

Drainage Strategy

And

Flood Risk Assessment

for

Proposed Development

Greene's Road

Whiston

St Helens L35 3RD

Client Name: Built Group Ltd
Our ref: LRD31895
Date: August 2021
Revision: 002

SUTCLIFFE

Drainage Strategy & Flood Risk Assessment

DOCUMENT VERIFICATION

Report Reference: LRD31895 Issue: 02 Date: August 2021

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01	Aug 2021	Issued for Planning	DS	MP	DS
02	Sep 2021	Appendix D additional calculations. Appendix E added	DS	MP	DS

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1.0 Introduction

The site is currently overgrown with grass and self-seeded trees with a few areas of tarmac concrete hard standings. The site is located within a developed area of Whiston, St Helens.

The site is bound by Greene's Road, to the north, Paradise Lane, to the east, Stadt Moers Park car park, to the south, and a house to the west.

The proposed scheme consists of 22 dwellings with infrastructure.

The total site area is approximately 0.2 Ha and its location can be found by the following references;

Postcode L35 3RE

Coordinates 346719, 390302

Grid reference SJ 46719 90902

The site is currently undeveloped with a level difference of up to 0.9m from north to south.

The purpose of the strategy and flood risk assessment is to consider how the surface water runoff from the development site will be effectually drained and managed throughout the lifetime of the development.

The site must, in the first instance, consider the use of SUDS in accordance with the National Planning Policy Framework.

SUDS are the provision of a surface water drainage scheme that manages the surface water runoff at source.

The hierarchy of managing surface water at source is:

- Infiltration to ground
- Discharge to a suitable water course
- Discharge to a suitable surface water sewer network
- Discharge to a combined sewer network

The following statements are made in relation to the above stated hierarchy in relation to the proposed scheme.

2.0 Existing Flood Risk

An inspection of the Environment Agency flood maps was made on the internet and the following can be stated.

- That the site is located within a Zone 1 low risk flood area and the site is, therefore, considered not to be at risk of flooding from rivers or sea.

- That the site is not indicated as having surface water flooding. The site can, therefore, be assessed as having a very low risk of surface water flooding.
- That the site is not at risk from flooding from reservoirs or other man-made water features

Therefore, from the above observations we confirm that the site is at low risk of flooding from existing sources.

3.0 Infiltration to ground

Infiltration to ground is, in the main, provided by the provision of soakaways and permeable paving.

To provide infiltration via soakaways the ground conditions must be suitable to allow infiltration to occur and the ground water table must be at least 1.0m below the base of any soakaways provided.

To allow infiltration via permeable paving the ground conditions must be suitable to allow infiltration to occur.

Soakaways cannot be located within 5m of boundaries, highways or existing / proposed buildings.

An intrusive ground investigation has been carried out and revealed that the ground conditions consist of made ground overlying soft to firm clay overlying mudstone.

Therefore, the use of soakaways is not practical for this site.

However, surface infiltration will be achievable to allow the draining of some of the paths and patios around the dwellings by ensuring surface water flows into gravel trenches and / or landscaped areas where surface infiltration will occur in to the upper topsoil and also allow evaporation and plant uptake. By providing this the area of impermeable surfaces drained to a positive drainage network can be reduced.

Therefore, from the above it is not currently practical to provide soakaways for this development.

4.0 Discharge to suitable water course

An inspection of historic / current maps and the Environment Agency maps reveal that there are no watercourses either on, adjacent to, or within reasonable distance of the site.

Therefore, discharge of surface water into a water course is not available for this site.

5.0 Discharge to a suitable surface water network

A review of the existing drainage network within the surroundings of the development site was made and of United Utility sewer records.

The review indicated that there are no surface water sewers located within or adjacent to the site.

Therefore, disposal of surface water drainage into a surface water sewer or highway drainage is not available for this site.

6.0 Discharge to a suitable combined sewer network

A review of the existing drainage network and of United Utility sewer records within the surroundings of the development site was made.

The review indicated that there are combined sewers in the following locations.

- a 225mm $\varnothing$ combined sewer in Paradise Lane at a depth of approximately 3.0m
- a 600mm $\varnothing$ combined sewer in Paradise Street at a depth of approximately 6.8m. This sewer cuts into the south east corner of the site before turning south and exiting the site.

Therefore, discharge of surface water into a combined sewer is available for this site.

7.0 Existing Site Surface Water Drainage

A review of the existing drainage network and of United Utility sewer records within the surroundings of the development site was made.

This drainage strategy has established that there is a network of combined sewers that can service the site.

The site is considered as undeveloped and is, therefore, classed as greenfield.

Greenfield run-off rates have been calculated using Micro Drainage software as being;

$$Q_{\text{bar}} = 1.1 \text{ l/s}$$

$$Q_{1 \text{ year}} = 1.0 \text{ l/s}$$

$$Q_{2 \text{ year}} = 1.1 \text{ l/s}$$

$$Q_{30 \text{ year}} = 1.9 \text{ l/s}$$

$$Q_{100 \text{ year}} = 2.4 \text{ l/s}$$

A copy of the existing drainage plan is included in Appendix B. Hydraulic calculations are included in Appendix D.

8.0 Site Surface Water Runoff Drainage Proposals

From the above discussions made the following surface water drainage strategy is proposed.

Infiltration via soakaways is not proposed due to ground conditions that have been identified as not being suitable for infiltration.

There are no watercourses within reasonable and economic distance of the site.

There are no surface water sewers or highway drains available for the site drainage.

There are combined sewers adjacent to the site, which can be utilised.

The greenfield run off rates are small and cannot be reasonably managed for the lifetime of the proposed development.

United Utilities have been consulted and advised that the flows can be discharged into a combined sewer. We are currently discussing the connection point with United Utilities.

United Utilities advised that, if no infiltration is available then a discharge of 5 l/s into a combined sewer can be allowed.

Therefore, it is proposed to drain surface water from the proposed development to a combined sewer with a maximum pass forward rate of 5l/s.

9.0 Site Surface Water Runoff Drainage Design

The site is located in an area where SUDS cannot be utilised due to ground conditions.

From the discussion in the previous section, it is proposed to provide a positive drainage using a piped network with additional offline cellular attenuation providing the necessary attenuation for rainfall events that exceed the maximum discharge rate of 5 l/s, for storm events up to and including the 100-year plus 40% climate change storm events.

From the above discussion, it is our proposal to provide the following surface water drainage proposal;

To provide a private drainage network to collect and discharge surface water to the adopted United Utilities sewer at a pass forward discharge rate of no more than 5.0 l/s. Attenuation will be provided within the private drainage network on site to attenuate all storm events exceeding a 5.0 l/s discharge off site up to and including the 100 year + 40% climate change storm events. All discharges connecting to the public sewer will be maintained at or below 5.0 l/s.

Hydraulic calculations undertaken for the proposed sewer network design using Micro Drainage provide evidence that the various storm events can be attenuated within the proposed drainage network and reduce future flood risk both on and off site.

Calculations for the following rainfall events were interrogated;

- 1 Year
- 2 Year
- 30 Year
- 100 year + 20% Climate Change
- 100 year + 30% Climate Change
- 100 year + 40% Climate Change

No flooding occurred for any of the storm events listed above and all discharges were maintained at or below 5.0 l/s for storm events of up to and including 100 year + 40% climate change.

Hydraulic calculations are included in Appendix D.

A preliminary drainage plan, 31895-SUT-ZZ-XX-DR-C-6200, has been prepared in accordance with the above proposals and is included in Appendix C.

In the event of an exceedance storm event (greater than 100 year + 40% climate change) or a drainage failure event, such as a blockage, then overland flooding could be expected. Overland flood routes have been indicated on the site plan and indicate where the water will flow. No dwellings, either on or off site are affected. The flood routing drawing, 31895-SUT-ZZ-XX-DR-C-6201, is included in Appendix C.

From the above we believe that the requirements of the Lead Local Flood Authority and United Utilities have been met in relation to maximum allowable surface water discharge and volume of surface water runoff from the site.

10.0 Outstanding Flood Risk

From the above drainage strategy and flood risk assessment we confirm that the site is at a low risk of flooding from on site and external sources.

The drainage design also controls on-site and off-site flood risk as the surface water runoff generated, by the proposed development, is managed to discharge a maximum 5.0 l/s for all rainfall events up to and including the 100 year + 40% climate change.

In the event of exceedance rainfall events and / or blocked drains, flooding is likely to occur as the drainage system becomes overwhelmed. A flood exceedance flood route is indicated on drawing 31895-SUT-ZZ-XX-DR-C-6201, which shows the flows will pass to the south west corner of the site, where flows will pass into adjacent gardens as currently happens from natural runoff from the site.

Therefore, the proposed development has a low risk of flooding both on and off site and reduces flood risk from the previous development and has been designed to restrict surface water discharge off site for up to and including the 100 year + 40% climate change storm events.

11.0 Future Surface Water Drainage Management and Maintenance

At this point of the design process, we are not able to provide a full management and maintenance plan but the following summary can be provided to give a general strategy of future management and maintenance. As the development proceeds to full design and construction stage the management and maintenance strategy can be developed.

At this stage of design, it is anticipated that the drainage within the proposed development will remain privately owned and maintained by the Housing Association, who will be responsible for ongoing maintenance throughout the lifetime of the development.

The Housing Association will be responsible for the private drainage, including the off line attenuation and flow control device.

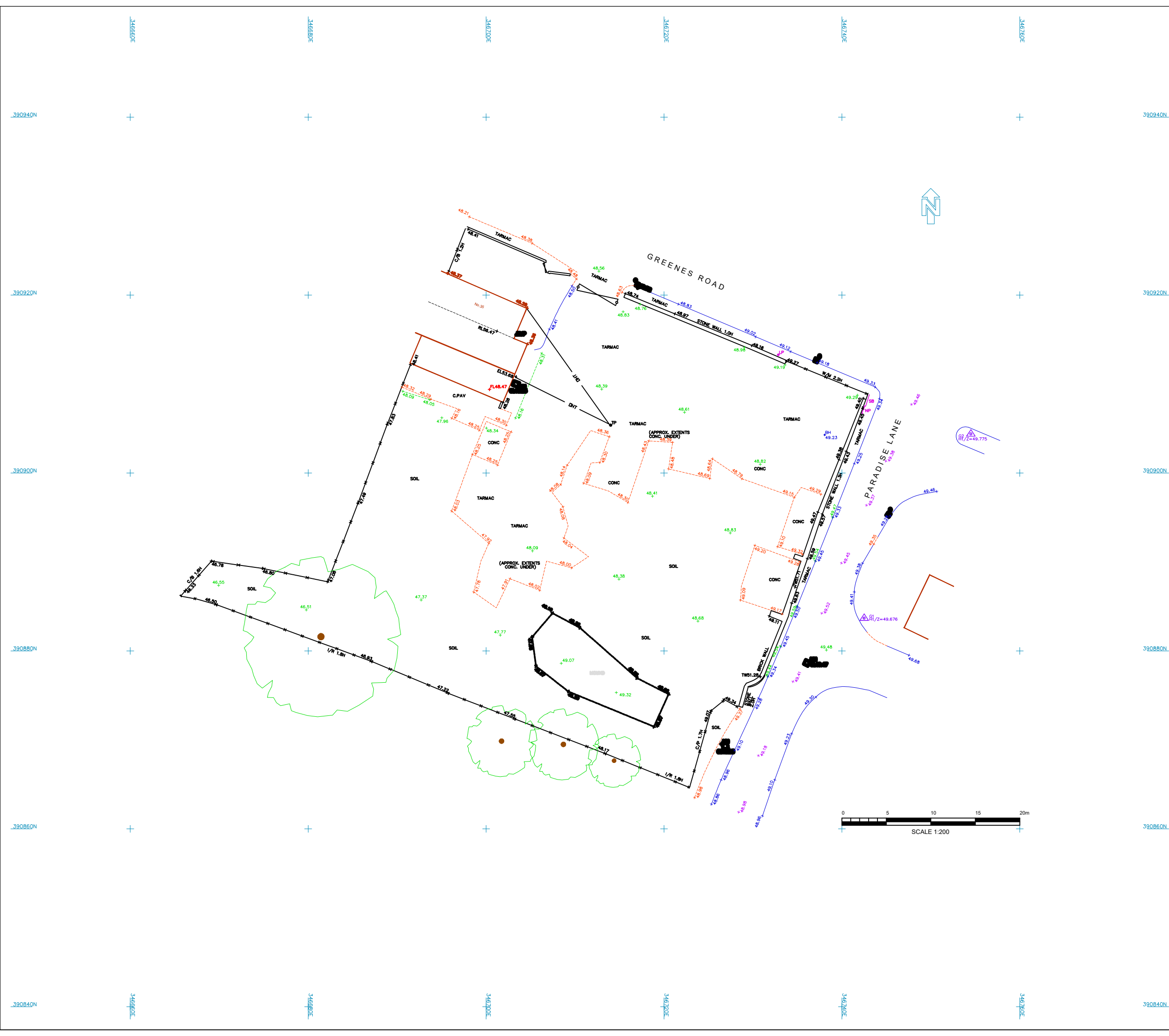
It is anticipated that the costs for ongoing maintenance will be charged via a management fee that tenants contribute towards as part of their rent. The Housing Association will ensure that the private drainage is maintained to the point of discharge into the adopted sewers.

