

Project name	Salt Box, Bognor Regis		
Design note title	Unit 2 and Estate Road Drainage Details		
Document reference	SAL-HYD-XX-ZZ-RP-C-0010		
Author	M.Griffin		
Revision	A		
Date	11 October 2019	Approved	✓

Introduction

This document has been prepared by Hydrock Consultants Limited on behalf of our Landlink Estates, to be submitted to be Arun District Council for discharge of conditions 9 and 10 of planning permission BE102/17.

BE102/17

Hybrid application comprising Outline application for development of employment units, warehouse, hotel, 2No. drive-thru units, public house, gym plus engineering works, landscaping & associated works. Full application for a Warehouse (class BS), fuel island, car parking, access roads with new entrance from Shripney Road plus engineering works, open space, landscaping & associated works

Condition 9: *Development shall not commence, other than works of site survey and investigation, until full details of the proposed surface water drainage scheme have been submitted to and approved in writing by the Local Planning Authority, to include arrangements for the future access and maintenance of any watercourse or culvert (piped watercourse) crossing or abutting the site. The design should follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations, the recommendations of the SuDS Manual produced by CIRIA. Winter groundwater monitoring to establish highest annual ground water levels and Percolation testing to BRE 365, or similar approved, will be required to support the design of any Infiltration drainage. No construction is permitted which will restrict current and future land owners from undertaking their riparian maintenance responsibilities of any watercourse on or adjacent to the site.*

Reason: To ensure that the duties and responsibilities, as required under the Land Drainage Act 1991, and amended by the Flood and Water Management Act 2010 can be fulfilled without additional impediment following the development completion. To ensure that the proposed development is satisfactorily drained in accordance with policies GEN7 and GEN9 of the Arun District Council Local Plan. It is considered necessary for this to be a pre-commencement condition because the site needs to have adequate drainage.

Condition 10: *Prior to the commencement of construction works details of a proposed foul drainage system shall be submitted to and approved in writing by the Local Planning Authority. This shall include details of its siting,*

design and subsequent management/ maintenance. No unit shall be occupied until works for the disposal of sewage have been fully implemented in accordance with the approved details.

Reason: To prevent pollution of groundwater, to ensure the satisfactory drainage of the site and to prevent flooding by ensuring the satisfactory storage of / disposal of surface water from the site in accordance with policies GEN?, GEN11 and GEN31 of the Arun District Local Plan. It is considered necessary for this to be a pre-commencement condition because the site drainage needs to be approved and implemented before the unit is built and occupied.

1. REFERENCE DOCUMENTS

This technical design should be read in conjunction with the following information:

Drawings:

- SAL-HYD-00-ZZ-DR-C-7010 Unit 2 Drainage layout
- SAL-HYD-00-ZZ-DR-C-7020 Access Road Drainage Layout Sheet 1
- SAL-HYD-00-ZZ-DR-C-7021 Access Road Drainage Layout Sheet 2
- SAL-HYD-00-ZZ-DR-C-7022 Access Road Drainage Layout Sheet 3
- SAL-HYD-00-ZZ-DR-C-7100 Drainage Details Sheet 1
- SAL-HYD-00-ZZ-DR-C-7101 Drainage Details Sheet 2
- SAL-HYD-00-ZZ-DR-C-7102 Drainage Details Sheet 3
- SAL-HYD-00-ZZ-DR-C-7103 Drainage Details Sheet 4
- SAL-HYD-00-ZZ-DR-C-7210 Unit 2 External Works

Calculations:

- SAL-HYD-00-ZZ-CA-C-0001 Network 1 (Unit 2-3-4_8)
- SAL-HYD-00-ZZ-CA-C-0002 Network 2 (Access Road)

Reports:

- SAL-HYD-XX-ZZ-RP-C-0011 Drainage O&M

2. CONDITION 9: SURFACE WATER DRAINAGE

2.1 Surface water run-off discharge destinations

The discharge of surface water run-off has been considered in accordance with the hierarchical approach:

- Infiltration
- Surface Water Body
- To dedicated surface water sewer (public, highways or otherwise)
- To a combined sewer
- To a foul sewer

Infiltration testing was carried out during both the Phase 2 Geo-Environmental Assessment and Supplementary Ground Investigation (both by EPS).

Due to the low permeability values recorded across the site, and the presence of high groundwater, infiltration to ground is not considered to be viable as the primary method of surface water disposal for this development.

Surface water run-off from the pre-developed site currently discharges into the ditch / watercourse on the western boundary during the more extreme storm events when the ground becomes saturated. Therefore, in order to mimic the existing situation, discharge to a surface water body is the preferred method of surface water disposal for the new development.

2.2 Catchment

The surface water drainage for the wider development has been split into 3 no. networks. The discharge of the condition relates to Surface Water Network 1 for Unit 2, and Surface Water Network 2 for the main estate roads

Surface Water Network 1
- Unit 2 - Unit 3 - Units 4-8
Description: Unit 3 and Units 4-8 will connect into Surface Water Network 1 on the western side of each of their respective plots. A carrier drain will then take flows northwards within the estate road, across the top of Unit 2, before out falling into the existing watercourse on the western boundary of the development. Unit 2 surface water will connect into Surface Water Network 1 at a location upstream of the outfall.
Surface Water Network 2
Main estate road including footpaths, verges and bell mouths to each unit / plot.
Description: Surface water run-off will be collected from the estate roads and associated footpaths to be discharged into Surface Water Network 2 located within the road which runs east to west across the development before out falling into the existing watercourse on the western boundary.
Surface Water Network 3 (Future Phase)
- Unit 1 - Unit 9
Description: Surface Water Network 3 collects run-off from Unit 9 into a carrier drain which runs along the south of Unit 1 before out falling into the existing watercourse/ditch on the western boundary.

The following table indicates the catchments for each surface water network based on the individual unit plots being 100% impermeable as noted above.

Network Ref:	Catchment (ha)
Surface Water Network 1	
Unit 2	1.33
Surface Water Network 2	
Estate Road (inc Footpaths, verges, and bell mouths)	1.09

Document Ref: SAL-HYD-00-ZZ-SK-C-7702 Proposed Catchment Area located in Appendix A.

2.3 Post-development run-off rates

In accordance with current guidance the peak runoff rate from the development for the 1 in 1-year rainfall event and the 1 in 100-year rainfall event should be restricted to a rate which is as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event.

