TECHNICAL NOTE

DATE	**31 August 2018**	**CONFIDENTIALITY**	**Public**
SUBJECT	**Surface and Foul Water Drainage Overview**		
PROJECT Bicester	**AUTHOR AJG**	**CHECKED MPB**	**APPROVED MPB**
Project no. 70033775			

1. INTRODUCTION

1.1. This note has been prepared to provide an overview of how surface water drainage and foul water drainage for the new Phase 1A development at Bicester Gateway is being addressed in order to achieve the objectives of providing a sustainable drainage solution for the new development whilst not increasing flooding in areas beyond the site.

2. EXISTING SITE

2.1. The existing site is a green field site bounded to the North West by the A41 Oxford Road, to the South East by Wendlebury Road and to the South by Vendee Drive. The site currently drains from north to south to an existing ditch on the eastern boundary of the site. An existing 450mm diameter surface water culvert runs through the southern part of the site in South Easterly direction.

3. SURFACE WATER DRAINAGE

3.1. The National Planning Policy Framework (NPPF) requires that new developments do not increase flood risk by reducing the current flood storage capacity of a site or increase storm water runoff form a site. In accordance with NPPF it is the intention that the design for the development drainage system attenuates surface water discharge rates back to Greenfield runoff rates including for the effects of climate change, as such the development will not increase the offsite storm water flows or the extent of flooding offsite compared to the undeveloped site. Sustainable Urban Drainage (SuDS) are the most sustainable method of achieving this and may also offer the opportunity for betterment.

3.2. As part of the planning process, the feasibility of integrating various SuDs techniques is being informed by an appraisal of the existing information, namely topographical, flood modelling and the underlying ground condition/geology.

3.3. SuDS are the preferred approach to managing rainfall runoff generated from impermeable surfaces and will be employed as a key sustainability feature of the new development at Bicester Gateway. SuDs can be used to reduce the rate and volume of surface water discharges from developments to the receiving environment (e.g. natural watercourses, public sewers) thereby reducing flood risk, as well as treating pollutants, improving water quality, maintaining recharge to groundwater and providing a natural amenity and green space within a development while also enhancing biodiversity.

3.4. There are various SuDS techniques that are available and operate on two main principles:

- Infiltration; and
- Attenuation.

3.5. Infiltration SuDS rely on discharging to ground, where suitable ground conditions allow. Infiltration methods include the use of permeable pavements under roads and parking areas, infiltration trenches, soakaways and other techniques that are generally located below ground such as geo cellular systems. Their effectiveness depends on the soakage potential of the underlying geology. From a review of the site ground investigation there is not an infiltration potential across the site due to the ground conditions and high ground water.

3.6. However, where site ground conditions are deemed unsuitable for the widespread implementation of infiltration techniques, surface water runoff will need to be attenuated using on-site attenuation storage. On site 'above ground' storage measures include basins, ponds and swales, with 'below ground' facilities generally following the more engineered forms of underground storage.

3.7. The proposed surface water drainage strategy is shown on the accompanying WSP Drawing Number 3775-WSP-00-ZZ-DR-CE-1002.

3.8. The surface water drainage strategy proposes to restrict the rate of discharge to the existing ditch to a green field rate of 4.6 l/s for up to the 1 in 100 year critical storm return event with 30% allowance for climate change. The restricted discharge will be controlled by a hydrobrake chamber located adjacent to the low point of the proposed car park.

3.9. The attenuation volume required will be provided in the form of permeable pavements under the proposed roads and parking areas. These will include concrete block paving and tarmac construction with course graded aggregate below. To help slow the flow of water through the permeable pavements and maximise the storage available for attenuation check dams with control pipes/openings will be located within the aggregate foundation.

3.10. Surface water runoff from the roof areas of the proposed hotel will be collected in rainwater pipes which will discharge to the permeable pavement course graded aggregate. Flow diffuser chambers will be included so as to help avoid erosion of the aggregate construction.

3.11. The existing 450mm diameter culvert will be removed and diverted by a proposed swale and French drain arrangement which will include a perforated pipe running alongside the southern boundary of the site. Inspection chambers will be provided for the purposes of maintenance.

3.12. The accompanying surface water drainage hydraulic calculations have been prepared using the software MicroDrainage WinDes to support the drainage strategy.

4. FOUL WATER DRAINAGE

4.1. The proposed foul water drainage strategy is included on the accompanying WSP Drawing Number 3775-WSP-00-ZZ-DR-CE-1002.

4.2. The foul water discharge from the new hotel will be collected by a new on-site gravity pipe system which will outfall to a new private foul water pumping station located in the northern area of the Phase 1A site. Peak hotel foul flows are calculated at 12.5 l/s. Foul water storage to accommodate 1 hour peak pumped flows to meet the requirements of Sewers for Adoption 7th edition will be provided for the hotel within the on-site gravity pipes and manholes and a wet well chamber within the pumping station compound. The foul flows will be pumped from two pumps at a combined flow of 24 l/s via a rising main to the existing 600mm diameter Thames Water public sewer located in Oxford Road a distance of approximately 0.5km to the north.

