

University of Chichester

Drainage Strategy

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Quality information

Prepared by	Checked by	Verified by	Approved by
Stamatia Kantziari	Nick Price	Anne Farmer	Niall Mulligan
Graduate Infrastructure Engineer	Senior Infrastructure Engineer	Associate Director	Associate, Programme and Project Management

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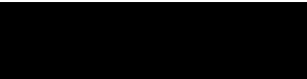
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Prepared for (the Client):

University of Chichester

Prepared by:

AECOM Infrastructure & Environment UK Limited
Midpoint
Alencon Link
Basingstoke
Hampshire RG21 7PP
UK



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1. Drainage Strategy

In order to prevent any increased surface water or sewer flood risk either to the Site or to adjacent sites due to the Proposed Development, an outline drainage strategy has been developed for the Site. The drainage strategy specifies the mitigation measures that can be used to manage surface water flood risk.

1.1 Background

The NPPF states that as well as assessing risk to a development, an FRA should consider the risk of flooding arising from a development.

Greenfield and undeveloped sites rely on natural drainage to convey or absorb rainfall. In general, site development reduces the permeability of the site, increasing the rate of water running off the site to nearby watercourses, potentially increasing flood risk to downstream areas. Therefore appropriate drainage arrangements are required for new developments to ensure that flood risk to others is not increased.

According to the Flood Risk and Coastal Change Planning Practice Guidance, the surface water arrangements for any development site should be such that the peak flow rates of surface water leaving a developed site are no greater than the rates prior to the Proposed Development, unless specific off-site arrangements are made and result in the same net effect. In addition, surface water arising from a development site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the Proposed Development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account. The following sections of the drainage strategy establish the hydraulic capacity of the existing outfalls that serve the Site and provide details of SuDS that are required to ensure that the Proposed Development will not increase the peak rate of surface water discharged from the Site.

Building Regulations Part H 2015 states that surface water shall be discharged by one of the following methods listed in order of priority:

- a. An adequate soakaway or some other adequate infiltration system: or where that is not reasonably practicable,
- b. a watercourse: or, where that is not reasonable practicable,
- c. a sewer.

Where possible, this hierarchy has been followed as described in the following sections.

1.2 Disposal of surface water via Infiltration

The information contained within the WSP| Parsons Brinckerhoff UK (WSP) Ground Investigation Report (GI) indicates the presence of shallow ground water at approx. 0.55m to 2.54m below ground level. In general the soil types that are typically unsuitable for infiltration features, including Lambeth Clay with overlying superficial deposits and made ground. The GI also included two infiltration tests, both of which stopped at 180 minutes which showed a very slow infiltration rate for the first 20 minutes, showing a reduction in water depth of approx. 30mm, after which no further infiltration or reduction in the water depth was noted. Based on these results the Drainage Strategy will preclude the use of infiltration drainage features.

The surface water drainage strategy has therefore progressed on the basis of providing positive outfalls to suitable existing surface water sewer or watercourse.

1.3 Proposed Discharge Rates and Greenfield Rates

The Proposed Development occupies an area of the existing Chichester University site that is currently undeveloped. It is expected that the existing Site drains via natural processes, with an element of the runoff being absorbed into the ground while the remainder of the runoff is able to escape the Site along paths most conducive to surface water flow. This is generally expected to be from north to south toward an existing surface water ditch which runs along the southern perimeter of the Site. The existing site predominately falls at 1:300 to the south with 1:400 fall towards the eastern perimeter where an existing cut off ditch is present. Both drainage ditches

convey runoff to the southeast corner of the Site where the ditch crosses beneath the B2259 and discharges to the River Lidsey Rife.

Based on the existing site conditions, in order to ensure that the proposed development mimics the existing regime and does not result in an increase in surface water drainage discharged, the proposed discharge rates will be limited to the Greenfield rates.

The total area within the Site boundary is 0.39ha. However the total drained area is 0.267ha, comprising of a proposed student accommodation building, a lined detention basin, adjacent soft landscaping and a provision for a future accommodation block. The remainder of the Site area will either stay as undeveloped landscaped surfaces or have a negligible surface area therefore will drain to the permeable landscaping and any resultant flows will be intercepted by the existing ditch, as per the undeveloped regime.

Existing Greenfield runoff rates have been calculated for the Site using the Source Control module of MicroDrainage software (ICP SUDS – FSR Method). The model has been subjected to simulated rainfall events for the 1 in 1, 1 in 30 and 1 in 100 year events.

The Greenfield rate calculation results are tabulated in the following table:

Table 1-8: Greenfield Runoff Rates for the Site

Return Period (Years)	Greenfield Runoff Rates (l/s)
1	0.8*
30	2.1*
100	3.0*
QBAR	0.9*

To meet the BREEAM excellent criteria, the proposed runoff rates for the surface water drainage networks must be restricted to the QBAR Greenfield runoff rates. However Section 12, Pol03 of the BREEAM Technical Manual states 'where the limiting discharge flow rate would require a flow rate of less than 5l/s at a discharge point, a flow rate of up to 5l/s may be used where required to reduce the risk of blockage'. Following discussions with Arun District Council, the flow rate of 2 l/s will be adopted to meet their request and exceed the BREEAM requirement. By using a vortex flow control device, the risk of blockage will be minimised as the orifice size will be maximized for the given flow rate.

Details of the calculations are included within Appendix A. The areas specified in the section above are detailed on drawings within Appendix B.

1.4 Proposed Surface Water Infrastructure

A preliminary proposed drainage network has been developed to determine the feasibility of draining the proposed student accommodation buildings and achieving an outfall into the existing surface water ditch located south of the site. A network has not been developed for the future student accommodation building, however the estimated runoff produced by the building area will be included in the attenuation calculations to future proof the drainage strategy.

The networks will be designed to cater for all storms up to and including the 100 year events with an allowance of 40% additional runoff for climate change. The networks will include attenuation in the form of a detention basin to allow the runoff rates to be limited to 2l/s.

The proposed drainage network will include pipes and chambers laid around the perimeter of the proposed building, accepting surface water flows from the rainwater pipes. The network has been designed to allow the appropriate cover to all pipes for protection against expecting loading and the gradients to achieve self-cleansing velocities of at least 1m/s under full bore flow conditions. Drawings included within Appendix B show the indicative layouts of the proposed network.

The surface water flow from the proposed drainage network will be controlled with a vortex flow control chamber to limit the surface water discharged from the site to the rates stated in Section 1.3 above.

