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North Kiln Felaw Maltings 46 Felaw Street Ipswich IP2 8PN	668050 - Kiln Court Unit 1 - Drainage Design Proposed Development Only	
Date 30/03/2017 File 668050-CALC-SBU-C-Netwo...	Designed by Darragh O'Connell Checked by CB/BF	
XP Solutions	Network 2016.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	30
Site Location GB 528450 185200 TQ 28450 85200	
C (1km)	-0.026
D1 (1km)	0.331
D2 (1km)	0.331
D3 (1km)	0.240
E (1km)	0.334
F (1km)	2.478
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.000
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

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	9.835	0.246	40.0	0.010	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	9.046	0.113	80.1	0.010	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	12.021	0.150	80.1	0.012	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	4.518	0.075	60.2	0.006	5.00	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)
1.000	50.00	5.10	41.200	0.010	0.0	0.0	0.0	1.60	28.2	1.4
1.001	50.00	5.24	40.200	0.020	0.0	0.0	0.0	1.12	19.9	2.7
1.002	50.00	5.42	40.087	0.032	0.0	0.0	0.0	1.12	19.9	4.3
2.000	50.00	5.06	39.800	0.006	0.0	0.0	0.0	1.30	22.9	0.8

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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	5.258	0.088	59.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	1.362	0.023	60.0	0.026	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	4.070	0.008	508.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.006	2.859	0.029	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.007	7.466	0.075	100.0	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)
1.003	50.00	5.47	39.650	0.038	0.0	0.0	0.0	1.70	67.4	5.1
1.004	50.00	5.48	39.562	0.064	0.0	0.0	0.0	1.69	67.3	8.7
1.005	50.00	5.63	39.489	0.064	0.0	0.0	0.0	0.44	7.8	8.7
1.006	50.00	5.68	39.481	0.064	0.0	0.0	0.0	1.00	17.8	8.7
1.007	50.00	5.81	39.452	0.064	0.0	0.0	0.0	1.00	17.8	8.7

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)
S1.0	41.860	0.660	Open Manhole	600 x 750	1.000	41.200	150			
S1.1	41.450	1.250	Open Manhole	600 x 750	1.001	40.200	150	1.000	40.954	150
S1.2	41.095	1.008	Open Manhole	600	1.002	40.087	150	1.001	40.087	150
S2.0	40.520	0.720	Open Manhole	600	2.000	39.800	150			
S1.3	40.795	1.145	Open Manhole	1200	1.003	39.650	225	1.002	39.937	150
								2.000	39.725	150
S1.4	41.000	1.438	Open Manhole	1200	1.004	39.562	225	1.003	39.562	225
CELLULAT STORAGE	40.950	1.461	Sealed Manhole	1200	1.005	39.489	150	1.004	39.539	225
Outlet	40.900	1.419	Open Manhole	1200	1.006	39.481	150	1.005	39.481	150
S1.5	41.000	1.548	Open Manhole	1200	1.007	39.452	150	1.006	39.452	150
	41.060	1.682	Open Manhole	750 x 750		OUTFALL		1.007	39.378	150

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	S1.0	41.860	41.200	0.510	Open Manhole	600 x 750
1.001	o	150	S1.1	41.450	40.200	1.100	Open Manhole	600 x 750
1.002	o	150	S1.2	41.095	40.087	0.858	Open Manhole	600
2.000	o	150	S2.0	40.520	39.800	0.570	Open Manhole	600
1.003	o	225	S1.3	40.795	39.650	0.920	Open Manhole	1200
1.004	o	225	S1.4	41.000	39.562	1.213	Open Manhole	1200
1.005	o	150	CELLULAT STORAGE	40.950	39.489	1.311	Sealed Manhole	1200
1.006	o	150	Outlet	40.900	39.481	1.269	Open Manhole	1200
1.007	o	150	S1.5	41.000	39.452	1.398	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	9.835	40.0	S1.1	41.450	40.954	0.346	Open Manhole	600 x 750
1.001	9.046	80.1	S1.2	41.095	40.087	0.858	Open Manhole	600
1.002	12.021	80.1	S1.3	40.795	39.937	0.708	Open Manhole	1200
2.000	4.518	60.2	S1.3	40.795	39.725	0.920	Open Manhole	1200
1.003	5.258	59.8	S1.4	41.000	39.562	1.213	Open Manhole	1200
1.004	1.362	60.0	CELLULAT STORAGE	40.950	39.539	1.186	Sealed Manhole	1200
1.005	4.070	508.8	Outlet	40.900	39.481	1.269	Open Manhole	1200
1.006	2.859	100.0	S1.5	41.000	39.452	1.398	Open Manhole	1200
1.007	7.466	100.0		41.060	39.378	1.532	Open Manhole	750 x 750

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.010	0.010	0.010
1.001	-	-	100	0.010	0.010	0.010
1.002	-	-	100	0.012	0.012	0.012
2.000	-	-	100	0.006	0.006	0.006
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.026	0.026	0.026
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.064	0.064	0.064

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.007		41.060	39.378	39.350	750	750

