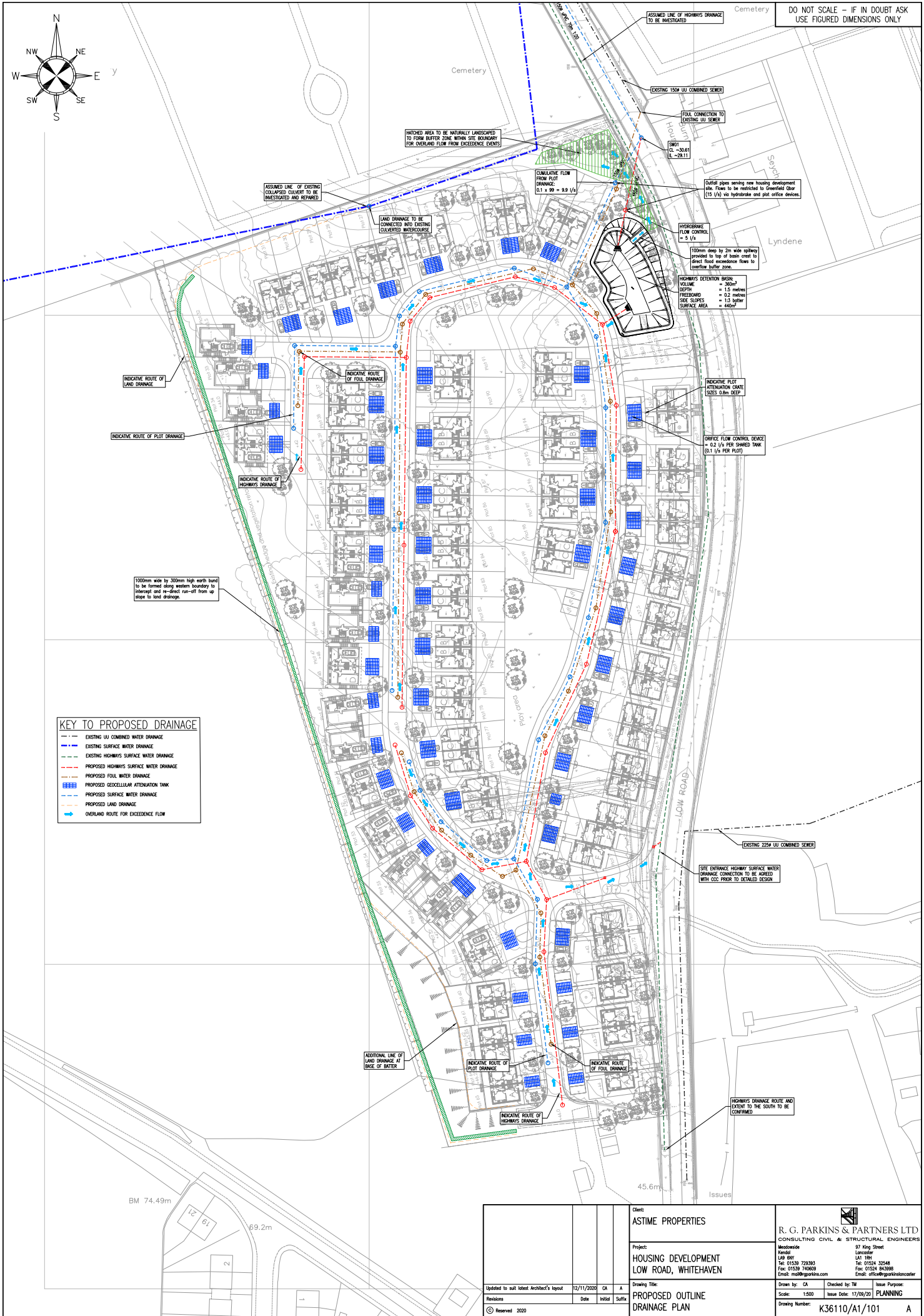




DO NOT SCALE - IF IN DOUBT ASK
USE FIGURED DIMENSIONS ONLY

KEY TO PROPOSED DRAINAGE	
	EXISTING LAND DRAINAGE
	EXISTING FOWL WATER DRAINAGE
	EXISTING HIGHWAYS SURFACE WATER DRAINAGE
	PROPOSED HIGHWAYS SURFACE WATER DRAINAGE
	PROPOSED FOWL WATER DRAINAGE
	PROPOSED GEOCELLULAR ATTENUATION TANK
	PROPOSED SURFACE WATER DRAINAGE
	PROPOSED LAND DRAINAGE
	OVERLAND ROUTE FOR EXCESS FLOW

