
9.004	34	-0.225	0.000	0.14			10.0	OK	
9.005	35	-0.208	0.000	0.20			14.4	OK	
9.006	36	-0.198	0.000	0.23			14.3	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
10.000	37	-0.152	0.000	0.01		204	0.8	OK	
10.001	38	-0.107	0.000	0.01			0.4	OK	
10.002	39	-0.243	0.000	0.08			4.6	OK	
9.007	40	-0.177	0.000	0.35			18.7	OK	
1.013	41	-0.005	0.000	0.76		409	4.3	OK	
1.014	42	0.006	0.000	0.80			4.3	SURCHARGED	
1.015	43	0.020	0.000	0.24			3.7	SURCHARGED	
1.016	44	0.145	0.000	0.26			3.7	SURCHARGED	

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 Coeffiecient	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 Storage Structures	7
Number of Online Controls	7	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.437
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
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)	1, 30, 100
Climate Change (%)	0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	30	+40%					67.541
1.001	2	15 Winter	30	+40%					65.070
1.002	3	15 Winter	30	+40%					60.983
2.000	4	15 Winter	30	+40%	100/15 Summer				60.763
3.000	5	120 Winter	30	+40%	100/60 Summer				61.744
3.001	6	120 Winter	30	+40%	30/15 Summer				61.742
2.001	7	15 Winter	30	+40%	100/15 Summer				60.559
1.003	8	15 Winter	30	+40%	30/15 Summer				60.347
1.004	9	15 Winter	30	+40%	30/15 Summer				59.790
1.005	10	15 Winter	30	+40%					59.314
4.000	11	15 Winter	30	+40%					58.737
1.006	12	15 Winter	30	+40%					57.948
5.000	13	240 Winter	30	+40%	30/120 Winter				58.609
5.001	14	240 Winter	30	+40%	1/120 Winter				58.607
1.007	15	15 Winter	30	+40%					57.539
1.008	16	15 Winter	30	+40%					56.965
6.000	17	15 Winter	30	+40%	30/15 Summer				57.547
6.001	18	15 Winter	30	+40%	100/15 Summer				57.142
7.000	19	60 Winter	30	+40%	1/15 Summer				56.938

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.184	0.000	0.08			9.9	OK	
1.001	2	-0.155	0.000	0.21			27.1	OK	
1.002	3	-0.167	0.000	0.41			86.1	OK	
2.000	4	-0.154	0.000	0.47			45.3	OK	
3.000	5	-0.006	0.000	0.08			0.6	FLOOD RISK	
3.001	6	0.073	0.000	0.05			0.3	FLOOD RISK	
2.001	7	-0.176	0.000	0.35			44.8	OK	
1.003	8	0.328	0.000	1.19			122.7	SURCHARGED	
1.004	9	0.172	0.000	1.41			134.7	SURCHARGED	
1.005	10	-0.126	0.000	0.63			135.1	OK	
4.000	11	-0.313	0.000	0.20			59.0	OK	
1.006	12	-0.203	0.000	0.58			212.3	OK	
5.000	13	0.009	0.000	0.06			0.5	FLOOD RISK	
5.001	14	0.098	0.000	0.06			0.4	FLOOD RISK	
1.007	15	-0.185	0.000	0.64			211.0	OK	
1.008	16	-0.248	0.000	0.41			212.2	OK	
6.000	17	0.160	0.000	1.31			18.2	SURCHARGED	
6.001	18	-0.035	0.000	0.63			17.5	OK	
7.000	19	0.638	0.000	0.27			9.1	FLOOD RISK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.002	20	60 Winter	30	+40%	1/15 Summer				56.935
6.003	21	60 Winter	30	+40%	1/15 Summer				56.938
1.009	22	15 Winter	30	+40%	30/15 Summer				56.140
1.010	23	15 Winter	30	+40%	100/15 Summer				56.021
1.011	24	15 Winter	30	+40%	30/15 Winter				55.858
8.000	25	60 Winter	30	+40%	1/15 Winter				56.210
8.001	26	60 Winter	30	+40%	1/15 Summer				56.208
8.002	27	15 Winter	30	+40%	100/15 Winter				55.724
8.003	28	15 Winter	30	+40%	100/15 Summer				55.651
1.012	29	15 Winter	30	+40%	30/15 Winter				55.630
9.000	30	60 Winter	30	+40%	1/15 Summer				57.576
9.001	31	60 Winter	30	+40%	1/15 Summer				57.577
9.002	32	60 Winter	30	+40%					55.874
9.003	33	15 Winter	30	+40%					55.817
9.004	34	15 Winter	30	+40%	100/15 Winter				55.683
9.005	35	15 Winter	30	+40%	100/15 Summer				55.632
9.006	36	960 Winter	30	+40%	30/15 Summer				55.566
10.000	37	480 Winter	30	+40%	30/120 Winter				55.900
10.001	38	480 Winter	30	+40%	30/60 Summer				55.906
10.002	39	15 Winter	30	+40%					55.583
9.007	40	960 Winter	30	+40%	30/15 Summer				55.566
1.013	41	960 Winter	30	+40%	30/15 Summer				55.565
1.014	42	960 Winter	30	+40%	1/360 Winter				55.550
1.015	43	960 Winter	30	+40%	1/240 Winter				55.523
1.016	44	960 Winter	30	+40%	1/60 Summer				55.514