The maintenance schedule will be developed once planning is awarded and the drainage design is finalised.

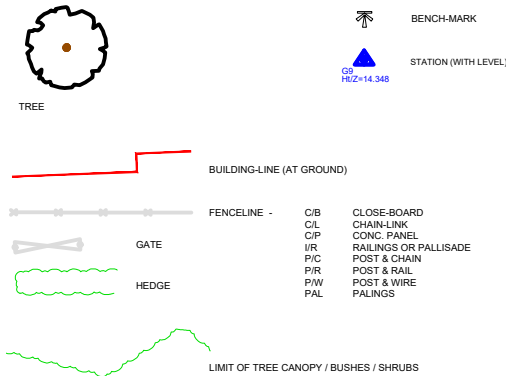
Appendix A

Existing Site Layout

Proposed Site Layout



SYMBOLS



ABBREVIATIONS

ACD	'ACC' DRAINAGE CHANNEL	NP	NAME-PLATE
AV	AIR-VALVE COVER	NTL	NTL COMMS. I.C.
B.PAV	BLOCK PAVING	DGP	OVER-GROUND PIPE/CONDUIT
BdL	BED-LEVEL	DH	OVERHEAD ELECTRIC CABLE(S)
BH	BOREHOLE (WITH GROUND-LEVEL)	DHG	OVERHEAD GANTRY/PIPE-BRIDGE
BIN	LITTER-BIN	DHP	OVERHEAD PIPE(S)
Bd	BOLLARD	DHT	OVERHEAD TELECOM CABLE(S)
BT	B.TELECOM IC	DP	OUTLET or OUTFALL PIPE
C.PAV	CONCRETE PAVING (FLAGS)	DSBM	ORDNANCE SURVEY BENCH-MARK
Cam	CAMERA/CAMERA-POLE	P	POST
CB	CONTROL-BOX	PV	PIPE (VERTICAL)
CHAN	CHANNEL/SLOT-DRAIN	PZ	PIEZOMETER (WITH GROUND-LEVEL)
CH	CEILING HEIGHT	RE	RODDING-EYE
CdL	CEILING LEVEL	RL	RIDGE LEVEL
CL	COVER-LEVEL	RS	ROAD-SIGN
CDBS	STONE COBBLES	RVP	RAINWATER PIPE
CONC	CONCRETE	S.PAV	STONE PAVING
C-L	CROWN LEVEL	Sap	SAPLING
CTV	CABLE TV POINT/IC	SB	SIGN-BOARD
EIC	ELECTRIC IC	SCH	SUSPENDED-CEILING HEIGHT
EL	EAVES LEVEL	SETTS	STONE SETTS
EP	ELECTRIC-POLE	ST	STOP-TAP
ER	EARTH-ROD	Stp	TREE-STUMP
FB	FOOTBRIDGE	SV	STOP-VALVE
FH	FIRE HYDRANT COVER	TAC	TACTILE PAVING
FL	FLOODLIGHT	TAR	TARMAC
FL	FLOOR LEVEL	TBC	TO BE CONFIRMED (ON-SITE)
FP	FLAGPOLE	TBM	TEMPORARY BENCH-MARK
G	GULLEY	TCB	TELEPHONE CALL-BOX
GL	GROUND-LEVEL	TEL	TELECOM BOX
Gr	GRILLE-COVER	THL	THRESHOLD LEVEL
H	HEIGHT (IN METRES)	TL	TRAFFIC LIGHT
HD	HEAD	TP	TELECOM POLE
H-L	HANDRAIL / SAFETY-RAIL	TW	TOP OF WALL LEVEL
IL	INVERT LEVEL	UL	UPLIGHTER
IC	INSPECTION CHAMBER	UTL	UNABLE TO LIFT
IP	INLET PIPE	UTS	UNABLE TO SURVEY (ACCESS ISSUE)
IS	INFORMATION SIGN	U/S	UNDERSIDE (SUFFIT)
KD	KERB-OUTLET	VP	VENT-PIPE
LB	LETTER-BOX	VL	WATER LEVEL
LP	LAMP POST	WM	WATER METER COVER
MH	MANHOLE	WD	WASHOUT VALVE COVER
		WV	WATER VALVE COVER

NOTES

1. This survey has been presented at the survey scale indicated below with its accuracy commensurate with that scale.
2. All heights and levels in metres (u.o.n.)
3. All levels are at ground u.o.n.

CONTROL STATIONS

REF	EASTING	NORTHING	LEVEL	TYPE
G1	346742.502	390883.688	49.676	NAIL
G2	346754.499	390904.400	49.775	NAIL

SURVEY GRID

ORDNANCE SURVEY OSG836 NATIONAL GRID AT STATION G1.
GPS OBSERVATIONS ON ETRS89 TRANSFORMED USING OSTN02
SURVEY THEN TRANSFORMED TO A SCALE FACTOR OF 1.000000 FROM STATION G1

LEVEL DATUM

ORDNANCE SURVEY DATUM NEWLYN (ODN) BY GPS OBSERVATIONS AT STATION G1
TRANSFORMED FROM ETRS89 USING OSGM02 GEOID

REV.	DESCRIPTION	CHECKED	BY	CHK	DATE
0	ORIGINAL ISSUE				07/08/21
DRAWN	MPW	CHECKED	LW	DATE	07 AUG. 2021

TITLE	TOPOGRAPHICAL SURVEY AT GREENES LANE, WHISTON MERSEYSIDE L35 3RF
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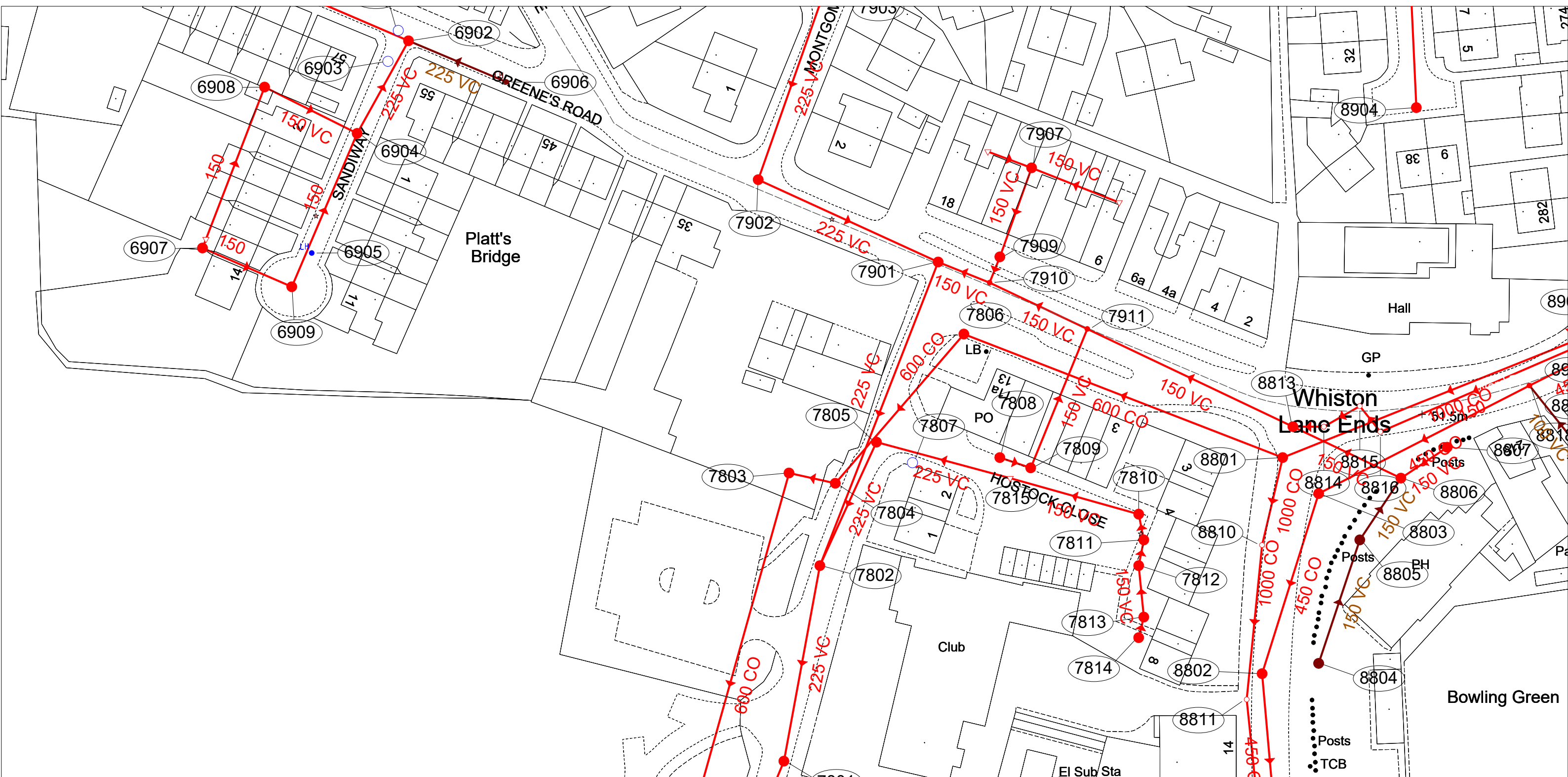
CLIENT	BUILT GROUP LTD
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SURVEYED BY	27 PROSPECT VALE LIVERPOOL L6 8PE
GEOSPATIAL ENGINEERING SERVICES LTD	TEL 0151-280-2021 EMAIL : mail@GESuk.net

