Drainage Statement Addendum

Site: Former Prince of Wales, Solihull

Reference: CS230702-RP01

INTRODUCTION

CTS Design have been appointed by MACC Group Limited to support a planning application to redevelop a former public house, Prince of Wales, High Street, Solihull. (B90 1JW).

The application site has previously been supported by HSP Consulting for GNM Developments, who have designed and submitted a drainage strategy and Flood Risk Assessment.

The site location borders two local authorities and is being assed for compliance by both authorities, these being, Solihull Metropolitan Borough Council and Bromsgrove District Council.

Following development interest by MACC Group Limited, the application details are being reassessed and resubmitted to address previous LLFA commentary and conditions on the planning approvals.

The following note discusses the submitted drainage information to support discharge of conditions.

DRAINAGE CONDITIONS AND PREVIOUS LLFA COMMENTS

LLFA Comments received to data on previously submitted information:

SMBC Application PL/2022/01784/PPFL

Condition #16 - *No above-ground work shall commence until such a time as a scheme to manage the surface water runoff from the development has been submitted to and approved in writing by the Lead Local Flood Authority in conjunction with the Local Planning Authority*

The LLFA have responded to the previous application on 20.09.2022, 21.11.2022, 23.12.2022 and again on 16.01.2023. The latter being to grant approval with a condition to submit a drainage design.

Previously dated comments request consideration for:

- Exceedance overland flow routes to ensure the property is not at risk to flooding.
- Use of SuDS features within the rear gardens
- Rainwater harvesting systems
- Green Roofs to the building.
- Commitment to a SuDS drainage strategy and treatment train serving the whole site.

Bromsgrove DC Application 22/01146/FUL

Condition #3 - *No works in connection with site drainage shall commence until a scheme for a surface water drainage strategy for the proposed development has been submitted to, and approved in writing by the Local Planning Authority*

Condition #4 - *The permeable paving areas shall be maintained to facilitate the optimal functionality and performance of the surface water drainage scheme.*

DETAILS OF RESUBMITTED INFORMATION TO DISCHARGE CONDITIONS

It should be noted that the previously submitted HSP Consulting drainage strategy D1180-HSP-ZZ-XX-DRC-1002 revision P06, dated 10.01.2023, shows both a foul package pumping station and a surface water package pumping station. Pumping stations are not considered to be very sustainable and are required to include additional storage resilience in the event of a pump failure. It should be noted that the submitted CTS Design drainage strategy achieves a gravity outfall to both foul and storm sewers without the need for any pumping.

External levels and flood exceedance routes:

The building is set a minimum of 150mm above the surrounding external levels. The open car parking area is designed to direct surface water away from the building and towards a low point to the east of the site. The west and southern portions of the site are set much lower than the building floor level due to constraints of existing boundary levels and root protection areas of existing trees, thus the building includes a retaining feature along the building envelope, with the external areas sited below the building.

The drainage network and attenuation is designed to ensure that no flooding occurs within the design criteria, of a return period of 1 in 100 years, plus 40% climate change allowance.

Refer to Appendix A for topographical survey information.
Refer to Appendix B for external levels and exceedance flood routing.

Discharge Rates:

The site area has been reassessed to analyse catchment areas for the use of Q-Bar calculations. The southern area of the site will be subject to hard and soft landscaping, though not positively drained. Only the northern area of the site will form part of the proposed catchment, thus the site area used for Q-Bar calculations is limited to the redevelopment portion of the site.

Site area Q-Bar is calculated against = 0.33 ha
Max discharge rate Q-Bar Value is thus calculated at 1.71 l/s
Though a value of 2.0l/s is used to ensure a minimum aperture size does not increase the risk of blockages and thus make the drainage system less sustainable.

Refer to Appendix C for Q-Bar calculations.

Infiltration / Soakaways:

The previous HSP Consulting Drainage Report included infiltration results which conclude that this site is not suitable for soakaways.

Sustainable Drainage Techniques:

The previous LLFA comments to HSP Consulting discussed at length the inclusion of SuDS features to achieve water quality improvements within the design of the on site drainage system.

This resubmitted information follows that philosophy and adds additional context and constraint information to conclude those discussions.

SuDS Hierarchy

Discharge to ground, infiltration	Not viable at this site
Discharge to a Watercourse	No suitable feature available. 3rd party land issues
Discharge to surface water sewer	SW Sewer available north of the site
Discharge to combined sewer	not applicable

Use of SuDS Features

Rainwater Harvesting	A dedicated below ground rainwater harvesting tank is not proposed for this development. The large open space will be fed from general rainfall with low maintenance and low water demand vegetation. Some communal areas benefit from localised planters, and these areas are provided with **water butts**, for residents to enjoy garden activities.
Open Attenuation Features	It is not appropriate for this size of development to include a large open surface water attenuation feature which detracts from developable area which ultimately reduces the viability of such a scheme.
Open Swales and Rain Gardens, or similar bio-retention features	Due to external level constraints having to tie in with existing tree root protection areas and boundary levels, the only land where such features would be included, are below a ground level for such features to become viable. Therefore due to these site constraints, no rain gardens or swales are included on this site.