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.002	20	0.746	0.000	0.16		56	4.6	FLOOD RISK	
6.003	21	0.786	0.000	0.11			3.3	FLOOD RISK	
1.009	22	0.054	0.000	1.24			232.7	SURCHARGED	
1.010	23	-0.026	0.000	0.92			241.6	OK	
1.011	24	0.005	0.000	1.08			235.4	SURCHARGED	
8.000	25	0.285	0.000	0.07		61	2.1	FLOOD RISK	
8.001	26	0.341	0.000	0.04			1.4	FLOOD RISK	
8.002	27	-0.085	0.000	0.68			23.4	OK	
8.003	28	0.000	0.000	0.76			23.3	OK	
1.012	29	0.029	0.000	1.14			247.9	SURCHARGED	
9.000	30	1.366	0.000	0.57		44	4.4	FLOOD RISK	
9.001	31	1.401	0.000	0.14			1.6	FLOOD RISK	
9.002	32	-0.269	0.000	0.02			1.6	OK	
9.003	33	-0.202	0.000	0.23			22.7	OK	
9.004	34	-0.130	0.000	0.59			42.6	OK	
9.005	35	-0.011	0.000	0.77			55.1	OK	
9.006	36	0.094	0.000	0.07			4.4	SURCHARGED	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
10.000	37	0.051	0.000	0.04		651	2.1	FLOOD RISK	
10.001	38	0.101	0.000	0.01			0.5	FLOOD RISK	
10.002	39	-0.177	0.000	0.35			19.6	OK	
9.007	40	0.144	0.000	0.11			5.8	SURCHARGED	
1.013	41	0.415	0.000	0.74		1406	4.2	SURCHARGED	
1.014	42	0.429	0.000	0.77			4.1	SURCHARGED	
1.015	43	0.449	0.000	0.25			3.8	SURCHARGED	
1.016	44	0.576	0.000	0.26			3.7	SURCHARGED	

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 Coeffiecient	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 Storage Structures	7
Number of Online Controls	7	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.437
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
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)	1, 30, 100
Climate Change (%)	0, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+40%					67.548
1.001	2	15 Winter	100	+40%					65.080
1.002	3	15 Winter	100	+40%					61.010
2.000	4	15 Winter	100	+40%	100/15 Summer				61.060
3.000	5	120 Winter	100	+40%	100/60 Summer				61.782
3.001	6	120 Winter	100	+40%	30/15 Summer				61.780
2.001	7	15 Winter	100	+40%	100/15 Summer				60.920
1.003	8	15 Winter	100	+40%	30/15 Summer				60.716
1.004	9	15 Winter	100	+40%	30/15 Summer				59.935
1.005	10	15 Winter	100	+40%					59.335
4.000	11	15 Winter	100	+40%					58.756
1.006	12	15 Winter	100	+40%					57.985
5.000	13	240 Winter	100	+40%	30/120 Winter				58.653
5.001	14	240 Winter	100	+40%	1/120 Winter				58.651
1.007	15	15 Winter	100	+40%					57.582
1.008	16	15 Winter	100	+40%					56.992
6.000	17	15 Winter	100	+40%	30/15 Summer				57.789
6.001	18	15 Winter	100	+40%	100/15 Summer				57.306
7.000	19	60 Winter	100	+40%	1/15 Summer				57.064