However, due to the increase in impermeable area it is expected that the volume of surface water run-off discharging from both the Unit 2 and Estate Road catchment will increase from the pre-developed situation. And as such, flows are to be restricted to a rate which does not adversely affect flood risk, this is considered to be QBAR.

The Kirk Saunders Flood Risk Assessment indicates that the Greenfield QBAR rate for this development is **2.90 ltr/sec/ha**.

Based on the QBAR rate for this development the following post-development flow rates for each catchment is noted in the following table.

Network Ref:	Post-development flow rate (l/s)
Surface Water Network 1	
Unit 2	3.86
Surface Water Network 2	
Estate Road (inc Footpaths, verges, and bell mouths)	3.16

2.4 Surface Water Drainage Strategy

The surface water drainage for both Unit 2 and the Estate Road has been designed to ensure that:

- No flooding will occur during the 1 in 100-year rainfall event in any part of the building, or in any utility plant susceptible to water.
- Surface water for the 100-year rainfall event is contained within each catchment boundary.
- An allowance for **45%** climate change is incorporated into the surface water drainage design in accordance with local and national planning policy.

Document Ref: **MicroDrainage Surface Water Calculations** located in **Appendix B**.

2.5 Surcharged Outfall

The surface water drainage network has been modelled to take into consideration the effects surcharge should an extreme storm event occur at the same time as high flood levels from the adjacent water course.

The 100 year plus 45% climate change flood level of **1.85 mAOD** has specified at the outfall of each network and rainfall simulated for all storm events up to and including the 100 year plus 40% climate change. The calculations demonstrate that all surface water can be retained below ground.

Document Ref: **MicroDrainage Surface Water Calculations** located in **Appendix B**.

2.6 Post-Development Exceedance routes

Should rainfall exceed the 1 in 100-year storm event or the system failure through lack of maintenance, surface water run-off is to be directed via designated exceedance routes away buildings and/or critical infrastructure.

Document Ref: **SAL-HYD-00-ZZ-SK-C-7710 Unit 2 Exceedance route** located in **Appendix C**

Document Ref: **SAL-HYD-00-ZZ-SK-C-7720 Access Road Exceedance Route** located in **Appendix C**

2.7 Water Quality

Due to the higher risk of pollution from Unit 2 and the Estate Road Class I Full Retention interceptors have been specified and sized in accordance with Environment Agency Document PPG3 (withdrawn but still referenced).

Porous paving has been utilised within the Unit 2 car park to provide treatment of surface water run-off.

3. CONDITION 10: FOUL WATER DRAINAGE

Foul water drainage from each unit plot will discharge into a new sewer located within the estate roads. Flows will be directed towards the north of the development where they will then be pumped from a new foul pumping station offsite via a rising main into the Southern Water Foul Sewer at Manhole ref 8801 to the north east in Shripney Road.

Details of the foul drainage system for Unit 2 and the Estate Road have been shown on drawings:

- SAL-HYD-00-ZZ-DR-C-7010 Unit 2 Drainage layout
- SAL-HYD-00-ZZ-DR-C-7020 Access Road Drainage Layout Sheet 1
- SAL-HYD-00-ZZ-DR-C-7021 Access Road Drainage Layout Sheet 2
- SAL-HYD-00-ZZ-DR-C-7022 Access Road Drainage Layout Sheet 3

3.1 Management / Maintenance

The foul drainage which serves Unit 2 will be maintained by the owner / occupier.

The foul sewer located within the Estate Road including the pump station is to be maintained as part of the site wide facilities management.

Document Ref: **SAL-HYD-XX-ZZ-RP-C-0011 Drainage O&M**

Appendix A



KEY PLAN

NOTES

ISSUED FOR INFORMATION					
P01	R.HUNT	11/10/19	M.GRIFFIN	11/10/19	M.GRIFFIN
REVISION NOTES/COMMENTS					
REV	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY

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CLIENT

LANDLINK ESTATES

PROJECT

SALTBOX
BOGNOR REGIS

TITLE

POST DEVELOPMENT
UNIT PLOT CATCHMENT AREAS

HYDROCK PROJECT NO. C-13319-C	SCALE @ A1 NTS
STATUS DESCRIPTION INFORMATION	STATUS S2
DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) SAL-HYD-00-ZZ-SK-C-7702	REVISION P01

Appendix B

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Date 11/10/2019 File Network 1.MDX	Designed by D. Gallimore Checked by M. Griffin	
Innovyze Network 2018.1.1		

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)	100	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.574	4-8	1.930	8-12	0.555