CAD FILE	01065.DWG	SCALE	1 : 200	SHT. SIZE	A1
DRAWING No	01065			REVISION	O

Appendix B

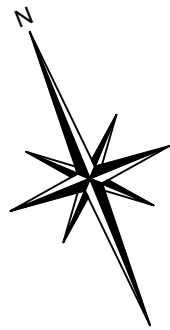
Existing United Utilities Sewer Records



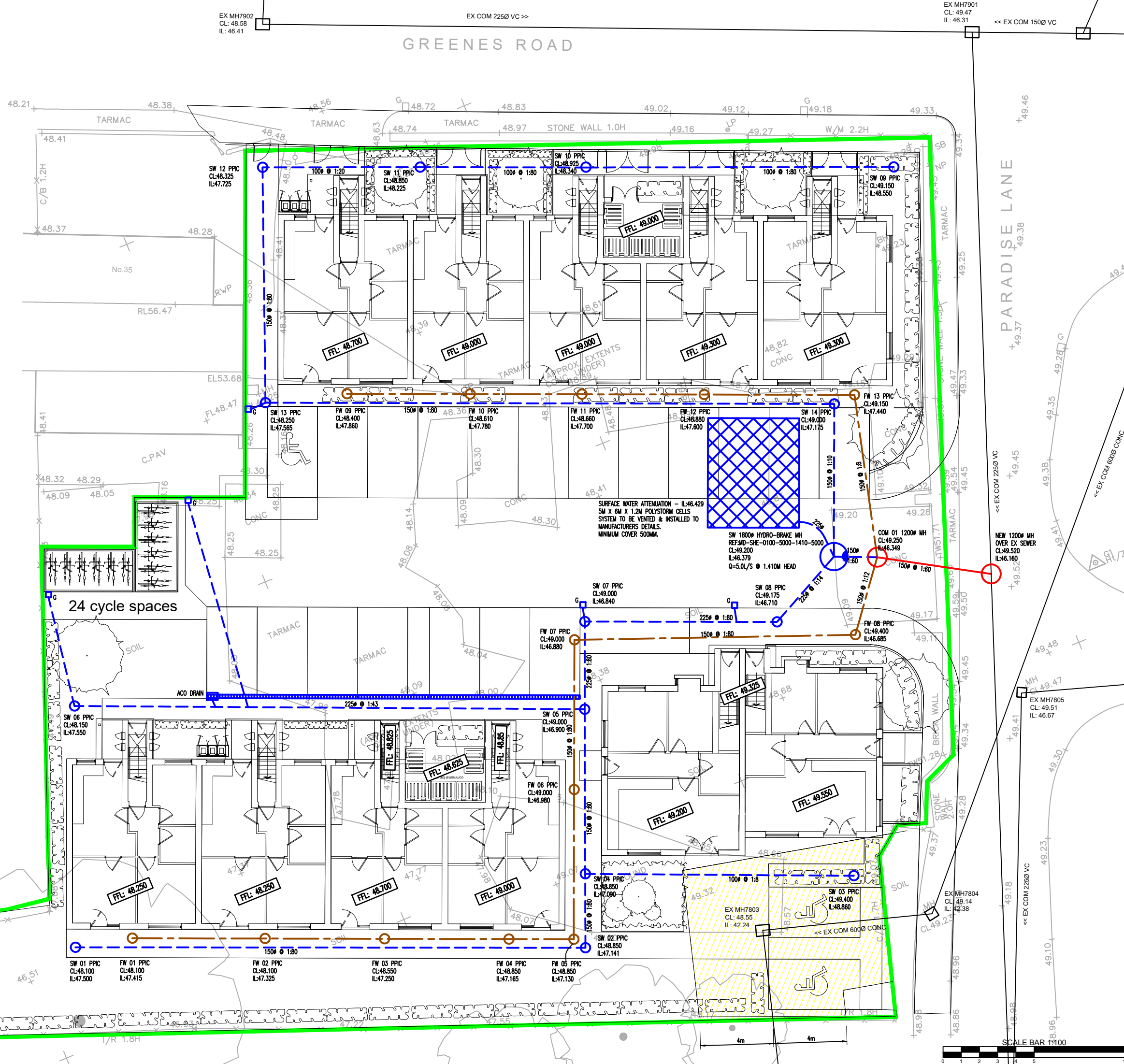
Appendix C

Proposed Drainage Layout

Proposed Flood Routing



NOTE: FFL'S TO BE CONFIRMED



General Notes

DO NOT SCALE OFF THIS DRAWING

THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT STRUCTURAL AND ARCHITECTURAL DRAWINGS AND SPECIFICATIONS.

ALL DIMENSIONS TO BE CHECKED ON SITE BY THE CONTRACTOR / FABRICATOR PRIOR TO COMMENCEMENT OF WORKS.

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.

ALL WORKS TO BE CARRIED OUT IN STRICT ACCORDANCE WITH THE ENGINEER'S SPECIFICATIONS, RELEVANT BRITISH STANDARDS, STATUTORY HEALTH AND SAFETY/C.D.M. REGULATIONS, RELEVANT CODES OF PRACTICE AND THE CURRENT EDITION OF THE BUILDING REGULATIONS.

FOR FINAL SETTING OUT INFORMATION RELATING TO GRID LINES AND WALL POSITIONS REFER TO THE ARCHITECT'S DRAWINGS.

ALL FINISHED FLOOR LEVELS TO BE CONFIRMED BY ARCHITECT PRIOR TO CONSTRUCTION

ALL COVER LEVELS TO BE CONFIRMED BY ARCHITECT PRIOR TO CONSTRUCTION

ALL DRAINAGE PENETRATING THROUGH FLOOR SLABS AND RAINWATER PIPE LOCATIONS TAKEN FROM ARCHITECTS DRAWINGS. ARCHITECT TO CONFIRM LOCATIONS PRIOR TO CONSTRUCTION.

EXISTING SERVICES

CONTRACTOR TO SATISFY THEMSELVES THAT EXISTING AND PROPOSED SERVICES DO NOT CLASH WITH PROPOSED DRAINAGE

THE CONTRACTOR PRIOR TO START OF WORKS IS TO ENSURE THAT PROPOSED DRAINAGE LEVELS DO NOT INTERFERE WITH SERVICES. ALL DISCREPANCIES SHALL BE REPORTED TO ENGINEER IMMEDIATELY.

THE CONTRACTOR SHALL CHECK ALL EXISTING COVER / INVERT LEVELS AND PIPE / SEWER SIZES ON SITE PRIOR TO START OF WORKS TO ENSURE PROPOSED DRAINAGE CAN BE CONSTRUCTED AS INDICATED ON THE DRAWING. ANY DISCREPANCIES TO BE REPORTED TO THE ENGINEER IMMEDIATELY.

ALL REDUNDANT DRAINAGE WITHIN SITE TO BE GRUBBED UP, CHASED AND SEALED TO APPROVAL OF LOCAL AUTHORITY

PROPOSED DRAINAGE

OUTSIDE EDGE OF ADOPTED SEWER SHALL NOT ENCRoACH WITHIN 1M OF KERB FACE.

OUTSIDE EDGE OF ADOPTED MANHOLES SHALL NOT ENCRoACH WITHIN 0.5M OF KERB FACE.

ALL DRAINAGE IN HIGHWAYS/CAR PARKING AREAS/DRIVEWAYS LESS THAN 1.2M DEEP TO BE CONCRETE ENCASED.

ALL PPIC'S GREATER THAN 1.2M DEEP TO HAVE REDUCED ACCESS COVERS TO PREVENT MAN ENTRY.

SURFACE WATER DRAINAGE:

ALL PRIVATE SURFACE WATER DRAINAGE TO BE 100MM @ 1:80 GRADIENT UNLESS NOTED OTHERWISE.

ALLOWANCE TO BE MADE FOR DRIVEWAY GULLIES AND ASSOCIATED DRAIN RUNS WHERE APPLICABLE

FOUL WATER / COMBINED DRAINAGE:

ALL UNDERGROUND FOUL WATER DRAINAGE TO BE 100MM @ 1:40 GRADIENT UNLESS NOTED OTHERWISE. ALL OTHER PRIVATE FOUL WATER DRAINAGE TO BE 100MM @ 1:80 GRADIENT UNLESS NOTED OTHERWISE.

INTERNAL VENTING OF DRAINAGE SYSTEM TO ARCHITECTS DETAILS

ALL INTERNAL SP/SWP POSITIONS TO BE CONFIRMED BY ARCHITECT PRIOR TO CONSTRUCTION OF GROUND FLOOR SLAB

DRAINAGE KEY

	SITE BOUNDARY		ACD CHANNEL		RODDING EYE
	EXTG FOUL WATER DRAINAGE		MAC		MINI ACCESS CHAMBER
	EXTG SURFACE WATER DRAINAGE		RWP		FOUL WATER POLYPROPYLENE INSPECTION CHAMBER
	EXTG COMBINED DRAINAGE		SWP		SURFACE WATER POLYPROPYLENE INSPECTION CHAMBER
	PROPOSED FOUL WATER DRAINAGE		SG		DRIVEWAY GULLY
	PROPOSED SURFACE WATER DRAINAGE				
	PROPOSED COMBINED DRAINAGE				
	SEWER EASEMENT (AS DIMENSIONED ON PLAN)				

Rev Description Date By Chkd

Drawing Status

PRELIMINARY DRAWING

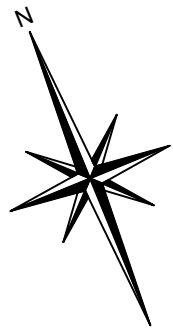
Client
BUILT GROUP LTD

Project
GREENES ROAD WHISTON

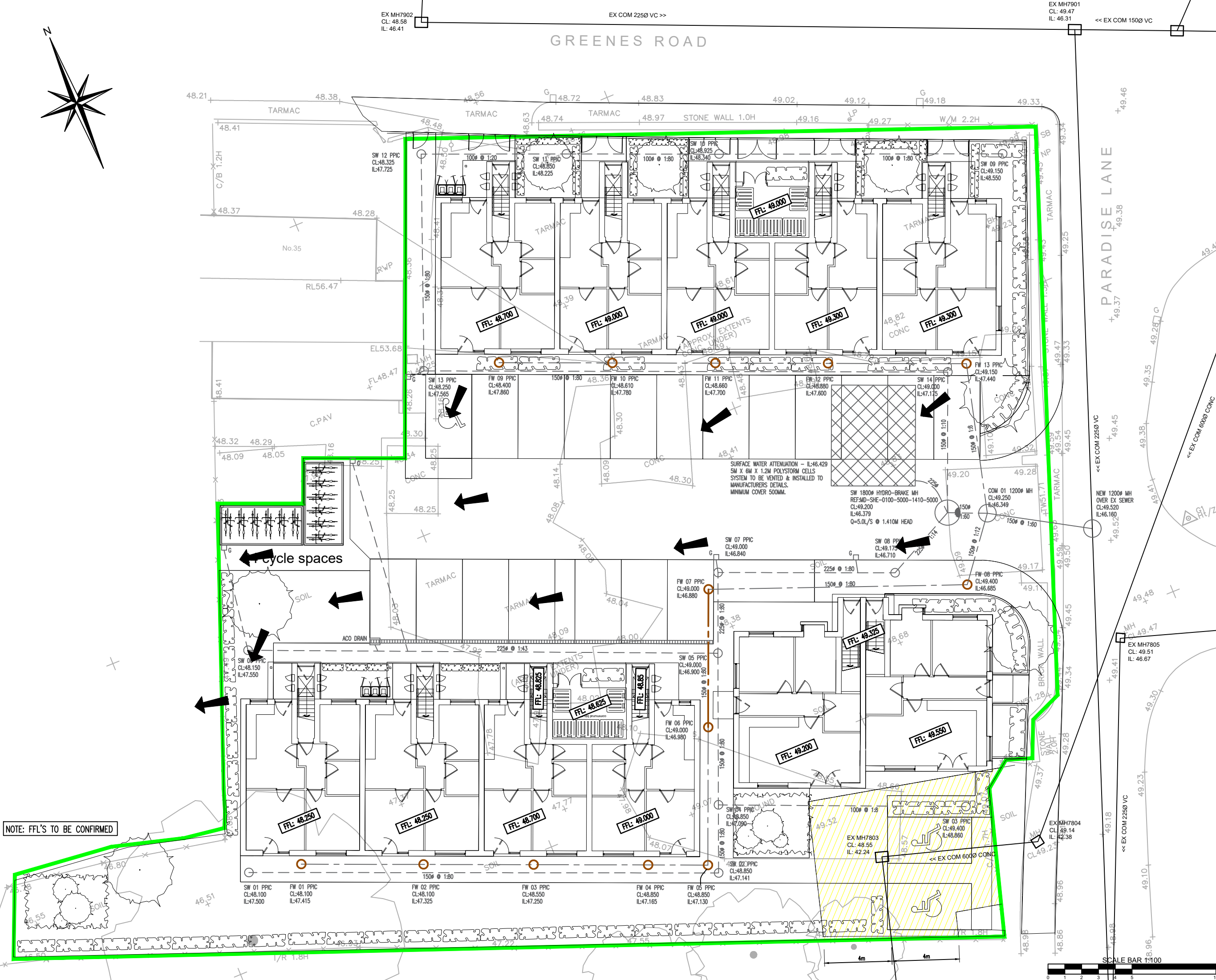
Drawing Title
PROPOSED DRAINAGE STRATEGY DRAWING