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.177	0.000	0.10			12.8	OK	
1.001	2	-0.145	0.000	0.27			35.2	OK	
1.002	3	-0.140	0.000	0.53			111.8	OK	
2.000	4	0.143	0.000	0.58			55.9	SURCHARGED	
3.000	5	0.032	0.000	0.08			0.6	FLOOD RISK	
3.001	6	0.112	0.000	0.06			0.4	FLOOD RISK	
2.001	7	0.185	0.000	0.48			62.7	SURCHARGED	
1.003	8	0.697	0.000	1.39			143.3	SURCHARGED	
1.004	9	0.316	0.000	1.67			159.8	SURCHARGED	
1.005	10	-0.104	0.000	0.75			159.9	OK	
4.000	11	-0.294	0.000	0.25			76.4	OK	
1.006	12	-0.166	0.000	0.72			263.6	OK	
5.000	13	0.053	0.000	0.06			0.4	FLOOD RISK	
5.001	14	0.141	0.000	0.07			0.4	FLOOD RISK	
1.007	15	-0.142	0.000	0.79			260.1	OK	
1.008	16	-0.221	0.000	0.51			262.2	OK	
6.000	17	0.402	0.000	1.61			22.4	SURCHARGED	
6.001	18	0.129	0.000	0.70			19.5	SURCHARGED	
7.000	19	0.764	0.000	0.36			11.9	FLOOD RISK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.002	20	60 Winter	100	+40%	1/15 Summer				57.060
6.003	21	60 Winter	100	+40%	1/15 Summer				57.061
1.009	22	15 Winter	100	+40%	30/15 Summer				56.350
1.010	23	15 Winter	100	+40%	100/15 Summer				56.189
1.011	24	15 Winter	100	+40%	30/15 Winter				55.936
8.000	25	60 Winter	100	+40%	1/15 Winter				56.297
8.001	26	120 Winter	100	+40%	1/15 Summer				56.295
8.002	27	15 Winter	100	+40%	100/15 Winter				55.831
8.003	28	15 Winter	100	+40%	100/15 Summer				55.769
1.012	29	960 Winter	100	+40%	30/15 Winter				55.753
9.000	30	60 Winter	100	+40%	1/15 Summer				57.666
9.001	31	60 Winter	100	+40%	1/15 Summer				57.669
9.002	32	15 Winter	100	+40%					55.880
9.003	33	15 Winter	100	+40%					55.860
9.004	34	15 Winter	100	+40%	100/15 Winter				55.836
9.005	35	960 Winter	100	+40%	100/15 Summer				55.754
9.006	36	960 Winter	100	+40%	30/15 Summer				55.753
10.000	37	480 Winter	100	+40%	30/120 Winter				55.996
10.001	38	480 Winter	100	+40%	30/60 Summer				55.996
10.002	39	960 Winter	100	+40%					55.753
9.007	40	960 Winter	100	+40%	30/15 Summer				55.753
1.013	41	960 Winter	100	+40%	30/15 Summer				55.752
1.014	42	960 Winter	100	+40%	1/360 Winter				55.735
1.015	43	960 Winter	100	+40%	1/240 Winter				55.707
1.016	44	960 Winter	100	+40%	1/60 Summer				55.697