Updated to suit latest Architect's layout		12/11/2020	CA	A
Revisions	Date	Initial	Suffix	
© Reserved 2020				
Client: ASTIME PROPERTIES				
Project: HOUSING DEVELOPMENT LOW ROAD, WHITEHAVEN				
Drawing Title: PROPOSED OUTLINE DRAINAGE PLAN				
Scale: 1:500 Issue Date: 17/09/20				
Client: R. G. PARKINS & PARTNERS LTD CONSULTING CIVIL & STRUCTURAL ENGINEERS Head Office: 97 King Street, Lancaster, LA1 1RN Tel: 01524 720363 Fax: 01524 740609 Email: mail@rgparkins.com Drawing Number: K36110/A1/101				
Drawn by: CA Checked by: TM Issue Purpose: PLANNING				
A				

APPENDIX B: CALCULATIONS

R G PARKINS & PARTNERS LTD	CALCULATION		Job No.	K36110	Page	1 of 4
Meadowside	Job	Low Road	Drg no.	N/A	Date	15/09/2020
Shap Road		Whitehaven	Revision	Orig	Initial	CA
KENDAL LA9 6NY	Title	Rate of Run-Off			Checked	TM

DESIGN BASIS MEMORANDUM - PEAK RATE OF RUN-OFF CALCULATION

Design Brief

The following peak rate of run-off calculations have been undertaken to determine changes in peak flow resulting from the development of a greenfield or brownfield site. These calculations are for the **Peak Rate of Run-Off** requirements only.

Background Information & References

The site area is **less than** 200ha and the Greenfield (pre-development) calculation has been undertaken in accordance with methodology described by Marshall & Bayliss, Institute of Hydrology, Report No. 124, Flood Estimation for Small Catchments, 1994 (IoH 124).

In addition, the following references have been used in the preparation of these calculations:

- Interim Code of Practice for Sustainable Drainage Systems (SUDS), CIRIA, 2004
- CIRIA, The SUDS Manual, Report C753, 2015
- Designing for Exceedance in Urban Drainage - good practice, CIRIA Report C635, 2006
- Flood Estimation Handbook (FEH)
- Flood Studies Report (FSR), Volume 1, Hydrological Studies, 1993
- Flood Studies Supplementary Report No 2 (FSSR2), The Estimation of Low Return Period Floods
- Flood Studies Supplementary Report No 14 (FSSR14), Review of Regional Growth Curves, 1983
- Planning Practice guidance of the National Planning Policy Framework, Recommended national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights.

Proposed Land Use Changes

Changes to the existing site are as follows:

Greenfield Site to Brownfield Site

Results Summary

Rate of Run-Off (l/s)			
Event	Greenfield		Post-Development
Q1	13.1		13.1
QBAR	15.1		15.1
Q10	20.8		20.8
Q30	25.7		25.7
Q100	31.4		31.4
Q100 + 40% CC	44.0		44.0

R G PARKINS & PARTNERS LTD	CALCULATION		Job No.	K36110	Page	2 of 4
Meadowside	Job	Low Road	Drg no.	N/A	Date	15/09/2020
Shap Road		Whitehaven	Revision	Orig	Initial	CA
KENDAL LA9 6NY	Title	Rate of Run-Off			Checked	TM

SITE AREAS (LAND COVER AREAS)

Existing Impermeable & Permeable Land Cover

Total Site Area: **3.425** ha **34250** m²

Existing Impermeable & Permeable Land Cover

Land Cover	Area		Percentage of total site area
	m ²	ha	
Total impermeable area	0.0	0.000	0%
Remaining permeable area	34250.0	3.425	100%

Proposed Land Cover Areas

Land Cover	Area		Percentage of total site area
	m ²	ha	
Total housing roof area	6689.5	0.669	20%
Total parking and paved area	5943.9	0.594	17%
Total road area	5751.5	0.575	17%
Garden & landscaped areas	15865.1	1.587	46%

Proposed Impermeable & Permeable Land Cover

Land Cover	Area		Percentage of total site area
	m ²	ha	
Total impermeable area	18384.9	1.838	54%
Remaining permeable area	15865.1	1.587	46%

R G PARKINS & PARTNERS LTD	CALCULATION		Job No.	K36110	Page	3 of 4
Meadowside	Job	Low Road	Drg no.	N/A	Date	15/09/2020
Shap Road		Whitehaven	Revision	Orig	Initial	CA
KENDAL LA9 6NY	Title	Rate of Run-Off			Checked	TM