As the source of the surface water run off accepted by the proposed drainage network is from roof areas, the use of pollution prevention features is not required. However it is recommended the proposed drainage network includes catchpits downstream of the detention basin to intercept silt, thereby reducing the risk of blockages in the downstream network, particularly the vortex flow control chamber.

The proposed surface water network has been modelled in Micro Drainage applying sufficient attenuation and the results showed that there is no flooding for any of the design storms.

1.5 Attenuation

Attenuation features will be implemented within the drainage networks to achieve the following:

1. Provide sufficient volume to store the balance of runoff between that generated from the critical storm event and the discharge rates set in section 1.3.
2. Provide filtration to the runoff in order to ensure that silt and pollutants are intercepted as far as practicable prior to release of the runoff to offsite sewers.
3. Provide amenity space that encourages residents to use the outdoor space safely.
4. Provide a means to develop the biodiversity credentials of the Site.

Typically the site falls towards the southern boundary with an average gradient of 1:300 and is therefore, favourable to open water features such as swales and detention basins. By utilising a vegetated open water feature the proposed drainage strategy can achieve all the objectives outlined above. From a technical perspective, by incorporating an open water feature the attenuation can be positioned high in the ground allowing the site to achieve an outfall into the very shallow existing surface water ditch.

The total drained area including the proposed student accommodation, future student accommodation and the proposed basin area has been estimated at 2667m². Using the rate in section 1.3 the attenuation requirement has been calculated providing an approximate volume of up to 247m³ (using Microdrainage software to produce the Hydraulic Model) as detailed in the calculations contained within Appendix A

This volume is provided within a single detention basin located south of the proposed student accommodation building. The base level of the proposed detention basin has been set at approximately 0.010m AOD to provide sufficient fall from the upstream-proposed network. The proposed drainage network has been modelled using Microdrainage software and shows a water depth of approximately 0.9m in the 1 in 100 year event with climate change creating an associated freeboard of 0.334m assuming an adjacent ground level of 1.300m AOD. Refer to Calculations in Appendix A. The FRA has identified a flood compensation volume of 20m³, with a proposed total depth of 1.223m the basin is capable of attenuating approximately 371.3m³ and there is therefore, adequate capacity within the attenuation pond to contain both displaced floodwater and surface water from the proposed development. For details of the flood compensation volume calculations, refer to the FRA.

The FRA has identified a high groundwater table. It is therefore recommended that the basin will be lined with an impermeable membrane to avoid the ingress of ground water. Any associated earthworks will be designed with side slopes no steeper than 1:4 to facilitate access for maintenance as well as use by residents during dry spells. Future design of the detention basin will be progressed in a manner to protect the liner from flotation.

1.6 Maintenance and Adoption

The proposed surface water drainage infrastructure serves one curtilage and therefore is unlikely to be adopted. With this in mind the drainage shall be designed in accordance with Building Regulations Part H and the relevant British Standards to provide drainage systems that are suitable the Proposed Development and can be accessed and maintained as required.

Gullies and linear channels will include sump units to capture silt and reduce the likelihood of blockages further downstream. The chambers at strategic locations along the network will also include sumps. The flow control devices will include bypass doors that can be activated in the event of a blockage.

The detention basin will require maintenance as detailed in the extract from the SuDS Manual below:

TABLE 22.1 Operation and maintenance requirements for detention basins

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect bankside, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Re-seed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by re-seeding or re-turfing	As required
	Re-alignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Re-level uneven surfaces and reinstate design levels	As required

1.7 Proposed Surface Water Outfall and Offsite Drainage

The proposed drainage network described within Section 1.4 will outfall into an existing surface pipe located southeast of the proposed accommodation building. The connection will be made by construction a new chamber onto the existing pipe as shown on drawing UOCC-ACM-XX-05-DR-DR-00001 within Appendix B. The existing pipe is 300mm diameter laid at 1:300 providing a design capacity of 60l/s. As shown on WSP drawing 0938-D-106-B the existing surface water drainage network is limited via a flow control device upstream of the proposed connection point. WSP drawing 0938-D-106-B indicates the peak flow is restricted to 5l/s. The proposed flow control serving the proposed surface water network restricts to a peak rate of 2l/s, therefore the combined flow through the existing 300mm pipe will be 7l/s peak, confirming that the existing pipe can accept the proposed flows arising from the Proposed Development.

Upon review of the topographical survey, the existing 300mm pipe discharges to an existing surface water ditch located along the southern boundary of the Site. From this outfall it is understood that the existing surface water ditch will convey flows east towards the B2259. It is assumed that the ditch enters a culvert below the B2259, which then discharges back into a ditch east of the highway. The ditch appears to convey runoff east, ultimately discharging into the River Lidsey Rife.

It is recommended that a survey is undertaken to assess the condition of the existing surface water ditch and the culvert running beneath the B2259 to determine if any remedial works are required to improve capacity and conveyance to reduce the flood risk.

In order to ensure that the hydraulic model used in this drainage strategy is robust a surcharged outfall condition of 1.2m deep has been adopted for the outlet at the ditch. The results of the simulation are included in Appendix A and demonstrate that the attenuation volume, flow control device and the associated pipe network can adequately operate under this outfall condition.

1.8 Foul Water Drainage

1.8.1 Existing Infrastructure

The Site has an existing foul water sewer running from west to east along the southern boundary. At the southeast corner of the Site the existing foul sewer turns south leaving the Proposed Development. The existing foul water pipe is owned by Southern Water therefore consent to connect and a pre development enquiry will be required to confirm the connection point and the capacity of the existing sewer.

1.8.2 Foul Water Discharge Connection Point

The proposed connection point to serve the foul water network is manhole S106/SWFW 4604 which is south of the proposed building at National Grid Reference SZ944996. The existing connection manhole has a cover level of 1.380m and an invert level of 0.180m.

1.8.3 Proposed Infrastructure

The proposed foul drainage network will include pipes and chambers around the perimeter of the proposed building, accepting soil vent pipes (SVP). The network has been designed to allow the appropriate cover to all pipes for protection against expected loading and the gradients to achieve the required self-cleansing velocities. A preliminary assessment of the drainage invert levels and gradients has been undertaken that shows the proposed foul water drainage network can drain via gravity to the existing network on site. Drawings included within Appendix B show the indicative layout of the proposed foul water network.