Total Area Contributing (ha) = 3.060

Total Pipe Volume (m³) = 92.967

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Date 11/10/2019				Designed by D. Gallimore							
File Network 1.MDX				Checked by M. Griffin							
Innovyze				Network 2018.1.1							
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)	Dia (mm)	
S18	2.700	1.470	Open Manhole	1500	S7.000	1.230	600				
S19	2.535	1.405	Open Manhole	1500	S7.001	1.130	450	S7.000	1.130		
S20	2.840	1.760	Open Manhole	1350	S7.002	1.080	450	S7.001	1.080		
S21	2.400	1.150	Open Manhole	1500	S8.000	1.250	600				
S22	2.250	1.100	Open Manhole	1500	S8.001	1.150	350	S8.000	1.150		
S23	2.250	1.200	Open Manhole	1200	S8.002	1.050	350	S8.001	1.050		
S21	2.440	1.610	Open Manhole	1350	S7.003	0.830	450	S7.002	0.830		
								S8.002	0.830		
S22	2.925	2.265	Open Manhole	1350	S7.004	0.660	450	S7.003	0.660		
S23	2.240	1.730	Open Manhole	1350	S7.005	0.510	450	S7.004	0.510		
S10	2.660	0.840	Open Manhole	1200	S9.000	1.820	350				
S11	2.660	1.200	Open Manhole	1200	S9.001	1.460	350	S9.000	1.460		
S12	2.660	1.725	Open Manhole	1200	S9.002	0.935	350	S9.001	0.935		
S13	2.660	1.660	Open Manhole	1200	S10.000	1.000	350				
S13	2.900	2.105	Open Manhole	1350	S9.003	0.795	400	S9.002	0.795		
								S10.000	0.795		
S14	2.900	2.170	Open Manhole	1350	S9.004	0.730	350	S9.003	0.730		
S15	1.950	1.425	Open Manhole	1200	S9.005	0.525	350	S9.004	0.575		
S17	2.400	0.950	Open Manhole	1200	S11.000	1.450	300				
S18	2.400	1.550	Open Manhole	1200	S11.001	0.850	300	S11.000	0.850		
S19	3.330	2.730	Open Manhole	1200	S11.002	0.600	300	S11.001	0.675		
S20	2.780	2.255	Open Manhole	1350	S11.003	0.525	400	S11.002	0.525		
S19	3.300	0.550	Open Manhole	1200	S12.000	2.750	225				
S20	3.300	2.325	Open Manhole	1200	S12.001	0.975	225	S12.000	2.000		
S24	2.500	1.625	Open Manhole	1200	S12.002	0.875	225	S12.001	0.875		
S21	2.500	1.980	Open Manhole	1350	S11.004	0.520	400	S11.003	0.520		
								S12.002	0.695		
S17	1.950	1.575	Open Manhole	1350	S9.006	0.375	225	S9.005	0.375		
								S11.004	0.375		
S9	1.950	1.600	Open Manhole	1350	S7.006	0.350	450	S7.005	0.350		
								S9.006	0.350		
S10	2.000	1.700	Open Manhole	1350	S7.007	0.300	450	S7.006	0.300		
S	1.600	1.350	Open Manhole	0		OUTFALL		S7.007	0.250		
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Innovyze				Network 2018.1.1					
PIPELINE SCHEDULES for Storm									
Upstream Manhole									
PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)	
S7.000	o	600	S18	2.700	1.230	0.870	Open Manhole		1500
S7.001	o	450	S19	2.535	1.130	0.955	Open Manhole		1500
S7.002	o	450	S20	2.840	1.080	1.310	Open Manhole		1350
S8.000	o	600	S21	2.400	1.250	0.550	Open Manhole		1500
S8.001	o	350	S22	2.250	1.150	0.750	Open Manhole		1500
S8.002	o	350	S23	2.250	1.050	0.850	Open Manhole		1200
S7.003	o	450	S21	2.440	0.830	1.160	Open Manhole		1350
S7.004	o	450	S22	2.925	0.660	1.815	Open Manhole		1350
S7.005	o	450	S23	2.240	0.510	1.280	Open Manhole		1350
S9.000	o	350	S10	2.660	1.820	0.490	Open Manhole		1200
S9.001	o	350	S11	2.660	1.460	0.850	Open Manhole		1200
S9.002	o	350	S12	2.660	0.935	1.375	Open Manhole		1200
S10.000	o	350	S13	2.660	1.000	1.310	Open Manhole		1200
S9.003	o	400	S13	2.900	0.795	1.705	Open Manhole		1350
S9.004	o	350	S14	2.900	0.730	1.820	Open Manhole		1350
S9.005	o	350	S15	1.950	0.525	1.075	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)	
S7.000	20.043	200.4	S19	2.535	1.130	0.805	Open Manhole		1500
S7.001	8.843	176.9	S20	2.840	1.080	1.310	Open Manhole		1350
S7.002	65.823	263.3	S21	2.440	0.830	1.160	Open Manhole		1350
S8.000	7.553	75.5	S22	2.250	1.150	0.500	Open Manhole		1500
S8.001	10.045	100.5	S23	2.250	1.050	0.850	Open Manhole		1200
S8.002	9.498	43.2	S21	2.440	0.830	1.260	Open Manhole		1350
S7.003	41.247	242.6	S22	2.925	0.660	1.815	Open Manhole		1350
S7.004	73.070	487.1	S23	2.240	0.510	1.280	Open Manhole		1350
S7.005	78.835	492.7	S9	1.950	0.350	1.150	Open Manhole		1350
S9.000	43.259	120.2	S11	2.660	1.460	0.850	Open Manhole		1200
S9.001	62.530	119.1	S12	2.660	0.935	1.375	Open Manhole		1200
S9.002	12.393	88.5	S13	2.900	0.795	1.755	Open Manhole		1350
S10.000	4.013	19.6	S13	2.900	0.795	1.755	Open Manhole		1350
S9.003	12.904	198.5	S14	2.900	0.730	1.770	Open Manhole		1350
S9.004	31.560	203.6	S15	1.950	0.575	1.025	Open Manhole		1200
S9.005	45.909	306.1	S17	1.950	0.375	1.225	Open Manhole		1350
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Innovyze				Network 2018.1.1				
PIPELINE SCHEDULES for Storm								
Upstream Manhole								
PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S11.000	o	300	S17	2.400	1.450	0.650	Open Manhole	1200
S11.001	o	300	S18	2.400	0.850	1.250	Open Manhole	1200
S11.002	o	300	S19	3.330	0.600	2.430	Open Manhole	1200
S11.003	o	400	S20	2.780	0.525	1.855	Open Manhole	1350
S12.000	o	225	S19	3.300	2.750	0.325	Open Manhole	1200
S12.001	o	225	S20	3.300	0.975	2.100	Open Manhole	1200
S12.002	o	225	S24	2.500	0.875	1.400	Open Manhole	1200
S11.004	o	400	S21	2.500	0.520	1.580	Open Manhole	1350
S9.006	o	225	S17	1.950	0.375	1.350	Open Manhole	1350
S7.006	o	450	S9	1.950	0.350	1.150	Open Manhole	1350
S7.007	o	450	S10	2.000	0.300	1.250	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)
S11.000	60.744	101.2	S18	2.400	0.850	1.250	Open Manhole	1200
S11.001	12.701	72.6	S19	3.330	0.675	2.355	Open Manhole	1200
S11.002	11.217	149.6	S20	2.780	0.525	1.955	Open Manhole	1350
S11.003	39.348	7869.6	S21	2.500	0.520	1.580	Open Manhole	1350
S12.000	71.633	95.5	S20	3.300	2.000	1.075	Open Manhole	1200
S12.001	4.209	42.1	S24	2.500	0.875	1.400	Open Manhole	1200
S12.002	7.139	39.7	S21	2.500	0.695	1.580	Open Manhole	1350
S11.004	14.057	96.9	S17	1.950	0.375	1.175	Open Manhole	1350
S9.006	5.079	203.2	S9	1.950	0.350	1.375	Open Manhole	1350
S7.006	15.307	306.1	S10	2.000	0.300	1.250	Open Manhole	1350
S7.007	7.715	154.3	S	1.600	0.250	0.900	Open Manhole	0
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Date 11/10/2019 File Network 1.MDX	Designed by D. Gallimore Checked by M. Griffin	
Innovyze Network 2018.1.1		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S19, DS/PN: S7.001, Volume (m³): 7.7