ESTIMATION OF QBAR (RURAL) (GREENFIELD RUNOFF RATE)

loH 124 based on research on small catchments < 25 km²

Method is based on regression analysis of response times
using catchments from 0.9 to 22.9 km²

QBAR_{rural} is mean annual flood on rural catchment

QBAR_{rural} depends on SOIL, SAAR and AREA most significantly

$$QBAR_{rural} = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

For SOIL refer to FSR Vol 1, Section 4.2.3 and 4.2.6 and loH 124

Contributing watershed area

Area, A	=	500000	m ²	insert 50 ha for EA
	=	0.500	km ²	small catchment method
	=	50.000	ha	

SAAR	=	1102	mm	From UKSuds website (point data)
------	---	------	----	----------------------------------

Soil index based on soil type, SOIL	=	$\frac{(0.1S1+0.3S2+0.37S3+0.47S4+0.53S5)}{(S1+S2+S3+S4+S5)}$
-------------------------------------	---	---

Where:	S1	=		%
	S2	=		%
	S3	=		%
	S4	=	100	%
	S5	=		%
			100	%

UK Suds website provides a value of 3 based on the equivalent Host value. This seems reasonable based on ground investigation.

So,	SOIL	=	0.47
-----	------	---	------

Note: for very small catchments it is far better to rely on local site investigation information.

QBAR _{rural}	=	0.410	m ³ /s
	=	410.5	l/s

Small rural catchments less than 50 ha

The Environment Agency recommends that this method should be used for development sizes from 0 to 50 ha and should linearly interpolate the formula to 50 ha.

So, catchment size	=	18385	m ²
	=	0.018	km ²
	=	1.839	ha

Excluding significant open space which would remain disconnected from the positive drainage system during flood events.

QBAR _{rural site}	=	0.01509	m ³ /s
	=	15.09	l/s

R G PARKINS & PARTNERS LTD	CALCULATION		Job No.	K36110	Page	4 of 4
Meadowside	Job	Low Road	Drg no.	N/A	Date	15/09/2020
Shap Road		Whitehaven	Revision	Orig	Initial	CA
KENDAL LA9 6NY	Title	Rate of Run-Off			Checked	TM

GREENFIELD RETURN PERIOD ORDINATES

QBAR can be factored by the UK FSR regional growth curves for return periods <2 years and for all other return periods to obtain peak flow estimates for required return periods.

These regional growth curves are constant throughout a region, whatever the catchment type and size.

See Table 2.39 for region curve ordinates
Use FSSR2 Growth Curves to estimate Qbar

Reference- Pg 173-FSR V.1, ch 2.6.2

Region

= 10

Use Figure A1.1 to determine region

GREENFIELD RETURN PERIOD FLOW RATES

Return Period	Ordinate	Q (l/s)
1	0.87	13.13
2	0.93	14.04
5	1.19	17.96
10	1.38	20.83
25	1.64	24.75
30	1.7	25.66
50	1.85	27.92
100	2.08	31.40
200	2.32	35.02
500	2.73	41.21
1000	3.04	45.89