2. Summary

The Drainage strategy has concluded the following:

- In accordance with the flood risk vulnerability table, the Proposed Development is classified as 'More Vulnerable' and is permitted within Flood Zone 3a therefore requiring a 40% climate change factor.
- The Proposed Development has a high groundwater table therefore infiltration features have not been considered.
- QBAR runoff is 0.9l/s therefore the Proposed Development will use 2l/s, the minimum practical discharge rate via a vortex flow control device.
- The Proposed Development will cause the impermeable area within the Site to be increased. Sustainable Drainage Systems will be required to ensure that the Proposed Development will not cause the peak rate of surface water discharge from the Site to be increased. An outline drainage strategy has been developed in order to demonstrate that sufficient space is available within the development to attenuate within a detention basin and discharge at 2l/s for all events up to and including the 1 in 100 year event with a 40% allowance for climate change. The SuDS features that have been selected include a detention basin in order to maximise opportunities for landscape and ecological enhancement. The attenuated discharge will be conveyed to the provide 300mm pipe southeast of the proposed building.
- The proposed foul drainage network which serves the Proposed Development will include pipes and chambers around the perimeter of the proposed building and will be discharging to S106/SWFW 4604 manhole which is south of the proposed building.
- The proposed detention basin has been designed with additional capacity in order to accept overland flood flows above the design criteria of a 100 year storm event + 40% for climate change. If the capacity of the detention basin were to be exceeded, the ground levels fall from north to south, away from the proposed buildings, directing exceedance flows to an existing ditch along the southern boundary of the Proposed

Development. Levels around the proposed buildings should be designed to direct overland flows towards the detention basin.

- A Pre-Planning Enquiry will be required to assess the capacity of the existing foul water sewer.
- Capacity within the existing sewers cannot be reserved, therefore it is recommended that as the Proposed Development and foul water drainage design evolves, Southern Water should be consulted to confirm the acceptability of the proposed rates, capacity of the receiving existing sewer and the most suitable connection location. The same consideration should be given to the surface water connections and capacity checks.

Appendix A Calculations

Chichester University Student Accommodation Greenfield Micro Drainage Calculations

Greenfield Run off Rates using the ICP SUDS Module of the Rural Runoff Calculator:

ICP SUDS

ICP SUDS Input (FGR Method)

Return Period (Years): 100

Area (ha): 0.267

SAAR (mm): 714

Soil: 0.400

Growth Curve: (None)

Partly Urbanised Catchment (QBAR)

Urban: 0.000

Region: Region 7

Calculate

Results

QBAR rural (l/s): 0.9

QBAR urban (l/s): 0.9

Return Period Flood

Region	QBAR (l/s)	Q (100 yrs) (l/s)	Q (1 yrs) (l/s)	Q (10 yrs) (l/s)	Q (100 yrs) (l/s)
ICP SUDS	0.9	2.3	0.8	1.8	2.3
ADAS 345	0.9	2.4	0.8	1.8	2.4
FEH	0.9	1.8	0.8	1.6	1.8
ReFH2	0.9	2.4	0.8	1.8	2.4
Greenfield Volume	0.9	3.3	0.8	2.2	3.3
Greenfield Volume (ReFH2)	0.9	3.0	0.8	2.1	3.0
Region 8	0.9	2.2	0.7	1.8	2.2
Region 9	0.9	2.8	0.8	1.8	2.8
Region 10	0.9	1.8	0.8	1.6	1.8

OK Cancel Help

Enter Return Period between 1 and 1000

Attenuation volume calculation using the Quick Storage Estimate tool:

Quick Storage Estimate

Results

Global Variables require approximate storage of between 115 m³ and 170 m³.

These values are estimates only and should not be used for design purposes.

Variables

Results

Design

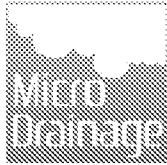
Overview 2D

Overview 3D

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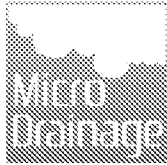
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Basingstoke		
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XP Solutions	Network 2018.1	

Existing Network Details for Existing

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
1.000	8.434	0.056	150.6	0.010	1.00	0.0	0.600	o	225	Pipe/Conduit
1.001	39.291	0.262	150.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit
1.002	9.979	0.067	148.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
1.003	8.009	0.055	145.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
1.004	9.782	0.190	51.5	0.022	0.00	0.0	0.600	o	225	Pipe/Conduit
1.005	14.681	0.067	217.5	0.184	0.00	0.0	0.600	o	400	Pipe/Conduit
1.006	14.681	0.068	215.9	0.000	0.00	0.0	0.600	o	400	Pipe/Conduit
1.007	22.673	0.095	238.7	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit
1.008	20.289	0.085	238.7	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit
2.000	23.632	0.158	149.6	0.021	1.00	0.0	0.600	o	150	Pipe/Conduit
1.009	14.953	0.149	100.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit
1.010	6.588	0.066	99.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit

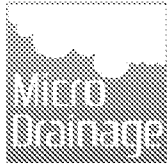
Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
1.000	0.787	0.010	0.0	1.06	42.3
1.001	0.651	0.026	0.0	1.07	42.4
1.002	0.389	0.026	0.0	1.07	42.5
1.003	0.322	0.026	0.0	1.08	43.0
1.004	0.267	0.048	0.0	1.83	72.6
1.005	0.077	0.232	0.0	1.28	160.3
1.006	0.019	0.232	0.0	1.28	160.9
1.007	-0.058	0.246	0.0	1.01	71.6
1.008	-0.153	0.246	0.0	1.01	71.6
2.000	-0.080	0.021	0.0	0.82	14.5
1.009	-0.238	0.267	0.0	1.00	17.7
1.010	-0.387	0.267	0.0	1.01	17.8

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Midpoint	SURFACE WATER	
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Basingstoke		
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Manhole Schedules for Existing

