TWEDDELL & SLATER
CONSULTING CIVIL & STRUCTURAL ENGINEERS

Unit 2, Mereside
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PROPOSED RESIDENTIAL DEVELOPMENT
MORESBY PARKS, CUMBRIA
DRAINAGE STRATEGY

Introduction

Tweddell and Slater Ltd have been appointed to prepare a surface water and foul drainage statement that is compliant with the National Planning Policy.

This report has been prepared in support of a residential development at Moresby Parks, near Whitehaven in Cumbria. Proposals specify approximately 56 dwellings on an area of land totalling 2.88Ha. The closest postcode to the site is CA28 8UX and the development area is currently greenfield.

The layout of the proposed site is indicated in Figure 1 below.

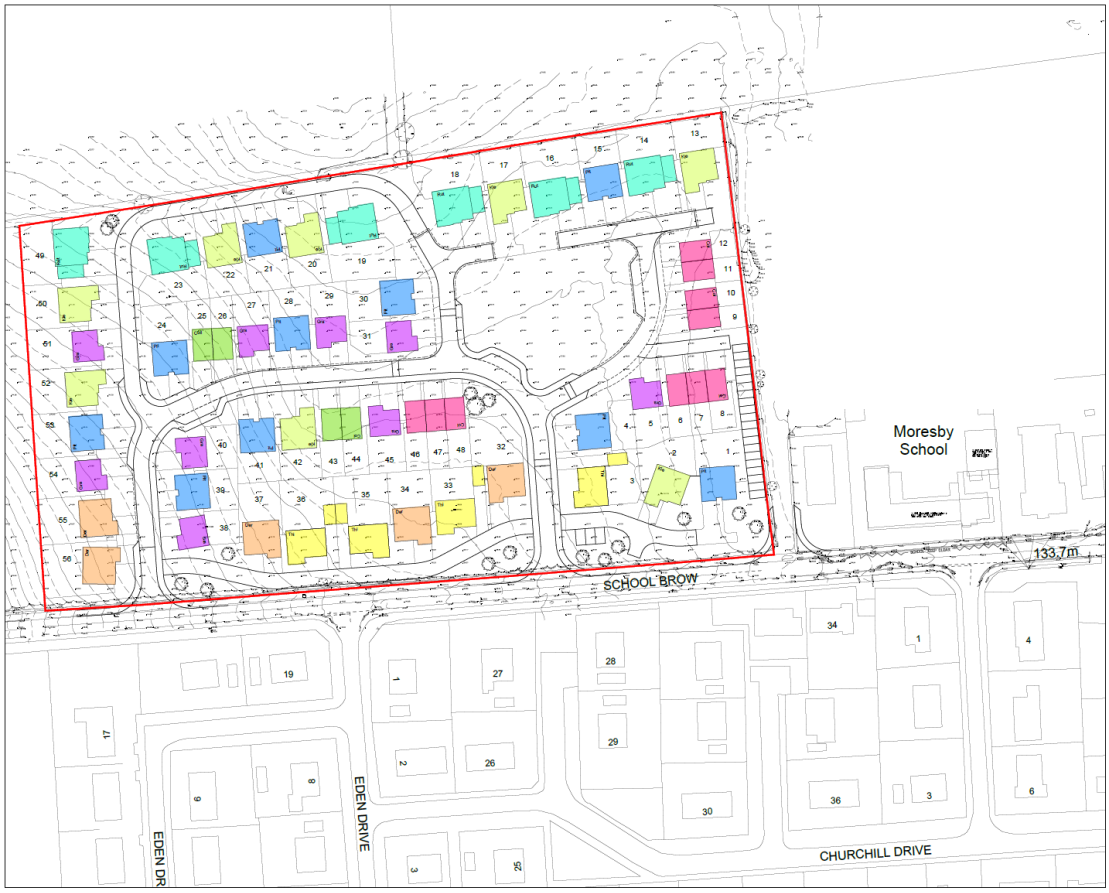

Figure 1 – Proposed Site Plan

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In accordance with the recognised guidance, there is a hierarchy of where surface water should be discharged. This hierarchy where practicable, is as follows:

1) Infiltration
2) Watercourse
3) Public sewer

A site walkover was undertaken in June 2023. The existing site surface water appears to be drained straight to ground. An analysis of the area's topography has shown that overland flow generated in saturated conditions would generally fall to the northeast, in the direction of an unnamed tributary of Lowca Beck. This tributary joins Lowca Beck approximately 1.5km northwest of the development.

The EA flood risk maps and flood map for planning show that the entirety of the site is not identified as at risk from flooding from rivers and is categorised as Flood Zone 1. Flood Zone 1 is considered to be land having a 1 in 1000 or lesser annual probability of river or sea flooding.

By review of the government long term flood risk information, it has been determined that the site is at a very low risk from surface water flooding (Appendix D).

Existing Site Runoff

The greenfield runoff rate calculation for the site is shown within Appendix B. The greenfield runoff rates for the site are shown below:

Event	Greenfield Runoff Rate
1 in 1 year	22.24 l/s
Q Bar	25.57 l/s
1 in 30 years	43.46 l/s
1 in 100 years	53.18 l/s

Soil infiltration testing has been undertaken by the client in June 2015 in accordance with the method prescribed in BRE Digest 365. Percolation testing was undertaken in several trial pits within the field to the east of Moresby School. Infiltration testing demonstrated that the ground has insufficient infiltration properties to allow for the usage of soakaways and permeable paving. As this field is less than 200m from the site boundary, these test results are assumed to provide an accurate representation of the conditions within the development boundary.

The closest watercourse to the site is the previously mentioned unnamed tributary of Lowca Beck. This watercourse runs along the eastern edge of the adjacent field and is approximately 120m to the northeast of the development. The unnamed watercourse is not classified as a main river by the Environment Agency (EA). The closest main river to the site is Lowca Beck located approximately 1.5km northwest at the closest point. Due to the proximity of the unnamed tributary, discharging to this watercourse is considered to be a viable option for the development.

Sewer records obtained from United Utilities (UU) show that there is a 150mm diameter surface water sewer running within the private gardens to the south of School Brow. This is approximately 20m to the south of the site at the closest point (Appendix F).

Surface Water Proposals

A surface water drainage strategy (Appendix A) has therefore been developed to discharge the runoff generated by the proposed access road and roof areas to the unnamed watercourse to the northeast of the development. This is in line with the drainage hierarchy as infiltration is not a viable option in this location.

To achieve a discharge rate in line with the site's Q_{BAR} value of 25.57 l/s it is proposed to attenuate surface water within a basin prior to discharge. As there is insufficient space for such a structure on site, it is proposed that the basin will be located a short distance offsite - within the field to the northeast as agreed with the landowner. Discharge rates are to be controlled via a flow control device downstream of the proposed basin. To minimise impermeable area on site and to improve water quality, the proposed driveways are to be of a permeable construction.

The attenuation basin and surface water system will be designed such that there will be no flooding in events up to 30 years. An allowance for climate change of a 40% increase in flows and an urban creep allowance of 10% have also been included within the calculation.

The proposed surface water drainage system will be designed to building regulations to ensure the structural integrity under anticipated loading conditions over the design life, this includes the cover to pipes that have been designed in accordance with the manufacturer's requirements and specification.

Foul System Proposal

From UU records the closest foul sewer is located beneath School Brow, approximately 75m southeast of the development. School Brow has a significant gradient sloping away from the site and as such connecting to the existing UU manhole will be possible via gravity.