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.002	20	0.871	0.000	0.15			4.4	FLOOD RISK	
6.003	21	0.909	0.000	0.12			3.5	FLOOD RISK	
1.009	22	0.264	0.000	1.53			286.4	SURCHARGED	
1.010	23	0.142	0.000	1.14			299.7	SURCHARGED	
1.011	24	0.083	0.000	1.36			297.4	SURCHARGED	
8.000	25	0.372	0.000	0.08			2.6	FLOOD RISK	
8.001	26	0.428	0.000	0.05			1.5	FLOOD RISK	
8.002	27	0.022	0.000	0.88			30.2	SURCHARGED	
8.003	28	0.118	0.000	0.92			28.0	SURCHARGED	
1.012	29	0.152	0.000	0.12			26.4	SURCHARGED	
9.000	30	1.456	0.000	0.60			4.7	FLOOD RISK	
9.001	31	1.492	0.000	0.15			1.7	FLOOD RISK	
9.002	32	-0.263	0.000	0.02			1.7	OK	
9.003	33	-0.159	0.000	0.30			28.8	OK	
9.004	34	0.022	0.000	0.68			49.2	SURCHARGED	
9.005	35	0.111	0.000	0.08			5.8	SURCHARGED	
9.006	36	0.281	0.000	0.09			5.8	SURCHARGED	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
10.000	37	0.147	0.000	0.12			7.0	FLOOD RISK	
10.001	38	0.191	0.000	0.01			0.5	FLOOD RISK	
10.002	39	-0.008	0.000	0.03			1.9	OK	
9.007	40	0.331	0.000	0.14			7.6	SURCHARGED	
1.013	41	0.602	0.000	0.73		2031	4.2	SURCHARGED	
1.014	42	0.614	0.000	0.77			4.1	SURCHARGED	
1.015	43	0.633	0.000	0.25			3.8	SURCHARGED	
1.016	44	0.759	0.000	0.26			3.7	SURCHARGED	

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Yare Perez
Site name:	Land off Froghall Lane
Site location:	Chigwell

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.

Site Details

Latitude:	51.61648° N
Longitude:	0.09368° E
Reference:	3491739549
Date:	Mar 21 2022 09:07

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 1

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	600	600
Hydrological region:	6	6
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 ≤ 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):	4.03	4.03
1 in 1 year (l/s):	3.43	3.43
1 in 30 years (l/s):	9.27	9.27
1 in 100 year (l/s):	12.86	12.86
1 in 200 years (l/s):	15.08	15.08

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APPENDIX C MICRO DRAINAGE SIMULATION CALCULATIONS 1 IN 1000 YEAR

1000 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 Coeffiecient	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 Storage Structures	7
Number of Online Controls	7	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.437
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15
Return Period(s) (years)	1000
Climate Change (%)	0

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	1000	+0%					67.551
1.001	2	15 Winter	1000	+0%					65.087
1.002	3	15 Winter	1000	+0%	1000/15 Summer				61.450
2.000	4	15 Winter	1000	+0%	1000/15 Summer				61.465
3.000	5	15 Winter	1000	+0%					61.740
3.001	6	15 Winter	1000	+0%	1000/15 Summer				61.738
2.001	7	15 Winter	1000	+0%	1000/15 Summer				61.336
1.003	8	15 Winter	1000	+0%	1000/15 Summer				61.153
1.004	9	15 Winter	1000	+0%	1000/15 Summer				60.105
1.005	10	15 Winter	1000	+0%					59.355
4.000	11	15 Winter	1000	+0%					58.771
1.006	12	15 Winter	1000	+0%					58.014
5.000	13	15 Winter	1000	+0%					58.593
5.001	14	15 Winter	1000	+0%	1000/15 Summer				58.591
1.007	15	15 Winter	1000	+0%					57.611
1.008	16	15 Winter	1000	+0%					57.010

1000 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.174	0.000	0.12			15.1	OK	
1.001	2	-0.138	0.000	0.32			41.5	OK	
1.002	3	0.300	0.000	0.58			122.1	SURCHARGED	
2.000	4	0.548	0.000	0.63			60.3	SURCHARGED	
3.000	5	-0.010	0.000	0.26			1.9	OK	
3.001	6	0.069	0.000	0.05			0.3	FLOOD RISK	
2.001	7	0.601	0.000	0.49			63.6	SURCHARGED	
1.003	8	1.134	0.000	1.60			165.6	SURCHARGED	
1.004	9	0.486	0.000	1.91			182.3	SURCHARGED	
1.005	10	-0.085	0.000	0.86			182.7	OK	
4.000	11	-0.279	0.000	0.30			89.9	OK	
1.006	12	-0.137	0.000	0.81			299.7	OK	
5.000	13	-0.007	0.000	0.27			2.0	FLOOD RISK	
5.001	14	0.081	0.000	0.06			0.3	FLOOD RISK	
1.007	15	-0.112	0.000	0.91			297.9	OK	
1.008	16	-0.203	0.000	0.58			299.3	OK	