Filter trenches and permeable surfaces	The open parking area is designed such that all parking surfacing is drained across onto the permeable surface to drain through the sub base filter media. Where possible, roof areas are routed through perforated pipes within the permeable paving sub base medium, such that flows can pass into the sub base and back to the perforated pipes, passing rainwater through the gravel filter media enhancing water quality. There are however portions of the building roof which are unable to achieve a connection to the filter trenches and drain directly to the below ground attenuation tank. These situations are limited as far as reasonably practical and are due to pipe lengths and drainage depths.
Attenuation and Flow Restriction	A below ground attenuation tank is proposed within the external parking area to restrict all rainwater flows to meet greenfield discharge equivalent rates. The tank is sized to accommodate all flows upto and including a rainfall event of 100 years, plus an addition 40% allowance for climate change.
Green Roofs, (extensive or intensive)	The roof type has been carefully planning by the architects and planning authority to compliment the surrounding architecture. The roof type is of a pitch version, which is not suitable for large flat green roof areas.

Existing Site Discharge

The existing site drains to the east, through third party land, initial investigations show this existing sewer to be heavily silted and damaged with root ingress.
The existing sewer appears to discharge to the east then north, connecting to the existing public sewer network within the existing highway.
Repair works to this sewer would be extensive and cost prohibitive when compared to the cost of a new sewer connection at the site entrance.

Simple Index Approach

For a development of this size, it is appropriate to assess the site using the "Simple Index Approach" which, referring to the CIRIA SuDS Guide, outlines the pollution factors of a development, and then gives a selection of mitigation measures to achieve water quality enhancements prior to discharge from the site.

The pollution generated by the development is listed in the below table:

Pollution hazard	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Very Low (roofs)	0.2	0.2	0.05
Low (drives & low traffic roads)	0.5	0.4	0.4

Referenced from Table 26.2 of the CIRIA SuDS Manual

Mitigation provided by SuDS features are listed in the table below

SuDS Componend	Mitigation Benefits of SuDS		
	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7

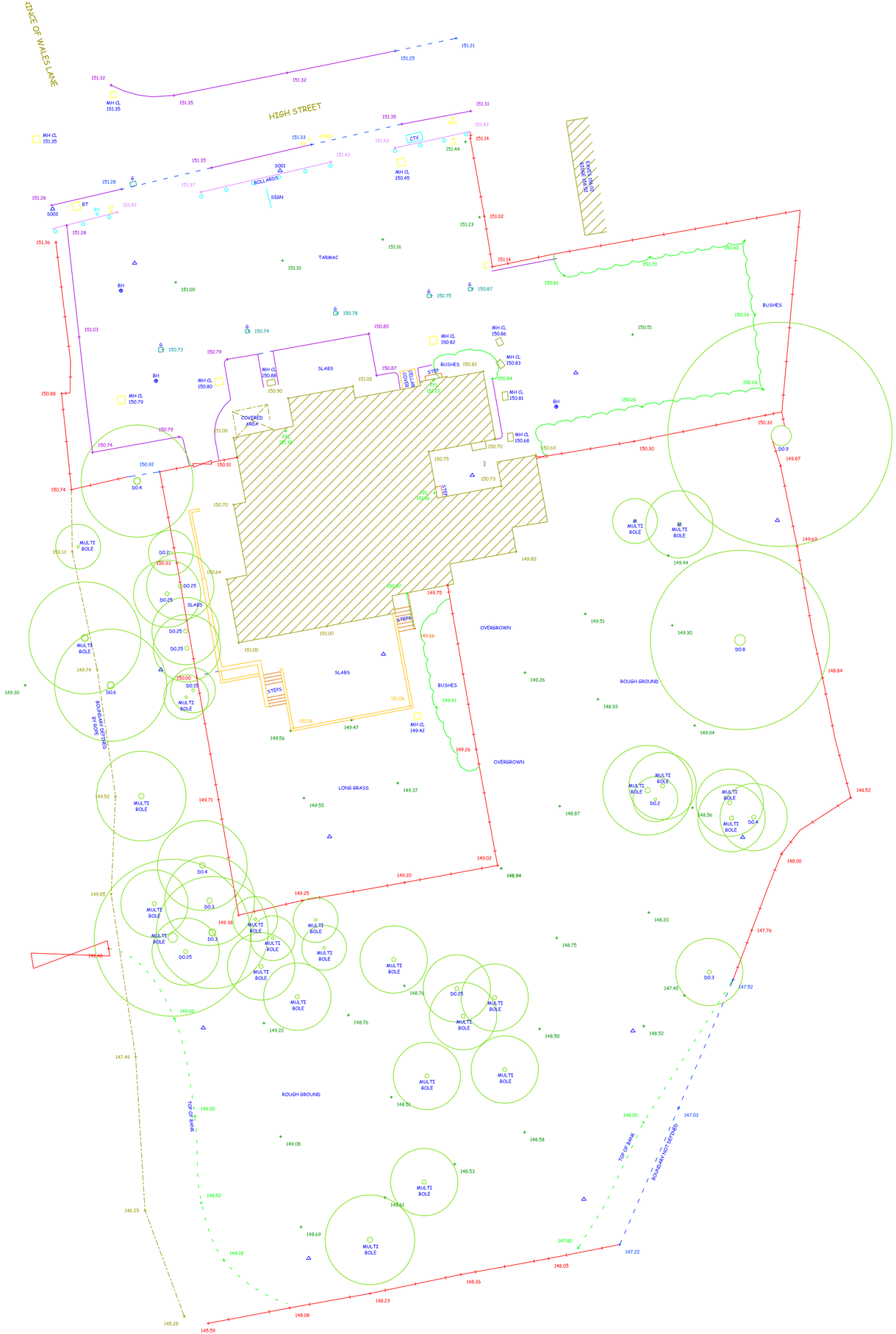
Referenced from Table 26.3 and 26.4 of the CIRIA SuDS Manual

By providing permeable paving to the private parking areas, those areas benefiting from the permeable paving sub strata filtration, both all external parking and half the building roof area, will be fully mitigated.

