BANNERS GATE LIMITED

TECHNICAL NOTE

Client	Hayfield Homes		
Project Title	Pixiefields	Project No	18019
Prepared By	S.Marshall	Date	8 March 2019
Subject	Reserved Matters Drainage Strategy	Revision	-

Introduction

Outline Planning Permission[1], for up to 51 dwellings on land off Pixiefields in Cradley, Herefordshire, with all matters reserved except for access was granted on 30 July 2018 and included the following drainage related conditions:

9) Unless otherwise agreed in writing the adoptable highway and all pedestrian / cycle routes shall not exceed a gradient of 1:12 and no private drive shall exceed a gradient of 1:8. Private drainage arrangements must be made to prevent run-off from private driveways onto the public highway.

15) Prior to commencement of the development hereby permitted the following matters shall be submitted to the Local Planning Authority for their written approval:-

- *Drainage plans for the disposal of foul and surface water flows.*

Existing Conditions

The Site extends to 2.39 hectares of grazing land to north of Pixiefields at approximate National Grid Reference 372385, 246845.

The Site is bounded by:

- Chockbury Lane, to the north,
- Dwellings of Pixiefields estate, to the south,
- Dwellings of Credenleigh and Chockbury Lane, to the east,
- A single-track lane, to the west.

Ground levels within the Site fall from northwest to southeast from approximately 111.0mAOD to 96.2mAOD.

Background Reports

A Flood Risk Assessment[2] was prepared by Hydro-Logic Services LLP in support of the outline planning application.

The Flood Risk Assessment concluded:

- The Site is located within Flood Zone 1 and *'flooding from any source is regarded as highly unlikely'*.
- Infiltration rates, of between$1.4x10^{-6}$m/s and $1.1x10^{-7}$m/s, were calculated for five test pits located across the Site.
- Surface water runoff would be directed to two infiltration basins, one located in the southwest corner of the Site with an additional restricted discharge to the offsite Cradley Brook, the other located in the southeast corner of the Site with an additional restricted discharge to the surface water drainage network serving Pixiefields.

There is a lack of certainty as to how the infiltration tests were conducted and rates calculated, thus we would recommend caution when interpreting these results. The test results[3] presented in Appendix E

[1] Herefordshire Council Application No: 174057
[2] Report Ref: K0488/1 (Rev.4) dated October 2017
[3] BM Evans Groundwork & Drainage letter dated 23rd June 2014

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of the Flood Risk Assessment describe the time taken for the test water to drop 1mm. This presentation of results is consistent with the percolation test method described within BS 6297, relating to the design and installation of drainage fields for use in wastewater treatment, whereas the methodology described within BRE Digest 365, relating to the calculation, design and construction procedures for soakaways, is applicable in this instance.

Notwithstanding the uncertainties surrounding the infiltration test method Hydro-Logic Services LLP have made several, reasonable, assumptions when calculating infiltration rates form the very limited information provided by BM Evans Groundwork & Drainage. However, should any of these assumptions be incorrect then the resultant infiltration rates would also be incorrect.

Despite the very low infiltration rates calculated, the surface water drainage strategy described within the Flood Risk Assessment largely relies upon infiltration techniques as the primary method of surface water disposal.

The table below summarises the baseline Greenfield runoff rates presented within the Flood Risk Assessment which were calculated using the IH 124 methodology.

Return Period (years)	Greenfield Runoff (l/s/ha)
QBAR	3.275
100	9.405

Table 1 – Flood Risk Assessment Calculated Greenfield Runoff Rates

The following table summarises the published parameters that were adjusted by Hydro-Logic within the Greenfield runoff calculations.

Parameters	Published	Adjusted
SAAR	707mm	745mm*
Soil	0.3	0.4

*$SAAR_{4170}$ Figure

Table 2 – Flood Risk Assessment Adjusted Greenfield Runoff Parameters

It should be noted that Greenfield runoff rates are increased as a result of the adjusted parameters,

The proposed restricted discharges from the southwest and southeast infiltration basins, 1.13l/s and 0.77l/s respectively, are considered lower than the practical minimum rate to minimise the risk of blockage within the control device. The stated 30-50mm diameter orifices required to achieve these proposed rates are considered to have a high blockage risk.

Whilst it is stated the route of the offsite outfall into the Cradley Brook has been agreed in principle with the third-party landowner in the absence of written evidence this should be considered speculative.

Development Proposals

Referring to the Hayfield Homes Proposed Site Layout[4] 51 dwellings are proposed.

[4] Drawing No: 18019_PL01

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Surface Water Drainage Appraisal

Pre-development Runoff Rates

Greenfield Runoff:

The 'CIRIA C753 – The SuDS Manual' states that whilst several methods are available for calculating peak runoff rates, and volumes, the more recent FEH[5] methods should be the preferred approach. It is noted that whilst the IoH 124 method used within the Hydro-Logic Flood Risk Assessment can still be used as an alternative, with the agreement of the approving body, it is more likely to underestimate runoff rates potentially leading to the overdesign of attenuation storage components.

The following table provides a comparison of the Greenfield runoff rates described within the Flood Risk Assessment, those calculated using the unadjusted IH 124 parameters and the newer FEH methodology.

Return Period	Greenfield Peak Flow (l/s/ha)		
	IoH 124 (Flood Risk Assessment adjusted parameters)	IH 124 (unadjusted parameters)	ReFH2
Qbar	3.7	1.8	2.1
100 year	9.4	4.7	6.2

Table 3 – Greenfield Runoff Rate Comparison

As expected, the adjusted parameters used within the Flood Risk Assessment result in overestimated Greenfield runoff rates. It is recommended that the ReFH2 method is adopted for design purposes.

Disposal Options - Summary

We do not consider the strategy proposed within the Flood Risk Assessment to be appropriate for several reasons, including but not limited to:

- The uncertainty surrounding the infiltration testing/calculation method.
- The uncertainty surrounding the approval of third-party landowners to discharge surface water into the Cradley Brook.
- The stated infiltration rate being too low to offer a viable drainage solution.
- The stated restricted discharge being too low to offer a viable drainage solution.