1000 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
6.000	17	15 Winter	1000	+0%	1000/15 Summer				58.029
6.001	18	15 Winter	1000	+0%	1000/15 Summer				57.482
7.000	19	15 Winter	1000	+0%	1000/15 Summer				57.010
6.002	20	15 Winter	1000	+0%	1000/15 Summer				57.008
6.003	21	15 Winter	1000	+0%	1000/15 Summer				57.010
1.009	22	15 Winter	1000	+0%	1000/15 Summer				56.608
1.010	23	15 Winter	1000	+0%	1000/15 Summer				56.395
1.011	24	15 Winter	1000	+0%	1000/15 Summer				56.069
8.000	25	15 Winter	1000	+0%	1000/15 Summer				56.257
8.001	26	15 Winter	1000	+0%	1000/15 Summer				56.255
8.002	27	15 Winter	1000	+0%	1000/15 Summer				55.960
8.003	28	15 Winter	1000	+0%	1000/15 Summer				55.890
1.012	29	15 Winter	1000	+0%	1000/15 Summer				55.833
9.000	30	15 Winter	1000	+0%	1000/15 Summer				57.623
9.001	31	15 Winter	1000	+0%	1000/15 Summer				57.626
9.002	32	15 Winter	1000	+0%					55.979
9.003	33	15 Winter	1000	+0%					55.978
9.004	34	15 Winter	1000	+0%	1000/15 Summer				55.933
9.005	35	15 Winter	1000	+0%	1000/15 Summer				55.837
9.006	36	15 Winter	1000	+0%	1000/15 Summer				55.643
10.000	37	15 Winter	1000	+0%					55.836
10.001	38	15 Winter	1000	+0%	1000/15 Summer				55.836
10.002	39	15 Winter	1000	+0%					55.617
9.007	40	15 Winter	1000	+0%	1000/15 Summer				55.553
1.013	41	15 Winter	1000	+0%	1000/15 Summer				55.308
1.014	42	15 Winter	1000	+0%	1000/15 Summer				55.309
1.015	43	15 Winter	1000	+0%	1000/15 Summer				55.307
1.016	44	15 Winter	1000	+0%	1000/15 Summer				55.299

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.000	17	0.642	0.000	1.81			25.1	FLOOD RISK	
6.001	18	0.305	0.000	0.80			22.4	SURCHARGED	
7.000	19	0.710	0.000	0.82			27.3	FLOOD RISK	
6.002	20	0.819	0.000	0.26			7.5	FLOOD RISK	
6.003	21	0.858	0.000	0.12			3.4	FLOOD RISK	
1.009	22	0.522	0.000	1.70			319.5	FLOOD RISK	
1.010	23	0.348	0.000	1.28			335.1	SURCHARGED	
1.011	24	0.216	0.000	1.54			335.6	SURCHARGED	
8.000	25	0.332	0.000	0.22			7.0	FLOOD RISK	
8.001	26	0.388	0.000	0.05			1.5	FLOOD RISK	
8.002	27	0.151	0.000	0.98			33.8	SURCHARGED	
8.003	28	0.239	0.000	0.89			27.4	SURCHARGED	
1.012	29	0.233	0.000	1.64			357.7	SURCHARGED	
9.000	30	1.413	0.000	1.24			9.7	FLOOD RISK	