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)
SW01	1.435	0.728	Open Manhole	1200	1.000	0.757	225				
SW02	1.435	0.784	Open Manhole	1200	1.001	0.651	225	1.000	0.651	225	
SW03	1.435	1.046	Open Manhole	1200	1.002	0.389	225	1.001	0.389	225	
SW04	2.750	2.428	Open Manhole	1200	1.003	0.322	225	1.002	0.322	225	
SW05	2.750	2.483	Open Manhole	1200	1.004	0.267	225	1.003	0.267	225	
INLET	1.300	1.223	Open Manhole	1350	1.005	0.077	400	1.004	0.077	225	
Pond (Dummy)	1.300	1.290	Junction		1.006	0.010	400	1.005	0.010	400	
OUTLET	1.300	1.358	Open Manhole	1350	1.007	-0.058	300	1.006	-0.058	400	
SW06	1.220	1.473	Open Manhole	1200	1.008	-0.153	300	1.007	-0.153	300	
SW09	1.435	1.515	Open Manhole	1200	2.000	-0.080	150				
SW07	1.300	1.538	Open Manhole	1200	1.009	-0.238	150	1.008	-0.238	300	
								2.000	-0.238	150	
SW08	2.050	2.437	Open Manhole	1200	1.010	-0.387	150	1.009	-0.387	150	
	2.050	2.503	Open Manhole	1200		OUTFALL		1.010	-0.453	150	

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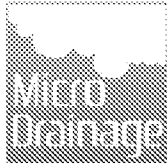
PIPELINE SCHEDULES for Existing

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	225	SW01	1.435	0.707	0.508	Open Manhole	1200
1.001	o	225	SW02	1.435	0.651	0.559	Open Manhole	1200
1.002	o	225	SW03	1.435	0.389	0.821	Open Manhole	1200
1.003	o	225	SW04	2.750	0.322	2.203	Open Manhole	1200
1.004	o	225	SW05	2.750	0.267	2.258	Open Manhole	1200
1.005	o	400	INLET	1.300	0.077	0.823	Open Manhole	1350
1.006	o	400	Pond (Dummy)	1.300	0.010	0.890	Junction	
1.007	o	300	OUTLET	1.300	-0.058	1.058	Open Manhole	1350
1.008	o	300	SW06	1.320	-0.153	1.173	Open Manhole	1200
2.000	o	150	SW09	1.435	-0.980	1.365	Open Manhole	1200
1.009	o	150	SW07	1.300	-0.238	1.388	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	8.434	150.6	SW02	1.435	0.651	0.559	Open Manhole	1200
1.001	39.291	150.0	SW03	1.435	0.389	0.821	Open Manhole	1200
1.002	9.979	148.9	SW04	2.750	0.322	2.203	Open Manhole	1200
1.003	8.009	145.6	SW05	2.750	0.267	2.258	Open Manhole	1200
1.004	9.782	51.5	INLET	1.300	0.077	0.998	Open Manhole	1350
1.005	14.681	217.5	Pond (Dummy)	1.300	0.010	0.890	Junction	
1.006	14.681	215.9	OUTLET	1.300	-0.058	0.958	Open Manhole	1350
1.007	22.673	238.7	SW06	1.320	-0.153	1.173	Open Manhole	1200
1.008	20.289	238.7	SW07	1.300	-0.238	1.238	Open Manhole	1200
2.000	23.632	149.6	SW07	1.300	-0.238	1.388	Open Manhole	1200
1.009	14.953	100.4	SW08	2.950	-0.387	2.287	Open Manhole	1200

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PIPELINE SCHEDULES for Existing

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)
1.010	o	150	SW08	2.050	-0.387	2.287	Open Manhole	1200

Downstream Manhole

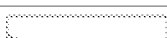
PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.010	6.588	99.8		2.050	-0.453	2.353	Open Manhole	1200

Surcharged Outfall Details for Existing

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.010		2.050	-0.453	0.000	1200	0

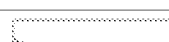
Datum (m) -0.453 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
15	1.200	135	1.200	255	1.200	375	1.200	495	1.200	615	1.200	735	1.200	855	1.200	975	1.200	1095	1.200
30	1.200	150	1.200	270	1.200	390	1.200	510	1.200	630	1.200	750	1.200	870	1.200	990	1.200	1110	1.200
45	1.200	165	1.200	285	1.200	405	1.200	525	1.200	645	1.200	765	1.200	885	1.200	1005	1.200	1125	1.200
60	1.200	180	1.200	300	1.200	420	1.200	540	1.200	660	1.200	780	1.200	900	1.200	1020	1.200	1140	1.200
75	1.200	195	1.200	315	1.200	435	1.200	555	1.200	675	1.200	795	1.200	915	1.200	1035	1.200	1155	1.200
90	1.200	210	1.200	330	1.200	450	1.200	570	1.200	690	1.200	810	1.200	930	1.200	1050	1.200	1170	1.200
105	1.200	225	1.200	345	1.200	465	1.200	585	1.200	705	1.200	825	1.200	945	1.200	1065	1.200	1185	1.200
120	1.200	240	1.200	360	1.200	480	1.200	600	1.200	720	1.200	840	1.200	960	1.200	1080	1.200	1200	1.200

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Surcharged Outfall Details for Existing