The use of a foul drainage field is not viable due to the ground conditions.

The proposed foul water drainage system will be designed to building regulations to ensure the structural integrity under anticipated loading conditions over the design life this includes the cover to pipes that have been designed in accordance with the manufacturer's requirements and specification.

Simon Johnston Meng GMICE
For Tweddell & Slater Ltd
Unit 2 Mereside Greenbank Road
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June 2023

APPENDIX A -
DRAINAGE STRATEGY DRAWING

Revision Notes

A	26/06/23	Drainage adjusted to suit latest site layout
B	28/06/23	Amendments to SW numbering scheme

PRELIMINARY

Suitability --

Project

WEST SITE

MORESBY PARKS

Client

Drawing

OUTLINE DRAINAGE STRATEGY

SHEET 1 OF 3

Project no	Drawing no	Date	Drawn by	Rev	Scale	Sheet
7584	200	JUN 23	SJ	B	1:250	A1

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SCHOOL BROW

Revision Notes

A	26/06/23	Drainage adjusted to suit latest site layout
B	28/06/23	Adjustments to foul + SW drainage layouts + levels

PRELIMINARY

Suitability --

Project
WEST SITE
MORESBY PARKS

Client

Drawing
OUTLINE DRAINAGE STRATEGY
SHEET 2 OF 3

Project no	Drawing no	Date	Drawn by	Rev	Scale	Sheet
7584	201	JUN 23	SJ	B	1:250	A1

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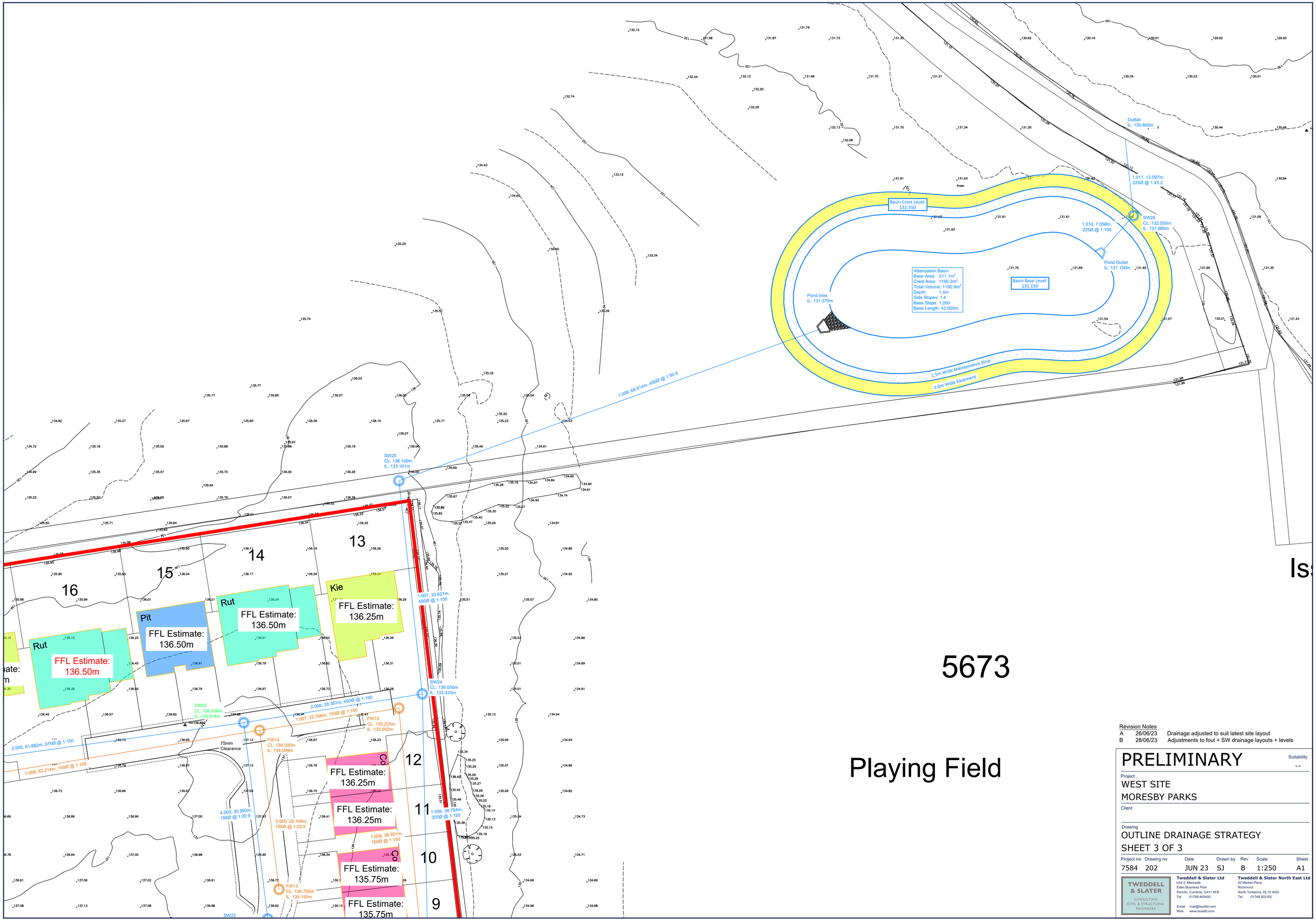

Revision Notes

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PRELIMINARY

Suitability --

Project
WEST SITE
MORESBY PARKS

Client

Drawing
OUTLINE DRAINAGE STRATEGY
SHEET 3 OF 3

Project no	Drawing no	Date	Drawn by	Rev	Scale	Sheet
7584	202	JUN 23	SJ	B	1:250	A1

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APPENDIX B -
GREENFIELD RUNOFF CALCULATIONS

hrwallingford

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Simon Johnston
Site name:	Plot A
Site location:	Moresby park

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:	54.56221° N
Longitude:	3.55707° W
Reference:	358152079
Date:	May 26 2023 12:42

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	2.88045

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):	1178	1178
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

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.