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1
Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
Site Location	GB 528450 185200 TQ 28450 85200
C (1km)	-0.026
D1 (1km)	0.331
D2 (1km)	0.331
D3 (1km)	0.240
E (1km)	0.334
F (1km)	2.478
Summer Storms	Yes
Winter Storms	No
Cv (Summer)	0.750
Cv (Winter)	0.840

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<u>Synthetic Rainfall Details</u> Storm Duration (mins) 30		
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Online Controls for Storm

Hydro-Brake Optimum® Manhole: S1.5, DS/PN: 1.007, Volume (m³): 1.8

Unit Reference	MD-CHE-0098-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	No
Diameter (mm)	98
Invert Level (m)	39.452
Minimum Outlet Pipe Diameter (mm)	Error (Contact Hydro International)
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0
Flush-Flo™	0.241	4.9
Kick-Flo®	0.353	2.8
Mean Flow over Head Range	-	3.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6	1.200	5.0	3.000	7.8	7.000	11.9
0.200	4.5	1.400	5.4	3.500	8.5	7.500	12.3
0.300	3.2	1.600	5.8	4.000	9.0	8.000	12.7
0.400	2.9	1.800	6.1	4.500	9.6	8.500	13.1
0.500	3.3	2.000	6.4	5.000	10.1	9.000	13.4
0.600	3.6	2.200	6.7	5.500	10.5	9.500	13.8
0.800	4.1	2.400	7.0	6.000	11.0		
1.000	4.6	2.600	7.3	6.500	11.4		

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Storage Structures for Storm

Cellular Storage Manhole: CELLULAT STORAGE, DS/PN: 1.005

Invert Level (m) 39.489 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	25.5	25.5	0.900	0.0	43.9
0.800	25.5	43.9			

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<u>1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>																																																																																		
<u>Simulation Criteria</u> Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000 Hot Start Level (mm) 0 Inlet Coefficient 0.800 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000 Foul Sewage per hectare (l/s) 0.000 Number of Input Hydrographs 0 Number of Storage Structures 1 Number of Online Controls 1 Number of Time/Area Diagrams 0 Number of Offline Controls 0 Number of Real Time Controls 0 <u>Synthetic Rainfall Details</u> Rainfall Model FEH Site Location GB 528450 185200 TQ 28450 85200 C (1km) -0.026 D1 (1km) 0.331 D2 (1km) 0.331 D3 (1km) 0.240 E (1km) 0.334 F (1km) 2.478 Cv (Summer) 0.750 Cv (Winter) 0.840 Margin for Flood Risk Warning (mm) 100.0 DVD Status ON Analysis Timestep Fine Inertia Status OFF DTS 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 (%) 30, 30, 30																																																																																		
<table border="1"> <thead> <tr> <th>PN</th> <th>US/MH Name</th> <th>Storm</th> <th>Return Period</th> <th>Climate Change</th> <th>First (X) Surchage</th> <th>First (Y) Flood</th> <th>First (Z) Overflow</th> </tr> </thead> <tbody> <tr> <td>1.000</td> <td></td> <td>S1.0 15 Winter</td> <td>1</td> <td>+30%</td> <td></td> <td></td> <td></td> </tr> <tr> <td>1.001</td> <td></td> <td>S1.1 15 Winter</td> <td>1</td> <td>+30%</td> <td>100/15 Summer</td> <td></td> <td></td> </tr> <tr> <td>1.002</td> <td></td> <td>S1.2 15 Winter</td> <td>1</td> <td>+30%</td> <td>30/15 Summer</td> <td></td> <td></td> </tr> <tr> <td>2.000</td> <td></td> <td>S2.0 15 Winter</td> <td>1</td> <td>+30%</td> <td>30/15 Summer</td> <td></td> <td></td> </tr> <tr> <td>1.003</td> <td></td> <td>S1.3 15 Winter</td> <td>1</td> <td>+30%</td> <td>30/15 Summer</td> <td></td> <td></td> </tr> <tr> <td>1.004</td> <td></td> <td>S1.4 15 Winter</td> <td>1</td> <td>+30%</td> <td>30/15 Summer</td> <td></td> <td></td> </tr> <tr> <td>1.005</td> <td>CELLULAT STORAGE</td> <td>30 Winter</td> <td>1</td> <td>+30%</td> <td>30/15 Summer</td> <td></td> <td></td> </tr> <tr> <td>1.006</td> <td>Outlet</td> <td>30 Winter</td> <td>1</td> <td>+30%</td> <td>30/15 Summer</td> <td></td> <td></td> </tr> <tr> <td>1.007</td> <td></td> <td>S1.5 30 Winter</td> <td>1</td> <td>+30%</td> <td>30/15 Summer</td> <td></td> <td></td> </tr> </tbody> </table>	PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	1.000		S1.0 15 Winter	1	+30%				1.001		S1.1 15 Winter	1	+30%	100/15 Summer			1.002		S1.2 15 Winter	1	+30%	30/15 Summer			2.000		S2.0 15 Winter	1	+30%	30/15 Summer			1.003		S1.3 15 Winter	1	+30%	30/15 Summer			1.004		S1.4 15 Winter	1	+30%	30/15 Summer			1.005	CELLULAT STORAGE	30 Winter	1	+30%	30/15 Summer			1.006	Outlet	30 Winter	1	+30%	30/15 Summer			1.007		S1.5 30 Winter	1	+30%	30/15 Summer				
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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Overflow Act.	Water Surcharged Flooded			Pipe		Status
			Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	
1.000	S1.0		41.226	-0.124	0.000	0.07	1.8	OK
1.001	S1.1		40.244	-0.106	0.000	0.18	3.2	OK
1.002	S1.2		40.141	-0.096	0.000	0.28	5.0	OK
2.000	S2.0		39.824	-0.126	0.000	0.06	1.1	OK
1.003	S1.3		39.707	-0.168	0.000	0.15	6.1	OK
1.004	S1.4		39.652	-0.135	0.000	0.33	10.0	OK
1.005	CELLULAT STORAGE		39.612	-0.027	0.000	0.39	3.8	OK
1.006	Outlet		39.606	-0.025	0.000	0.34	3.7	OK
1.007	S1.5		39.601	-0.001	0.000	0.24	3.7	OK