1000 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
9.001	31	1.450	0.000	0.15			1.6	FLOOD RISK	
9.002	32	-0.164	0.000	0.04			2.7	OK	
9.003	33	-0.041	0.000	0.33			32.1	OK	
9.004	34	0.119	0.000	0.74			53.1	SURCHARGED	
9.005	35	0.195	0.000	1.04			74.8	SURCHARGED	
9.006	36	0.171	0.000	1.22			74.7	SURCHARGED	
10.000	37	-0.013	0.000	0.15			8.2	FLOOD RISK	
10.001	38	0.031	0.000	0.01			0.5	FLOOD RISK	
10.002	39	-0.144	0.000	0.53			29.7	OK	
9.007	40	0.131	0.000	1.89			101.0	SURCHARGED	
1.013	41	0.158	0.000	1.62			9.2	SURCHARGED	
1.014	42	0.188	0.000	1.60			8.6	SURCHARGED	
1.015	43	0.233	0.000	0.38			5.9	SURCHARGED	
1.016	44	0.361	0.000	0.26			3.7	SURCHARGED	

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APPENDIX D COMMENTS FROM LLFA

Essex County Council
Development and Flood Risk
Environment and Climate Action,
C426 County Hall
Chelmsford
Essex CM1 1QH

Essex County Council

Cuma Ahmet
Epping Forest District Council
Planning Services

Date: 3rd February 2022
Our Ref: SUDS-002713
Your Ref: EPF/1182/18

Dear Mr Ahmet,

Consultation Response –EPF/1182/18– Land west of Froghall Lane, Chigwell, Essex.

Thank you for your email received on 13/01/2022 which provides this Council with the opportunity to assess and advise on the proposed surface water drainage strategy for the above mentioned planning application.

As the Lead Local Flood Authority (LLFA) this Council provides advice on SuDS schemes for major developments. We have been statutory consultee on surface water since the 15th April 2015.

In providing advice this Council looks to ensure sustainable drainage proposals comply with the required standards as set out in the following documents:

- Non-statutory technical standards for sustainable drainage systems
- Essex County Council's (ECC's) adopted Sustainable Drainage Systems Design Guide
- The CIRIA SuDS Manual (C753)
- BS8582 Code of practice for surface water management for development sites.

Lead Local Flood Authority position
Having reviewed the Flood Risk Assessment and the associated documents which accompanied the planning application, we wish to issue a **holding objection** to the granting of planning permission based on the following:

- Surface water drainage hierarchy should be considered as stated in Essex SuDS Design Guide. Rainwater harvesting should be utilised as much as possible in the first instance. Where rainwater re-use is excluded, an appropriate justification would be required.

- It is appreciated an attenuation lagoon is proposed closed to outfall, however we would like to see source control features such as green roofs, raingardens, planters, tree pits and permeable paving within drainage strategy wherever possible.

- Discharge rates from the site should be calculated for the areas draining through SuDS. The free draining landscape areas should be discounted from runoff rate calculation.

- Discharge from the site should be restricted to 1 year Greenfield runoff rate for all storm event including and up to 1 in 100 year plus 40% climate change event. Discharge rates at 5l/s is not acceptable.

- It should be demonstrated that the storage feature should half empty with 24 hours of 1 in 30 year plus 40% critical storm event.

We also have the following advisory comments:

- We strongly recommend looking at the Essex Green Infrastructure Strategy to ensure that the proposals are implementing multifunctional green/blue features effectively. The link can be found below.
  https://www.essex.gov.uk/protecting-environment

In the event that more information was supplied by the applicants then the County Council may be in a position to withdraw its objection to the proposal once it has considered the additional clarification/details that are required.

Any questions raised within this response should be directed to the applicant and the response should be provided to the LLFA for further consideration. If you are minded to approve the application contrary to this advice, we request that you contact us to allow further discussion and/or representations from us.

Summary of Flood Risk Responsibilities for your Council

We have not considered the following issues as part of this planning application as they are not within our direct remit; nevertheless these are all very important considerations for managing flood risk for this development, and determining the safety and acceptability of the proposal. Prior to deciding this application you should give due consideration to the issue(s) below. It may be that you need to consult relevant experts outside your planning team.

- Sequential Test in relation to fluvial flood risk;
- Safety of people (including the provision and adequacy of an emergency plan, temporary refuge and rescue or evacuation arrangements);
- Safety of the building;
- Flood recovery measures (including flood proofing and other building level resistance and resilience measures);
- Sustainability of the development.