We would recommend additional infiltration testing is undertaken, in full accordance with BRE Digest 365, to inform the detailed design stage. The testing should be targeted specifically within the southeast corner of the Site although multiple test locations across the Site would be beneficial. A Borehole should also be drilled in the southeast corner, to at least 4mbgl, to monitor groundwater levels.

Due to the topography of the Site it is recommended that all surface water is directed to a primary attenuation feature in the southeast corner of the Site. Should the results of subsequent infiltration testing demonstrate that infiltration is suitable, either as a partial or total drainage solution, then an infiltration basin should be provided. Should the results of the testing conclude that infiltration techniques are unsuitable then a detention basin should be provided.

A restricted overflow/outlet from the infiltration/detention basin into the public surface water sewerage serving the Pixiefields estate is be provided, subject to Severn Trent Water approval. It should be noted that as records show this sewerage discharges into a tributary of the Cradley Brook a direct connection from the Site across third-party land to the Cradley Brook is unnecessary.

[5] Flood Estimation Handbook

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Recommended Preliminary Design Parameters
(Subject to Severn Trent Water/Lead Local Flood Authority approval)

Description	Preliminary Design Parameter
Post-Development Impermeable Area	1.065 ha
Permissible Rate of Discharge	5 l/s
Design Rainfall	FEH
Attenuation Storage – 30 year	Adoptable network / Basin
Attenuation Storage – 100 year + CC	Offline Tanked Storage (below POS) / Basin
Development Flood Protection	100 year + Climate Change
Climate Change allowance	40%

Table 4 – Preliminary Design Parameters

Preliminary Attenuation Storage Estimate

Return Period (years)	Climate Change Allowance	Attenuation Storage Estimate (m^3)	
		No Infiltration	Partial Infiltration ($1.4x10^{-6}m/s$)
30	0%	347 - 470	282 - 459
100	20%	593 – 744	475 - 722
	40%	714 – 903	561 - 863

Table 5 – Preliminary Attenuation Storage Estimate

Foul Water Drainage Appraisal

A gravity connection to the public foul water sewer within the Pixiefields estate is viable, subject to Severn Trent Water approval.

Severn Trent Water Approval

A Development Enquiry Request has been submitted to Severn Trent Water. This Technical Note will be updated upon receipt of a response.

Recommendations

Infiltration testing, in full accordance with BRE Digest 365, should be undertaken.

Groundwater monitoring should be undertaken in the southeast corner of the Site.

The detailed design stage should give priority to infiltration techniques, where deemed appropriate.

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TECHNICAL NOTE

Surface Water

Hydraulic Calculations

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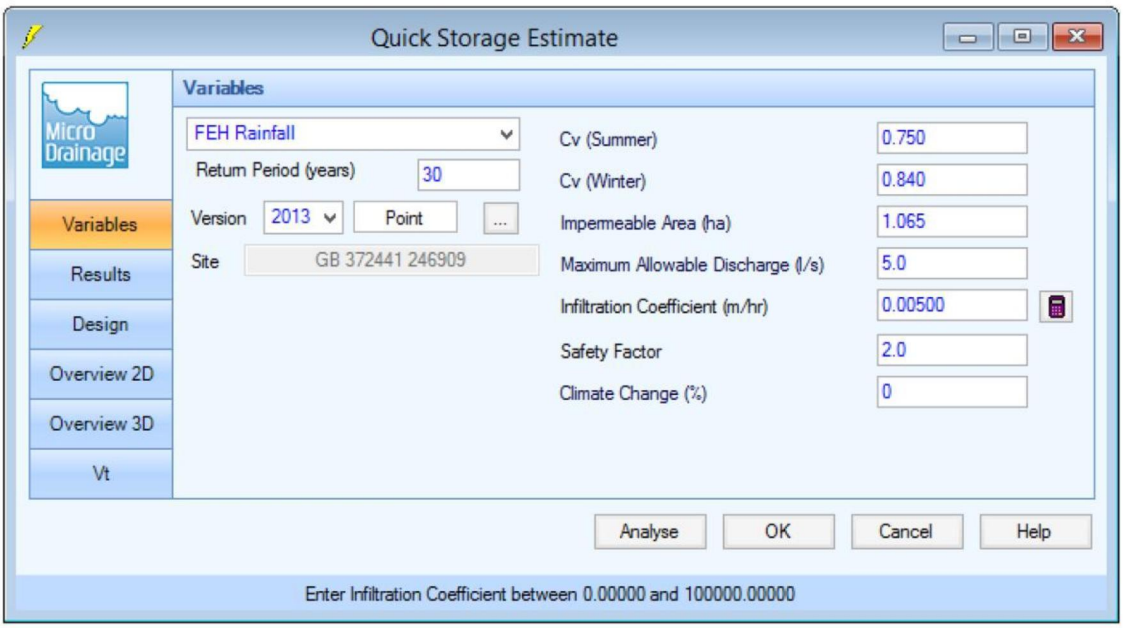
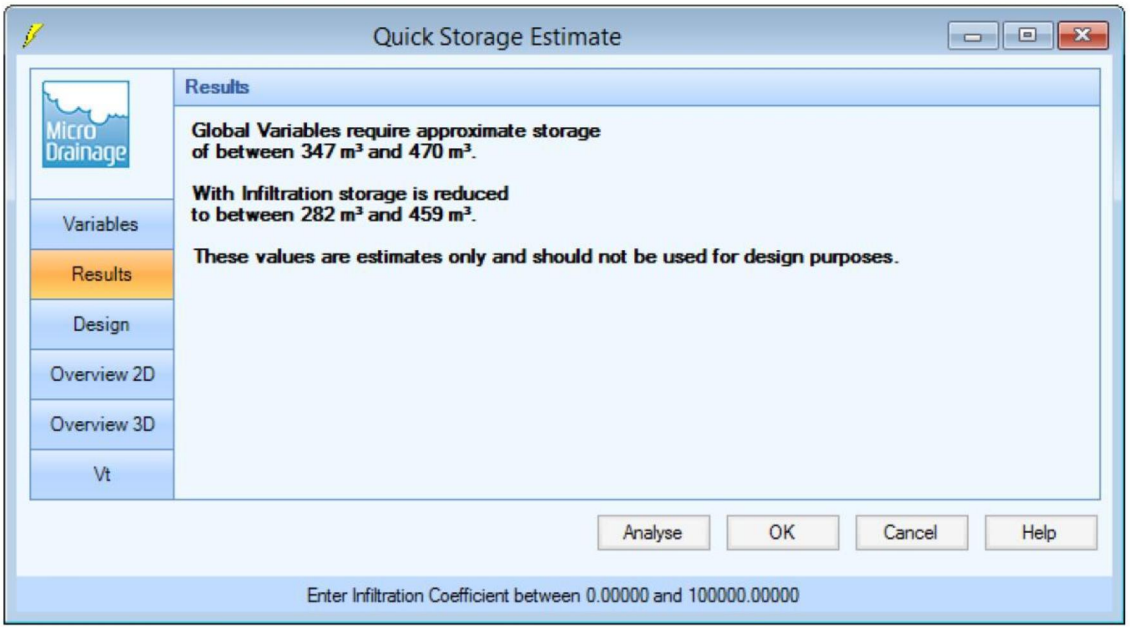

Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Variables
FEH Rainfall
Return Period (years) 30
Version 2013
Point
...
Site GB 372441 246909
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 1.065
Maximum Allowable Discharge (l/s) 5.0
Infiltration Coefficient (m/hr) 0.00500
Safety Factor 2.0
Climate Change (%) 0
Analyse
OK
Cancel
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000


Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Results
Global Variables require approximate storage of between 347 m³ and 470 m³.
With Infiltration storage is reduced to between 282 m³ and 459 m³.
These values are estimates only and should not be used for design purposes.
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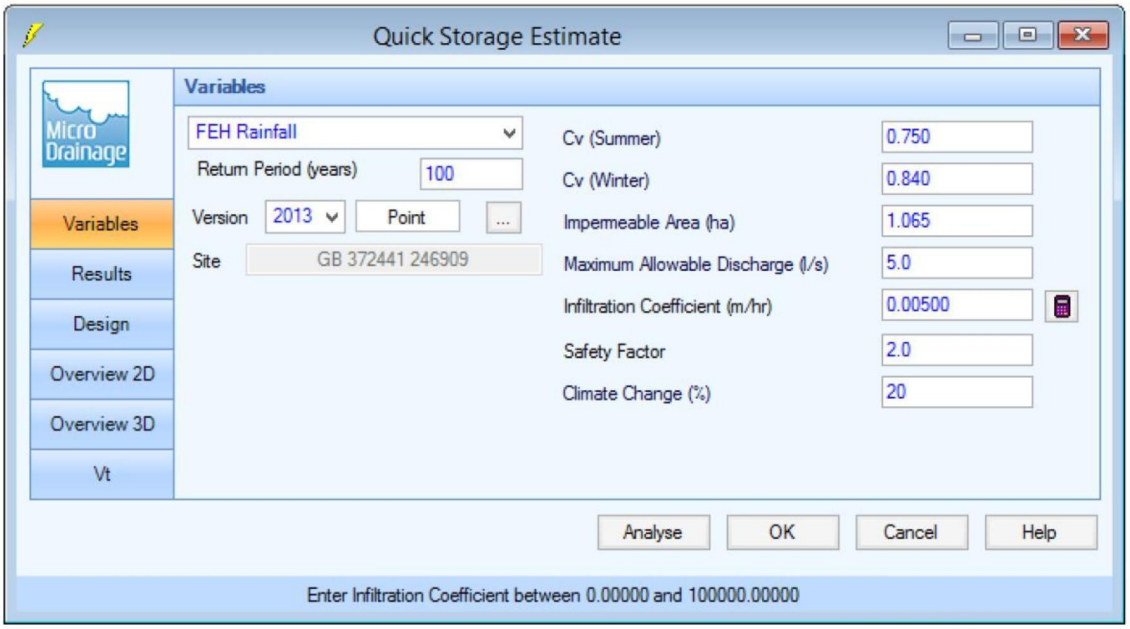
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000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Micro Drainage
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Overview 2D
Overview 3D
Vt
Variables
FEH Rainfall
Return Period (years) 100
Version 2013 Point ...
Site GB 372441 246909
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 1.065
Maximum Allowable Discharge (l/s) 5.0
Infiltration Coefficient (m/hr) 0.00500
Safety Factor 2.0
Climate Change (%) 20
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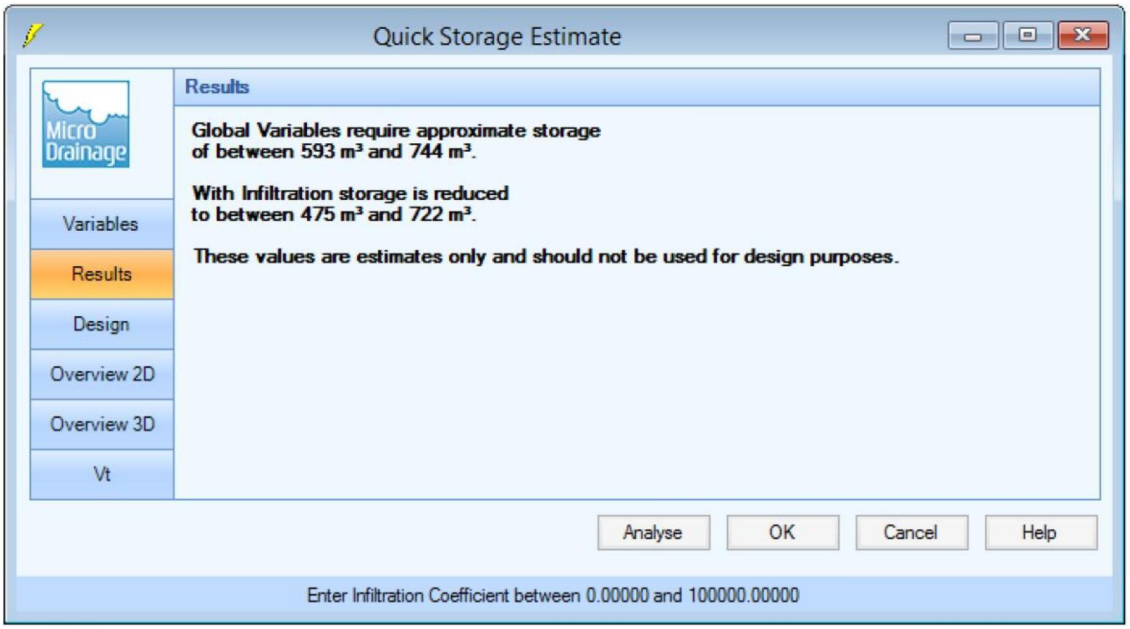
Cancel
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000


Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Results
Global Variables require approximate storage
of between 593 m³ and 744 m³.
With Infiltration storage is reduced
to between 475 m³ and 722 m³.
These values are estimates only and should not be used for design purposes.
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OK
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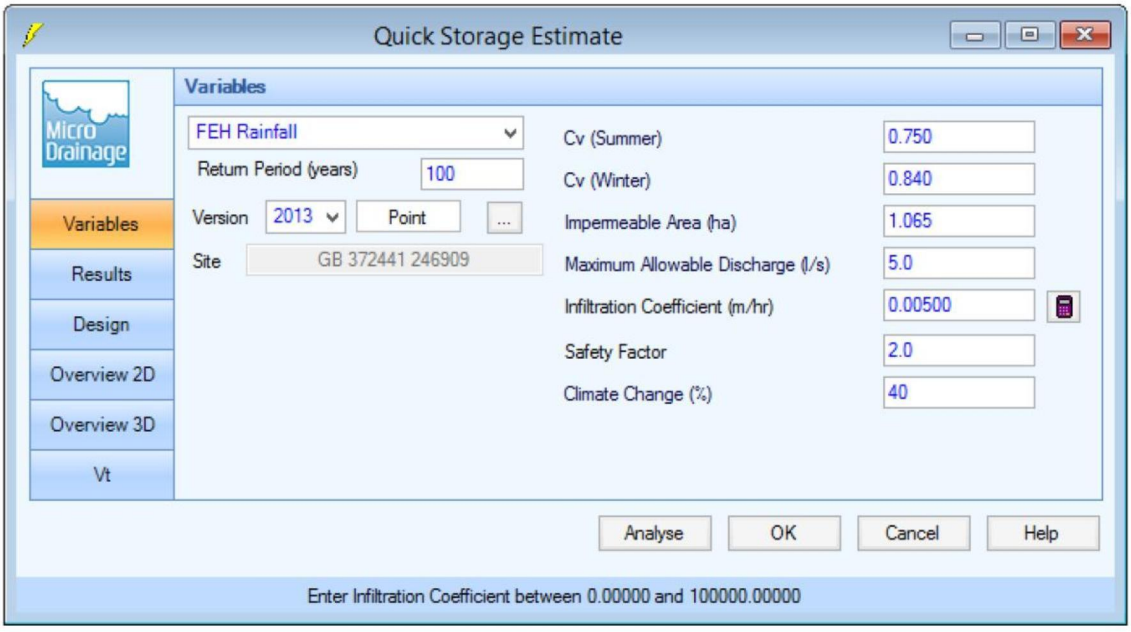
Enter Infiltration Coefficient between 0.00000 and 100000.00000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Overview 3D
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Variables
FEH Rainfall
Return Period (years) 100
Version 2013
Point
...
Site GB 372441 246909
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 1.065
Maximum Allowable Discharge (l/s) 5.0
Infiltration Coefficient (m/hr) 0.00500
Safety Factor 2.0
Climate Change (%) 40
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Cancel
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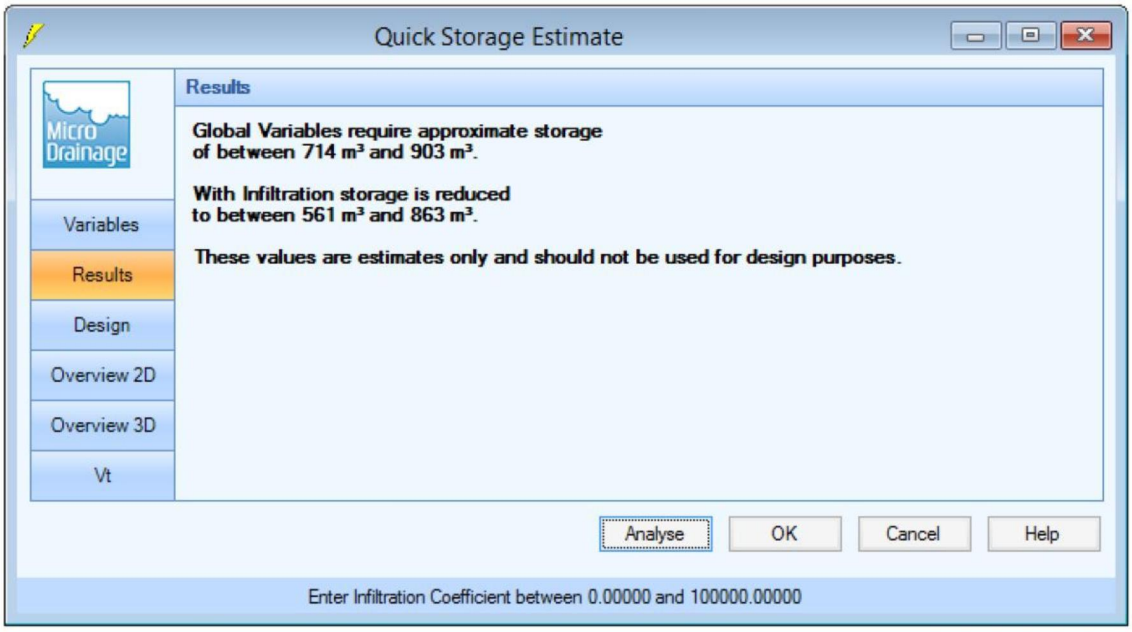
Enter Infiltration Coefficient between 0.00000 and 100000.00000


Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Results
Global Variables require approximate storage
of between 714 m³ and 903 m³.
With Infiltration storage is reduced
to between 561 m³ and 863 m³.
These values are estimates only and should not be used for design purposes.
Analyse
OK
Cancel
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

Pipe Sizes 18019 - STORM WATER NETWORK 1 2018.12.20
Manhole Sizes 18019 - STORM WATER NETWORK 1 2018.12.20

FEH Rainfall Model	
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 372441 246909
Data Type	Point
Maximum Rainfall (mm/hr)	100
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	0.000
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	0.75
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

« - Indicates pipe capacity < flow

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	35.036	2.347	14.9	0.084	6.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	16.851	2.025	8.3	0.034	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	12.271	0.100	122.7	0.092	6.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	14.371	0.100	143.7	0.062	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	13.339	0.843	15.8	0.015	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	54.13	6.17	106.272	0.084	0.0	0.0	0.0	3.40	135.4	12.3
S1.001	53.88	6.23	103.925	0.118	0.0	0.0	0.0	4.56	181.5	17.2
S2.000	54.13	6.17	102.000	0.092	0.0	0.0	0.0	1.18	46.9	13.5
S1.002	53.00	6.45	101.900	0.272	0.0	0.0	0.0	1.09	43.3	39.0
S1.003	52.73	6.52	101.800	0.287	0.0	0.0	0.0	3.31	131.5	41.0

Network Design Table for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

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
S1.004	27.253	1.626	16.8	0.128	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.005	26.010	1.775	14.7	0.075	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	12.917	0.700	18.5	0.079	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.007	15.249	1.291	11.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	10.153	0.043	236.1	0.000	6.00	0.0	0.600	o	300	Pipe/Conduit	
S3.001	8.163	0.035	233.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.008	32.726	0.083	394.3	0.017	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.009	12.510	0.032	390.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.010	8.161	0.200	40.8	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.011	20.054	0.100	200.5	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S4.000	35.356	3.450	10.2	0.197	6.00	0.0	0.600	o	225	Pipe/Conduit	
S4.001	24.360	2.925	8.3	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.002	17.197	0.104	165.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.003	33.394	1.601	20.9	0.125	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.004	15.014	1.795	8.4	0.101	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.000	9.185	1.661	5.5	0.010	6.00	0.0	0.600	o	150	Pipe/Conduit	
S1.012	13.419	0.090	149.1	0.016	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)
S1.004	52.28	6.64	100.957	0.415	0.0	0.0	0.0	3.86	272.8	58.8
S1.005	51.88	6.74	99.331	0.490	0.0	0.0	0.0	4.13	291.8	68.8
S1.006	51.66	6.80	97.556	0.569	0.0	0.0	0.0	3.68	259.9	79.6
S1.007	51.46	6.86	96.856	0.569	0.0	0.0	0.0	4.60	325.1	79.6
S3.000	54.16	6.17	95.500	0.000	0.0	0.0	0.0	1.02	72.0	0.0
S3.001	53.61	6.30	95.450	0.000	0.0	0.0	0.0	1.03	72.5	0.0
S1.008	49.57	7.39	95.415	0.586	0.0	0.0	0.0	1.02	161.9	79.6
S1.009	48.89	7.60	95.332	0.586	0.0	0.0	0.0	1.02	162.6	79.6
S1.010	48.75	7.64	95.300	0.586	0.0	0.0	0.0	3.19	507.4	79.6
S1.011	48.01	7.87	95.100	0.586	0.0	0.0	0.0	1.43	227.7	79.6
S4.000	54.25	6.14	104.950	0.197	0.0	0.0	0.0	4.11	163.5	28.9
S4.001	53.88	6.23	101.500	0.227	0.0	0.0	0.0	4.56	181.4	33.1
S4.002	52.75	6.51	98.575	0.227	0.0	0.0	0.0	1.01	40.3	33.1
S4.003	52.01	6.71	98.471	0.352	0.0	0.0	0.0	2.88	114.4	49.6
S4.004	51.84	6.75	96.795	0.453	0.0	0.0	0.0	5.47	386.5	63.6
S5.000	54.70	6.04	96.661	0.010	0.0	0.0	0.0	4.31	76.2	1.5
S1.012	47.17	8.15	95.000	1.065	0.0	0.0	0.0	0.82	14.5«	136.0