PN	US/MH Name	Level Exceeded
1.000	S1.0	
1.001	S1.1	
1.002	S1.2	
2.000	S2.0	
1.003	S1.3	
1.004	S1.4	
1.005	CELLULAT STORAGE	
1.006	Outlet	
1.007	S1.5	

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

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Site Location	GB 528450 185200 TQ 28450 85200
C (1km)	-0.026
D1 (1km)	0.331
D2 (1km)	0.331
D3 (1km)	0.240
E (1km)	0.334
F (1km)	2.478
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	100.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	OFF
DTS 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 (%)	30, 30, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
1.000	S1.0	15 Winter	30	+30%			
1.001	S1.1	15 Winter	30	+30%	100/15	Summer	
1.002	S1.2	15 Winter	30	+30%	30/15	Summer	
2.000	S2.0	30 Winter	30	+30%	30/15	Summer	
1.003	S1.3	30 Winter	30	+30%	30/15	Summer	
1.004	S1.4	30 Winter	30	+30%	30/15	Summer	
1.005	CELLULAT STORAGE	30 Winter	30	+30%	30/15	Summer	
1.006	Outlet	60 Winter	30	+30%	30/15	Summer	
1.007	S1.5	60 Winter	30	+30%	30/15	Summer	

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

PN	US/MH Name	Overflow Act.	Water Surcharged Flooded			Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
			Level (m)	Depth (m)	Volume (m³)			
1.000	S1.0		41.250	-0.100	0.000	0.25		6.2
1.001	S1.1		40.333	-0.017	0.000	0.71		12.4
1.002	S1.2		40.273	0.036	0.000	1.10		19.8
2.000	S2.0		40.048	0.098	0.000	0.14		2.4
1.003	S1.3		40.047	0.172	0.000	0.37		15.3
1.004	S1.4		40.045	0.258	0.000	0.84		25.2
1.005	CELLULAT STORAGE		40.044	0.405	0.000	0.57		5.5
1.006	Outlet		40.041	0.410	0.000	0.40		4.3
1.007	S1.5		40.040	0.438	0.000	0.26		3.9

PN	US/MH Name	Status	Level Exceeded
1.000	S1.0	OK	
1.001	S1.1	OK	
1.002	S1.2	SURCHARGED	
2.000	S2.0	SURCHARGED	
1.003	S1.3	SURCHARGED	
1.004	S1.4	SURCHARGED	
1.005	CELLULAT STORAGE	SURCHARGED*	
1.006	Outlet	SURCHARGED	
1.007	S1.5	SURCHARGED	

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XP Solutions	Network 2016.1	

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

PN	US/MH Name	Overflow Act.	Water Surcharged Flooded			Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
			Level (m)	Depth (m)	Volume (m³)			
1.000	S1.0		41.265	-0.085	0.000	0.39		9.7
1.001	S1.1		40.737	0.387	0.000	1.08		18.9
1.002	S1.2		40.622	0.385	0.000	1.68		30.3
2.000	S2.0		40.515	0.565	0.000	0.20		3.4
1.003	S1.3		40.514	0.639	0.000	0.52		21.8
1.004	S1.4		40.512	0.725	0.000	1.25		37.4
1.005	CELLULAT STORAGE		40.510	0.871	0.000	0.63		6.1
1.006	Outlet		40.502	0.871	0.000	0.48		5.2
1.007	S1.5		40.497	0.894	0.000	0.31		4.7

PN	US/MH Name	Status	Level Exceeded
1.000	S1.0	OK	
1.001	S1.1	SURCHARGED	
1.002	S1.2	SURCHARGED	
2.000	S2.0	FLOOD RISK	
1.003	S1.3	SURCHARGED	
1.004	S1.4	SURCHARGED	
1.005	CELLULAT STORAGE	SURCHARGED*	
1.006	Outlet	SURCHARGED	
1.007	S1.5	SURCHARGED	