Ordinate from FSSR2

Interpolation taken from Figure 24.2 (pg 515) SuDS Manual

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Meadowside Sharp Road Kendal Cumbria LA9 6NY		
Date 10/09/2020 14:54 File K36110 Detention Basin Sour...	Designed by Chris Abram Checked by	
XP Solutions	Source Control 2019.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
15 min Summer	9.072	0.572	5.0	122.1	O K
30 min Summer	9.252	0.752	5.0	171.8	O K
60 min Summer	9.437	0.937	5.0	228.6	Flood Risk
120 min Summer	9.548	1.048	5.0	265.9	Flood Risk
180 min Summer	9.604	1.104	5.0	285.6	Flood Risk
240 min Summer	9.635	1.135	5.0	297.1	Flood Risk
360 min Summer	9.663	1.163	5.0	307.2	Flood Risk
480 min Summer	9.666	1.166	5.0	308.3	Flood Risk
600 min Summer	9.659	1.159	5.0	305.8	Flood Risk
720 min Summer	9.651	1.151	5.0	302.8	Flood Risk
960 min Summer	9.631	1.131	5.0	295.4	Flood Risk
1440 min Summer	9.588	1.088	5.0	280.0	Flood Risk
2160 min Summer	9.526	1.026	5.0	258.4	Flood Risk
2880 min Summer	9.464	0.964	5.0	237.4	Flood Risk
4320 min Summer	9.326	0.826	5.0	193.7	O K
5760 min Summer	9.158	0.658	5.0	145.0	O K
7200 min Summer	9.030	0.530	5.0	111.3	O K
8640 min Summer	8.929	0.429	5.0	86.7	O K
10080 min Summer	8.852	0.352	5.0	69.1	O K
15 min Winter	9.129	0.629	5.0	137.2	O K
30 min Winter	9.325	0.825	5.0	193.4	O K
60 min Winter	9.524	1.024	5.0	257.5	Flood Risk
120 min Winter	9.646	1.146	5.0	301.0	Flood Risk
180 min Winter	9.710	1.210	5.0	324.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	117.275	0.0	125.9	22
30 min Summer	83.079	0.0	178.5	37
60 min Summer	56.245	0.0	242.6	66
120 min Summer	34.120	0.0	294.3	126
180 min Summer	25.411	0.0	328.8	184
240 min Summer	20.588	0.0	355.2	244
360 min Summer	15.263	0.0	395.0	362
480 min Summer	12.329	0.0	425.5	480
600 min Summer	10.441	0.0	450.4	536
720 min Summer	9.112	0.0	471.6	596
960 min Summer	7.342	0.0	506.6	724
1440 min Summer	5.412	0.0	559.8	996
2160 min Summer	4.009	0.0	623.2	1408
2880 min Summer	3.251	0.0	673.8	1824
4320 min Summer	2.426	0.0	754.0	2640
5760 min Summer	1.983	0.0	822.3	3344
7200 min Summer	1.707	0.0	884.7	4032
8640 min Summer	1.517	0.0	943.4	4752
10080 min Summer	1.378	0.0	999.8	5352
15 min Winter	117.275	0.0	141.0	22
30 min Winter	83.079	0.0	199.9	37
60 min Winter	56.245	0.0	271.7	66
120 min Winter	34.120	0.0	329.7	124
180 min Winter	25.411	0.0	368.3	180

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
240 min Winter	9.748	1.248	5.0	339.4	Flood Risk
360 min Winter	9.785	1.285	5.0	354.0	Flood Risk
480 min Winter	9.797	1.297	5.0	358.6	Flood Risk
600 min Winter	9.794	1.294	5.0	357.6	Flood Risk
720 min Winter	9.784	1.284	5.0	353.4	Flood Risk
960 min Winter	9.758	1.258	5.0	343.2	Flood Risk
1440 min Winter	9.700	1.200	5.0	321.3	Flood Risk
2160 min Winter	9.608	1.108	5.0	287.1	Flood Risk
2880 min Winter	9.510	1.010	5.0	252.9	Flood Risk
4320 min Winter	9.265	0.765	5.0	175.3	O K
5760 min Winter	9.005	0.505	5.0	105.1	O K
7200 min Winter	8.834	0.334	5.0	65.1	O K
8640 min Winter	8.733	0.233	4.8	43.6	O K
10080 min Winter	8.674	0.174	4.5	31.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
240 min Winter	20.588	0.0	397.9	238
360 min Winter	15.263	0.0	442.4	352
480 min Winter	12.329	0.0	476.5	464
600 min Winter	10.441	0.0	504.4	572
720 min Winter	9.112	0.0	528.1	672
960 min Winter	7.342	0.0	567.3	762
1440 min Winter	5.412	0.0	626.6	1072
2160 min Winter	4.009	0.0	698.0	1536
2880 min Winter	3.251	0.0	754.7	1988
4320 min Winter	2.426	0.0	844.5	2848
5760 min Winter	1.983	0.0	921.0	3456
7200 min Winter	1.707	0.0	990.8	4040
8640 min Winter	1.517	0.0	1056.6	4672
10080 min Winter	1.378	0.0	1119.8	5344

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 297535 516386 NX 97535 16386
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.576

Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)
0 4	0.288	4 8	0.288

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 8.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	170.6	1.500	442.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0101-5000-1300-5000
Design Head (m)	1.300
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	101
Invert Level (m)	8.500
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)	1.300	5.0	Kick-Flo®	0.798	4.0
Flush-Flo™	0.384	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)
0.100	3.4	1.200	4.8	3.000	7.4	7.000	11.0
0.200	4.7	1.400	5.2	3.500	7.9	7.500	11.4
0.300	4.9	1.600	5.5	4.000	8.5	8.000	11.8
0.400	5.0	1.800	5.8	4.500	9.0	8.500	12.1
0.500	4.9	2.000	6.1	5.000	9.4	9.000	12.5
0.600	4.8	2.200	6.4	5.500	9.8	9.500	12.8
0.800	4.0	2.400	6.7	6.000	10.3		
1.000	4.4	2.600	6.9	6.500	10.7		