Manhole Schedules for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S02	107.520	1.248	Open Manhole	1200	S1.000	106.272	225				
S04	105.200	1.275	Open Manhole	1200	S1.001	103.925	225	S1.000	103.925	225	
S06	103.870	1.870	Open Manhole	1200	S2.000	102.000	225				
S08	104.120	2.220	Open Manhole	1200	S1.002	101.900	225	S1.001	101.900	225	
								S2.000	101.900	225	
S10	103.220	1.420	Open Manhole	1200	S1.003	101.800	225	S1.002	101.800	225	
S12	102.390	1.433	Open Manhole	1200	S1.004	100.957	300	S1.003	100.957	225	
S14	100.820	1.489	Open Manhole	1200	S1.005	99.331	300	S1.004	99.331	300	
S16	99.340	1.784	Open Manhole	1200	S1.006	97.556	300	S1.005	97.556	300	
S18	98.820	1.964	Open Manhole	1200	S1.007	96.856	300	S1.006	96.856	300	
S20	98.750	3.250	Open Manhole	1200	S3.000	95.500	300				
S22	98.750	3.300	Open Manhole	1200	S3.001	95.450	300	S3.000	95.457	300	
S24	98.460	3.045	Open Manhole	1500	S1.008	95.415	450	S1.007	95.565	300	
								S3.001	95.415	300	
S26	98.150	2.818	Open Manhole	1500	S1.009	95.332	450	S1.008	95.332	450	
SHW	97.000	1.700	Open Manhole	1500	S1.010	95.300	450	S1.009	95.300	450	
SPOND	97.000	1.900	Open Manhole	1500	S1.011	95.100	450	S1.010	95.100	450	
S28	105.940	0.990	Open Manhole	1200	S4.000	104.950	225				
S30	103.150	1.650	Open Manhole	1200	S4.001	101.500	225	S4.000	101.500	225	
S32	100.500	1.925	Open Manhole	1200	S4.002	98.575	225	S4.001	98.575	225	
S34	100.040	1.569	Open Manhole	1500	S4.003	98.471	225	S4.002	98.471	225	
S36	98.300	1.505	Open Manhole	1500	S4.004	96.795	300	S4.003	96.870	225	
S38	98.011	1.350	Open Manhole	1200	S5.000	96.661	150				
SCC-01	97.590	2.590	Open Manhole	2700	S1.012	95.000	150	S1.011	95.000	450	
								S4.004	95.000	300	
								S5.000	95.000	150	
S44	96.560	1.650	Open Manhole	2700		OUTFALL		S1.012	94.910	150	

PIPELINE SCHEDULES for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	S02	107.520	106.272	1.023	Open Manhole	1200
S1.001	o	225	S04	105.200	103.925	1.050	Open Manhole	1200
S2.000	o	225	S06	103.870	102.000	1.645	Open Manhole	1200
S1.002	o	225	S08	104.120	101.900	1.995	Open Manhole	1200
S1.003	o	225	S10	103.220	101.800	1.195	Open Manhole	1200
S1.004	o	300	S12	102.390	100.957	1.133	Open Manhole	1200
S1.005	o	300	S14	100.820	99.331	1.189	Open Manhole	1200
S1.006	o	300	S16	99.340	97.556	1.484	Open Manhole	1200
S1.007	o	300	S18	98.820	96.856	1.664	Open Manhole	1200
S3.000	o	300	S20	98.750	95.500	2.950	Open Manhole	1200
S3.001	o	300	S22	98.750	95.450	3.000	Open Manhole	1200
S1.008	o	450	S24	98.460	95.415	2.595	Open Manhole	1500
S1.009	o	450	S26	98.150	95.332	2.368	Open Manhole	1500
S1.010	o	450	SHW	97.000	95.300	1.250	Open Manhole	1500
S1.011	o	450	SPOND	97.000	95.100	1.450	Open Manhole	1500
S4.000	o	225	S28	105.940	104.950	0.765	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	35.036	14.9	S04	105.200	103.925	1.050	Open Manhole	1200
S1.001	16.851	8.3	S08	104.120	101.900	1.995	Open Manhole	1200
S2.000	12.271	122.7	S08	104.120	101.900	1.995	Open Manhole	1200
S1.002	14.371	143.7	S10	103.220	101.800	1.195	Open Manhole	1200
S1.003	13.339	15.8	S12	102.390	100.957	1.208	Open Manhole	1200
S1.004	27.253	16.8	S14	100.820	99.331	1.189	Open Manhole	1200
S1.005	26.010	14.7	S16	99.340	97.556	1.484	Open Manhole	1200
S1.006	12.917	18.5	S18	98.820	96.856	1.664	Open Manhole	1200
S1.007	15.249	11.8	S24	98.460	95.565	2.595	Open Manhole	1500
S3.000	10.153	236.1	S22	98.750	95.457	2.993	Open Manhole	1200
S3.001	8.163	233.2	S24	98.460	95.415	2.745	Open Manhole	1500
S1.008	32.726	394.3	S26	98.150	95.332	2.368	Open Manhole	1500
S1.009	12.510	390.9	SHW	97.000	95.300	1.250	Open Manhole	1500
S1.010	8.161	40.8	SPOND	97.000	95.100	1.450	Open Manhole	1500
S1.011	20.054	200.5	SCC-01	97.590	95.000	2.140	Open Manhole	2700
S4.000	35.356	10.2	S30	103.150	101.500	1.425	Open Manhole	1200

PIPELINE SCHEDULES for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S4.001	o	225	S30	103.150	101.500	1.425	Open Manhole	1200
S4.002	o	225	S32	100.500	98.575	1.700	Open Manhole	1200
S4.003	o	225	S34	100.040	98.471	1.344	Open Manhole	1500
S4.004	o	300	S36	98.300	96.795	1.205	Open Manhole	1500
S5.000	o	150	S38	98.011	96.661	1.200	Open Manhole	1200
S1.012	o	150	SCC-01	97.590	95.000	2.440	Open Manhole	2700

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S4.001	24.360	8.3	S32	100.500	98.575	1.700	Open Manhole	1200
S4.002	17.197	165.4	S34	100.040	98.471	1.344	Open Manhole	1500
S4.003	33.394	20.9	S36	98.300	96.870	1.205	Open Manhole	1500
S4.004	15.014	8.4	SCC-01	97.590	95.000	2.290	Open Manhole	2700
S5.000	9.185	5.5	SCC-01	97.590	95.000	2.440	Open Manhole	2700
S1.012	13.419	149.1	S44	96.560	94.910	1.500	Open Manhole	2700

Free Flowing Outfall Details for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.012	S44	96.560	94.910	94.910	2700	0

Simulation Criteria for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

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

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

Synthetic Rainfall Details

Synthetic Rainfall Details

Rainfall Model	FEH	Summer Storms	Yes
Return Period (years)	2	Winter Storms	Yes
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 372441 246909	Cv (Winter)	0.840
Data Type	Point	Storm Duration (mins)	30