Date SEP 21	Drawn By MJG	Checked By DS
Scale at A1 1:100	Sheet Number 31895	Revision P01

31895-SUT-ZZ-XX-DR-C-6200



NOTE: FFL'S TO BE CONFIRMED



General Notes
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P01	FOR INFORMATION	08.09.21	MJG	DS
Rev	Description	Date	By	Chkd

Drawing Status
PRELIMINARY DRAWING



Client
BUILT GROUP LTD

Project
GREENES ROAD WHISTON

Drawing Title
PROPOSED FLOOD ROUTING DRAWING

Date SEP 21	Drawn By MJG	Checked By DS
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Scale at A1 1:100	Project Number 31895
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Sheet Number 31895-SUT-ZZ-XX-DR-C-6201	Revision P01
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Appendix D

Q_{bar} Hydraulic Calculations

Proposed Drainage Network Hydraulic Calculations

Drainage Areas Plan

Summer volume of discharge calculation

Winer volume of discharge calculation

Sutcliffe		Page 1
18-20 Harrington Street Liverpool L2 9QA	GREENES ROAD WHISTON QBAR	
Date 07/09/2021 16:30 File	Designed by MJG Checked by DS	
Innovyze	Source Control 2020.1.3	

ICP SUDS Mean Annual Flood

Input

Return Period (years) 2 SAAR (mm) 876 Urban 0.000
Area (ha) 0.200 Soil 0.450 Region Number Region 10

Results 1/s

QBAR Rural 1.1
QBAR Urban 1.1

Q2 years 1.1

Q1 year 1.0
Q30 years 1.9
Q100 years 2.4

Sutcliffe		Page 1
18-20 Harrington Street Liverpool L2 9QA	GREENES ROAD WHISTON SW CALCS - 1, 2, 30 YR	
Date 07/09/2021 16:23 File 31895-SW CALCS-001.MDX	Designed by MJG Checked by DS	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.398	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)
0-4	0.098	4-8	0.031

Total Area Contributing (ha) = 0.129

Total Pipe Volume (m³) = 4.118

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	28.760	0.360	80.0	0.016	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	4.049	0.051	80.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	14.728	1.720	8.6	0.010	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	9.027	0.113	79.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.000	27.973	0.648	43.2	0.041	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	4.804	0.060	80.1	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	10.537	0.132	79.8	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.43	47.500	0.016	0.0	0.0	0.0	1.12	19.9	2.1
S1.001	50.00	5.49	47.141	0.016	0.0	0.0	0.0	1.12	19.9	2.1
S2.000	50.00	5.09	48.860	0.010	0.0	0.0	0.0	2.66	20.9	1.3
S1.002	50.00	5.62	47.090	0.026	0.0	0.0	0.0	1.13	19.9	3.5
S3.000	50.00	5.23	47.550	0.041	0.0	0.0	0.0	2.00	79.4	5.5
S1.003	50.00	5.67	46.902	0.070	0.0	0.0	0.0	1.46	58.2	9.5
S1.004	50.00	5.79	46.842	0.091	0.0	0.0	0.0	1.46	58.2	12.3

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.005	4.746	0.331	14.3	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.000	16.874	0.211	80.0	0.005	5.00	0.0	0.600	o	100	Pipe/Conduit	
S4.001	9.088	0.114	80.0	0.008	0.00	0.0	0.600	o	100	Pipe/Conduit	
S4.002	8.640	0.450	19.2	0.005	0.00	0.0	0.600	o	100	Pipe/Conduit	
S4.003	12.900	0.161	80.0	0.003	0.00	0.0	0.600	o	150	Pipe/Conduit	
S4.004	31.177	0.390	80.0	0.013	0.00	0.0	0.600	o	150	Pipe/Conduit	
S4.005	8.368	0.795	10.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.006	1.851	0.030	61.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.007	6.842	0.114	60.0	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)
S1.005	50.00	5.82	46.710	0.095	0.0	0.0	0.0	3.47	138.1	12.9
S4.000	50.00	5.33	48.550	0.005	0.0	0.0	0.0	0.86	6.8	0.6
S4.001	50.00	5.50	48.339	0.012	0.0	0.0	0.0	0.86	6.8	1.7
S4.002	50.00	5.58	48.225	0.017	0.0	0.0	0.0	1.77	13.9	2.3
S4.003	50.00	5.77	47.725	0.021	0.0	0.0	0.0	1.12	19.9	2.8
S4.004	50.00	6.24	47.564	0.034	0.0	0.0	0.0	1.12	19.9	4.6
S4.005	50.00	6.28	47.174	0.034	0.0	0.0	0.0	3.12	55.2	4.6
S1.006	50.00	6.31	46.379	0.129	0.0	0.0	0.0	1.28	22.7	17.5
S1.007	50.00	6.39	46.349	0.129	0.0	0.0	0.0	1.30	23.0	17.5

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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	0.016	0.016	0.016
1.001	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.003	0.003	0.003
	User	-	100	0.007	0.007	0.010
1.002	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.029	0.029	0.029
	User	-	100	0.012	0.012	0.041
1.003	User	-	100	0.004	0.004	0.004
1.004	User	-	100	0.021	0.021	0.021
1.005	User	-	100	0.004	0.004	0.004
4.000	User	-	100	0.005	0.005	0.005
4.001	User	-	100	0.008	0.008	0.008
4.002	User	-	100	0.005	0.005	0.005
4.003	User	-	100	0.003	0.003	0.003
4.004	User	-	100	0.013	0.013	0.013
4.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.129	0.129	0.129

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)
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S1.007	S	49.520	46.235	46.235	0	0
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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	0.000
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 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	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.398		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S7, DS/PN: S1.006, Volume (m³): 3.5

Unit Reference MD-SHE-0100-5000-1410-5000
Design Head (m) 1.410
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 100
Invert Level (m) 46.379
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.410	5.0	Kick-Flo®	0.866	4.0
Flush-Flo™	0.424	5.0	Mean Flow over Head Range	-	4.4

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)	Depth (m)	Flow (l/s)
0.100	3.3	0.800	4.4	2.000	5.9	4.000	8.2	7.000	10.6
0.200	4.6	1.000	4.3	2.200	6.2	4.500	8.6	7.500	11.0
0.300	4.9	1.200	4.6	2.400	6.4	5.000	9.1	8.000	11.3
0.400	5.0	1.400	5.0	2.600	6.7	5.500	9.5	8.500	11.7
0.500	5.0	1.600	5.3	3.000	7.1	6.000	9.9	9.000	12.0
0.600	4.9	1.800	5.6	3.500	7.7	6.500	10.3	9.500	12.3

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Storage Structures for Storm

Cellular Storage Manhole: S7, DS/PN: S1.006

Invert Level (m) 46.429 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	30.0	20.0	1.200	30.0	41.6	1.201	0.0	41.6

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
S1.000	S1	0.679	0.508	0.000	1.187
S1.001	S2	1.933	0.072	0.000	2.004
S2.000	S3	0.611	0.116	0.000	0.726
S1.002	S3	1.991	0.160	0.000	2.150
S3.000	S5	0.679	1.112	0.000	1.791
S1.003	S4	2.373	0.191	0.000	2.564
S1.004	S5	2.441	0.419	0.000	2.860
S1.005	S6	2.788	0.189	0.000	2.977
S4.000	S9	0.679	0.133	0.000	0.811
S4.001	S10	0.663	0.071	0.000	0.734
S4.002	S11	0.707	0.068	0.000	0.775
S4.003	S12	0.679	0.228	0.000	0.907
S4.004	S13	0.776	0.551	0.000	1.327
S4.005	S14	2.065	0.148	0.000	2.213
S1.006	S7	3.190	0.033	34.210	37.433
S1.007	S8	3.281	0.121	0.000	3.402
Total		25.532	4.118	34.210	63.859

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
S1.000	S1	0.679	0.487	0.000	1.166
S1.001	S2	1.933	0.050	0.000	1.983
S2.000	S3	0.611	0.106	0.000	0.717
S1.002	S3	1.991	0.138	0.000	2.129
S3.000	S5	0.679	1.065	0.000	1.743
S1.003	S4	2.373	0.143	0.000	2.516
S1.004	S5	2.441	0.371	0.000	2.812
S1.005	S6	2.788	0.141	0.000	2.929
S4.000	S9	0.679	0.123	0.000	0.802
S4.001	S10	0.663	0.062	0.000	0.725
S4.002	S11	0.707	0.058	0.000	0.765
S4.003	S12	0.679	0.207	0.000	0.885
S4.004	S13	0.776	0.530	0.000	1.306
S4.005	S14	2.065	0.127	0.000	2.192
S1.006	S7	3.190	0.012	34.210	37.411

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Volume Summary (Static)

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
S1.007	S8	3.281	0.110	0.000	3.391
Total		25.532	3.730	34.210	63.472

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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 0.000
 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 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) 20.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.398 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 2, 30
 Climate Change (%) 0, 0, 0

PN	US/MH		Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded
	Name	Storm							Level (m)	Depth (m)	Volume (m³)
S1.000	S1	15 Winter	1	+0%					47.534	-0.116	0.000
S1.001	S2	15 Winter	1	+0%					47.180	-0.111	0.000
S2.000	S3	15 Winter	1	+0%					48.877	-0.083	0.000
S1.002	S3	15 Winter	1	+0%					47.136	-0.104	0.000
S3.000	S5	15 Winter	1	+0%					47.591	-0.184	0.000
S1.003	S4	15 Winter	1	+0%					46.983	-0.144	0.000
S1.004	S5	15 Winter	1	+0%					46.918	-0.149	0.000
S1.005	S6	15 Winter	1	+0%	30/15 Winter				46.769	-0.166	0.000
S4.000	S9	15 Winter	1	+0%					48.571	-0.079	0.000
S4.001	S10	15 Winter	1	+0%					48.373	-0.066	0.000
S4.002	S11	15 Winter	1	+0%					48.252	-0.073	0.000
S4.003	S12	15 Winter	1	+0%					47.762	-0.113	0.000
S4.004	S13	15 Winter	1	+0%					47.610	-0.104	0.000
S4.005	S14	15 Winter	1	+0%					47.203	-0.121	0.000
S1.006	S7	30 Winter	1	+0%	1/15 Summer				46.616	0.087	0.000
S1.007	S8	30 Winter	1	+0%					46.398	-0.101	0.000

PN	US/MH		Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded
	Name							
S1.000	S1		0.11			2.2	OK	
S1.001	S2		0.15			2.2	OK	
S2.000	S3		0.07			1.4	OK	
S1.002	S3		0.20			3.5	OK	
S3.000	S5		0.08			5.6	OK	
S1.003	S4		0.27			9.5	OK	
S1.004	S5		0.24			12.0	OK	
S1.005	S6		0.15			12.5	OK	
S4.000	S9		0.10			0.6	OK	

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

PN	US/MH		Flow / Cap.	Overflow (l/s)	Half Drain Pipe		Status	Level Exceeded
	Name				Time (mins)	Flow (l/s)		
S4.001	S10		0.25			1.5	OK	
S4.002	S11		0.16			2.1	OK	
S4.003	S12		0.14			2.5	OK	
S4.004	S13		0.21			3.9	OK	
S4.005	S14		0.08			4.0	OK	
S1.006	S7		0.42		18	4.6	SURCHARGED	
S1.007	S8		0.24			4.6	OK	

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2 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 0.000
 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 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) 20.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.398 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 2, 30
 Climate Change (%) 0, 0, 0