By comparing the pollution hazard value against the higher mitigation value it is evident that by providing the SuDS features listed, that pollution hazards are mitigated against and that the water quality leaving the site complies with the water quality requirements of the SuDS Standards.

Appendix A:

Topographical Survey



Station	Easting	Northing	Level
S001	409047.584	278532.131	151.522
S002	409027.293	278528.722	151.393

NOTES

CO-ORDINATES AND LEVELS RELATE TO ORDNANCE SURVEY DATUM OBTAINED USING GPS EQUIPMENT

PROJECT

PRINCE OF WALES P.H. SOLIHULL LODGE.

CLIENT

GNM DEVELOPMENTS LTD

DRAWING

LAND SURVEY

OAKLEY
BUILDING SURVEYORS
23 NEWROAD, WATER ORTON, BIRMINGHAM. B46 1QP.
Tel. 07973 525677

SCALE	DRG No	REV
1:200 (A1)	5207-01	
DATE		
MAR 22		

Appendix B:

Proposed Levels and Flood Exceedance Routes

1:250 0 4 6 8 10 12 14 16 18

Scale Bar:

N

MAYPOLE LANE

234 236

El Sub Sta

FFL 151.50

Construction over RPA to use Cellweb or similar

Construction over RPA to use Cellweb or similar

Construction over RPA to use Cellweb or similar

KEY

+150.10	Existing Survey Levels
+150.35	Proposed Level
FFL 150.50	Proposed Finished Floor Level
EXP EXP	Exposed Brickwork
	Retaining Wall

Overland Exceedance Flood Routing

Building levels are designed to be 150mm above external ground levels, except where level thresholds are required for accessibility, in these cases the ground is sloped away from the entrance to ensure no flooding enters the building.

Flood routing arrows are indicated to show where overland flooding will be directed. The drainage system is designed to accommodate all rainfall up to and including a 100 year return period with an additional 40% allowance for climate change. Flooding will only occur if a rainfall event above these parameters, or critical failure of the network should occur

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PROJECT
Redevelopment of former Prince of Wales, Shirley