Online Controls for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

Non Return Valve Manhole: S22, DS/PN: S3.001, Volume (m³): 4.4

Hydro-Brake® Optimum Manhole: SCC-01, DS/PN: S1.012, Volume (m³): 18.7

Unit Reference	MD-SHE-0095-5000-1750-5000
Design Head (m)	1.750
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	95
Invert Level (m)	95.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.750	5.0
Flush-Flo™	0.415	4.5
Kick-Flo®	0.847	3.6
Mean Flow over Head Range	-	4.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.0	1.200	4.2	3.000	6.4	7.000	9.6
0.200	4.1	1.400	4.5	3.500	6.9	7.500	9.9
0.300	4.4	1.600	4.8	4.000	7.4	8.000	10.2
0.400	4.5	1.800	5.1	4.500	7.8	8.500	10.5
0.500	4.4	2.000	5.3	5.000	8.2	9.000	10.8
0.600	4.3	2.200	5.6	5.500	8.6	9.500	11.1
0.800	3.8	2.400	5.8	6.000	8.9		
1.000	3.9	2.600	6.0	6.500	9.3		

Offline Controls for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

Pipe Manhole: S24, DS/PN: S1.008, Loop to PN: S3.000

Diameter (m)	0.225	Roughness k (mm)	0.600
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	96.500

Storage Structures for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

Cellular Storage Manhole: S20, DS/PN: S3.000

Invert Level (m) 95.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	360.0	360.0	0.801	0.0	420.8
0.400	360.0	390.4	1.201	0.0	420.8
0.800	360.0	420.7			

Tank or Pond Manhole: SPOND, DS/PN: S1.011

Invert Level (m) 95.100

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	210.0	0.700	301.0	1.400	392.0	2.100	0.0
0.100	223.0	0.800	314.0	1.500	405.0	2.200	0.0
0.200	236.0	0.900	327.0	1.600	418.0	2.300	0.0
0.300	249.0	1.000	340.0	1.700	431.0	2.400	0.0
0.400	262.0	1.100	353.0	1.800	454.0	2.500	0.0
0.500	275.0	1.200	366.0	1.900	460.0		
0.600	288.0	1.300	379.0	1.910	0.0		

Summary of Critical Results by Maximum Level (Rank 1) for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Point
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location GB 372441 246909		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)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S02	60 Summer	100	+40%				
S1.001	S04	60 Summer	100	+40%				
S2.000	S06	60 Summer	100	+40%	100/60 Summer			
S1.002	S08	60 Summer	100	+40%	100/60 Summer			
S1.003	S10	60 Summer	100	+40%	100/60 Summer			
S1.004	S12	60 Summer	100	+40%				
S1.005	S14	60 Summer	100	+40%				
S1.006	S16	60 Summer	100	+40%	100/60 Summer			
S1.007	S18	60 Summer	100	+40%	100/60 Summer			
S3.000	S20	600 Winter	100	+40%	100/120 Winter			
S3.001	S22	600 Winter	100	+40%	100/120 Winter			
S1.008	S24	120 Winter	100	+40%	100/60 Summer		100/60 Summer	22
S1.009	S26	120 Winter	100	+40%	100/60 Summer			
S1.010	SHW	240 Winter	100	+40%	100/60 Summer			
S1.011	SPOND	240 Winter	100	+40%	100/60 Summer			
S4.000	S28	60 Summer	100	+40%				
S4.001	S30	60 Summer	100	+40%				
S4.002	S32	60 Summer	100	+40%	100/60 Summer			

Summary of Critical Results by Maximum Level (Rank 1) for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S02	106.354	-0.143	0.000	0.28		36.3	OK	
S1.001	S04	104.012	-0.138	0.000	0.32		51.5	OK	
S2.000	S06	103.092	0.867	0.000	0.99		39.6	SURCHARGED	
S1.002	S08	102.997	0.872	0.000	3.00		113.5	SURCHARGED	
S1.003	S10	102.099	0.074	0.000	1.05		119.0	SURCHARGED	
S1.004	S12	101.145	-0.112	0.000	0.70		172.5	OK	
S1.005	S14	99.534	-0.097	0.000	0.79		206.2	OK	
S1.006	S16	98.282	0.426	0.000	1.12		234.1	SURCHARGED	
S1.007	S18	97.435	0.279	0.000	0.85		231.1	SURCHARGED	
S3.000	S20	96.273	0.473	0.000	0.04		2.1	SURCHARGED	
S3.001	S22	96.274	0.524	0.000	0.04		2.1	SURCHARGED	
S1.008	S24	96.706	0.841	0.000	0.89	43.3	124.7	SURCHARGED	
S1.009	S26	96.690	0.908	0.000	1.18		123.5	SURCHARGED	
S1.010	SHW	96.690	0.940	0.000	0.28		71.3	SURCHARGED	
S1.011	SPOND	96.698	1.148	0.000	0.03		5.1	SURCHARGED	
S4.000	S28	105.070	-0.105	0.000	0.55		85.1	OK	
S4.001	S30	101.625	-0.100	0.000	0.59		98.4	OK	
S4.002	S32	100.452	1.652	0.000	2.60		93.5	FLOOD RISK	

Summary of Critical Results by Maximum Level (Rank 1) for 18019 - STORM WATER NETWORK 1 2018.12.20.SWS

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S4.003	S34	60 Summer	100	+40%	100/60 Summer				99.751
S4.004	S36	60 Summer	100	+40%					96.955
S5.000	S38	240 Winter	100	+40%					96.711
S1.012	SCC-01	240 Winter	100	+40%	100/60 Summer				96.710

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S4.003	S34	1.055	0.000	1.29		138.5	FLOOD RISK	
S4.004	S36	-0.140	0.000	0.55		177.0	OK	
S5.000	S38	-0.100	0.000	0.02		1.3	OK	
S1.012	SCC-01	1.560	0.000	0.37		4.9	SURCHARGED	

BANNERS GATE LIMITED

TECHNICAL NOTE

Drawings

Cavendish House, 10-11 Birmingham Street, Halesowen, West Midlands, B63 3HN • Tel: 0121 687 1500