PN	US/MH		Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume
	Name	Storm							(m)	(m)	(m³)
S1.000	S1	15 Winter	2	+0%					47.539	-0.111	0.000
S1.001	S2	15 Winter	2	+0%					47.186	-0.105	0.000
S2.000	S3	15 Winter	2	+0%					48.880	-0.080	0.000
S1.002	S3	15 Winter	2	+0%					47.142	-0.098	0.000
S3.000	S5	15 Winter	2	+0%					47.597	-0.178	0.000
S1.003	S4	15 Winter	2	+0%					46.995	-0.132	0.000
S1.004	S5	15 Winter	2	+0%					46.929	-0.138	0.000
S1.005	S6	15 Winter	2	+0%	30/15 Winter				46.778	-0.157	0.000
S4.000	S9	15 Winter	2	+0%					48.573	-0.077	0.000
S4.001	S10	15 Winter	2	+0%					48.378	-0.061	0.000
S4.002	S11	15 Winter	2	+0%					48.256	-0.069	0.000
S4.003	S12	15 Winter	2	+0%					47.768	-0.107	0.000
S4.004	S13	15 Winter	2	+0%					47.617	-0.097	0.000
S4.005	S14	15 Winter	2	+0%					47.207	-0.117	0.000
S1.006	S7	30 Winter	2	+0%	1/15 Summer				46.695	0.166	0.000
S1.007	S8	30 Winter	2	+0%					46.400	-0.099	0.000

PN	US/MH		Flow / Cap.	Overflow (l/s)	Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
	Name							
S1.000	S1		0.15			2.8	OK	
S1.001	S2		0.20			2.8	OK	
S2.000	S3		0.09			1.8	OK	
S1.002	S3		0.26			4.6	OK	
S3.000	S5		0.10			7.3	OK	
S1.003	S4		0.35			12.2	OK	
S1.004	S5		0.32			15.5	OK	
S1.005	S6		0.20			16.2	OK	
S4.000	S9		0.12			0.8	OK	

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

PN	US/MH Flow / Overflow			Half Drain	Pipe	Status	Level Exceeded
	Name	Cap.	(l/s)	Time (mins)	Flow (l/s)		
S4.001	S10	0.32			2.0	OK	
S4.002	S11	0.21			2.7	OK	
S4.003	S12	0.18			3.3	OK	
S4.004	S13	0.27			5.1	OK	
S4.005	S14	0.11			5.1	OK	
S1.006	S7	0.45		21	4.9	SURCHARGED	
S1.007	S8	0.25			4.9	OK	

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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 0.000
 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 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) 20.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.398 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 2, 30
 Climate Change (%) 0, 0, 0

									Water	Surcharged	Flooded
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)
S1.000	S1	15 Winter	30	+0%					47.554	-0.096	0.000
S1.001	S2	15 Winter	30	+0%					47.205	-0.086	0.000
S2.000	S3	15 Winter	30	+0%					48.888	-0.072	0.000
S1.002	S3	15 Winter	30	+0%					47.165	-0.075	0.000
S3.000	S5	15 Winter	30	+0%					47.616	-0.159	0.000
S1.003	S4	60 Winter	30	+0%					47.057	-0.070	0.000
S1.004	S5	60 Winter	30	+0%					47.055	-0.012	0.000
S1.005	S6	60 Winter	30	+0%	30/15 Winter				47.050	0.115	0.000
S4.000	S9	15 Winter	30	+0%					48.583	-0.067	0.000
S4.001	S10	15 Winter	30	+0%					48.401	-0.038	0.000
S4.002	S11	15 Winter	30	+0%					48.274	-0.051	0.000
S4.003	S12	15 Winter	30	+0%					47.792	-0.083	0.000
S4.004	S13	15 Winter	30	+0%					47.651	-0.063	0.000
S4.005	S14	15 Winter	30	+0%					47.224	-0.100	0.000
S1.006	S7	60 Winter	30	+0%	1/15 Summer				47.047	0.518	0.000
S1.007	S8	240 Summer	30	+0%					46.400	-0.099	0.000

Half Drain Pipe							
PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.28			5.3	OK	
S1.001	S2	0.38			5.3	OK	
S2.000	S3	0.17			3.4	OK	
S1.002	S3	0.49			8.7	OK	
S3.000	S5	0.19			13.8	OK	
S1.003	S4	0.36			12.3	OK	
S1.004	S5	0.33			16.0	OK	
S1.005	S6	0.20			16.5	SURCHARGED	
S4.000	S9	0.23			1.5	OK	

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18-20 Harrington Street Liverpool L2 9QA	GREENES ROAD WHISTON SW CALCS - 1, 2, 30 YR	
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Innovyze	Network 2020.1.3	

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

			Half Drain Pipe				
US/MH Flow /		Overflow	Time	Flow	Level		
PN	Name	Cap.	(l/s)	(mins)	(l/s)	Status	Exceeded
S4.001	S10	0.69			4.3	OK	
S4.002	S11	0.47			6.1	OK	
S4.003	S12	0.40			7.3	OK	
S4.004	S13	0.61			11.6	OK	
S4.005	S14	0.24			11.8	OK	
S1.006	S7	0.46		47	5.0	SURCHARGED	
S1.007	S8	0.26			5.0	OK	

Sutcliffe		Page 1
18-20 Harrington Street Liverpool L2 9QA	GREENES ROAD WHISTON SW CALCS - 100 YR + 20% CC	
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Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.398	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)
0-4	0.098	4-8	0.031

Total Area Contributing (ha) = 0.129

Total Pipe Volume (m³) = 4.118

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	28.760	0.360	80.0	0.016	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	4.049	0.051	80.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	14.728	1.720	8.6	0.010	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	9.027	0.113	79.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.000	27.973	0.648	43.2	0.041	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	4.804	0.060	80.1	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	10.537	0.132	79.8	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.43	47.500	0.016	0.0	0.0	0.0	1.12	19.9	2.1
S1.001	50.00	5.49	47.141	0.016	0.0	0.0	0.0	1.12	19.9	2.1
S2.000	50.00	5.09	48.860	0.010	0.0	0.0	0.0	2.66	20.9	1.3
S1.002	50.00	5.62	47.090	0.026	0.0	0.0	0.0	1.13	19.9	3.5
S3.000	50.00	5.23	47.550	0.041	0.0	0.0	0.0	2.00	79.4	5.5
S1.003	50.00	5.67	46.902	0.070	0.0	0.0	0.0	1.46	58.2	9.5
S1.004	50.00	5.79	46.842	0.091	0.0	0.0	0.0	1.46	58.2	12.3

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18-20 Harrington Street Liverpool L2 9QA	GREENES ROAD WHISTON SW CALCS - 100 YR + 20% CC	
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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.005	4.746	0.331	14.3	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.000	16.874	0.211	80.0	0.005	5.00	0.0	0.600	o	100	Pipe/Conduit	
S4.001	9.088	0.114	80.0	0.008	0.00	0.0	0.600	o	100	Pipe/Conduit	
S4.002	8.640	0.450	19.2	0.005	0.00	0.0	0.600	o	100	Pipe/Conduit	
S4.003	12.900	0.161	80.0	0.003	0.00	0.0	0.600	o	150	Pipe/Conduit	
S4.004	31.177	0.390	80.0	0.013	0.00	0.0	0.600	o	150	Pipe/Conduit	
S4.005	8.368	0.795	10.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.006	1.851	0.030	61.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.007	6.842	0.114	60.0	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)
S1.005	50.00	5.82	46.710	0.095	0.0	0.0	0.0	3.47	138.1	12.9
S4.000	50.00	5.33	48.550	0.005	0.0	0.0	0.0	0.86	6.8	0.6
S4.001	50.00	5.50	48.339	0.012	0.0	0.0	0.0	0.86	6.8	1.7
S4.002	50.00	5.58	48.225	0.017	0.0	0.0	0.0	1.77	13.9	2.3
S4.003	50.00	5.77	47.725	0.021	0.0	0.0	0.0	1.12	19.9	2.8
S4.004	50.00	6.24	47.564	0.034	0.0	0.0	0.0	1.12	19.9	4.6
S4.005	50.00	6.28	47.174	0.034	0.0	0.0	0.0	3.12	55.2	4.6
S1.006	50.00	6.31	46.379	0.129	0.0	0.0	0.0	1.28	22.7	17.5
S1.007	50.00	6.39	46.349	0.129	0.0	0.0	0.0	1.30	23.0	17.5

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18-20 Harrington Street Liverpool L2 9QA	GREENES ROAD WHISTON SW CALCS - 100 YR + 20% CC	
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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	0.016	0.016	0.016
1.001	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.003	0.003	0.003
	User	-	100	0.007	0.007	0.010
1.002	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.029	0.029	0.029
	User	-	100	0.012	0.012	0.041
1.003	User	-	100	0.004	0.004	0.004
1.004	User	-	100	0.021	0.021	0.021
1.005	User	-	100	0.004	0.004	0.004
4.000	User	-	100	0.005	0.005	0.005
4.001	User	-	100	0.008	0.008	0.008
4.002	User	-	100	0.005	0.005	0.005
4.003	User	-	100	0.003	0.003	0.003
4.004	User	-	100	0.013	0.013	0.013
4.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.129	0.129	0.129

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)
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S1.007	S	49.520	46.235	46.235	0	0
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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	0.000
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 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	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.398		

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18-20 Harrington Street Liverpool L2 9QA	GREENES ROAD WHISTON SW CALCS - 100 YR + 20% CC	
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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S7, DS/PN: S1.006, Volume (m³): 3.5

Unit Reference MD-SHE-0100-5000-1410-5000
Design Head (m) 1.410
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 100
Invert Level (m) 46.379
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.410	5.0	Kick-Flo®	0.866	4.0
Flush-Flo™	0.424	5.0	Mean Flow over Head Range	-	4.4

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)	Depth (m)	Flow (l/s)
0.100	3.3	0.800	4.4	2.000	5.9	4.000	8.2	7.000	10.6
0.200	4.6	1.000	4.3	2.200	6.2	4.500	8.6	7.500	11.0
0.300	4.9	1.200	4.6	2.400	6.4	5.000	9.1	8.000	11.3
0.400	5.0	1.400	5.0	2.600	6.7	5.500	9.5	8.500	11.7
0.500	5.0	1.600	5.3	3.000	7.1	6.000	9.9	9.000	12.0
0.600	4.9	1.800	5.6	3.500	7.7	6.500	10.3	9.500	12.3

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Storage Structures for Storm

Cellular Storage Manhole: S7, DS/PN: S1.006

Invert Level (m) 46.429 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	30.0	20.0	1.200	30.0	41.6	1.201	0.0	41.6

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
S1.000	S1	0.679	0.508	0.000	1.187
S1.001	S2	1.933	0.072	0.000	2.004
S2.000	S3	0.611	0.116	0.000	0.726
S1.002	S3	1.991	0.160	0.000	2.150
S3.000	S5	0.679	1.112	0.000	1.791
S1.003	S4	2.373	0.191	0.000	2.564
S1.004	S5	2.441	0.419	0.000	2.860
S1.005	S6	2.788	0.189	0.000	2.977
S4.000	S9	0.679	0.133	0.000	0.811
S4.001	S10	0.663	0.071	0.000	0.734
S4.002	S11	0.707	0.068	0.000	0.775
S4.003	S12	0.679	0.228	0.000	0.907
S4.004	S13	0.776	0.551	0.000	1.327
S4.005	S14	2.065	0.148	0.000	2.213
S1.006	S7	3.190	0.033	34.210	37.433
S1.007	S8	3.281	0.121	0.000	3.402
Total		25.532	4.118	34.210	63.859

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
S1.000	S1	0.679	0.487	0.000	1.166
S1.001	S2	1.933	0.050	0.000	1.983
S2.000	S3	0.611	0.106	0.000	0.717
S1.002	S3	1.991	0.138	0.000	2.129
S3.000	S5	0.679	1.065	0.000	1.743
S1.003	S4	2.373	0.143	0.000	2.516
S1.004	S5	2.441	0.371	0.000	2.812
S1.005	S6	2.788	0.141	0.000	2.929
S4.000	S9	0.679	0.123	0.000	0.802
S4.001	S10	0.663	0.062	0.000	0.725
S4.002	S11	0.707	0.058	0.000	0.765
S4.003	S12	0.679	0.207	0.000	0.885
S4.004	S13	0.776	0.530	0.000	1.306
S4.005	S14	2.065	0.127	0.000	2.192
S1.006	S7	3.190	0.012	34.210	37.411

Volume Summary (Static)

Pipe	USMH	Manhole	Pipe	Storage	Total
Number	Name	Volume (m³)	Volume (m³)	Structure Volume (m³)	Volume (m³)
S1.007	S8	3.281	0.110	0.000	3.391
Total		25.532	3.730	34.210	63.472

