



CALCULATIONS

DOCUMENT No
104-014-UA001881-02

OFFICE

PROJECT TITLE

NW Bicester Eco Development - Exemplar Site

SUBJECT

S38 Central spine road drainage

SHEET No

1 OF 10

ISSUE	TOTAL SHEETS	AUTHOR	DATE	CHECKED BY	DATE	APPROVED BY	DATE	COMMENTS
2	10	MP	31/10/12	SJ	02/11/12	SAD	02/11/12	

SUPERSEDES DOC No

DATE

DESIGN BASIS STATEMENT (Inc. sources of info/data, assumptions made, standards, etc.)

Introduction

This calculation covers the design of the proposed SuDS network incorporating pipes and cellular storage discharging to an enhanced swale as detailed on drawings 7253 to 7256.
The drained areas are shown on drawings 103-015 and 103-016.
The network has been assessed using WinDES software, a widely used industry standard package for drainage design produced by MicroDrainage.


Assumptions

- 1) Design to accommodate 100 yr rainfall events with a variety of durations
- 2) Climate change factor of 30% applied to rainfall
- 3) An allowance has been made for the attenuated peak flow from the school (3l/s) in the pipe system's peak outflow

Results

The calculation shows the following key results:

- No flooding during any of the rainfall events
- Peak discharges at the outfall meet the discharge restriction of 10l/s set for this catchment within the drainage strategy

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Date 02/11/2012 15:01 File S200 CENTRAL SPIN...	Designed By mp49220 Checked By	
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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)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.000
Ratio R	0.400	Maximum Backdrop Height (m)	20.000
Maximum Rainfall (mm/hr)	0	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.00	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

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.317	4-8	0.121

Total Area Contributing (ha) = 0.438


Total Pipe Volume (m³) = 111.513

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	26.010	0.440	59.1	0.093	4.00	0.0	0.600	o	1050
1.001	23.247	0.385	60.4	0.015	0.00	0.0	0.600	o	1050
1.002	10.878	0.190	57.3	0.081	0.00	0.0	0.600	o	1050
1.003	20.155	0.335	60.2	0.024	0.00	0.0	0.600	o	1050
2.000	32.157	0.150	214.4	0.060	4.00	0.0	0.600	o	1050

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	0.00	4.10	85.150	0.093	0.0	0.0	0.0	4.49	3884.9	0.0
1.001	0.00	4.18	84.710	0.108	0.0	0.0	0.0	4.44	3843.8	0.0
1.002	0.00	4.22	84.325	0.189	0.0	0.0	0.0	4.56	3947.7	0.0
1.003	0.00	4.30	84.135	0.213	0.0	0.0	0.0	4.45	3850.8	0.0
2.000	0.00	4.23	84.000	0.060	0.0	0.0	0.0	2.35	2034.7	0.0

Hyder Consulting Limited		Page 2
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Date 02/11/2012 15:01 File S200 CENTRAL SPIN...	Designed By mp49220 Checked By	
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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (1/s)	k (mm)	HYD SECT	DIA (mm)
3.000	11.327	0.075	151.0	0.055	4.00	0.0	0.600	o	225
2.001	12.081	0.050	241.6	0.065	0.00	0.0	0.600	o	1050
4.000	9.815	0.100	98.2	0.000	4.00	0.0	0.600	o	300
1.004	6.239	0.050	124.8	0.045	0.00	0.0	0.600	o	225
1.005	24.140	0.300	80.5	0.000	0.00	0.0	0.600	o	225
1.006	33.509	0.200	167.5	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ Area (ha)	Σ DWF (1/s)	Foul (1/s)	Add Flow (1/s)	Vel (m/s)	Cap (1/s)	Flow (1/s)
3.000	0.00	4.18	84.750	0.055	0.0	0.0	0.0	1.06	42.2	0.0
2.001	0.00	4.32	83.850	0.180	0.0	0.0	0.0	2.21	1915.9	0.0
4.000	0.00	4.10	83.900	0.000	0.0	0.0	0.0	1.59	112.2	0.0
1.004	0.00	4.41	83.800	0.438	0.0	0.0	0.0	1.17	46.5	0.0
1.005	0.00	4.68	83.750	0.438	0.0	0.0	0.0	1.46	58.0	0.0
1.006	0.00	5.24	83.450	0.438	0.0	0.0	0.0	1.01	40.0	0.0

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Date 02/11/2012 15:01
File S200 CENTRAL SPIN...