Chockbury Lane

Chockbury Lane

N

Notes
Levels related to Ordnance Datum
Grid related to arbitrary co-ordinates
North Point Indicative only
Survey carried out to client specification and in accordance with RICS publication: SURVEYS OF LAND, BUILDINGS & UTILITY SERVICES AT SCALES 1:500 & LARGER, 2nd EDITION

levett surveying

CLIENT James Spreckley
Brinsop House
Brinsop
Hereford
HR4 7AS

PROJECT Land adjoining Chockbury Lane
Cradley
WR13 5NA

DRAWING TITLE Topographical Survey

SCALE 1:200 (0 10m)
SHEET SIZE A0
DATE 02/09/13

DRAWING NO. PLS2013JS03_01

DRAWN BY PAL

HAYFIELD HOMES

BANNERS GATE

18019_PL01

Pixiefields,
Cradley, Herefordshire

Scale 1:500 @ A1

Proposed Site Layout

The Contractor is to check and verify in conjunction with the Architects details all setting out points, building and site dimensions, levels and sewer invert levels at connection points and ensure that they are fully conversant with the contents and requirements of the site investigation report before work starts. The Contractor is to comply in all respects with current building legislation, British Standard Specifications, Building Regulations etc.,whether or not specifically stated on this drawing.

This drawing is not intended to show details of ground conditions or ground contaminants. Each area of ground relied upon to support any structure depicted (including drainage) must be investigated by the Contractor any areas of formation for said structures which do not accord with the anticipated conditions as described in the site investigation report are to be immediately notified to the Engineer, where applicable. Any suspect fluid ground or ground contaminants on or within the ground should be further investigated by a suitable expert. Any earthworks shown indicate typical slopes for guidance only and should be investigated further by a suitable geotechnical expert.

Where existing trees are shown to be retained they should be subject to a full Arboricultural inspection for safety. All trees are to be planted so as to ensure they are a minimum of 5 metres from buildings and 3 metres from drainage and services, where applicable. A foundation is to be provided to accommodate the proposed tree planting, where applicable.

GENERAL NOTES

- This drawing is to be read in conjunction with relevant architectural and engineering drawings.
- Levels indicated in blocks are Finished floor levels and are 150mm above adjacent finished ground levels unless otherwise shown.
- Levels of the existing road at the point of tie-in with proposed site road must be checked prior to commencement of works.
- Any discrepancies between the details shown and actual on site conditions to be reported immediately to the engineer prior to commencement of works.

ADOPTABLE ROADS AND SEWERS

- Roads, footways and parking bays which form part of the highway to be adopted under Section 38 of the Highways Act 1980 shall comply with the requirements of the Adopting Authority.
- Sewers to be adopted under Section 104 of the Water Industries Act 1991 shall comply with the Water Authorities Association "Sewers for Adoption 6th or 7th Edition" with any amendments specified by the Adopting Water Authority.
- All pipes to be used in adoptable sewerage shall be either clayware to BS EN 295 or concrete to BS EN 1916 and BS 5911: Part 1 with Class S bedding unless otherwise stated. With approval of the Adopting Authority solid wall concentric external rib reinforced uPVC pipes complying with the relevant provisions of BS EN 13476 may be used.
- Where cover to a pipe is more than 1200mm under adoptable carriageway the trench shall be filled to formation of the carriageway with well compacted DTp Type 1 material.
- Where cover to a pipe is less than 1200mm under adoptable carriageway it shall be provided with concrete protection in accordance with the specification of the adopting authority and back filled to formation of the carriageway with well compacted DTp Type 1 material. Where concrete bed and surround is specified flexibility of joints is to be maintained by using compressible bitumen impregnated fibreboard at each pipe joint.
- All existing drainage invert levels, diameters and locations are to be checked by the Contractor prior to the commencement of any proposed drainage work. Any difference between actual and drawn details is to be reported to the Engineer immediately.
- Positions of existing services/statutory undertakers apparatus adjacent to or crossing proposed sewers is to be checked by the Contractor prior to starting work.

Drainage Strategy Notes:

- The foul water gravitates & outfalls to an existing MH located in the south-east corner of the site within Pixiefields & totals 51 'units', subject to S106/S104 approval with Severn Trent.
- The storm water drainage gravitates & outfalls into an existing MH located in the south-east corner of the site within Pixiefields. Storm water storage equates to 619m³ of storage required within a pond for the 30yr storm event, with 288m³ required in cellular storage for up to and including 100yr + 40% storm event.
- Discharge rate is 5 l/s as per concept levels & drainage prepared by RPS. Subject to approvals from Severn Trent Water, Environment Agency & The Lead Local Flood Authority.

Drainage Strategy Legend:

General

Site Boundary

Adoptable Drainage

S104 Surface Water Manhole, Sewer & Pipe No.
S104 Foul Water Manhole, Sewer & Pipe No.
S104 Surface Water Manhole Reference
S104 Foul Water Manhole Reference
S104 Surface Water Pipe Details
S104 Foul Water Pipe Details
S104 Surface Water Headwall

Adoptable Drainage

Private Cellular Storage

Existing Drainage

Existing Foul MH & Sewer
Existing Storm MH & Sewer

Rev.	Description	Date	By
D	High level overflow amended, 0.5m berm added to pond & adoptable drainage levels amended to suit road design.	01/03/2019	LJ
C	Updated to suit new layout.	26/02/2019	CS
B	Updated to suit new revision.	21/12/2018	CS
A	Drainage strategy updated to suit latest layout.	12/11/2018	LJ
-	First Issue	22/10/2018	LJ

Drawing Status

SCHEMATIC

SUBJECT TO DETAILED DESIGN.

Client

HAYFIELD HOMES

Project

Pixiefields, Cradley
Malvern

Title

Schematic Drainage Strategy Layout Plan

BANNERS GATE

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Scale	1:500 @ A1	Drawn	LJ
Date	October 2018	Checked	
File	18019 / dwgs / civils / current	Drawing	18019 / SK101 - D