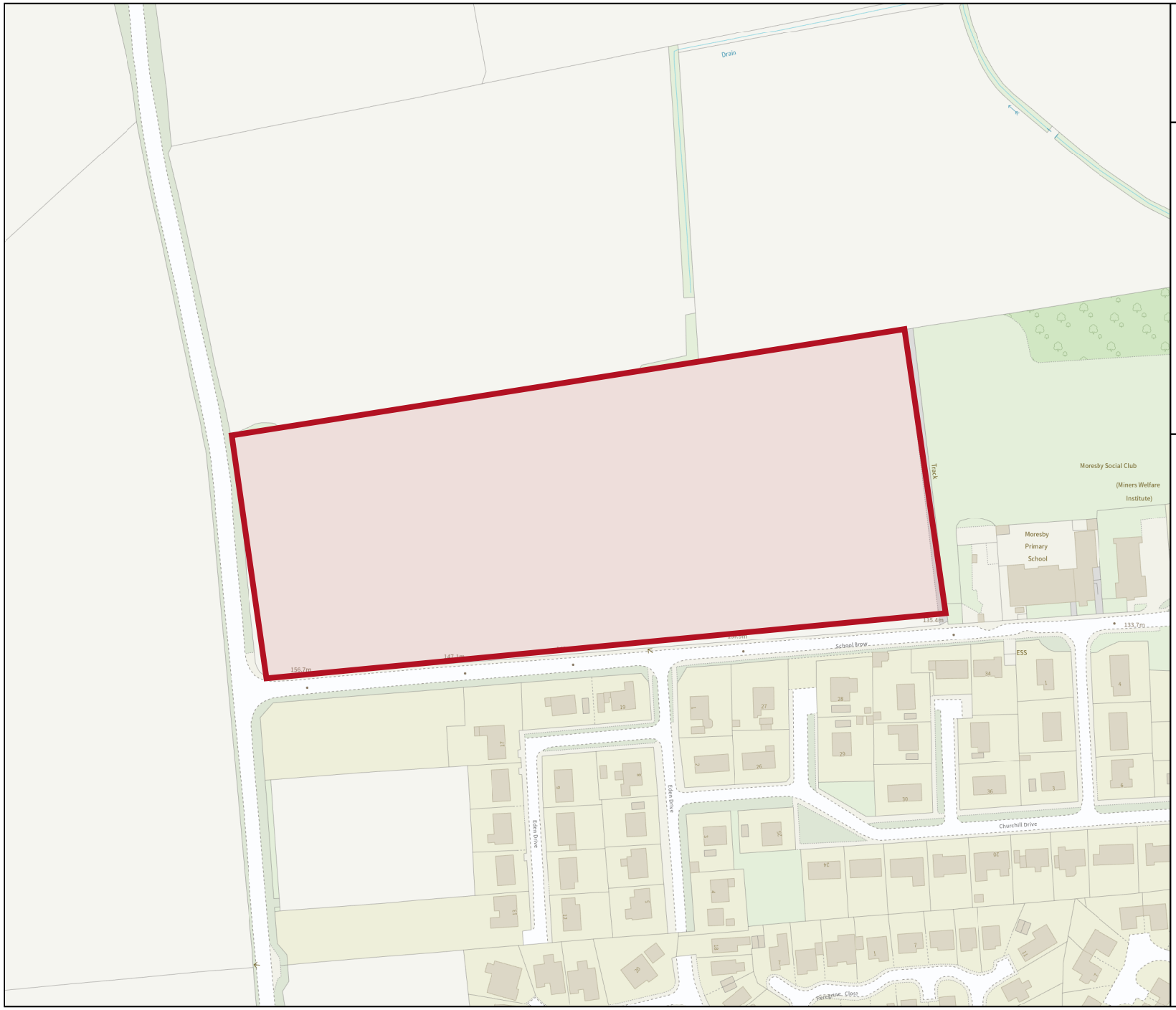
(3) Is SPR/SPRHOST ≤ 0.3?

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):	25.57	25.57
1 in 1 year (l/s):	22.24	22.24
1 in 30 years (l/s):	43.46	43.46
1 in 100 year (l/s):	53.18	53.18
1 in 200 years (l/s):	60.6	60.6

APPENDIX C -
EA FLOOD MAP FOR PLANNING AND LONG-TERM FLOOD RISK



Environment Agency

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
299325/519686

Scale
1:2500

Created
26 May 2023 12:21

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

APPENDIX D -
ATTENUATION VOLUMES CALCULATION

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	x
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
SW1	0.032	5.00	141.150	1200	1.350
SW2	0.058	5.00	139.350	1200	1.350
SW3	0.045	5.00	138.550	1200	1.425
SW4	0.033	5.00	137.450	1200	1.425
SW5	0.032	5.00	136.800	1200	1.425
SW6	0.031	5.00	135.700	1200	1.567
SW7	0.037	5.00	135.575	1200	1.842
SW8	0.052	5.00	143.350	1200	1.350
SW9	0.039	5.00	142.750	1200	1.350
SW10	0.039	5.00	142.000	1200	1.450
SW11	0.062	5.00	138.800	1200	1.438
SW12	0.088	5.00	137.500	1200	2.701
SW13	0.032	5.00	141.500	1200	1.350
SW14	0.047	5.00	138.800	1200	1.350
SW15	0.035	5.00	138.400	1200	1.425
SW16	0.054	5.00	136.100	1200	1.554
SW17	0.035	5.00	136.050	1200	1.603
SW18	0.054	5.00	136.000	1350	2.000
SW19	0.020	5.00	138.000	1200	1.350
SW20	0.031	5.00	137.600	1200	1.350
SW21	0.028	5.00	136.950	1200	1.350
SW22	0.032	5.00	136.650	1200	1.350
SW23	0.068	5.00	136.500	1350	2.986
SW24	0.055	5.00	136.050	1350	2.725
SW25			136.100	1350	2.999
POND INLET			132.550		1.190
POND OUTLET		5.00	132.550		1.400
SW26			132.550	1800	1.470
OUTFALL			131.200		0.400

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	SW1	SW2	50.751	0.600	139.800	138.000	1.800	28.2	150	5.44	50.0
1.001	SW2	SW3	28.079	0.600	138.000	137.200	0.800	35.1	150	5.72	50.0
1.002	SW3	SW4	32.066	0.600	137.125	136.025	1.100	29.2	225	5.94	50.0
1.003	SW4	SW5	17.646	0.600	136.025	135.375	0.650	27.1	225	6.06	50.0
1.004	SW5	SW6	25.713	0.600	135.375	134.208	1.167	22.0	225	6.21	50.0
1.005	SW6	SW7	60.020	0.600	134.133	133.733	0.400	150.0	300	6.99	50.0
1.006	SW7	SW24	38.764	0.600	133.733	133.475	0.258	150.0	300	7.49	50.0
2.000	SW8	SW9	19.161	0.600	142.000	141.400	0.600	31.9	150	5.18	50.0
2.001	SW9	SW10	13.434	0.600	141.400	140.550	0.850	15.8	150	5.27	50.0
2.002	SW10	SW11	32.365	0.600	140.550	137.437	3.113	10.4	150	5.44	50.0
2.003	SW11	SW12	63.849	0.600	137.362	134.799	2.563	24.9	225	5.84	50.0
2.004	SW12	SW18	33.957	0.600	134.799	134.150	0.649	52.3	225	6.15	50.0
3.000	SW13	SW14	41.036	0.600	140.150	137.450	2.700	15.2	150	5.26	50.0
3.001	SW14	SW15	9.097	0.600	137.450	137.050	0.400	22.7	150	5.33	50.0
3.002	SW15	SW16	66.486	0.600	136.975	134.621	2.354	28.2	225	5.78	50.0
3.003	SW16	SW17	9.896	0.600	134.546	134.447	0.099	100.0	300	5.89	50.0
3.004	SW17	SW18	25.644	0.600	134.447	134.075	0.372	68.9	300	6.11	50.0
2.005	SW18	SW23	61.682	0.600	134.000	133.589	0.411	150.0	375	6.85	50.0
4.000	SW19	SW20	18.921	0.600	136.650	136.250	0.400	47.3	150	5.22	50.0
4.001	SW20	SW21	26.771	0.600	136.250	135.600	0.650	41.2	150	5.50	50.0
4.002	SW21	SW22	18.106	0.600	135.600	135.300	0.300	60.4	150	5.73	50.0
4.003	SW22	SW23	30.993	0.600	135.300	133.814	1.486	20.9	150	5.96	50.0
2.006	SW23	SW24	28.357	0.600	133.514	133.325	0.189	150.0	450	7.14	50.0
1.007	SW24	SW25	33.621	0.600	133.325	133.101	0.224	150.1	450	7.83	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.903	33.6	8.1	1.200	1.200	0.032	0.0	50	1.571
1.001	1.704	30.1	22.8	1.200	1.200	0.090	0.0	98	1.869
1.002	2.432	96.7	34.2	1.200	1.200	0.135	0.0	92	2.223
1.003	2.521	100.2	42.5	1.200	1.200	0.168	0.0	102	2.422
1.004	2.799	111.3	50.6	1.200	1.267	0.200	0.0	107	2.739
1.005	1.281	90.6	58.4	1.267	1.542	0.231	0.0	175	1.358
1.006	1.281	90.6	67.8	1.542	2.275	0.268	0.0	194	1.401
2.000	1.787	31.6	13.2	1.200	1.200	0.052	0.0	68	1.710
2.001	2.546	45.0	23.0	1.200	1.300	0.091	0.0	76	2.558
2.002	3.142	55.5	32.9	1.300	1.213	0.130	0.0	83	3.268
2.003	2.632	104.6	48.6	1.213	2.476	0.192	0.0	108	2.584
2.004	1.812	72.0	70.8	2.476	1.625	0.280	0.0	182	2.055
3.000	2.597	45.9	8.1	1.200	1.200	0.032	0.0	42	1.962
3.001	2.120	37.5	20.0	1.200	1.200	0.079	0.0	78	2.157
3.002	2.471	98.2	28.8	1.200	1.254	0.114	0.0	83	2.152
3.003	1.572	111.1	42.5	1.254	1.303	0.168	0.0	129	1.471
3.004	1.896	134.0	51.4	1.303	1.625	0.203	0.0	129	1.774
2.005	1.477	163.1	135.9	1.625	2.536	0.537	0.0	263	1.644
4.000	1.466	25.9	5.1	1.200	1.200	0.020	0.0	45	1.140
4.001	1.572	27.8	12.9	1.200	1.200	0.051	0.0	72	1.543
4.002	1.297	22.9	20.0	1.200	1.200	0.079	0.0	109	1.458
4.003	2.215	39.1	28.1	1.200	2.536	0.111	0.0	94	2.404
2.006	1.657	263.6	181.1	2.536	2.275	0.716	0.0	275	1.780
1.007	1.657	263.5	262.8	2.275	2.549	1.039	0.0	370	1.875