4.3. As part of the foul water provision a parallel rising main will be installed adjacent the proposed cycleway within public highway to the west of the site to allow the future connection of the Phase 1B development at a flow rate of 10 l/s. The pumping station arrangement wet well storage will be provided to include the future Phase 1B development pumped foul flows. The wet well chamber has been sized to provide the 1 hour peak pumped flow required foul storage for the proposed 160,000 sq ft of office space in accordance with Sewers for Adoption.

DO NOT SCALE

NOTES

1. ALL DIMENSIONS SHOWN ARE IN METRES UNLESS OTHERWISE STATED.

2. ALL LEVELS ARE IN METRES 34.0m ABOVE ORDNANCE DATUM.

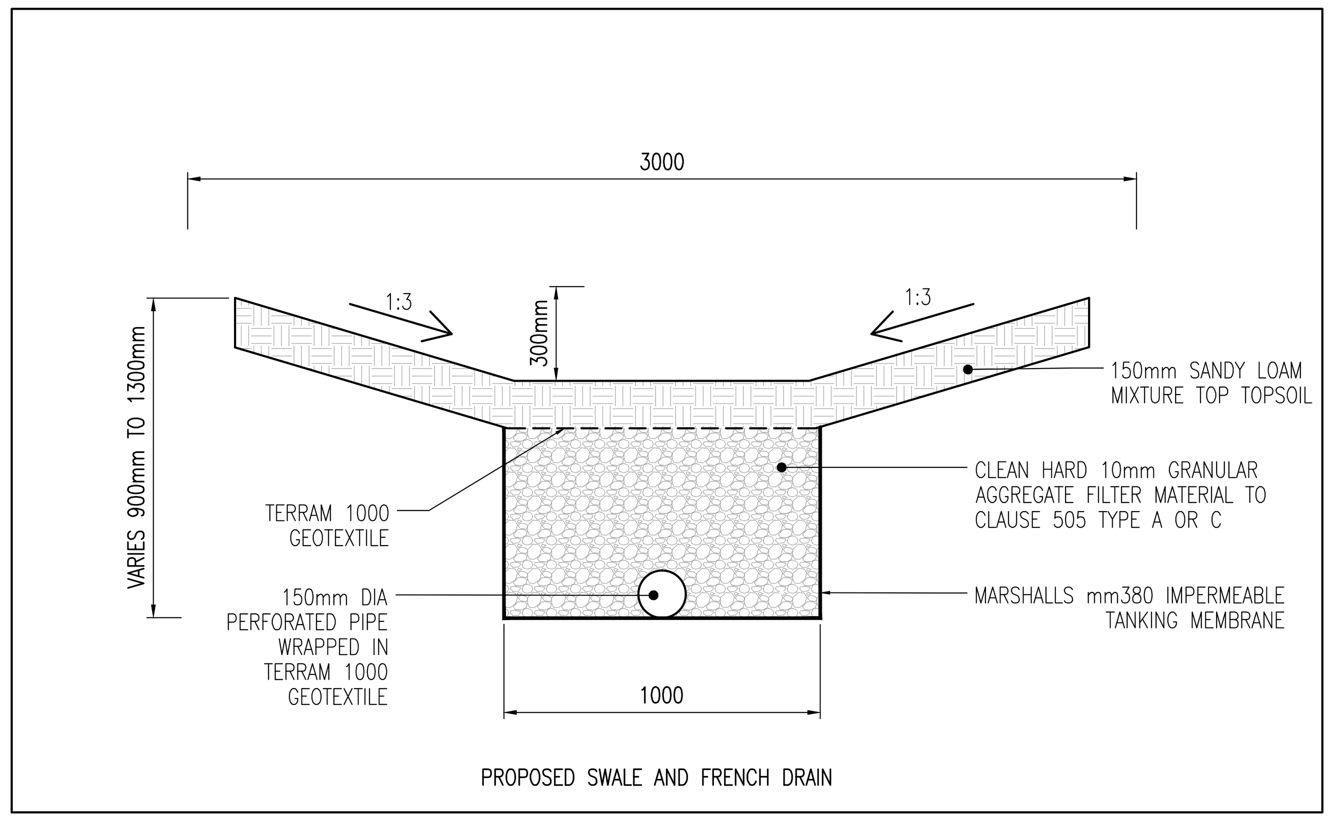
3. THIS DRAWING IS BASED ON:

TURKINGTON MARTIN'S LANDSCAPE MASTERPLAN TM336L01 REV B.
TOPOGRAPHICAL SURVEY BY TARGET SURVEYS LIMITED REFERENCE 1206/1 DATED APRIL 2015.