Unit Reference	MD-SHE-0082-3000-1020-3000
Design Head (m)	1.020
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	1.130
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.020	3.0
Flush-Flo™	0.305	3.0
Kick-Flo®	0.636	2.4
Mean Flow over Head Range	-	2.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.4	1.200	3.2	3.000	4.9	7.000	7.4
0.200	2.9	1.400	3.5	3.500	5.3	7.500	7.6
0.300	3.0	1.600	3.7	4.000	5.7	8.000	7.9
0.400	3.0	1.800	3.9	4.500	6.0	8.500	8.1
0.500	2.8	2.000	4.1	5.000	6.3	9.000	8.3
0.600	2.6	2.200	4.3	5.500	6.6	9.500	8.5
0.800	2.7	2.400	4.5	6.000	6.8		
1.000	3.0	2.600	4.6	6.500	7.1		

Hydro-Brake® Optimum Manhole: S22, DS/PN: S8.001, Volume (m³): 3.7

Unit Reference	MD-SHE-0070-2000-0820-2000
Design Head (m)	0.820
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	1.150
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

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<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>								
<u>Simulation Criteria</u>								
Areal Reduction Factor		1.000	Additional Flow - % of Total Flow		0.000			
Hot Start (mins)		0	MADD Factor * 10m³/ha Storage		2.000			
Hot Start Level (mm)		0	Inlet Coefficient		0.800			
Manhole Headloss Coeff (Global)		0.500	Flow per Person per Day (l/per/day)		0.000			
Foul Sewage per hectare (l/s)		0.000						
Number of Input Hydrographs		0	Number of Storage Structures		4			
Number of Online Controls		3	Number of Time/Area Diagrams		0			
Number of Offline Controls		0	Number of Real Time Controls		0			
<u>Synthetic Rainfall Details</u>								
Rainfall Model		FSR	Ratio R		0.350			
Region England and Wales Cv (Summer)		0.750						
M5-60 (mm)		19.100	Cv (Winter)		0.840			
Margin for Flood Risk Warning (mm)		300.0						
Analysis Timestep		2.5	Second Increment (Extended)					
DTS Status		ON						
DVD Status		ON						
Inertia Status		ON						
Profile(s)		Summer and Winter						
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080						
Return Period(s) (years)		2, 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.
S7.000	S18	15 Winter	100	+40%	30/15 Winter			
S7.001	S19	2160 Winter	100	+40%	100/120 Winter			
S7.002	S20	5760 Summer	30	+0%				
S8.000	S21	1440 Winter	100	+40%	100/480 Winter			
S8.001	S22	1440 Winter	100	+40%	30/360 Winter			
S8.002	S23	10080 Winter	100	+40%				
S7.003	S21	30 Summer	100	+40%				
S7.004	S22	30 Summer	100	+40%				
S7.005	S23	180 Winter	30	+0%				
S9.000	S10	15 Winter	100	+40%	100/15 Summer			
S9.001	S11	15 Winter	100	+40%	100/15 Summer			
S9.002	S12	15 Winter	100	+40%	2/15 Summer			
S10.000	S13	1440 Winter	100	+40%	100/120 Winter			
S9.003	S13	15 Winter	100	+40%	2/15 Summer			
S9.004	S14	15 Winter	100	+40%	2/15 Summer			
S9.005	S15	15 Winter	100	+40%	2/15 Summer			
S11.000	S17	15 Winter	100	+40%				
S11.001	S18	1440 Winter	100	+40%	30/120 Winter			
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<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>									
		Water	Surcharged	Flooded		Pipe			
PN	US/MH	Level	Depth	Volume	Flow /	Overflow	Flow		Level
	Name	(m)	(m)	(m³)	Cap.	(l/s)	(l/s)	Status	Exceeded
S7.000	S18	2.190	0.360	0.000	1.98		688.0	SURCHARGED	
S7.001	S19	1.948	0.368	0.000	0.02		3.0	SURCHARGED	
S7.002	S20	1.115	-0.415	0.000	0.02		3.0	OK	
S8.000	S21	1.911	0.061	0.000	0.04		14.4	SURCHARGED	
S8.001	S22	1.910	0.410	0.000	0.02		2.0	SURCHARGED	
S8.002	S23	1.071	-0.329	0.000	0.01		2.0	OK	
S7.003	S21	0.879	-0.401	0.000	0.03		5.0	OK	
S7.004	S22	0.715	-0.395	0.000	0.04		5.0	OK	
S7.005	S23	0.565	-0.395	0.000	0.04		5.0	OK	
S9.000	S10	2.635	0.465	0.000	0.19		26.9	FLOOD RISK	
S9.001	S11	2.614	0.804	0.000	0.84		120.7	FLOOD RISK	
S9.002	S12	2.275	0.990	0.000	1.33		169.6	SURCHARGED	
S10.000	S13	1.669	0.319	0.000	0.04		6.3	SURCHARGED	
S9.003	S13	2.034	0.839	0.000	0.46		57.6	SURCHARGED	
S9.004	S14	2.062	0.982	0.000	0.84		87.6	SURCHARGED	
S9.005	S15	1.944	1.069	0.000	1.60		140.5	FLOOD RISK	
S11.000	S17	1.738	-0.012	0.000	0.56		58.4	OK	
S11.001	S18	1.671	0.521	0.000	0.07		7.2	SURCHARGED	
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Innovyze				Network 2018.1.1					
Summary of Critical Results by Maximum Level (Rank 1) for Storm									
Water									
US/MH	Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level		
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
S11.002	S19	1440 Winter	100	+40%	2/120 Winter				1.671
S11.003	S20	1440 Winter	100	+40%	2/180 Winter				1.670
S12.000	S19	15 Winter	100	+40%					2.914
S12.001	S20	15 Winter	100	+40%	30/15 Summer				2.062
S12.002	S24	15 Winter	100	+40%	2/15 Winter				1.908
S11.004	S21	1440 Winter	100	+40%	2/15 Summer				1.669
S9.006	S17	1440 Winter	100	+40%	2/15 Summer				1.669
S7.006	S9	8640 Summer	100	+40%					0.422
S7.007	S10	8640 Summer	100	+40%					0.365
Surcharged Flooded									
US/MH	Depth	Volume	Flow /	Overflow	Pipe				
PN	Name	(m)	(m³)	Cap.	(l/s)	Flow	Status	Level	
								Exceeded	
S11.002	S19	0.771	0.000	0.14		9.7	SURCHARGED		
S11.003	S20	0.745	0.000	0.08		4.8	SURCHARGED		
S12.000	S19	-0.061	0.000	0.86		44.2	OK		
S12.001	S20	0.862	0.000	1.35		60.0	SURCHARGED		
S12.002	S24	0.808	0.000	1.66		99.0	SURCHARGED		
S11.004	S21	0.749	0.000	0.06		9.8	SURCHARGED		
S9.006	S17	1.069	0.000	0.15		4.0	FLOOD RISK		
S7.006	S9	-0.378	0.000	0.06		8.7	OK		
S7.007	S10	-0.385	0.000	0.05		8.7	OK		
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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)	100	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.053	4-8	0.541	8-12	0.459	12-16	0.039