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.008	SW25	POND INLET	69.914	0.600	133.101	131.370	1.731	40.4	450	8.20	50.0
1.010	POND OUTLET	SW26	7.058	0.600	131.150	131.080	0.070	100.8	300	5.08	50.0
1.011	SW26	OUTFALL	12.097	0.600	131.080	130.800	0.280	43.2	300	5.16	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.008	3.206	509.9	262.8	2.549	0.730	1.039	0.0	229	3.228
1.010	1.565	110.7	0.0	1.100	1.170	0.000	0.0	0	0.000
1.011	2.398	169.5	0.0	1.170	0.100	0.000	0.0	0	0.000

Simulation Settings

Rainfall Methodology	FSR
FSR Region	England and Wales
M5-60 (mm)	17.000
Ratio-R	0.300
Summer CV	1.000
Winter CV	1.000
Analysis Speed	Detailed
Skip Steady State	x
Drain Down Time (mins)	240

Additional Storage (m³/ha)	20.0
Check Discharge Rate(s)	✓
1 year (l/s)	22.2
2 year (l/s)	23.7
30 year (l/s)	43.4
100 year (l/s)	53.1
Check Discharge Volume	✓
100 year +40% 360 minute (m³)	1312

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	10	0
2	0	10	0
30	0	10	0
100	0	10	0
100	40	10	0

Pre-development Discharge Rate

Site Makeup	Greenfield
Greenfield Method	IH124
Positively Drained Area (ha)	2.873
SAAR (mm)	1178
Soil Index	4
SPR	0.47
Region	10
Growth Factor 1 year	0.85

Growth Factor 30 year	1.95
Growth Factor 100 year	2.48
Betterment (%)	0
QBar	25.5
Q 1 year (l/s)	
Q 30 year (l/s)	
Q 100 year (l/s)	

Pre-development Discharge Volume

Site Makeup	Greenfield
Greenfield Method	FSR/FEH
Positively Drained Area (ha)	2.873
Soil Index	4
SPR	0.47
CWI	125.445

Return Period (years)	100
Climate Change (%)	40
Storm Duration (mins)	360
Betterment (%)	0
PR	0.536
Runoff Volume (m³)	1312

Node SW26 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	131.080	Product Number	CTL-SHE-0220-2560-1070-2560
Design Depth (m)	1.070	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	25.6	Min Node Diameter (mm)	1500

Node POND OUTLET Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	42.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	131.150	Main Channel Slope (1:X)	200.0
Safety Factor	2.0	Time to half empty (mins)	216	Main Channel n	0.030

Inlets

POND INLET

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	511.1	0.0	1.400	1190.3	0.0

Approval Settings

Node Size	x	Backdrops	x	Return Period (years)	100
Node Losses	x	Full Bore Velocity	x	Discharge Rates	✓
Link Size	x	Proportional Velocity	x	1 year (l/s)	25.6
Link Length	x	Surcharged Depth	x	30 year (l/s)	25.6
Coordinates	x	Flooding	✓	100 year (l/s)	25.6
Crossings	x	Return Period (years)	30	Discharge Volume	✓
Cover Depth	x	Time to Half Empty	✓	100 year +40% 360 minute (m³)	1312

Approval Results

The network has been designed for a 1 in 100 year storm using FSR rainfall
It contains 29 nodes (1 outfall) and 27 links
The total impermeable area is 1.039 ha
1 online control has been defined
1 structure has been defined, providing 1071m³ of storage below the flood risk level
Infiltration has not been utilised
Simulations have been completed using FSR summer and winter storms from 15 to 1440 minute duration

The node size test has not been completed

The node losses test has not been completed

The link size test has not been completed

The link length test has not been completed

The coordinates test has not been completed

The crossings test has not been completed

The cover depth test has not been completed

The backdrops test has not been completed

The full bore velocity test has not been completed

The proportional velocity test has not been completed

The surcharged depth test has not been completed

No nodes flood during the 30 year return period

No infiltrating structures failed to half empty in 1440 minutes during the 100 year return period

No outfalls have a discharge rate greater than 25.6l/s during the 1 year return period

No outfalls have a discharge rate greater than 25.6l/s during the 30 year return period

No outfalls have a discharge rate greater than 25.6l/s during the 100 year return period

No outfalls have a discharge volume greater than 1312m³ during the 100 year 360 minute storm