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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Diam., L*W (mm)	Pipe Out		Pipes In		Backdrop (mm)
				PN	Invert Level (m)	Diameter (mm)	PN	
\$200	87.550	2.400	2100	1.000	85.150	1050		
\$201	87.350	2.640	2100	1.001	84.710	1050	1.000	84.710
\$202	87.000	2.675	2100	1.002	84.325	1050	1.001	84.325
\$203	86.700	2.565	2100	1.003	84.135	1050	1.002	84.135
\$204	86.250	2.250	2100	2.000	84.000	1050		
\$205	86.450	1.700	1200	3.000	84.750	225		
\$206	86.100	2.250	2100	2.001	83.850	1050	2.000	83.850
							3.000	84.675
\$207	87.000	3.100	1200	4.000	83.900	300		
\$208	86.200	2.400	2100	1.004	83.800	225	1.003	83.800
							2.001	83.800
							4.000	83.800
\$209	86.200	2.450	2100	1.005	83.750	225	1.004	83.750
\$210	85.400	1.950	1200	1.006	83.450	225	1.005	83.450
	83.500	0.250	0		OUTFALL		1.006	83.250

Hyder Consulting Limited		Page 4
5th Floor, The Pithay All Saints Street Bristol BS1 2LZ		
Date 02/11/2012 15:01 File S200 CENTRAL SPIN...	Designed By mp49220 Checked By	
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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 DIAM., L*W (mm)
1.000	o	1050	S200	87.550	85.150	1.350	2100
1.001	o	1050	S201	87.350	84.710	1.590	2100
1.002	o	1050	S202	87.000	84.325	1.625	2100
1.003	o	1050	S203	86.700	84.135	1.515	2100
2.000	o	1050	S204	86.250	84.000	1.200	2100
3.000	o	225	S205	86.450	84.750	1.475	1200
2.001	o	1050	S206	86.100	83.850	1.200	2100
4.000	o	300	S207	87.000	83.900	2.800	1200
1.004	o	225	S208	86.200	83.800	2.175	2100
1.005	o	225	S209	86.200	83.750	2.225	2100
1.006	o	225	S210	85.400	83.450	1.725	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH DIAM., L*W (mm)
1.000	26.010	59.1	S201	87.350	84.710	1.590	2100
1.001	23.247	60.4	S202	87.000	84.325	1.625	2100
1.002	10.878	57.3	S203	86.700	84.135	1.515	2100
1.003	20.155	60.2	S208	86.200	83.800	1.350	2100
2.000	32.157	214.4	S206	86.100	83.850	1.200	2100
3.000	11.327	151.0	S206	86.100	84.675	1.200	2100
2.001	12.081	241.6	S208	86.200	83.800	1.350	2100
4.000	9.815	98.2	S208	86.200	83.800	2.100	2100
1.004	6.239	124.8	S209	86.200	83.750	2.225	2100
1.005	24.140	80.5	S210	85.400	83.450	1.725	1200
1.006	33.509	167.5		83.500	83.250	0.025	0

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)
1.006		83.500	83.250	0.000	0	0

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Date 02/11/2012 15:01
File S200 CENTRAL SPIN...

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
PIMP (% impervious)	100	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	Run Time (mins)	120
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	2
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		

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	60
Ratio R	0.400		

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Date 02/11/2012 15:01
File S200 CENTRAL SPIN...

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Online Controls for Storm

Depth/Flow Relationship Manhole: S209, DS/PN: 1.005, Volume (m³): 8.7

Invert Level (m) 83.750

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.625	10.0000	2.450	10.0000

5th Floor, The Pithay
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Date 02/11/2012 15:01
 File S200 CENTRAL SPIN...