Total Area Contributing (ha) = 1.092

Total Pipe Volume (m³) = 1554.235

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Manhole Schedules for Storm										
MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)
S1	3.090	1.005	Open Manhole	1200	S1.000	2.085	300			
S2	2.880	1.170	Open Manhole	1200	S1.001	1.710	300	S1.000	1.710	
S9	2.650	1.055	Open Manhole	1200	S2.000	1.595	225			
S3	2.400	1.320	Open Manhole	1500	S1.002	1.080	600	S1.001	1.380	
								S2.000	1.455	
S5	2.640	1.220	Open Manhole	1200	S3.000	1.420	300			
S4	2.880	2.035	Open Manhole	1500	S1.003	0.845	600	S1.002	0.845	
								S3.000	1.130	
S5	2.860	2.190	Open Manhole	1500	S1.004	0.670	600	S1.003	0.670	
S6	2.500	1.850	Open Manhole	3000	S1.005	0.650	-1	S1.004	0.650	
S9	2.000	1.360	Open Manhole	3000	S1.006	0.640	225	S1.005	0.640	
S7	2.000	1.505	Open Manhole	1200	S1.007	0.495	225	S1.006	0.495	
S8	2.000	1.555	Open Manhole	1200	S1.008	0.445	225	S1.007	0.445	
S	2.000	1.610	Open Manhole	0		OUTFALL		S1.008	0.390	
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PIPELINE SCHEDULES for Storm								
Upstream Manhole								
PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	300	S1	3.090	2.085	0.705	Open Manhole	1200
S1.001	o	300	S2	2.880	1.710	0.870	Open Manhole	1200
S2.000	o	225	S9	2.650	1.595	0.830	Open Manhole	1200
S1.002	o	600	S3	2.400	1.080	0.720	Open Manhole	1500
S3.000	o	300	S5	2.640	1.420	0.920	Open Manhole	1200
S1.003	o	600	S4	2.880	0.845	1.435	Open Manhole	1500
S1.004	o	600	S5	2.860	0.670	1.590	Open Manhole	1500
S1.005	[]	-1	S6	2.500	0.650	0.850	Open Manhole	3000
S1.006	o	225	S9	2.000	0.640	1.135	Open Manhole	3000
S1.007	o	225	S7	2.000	0.495	1.280	Open Manhole	1200
S1.008	o	225	S8	2.000	0.445	1.330	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)
S1.000	74.508	198.7	S2	2.880	1.710	0.870	Open Manhole	1200
S1.001	65.940	199.8	S3	2.400	1.380	0.720	Open Manhole	1500
S2.000	34.268	244.8	S3	2.400	1.455	0.720	Open Manhole	1500
S1.002	89.634	381.4	S4	2.880	0.845	1.435	Open Manhole	1500
S3.000	28.683	98.9	S4	2.880	1.130	1.450	Open Manhole	1500
S1.003	57.120	326.4	S5	2.860	0.670	1.590	Open Manhole	1500
S1.004	1.376	68.8	S6	2.500	0.650	1.250	Open Manhole	3000
S1.005	99.829	9982.9	S9	2.000	0.640	0.360	Open Manhole	3000
S1.006	25.506	175.9	S7	2.000	0.495	1.280	Open Manhole	1200
S1.007	8.286	165.7	S8	2.000	0.445	1.330	Open Manhole	1200
S1.008	6.318	114.9	S	2.000	0.390	1.385	Open Manhole	0
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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.170	0.170	0.170
1.001	User	-	100	0.102	0.102	0.102
2.000	User	-	100	0.095	0.095	0.095
1.002	User	-	100	0.167	0.167	0.167
3.000	User	-	100	0.145	0.145	0.145
1.003	User	-	100	0.131	0.131	0.131
1.004	-	-	100	0.000	0.000	0.000
1.005	User	-	100	0.219	0.219	0.219
1.006	User	-	100	0.063	0.063	0.063
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.092	1.092	1.092

Simulation Criteria for Storm

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.350		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S9, DS/PN: S1.006, Volume (m³): 1462.1

Unit Reference	MD-SHE-0069-3200-2450-3200
Design Head (m)	2.450
Design Flow (l/s)	3.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	69
Invert Level (m)	0.640
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.450	3.2
Flush-Flo™	0.300	2.1
Kick-Flo®	0.618	1.7
Mean Flow over Head Range	-	2.4

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	1.8	1.200	2.3	3.000	3.5	7.000	5.2
0.200	2.1	1.400	2.5	3.500	3.8	7.500	5.4
0.300	2.1	1.600	2.6	4.000	4.0	8.000	5.6
0.400	2.1	1.800	2.8	4.500	4.2	8.500	5.7
0.500	2.0	2.000	2.9	5.000	4.5	9.000	5.9
0.600	1.8	2.200	3.0	5.500	4.7	9.500	6.0
0.800	1.9	2.400	3.2	6.000	4.8		
1.000	2.1	2.600	3.3	6.500	5.0		

Manhole Headloss for Storm

PN	US/MH Name	US/MH Headloss
S1.000	S1	0.500
S1.001	S2	0.500
S2.000	S9	0.500
S1.002	S3	0.500
S3.000	S5	0.500
S1.003	S4	0.500
S1.004	S5	0.500
S1.005	S6	0.500
S1.006	S9	0.500
S1.007	S7	0.500