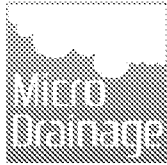
Time	Depth	Time	Depth	Time	Depth	Time	Depth	Time	Depth	Time	Depth	Time	Depth	Time	Depth	Time	Depth	Time	Depth
(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)	(mins)	(m)
1455	1.200	1965	1.200	2475	1.200	2985	1.200	3495	1.200	4005	1.200	4515	1.200	5025	1.200	5535	1.200	6045	1.200
1470	1.200	1980	1.200	2490	1.200	3000	1.200	3510	1.200	4020	1.200	4530	1.200	5040	1.200	5550	1.200	6060	1.200
1485	1.200	1995	1.200	2505	1.200	3015	1.200	3525	1.200	4035	1.200	4545	1.200	5055	1.200	5565	1.200	6075	1.200
1500	1.200	2010	1.200	2520	1.200	3030	1.200	3540	1.200	4050	1.200	4560	1.200	5070	1.200	5580	1.200	6090	1.200
1515	1.200	2025	1.200	2535	1.200	3045	1.200	3555	1.200	4065	1.200	4575	1.200	5085	1.200	5595	1.200	6105	1.200
1530	1.200	2040	1.200	2550	1.200	3060	1.200	3570	1.200	4080	1.200	4590	1.200	5100	1.200	5610	1.200	6120	1.200
1545	1.200	2055	1.200	2565	1.200	3075	1.200	3585	1.200	4095	1.200	4605	1.200	5115	1.200	5625	1.200	6135	1.200
1560	1.200	2070	1.200	2580	1.200	3090	1.200	3600	1.200	4110	1.200	4620	1.200	5130	1.200	5640	1.200	6150	1.200
1575	1.200	2085	1.200	2595	1.200	3105	1.200	3615	1.200	4125	1.200	4635	1.200	5145	1.200	5655	1.200	6165	1.200
1590	1.200	2100	1.200	2610	1.200	3120	1.200	3630	1.200	4140	1.200	4650	1.200	5160	1.200	5670	1.200	6180	1.200
1605	1.200	2115	1.200	2625	1.200	3135	1.200	3645	1.200	4155	1.200	4665	1.200	5175	1.200	5685	1.200	6195	1.200
1620	1.200	2130	1.200	2640	1.200	3150	1.200	3660	1.200	4170	1.200	4680	1.200	5190	1.200	5700	1.200	6210	1.200
1635	1.200	2145	1.200	2655	1.200	3165	1.200	3675	1.200	4185	1.200	4695	1.200	5205	1.200	5715	1.200	6225	1.200
1650	1.200	2160	1.200	2670	1.200	3180	1.200	3690	1.200	4200	1.200	4710	1.200	5220	1.200	5730	1.200	6240	1.200
1665	1.200	2175	1.200	2685	1.200	3195	1.200	3705	1.200	4215	1.200	4725	1.200	5235	1.200	5745	1.200	6255	1.200
1680	1.200	2190	1.200	2700	1.200	3210	1.200	3720	1.200	4230	1.200	4740	1.200	5250	1.200	5760	1.200	6270	1.200
1695	1.200	2205	1.200	2715	1.200	3225	1.200	3735	1.200	4245	1.200	4755	1.200	5265	1.200	5775	1.200	6285	1.200
1710	1.200	2220	1.200	2730	1.200	3240	1.200	3750	1.200	4260	1.200	4770	1.200	5280	1.200	5790	1.200	6300	1.200
1725	1.200	2235	1.200	2745	1.200	3255	1.200	3765	1.200	4275	1.200	4785	1.200	5295	1.200	5805	1.200	6315	1.200
1740	1.200	2250	1.200	2760	1.200	3270	1.200	3780	1.200	4290	1.200	4800	1.200	5310	1.200	5820	1.200	6330	1.200
1755	1.200	2265	1.200	2775	1.200	3285	1.200	3795	1.200	4305	1.200	4815	1.200	5325	1.200	5835	1.200	6345	1.200
1770	1.200	2280	1.200	2790	1.200	3300	1.200	3810	1.200	4320	1.200	4830	1.200	5340	1.200	5850	1.200	6360	1.200
1785	1.200	2295	1.200	2805	1.200	3315	1.200	3825	1.200	4335	1.200	4845	1.200	5355	1.200	5865	1.200	6375	1.200
1800	1.200	2310	1.200	2820	1.200	3330	1.200	3840	1.200	4350	1.200	4860	1.200	5370	1.200	5880	1.200	6390	1.200
1815	1.200	2325	1.200	2835	1.200	3345	1.200	3855	1.200	4365	1.200	4875	1.200	5385	1.200	5895	1.200	6405	1.200
1830	1.200	2340	1.200	2850	1.200	3360	1.200	3870	1.200	4380	1.200	4890	1.200	5400	1.200	5910	1.200	6420	1.200
1845	1.200	2355	1.200	2865	1.200	3375	1.200	3885	1.200	4395	1.200	4905	1.200	5415	1.200	5925	1.200	6435	1.200
1860	1.200	2370	1.200	2880	1.200	3390	1.200	3900	1.200	4410	1.200	4920	1.200	5430	1.200	5940	1.200	6450	1.200
1875	1.200	2385	1.200	2895	1.200	3405	1.200	3915	1.200	4425	1.200	4935	1.200	5445	1.200	5955	1.200	6465	1.200
1890	1.200	2400	1.200	2910	1.200	3420	1.200	3930	1.200	4440	1.200	4950	1.200	5460	1.200	5970	1.200	6480	1.200
1905	1.200	2415	1.200	2925	1.200	3435	1.200	3945	1.200	4455	1.200	4965	1.200	5475	1.200	5985	1.200	6495	1.200
1920	1.200	2430	1.200	2940	1.200	3450	1.200	3960	1.200	4470	1.200	4980	1.200	5490	1.200	6000	1.200	6510	1.200
1935	1.200	2445	1.200	2955	1.200	3465	1.200	3975	1.200	4485	1.200	4995	1.200	5505	1.200	6015	1.200	6525	1.200
1950	1.200	2460	1.200	2970	1.200	3480	1.200	3990	1.200	4500	1.200	5010	1.200	5520	1.200	6030	1.200	6540	1.200

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Surcharged Outfall Details for Existing