PHASE
PLANNING

DRAWN BY	DATE
DMcC	08.08.2023
CHECKED BY	DATE

SCALE
1:250 @ A1

DRAWING
External Levels

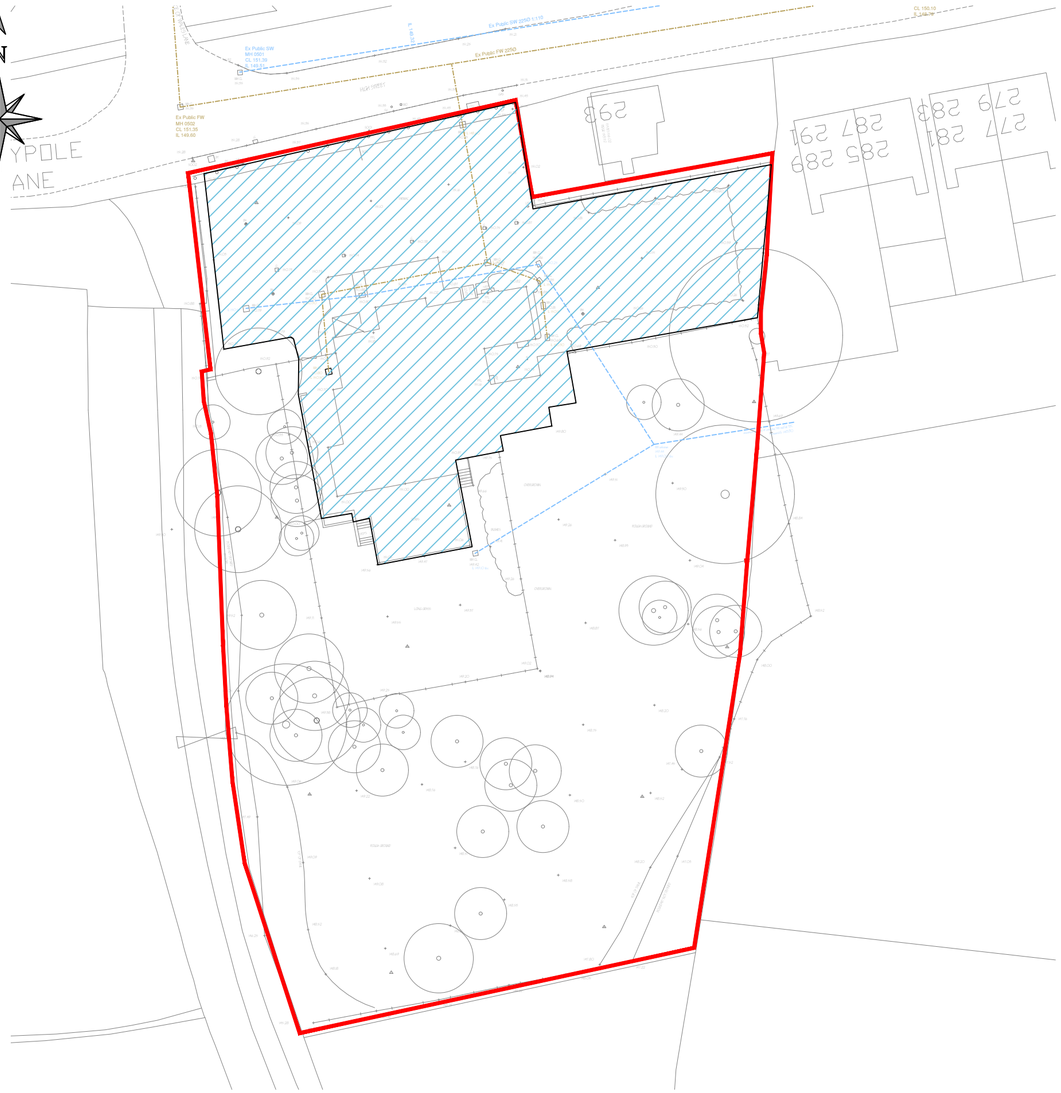
DWG No	REV
CS230702 - 101	

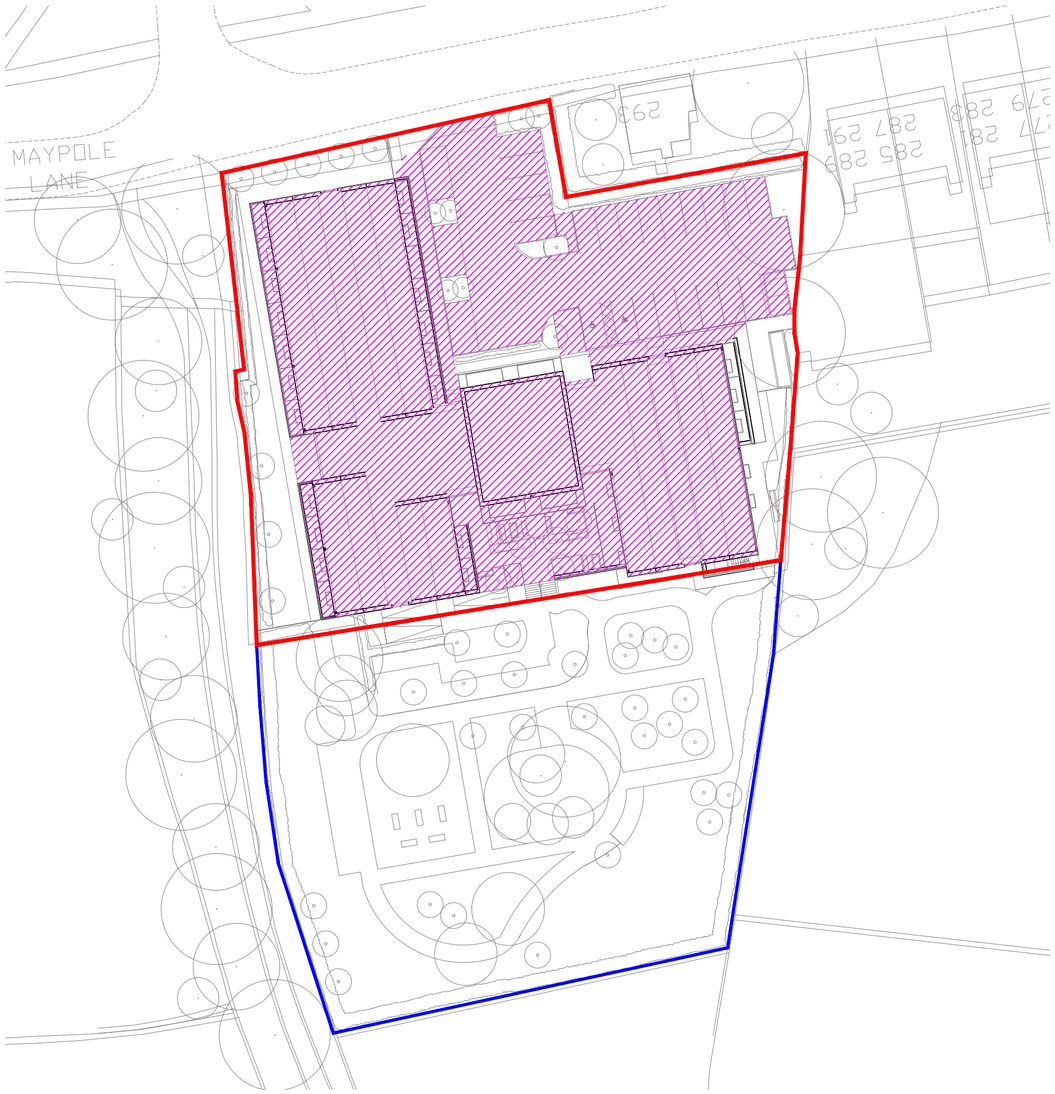
Appendix C:

Q-Bar Calculations

1:500 10 20 30

Scale Bar:





Total Site Development Area 0.577 hectares

Total existing impermeable Area Draining 1870m2
Using the Modified Rational Method, existing SW discharge is calculated at 0.187 x 2.78 x 50 = 26 l/s unrestricted discharge.

By redeveloping the site, local plan policy requires the site to be returned to the equivalent of a green field discharge rate.
Q-Bar Rate is calculated by using the HR Wallingford - UK SuDS toolset.

The southern portion of the site is hard and soft landscaping and is not positively drained, thus this area remains draining as per the existing condition.
Q-Bar calaulation area is thus restricted to the portion of the site redeveloped.

Site area Q-Bar is calculated against = 0.33 ha
Max discharge rate **Q-Bar Value** is thus calculated at 1.71 l/s
Though a value of **2.0l/s** is used to ensure a minimum aperture size does not increase the risk of blockages and thus make the drainage system less sustainable.