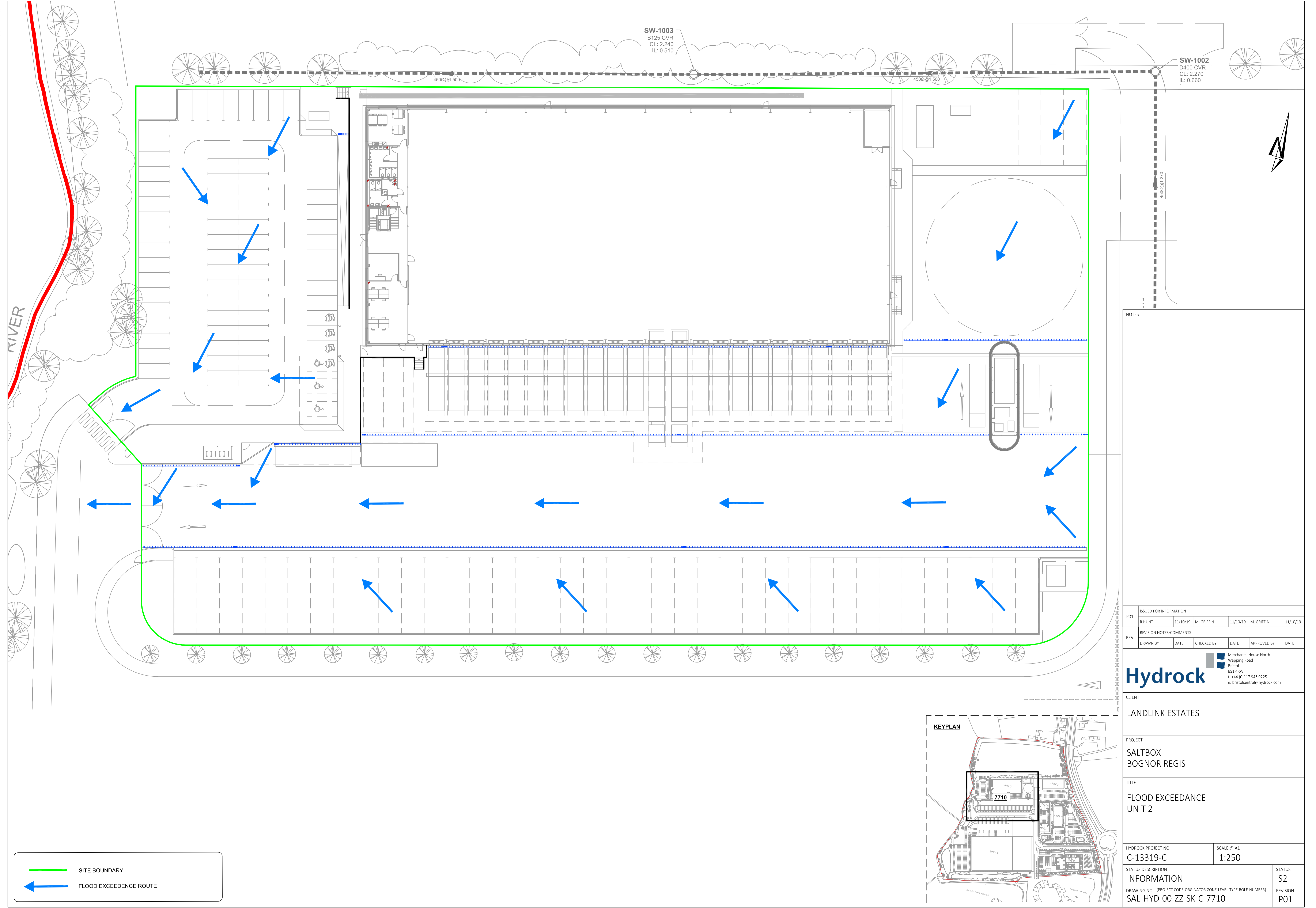
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Innovyze	Network 2018.1.1										
<u>Manhole Headloss for Storm</u> <table> <thead> <tr> <th>PN</th><th>US/MH</th><th>US/MH</th></tr> <tr> <th></th><th>Name</th><th>Headloss</th></tr> </thead> <tbody> <tr> <td>S1.008</td><td>S8</td><td>0.500</td></tr> </tbody> </table>			PN	US/MH	US/MH		Name	Headloss	S1.008	S8	0.500
PN	US/MH	US/MH									
	Name	Headloss									
S1.008	S8	0.500									
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. . .				SALTBOX BOGNOR REGIS				Micro Drainage																																																																																																															
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Simulation Criteria Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000 Hot Start Level (mm) 0 Inlet Coefficient 0.800 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000 Foul Sewage per hectare (l/s) 0.000																																																																																																																							
Number of Input Hydrographs 0 Number of Storage Structures 0 Number of Online Controls 1 Number of Time/Area Diagrams 0 Number of Offline Controls 0 Number of Real Time Controls 0																																																																																																																							
Synthetic Rainfall Details Rainfall Model FSR Ratio R 0.350 Region England and Wales Cv (Summer) 0.750 M5-60 (mm) 19.000 Cv (Winter) 0.840																																																																																																																							
Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep 2.5 Second Increment (Extended) DTS Status ON DVD Status OFF 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, 30, 100 Climate Change (%) 0, 0, 40																																																																																																																							
<table><tr><th>PN</th><th>US/MH Name</th><th>Storm</th><th>Return Period</th><th>Climate Change</th><th>First (X) Surchage</th><th>First (Y) Flood</th><th>First (Z) Overflow</th><th>Overflow Act.</th></tr><tr><td>S1.000</td><td>S1</td><td>15 Winter</td><td>100</td><td>+40%</td><td>100/15 Summer</td><td></td><td></td><td></td></tr><tr><td>S1.001</td><td>S2</td><td>15 Winter</td><td>100</td><td>+40%</td><td>100/15 Summer</td><td></td><td></td><td></td></tr><tr><td>S2.000</td><td>S9</td><td>15 Winter</td><td>100</td><td>+40%</td><td>100/15 Summer</td><td></td><td></td><td></td></tr><tr><td>S1.002</td><td>S3</td><td>2880 Winter</td><td>100</td><td>+40%</td><td></td><td></td><td></td><td></td></tr><tr><td>S3.000</td><td>S5</td><td>15 Winter</td><td>100</td><td>+40%</td><td></td><td></td><td></td><td></td></tr><tr><td>S1.003</td><td>S4</td><td>2880 Winter</td><td>100</td><td>+40%</td><td>100/1440 Winter</td><td></td><td></td><td></td></tr><tr><td>S1.004</td><td>S5</td><td>2880 Winter</td><td>100</td><td>+40%</td><td>100/360 Winter</td><td></td><td></td><td></td></tr><tr><td>S1.005</td><td>S6</td><td>2880 Winter</td><td>100</td><td>+40%</td><td></td><td></td><td></td><td></td></tr><tr><td>S1.006</td><td>S9</td><td>2880 Winter</td><td>100</td><td>+40%</td><td>2/180 Winter</td><td></td><td></td><td></td></tr><tr><td>S1.007</td><td>S7</td><td>2880 Winter</td><td>100</td><td>+40%</td><td>2/15 Summer</td><td></td><td></td><td></td></tr><tr><td>S1.008</td><td>S8</td><td>2880 Winter</td><td>100</td><td>+40%</td><td>2/15 Summer</td><td></td><td></td><td></td></tr></table>												PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	S1.000	S1	15 Winter	100	+40%	100/15 Summer				S1.001	S2	15 Winter	100	+40%	100/15 Summer				S2.000	S9	15 Winter	100	+40%	100/15 Summer				S1.002	S3	2880 Winter	100	+40%					S3.000	S5	15 Winter	100	+40%					S1.003	S4	2880 Winter	100	+40%	100/1440 Winter				S1.004	S5	2880 Winter	100	+40%	100/360 Winter				S1.005	S6	2880 Winter	100	+40%					S1.006	S9	2880 Winter	100	+40%	2/180 Winter				S1.007	S7	2880 Winter	100	+40%	2/15 Summer				S1.008	S8	2880 Winter	100	+40%	2/15 Summer			