In all circumstances where warning and emergency response is fundamental to managing flood risk, we advise local planning authorities to formally consider the emergency planning and rescue implications of new development in making their decisions.

Please see Appendix 1 at the end of this letter with more information on the flood risk responsibilities for your council.

INFORMATIVES:

- Essex County Council has a duty to maintain a register and record of assets which have a significant impact on the risk of flooding. In order to capture proposed SuDS which may form part of the future register, a copy of the SuDS assets in a GIS layer should be sent to suds@essex.gov.uk.
- Any drainage features proposed for adoption by Essex County Council should be consulted on with the relevant Highways Development Management Office.
- Changes to existing water courses may require separate consent under the Land Drainage Act before works take place. More information about consenting can be found in the attached standing advice note.
- It is the applicant's responsibility to check that they are complying with common law if the drainage scheme proposes to discharge into an off-site ditch/pipe. The applicant should seek consent where appropriate from other downstream riparian landowners.
- The Ministerial Statement made on 18th December 2014 (ref. HCWS161) states that the final decision regarding the viability and reasonableness of maintenance requirements lies with the LPA. It is not within the scope of the LLFA to comment on the overall viability of a scheme as the decision is based on a range of issues which are outside of this authority's area of expertise.
- We will advise on the acceptability of surface water and the information submitted on all planning applications submitted after the 15th of April 2015 based on the key documents listed within this letter. This includes applications which have been previously submitted as part of an earlier stage of the planning process and granted planning permission based on historic requirements. The Local Planning Authority should use the information submitted within this response in conjunction with any other relevant information submitted as part of this application or as part of preceding applications to make a balanced decision based on the available information.

Yours sincerely,

Dr Zahida Yousaf,
Senior Development and Flood Risk Officer
Team: Green Infrastructure and Sustainable Drainage
Service: Climate Action and Mitigation
Essex County Council

Internet: www.essex.gov.uk
Email: suds@essex.gov.uk

Appendix 1 - Flood Risk responsibilities for your Council

The following paragraphs provide guidance to assist you in determining matters which are your responsibility to consider.

- Safety of People (including the provision and adequacy of an emergency plan, temporary refuge and rescue or evacuation arrangements)

You need to be satisfied that the proposed procedures will ensure the safety of future occupants of the development. In all circumstances where warning and emergency response is fundamental to managing flood risk, we advise LPAs formally consider the emergency planning and rescue implications of new development in making their decisions.
We do not normally comment on or approve the adequacy of flood emergency response procedures accompanying development proposals as we do not carry out these roles during a flood.

- Flood recovery measures (including flood proofing and other building level resistance and resilience measures)

  We recommend that consideration is given to the use of flood proofing measures to reduce the impact of flooding when it occurs. Both flood resilience and resistance measures can be used for flood proofing.

  Flood resilient buildings are designed to reduce the consequences of flooding and speed up recovery from the effects of flooding; flood resistant construction can help prevent or minimise the amount of water entering a building. The National Planning Policy Framework confirms that resilient construction is favoured as it can be achieved more consistently and is less likely to encourage occupants to remain in buildings that could be at risk of rapid inundation.

  Flood proofing measures include barriers on ground floor doors, windows and access points and bringing in electrical services into the building at a high level so that plugs are located above possible flood levels. Consultation with your building control department is recommended when determining if flood proofing measures are effective.

  Further information can be found in the Department for Communities and Local Government publications 'Preparing for Floods' and 'Improving the flood performance of new buildings'.

- Sustainability of the development

  The purpose of the planning system is to contribute to the achievement of sustainable development. The NPPF recognises the key role that the planning system plays in helping to mitigate and adapt to the impacts of climate change, taking full account of flood risk and coastal change; this includes minimising vulnerability and providing resilience to these impacts. In making your decision on this planning application we advise you consider the sustainability of the development over its lifetime.

CONTINUE THE CONVERSATION

TO DISCUSS YOUR PROJECT WITH US PLEASE GET IN TOUCH ON 020 8340 4041 OR EMAIL US AT INFO@SYMMETRYS.COM