REV	DESCRIPTION	BY	DATE

DRAWING: Existing Drainage & Q-Bar Calculation
REV:
DWG No: CS230702-110

DRAWN BY: DMcC
DATE: 08.08.2023
CHECKED BY:
DATE:
SCALE: 1:500 @ A2

PROJECT: Redevelopment of former Prince of Wales, Shirley
PHASE: PLANNING

CLIENT: MACC Group

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Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Daniel McCrudden
Site name:	Prince of Wales
Site location:	Shirley

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	52.40443° N
Longitude:	1.86841° W
Reference:	1022111919
Date:	Aug 08 2023 16:07

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	0.33

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	745	745
Hydrological region:	4	4
Growth curve factor 1 year:	0.83	0.83
Growth curve factor 30 years:	2	2
Growth curve factor 100 years:	2.57	2.57
Growth curve factor 200 years:	3.04	3.04

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	1.71	1.71
1 in 1 year (l/s):	1.42	1.42
1 in 30 years (l/s):	3.43	3.43
1 in 100 year (l/s):	4.4	4.4
1 in 200 years (l/s):	5.21	5.21

Appendix D:

Drainage Strategy

KEY

	Existing Foul Sewer
	Existing Storm Sewer
	Private Sewers Abandoned
	Private Foul Drains
	Private Storm Drains
DC	Drainage Channel
RG	Gully
RE	Storm Rodding Eye
	Porous Paving
	Porous Paving Filter Pipe
	Attenuation Tank
WB	Water Butt

Drainage Strategy
Sustainable Drainage:

The principals of providing sustainable drainage is to manage water quantity, which is achieved through the use of a below ground attenuation basin, and secondly to improve water quality prior to the point water leaves the site.

Due to site constraints, some SuDS features are unviable to be implimented on this development, refer to SuDS Statement for an assessment of each type.

The primary SuDS feature used on this development is permeable paving, with adjacent roof areas draining through the substrata filter pipe, which allows the first 5mm of rainfall to pass through and into the paving sub base, which provides water quality improvements.
The parking area levels are designed to shed water from the impervious aisle onto the permeable parking bays, providing maximum benefit to water quality for all vehicular areas.

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PROJECT
Redevelopment of former Prince of Wales, Shirley

PHASE
PLANNING

DRAWN BY	DATE
DMcC	08.08.2023
CHECKED BY	DATE

SCALE
1:250 @ A1

DRAWING
Drainage Strategy

DWG No	REV
CS230702 - 102	

Appendix E:

Drainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	22.000	0.250	88.0	0.024	2.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	20.500	0.200	102.5	0.022	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	19.400	0.200	97.0	0.003	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	19.400	0.500	38.8	0.005	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	4.000	0.150	26.7	0.007	2.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	5.000	0.100	50.0	0.005	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.002	5.000	0.950	5.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	5.000	0.150	33.3	0.019	2.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	5.000	0.100	50.0	0.006	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.002	5.000	0.900	5.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	15.000	0.200	75.0	0.038	2.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	8.000	0.400	20.0	0.006	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.002	12.000	0.200	60.0	0.013	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.003	11.000	0.400	27.5	0.012	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.000	221.000	0.200	1105.0	0.018	2.00	0.0	0.600	o	150	Pipe/Conduit	
6.000	5.000	0.100	50.0	0.028	2.00	0.0	0.600	o	150	Pipe/Conduit	
7.000	6.000	0.150	40.0	0.011	2.00	0.0	0.600	o	150	Pipe/Conduit	
7.001	19.000	0.600	31.7	0.014	0.00	0.0	0.600	o	150	Pipe/Conduit	
7.002	3.000	0.100	30.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.001	20.000	0.300	66.7	0.003	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	5.000	0.050	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	5.00	2.34	150.750	0.024	0.0	0.0	0.0	1.07	18.9	0.3
1.001	5.00	2.69	150.500	0.046	0.0	0.0	0.0	0.99	17.5	0.6
1.002	5.00	3.00	150.300	0.049	0.0	0.0	0.0	1.02	18.0	0.7
1.003	5.00	3.20	150.100	0.054	0.0	0.0	0.0	1.62	28.6	0.7
2.000	5.00	2.03	150.750	0.007	0.0	0.0	0.0	1.96	34.6	0.1
2.001	5.00	2.09	150.600	0.012	0.0	0.0	0.0	1.43	25.2	0.2
2.002	5.00	2.11	150.500	0.012	0.0	0.0	0.0	4.42	78.2	0.2
3.000	5.00	2.05	150.750	0.019	0.0	0.0	0.0	1.75	30.9	0.3
3.001	5.00	2.11	150.600	0.025	0.0	0.0	0.0	1.43	25.2	0.3
3.002	5.00	2.13	150.500	0.025	0.0	0.0	0.0	4.30	76.1	0.3
4.000	5.00	2.22	150.800	0.038	0.0	0.0	0.0	1.16	20.5	0.5
4.001	5.00	2.27	150.600	0.044	0.0	0.0	0.0	2.26	40.0	0.6
4.002	5.00	2.43	150.200	0.057	0.0	0.0	0.0	1.30	23.0	0.8
4.003	5.00	2.52	150.000	0.069	0.0	0.0	0.0	1.93	34.1	0.9
5.000	5.00	14.51	150.100	0.018	0.0	0.0	0.0	0.29	5.2	0.2
6.000	5.00	2.06	150.000	0.028	0.0	0.0	0.0	1.43	25.2	0.4
7.000	5.00	2.06	150.750	0.011	0.0	0.0	0.0	1.60	28.2	0.1
7.001	5.00	2.24	150.600	0.025	0.0	0.0	0.0	1.80	31.7	0.3
7.002	5.00	2.27	150.000	0.025	0.0	0.0	0.0	1.84	32.6	0.3
5.001	5.00	14.78	149.900	0.074	0.0	0.0	0.0	1.23	21.8	1.0
1.004	5.00	14.86	149.550	0.234	0.0	0.0	0.0	1.00	17.8	3.2