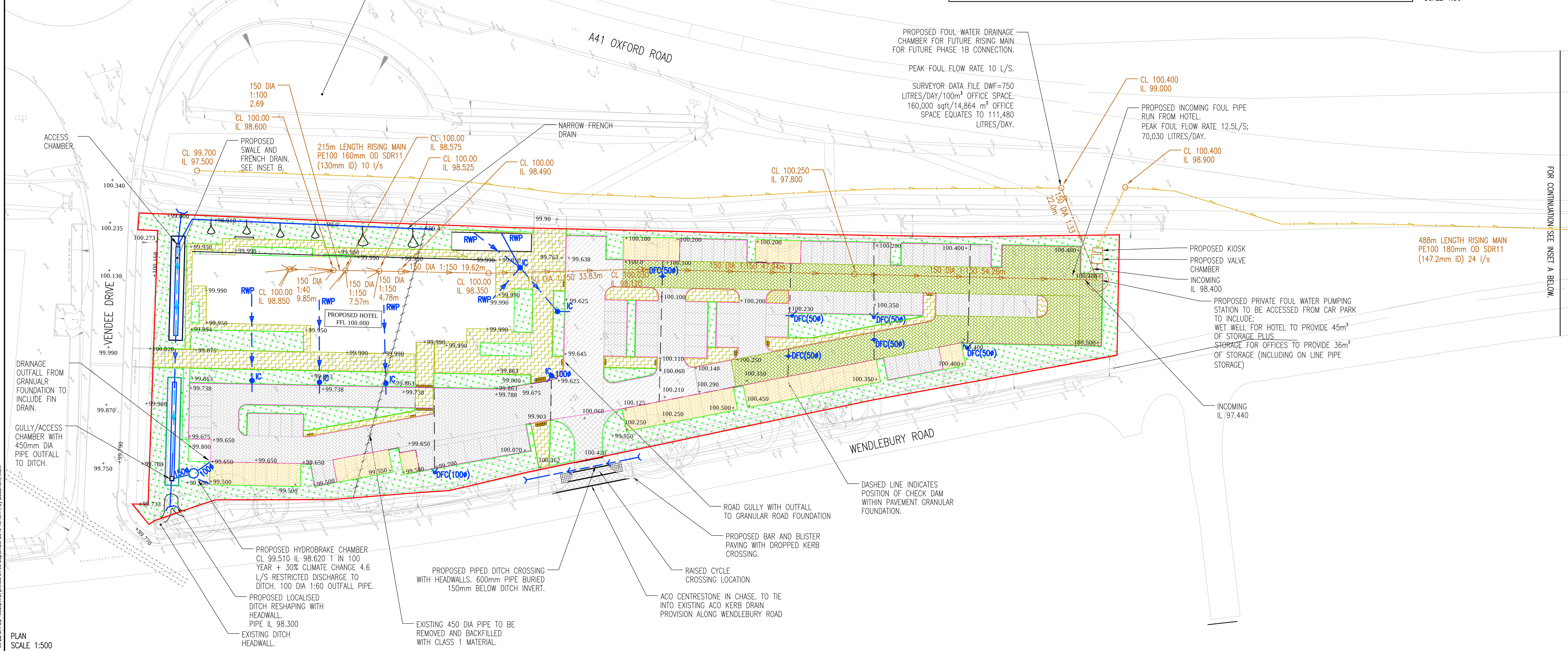
4. REFER TO DRAWING NUMBER 3775-WSP-00-ZZ-DR-CE-1004 FOR SECTION AND DETAILS.