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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 0.000
 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 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) 20.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.398 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 100
 Climate Change (%) 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth
									(m)	(m)
S1.000	S1	15 Winter	100	+20%					47.570	-0.080
S1.001	S2	60 Winter	100	+20%	100/15 Winter				47.521	0.230
S2.000	S3	15 Winter	100	+20%					48.895	-0.065
S1.002	S3	60 Winter	100	+20%	100/15 Winter				47.520	0.280
S3.000	S5	15 Winter	100	+20%					47.633	-0.142
S1.003	S4	60 Winter	100	+20%	100/15 Summer				47.517	0.390
S1.004	S5	60 Winter	100	+20%	100/15 Summer				47.515	0.448
S1.005	S6	60 Winter	100	+20%	100/15 Summer				47.510	0.575
S4.000	S9	15 Winter	100	+20%					48.592	-0.058
S4.001	S10	15 Winter	100	+20%	100/15 Summer				48.447	0.008
S4.002	S11	15 Winter	100	+20%					48.288	-0.037
S4.003	S12	15 Winter	100	+20%					47.810	-0.065
S4.004	S13	15 Winter	100	+20%					47.681	-0.033
S4.005	S14	60 Winter	100	+20%	100/30 Winter				47.512	0.188
S1.006	S7	60 Winter	100	+20%	100/15 Summer				47.508	0.979
S1.007	S8	480 Winter	100	+20%					46.400	-0.099

PN	US/MH Name	Flooded		Half Drain	Pipe	Status	Level Exceeded
		Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)		
S1.000	S1	0.000	0.43			8.2	OK
S1.001	S2	0.000	0.31			4.4	SURCHARGED
S2.000	S3	0.000	0.26			5.3	OK
S1.002	S3	0.000	0.41			7.1	SURCHARGED
S3.000	S5	0.000	0.29			21.5	OK
S1.003	S4	0.000	0.54			18.5	SURCHARGED
S1.004	S5	0.000	0.47			23.0	SURCHARGED
S1.005	S6	0.000	0.27			22.1	SURCHARGED
S4.000	S9	0.000	0.36			2.3	OK

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

PN	US/MH Name	Flooded		Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Volume (m³)	Flow / Overflow Cap. (l/s)				
S4.001	S10	0.000	1.03		6.5	SURCHARGED	
S4.002	S11	0.000	0.71		9.1	OK	
S4.003	S12	0.000	0.61		11.0	OK	
S4.004	S13	0.000	0.93		17.8	OK	
S4.005	S14	0.000	0.19		9.4	SURCHARGED	
S1.006	S7	0.000	0.46	81	5.0	SURCHARGED	
S1.007	S8	0.000	0.26		5.0	OK	

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18-20 Harrington Street Liverpool L2 9QA	GREENES ROAD WHISTON SW CALCS - 100 YR + 30% CC	
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Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.398	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)
0-4	0.098	4-8	0.031

Total Area Contributing (ha) = 0.129

Total Pipe Volume (m³) = 4.118

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	28.760	0.360	80.0	0.016	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	4.049	0.051	80.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	14.728	1.720	8.6	0.010	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	9.027	0.113	79.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.000	27.973	0.648	43.2	0.041	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	4.804	0.060	80.1	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	10.537	0.132	79.8	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.43	47.500	0.016	0.0	0.0	0.0	1.12	19.9	2.1
S1.001	50.00	5.49	47.141	0.016	0.0	0.0	0.0	1.12	19.9	2.1
S2.000	50.00	5.09	48.860	0.010	0.0	0.0	0.0	2.66	20.9	1.3
S1.002	50.00	5.62	47.090	0.026	0.0	0.0	0.0	1.13	19.9	3.5
S3.000	50.00	5.23	47.550	0.041	0.0	0.0	0.0	2.00	79.4	5.5
S1.003	50.00	5.67	46.902	0.070	0.0	0.0	0.0	1.46	58.2	9.5
S1.004	50.00	5.79	46.842	0.091	0.0	0.0	0.0	1.46	58.2	12.3

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18-20 Harrington Street Liverpool L2 9QA	GREENES ROAD WHISTON SW CALCS - 100 YR + 30% CC	
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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.005	4.746	0.331	14.3	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.000	16.874	0.211	80.0	0.005	5.00	0.0	0.600	o	100	Pipe/Conduit	
S4.001	9.088	0.114	80.0	0.008	0.00	0.0	0.600	o	100	Pipe/Conduit	
S4.002	8.640	0.450	19.2	0.005	0.00	0.0	0.600	o	100	Pipe/Conduit	
S4.003	12.900	0.161	80.0	0.003	0.00	0.0	0.600	o	150	Pipe/Conduit	
S4.004	31.177	0.390	80.0	0.013	0.00	0.0	0.600	o	150	Pipe/Conduit	
S4.005	8.368	0.795	10.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.006	1.851	0.030	61.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.007	6.842	0.114	60.0	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)
S1.005	50.00	5.82	46.710	0.095	0.0	0.0	0.0	3.47	138.1	12.9
S4.000	50.00	5.33	48.550	0.005	0.0	0.0	0.0	0.86	6.8	0.6
S4.001	50.00	5.50	48.339	0.012	0.0	0.0	0.0	0.86	6.8	1.7
S4.002	50.00	5.58	48.225	0.017	0.0	0.0	0.0	1.77	13.9	2.3
S4.003	50.00	5.77	47.725	0.021	0.0	0.0	0.0	1.12	19.9	2.8
S4.004	50.00	6.24	47.564	0.034	0.0	0.0	0.0	1.12	19.9	4.6
S4.005	50.00	6.28	47.174	0.034	0.0	0.0	0.0	3.12	55.2	4.6
S1.006	50.00	6.31	46.379	0.129	0.0	0.0	0.0	1.28	22.7	17.5
S1.007	50.00	6.39	46.349	0.129	0.0	0.0	0.0	1.30	23.0	17.5

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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	0.016	0.016	0.016
1.001	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.003	0.003	0.003
	User	-	100	0.007	0.007	0.010
1.002	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.029	0.029	0.029
	User	-	100	0.012	0.012	0.041
1.003	User	-	100	0.004	0.004	0.004
1.004	User	-	100	0.021	0.021	0.021
1.005	User	-	100	0.004	0.004	0.004
4.000	User	-	100	0.005	0.005	0.005
4.001	User	-	100	0.008	0.008	0.008
4.002	User	-	100	0.005	0.005	0.005
4.003	User	-	100	0.003	0.003	0.003
4.004	User	-	100	0.013	0.013	0.013
4.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.129	0.129	0.129

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)
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S1.007	S	49.520	46.235	46.235	0	0
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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	0.000
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 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	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.398		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S7, DS/PN: S1.006, Volume (m³): 3.5

Unit Reference MD-SHE-0100-5000-1410-5000
Design Head (m) 1.410
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 100
Invert Level (m) 46.379
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.410	5.0	Kick-Flo®	0.866	4.0
Flush-Flo™	0.424	5.0	Mean Flow over Head Range	-	4.4

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)	Depth (m)	Flow (l/s)
0.100	3.3	0.800	4.4	2.000	5.9	4.000	8.2	7.000	10.6
0.200	4.6	1.000	4.3	2.200	6.2	4.500	8.6	7.500	11.0
0.300	4.9	1.200	4.6	2.400	6.4	5.000	9.1	8.000	11.3
0.400	5.0	1.400	5.0	2.600	6.7	5.500	9.5	8.500	11.7
0.500	5.0	1.600	5.3	3.000	7.1	6.000	9.9	9.000	12.0
0.600	4.9	1.800	5.6	3.500	7.7	6.500	10.3	9.500	12.3

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Storage Structures for Storm

Cellular Storage Manhole: S7, DS/PN: S1.006

Invert Level (m) 46.429 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	30.0	20.0	1.200	30.0	41.6	1.201	0.0	41.6

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
S1.000	S1	0.679	0.508	0.000	1.187
S1.001	S2	1.933	0.072	0.000	2.004
S2.000	S3	0.611	0.116	0.000	0.726
S1.002	S3	1.991	0.160	0.000	2.150
S3.000	S5	0.679	1.112	0.000	1.791
S1.003	S4	2.373	0.191	0.000	2.564
S1.004	S5	2.441	0.419	0.000	2.860
S1.005	S6	2.788	0.189	0.000	2.977
S4.000	S9	0.679	0.133	0.000	0.811
S4.001	S10	0.663	0.071	0.000	0.734
S4.002	S11	0.707	0.068	0.000	0.775
S4.003	S12	0.679	0.228	0.000	0.907
S4.004	S13	0.776	0.551	0.000	1.327
S4.005	S14	2.065	0.148	0.000	2.213
S1.006	S7	3.190	0.033	34.210	37.433
S1.007	S8	3.281	0.121	0.000	3.402
Total		25.532	4.118	34.210	63.859

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
S1.000	S1	0.679	0.487	0.000	1.166
S1.001	S2	1.933	0.050	0.000	1.983
S2.000	S3	0.611	0.106	0.000	0.717
S1.002	S3	1.991	0.138	0.000	2.129
S3.000	S5	0.679	1.065	0.000	1.743
S1.003	S4	2.373	0.143	0.000	2.516
S1.004	S5	2.441	0.371	0.000	2.812
S1.005	S6	2.788	0.141	0.000	2.929
S4.000	S9	0.679	0.123	0.000	0.802
S4.001	S10	0.663	0.062	0.000	0.725
S4.002	S11	0.707	0.058	0.000	0.765
S4.003	S12	0.679	0.207	0.000	0.885
S4.004	S13	0.776	0.530	0.000	1.306
S4.005	S14	2.065	0.127	0.000	2.192
S1.006	S7	3.190	0.012	34.210	37.411

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Volume Summary (Static)

Pipe	USMH	Manhole	Pipe	Storage	Total
Number	Name	Volume (m³)	Volume (m³)	Structure Volume (m³)	Volume (m³)
S1.007	S8	3.281	0.110	0.000	3.391
Total		25.532	3.730	34.210	63.472

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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 0.000
 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 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) 20.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.398 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 100
 Climate Change (%) 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth
									(m)	(m)
S1.000	S1	60 Winter	100	+30%					47.621	-0.029
S1.001	S2	60 Winter	100	+30%	100/15 Winter				47.617	0.326
S2.000	S3	15 Winter	100	+30%					48.897	-0.063
S1.002	S3	60 Winter	100	+30%	100/15 Summer				47.616	0.376
S3.000	S5	15 Winter	100	+30%					47.637	-0.138
S1.003	S4	60 Winter	100	+30%	100/15 Summer				47.612	0.485
S1.004	S5	60 Winter	100	+30%	100/15 Summer				47.610	0.543
S1.005	S6	60 Winter	100	+30%	100/15 Summer				47.605	0.670
S4.000	S9	15 Winter	100	+30%					48.594	-0.056
S4.001	S10	15 Winter	100	+30%	100/15 Summer				48.467	0.028
S4.002	S11	15 Winter	100	+30%					48.292	-0.033
S4.003	S12	15 Winter	100	+30%					47.814	-0.061
S4.004	S13	15 Winter	100	+30%					47.699	-0.015
S4.005	S14	60 Winter	100	+30%	100/30 Summer				47.607	0.283
S1.006	S7	60 Winter	100	+30%	100/15 Summer				47.603	1.074
S1.007	S8	240 Summer	100	+30%					46.400	-0.099

PN	US/MH Name	Flooded		Half Drain	Pipe	Status	Level Exceeded
		Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)		
S1.000	S1	0.000	0.25			4.7	OK
S1.001	S2	0.000	0.33			4.7	SURCHARGED
S2.000	S3	0.000	0.29			5.7	OK
S1.002	S3	0.000	0.43			7.5	SURCHARGED
S3.000	S5	0.000	0.32			23.3	OK
S1.003	S4	0.000	0.55			19.1	SURCHARGED
S1.004	S5	0.000	0.49			23.9	SURCHARGED
S1.005	S6	0.000	0.28			23.0	SURCHARGED
S4.000	S9	0.000	0.39			2.5	OK