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	151.350	0.600	Open Manhole	450	1.000	150.750	150				
S2	151.350	0.850	Open Manhole	450	1.001	150.500	150	1.000	150.500	150	
S3	151.350	1.050	Open Manhole	450	1.002	150.300	150	1.001	150.300	150	
S4	151.350	1.250	Open Manhole	450	1.003	150.100	150	1.002	150.100	150	
S6	151.350	0.600	Open Manhole	450	2.000	150.750	150				
S7	151.300	0.700	Open Manhole	450	2.001	150.600	150	2.000	150.600	150	
S8	151.300	0.800	Open Manhole	450	2.002	150.500	150	2.001	150.500	150	
S9	151.350	0.600	Open Manhole	450	3.000	150.750	150				
S10	151.320	0.720	Open Manhole	450	3.001	150.600	150	3.000	150.600	150	
S11	151.300	0.800	Open Manhole	450	3.002	150.500	150	3.001	150.500	150	
S13	151.350	0.550	Open Manhole	450	4.000	150.800	150				
S14	151.350	0.750	Open Manhole	450	4.001	150.600	150	4.000	150.600	150	
S15	151.350	1.150	Open Manhole	450	4.002	150.200	150	4.001	150.200	150	
S16	151.350	1.350	Open Manhole	450	4.003	150.000	150	4.002	150.000	150	
S17	150.800	0.700	Open Manhole	1200	5.000	150.100	150				
S20	150.750	0.750	Open Manhole	450	6.000	150.000	150				
S21	151.350	0.600	Open Manhole	450	7.000	150.750	150				
S22	151.350	0.750	Open Manhole	450	7.001	150.600	150	7.000	150.600	150	
S18	150.800	0.800	Open Manhole	450	7.002	150.000	150	7.001	150.000	150	
S19	151.780	1.880	Open Manhole	450	5.001	149.900	150	5.000	149.900	150	
								6.000	149.900	150	
								7.002	149.900	150	
S25FCC	151.370	1.820	Open Manhole	1500	1.004	149.550	150	1.003	149.600	150	50
								2.002	149.550	150	
								3.002	149.600	150	50
								4.003	149.600	150	50
								5.001	149.600	150	50
	151.400	1.900	Open Manhole	0		OUTFALL		1.004	149.500	150	

No coordinates have been specified, layout information cannot be produced.

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	S1	151.350	150.750	0.450	Open Manhole	450
1.001	o	150	S2	151.350	150.500	0.700	Open Manhole	450
1.002	o	150	S3	151.350	150.300	0.900	Open Manhole	450
1.003	o	150	S4	151.350	150.100	1.100	Open Manhole	450
2.000	o	150	S6	151.350	150.750	0.450	Open Manhole	450
2.001	o	150	S7	151.300	150.600	0.550	Open Manhole	450
2.002	o	150	S8	151.300	150.500	0.650	Open Manhole	450
3.000	o	150	S9	151.350	150.750	0.450	Open Manhole	450
3.001	o	150	S10	151.320	150.600	0.570	Open Manhole	450
3.002	o	150	S11	151.300	150.500	0.650	Open Manhole	450
4.000	o	150	S13	151.350	150.800	0.400	Open Manhole	450
4.001	o	150	S14	151.350	150.600	0.600	Open Manhole	450
4.002	o	150	S15	151.350	150.200	1.000	Open Manhole	450
4.003	o	150	S16	151.350	150.000	1.200	Open Manhole	450
5.000	o	150	S17	150.800	150.100	0.550	Open Manhole	1200
6.000	o	150	S20	150.750	150.000	0.600	Open Manhole	450
7.000	o	150	S21	151.350	150.750	0.450	Open Manhole	450
7.001	o	150	S22	151.350	150.600	0.600	Open Manhole	450
7.002	o	150	S18	150.800	150.000	0.650	Open Manhole	450
5.001	o	150	S19	151.780	149.900	1.730	Open Manhole	450
1.004	o	150	S25FCC	151.370	149.550	1.670	Open Manhole	1500

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	22.000	88.0	S2	151.350	150.500	0.700	Open Manhole	450
1.001	20.500	102.5	S3	151.350	150.300	0.900	Open Manhole	450
1.002	19.400	97.0	S4	151.350	150.100	1.100	Open Manhole	450
1.003	19.400	38.8	S25FCC	151.370	149.600	1.620	Open Manhole	1500
2.000	4.000	26.7	S7	151.300	150.600	0.550	Open Manhole	450
2.001	5.000	50.0	S8	151.300	150.500	0.650	Open Manhole	450
2.002	5.000	5.3	S25FCC	151.370	149.550	1.670	Open Manhole	1500
3.000	5.000	33.3	S10	151.320	150.600	0.570	Open Manhole	450
3.001	5.000	50.0	S11	151.300	150.500	0.650	Open Manhole	450
3.002	5.000	5.6	S25FCC	151.370	149.600	1.620	Open Manhole	1500
4.000	15.000	75.0	S14	151.350	150.600	0.600	Open Manhole	450
4.001	8.000	20.0	S15	151.350	150.200	1.000	Open Manhole	450
4.002	12.000	60.0	S16	151.350	150.000	1.200	Open Manhole	450
4.003	11.000	27.5	S25FCC	151.370	149.600	1.620	Open Manhole	1500
5.000	221.000	1105.0	S19	151.780	149.900	1.730	Open Manhole	450
6.000	5.000	50.0	S19	151.780	149.900	1.730	Open Manhole	450
7.000	6.000	40.0	S22	151.350	150.600	0.600	Open Manhole	450
7.001	19.000	31.7	S18	150.800	150.000	0.650	Open Manhole	450
7.002	3.000	30.0	S19	151.780	149.900	1.730	Open Manhole	450
5.001	20.000	66.7	S25FCC	151.370	149.600	1.620	Open Manhole	1500
1.004	5.000	100.0		151.400	149.500	1.750	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004		151.400	149.500	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 0
Number of Online Controls 1	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	0.400	Cv (Winter)	0.840
Region	England and Wales	Profile Type	Summer	Storm Duration (mins)	30