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Meadowside Sharp Road Kendal Cumbria LA9 6NY	Low Road, Whitehaven K36110 House Type A Crate System	
Date 13/11/2020	Designed by CA	
File K36110 CRATE SOURCE CONTROL...	Checked by	
XP Solutions	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 565 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	8.859	0.259	0.0	0.1	0.1	1.7	O K
30 min Summer	8.963	0.363	0.0	0.1	0.1	2.4	O K
60 min Summer	9.082	0.482	0.0	0.1	0.1	3.2	O K
120 min Summer	9.162	0.562	0.0	0.1	0.1	3.7	O K
180 min Summer	9.205	0.605	0.0	0.1	0.1	4.0	O K
240 min Summer	9.230	0.630	0.0	0.1	0.1	4.2	O K
360 min Summer	9.253	0.653	0.0	0.1	0.1	4.3	O K
480 min Summer	9.261	0.661	0.0	0.1	0.1	4.4	O K
600 min Summer	9.265	0.665	0.0	0.1	0.1	4.4	O K
720 min Summer	9.267	0.667	0.0	0.1	0.1	4.4	O K
960 min Summer	9.263	0.663	0.0	0.1	0.1	4.4	O K
1440 min Summer	9.244	0.644	0.0	0.1	0.1	4.3	O K
2160 min Summer	9.209	0.609	0.0	0.1	0.1	4.0	O K
2880 min Summer	9.173	0.573	0.0	0.1	0.1	3.8	O K
4320 min Summer	9.108	0.508	0.0	0.1	0.1	3.4	O K
5760 min Summer	9.057	0.457	0.0	0.1	0.1	3.0	O K
7200 min Summer	9.016	0.416	0.0	0.1	0.1	2.8	O K
8640 min Summer	8.984	0.384	0.0	0.1	0.1	2.6	O K
10080 min Summer	8.957	0.357	0.0	0.1	0.1	2.4	O K
15 min Winter	8.891	0.291	0.0	0.1	0.1	1.9	O K
30 min Winter	9.008	0.408	0.0	0.1	0.1	2.7	O K
60 min Winter	9.142	0.542	0.0	0.1	0.1	3.6	O K
120 min Winter	9.234	0.634	0.0	0.1	0.1	4.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	117.275	0.0	1.7	19
30 min Summer	83.079	0.0	2.5	33
60 min Summer	56.245	0.0	3.4	64
120 min Summer	34.120	0.0	4.1	122
180 min Summer	25.411	0.0	4.6	182
240 min Summer	20.588	0.0	4.9	242
360 min Summer	15.263	0.0	5.5	358
480 min Summer	12.329	0.0	5.9	410
600 min Summer	10.441	0.0	6.3	474
720 min Summer	9.112	0.0	6.6	536
960 min Summer	7.342	0.0	7.0	672
1440 min Summer	5.412	0.0	7.8	950
2160 min Summer	4.009	0.0	8.7	1360
2880 min Summer	3.251	0.0	9.4	1760
4320 min Summer	2.426	0.0	10.5	2552
5760 min Summer	1.983	0.0	11.4	3296
7200 min Summer	1.707	0.0	12.3	4040
8640 min Summer	1.517	0.0	13.1	4832
10080 min Summer	1.378	0.0	13.9	5544
15 min Winter	117.275	0.0	2.0	19
30 min Winter	83.079	0.0	2.8	33
60 min Winter	56.245	0.0	3.8	62
120 min Winter	34.120	0.0	4.6	120