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Storage Structures for Storm

Cellular Storage Manhole: S207, DS/PN: 4.000

Invert Level (m) 83.900 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	15.0	15.0	1.201	0.0	33.6
1.200	15.0	33.6			

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

Margin for Flood Risk Warning (mm) 0.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status ON
 Inertia Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
 720, 960, 1440, 2160, 2880, 4320, 5760, 7200,
 8640, 10080
 Return Period(s) (years) 2, 100
 Climate Change (%) 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Summer	2	0%					
1.001	15 Winter	2	0%	100/60 Winter				
1.002	15 Winter	2	0%	100/30 Winter				
1.003	60 Winter	2	0%	100/30 Winter				
2.000	60 Winter	2	0%	100/30 Summer				
3.000	15 Summer	2	0%	100/15 Winter				
2.001	60 Winter	2	0%	100/15 Summer				
4.000	60 Winter	2	0%					
1.004	60 Winter	2	0%					
1.005	60 Winter	2	0%					
1.006	60 Winter	2	0%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	S200	85.194	-1.006	0.000	0.01	0.0	18.0	OK
1.001	S201	84.763	-0.997	0.000	0.01	0.0	20.2	OK
1.002	S202	84.433	-0.942	0.000	0.02	0.0	32.4	OK
1.003	S203	84.388	-0.797	0.000	0.01	0.0	17.9	OK
2.000	S204	84.388	-0.662	0.000	0.00	0.0	4.2	OK
3.000	S205	84.833	-0.142	0.000	0.30	0.0	10.6	OK
2.001	S206	84.388	-0.512	0.000	0.00	0.0	4.9	OK
4.000	S207	84.388	0.188	0.000	0.02	0.0	1.4	SURCHARGED
1.004	S208	84.388	0.363	0.000	0.34	0.0	10.7	SURCHARGED
1.005	S209	84.382	0.407	0.000	0.19	0.0	10.0	SURCHARGED
1.006	S210	83.528	-0.147	0.000	0.27	0.0	10.0	OK

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Date 02/11/2012 15:01
 File S200 CENTRAL SPIN...

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Micro Drainage Network W.12.4

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

Margin for Flood Risk Warning (mm) 0.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status ON
 Inertia Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
 720, 960, 1440, 2160, 2880, 4320, 5760, 7200,
 8640, 10080
 Return Period(s) (years) 2, 100
 Climate Change (%) 0, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	120 Winter	100	+30%					
1.001	120 Winter	100	+30%	100/60 Winter				
1.002	120 Winter	100	+30%	100/30 Winter				
1.003	120 Winter	100	+30%	100/30 Winter				
2.000	120 Winter	100	+30%	100/30 Summer				
3.000	120 Winter	100	+30%	100/15 Winter				
2.001	120 Winter	100	+30%	100/15 Summer				
4.000	120 Winter	100	+30%					
1.004	120 Winter	100	+30%					
1.005	120 Winter	100	+30%					
1.006	240 Summer	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	S200	86.017	-0.183	0.000	0.01	0.0	17.1	OK
1.001	S201	86.016	0.256	0.000	0.01	0.0	17.7	SURCHARGED
1.002	S202	86.016	0.641	0.000	0.02	0.0	22.4	SURCHARGED
1.003	S203	86.017	0.832	0.000	0.01	0.0	20.2	SURCHARGED
2.000	S204	86.016	0.966	0.000	0.01	0.0	8.4	SURCHARGED
3.000	S205	86.018	1.043	0.000	0.27	0.0	9.7	SURCHARGED
2.001	S206	86.016	1.116	0.000	0.02	0.0	20.8	SURCHARGED
4.000	S207	86.017	1.817	0.000	0.02	0.0	1.7	SURCHARGED
1.004	S208	86.017	1.992	0.000	0.40	0.0	12.6	SURCHARGED
1.005	S209	86.007	2.032	0.000	0.19	0.0	10.0	SURCHARGED
1.006	S210	83.528	-0.147	0.000	0.27	0.0	10.0	OK