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S25FCC, DS/PN: 1.004, Volume (m³): 4.2

Unit Reference	MD-SHE-0069-2000-0850-2000	Sump Available	Yes
Design Head (m)	0.850	Diameter (mm)	69
Design Flow (l/s)	2.0	Invert Level (m)	149.550
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)	0.850	2.0	Kick-Flo®	0.535	1.6
Flush-Flo™	0.257	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)
0.100	1.7	0.800	1.9	2.000	3.0	4.000	4.1	7.000	5.3
0.200	2.0	1.000	2.2	2.200	3.1	4.500	4.3	7.500	5.5
0.300	2.0	1.200	2.3	2.400	3.2	5.000	4.5	8.000	5.7
0.400	1.9	1.400	2.5	2.600	3.3	5.500	4.7	8.500	5.8
0.500	1.7	1.600	2.7	3.000	3.6	6.000	4.9	9.000	6.0
0.600	1.7	1.800	2.8	3.500	3.8	6.500	5.1	9.500	6.1

Storage Structures for Storm

Tank or Pond Manhole: S25FCC, DS/PN: 1.004

Invert Level (m) 149.550

Depth (m)	Area (m²)
0.000	160.0

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

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	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	0.400	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, 240, 360, 480, 960, 1440
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 Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	S1	15 Summer	1	+0%	100/15 Summer				150.799	-0.101	0.000	0.24
1.001	S2	15 Summer	1	+0%	30/15 Summer				150.565	-0.085	0.000	0.38
1.002	S3	15 Summer	1	+0%	30/15 Summer				150.366	-0.084	0.000	0.39
1.003	S4	15 Summer	1	+0%	100/15 Summer				150.152	-0.098	0.000	0.27
2.000	S6	15 Summer	1	+0%					150.772	-0.128	0.000	0.05
2.001	S7	15 Summer	1	+0%					150.630	-0.120	0.000	0.09
2.002	S8	15 Summer	1	+0%					150.517	-0.133	0.000	0.03
3.000	S9	15 Summer	1	+0%					150.787	-0.113	0.000	0.14
3.001	S10	15 Summer	1	+0%					150.646	-0.104	0.000	0.20
3.002	S11	15 Summer	1	+0%					150.526	-0.124	0.000	0.07
4.000	S13	15 Summer	1	+0%	100/15 Summer				150.862	-0.088	0.000	0.36
4.001	S14	15 Summer	1	+0%	100/15 Summer				150.647	-0.103	0.000	0.21
4.002	S15	15 Summer	1	+0%	30/15 Summer				150.267	-0.083	0.000	0.42
4.003	S16	15 Summer	1	+0%	100/15 Summer				150.059	-0.091	0.000	0.32
5.000	S17	15 Summer	1	+0%	30/15 Summer				150.183	-0.067	0.000	0.28
6.000	S20	15 Summer	1	+0%	100/15 Summer				150.051	-0.099	0.000	0.25
7.000	S21	15 Summer	1	+0%					150.779	-0.121	0.000	0.08
7.001	S22	15 Summer	1	+0%					150.634	-0.116	0.000	0.11
7.002	S18	15 Summer	1	+0%	100/15 Summer				150.042	-0.108	0.000	0.17
5.001	S19	15 Summer	1	+0%	100/15 Summer				149.972	-0.078	0.000	0.46
1.004	S25FCC	240 Winter	1	+0%	30/15 Summer				149.690	-0.010	0.000	0.13

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1		4.2	OK	
1.001	S2		6.3	OK	
1.002	S3		6.7	OK	
1.003	S4		7.1	OK	
2.000	S6		1.2	OK	
2.001	S7		1.7	OK	
2.002	S8		1.7	OK	
3.000	S9		3.4	OK	
3.001	S10		4.0	OK	
3.002	S11		4.0	OK	
4.000	S13		6.8	OK	
4.001	S14		7.4	OK	
4.002	S15		8.7	OK	
4.003	S16		9.8	OK	

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

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
5.000	S17		1.5	OK	
6.000	S20		5.0	OK	
7.000	S21		2.0	OK	
7.001	S22		3.4	OK	
7.002	S18		3.3	OK	
5.001	S19		9.3	OK	
1.004	S25FCC		1.9	OK	