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.																																																																																																															
S1.000	S1	15 Winter	100	+40%	100/15 Summer																																																																																																																		
S1.001	S2	15 Winter	100	+40%	100/15 Summer																																																																																																																		
S2.000	S9	15 Winter	100	+40%	100/15 Summer																																																																																																																		
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S1.003	S4	2880 Winter	100	+40%	100/1440 Winter																																																																																																																		
S1.004	S5	2880 Winter	100	+40%	100/360 Winter																																																																																																																		
S1.005	S6	2880 Winter	100	+40%																																																																																																																			
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S1.007	S7	2880 Winter	100	+40%	2/15 Summer																																																																																																																		
S1.008	S8	2880 Winter	100	+40%	2/15 Summer																																																																																																																		
<table><tr><th rowspan="2">PN</th><th rowspan="2">US/MH Name</th><th colspan="3">Water Surcharged Flooded</th><th colspan="2">Pipe</th><th rowspan="2">Status</th><th rowspan="2">Level Exceeded</th></tr><tr><th>Level (m)</th><th>Depth (m)</th><th>Volume (m³)</th><th>Flow / Overflow Cap.</th><th>Flow (l/s)</th></tr><tr><td>S1.000</td><td>S1</td><td>2.950</td><td>0.565</td><td>0.000</td><td>1.03</td><td>78.0</td><td>FLOOD RISK</td><td></td></tr></table>												PN	US/MH Name	Water Surcharged Flooded			Pipe		Status	Level Exceeded	Level (m)	Depth (m)	Volume (m³)	Flow / Overflow Cap.	Flow (l/s)	S1.000	S1	2.950	0.565	0.000	1.03	78.0	FLOOD RISK																																																																																						
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<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>								
		Water	Surcharged	Flooded		Pipe		
PN	US/MH	Level	Depth	Volume	Flow /	Overflow	Flow	Level
	Name	(m)	(m)	(m³)	Cap.	(l/s)	(l/s)	Exceeded
S1.001	S2	2.545	0.535	0.000	1.53		114.7	SURCHARGED
S2.000	S9	2.059	0.239	0.000	1.64		51.0	SURCHARGED
S1.002	S3	1.590	-0.090	0.000	0.03		9.3	OK
S3.000	S5	1.626	-0.094	0.000	0.79		80.0	OK
S1.003	S4	1.590	0.145	0.000	0.04		13.6	SURCHARGED
S1.004	S5	1.590	0.320	0.000	0.07		17.3	SURCHARGED
S1.005	S6	1.590	-0.060	0.000	0.00		19.2	OK
S1.006	S9	1.590	0.725	0.000	0.06		2.1	SURCHARGED
S1.007	S7	1.590	0.870	0.000	0.91		28.8	SURCHARGED
S1.008	S8	1.591	0.921	0.000	1.48		49.0	SURCHARGED
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Appendix C