Results for 1 year +10% A Critical Storm Duration. Lowest mass balance: 99.07%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	10	139.838	0.038	4.8	0.0628	0.0000	OK
15 minute summer	SW2	11	138.072	0.072	13.5	0.1486	0.0000	OK
15 minute summer	SW3	11	137.194	0.069	19.8	0.1256	0.0000	OK
15 minute summer	SW4	11	136.104	0.079	24.6	0.1291	0.0000	OK
15 minute summer	SW5	11	135.457	0.082	29.3	0.1327	0.0000	OK
15 minute summer	SW6	11	134.262	0.128	33.9	0.2012	0.0000	OK
15 minute summer	SW7	12	133.873	0.140	39.4	0.2206	0.0000	OK
15 minute summer	SW8	10	142.051	0.051	7.9	0.1010	0.0000	OK
15 minute summer	SW9	10	141.458	0.058	13.7	0.1030	0.0000	OK
15 minute summer	SW10	10	140.613	0.063	19.5	0.1077	0.0000	OK
15 minute summer	SW11	11	137.442	0.080	28.7	0.1656	0.0000	OK
15 minute summer	SW12	11	134.926	0.127	41.6	0.2351	0.0000	OK
15 minute summer	SW13	10	140.183	0.033	4.8	0.0539	0.0000	OK
15 minute summer	SW14	10	137.512	0.062	11.8	0.1169	0.0000	OK
15 minute summer	SW15	11	137.039	0.063	17.0	0.1060	0.0000	OK
15 minute summer	SW16	11	134.651	0.105	24.6	0.1983	0.0000	OK
15 minute summer	SW17	10	134.545	0.098	29.8	0.1584	0.0000	OK
15 minute summer	SW18	11	134.188	0.188	79.1	0.3798	0.0000	OK
15 minute summer	SW19	10	136.684	0.034	3.0	0.0500	0.0000	OK
15 minute summer	SW20	10	136.303	0.053	7.7	0.0874	0.0000	OK
15 minute summer	SW21	11	135.680	0.080	11.8	0.1270	0.0000	OK
15 minute summer	SW22	11	135.369	0.069	16.3	0.1146	0.0000	OK
15 minute summer	SW23	11	133.728	0.214	103.5	0.4142	0.0000	OK
15 minute summer	SW24	12	133.580	0.254	147.6	0.4772	0.0000	OK
15 minute summer	SW25	12	133.268	0.167	148.7	0.2390	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW1	1.000	SW2	4.7	0.817	0.140	0.2986	
15 minute summer	SW2	1.001	SW3	13.2	1.626	0.440	0.2287	
15 minute summer	SW3	1.002	SW4	19.8	1.753	0.205	0.3628	
15 minute summer	SW4	1.003	SW5	24.7	1.950	0.247	0.2238	
15 minute summer	SW5	1.004	SW6	29.4	2.323	0.264	0.3257	
15 minute summer	SW6	1.005	SW7	34.1	1.130	0.376	1.8214	
15 minute summer	SW7	1.006	SW24	38.3	1.217	0.423	1.2192	
15 minute summer	SW8	2.000	SW9	7.8	1.348	0.248	0.1112	
15 minute summer	SW9	2.001	SW10	13.6	2.052	0.302	0.0891	
15 minute summer	SW10	2.002	SW11	19.3	2.820	0.347	0.2212	
15 minute summer	SW11	2.003	SW12	28.4	1.621	0.271	1.1395	
15 minute summer	SW12	2.004	SW18	41.3	1.838	0.573	0.7630	
15 minute summer	SW13	3.000	SW14	4.7	1.003	0.103	0.1978	
15 minute summer	SW14	3.001	SW15	11.7	1.791	0.311	0.0592	
15 minute summer	SW15	3.002	SW16	16.8	1.849	0.171	0.6048	
15 minute summer	SW16	3.003	SW17	24.7	1.180	0.222	0.2071	
15 minute summer	SW17	3.004	SW18	30.0	1.423	0.224	0.5657	
15 minute summer	SW18	2.005	SW23	77.4	1.460	0.474	3.2967	
15 minute summer	SW19	4.000	SW20	3.0	0.694	0.115	0.0819	
15 minute summer	SW20	4.001	SW21	7.6	1.000	0.272	0.2028	
15 minute summer	SW21	4.002	SW22	11.6	1.329	0.508	0.1586	
15 minute summer	SW22	4.003	SW23	16.3	2.086	0.417	0.2427	
15 minute summer	SW23	2.006	SW24	102.8	1.235	0.390	2.3601	
15 minute summer	SW24	1.007	SW25	148.7	2.041	0.564	2.4529	
15 minute summer	SW25	1.008	POND INLET	148.7	2.817	0.292	3.6913	

Results for 1 year +10% A Critical Storm Duration. Lowest mass balance: 99.07%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	POND INLET	12	131.404	0.043	148.7	0.0000	0.0000	OK
120 minute summer	POND OUTLET	82	131.394	0.244	78.8	0.0000	0.0000	OK
120 minute winter	SW26	78	131.417	0.337	45.9	0.8579	0.0000	SURCHARGED
15 minute summer	OUTFALL	1	130.800	0.000	25.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	POND INLET	Flow through pond	POND OUTLET	155.2	0.253	0.004	52.7499	
120 minute summer	POND OUTLET	1.010	SW26	34.6	0.732	0.312	0.4649	
120 minute winter	SW26	Hydro-Brake®	OUTFALL	25.6				157.6

Results for 30 year +10% A Critical Storm Duration. Lowest mass balance: 99.07%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	10	139.861	0.061	11.8	0.1006	0.0000	OK
15 minute summer	SW2	12	138.189	0.189	33.0	0.3927	0.0000	SURCHARGED
15 minute summer	SW3	10	137.237	0.112	47.4	0.2037	0.0000	OK
15 minute summer	SW4	10	136.159	0.134	59.5	0.2195	0.0000	OK
15 minute summer	SW5	10	135.510	0.135	70.8	0.2192	0.0000	OK
15 minute summer	SW6	12	134.371	0.238	81.6	0.3726	0.0000	OK
15 minute summer	SW7	12	134.148	0.415	92.2	0.6529	0.0000	SURCHARGED
15 minute summer	SW8	10	142.086	0.086	19.2	0.1696	0.0000	OK
15 minute summer	SW9	10	141.502	0.102	33.4	0.1809	0.0000	OK
15 minute summer	SW10	10	140.662	0.112	47.6	0.1927	0.0000	OK
15 minute summer	SW11	10	137.495	0.133	69.9	0.2762	0.0000	OK
15 minute summer	SW12	12	135.672	0.873	101.6	1.6133	0.0000	SURCHARGED
15 minute summer	SW13	10	140.202	0.052	11.8	0.0854	0.0000	OK
15 minute summer	SW14	10	137.562	0.112	29.0	0.2127	0.0000	OK
15 minute summer	SW15	10	137.077	0.102	41.4	0.1711	0.0000	OK
15 minute summer	SW16	10	134.726	0.180	61.0	0.3415	0.0000	OK
15 minute summer	SW17	12	134.642	0.195	73.1	0.3144	0.0000	OK
15 minute summer	SW18	12	134.569	0.568	173.9	1.1512	0.0000	SURCHARGED
15 minute summer	SW19	10	136.705	0.055	7.4	0.0795	0.0000	OK
15 minute summer	SW20	11	136.340	0.090	18.7	0.1476	0.0000	OK
15 minute summer	SW21	11	135.913	0.312	28.8	0.4959	0.0000	SURCHARGED
15 minute summer	SW22	11	135.422	0.122	37.7	0.2009	0.0000	OK
15 minute summer	SW23	12	134.071	0.557	222.7	1.0756	0.0000	SURCHARGED
15 minute summer	SW24	12	133.884	0.559	322.2	1.0488	0.0000	SURCHARGED
15 minute summer	SW25	12	133.365	0.264	323.6	0.3773	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW1	1.000	SW2	11.6	0.973	0.346	0.6137	
15 minute summer	SW2	1.001	SW3	30.8	1.864	1.022	0.4876	
15 minute summer	SW3	1.002	SW4	47.3	2.137	0.489	0.7091	
15 minute summer	SW4	1.003	SW5	59.0	2.385	0.588	0.4362	
15 minute summer	SW5	1.004	SW6	70.2	2.707	0.631	0.6803	
15 minute summer	SW6	1.005	SW7	78.9	1.317	0.872	3.9116	
15 minute summer	SW7	1.006	SW24	83.6	1.260	0.923	2.7297	
15 minute summer	SW8	2.000	SW9	19.1	1.639	0.603	0.2224	
15 minute summer	SW9	2.001	SW10	33.2	2.468	0.738	0.1807	
15 minute summer	SW10	2.002	SW11	47.1	3.437	0.848	0.4434	
15 minute summer	SW11	2.003	SW12	69.2	1.932	0.662	2.0479	
15 minute summer	SW12	2.004	SW18	86.4	2.172	1.199	1.3505	
15 minute summer	SW13	3.000	SW14	11.7	1.195	0.255	0.4001	
15 minute summer	SW14	3.001	SW15	28.5	2.165	0.760	0.1196	
15 minute summer	SW15	3.002	SW16	41.1	2.302	0.418	1.1891	
15 minute summer	SW16	3.003	SW17	60.8	1.466	0.547	0.4544	
15 minute summer	SW17	3.004	SW18	71.3	1.509	0.532	1.5249	
15 minute summer	SW18	2.005	SW23	166.4	1.629	1.020	6.8033	
15 minute summer	SW19	4.000	SW20	7.3	0.878	0.283	0.1582	
15 minute summer	SW20	4.001	SW21	18.5	1.161	0.665	0.3837	
15 minute summer	SW21	4.002	SW22	26.5	1.530	1.157	0.2979	
15 minute summer	SW22	4.003	SW23	37.9	2.434	0.968	0.5099	
15 minute summer	SW23	2.006	SW24	223.0	1.407	0.846	4.4930	
15 minute summer	SW24	1.007	SW25	323.6	2.297	1.228	4.2858	
15 minute summer	SW25	1.008	POND INLET	323.2	3.417	0.634	6.6119	