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

PN	US/MH Name	Flooded		Flow / Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Volume (m³)	Flow / Cap. (l/s)					
S4.001	S10	0.000	1.12			7.0	SURCHARGED	
S4.002	S11	0.000	0.76			9.7	OK	
S4.003	S12	0.000	0.64			11.7	OK	
S4.004	S13	0.000	1.00			19.1	OK	
S4.005	S14	0.000	0.21			10.2	SURCHARGED	
S1.006	S7	0.000	0.46		89	5.0	SURCHARGED	
S1.007	S8	0.000	0.26			5.0	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)	2	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.398	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)
0-4	0.098	4-8	0.031

Total Area Contributing (ha) = 0.129

Total Pipe Volume (m³) = 4.118

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	28.760	0.360	80.0	0.016	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	4.049	0.051	80.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	14.728	1.720	8.6	0.010	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	9.027	0.113	79.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.000	27.973	0.648	43.2	0.041	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	4.804	0.060	80.1	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	10.537	0.132	79.8	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.43	47.500	0.016	0.0	0.0	0.0	1.12	19.9	2.1
S1.001	50.00	5.49	47.141	0.016	0.0	0.0	0.0	1.12	19.9	2.1
S2.000	50.00	5.09	48.860	0.010	0.0	0.0	0.0	2.66	20.9	1.3
S1.002	50.00	5.62	47.090	0.026	0.0	0.0	0.0	1.13	19.9	3.5
S3.000	50.00	5.23	47.550	0.041	0.0	0.0	0.0	2.00	79.4	5.5
S1.003	50.00	5.67	46.902	0.070	0.0	0.0	0.0	1.46	58.2	9.5
S1.004	50.00	5.79	46.842	0.091	0.0	0.0	0.0	1.46	58.2	12.3

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.005	4.746	0.331	14.3	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.000	16.874	0.211	80.0	0.005	5.00	0.0	0.600	o	100	Pipe/Conduit	
S4.001	9.088	0.114	80.0	0.008	0.00	0.0	0.600	o	100	Pipe/Conduit	
S4.002	8.640	0.450	19.2	0.005	0.00	0.0	0.600	o	100	Pipe/Conduit	
S4.003	12.900	0.161	80.0	0.003	0.00	0.0	0.600	o	150	Pipe/Conduit	
S4.004	31.177	0.390	80.0	0.013	0.00	0.0	0.600	o	150	Pipe/Conduit	
S4.005	8.368	0.795	10.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.006	1.851	0.030	61.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.007	6.842	0.114	60.0	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)
S1.005	50.00	5.82	46.710	0.095	0.0	0.0	0.0	3.47	138.1	12.9
S4.000	50.00	5.33	48.550	0.005	0.0	0.0	0.0	0.86	6.8	0.6
S4.001	50.00	5.50	48.339	0.012	0.0	0.0	0.0	0.86	6.8	1.7
S4.002	50.00	5.58	48.225	0.017	0.0	0.0	0.0	1.77	13.9	2.3
S4.003	50.00	5.77	47.725	0.021	0.0	0.0	0.0	1.12	19.9	2.8
S4.004	50.00	6.24	47.564	0.034	0.0	0.0	0.0	1.12	19.9	4.6
S4.005	50.00	6.28	47.174	0.034	0.0	0.0	0.0	3.12	55.2	4.6
S1.006	50.00	6.31	46.379	0.129	0.0	0.0	0.0	1.28	22.7	17.5
S1.007	50.00	6.39	46.349	0.129	0.0	0.0	0.0	1.30	23.0	17.5

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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	0.016	0.016	0.016
1.001	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.003	0.003	0.003
	User	-	100	0.007	0.007	0.010
1.002	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.029	0.029	0.029
	User	-	100	0.012	0.012	0.041
1.003	User	-	100	0.004	0.004	0.004
1.004	User	-	100	0.021	0.021	0.021
1.005	User	-	100	0.004	0.004	0.004
4.000	User	-	100	0.005	0.005	0.005
4.001	User	-	100	0.008	0.008	0.008
4.002	User	-	100	0.005	0.005	0.005
4.003	User	-	100	0.003	0.003	0.003
4.004	User	-	100	0.013	0.013	0.013
4.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.129	0.129	0.129

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)
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S1.007	S	49.520	46.235	46.235	0	0
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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	0.000
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 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	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.398		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S7, DS/PN: S1.006, Volume (m³): 3.5

Unit Reference MD-SHE-0100-5000-1410-5000
Design Head (m) 1.410
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 100
Invert Level (m) 46.379
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.410	5.0	Kick-Flo®	0.866	4.0
Flush-Flo™	0.424	5.0	Mean Flow over Head Range	-	4.4

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)	Depth (m)	Flow (l/s)
0.100	3.3	0.800	4.4	2.000	5.9	4.000	8.2	7.000	10.6
0.200	4.6	1.000	4.3	2.200	6.2	4.500	8.6	7.500	11.0
0.300	4.9	1.200	4.6	2.400	6.4	5.000	9.1	8.000	11.3
0.400	5.0	1.400	5.0	2.600	6.7	5.500	9.5	8.500	11.7
0.500	5.0	1.600	5.3	3.000	7.1	6.000	9.9	9.000	12.0
0.600	4.9	1.800	5.6	3.500	7.7	6.500	10.3	9.500	12.3

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Storage Structures for Storm

Cellular Storage Manhole: S7, DS/PN: S1.006

Invert Level (m) 46.429 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	30.0	20.0	1.200	30.0	41.6	1.201	0.0	41.6

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
S1.000	S1	0.679	0.508	0.000	1.187
S1.001	S2	1.933	0.072	0.000	2.004
S2.000	S3	0.611	0.116	0.000	0.726
S1.002	S3	1.991	0.160	0.000	2.150
S3.000	S5	0.679	1.112	0.000	1.791
S1.003	S4	2.373	0.191	0.000	2.564
S1.004	S5	2.441	0.419	0.000	2.860
S1.005	S6	2.788	0.189	0.000	2.977
S4.000	S9	0.679	0.133	0.000	0.811
S4.001	S10	0.663	0.071	0.000	0.734
S4.002	S11	0.707	0.068	0.000	0.775
S4.003	S12	0.679	0.228	0.000	0.907
S4.004	S13	0.776	0.551	0.000	1.327
S4.005	S14	2.065	0.148	0.000	2.213
S1.006	S7	3.190	0.033	34.210	37.433
S1.007	S8	3.281	0.121	0.000	3.402
Total		25.532	4.118	34.210	63.859

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m ³)	Pipe Volume (m ³)	Storage Structure Volume (m ³)	Total Volume (m ³)
S1.000	S1	0.679	0.487	0.000	1.166
S1.001	S2	1.933	0.050	0.000	1.983
S2.000	S3	0.611	0.106	0.000	0.717
S1.002	S3	1.991	0.138	0.000	2.129
S3.000	S5	0.679	1.065	0.000	1.743
S1.003	S4	2.373	0.143	0.000	2.516
S1.004	S5	2.441	0.371	0.000	2.812
S1.005	S6	2.788	0.141	0.000	2.929
S4.000	S9	0.679	0.123	0.000	0.802
S4.001	S10	0.663	0.062	0.000	0.725
S4.002	S11	0.707	0.058	0.000	0.765
S4.003	S12	0.679	0.207	0.000	0.885
S4.004	S13	0.776	0.530	0.000	1.306
S4.005	S14	2.065	0.127	0.000	2.192
S1.006	S7	3.190	0.012	34.210	37.411

Volume Summary (Static)

Pipe	USMH	Manhole	Pipe	Storage	Total
Number	Name	Volume (m³)	Volume (m³)	Structure Volume (m³)	Volume (m³)
S1.007	S8	3.281	0.110	0.000	3.391
Total		25.532	3.730	34.210	63.472

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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 0.000
 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 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) 20.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.398 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 100
 Climate Change (%) 40

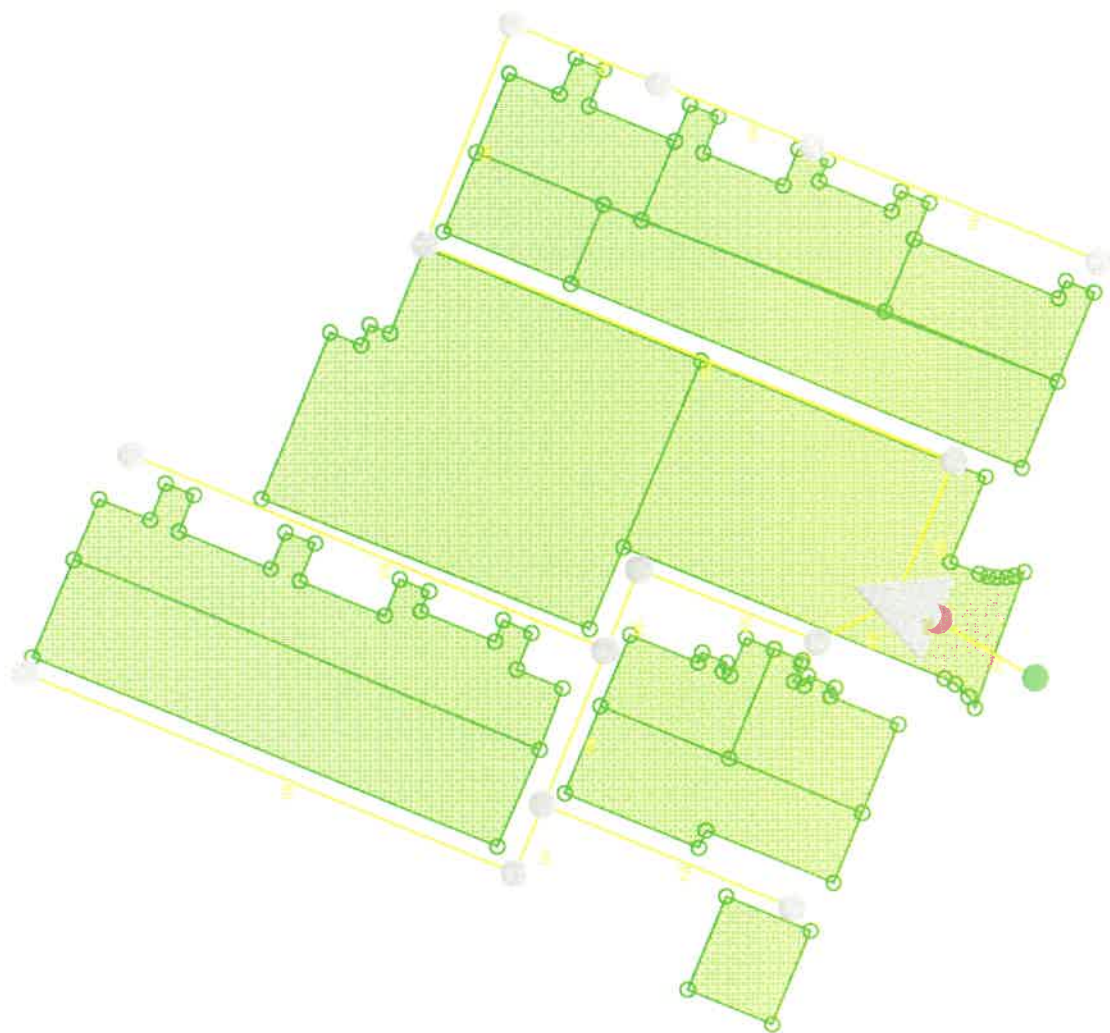
PN	US/MH		Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume
	Name	Storm							(m)	(m)	(m ³)
S1.000	S1	60 Winter	100	+40%	100/60 Winter				47.854	0.204	0.000
S1.001	S2	60 Winter	100	+40%	100/15 Summer				47.850	0.559	0.000
S2.000	S3	15 Winter	100	+40%					48.898	-0.062	0.000
S1.002	S3	60 Winter	100	+40%	100/15 Summer				47.849	0.609	0.000
S3.000	S5	60 Winter	100	+40%	100/60 Winter				47.851	0.076	0.000
S1.003	S4	60 Winter	100	+40%	100/15 Summer				47.846	0.719	0.000
S1.004	S5	60 Winter	100	+40%	100/15 Summer				47.844	0.777	0.000
S1.005	S6	60 Winter	100	+40%	100/15 Summer				47.839	0.904	0.000
S4.000	S9	15 Winter	100	+40%					48.596	-0.054	0.000
S4.001	S10	15 Winter	100	+40%	100/15 Summer				48.488	0.049	0.000
S4.002	S11	15 Winter	100	+40%					48.295	-0.030	0.000
S4.003	S12	60 Winter	100	+40%					47.852	-0.023	0.000
S4.004	S13	60 Winter	100	+40%	100/15 Summer				47.849	0.135	0.000
S4.005	S14	60 Winter	100	+40%	100/15 Winter				47.840	0.516	0.000
S1.006	S7	60 Winter	100	+40%	100/15 Summer				47.836	1.307	0.000
S1.007	S8	60 Winter	100	+40%					46.400	-0.099	0.000