KEY

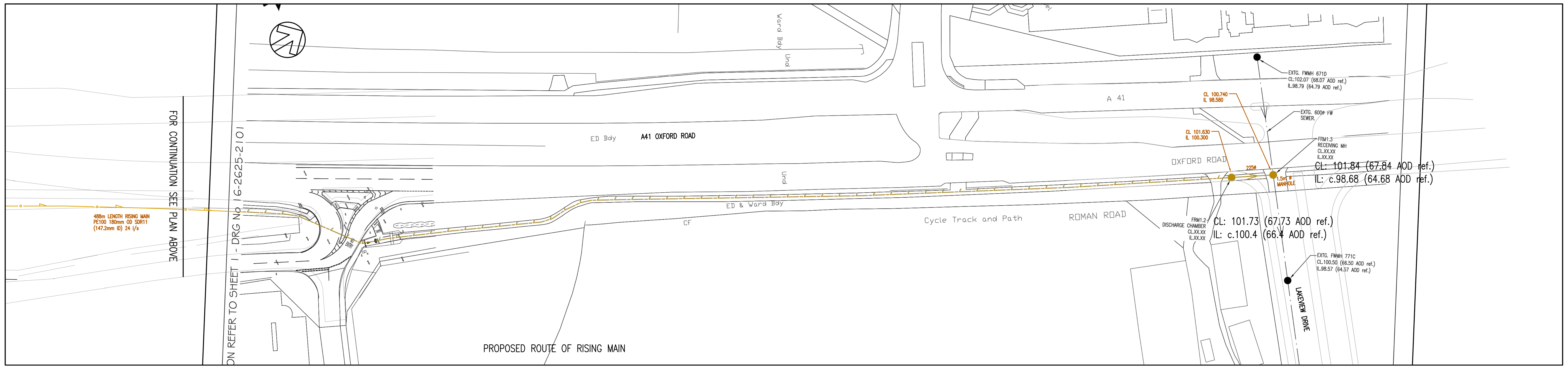
- PROPOSED PRIVATE FOUL WATER DRAINAGE
- PROPOSED PRIVATE FOUL WATER RISING MAIN
- PROPOSED PRIVATE SURFACE WATER DRAINAGE
- PROPOSED PRIVATE SURFACE WATER DRAINAGE PERFORATED PIPE
- RWP / IC — PROPOSED 110mmø RAIN WATER PIPE WITH FLOW DIFFUSER CHAMBER AND DISCHARGE TO GRANULAR PAVING CONSTRUCTION.
- DFC(50mm) — PROPOSED CHECK DAM WITH ACCESS CHAMBER TO FLOW CONTROL AND ASSOCIATED PIPE SIZE FOR FLOW CONTROL
- PROPOSED CONCRETE BLOCK PAVING TO LANDSCAPE ARCHITECT DETAILS.
- PROPOSED TARMAC CONSTRUCTION WITH NORMAL CONSTRUCTION BELOW FOR JUNCTION ACCESS.
  SURFACE COURSE – 40mm HRA 30/14 F SURF 40/60
  BINDER COURSE – 60mm AC DENSE BIN 40/60
  BASE COURSE – 180mm AC32 HDM BASE 40/60
  SUB-BASE – TYPE 1
  6F1 CAPPONG FOR CBR 3%
  FOR THICKNESS & SPECIFICATION SEE OXFORDSHIRE COUNTY COUNCIL DRG. NO.HSD/700/010.
- PROPOSED PERMEABLE BLOCK PAVING ACCESS WAY CONSTRUCTION WITH PERFORATED DBM BASE TO DETAIL 3. SEE NOTE 4
- PROPOSED PERMEABLE BLOCK PAVING CONSTRUCTION CAR PARK AREAS WITH COURSE GRADED AGGREGATE BELOW TO DETAIL 2. SEE NOTE 4.
- PROPOSED PERMEABLE BLOCK PAVING CONSTRUCTION CAR PARK AREAS WITH 100mm HBM SUB-BASE AND COURSE GRADED AGGREGATE BELOW TO DETAIL 1. SEE NOTE 4.
- PROPOSED PERMEABLE BLOCK PAVING CONSTRUCTION CAR PARKING BAY OVER ROOT PROTECTION AREA TO DETAIL 6. SEE NOTE 4.
- PROPOSED SOFT LANDSCAPING
  NOTE: REFER TO LANDSCAPE ARCHITECT DETAILS FOR TREE PITS.
- +99.360 PROPOSED FINISHED LEVEL.
- PROPOSED HEADWALL REFER TO DETAIL ON WSP DRAWING NUMBER 3775-WSP-00-ZZ-DR-CE-1006



INSET B
SCALE 1:50



PLAN
SCALE 1:500



INSET A
SCALE 1:1000

REV	DATE	BY	DESCRIPTION	CHK	APP
P06	24/08/2018	MM	LEVELS UPDATED TO SUIT FOUNDATION CHANGES	MB	MB
P05	09/08/2018	MM	LEVELS UPDATED	MB	MB
P04	13/02/2018	KW	UPDATED TO REVISED MASTERPLAN	MB	MB
P03	02/01/2018	MM	PIPED DITCH CROSSING SHOWN. NOTE 2 REVISED. PUMPING STATION STATION RELOCATED.	AJG	MB
P02	18/12/2017	MH	UPDATED MASTERPLAN	MB	MB
P01	15/12/2017	MM	FIRST ISSUE	AJG	MB

DRAWING STATUS:
S2 - FOR INFORMATION

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CLIENT: ATLAS HOTELS GROUP

ARCHITECT: NORR

SITE/PROJECT: HOLIDAY INN EXPRESS BICESTER GATEWAY

TITLE: PAVING AND DRAINAGE STRATEGY

SCALE @ A1: AS SHOWN	CHECKED: AJG	APPROVED: MB
PROJECT NO: 70033775	DESIGNED: MM / DRAWN: MM	DATE: September 18
DRAWING No: 3775-WSP-00-ZZ-DR-CE-1002		REV: P06

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	1999
Site Location	GB 454350 208500 SP 54350 08500
C (1km)	-0.023
D1 (1km)	0.345
D2 (1km)	0.312
D3 (1km)	0.226
E (1km)	0.292
F (1km)	2.461
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
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

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.275	4-8	0.332	8-12	0.008

Total Area Contributing (ha) = 0.616

Total Pipe Volume (m³) = 5.063

Network Design Table for Storm

- Indicates pipe length does not match coordinates
« - 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

Network Design Table for Storm

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)