PLAN DISTRICT COUNCIL REGISTRATION

RIVER

SW-1003
B125 CVR
CL: 2.240
IL: 0.510

SW-1002
D400 CVR
CL: 2.270
IL: 0.660

4500@1:500

4500@1:500

4500@1:270

SITE BOUNDARY

FLOOD EXCEEDANCE ROUTE

NOTES

ISSUED FOR INFORMATION					
P01	R.HUNT	11/10/19	M. GRIFFIN	11/10/19	M. GRIFFIN
REVISION NOTES/COMMENTS					
REV	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY

Hydrock

Merchants' House North

Wapping Road

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BS1 4RW

t: +44 (0)117 945 9225

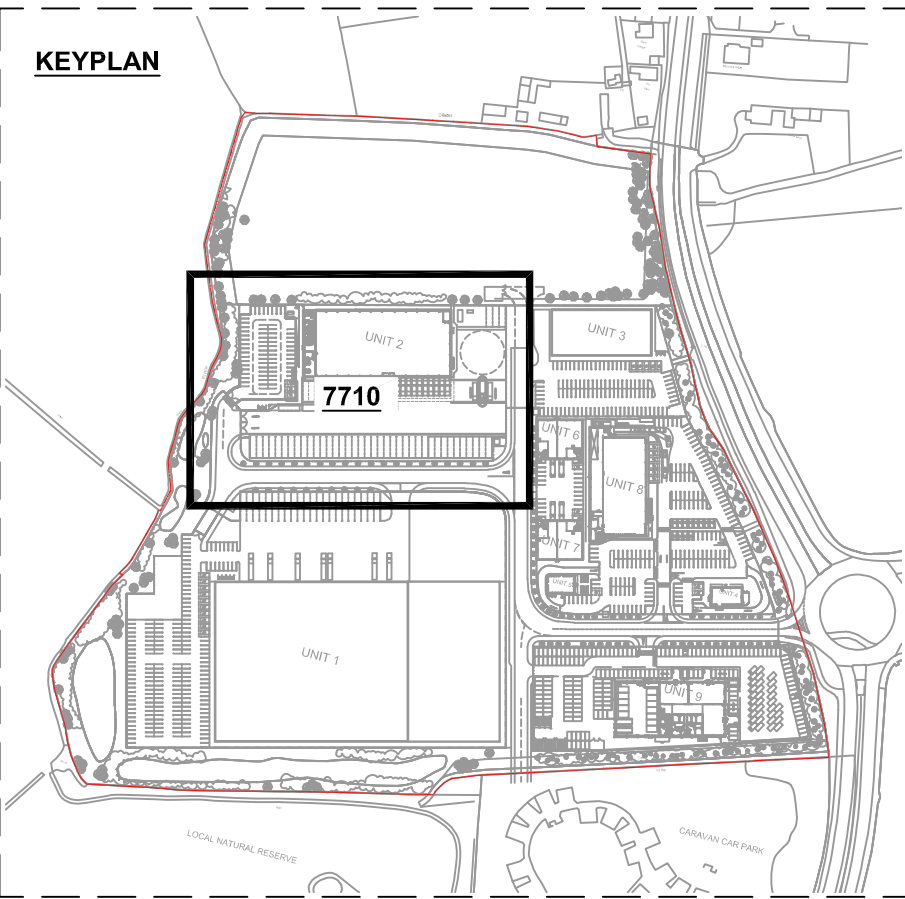
e: bristolcentral@hydrock.com

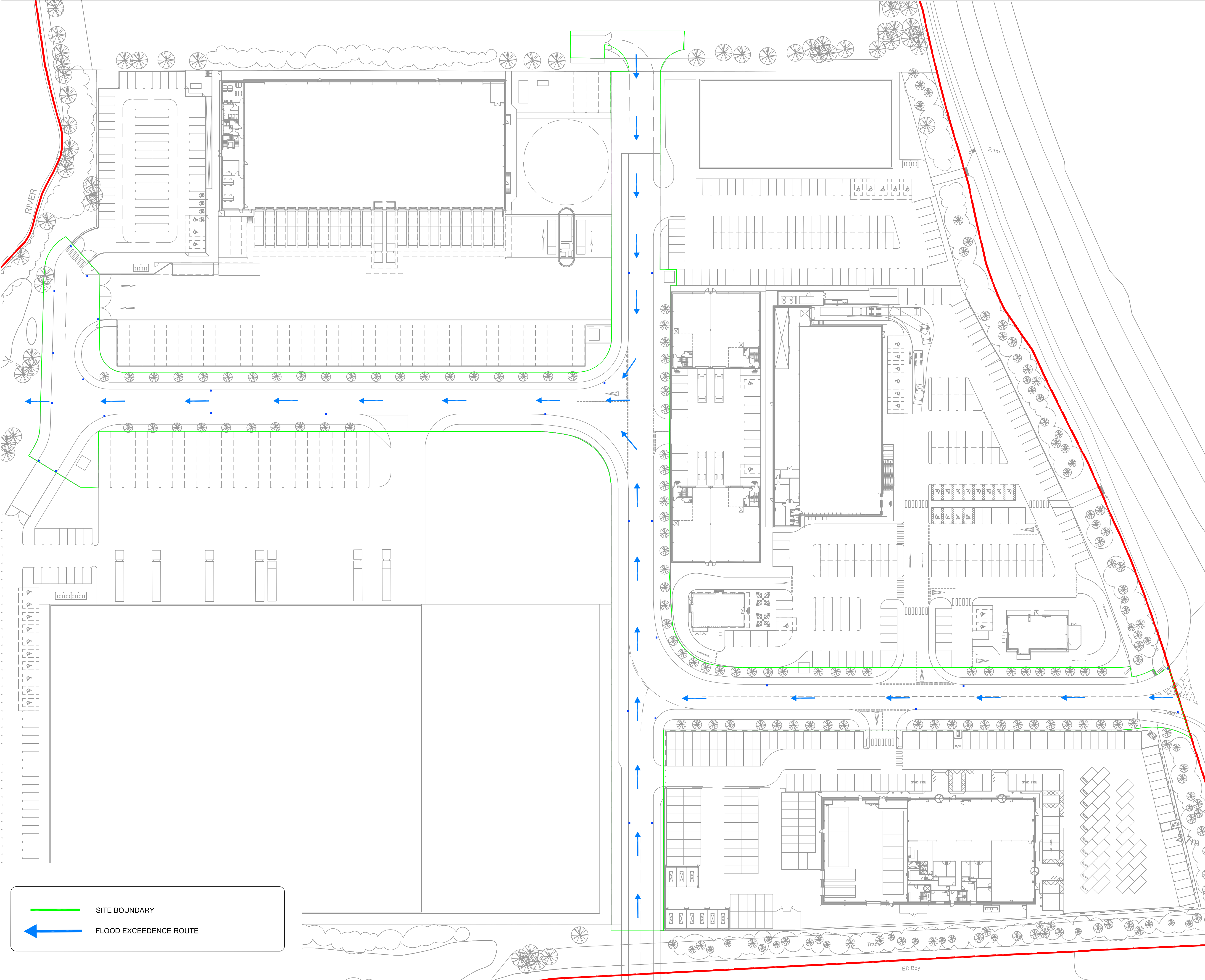
CLIENT
LANDLINK ESTATES

PROJECT
SALTBOX
BOGNOR REGIS

TITLE
FLOOD EXCEEDANCE
UNIT 2

HYDROCK PROJECT NO. C-13319-C		SCALE @ A1 1:250	
STATUS DESCRIPTION INFORMATION			STATUS S2
DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER) SAL-HYD-00-ZZ-SK-C-7710			REVISION P01





NOTES

ISSUED FOR INFORMATION					
PO1	R.HUNT	11/10/19	M. GRIFFIN	11/10/19	M. GRIFFIN
REVISION NOTES/COMMENTS					
REV	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY



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CLIENT

LANDLINK ESTATES

PROJECT

SALTBOX
BOGNOR REGIS

TITLE

FLOOD EXCEEDANCE
ACCESS ROAD

HYDROCK PROJECT NO.	SCALE @ A1	
C-13319-C	1:500	
STATUS DESCRIPTION		STATUS
INFORMATION		S2
DRAWING NO. (PROJECT CODE-ORIGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)		REVISION
SAL-HYD-00-ZZ-SK-C-7720		P01