Results for 30 year +10% A Critical Storm Duration. Lowest mass balance: 99.07%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	POND INLET	136	131.651	0.291	145.8	0.0000	0.0000	OK
180 minute summer	POND OUTLET	136	131.650	0.500	95.7	0.0000	0.0000	SURCHARGED
180 minute summer	SW26	140	131.645	0.565	48.6	1.4374	0.0000	SURCHARGED
15 minute summer	OUTFALL	1	130.800	0.000	25.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
180 minute summer	POND INLET	Flow through pond	POND OUTLET	95.7	0.094	0.002	242.6643	
180 minute summer	POND OUTLET	1.010	SW26	48.6	0.814	0.439	0.4970	
180 minute summer	SW26	Hydro-Brake®	OUTFALL	25.6				430.7

Results for 100 year +10% A Critical Storm Duration. Lowest mass balance: 99.07%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	10	139.870	0.070	15.1	0.1157	0.0000	OK
15 minute summer	SW2	12	138.552	0.552	42.4	1.1449	0.0000	SURCHARGED
15 minute summer	SW3	11	137.247	0.122	54.6	0.2222	0.0000	OK
15 minute summer	SW4	10	136.173	0.148	69.3	0.2421	0.0000	OK
15 minute summer	SW5	12	135.565	0.190	84.1	0.3091	0.0000	OK
15 minute summer	SW6	12	134.964	0.831	95.2	1.3014	0.0000	SURCHARGED
15 minute summer	SW7	12	134.499	0.766	105.1	1.2042	0.0000	SURCHARGED
15 minute summer	SW8	10	142.102	0.102	24.6	0.2011	0.0000	OK
15 minute summer	SW9	12	141.633	0.233	42.9	0.4121	0.0000	SURCHARGED
15 minute summer	SW10	12	140.888	0.338	60.3	0.5817	0.0000	SURCHARGED
30 minute summer	SW11	20	137.774	0.412	84.4	0.8561	0.0000	SURCHARGED
15 minute summer	SW12	12	136.470	1.671	121.4	3.0875	0.0000	SURCHARGED
15 minute summer	SW13	10	140.209	0.059	15.1	0.0975	0.0000	OK
15 minute summer	SW14	11	137.657	0.207	37.2	0.3929	0.0000	SURCHARGED
15 minute summer	SW15	11	137.089	0.113	50.4	0.1896	0.0000	OK
15 minute summer	SW16	12	135.189	0.643	75.5	1.2192	0.0000	SURCHARGED
15 minute summer	SW17	12	135.136	0.689	86.0	1.1102	0.0000	SURCHARGED
15 minute summer	SW18	12	134.988	0.988	193.4	2.0002	0.0000	SURCHARGED
15 minute summer	SW19	10	136.713	0.062	9.5	0.0911	0.0000	OK
15 minute summer	SW20	12	136.651	0.401	24.1	0.6559	0.0000	SURCHARGED
15 minute summer	SW21	12	136.352	0.752	33.2	1.1933	0.0000	SURCHARGED
15 minute summer	SW22	12	135.869	0.569	42.0	0.9406	0.0000	SURCHARGED
15 minute summer	SW23	12	134.324	0.810	254.1	1.5645	0.0000	SURCHARGED
15 minute summer	SW24	12	134.080	0.755	379.4	1.4152	0.0000	SURCHARGED
15 minute summer	SW25	12	133.394	0.293	379.0	0.4190	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW1	1.000	SW2	14.9	1.014	0.444	0.6513	
15 minute summer	SW2	1.001	SW3	35.0	1.988	1.162	0.4943	
15 minute summer	SW3	1.002	SW4	54.4	2.228	0.563	0.7913	
15 minute summer	SW4	1.003	SW5	69.7	2.466	0.695	0.5466	
15 minute summer	SW5	1.004	SW6	81.2	2.673	0.729	0.9718	
15 minute summer	SW6	1.005	SW7	91.3	1.335	1.009	4.2266	
15 minute summer	SW7	1.006	SW24	105.2	1.494	1.161	2.7297	
15 minute summer	SW8	2.000	SW9	24.4	1.676	0.773	0.2874	
15 minute summer	SW9	2.001	SW10	41.8	2.511	0.930	0.2365	
15 minute summer	SW10	2.002	SW11	55.5	3.340	0.999	0.5698	
30 minute summer	SW11	2.003	SW12	80.7	2.133	0.772	2.5393	
15 minute summer	SW12	2.004	SW18	100.2	2.519	1.390	1.3505	
15 minute summer	SW13	3.000	SW14	15.0	1.227	0.327	0.4932	
15 minute summer	SW14	3.001	SW15	34.6	2.179	0.923	0.1453	
15 minute summer	SW15	3.002	SW16	50.4	2.293	0.513	1.9888	
15 minute summer	SW16	3.003	SW17	69.4	1.414	0.625	0.6969	
15 minute summer	SW17	3.004	SW18	78.2	1.491	0.584	1.8058	
15 minute summer	SW18	2.005	SW23	193.4	1.754	1.186	6.8033	
15 minute summer	SW19	4.000	SW20	9.4	0.893	0.363	0.2305	
15 minute summer	SW20	4.001	SW21	20.6	1.244	0.743	0.4713	
15 minute summer	SW21	4.002	SW22	26.9	1.531	1.176	0.3188	
15 minute summer	SW22	4.003	SW23	38.1	2.365	0.973	0.5456	
15 minute summer	SW23	2.006	SW24	253.9	1.602	0.963	4.4930	
15 minute summer	SW24	1.007	SW25	379.0	2.577	1.438	4.4991	
15 minute summer	SW25	1.008	POND INLET	376.3	3.536	0.738	7.4634	