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
7575	1.200	8085	1.200	8595	1.200	9105	1.200	9615	1.200	10125	1.200	10635	1.200	11145	1.200	11655	1.200	12165	1.200
7590	1.200	8100	1.200	8610	1.200	9120	1.200	9630	1.200	10140	1.200	10650	1.200	11160	1.200	11670	1.200	12180	1.200
7605	1.200	8115	1.200	8625	1.200	9135	1.200	9645	1.200	10155	1.200	10665	1.200	11175	1.200	11685	1.200	12195	1.200
7620	1.200	8130	1.200	8640	1.200	9150	1.200	9660	1.200	10170	1.200	10680	1.200	11190	1.200	11700	1.200	12210	1.200
7635	1.200	8145	1.200	8655	1.200	9165	1.200	9675	1.200	10185	1.200	10695	1.200	11205	1.200	11715	1.200	12225	1.200
7650	1.200	8160	1.200	8670	1.200	9180	1.200	9690	1.200	10200	1.200	10710	1.200	11220	1.200	11730	1.200	12240	1.200
7665	1.200	8175	1.200	8685	1.200	9195	1.200	9705	1.200	10215	1.200	10725	1.200	11235	1.200	11745	1.200	12255	1.200
7680	1.200	8190	1.200	8700	1.200	9210	1.200	9720	1.200	10230	1.200	10740	1.200	11250	1.200	11760	1.200	12270	1.200
7695	1.200	8205	1.200	8715	1.200	9225	1.200	9735	1.200	10245	1.200	10755	1.200	11265	1.200	11775	1.200	12285	1.200
7710	1.200	8220	1.200	8730	1.200	9240	1.200	9750	1.200	10260	1.200	10770	1.200	11280	1.200	11790	1.200	12300	1.200
7725	1.200	8235	1.200	8745	1.200	9255	1.200	9765	1.200	10275	1.200	10785	1.200	11295	1.200	11805	1.200	12315	1.200
7740	1.200	8250	1.200	8760	1.200	9270	1.200	9780	1.200	10290	1.200	10800	1.200	11310	1.200	11820	1.200	12330	1.200
7755	1.200	8265	1.200	8775	1.200	9285	1.200	9795	1.200	10305	1.200	10815	1.200	11325	1.200	11835	1.200	12345	1.200
7770	1.200	8280	1.200	8790	1.200	9300	1.200	9810	1.200	10320	1.200	10830	1.200	11340	1.200	11850	1.200	12360	1.200
7785	1.200	8295	1.200	8805	1.200	9315	1.200	9825	1.200	10335	1.200	10845	1.200	11355	1.200	11865	1.200	12375	1.200
7800	1.200	8310	1.200	8820	1.200	9330	1.200	9840	1.200	10350	1.200	10860	1.200	11370	1.200	11880	1.200	12390	1.200
7815	1.200	8325	1.200	8835	1.200	9345	1.200	9855	1.200	10365	1.200	10875	1.200	11385	1.200	11895	1.200	12405	1.200
7830	1.200	8340	1.200	8850	1.200	9360	1.200	9870	1.200	10380	1.200	10890	1.200	11400	1.200	11910	1.200	12420	1.200
7845	1.200	8355	1.200	8865	1.200	9375	1.200	9885	1.200	10395	1.200	10905	1.200	11415	1.200	11925	1.200	12435	1.200
7860	1.200	8370	1.200	8880	1.200	9390	1.200	9900	1.200	10410	1.200	10920	1.200	11430	1.200	11940	1.200	12450	1.200
7875	1.200	8385	1.200	8895	1.200	9405	1.200	9915	1.200	10425	1.200	10935	1.200	11445	1.200	11955	1.200	12465	1.200
7890	1.200	8400	1.200	8910	1.200	9420	1.200	9930	1.200	10440	1.200	10950	1.200	11460	1.200	11970	1.200	12480	1.200
7905	1.200	8415	1.200	8925	1.200	9435	1.200	9945	1.200	10455	1.200	10965	1.200	11475	1.200	11985	1.200	12495	1.200
7920	1.200	8430	1.200	8940	1.200	9450	1.200	9960	1.200	10470	1.200	10980	1.200	11490	1.200	12000	1.200	12510	1.200
7935	1.200	8445	1.200	8955	1.200	9465	1.200	9975	1.200	10485	1.200	10995	1.200	11505	1.200	12015	1.200	12525	1.200
7950	1.200	8460	1.200	8970	1.200	9480	1.200	9990	1.200	10500	1.200	11010	1.200	11520	1.200	12030	1.200	12540	1.200
7965	1.200	8475	1.200	8985	1.200	9495	1.200	10005	1.200	10515	1.200	11025	1.200	11535	1.200	12045	1.200	12555	1.200
7980	1.200	8490	1.200	9000	1.200	9510	1.200	10020	1.200	10530	1.200	11040	1.200	11550	1.200	12060	1.200	12570	1.200
7995	1.200	8505	1.200	9015	1.200	9525	1.200	10035	1.200	10545	1.200	11055	1.200	11565	1.200	12075	1.200	12585	1.200
8010	1.200	8520	1.200	9030	1.200	9540	1.200	10050	1.200	10560	1.200	11070	1.200	11580	1.200	12090	1.200	12600	1.200
8025	1.200	8535	1.200	9045	1.200	9555	1.200	10065	1.200	10575	1.200	11085	1.200	11595	1.200	12105	1.200	12615	1.200
8040	1.200	8550	1.200	9060	1.200	9570	1.200	10080	1.200	10590	1.200	11100	1.200	11610	1.200	12120	1.200	12630	1.200
8055	1.200	8565	1.200	9075	1.200	9585	1.200	10095	1.200	10605	1.200	11115	1.200	11625	1.200	12135	1.200	12645	1.200
8070	1.200	8580	1.200	9090	1.200	9600	1.200	10110	1.200	10620	1.200	11130	1.200	11640	1.200	12150	1.200	12660	1.200

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
13695	1.200	14205	1.200	14715	1.200	15225	1.200	15735	1.200	16245	1.200	16755	1.200	17265	1.200	17775	1.200
13710	1.200	14220	1.200	14730	1.200	15240	1.200	15750	1.200	16260	1.200	16770	1.200	17280	1.200	17790	1.200
13725	1.200	14235	1.200	14745	1.200	15255	1.200	15765	1.200	16275	1.200	16785	1.200	17295	1.200	17805	1.200
13740	1.200	14250	1.200	14760	1.200	15270	1.200	15780	1.200	16290	1.200	16800	1.200	17310	1.200	17820	1.200
13755	1.200	14265	1.200	14775	1.200	15285	1.200	15795	1.200	16305	1.200	16815	1.200	17325	1.200	17835	1.200
13770	1.200	14280	1.200	14790	1.200	15300	1.200	15810	1.200	16320	1.200	16830	1.200	17340	1.200	17850	1.200
13785	1.200	14295	1.200	14805	1.200	15315	1.200	15825	1.200	16335	1.200	16845	1.200	17355	1.200	17865	1.200
13800	1.200	14310	1.200	14820	1.200	15330	1.200	15840	1.200	16350	1.200	16860	1.200	17370	1.200	17880	1.200
13815	1.200	14325	1.200	14835	1.200	15345	1.200	15855	1.200	16365	1.200	16875	1.200	17385	1.200	17895	1.200
13830	1.200	14340	1.200	14850	1.200	15360	1.200	15870	1.200	16380	1.200	16890	1.200	17400	1.200	17910	1.200
13845	1.200	14355	1.200	14865	1.200	15375	1.200	15885	1.200	16395	1.200	16905	1.200	17415	1.200	17925	1.200
13860	1.200	14370	1.200	14880	1.200	15390	1.200	15900	1.200	16410	1.200	16920	1.200	17430	1.200	17940	1.200
13875	1.200	14385	1.200	14895	1.200	15405	1.200	15915	1.200	16425	1.200	16935	1.200	17445	1.200	17955	1.200
13890	1.200	14400	1.200	14910	1.200	15420	1.200	15930	1.200	16440	1.200	16950	1.200	17460	1.200	17970	1.200
13905	1.200	14415	1.200	14925	1.200	15435	1.200	15945	1.200	16455	1.200	16965	1.200	17475	1.200	17985	1.200
13920	1.200	14430	1.200	14940	1.200	15450	1.200	15960	1.200	16470	1.200	16980	1.200	17490	1.200	18000	1.200
13935	1.200	14445	1.200	14955	1.200	15465	1.200	15975	1.200	16485	1.200	16995	1.200	17505	1.200	18015	1.200
13950	1.200	14460	1.200	14970	1.200	15480	1.200	15990	1.200	16500	1.200	17010	1.200	17520	1.200	18030	1.200
13965	1.200	14475	1.200	14985	1.200	15495	1.200	16005	1.200	16515	1.200	17025	1.200	17535	1.200	18045	1.200
13980	1.200	14490	1.200	15000	1.200	15510	1.200	16020	1.200	16530	1.200	17040	1.200	17550	1.200	18060	1.200
13995	1.200	14505	1.200	15015	1.200	15525	1.200	16035	1.200	16545	1.200	17055	1.200	17565	1.200	18075	1.200
14010	1.200	14520	1.200	15													