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
S1.000	5.000#	0.005	1000.0	0.000	4.00	0.0	0.600	o	100	Pipe/Conduit	
S1.001	5.000#	0.005	1000.0	0.065	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	5.000#	0.005	1000.0	0.056	0.00	0.0	0.600	oo	-2	Pipe/Conduit	
S1.003	5.000#	0.005	1000.0	0.044	0.00	0.0	0.600	oo	-2	Pipe/Conduit	
S1.004	20.000#	0.500	40.0	0.088	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.005	5.000#	0.005	1000.0	0.129	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.006	5.000#	0.005	1000.0	0.055	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.007	5.000#	0.005	1000.0	0.155	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.008	5.010	0.000	0.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	57.141	0.050	1143.0	0.015	4.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	23.769	0.021	1143.0	0.005	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.002	10.458	0.009	1143.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.003	21.075	0.018	1143.0	0.004	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.009	6.707	0.037	181.3	0.000	0.00	0.0	0.600	o	450	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)
S1.000	50.00	4.35	100.000	0.000	0.0	0.0	0.0	0.24	1.9	0.0
S1.001	50.00	4.71	99.920	0.065	0.0	0.0	0.0	0.24	1.9«	8.8
S1.002	50.00	5.28	99.725	0.121	0.0	0.0	0.0	0.14	0.6«	16.4
S1.003	50.00	5.86	99.720	0.165	0.0	0.0	0.0	0.14	0.6«	22.3
S1.004	50.00	6.13	99.620	0.253	0.0	0.0	0.0	1.22	9.6«	34.3
S1.005	50.00	6.48	98.970	0.382	0.0	0.0	0.0	0.24	1.9«	51.7
S1.006	50.00	6.84	98.965	0.437	0.0	0.0	0.0	0.24	1.9«	59.2
S1.007	50.00	7.11	98.960	0.592	0.0	0.0	0.0	0.31	5.5«	80.2
S1.008	50.00	8.01	98.770	0.592	0.0	0.0	0.0	0.09	1.6«	80.2
S2.000	50.00	7.29	98.400	0.015	0.0	0.0	0.0	0.29	5.1	2.0
S2.001	50.00	8.66	98.350	0.020	0.0	0.0	0.0	0.29	5.1	2.7
S2.002	50.00	8.96	98.329	0.020	0.0	0.0	0.0	0.59	94.3	2.7
S2.003	47.19	10.17	98.239	0.024	0.0	0.0	0.0	0.29	5.1	3.0
S1.009	46.96	10.24	98.337	0.616	0.0	0.0	0.0	1.51	239.7	80.2

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)	Backdrop (mm)
S1	100.500	0.500	Open Manhole	1200	S1.000	100.000	100				
S1	100.400	0.480	Open Manhole	1200	S1.001	99.920	100	S1.000	99.995	100	75
S2	100.200	0.475	Open Manhole	3000	S1.002	99.725	-2	S1.001	99.915	100	240
S3	100.200	0.480	Open Manhole	3000	S1.003	99.720	-2	S1.002	99.720	-2	
S4	100.100	0.480	Open Manhole	3000	S1.004	99.620	100	S1.003	99.715	-2	45
S5	99.625	0.655	Open Manhole	1200	S1.005	98.970	100	S1.004	99.120	100	150
S6	99.700	0.735	Open Manhole	1200	S1.006	98.965	100	S1.005	98.965	100	
S7	99.650	0.690	Open Manhole	1200	S1.007	98.960	150	S1.006	98.960	100	
S7	99.510	0.740	Open Manhole	1200	S1.008	98.770	150	S1.007	98.955	150	185
S9	99.450	1.050	Junction		S2.000	98.400	150				
S10	99.400	1.050	Junction		S2.001	98.350	150	S2.000	98.350	150	
S11	99.379	1.050	Junction		S2.002	98.329	450	S2.001	98.329	150	
S12	99.370	1.131	Junction	0	S2.003	98.239	150	S2.002	98.320	450	381
S13	99.510	1.289	Open Manhole	1350	S1.009	98.337	450	S1.008	98.770	150	133
								S2.003	98.221	150	
S	98.900	0.600	Open Manhole	0		OUTFALL		S1.009	98.300	450	

PIPELINE SCHEDULES for Storm

Upstream Manhole

- Indicates pipe length does not match coordinates

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	100	S1	100.500	100.000	0.400	Open Manhole	1200
S1.001	o	100	S1	100.400	99.920	0.380	Open Manhole	1200
S1.002	oo	-2	S2	100.200	99.725	0.425	Open Manhole	3000
S1.003	oo	-2	S3	100.200	99.720	0.430	Open Manhole	3000
S1.004	o	100	S4	100.100	99.620	0.380	Open Manhole	3000
S1.005	o	100	S5	99.625	98.970	0.555	Open Manhole	1200
S1.006	o	100	S6	99.700	98.965	0.635	Open Manhole	1200
S1.007	o	150	S7	99.650	98.960	0.540	Open Manhole	1200
S1.008	o	150	S7	99.510	98.770	0.590	Open Manhole	1200
S2.000	o	150	S9	99.450	98.400	0.900	Junction	
S2.001	o	150	S10	99.400	98.350	0.900	Junction	
S2.002	o	450	S11	99.379	98.329	0.600	Junction	
S2.003	o	150	S12	99.370	98.239	0.981	Junction	
S1.009	o	450	S13	99.510	98.337	0.723	Open Manhole	1350