Results for 100 year +10% A Critical Storm Duration. Lowest mass balance: 99.07%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	POND INLET	152	131.801	0.441	192.7	0.0000	0.0000	OK
180 minute summer	POND OUTLET	156	131.801	0.651	116.6	0.0000	0.0000	SURCHARGED
180 minute summer	SW26	156	131.796	0.716	27.1	1.8231	0.0000	SURCHARGED
15 minute summer	OUTFALL	1	130.800	0.000	25.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
180 minute summer	POND INLET	Flow through pond	POND OUTLET	116.6	0.121	0.003	354.0528	
180 minute summer	POND OUTLET	1.010	SW26	27.1	0.613	0.245	0.4970	
180 minute summer	SW26	Hydro-Brake®	OUTFALL	25.6				570.7

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.07%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	11	139.901	0.101	21.2	0.1662	0.0000	OK
15 minute summer	SW2	12	139.330	1.330	58.4	2.7608	0.0000	FLOOD RISK
30 minute summer	SW3	20	137.499	0.374	69.3	0.6834	0.0000	SURCHARGED
30 minute summer	SW4	20	136.975	0.950	87.0	1.5578	0.0000	SURCHARGED
30 minute summer	SW5	20	136.495	1.120	93.8	1.8201	0.0000	SURCHARGED
15 minute summer	SW6	12	135.578	1.445	108.2	2.2626	0.0000	FLOOD RISK
15 minute summer	SW7	12	134.971	1.238	123.1	1.9475	0.0000	SURCHARGED
15 minute summer	SW8	13	143.069	1.069	34.5	2.1138	0.0000	FLOOD RISK
15 minute summer	SW9	13	142.731	1.331	49.2	2.3518	0.0000	FLOOD RISK
30 minute summer	SW10	20	142.000	1.450	63.3	2.4984	0.1561	FLOOD
30 minute summer	SW11	19	138.800	1.438	91.2	2.9910	1.5605	FLOOD
30 minute summer	SW12	19	137.500	2.701	131.4	4.9914	0.6502	FLOOD
15 minute summer	SW13	10	140.221	0.071	21.2	0.1180	0.0000	OK
15 minute summer	SW14	11	138.039	0.589	52.1	1.1182	0.0000	SURCHARGED
15 minute summer	SW15	12	137.147	0.172	69.2	0.2876	0.0000	OK
15 minute summer	SW16	12	136.100	1.554	101.0	2.9448	0.8039	FLOOD
15 minute summer	SW17	12	136.015	1.568	98.7	2.5255	0.0000	FLOOD RISK
15 minute summer	SW18	12	135.754	1.754	236.0	3.5524	0.0000	FLOOD RISK
30 minute summer	SW19	20	137.451	0.801	12.6	1.1666	0.0000	SURCHARGED
30 minute summer	SW20	20	137.402	1.152	28.7	1.8841	0.0000	FLOOD RISK
30 minute summer	SW21	19	136.950	1.350	35.4	2.1425	1.3883	FLOOD
15 minute summer	SW22	12	136.559	1.259	47.6	2.0796	0.0000	FLOOD RISK
15 minute summer	SW23	12	134.762	1.248	310.1	2.4111	0.0000	SURCHARGED
15 minute summer	SW24	12	134.399	1.074	461.0	2.0138	0.0000	SURCHARGED
30 minute summer	SW25	20	133.442	0.341	458.3	0.4881	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW1	1.000	SW2	20.0	1.253	0.594	0.7654	
15 minute summer	SW2	1.001	SW3	42.8	2.432	1.422	0.4943	
30 minute summer	SW3	1.002	SW4	66.3	2.165	0.685	1.2753	
30 minute summer	SW4	1.003	SW5	77.8	2.438	0.776	0.7018	
30 minute summer	SW5	1.004	SW6	90.6	2.685	0.814	1.0226	
15 minute summer	SW6	1.005	SW7	105.2	1.495	1.162	4.2266	
15 minute summer	SW7	1.006	SW24	122.7	1.742	1.355	2.7297	
15 minute summer	SW8	2.000	SW9	25.2	1.686	0.798	0.3373	
15 minute summer	SW9	2.001	SW10	41.8	2.523	0.929	0.2365	
30 minute summer	SW10	2.002	SW11	53.5	3.445	0.963	0.5698	
30 minute summer	SW11	2.003	SW12	81.2	2.110	0.776	2.5393	
30 minute summer	SW12	2.004	SW18	110.8	2.786	1.538	1.3505	
15 minute summer	SW13	3.000	SW14	21.1	1.414	0.459	0.5308	
15 minute summer	SW14	3.001	SW15	47.1	2.677	1.258	0.1601	
15 minute summer	SW15	3.002	SW16	66.0	2.303	0.672	2.4058	
15 minute summer	SW16	3.003	SW17	87.5	1.392	0.787	0.6969	
15 minute summer	SW17	3.004	SW18	103.4	1.471	0.772	1.8058	
15 minute summer	SW18	2.005	SW23	235.6	2.136	1.444	6.8033	
30 minute summer	SW19	4.000	SW20	11.0	0.912	0.426	0.3331	
30 minute summer	SW20	4.001	SW21	21.2	1.243	0.764	0.4713	
30 minute summer	SW21	4.002	SW22	28.8	1.637	1.257	0.3188	
15 minute summer	SW22	4.003	SW23	39.9	2.312	1.019	0.5456	
15 minute summer	SW23	2.006	SW24	309.8	1.955	1.175	4.4930	
15 minute summer	SW24	1.007	SW25	460.6	3.000	1.748	4.8305	
30 minute summer	SW25	1.008	POND INLET	459.0	3.648	0.900	8.7977	

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.07%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	POND INLET	180	132.052	0.692	184.6	0.0000	0.0000	OK
180 minute winter	POND OUTLET	176	132.053	0.902	113.2	0.0000	0.0000	SURCHARGED
180 minute winter	SW26	176	132.048	0.967	48.2	2.4622	0.0000	SURCHARGED
15 minute summer	OUTFALL	1	130.800	0.000	25.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
180 minute winter	POND INLET	Flow through pond	POND OUTLET	113.2	0.112	0.003	564.3482	
180 minute winter	POND OUTLET	1.010	SW26	48.2	0.847	0.436	0.4970	
180 minute winter	SW26	Hydro-Brake®	OUTFALL	25.6				801.2

APPENDIX E -
UNITED UTILITIES SEWER RECORDS

Extract from Map of Water Mains

The position of underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available.

The actual positions may be different from those shown on the plan private service pipes may be shown by a broken blue line.

United Utilities will not accept any liability for any damage caused by the actual positions being different from those shown.

LEGEND

Proposed	Abandoned	Live	
			Distribution Main
			Trunk Main
			Comms Pipe
			Private Pipe
			Raw Water
			LDTM Raw Water
			LDTM Treated Water

MORESBY PARKS, WHITEHAVEN

Printed By : Property Searches Date: 15/08/2016

DO NOT SCALE

Approximate Scale: 1:5000

United Utilities
helping life flow smoothly

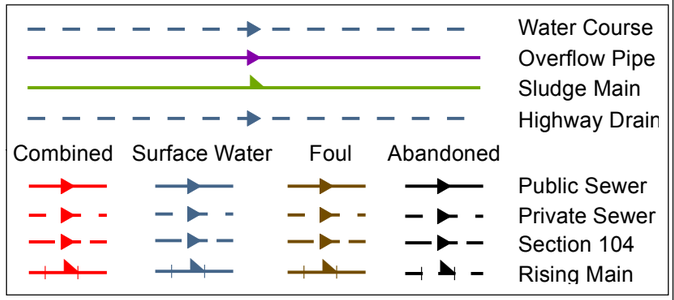
Extract from Map of Public Sewers

The position of underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available.