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Midpoint	SUFRACE WATER	
Alencon Link	UoC	
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Date 13/02/2019	Designed by SK	
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XP Solutions	Network 2018.1	

Surcharged Outfall Details for Existing

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
19815	1.200	19845	1.200	19875	1.200	19905	1.200	19935	1.200	19965	1.200	19995	1.200	20025	1.200	20055	1.200	20085	1.200
19830	1.200	19860	1.200	19890	1.200	19920	1.200	19950	1.200	19980	1.200	20010	1.200	20040	1.200	20070	1.200	20100	1.200
																		20130	1.200
																		20145	1.200
																		20160	1.200

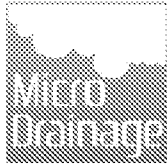
Simulation Criteria for Existing

Volumetric Runoff Coeff 0.840 Manhole Headloss Coeff (Global) 0.500 Inlet Coefficient 0.800
 Areal Reduction Factor 1.000 Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
 Hot Start (mins) 0 Additional Flow - % of Total Flow 0.000 Run Time (mins) 1200
 Hot Start Level (mm) 0 MADD Factor * 10m³/ha Storage 2.000 Output Interval (mins) 10

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 2 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
 Return Period (years) 100 Ratio R 0.350 Cv (Winter) 0.840
 Region England and Wales Profile Type Winter Storm Duration (mins) 600

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XP Solutions	Network 2018.1	

Online Controls for Existing

Hydro-Brake® Optimum Manhole: SW07, DS/PN: 1.009, Volume (m³): 3.5

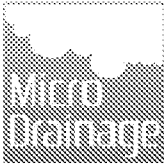
Unit Reference	MD-SHE-0069-2000-0900-2000	Sump Available	Yes
Design Head (m)	0.900	Diameter (mm)	69
Design Flow (l/s)	2.0	Invert Level (m)	-0.238
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	100
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	2.0	Kick-Flo®	0.568	1.6
Flush-Flo™	0.278	2.0	Mean Flow over Head Range	-	1.8

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.7	0.600	1.7	1.600	2.6	2.600	3.2	5.000	4.4	7.500	5.3
0.200	2.0	0.800	1.9	1.800	2.7	3.000	3.5	5.500	4.6	8.000	5.5
0.300	2.0	1.000	2.1	2.000	2.9	3.500	3.7	6.000	4.8	8.500	5.7
0.400	1.9	1.200	2.3	2.200	3.0	4.000	4.0	6.500	5.0	9.000	5.8
0.500	1.8	1.400	2.4	2.400	3.1	4.500	4.2	7.000	5.2	9.500	6.0

Non Return Valve Manhole: SW08, DS/PN: 1.010, Volume (m³): 3.0

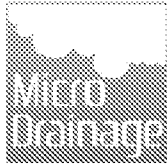
AECOM		Page 10
Midpoint	SUFRACE WATER	
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Storage Structures for Existing

Tank or Pond Manhole: Pond (Dummy), DS/PN: 1.006

Invert Level (m) 0.010

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	181.9	0.600	306.2	0.900	376.1	1.200	451.1
0.300	241.3	0.850	364.4	0.950	388.6	1.201	0.0

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 2 Number of Storage Structures 1 Number of Real Time Controls 0

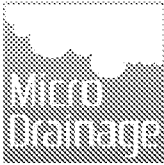
Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

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

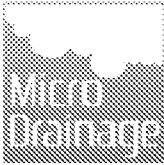
Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status
									Level (m)	Depth (m)	Volume (m³)			Flow (l/s)	
1.000	SW01	15 Summer	1	+0%					0.743	-0.189	0.000	0.05		1.8	OK
1.001	SW02	15 Summer	1	+0%					0.693	-0.183	0.000	0.07		3.0	OK
1.002	SW03	15 Summer	1	+0%	30/2160 Winter				0.434	-0.180	0.000	0.09		3.1	OK
1.003	SW04	4320 Winter	1	+0%	30/1440 Winter				0.428	-0.119	0.000	0.00		0.1	OK
1.004	SW05	4320 Winter	1	+0%	30/720 Winter				0.428	-0.064	0.000	0.00		0.2	OK
1.005	INLET	4320 Winter	1	+0%	30/600 Winter				0.429	-0.048	0.000	0.01		0.9	OK
1.006	Pond (Dummy)	4320 Winter	1	+0%	1/4320 Winter				0.429	0.019	0.000	0.05		6.4	SURCHARGED*
1.007	OUTLET	4320 Winter	1	+0%	1/600 Winter				0.445	0.203	0.000	0.05		3.3	SURCHARGED
1.008	SW06	4320 Winter	1	+0%	1/120 Winter				0.466	0.319	0.000	0.02		1.4	SURCHARGED
2.000	SW09	4320 Winter	1	+0%	1/30 Summer				0.459	0.389	0.000	0.06		0.8	SURCHARGED

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XP Solutions	Network 2018.1	

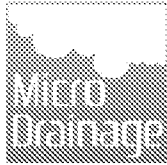
1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

PN	US/MH Name	Level Exceeded
1.000	SW01	
1.001	SW02	
1.002	SW03	
1.003	SW04	
1.004	SW05	
1.005	INLET	
1.006	Pond (Dummy)	
1.007	OUTLET	
1.008	SW06	
2.000	SW09	

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Midpoint	SUFRACE WATER	
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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

									Water	Surcharged	Flooded	Pipe				
PN	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume	Flow /	Overflow	Flow		Level
	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)	Cap.	(l/s)	(l/s)	Status	Exceeded
1.009	SW07	4320 Winter	1	+0%	1/15 Summer				0.467	0.555	0.000	0.02		0.3	SURCHARGED	
1.010	SW08	4320 Winter	1	+0%	1/15 Summer				0.440	0.677	0.000	0.00		0.0	SURCHARGED	