PN	US/MH		Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded
	Name							
S1.000	S1		0.27			5.1	FLOOD RISK	
S1.001	S2		0.34			4.8	SURCHARGED	
S2.000	S3		0.31			6.1	OK	
S1.002	S3		0.45			7.8	SURCHARGED	
S3.000	S5		0.18			13.2	FLOOD RISK	
S1.003	S4		0.57			19.7	SURCHARGED	
S1.004	S5		0.51			24.7	SURCHARGED	
S1.005	S6		0.29			23.9	SURCHARGED	
S4.000	S9		0.42			2.7	OK	

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

			Half Drain Pipe				
US/MH Flow /		Overflow	Time	Flow	Level		
PN	Name	Cap.	(l/s)	(mins)	(l/s)	Status	Exceeded
S4.001	S10	1.20			7.5	SURCHARGED	
S4.002	S11	0.81			10.4	OK	
S4.003	S12	0.37			6.8	OK	
S4.004	S13	0.57			11.0	SURCHARGED	
S4.005	S14	0.23			11.0	SURCHARGED	
S1.006	S7	0.46		102	5.0	SURCHARGED	
S1.007	S8	0.26			5.0	OK	



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Discharge Wizard Results for Storm

Summary

Discharge Rates Check - Fail

Discharge Volumes Check - Pass

Minimal Discharge Check - Not Run

Discharge Rates Check

PN	RP(yrs)/ CC(%)	Pre-development Discharge Rate (l/s)	Post-development Discharge Rate (l/s)	Pass/Fail
1.007	100yr +0%	2.4	5.0	Fail

Discharge Volumes Check

PN	Volume Calculation Method	Pre-development Volume (m³)	Post-development Volume (m³)	Pass/Fail
1.007	Greenfield	62.559 *	60.483	Pass

(Pre-development runoff volume (except those marked with '*') for the 100 year, 360 minutes, Summer storm)

(Post-development runoff volume for the 100 year, 360 minutes, Summer storm with 0% climate change)

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Discharge Wizard Results for Storm

Summary

Discharge Rates Check - Fail

Discharge Volumes Check - Fail

Minimal Discharge Check - Not Run

Discharge Rates Check

PN	RP(yrs)/ CC(%)	Pre-development Discharge Rate (l/s)	Post-development Discharge Rate (l/s)	Pass/Fail
1.007	100yr +0%	2.4	5.0	Fail

Discharge Volumes Check

PN	Volume Calculation Method	Pre-development Volume (m³)	Post-development Volume (m³)	Pass/Fail
1.007	Greenfield	62.559 *	67.733	Fail

(Pre-development runoff volume (except those marked with '*') for the 100 year, 360 minutes, Winter storm)

(Post-development runoff volume for the 100 year, 360 minutes, Winter storm with 0% climate change)

Appendix E

Pro-Forma 1: Sustainable Drainage System

PRO-FORMA 1: Sustainable Drainage System: Planning Permission

This pro-forma is a requirement of the Planning Validation Checklist. You **must complete all white boxes in full** and submit this pro-forma along with your supporting evidence to the Local Planning Authority for any application which seeks planning permission for major development (as defined in section 2 of [Statutory Instrument 2015 No. 595](#)).

This pro-forma supports developers and regulators in **summarising and confirming** how surface water from a development will be managed sustainably under current and future conditions. It should be completed in conjunction with the Council's 'Completing your Pro Forma' document and your sustainable drainage system should be designed in accordance with [CIRIA The SuDS Manual C753](#).

The pro-forma follows Policy CS24 of [Knowsley MBC's Local Plan](#), [National Planning Policy Framework](#), [House of Commons Written Statement \(HWSW 161\) on SuDS](#), [Planning Practice Guidance](#) and [Defra's Non-Statutory Technical Standards for Sustainable Drainage Systems](#). It is supported by the [Defra/EA Guidance on Rainfall Runoff Management](#) and can be completed using freely available tools such as [Tools for Sustainable Drainage Systems](#) or approved Industry Standard surface water management design software. The Council's [Sustainable Drainage & Surface Water Management Technical Guidance document](#) also provides further information.

Section 1: Development Details				
Development Name		Greene's Road, Whiston		
Development Address (including postcode)		Greene's Road	Planning Application Reference (if available)	
Development Grid Reference	Northings	390302	Expected lifetime of development (years)	100
	Eastings	346719	Have you submitted a Flood Risk Assessment?	Yes ☐ No ☒
Total Development Site Area (Ha)		0.2	Type of Planning Application (✓)	Outline ☐
Site area served by proposed drainage system (excluding open space) (Ha)*		0.129		Full ☒
Is your surface water drainage system designed to a (tick all that apply):				Hybrid ☐
Greenfield Standard - Site is undeveloped and a new drainage system will be installed; OR - Site is already developed and a new surface water drainage system will be installed to serve the new development.		☒		Reserved Matters ☐
Previously Developed Standard Site is already developed and the <u>entirety</u> of the existing surface water drainage system will be used to serve the new development.		☐		

PRO-FORMA 1: Sustainable Drainage System: Planning Permission

Section 2: Impermeable Area and Existing Drainage For outline or reserved matters applications, go to Section 3

	Existing (E)	Proposed (P)	Difference (P – E)	Evidence Checklist	
Impermeable Area (Ha)	0	0.129	0.129	☐	Plans showing development layout of site with existing and proposed impermeable areas.
State Drainage Method	Greenfield / slabs	Pipes	N/A	☒	Plans showing current and proposed locations of sustainable drainage system.
Are there existing sewers, watercourses, water bodies, highway drains, soakaways or filter drains on the site?			Yes ☐ No ☒	☐	Plans showing existing layout to include: • Watercourses, open or culverted • Water bodies – ponds, swales etc. • Sewers, including manholes • Highway drains, include manholes • Soakaways, filter drains

Section 3: Surface Water Discharge Hierarchy – Planning Practice Guidance

Surface Water Discharge Method	Proposed?	If YES - Evidence Checklist		If NO - Evidence Checklist	
1. Infiltration to ground	Yes ☐ No ☒	☐	Completed Infiltration Checklist from CIRIA The SuDS Manual C753 Appendix B <i>An editable version of this form is available on SusDrain website.</i>	☐	Geotechnical Survey, including Soil Permeability Testing stating Percolation Coefficient, in accordance with BRE 365 AND Statement providing justification in your Sustainable Drainage Strategy
2. Discharge to watercourse or surface water body (Main River or Ordinary)	Yes ☐ No ☒	☐	Watercourse and/or Water Body Survey Report	☐	Plan showing nearby watercourses and water bodies AND Statement providing justification in your Sustainable Drainage Strategy
3. Discharge to surface water sewer	Yes ☐ No ☒	☒	Water and Sewerage Company written agreement for the Right to Connect.	☒	Plan showing nearby sewers AND Statement providing justification in your Sustainable Drainage Strategy
4. Discharge to combined sewer	Yes ☒ No ☐				

PRO-FORMA 1: Sustainable Drainage System: Planning Permission

Section 4: Calculate Peak Discharge Rates – Technical Standards S2 and S3 (unless S1 applies)

Rainfall Event	Existing Rate (l/s)	Greenfield Rate (l/s)	Proposed Rate (l/s) <i>Brownfield sites must reduce discharge rates by 50%</i>	Evidence Checklist	
Qbar	1.1	1.1		☒	MicroDrainage (or equivalent) calculations
1:1 Year Event	1.0	1.0	5		
1:30 Year Event	1.9	1.9	5		
1:100 Year Event	2.4	2.4	5		

Section 5: Calculate Discharge Volume – Technical Standards S4 and S6 (unless S1 applies)

Rainfall Event	Existing Volume (m ³)	Greenfield Volume (m ³)	Proposed Volume (m ³)	Evidence Checklist	
1:100 Year 6 Hour Event	62.55	62.55	67.73 / 60.48	☒	MicroDrainage (or equivalent) calculations

Section 6: Infiltration

Site Information	✓	Evidence Checklist	
Do your sustainable drainage proposals include any infiltration?	Yes ☐ No ☒ <i>If NO, please move on to Section 7</i>	☐	Proposed sustainable drainage plans
You should submit an alternative 'Plan B' sustainable drainage design utilising an alternative discharge method if site specific ground conditions are unknown at this stage. This will become the default design in the event infiltration proposals are not feasible upon site specific ground investigation. Have you submitted an alternative 'Plan B' sustainable drainage design?	Yes ☐ No ☒	☐	'Plan B' conceptual sustainable drainage plans and statement of approach

PRO-FORMA 1: Sustainable Drainage System: Planning Permission

Section 7: Storage – Technical Standards S7, S8 and S9

Storage Details	Details	Evidence Checklist	
State climate change allowance used (%)	40	☒	State / use in MicroDrainage
State storage volume provided (m ³) (excluding non-void spaces) <i>Must include an allowance for climate change and urban creep.</i>	36	☒	Drainage plans showing location of attenuation and all flow control devices and any supporting calculations
Summarise how storage will be provided for 1:30 year event on site. <i>Storage must be designed to ensure that at no flooding occurs onsite in a 1 in 30 year event except in designed areas and no flooding occurs offsite in a 1 in 100 year (+ climate change allowance) event.</i>	Pipe network and off line cellular attenuation. Flow control provided by hydro-brake	☒	Plans showing size and location of storage and supporting calculations
Summarise how storage will be provided for 1:100 year (+ climate change) 6 hour event on site. <i>Where storage above the 1:30 year rainfall event is provided in designated areas designed to accommodate excess surface water volumes, plans showing storage locations and surface water depths and supported by MicroDrainage (or equivalent) calculations.</i>	Pipe network and off line cellular attenuation. Flow control provided by hydro-brake	☒	Plans showing size and location of storage and supporting calculations

Section 8: Operation and Maintenance – Technical Standard S12 and HCWS161

Consideration	Select <u>ALL</u> that apply (✓)		Evidence Checklist	
State how <u>ALL</u> components of the sustainable drainage system will be maintained for the design life of the development.	Sustainable drainage features are at property level	☐	☒	Statement provided within your Sustainable Drainage Strategy
	Sustainable drainage system to be adopted by Water and Sewerage Company through a Section 104 agreement (Water Industry Act 1991)	☐		
	Applicant to secure maintenance of sustainable drainage features by entering into a Section 106 agreement (Town and Country Planning Act 1990)	☒		

PRO-FORMA 1: Sustainable Drainage System: Planning Permission

Declaration and Submission

This pro-forma has been completed using evidence from information which has been submitted with my planning application.

The information submitted in the Sustainable Drainage Strategy and site-specific Flood Risk Assessment (FRA), where submitted, is proportionate to the site conditions, flood risks and magnitude of development and I agree that this information can be used as evidence to this sustainable drainage approach.

Submitter Details

Form <u>completed</u> by	Dave Samuels	Email Address	dave.samuels@sutcliffe.co.uk
		Daytime Telephone	0151 227 3155
Form <u>signed off</u> by	Dave Samuels	Accreditation(s) and/or Qualification(s) of Signatory	BEng(Hons) CEng MIStructE MaPS
Date (dd/mm/yyyy)	22.09.21	Company	Sutcliffe Projects

Client Details

Name	David Belcher	Company	Built Group Ltd
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