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)
S1.000	5.000#	1000.0	S1	100.400	99.995	0.305	Open Manhole	1200
S1.001	5.000#	1000.0	S2	100.200	99.915	0.185	Open Manhole	3000
S1.002	5.000#	1000.0	S3	100.200	99.720	0.430	Open Manhole	3000
S1.003	5.000#	1000.0	S4	100.100	99.715	0.335	Open Manhole	3000
S1.004	20.000#	40.0	S5	99.625	99.120	0.405	Open Manhole	1200
S1.005	5.000#	1000.0	S6	99.700	98.965	0.635	Open Manhole	1200
S1.006	5.000#	1000.0	S7	99.650	98.960	0.590	Open Manhole	1200
S1.007	5.000#	1000.0	S7	99.510	98.955	0.405	Open Manhole	1200
S1.008	5.010	0.0	S13	99.510	98.770	0.590	Open Manhole	1350
S2.000	57.141	1143.0	S10	99.400	98.350	0.900	Junction	
S2.001	23.769	1143.0	S11	99.379	98.329	0.900	Junction	
S2.002	10.458	1143.0	S12	99.370	98.320	0.600	Junction	
S2.003	21.075	1143.0	S13	99.510	98.221	1.139	Open Manhole	1350
S1.009	6.707	181.3	S	98.900	98.300	0.150	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.000	0.000	0.000
1.001	User	-	100	0.065	0.065	0.065
1.002	User	-	100	0.056	0.056	0.056
1.003	User	-	100	0.044	0.044	0.044
1.004	User	-	100	0.088	0.088	0.088
1.005	User	-	100	0.085	0.085	0.085
	User	-	100	0.030	0.030	0.115
	User	-	100	0.014	0.014	0.129
1.006	User	-	100	0.038	0.038	0.038
	User	-	100	0.014	0.014	0.052
	User	-	100	0.003	0.003	0.055
1.007	User	-	100	0.048	0.048	0.048
	User	-	100	0.047	0.047	0.094
	User	-	100	0.024	0.024	0.118
	User	-	100	0.027	0.027	0.145
	User	-	100	0.010	0.010	0.155
1.008	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.015	0.015	0.015
2.001	User	-	100	0.005	0.005	0.005
2.002	-	-	100	0.000	0.000	0.000
2.003	User	-	100	0.004	0.004	0.004
1.009	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.616	0.616	0.616

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
S1.000	S1	100	0.305	0.400	Unclassified	1200	0	0.400	Unclassified
S1.001	S1	100	0.185	0.380	Unclassified	1200	0	0.380	Unclassified
S1.002	S2	-2	0.425	0.430	Unclassified	3000	0	0.425	Unclassified
S1.003	S3	-2	0.335	0.430	Unclassified	3000	0	0.430	Unclassified
S1.004	S4	100	0.380	0.405	Unclassified	3000	0	0.380	Unclassified
S1.005	S5	100	0.555	0.635	Unclassified	1200	0	0.555	Unclassified
S1.006	S6	100	0.590	0.635	Unclassified	1200	0	0.635	Unclassified
S1.007	S7	150	0.405	0.540	Unclassified	1200	0	0.540	Unclassified
S1.008	S7	150	0.590	0.590	Unclassified	1200	0	0.590	Unclassified
S2.000	S9	150	0.900	0.900	Unclassified				Junction
S2.001	S10	150	0.900	0.900	Unclassified				Junction
S2.002	S11	450	0.600	0.600	Unclassified				Junction
S2.003	S12	150	0.981	1.139	Unclassified				Junction
S1.009	S13	450	0.150	0.723	Unclassified	1350	0	0.723	Unclassified

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)
S1.009	S	98.900	98.300	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	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	10
Number of Online Controls	3	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)	2
FEH Rainfall Version	1999
Site Location	GB 454350 208500 SP 54350 08500
C (1km)	-0.023
D1 (1km)	0.345
D2 (1km)	0.312
D3 (1km)	0.226
E (1km)	0.292

Synthetic Rainfall Details

F (1km)	2.461
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

Online Controls for Storm

Orifice Manhole: S1, DS/PN: S1.001, Volume (m³): 0.6

Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 99.920

Orifice Manhole: S4, DS/PN: S1.004, Volume (m³): 3.4

Diameter (m) 0.050 Discharge Coefficient 0.600 Invert Level (m) 99.620

Hydro-Brake® Optimum Manhole: S7, DS/PN: S1.008, Volume (m³): 0.9

Unit Reference	MD-SHE-0107-4600-0650-4600
Design Head (m)	0.650
Design Flow (l/s)	4.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	107
Invert Level (m)	98.770
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.650	4.6	Kick-Flo®	0.452	3.9
Flush-Flo™	0.202	4.6	Mean Flow over Head Range	-	3.9