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Midpoint	SUFRACE WATER	
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XP Solutions	Network 2018.1	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 2 Number of Storage Structures 1 Number of Real Time Controls 0

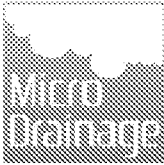
Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

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

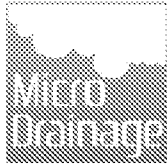
Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
									(m)	(m)	(m ³)				
1.000	SW01	15 Summer	30	+0%					0.765	-0.167	0.000	0.14		4.5	OK
1.001	SW02	15 Summer	30	+0%					0.725	-0.151	0.000	0.22		8.8	OK
1.002	SW03	4320 Winter	30	+0%	30/2160 Winter				0.720	0.106	0.000	0.01		0.2	SURCHARGED
1.003	SW04	4320 Winter	30	+0%	30/1440 Winter				0.720	0.173	0.000	0.01		0.2	SURCHARGED
1.004	SW05	4320 Winter	30	+0%	30/720 Winter				0.720	0.228	0.000	0.01		0.3	SURCHARGED
1.005	INLET	4320 Winter	30	+0%	30/600 Winter				0.721	0.244	0.000	0.01		1.6	SURCHARGED
1.006	Pond (Dummy)	4320 Winter	30	+0%	1/4320 Winter				0.721	0.311	0.000	0.07		8.9	SURCHARGED*
1.007	OUTLET	4320 Winter	30	+0%	1/600 Winter				0.743	0.501	0.000	0.08		5.0	SURCHARGED
1.008	SW06	4320 Winter	30	+0%	1/120 Winter				0.775	0.628	0.000	0.03		2.1	SURCHARGED
2.000	SW09	4320 Winter	30	+0%	1/30 Summer				0.764	0.694	0.000	0.09		1.2	SURCHARGED

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XP Solutions	Network 2018.1	

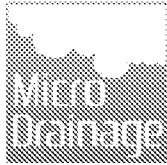
30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

PN	US/MH Name	Level Exceeded
1.000	SW01	
1.001	SW02	
1.002	SW03	
1.003	SW04	
1.004	SW05	
1.005	INLET	
1.006	Pond (Dummy)	
1.007	OUTLET	
1.008	SW06	
2.000	SW09	

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

									Water	Surcharged	Flooded	Pipe				
PN	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume	Flow /	Overflow	Flow	Level
	Name	Storm		Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)	Cap.	(l/s)	(l/s)	Status
																Exceeded
1.009	SW07	4320 Winter		30	+0%	1/15 Summer				0.776	0.864	0.000	0.03		0.4	SURCHARGED
1.010	SW08	4320 Winter		30	+0%	1/15 Summer				0.737	0.974	0.000	0.00		0.0	SURCHARGED

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 2 Number of Storage Structures 1 Number of Real Time Controls 0

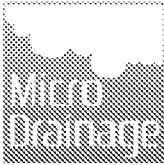
Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

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

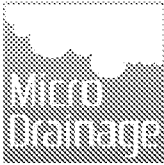
Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status
									Level (m)	Depth (m)	Volume (m³)			Flow (l/s)	
1.000	SW01	4320 Winter	100	+40%					0.861	-0.071	0.000	0.00		0.1	OK
1.001	SW02	4320 Winter	100	+40%					0.861	-0.015	0.000	0.01		0.3	OK
1.002	SW03	4320 Winter	100	+40%	30/2160 Winter				0.861	0.247	0.000	0.01		0.3	SURCHARGED
1.003	SW04	4320 Winter	100	+40%	30/1440 Winter				0.861	0.314	0.000	0.01		0.3	SURCHARGED
1.004	SW05	4320 Winter	100	+40%	30/720 Winter				0.861	0.369	0.000	0.01		0.5	SURCHARGED
1.005	INLET	4320 Winter	100	+40%	30/600 Winter				0.860	0.383	0.000	0.02		2.8	SURCHARGED
1.006	Pond (Dummy)	4320 Winter	100	+40%	1/4320 Winter				0.860	0.450	0.000	0.10		13.1	SURCHARGED*
1.007	OUTLET	4320 Winter	100	+40%	1/600 Winter				0.887	0.645	0.000	0.13		8.0	SURCHARGED
1.008	SW06	4320 Winter	100	+40%	1/120 Winter				0.925	0.778	0.000	0.07		4.2	SURCHARGED
2.000	SW09	4320 Winter	100	+40%	1/30 Summer				0.912	0.842	0.000	0.13		1.8	SURCHARGED

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

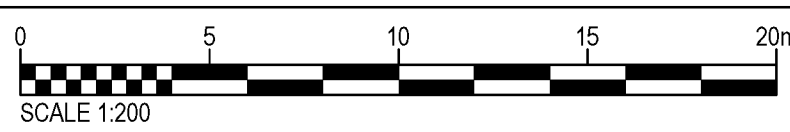
PN	US/MH Name	Level Exceeded
1.000	SW01	
1.001	SW02	
1.002	SW03	
1.003	SW04	
1.004	SW05	
1.005	INLET	
1.006	Pond (Dummy)	
1.007	OUTLET	
1.008	SW06	
2.000	SW09	

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Midpoint	SUFRACE WATER	
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XP Solutions	Network 2018.1	

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

									Water	Surcharged	Flooded	Pipe				
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	Level Exceeded
1.009	SW07	4320 Winter	100	+40%	1/15 Summer				0.926	1.014	0.000	0.10		1.7	SURCHARGED	
1.010	SW08	1440 Summer	100	+40%	1/15 Summer				0.753	0.990	0.000	0.08		1.2	SURCHARGED	

Appendix B Drawings



1. AECOM

About AECOM

AECOM (NYSE: ACM) is a global provider of professional technical and management support services to a broad range of markets, including transportation facilities, environmental, energy, water and government. With approximately 100,000 employees around the world, AECOM is a leader in all of the key markets that it serves. AECOM provides a blend of global reach, local knowledge, innovation, and collaborative technical excellence in delivering solutions that enhance and sustain the world's built, natural, and social environments. A Fortune 500 company, AECOM serves clients in more than 100 countries and has annual revenue in excess of \$6 billion.

More information on AECOM and its services can be found at www.aecom.com