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

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	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	0.400	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, 240, 360, 480, 960, 1440
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 Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	S1	15 Summer	30	+0%	100/15 Summer				150.832	-0.068	0.000	0.58
1.001	S2	15 Summer	30	+0%	30/15 Summer				150.656	0.006	0.000	1.02
1.002	S3	15 Summer	30	+0%	30/15 Summer				150.454	0.004	0.000	1.01
1.003	S4	15 Summer	30	+0%	100/15 Summer				150.193	-0.057	0.000	0.69
2.000	S6	15 Summer	30	+0%					150.785	-0.115	0.000	0.13
2.001	S7	15 Summer	30	+0%					150.650	-0.100	0.000	0.24
2.002	S8	15 Summer	30	+0%					150.528	-0.122	0.000	0.08
3.000	S9	15 Summer	30	+0%					150.810	-0.090	0.000	0.34
3.001	S10	15 Summer	30	+0%					150.677	-0.073	0.000	0.52
3.002	S11	15 Summer	30	+0%					150.542	-0.108	0.000	0.17
4.000	S13	15 Summer	30	+0%	100/15 Summer				150.909	-0.041	0.000	0.88
4.001	S14	15 Summer	30	+0%	100/15 Summer				150.678	-0.072	0.000	0.54
4.002	S15	15 Summer	30	+0%	30/15 Summer				150.395	0.045	0.000	1.08
4.003	S16	15 Summer	30	+0%	100/15 Summer				150.112	-0.038	0.000	0.88
5.000	S17	15 Summer	30	+0%	30/15 Summer				150.345	0.095	0.000	0.68
6.000	S20	15 Summer	30	+0%	100/15 Summer				150.085	-0.065	0.000	0.62
7.000	S21	15 Summer	30	+0%					150.796	-0.104	0.000	0.20
7.001	S22	15 Summer	30	+0%					150.659	-0.091	0.000	0.32
7.002	S18	15 Summer	30	+0%	100/15 Summer				150.074	-0.076	0.000	0.47
5.001	S19	15 Summer	30	+0%	100/15 Summer				150.032	-0.018	0.000	1.00
1.004	S25FCC	240 Winter	30	+0%	30/15 Summer				149.931	0.231	0.000	0.14

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1		10.4	OK	
1.001	S2		16.8	SURCHARGED	
1.002	S3		17.0	SURCHARGED	
1.003	S4		18.6	OK	
2.000	S6		3.1	OK	
2.001	S7		4.7	OK	
2.002	S8		4.7	OK	
3.000	S9		8.3	OK	
3.001	S10		10.3	OK	
3.002	S11		10.3	OK	
4.000	S13		16.6	OK	
4.001	S14		18.7	OK	
4.002	S15		22.4	SURCHARGED	
4.003	S16		27.0	OK	

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

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
5.000	S17		3.7	SURCHARGED	
6.000	S20		12.2	OK	
7.000	S21		4.8	OK	
7.001	S22		9.5	OK	
7.002	S18		9.4	OK	
5.001	S19		20.5	OK	
1.004	S25FCC		2.0	SURCHARGED	

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

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	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	0.400	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, 240, 360, 480, 960, 1440
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 Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	S1	15 Winter	100	+40%	100/15 Summer				151.301	0.401	0.000	0.76
1.001	S2	15 Winter	100	+40%	30/15 Summer				151.188	0.538	0.000	1.47
1.002	S3	15 Summer	100	+40%	30/15 Summer				150.746	0.296	0.000	1.53
1.003	S4	360 Winter	100	+40%	100/15 Summer				150.326	0.076	0.000	0.17
2.000	S6	15 Summer	100	+40%					150.798	-0.102	0.000	0.23
2.001	S7	15 Summer	100	+40%					150.669	-0.081	0.000	0.43
2.002	S8	15 Summer	100	+40%					150.537	-0.113	0.000	0.14
3.000	S9	15 Summer	100	+40%					150.835	-0.065	0.000	0.62
3.001	S10	15 Summer	100	+40%					150.715	-0.035	0.000	0.94
3.002	S11	15 Summer	100	+40%					150.558	-0.092	0.000	0.31
4.000	S13	15 Summer	100	+40%	100/15 Summer				151.329	0.379	0.000	1.31
4.001	S14	15 Summer	100	+40%	100/15 Summer				151.072	0.322	0.000	0.71
4.002	S15	15 Summer	100	+40%	30/15 Summer				150.898	0.548	0.000	1.54
4.003	S16	15 Summer	100	+40%	100/15 Summer				150.431	0.281	0.000	1.27
5.000	S17	15 Winter	100	+40%	30/15 Summer				150.749	0.499	0.000	1.12
6.000	S20	360 Winter	100	+40%	100/15 Summer				150.344	0.194	0.000	0.12
7.000	S21	15 Summer	100	+40%					150.813	-0.087	0.000	0.37
7.001	S22	15 Summer	100	+40%					150.683	-0.067	0.000	0.58
7.002	S18	360 Winter	100	+40%	100/15 Summer				150.352	0.202	0.000	0.10
5.001	S19	360 Winter	100	+40%	100/15 Summer				150.375	0.325	0.000	0.29
1.004	S25FCC	360 Winter	100	+40%	30/15 Summer				150.324	0.624	0.000	0.14

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1		13.6	FLOOD RISK	
1.001	S2		24.2	FLOOD RISK	
1.002	S3		25.8	SURCHARGED	
1.003	S4		4.4	SURCHARGED	
2.000	S6		5.5	OK	
2.001	S7		8.6	OK	
2.002	S8		8.5	OK	
3.000	S9		15.0	OK	
3.001	S10		18.7	OK	
3.002	S11		18.6	OK	
4.000	S13		24.9	FLOOD RISK	
4.001	S14		24.5	FLOOD RISK	
4.002	S15		32.2	SURCHARGED	
4.003	S16		38.8	SURCHARGED	

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

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
5.000	S17		6.1	FLOOD RISK	
6.000	S20		2.3	SURCHARGED	
7.000	S21		8.7	OK	
7.001	S22		17.2	OK	
7.002	S18		2.1	SURCHARGED	
5.001	S19		5.9	SURCHARGED	
1.004	S25FCC		2.0	SURCHARGED	