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	3.6	1.200	6.1	3.000	9.4	7.000	14.1
0.200	4.6	1.400	6.6	3.500	10.1	7.500	14.6
0.300	4.5	1.600	7.0	4.000	10.8	8.000	15.0
0.400	4.2	1.800	7.4	4.500	11.4	8.500	15.5
0.500	4.1	2.000	7.8	5.000	12.0	9.000	16.0
0.600	4.4	2.200	8.1	5.500	12.6	9.500	16.4
0.800	5.1	2.400	8.5	6.000	13.1		
1.000	5.6	2.600	8.8	6.500	13.6		

Storage Structures for Storm

Porous Car Park Manhole: S1, DS/PN: S1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	25.0
Membrane Percolation (mm/hr)	1000	Length (m)	25.0
Max Percolation (l/s)	173.6	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.32	Evaporation (mm/day)	1
Invert Level (m)	99.920	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: S2, DS/PN: S1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	20.6
Membrane Percolation (mm/hr)	1000	Length (m)	25.0
Max Percolation (l/s)	143.1	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.32	Evaporation (mm/day)	1
Invert Level (m)	99.725	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: S3, DS/PN: S1.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	16.0
Membrane Percolation (mm/hr)	1000	Length (m)	25.7
Max Percolation (l/s)	114.2	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.32	Evaporation (mm/day)	1
Invert Level (m)	99.720	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: S4, DS/PN: S1.004

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	28.0
Membrane Percolation (mm/hr)	1000	Length (m)	28.0
Max Percolation (l/s)	217.8	Slope (1:X)	40.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.32	Evaporation (mm/day)	1
Invert Level (m)	99.620	Cap Volume Depth (m)	0.500

Porous Car Park Manhole: S5, DS/PN: S1.005

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	27.8
Membrane Percolation (mm/hr)	1000	Length (m)	27.8
Max Percolation (l/s)	214.7	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.32	Evaporation (mm/day)	1
Invert Level (m)	98.970	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: S6, DS/PN: S1.006

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	23.8
Membrane Percolation (mm/hr)	1000	Length (m)	16.0
Max Percolation (l/s)	105.8	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.32	Evaporation (mm/day)	1
Invert Level (m)	98.965	Cap Volume Depth (m)	0.500

Porous Car Park Manhole: S7, DS/PN: S1.007

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	33.0
Membrane Percolation (mm/hr)	1000	Length (m)	23.0
Max Percolation (l/s)	210.8	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.32	Evaporation (mm/day)	1
Invert Level (m)	98.960	Cap Volume Depth (m)	0.440

Filter Drain Manhole: S9, DS/PN: S2.000

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	1143.0
Invert Level (m)	98.400	Cap Volume Depth (m)	0.600
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	57.1		

Filter Drain Manhole: S10, DS/PN: S2.001

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	1143.0
Invert Level (m)	98.350	Cap Volume Depth (m)	0.600
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	23.8		

Filter Drain Manhole: S11, DS/PN: S2.002

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	1143.0
Invert Level (m)	98.329	Cap Volume Depth (m)	0.600
Trench Width (m)	1.0	Cap Infiltration Depth (m)	0.000
Trench Length (m)	21.1		

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	10
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 454350 208500 SP 54350 08500
C (1km)	-0.023
D1 (1km)	0.345
D2 (1km)	0.312
D3 (1km)	0.226
E (1km)	0.292
F (1km)	2.461
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	140.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
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, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	60 Winter	1	+0%					100.000
S1.001	S1	480 Winter	1	+0%	100/15 Winter				99.959
S1.002	S2	960 Winter	1	+0%	1/360 Winter				99.782
S1.003	S3	960 Winter	1	+0%	1/480 Winter				99.774
S1.004	S4	240 Winter	1	+0%	1/60 Winter				99.741
S1.005	S5	480 Winter	1	+0%	30/30 Summer				99.051
S1.006	S6	480 Winter	1	+0%	30/30 Winter				99.039
S1.007	S7	480 Winter	1	+0%	30/240 Winter				99.025
S1.008	S7	480 Winter	1	+0%	30/15 Summer				98.869
S2.000	S9	15 Winter	1	+0%					98.445

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)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.100	0.000	0.00		0.0	OK	
S1.001	S1	-0.061	0.000	0.13		0.4	OK	
S1.002	S2	0.007	0.000	0.58		0.6	SURCHARGED	
S1.003	S3	0.004	0.000	0.75		0.8	SURCHARGED	
S1.004	S4	0.021	0.000	0.17		1.6	SURCHARGED	
S1.005	S5	-0.019	0.000	0.66		2.2	OK	
S1.006	S6	-0.026	0.000	0.77		2.6	OK	
S1.007	S7	-0.085	0.000	0.39		3.6	OK	
S1.008	S7	-0.051	0.000	0.40		3.6	OK	
S2.000	S9	-0.105	0.000	0.19		1.0	OK*	

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)
S2.001	S10	60 Winter	1	+0%					98.395
S2.002	S11	480 Winter	1	+0%					98.386
S2.003	S12	480 Winter	1	+0%	30/15 Summer				98.386
S1.009	S13	480 Winter	1	+0%					98.385