The actual positions may be different from those shown on the plan and private pipes, sewers or drains may not be recorded.

United Utilities will not accept any liability for any damage caused by the actual positions being different from those shown.

LEGEND



MORESBY PARKS, WHITEHAVEN

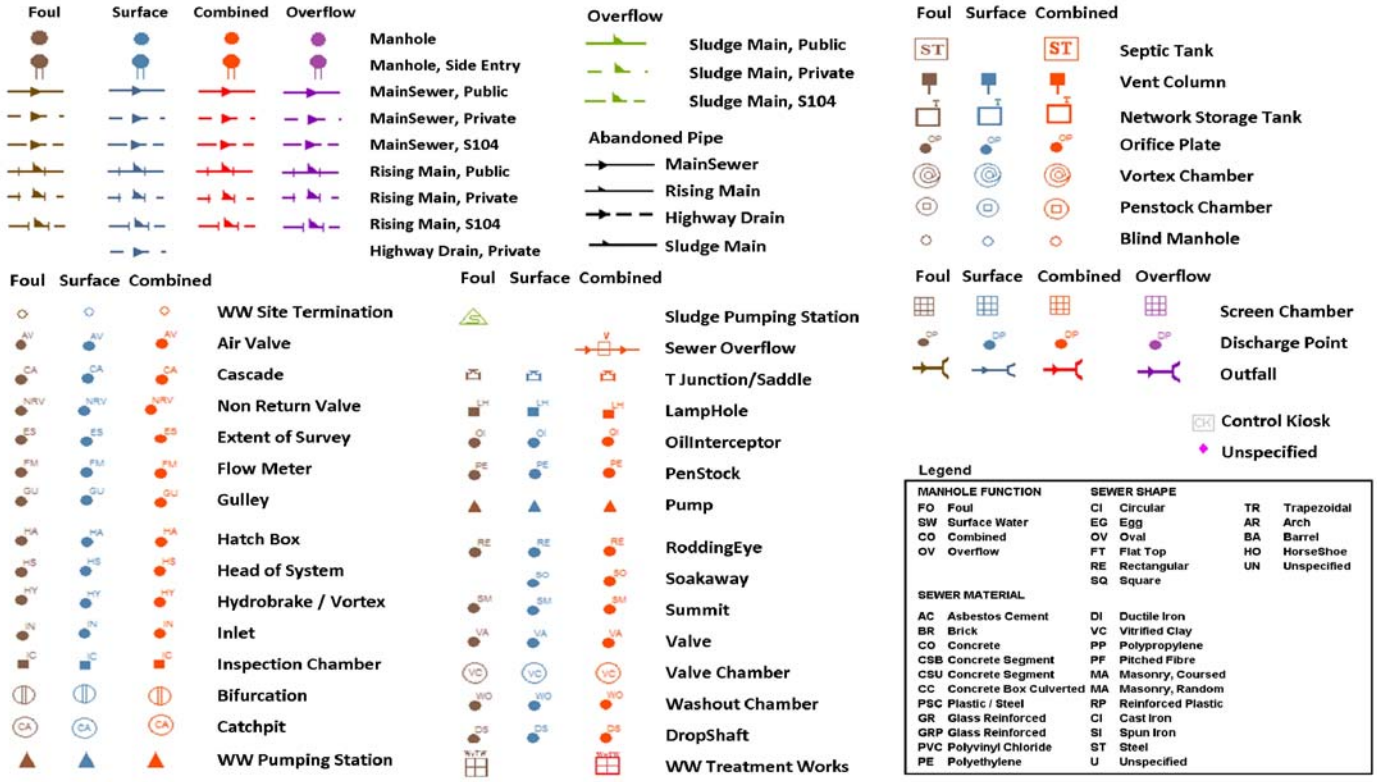
Printed By : Property Searches Date: 15/08/2016

DO NOT SCALE

Approximate Scale: 1:5000

United Utilities
helping life flow smoothly

WASTE WATER SYMBOLOGY



Legend

MANHOLE FUNCTION		SEWER SHAPE			
FO	Foul	CI	Circular	TR	Trapezoidal
SW	Surface Water	EG	Egg	AR	Arch
CO	Combined	OV	Oval	BA	Barrel
OV	Overflow	FT	Flat Top	HO	HorseShoe
		RE	Rectangular	UN	Unspecified
		SQ	Square		

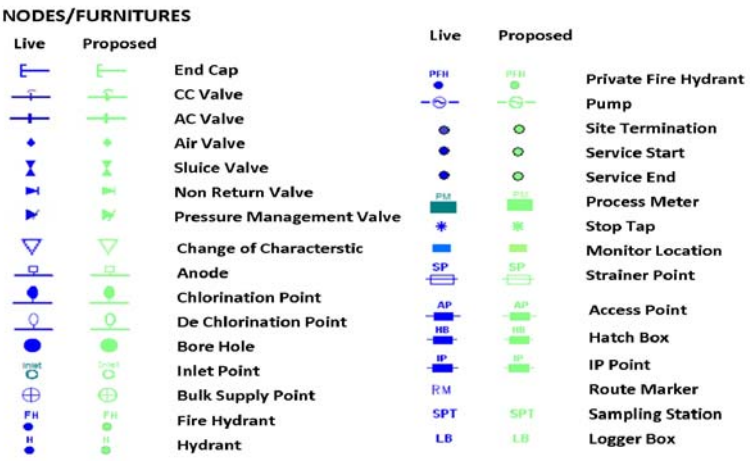
SEWER MATERIAL			
AC	Asbestos Cement	DI	Ductile Iron
BR	Brick	VC	Vitrified Clay
CO	Concrete	PP	Polypropylene
CSB	Concrete Segment	PF	Pitched Fibre
CSU	Concrete Segment	MA	Masonry, Coursed
CC	Concrete Box Culverted	MA	Masonry, Random
PSC	Plastic / Steel	RP	Reinforced Plastic
GR	Glass Reinforced	CI	Cast Iron
GRP	Glass Reinforced	SI	Spun Iron
PVC	Polyvinyl Chloride	ST	Steel
PE	Polyethylene	U	Unspecified

CLEAN WATER SYMBOLOGY

PIPE WORK

ABANDONED PIPE

NODES/FURNITURES



PROPERTY TYPES

Legend

MATERIAL TYPES		LINING TYPES	
AC	ASBESTOS CEMENT	CL	CEMENT LINING
CI	CAST IRON	TB	TAR OR BITUMEN
CU	COPPER	ERL	EPOXY RESIN
CO	CONCRETE		
DI	DUCTILE IRON	INSERTION TYPES	
GI	GALVANISED IRON		
GR	GREY IRON	DD	DIE DRAWN
OT	OTHERS	DR	DIRECTIONAL DRILLING
PB	LEAD	MO	MOLING
PV	uPVC	PI	PIPELINE
SI	SPUN IRON	SL	SLIP LINED
ST	STEEL		
UN	UNKONWN		
PE	POLYETHYLENE		