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.001	S10	-0.105	0.000	0.17		0.8	OK*	
S2.002	S11	-0.393	0.000	0.00		0.2	OK*	
S2.003	S12	-0.003	0.000	0.07		0.3	OK*	
S1.009	S13	-0.402	0.000	0.03		3.8	OK	

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	10
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 454350 208500 SP 54350 08500
C (1km)	-0.023
D1 (1km)	0.345
D2 (1km)	0.312
D3 (1km)	0.226
E (1km)	0.292
F (1km)	2.461
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	140.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
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, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	240 Winter	30	+0%					100.001
S1.001	S1	240 Winter	30	+0%	100/15 Winter				100.002
S1.002	S2	480 Winter	30	+0%	1/360 Winter				99.889
S1.003	S3	480 Winter	30	+0%	1/480 Winter				99.865
S1.004	S4	120 Winter	30	+0%	1/60 Winter				99.862
S1.005	S5	480 Winter	30	+0%	30/30 Summer				99.167
S1.006	S6	480 Winter	30	+0%	30/30 Winter				99.150
S1.007	S7	480 Winter	30	+0%	30/240 Winter				99.129
S1.008	S7	480 Winter	30	+0%	30/15 Summer				99.121
S2.000	S9	15 Winter	30	+0%					98.484

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)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.099	0.000	0.00		0.0	OK	
S1.001	S1	-0.018	0.000	0.38		1.2	OK	
S1.002	S2	0.114	0.000	1.11		1.2	SURCHARGED	
S1.003	S3	0.095	0.000	1.57		1.7	SURCHARGED	
S1.004	S4	0.142	0.000	0.26		2.4	SURCHARGED	
S1.005	S5	0.097	0.000	1.00		3.3	SURCHARGED	
S1.006	S6	0.085	0.000	1.05		3.5	SURCHARGED	
S1.007	S7	0.019	0.000	0.55		5.0	SURCHARGED	
S1.008	S7	0.201	0.000	0.51		4.6	SURCHARGED	
S2.000	S9	-0.066	0.000	0.56		3.1	OK*	

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)
S2.001	S10	30 Winter	30	+0%					98.438
S2.002	S11	30 Winter	30	+0%					98.415
S2.003	S12	30 Winter	30	+0%	30/15 Summer				98.413
S1.009	S13	30 Winter	30	+0%					98.400

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.001	S10	-0.062	0.000	0.56		2.6	OK*	
S2.002	S11	-0.364	0.000	0.02		2.5	OK*	
S2.003	S12	0.024	0.000	0.60		2.7	SURCHARGED*	
S1.009	S13	-0.387	0.000	0.05		7.2	OK	

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	10
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 454350 208500 SP 54350 08500
C (1km)	-0.023
D1 (1km)	0.345
D2 (1km)	0.312
D3 (1km)	0.226
E (1km)	0.292
F (1km)	2.461
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	140.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
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, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	360 Winter	100	+30%					100.079
S1.001	S1	360 Winter	100	+30%	100/15 Winter				100.079
S1.002	S2	480 Winter	100	+30%	1/360 Winter				100.018
S1.003	S3	480 Winter	100	+30%	1/480 Winter				99.992
S1.004	S4	120 Winter	100	+30%	1/60 Winter				99.988
S1.005	S5	960 Winter	100	+30%	30/30 Summer				99.409
S1.006	S6	960 Winter	100	+30%	30/30 Winter				99.387
S1.007	S7	960 Winter	100	+30%	30/240 Winter				99.362
S1.008	S7	960 Winter	100	+30%	30/15 Summer				99.353
S2.000	S9	15 Winter	100	+30%					98.539

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)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.021	0.000	-0.01		0.0	OK	
S1.001	S1	0.059	0.000	0.51		1.7	SURCHARGED	
S1.002	S2	0.243	0.000	1.36		1.5	SURCHARGED	
S1.003	S3	0.222	0.000	1.84		2.0	SURCHARGED	
S1.004	S4	0.268	0.000	0.33		3.1	FLOOD RISK	
S1.005	S5	0.339	0.000	1.48		4.9	SURCHARGED	
S1.006	S6	0.322	0.000	1.25		4.2	SURCHARGED	
S1.007	S7	0.252	0.000	0.54		4.9	SURCHARGED	
S1.008	S7	0.433	0.000	0.51		4.6	SURCHARGED	
S2.000	S9	-0.011	0.000	0.97		5.3	OK*	

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)
S2.001	S10	15 Winter	100	+30%					98.496
S2.002	S11	30 Winter	100	+30%					98.440
S2.003	S12	30 Winter	100	+30%	30/15 Summer				98.436
S1.009	S13	30 Winter	100	+30%					98.411

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.001	S10	-0.004	0.000	1.00		4.7	OK*	
S2.002	S11	-0.339	0.000	0.04		4.7	OK*	
S2.003	S12	0.047	0.000	1.20		5.3	SURCHARGED*	
S1.009	S13	-0.376	0.000	0.06		9.6	OK	