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Meadowside Sharp Road Kendal Cumbria LA9 6NY	Low Road, Whitehaven K36110 House Type A Crate System	
Date 13/11/2020	Designed by CA	
File K36110 CRATE SOURCE CONTROL...	Checked by	
XP Solutions	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	9.284	0.684	0.0	0.1	0.1	4.6	O K
240 min Winter	9.315	0.715	0.0	0.1	0.1	4.8	O K
360 min Winter	9.346	0.746	0.0	0.1	0.1	5.0	O K
480 min Winter	9.356	0.756	0.0	0.1	0.1	5.0	O K
600 min Winter	9.356	0.756	0.0	0.1	0.1	5.0	O K
720 min Winter	9.357	0.757	0.0	0.1	0.1	5.0	O K
960 min Winter	9.349	0.749	0.0	0.1	0.1	5.0	O K
1440 min Winter	9.316	0.716	0.0	0.1	0.1	4.8	O K
2160 min Winter	9.258	0.658	0.0	0.1	0.1	4.4	O K
2880 min Winter	9.202	0.602	0.0	0.1	0.1	4.0	O K
4320 min Winter	9.105	0.505	0.0	0.1	0.1	3.4	O K
5760 min Winter	9.031	0.431	0.0	0.1	0.1	2.9	O K
7200 min Winter	8.975	0.375	0.0	0.1	0.1	2.5	O K
8640 min Winter	8.931	0.331	0.0	0.1	0.1	2.2	O K
10080 min Winter	8.896	0.296	0.0	0.1	0.1	2.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180 min Winter	25.411	0.0	5.1	178
240 min Winter	20.588	0.0	5.5	236
360 min Winter	15.263	0.0	6.1	346
480 min Winter	12.329	0.0	6.6	452
600 min Winter	10.441	0.0	7.0	494
720 min Winter	9.112	0.0	7.3	564
960 min Winter	7.342	0.0	7.9	720
1440 min Winter	5.412	0.0	8.6	1024
2160 min Winter	4.009	0.0	9.7	1468
2880 min Winter	3.251	0.0	10.5	1876
4320 min Winter	2.426	0.0	11.7	2684
5760 min Winter	1.983	0.0	12.8	3464
7200 min Winter	1.707	0.0	13.8	4248
8640 min Winter	1.517	0.0	14.7	5008
10080 min Winter	1.378	0.0	15.6	5744

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Meadowside	Low Road, Whitehaven	
Sharp Road Kendal	K36110	
Cumbria LA9 6NY	House Type A Crate System	
Date 13/11/2020	Designed by CA	
File K36110 CRATE SOURCE CONTROL...	Checked by	
XP Solutions	Source Control 2020.1	

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 297535 516386 NX 97535 16386
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.008

Time (mins)	Area
From: To:	(ha)

0	4	0.008
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R G Parkins & Partners Ltd		Page 4
Meadowside Sharp Road Kendal Cumbria LA9 6NY	Low Road, Whitehaven K36110 House Type A Crate System	
Date 13/11/2020	Designed by CA	
File K36110 CRATE SOURCE CONTROL...	Checked by	
XP Solutions	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 10.000

Cellular Storage Structure

Invert Level (m) 8.600 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)
0.000	7.0	7.0	0.801	0.0	15.8
0.800	7.0	15.8			

Orifice Outflow Control

Diameter (m) 0.007 Discharge Coefficient 0.600 Invert Level (m) 8.600

R G Parkins & Partners Ltd		Page 1
Meadowside Sharp Road Kendal Cumbria LA9 6NY	Low Road, Wigton Whitehaven House Type E Geocellular Crate	
Date 13/11/2020	Designed by CA	
File K36110 CRATE SOURCE CONTROL...	Checked by	
XP Solutions	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1066 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	8.820	0.220	0.0	0.0	0.0	2.8	O K
30 min Summer	8.910	0.310	0.0	0.1	0.1	4.0	O K
60 min Summer	9.015	0.415	0.0	0.1	0.1	5.3	O K
120 min Summer	9.093	0.493	0.0	0.1	0.1	6.3	O K
180 min Summer	9.139	0.539	0.0	0.1	0.1	6.9	O K
240 min Summer	9.171	0.571	0.0	0.1	0.1	7.3	O K
360 min Summer	9.210	0.610	0.0	0.1	0.1	7.8	O K
480 min Summer	9.233	0.633	0.0	0.1	0.1	8.1	O K
600 min Summer	9.245	0.645	0.0	0.1	0.1	8.3	O K
720 min Summer	9.251	0.651	0.0	0.1	0.1	8.4	O K
960 min Summer	9.257	0.657	0.0	0.1	0.1	8.4	O K
1440 min Summer	9.260	0.660	0.0	0.1	0.1	8.5	O K
2160 min Summer	9.256	0.656	0.0	0.1	0.1	8.4	O K
2880 min Summer	9.244	0.644	0.0	0.1	0.1	8.3	O K
4320 min Summer	9.212	0.612	0.0	0.1	0.1	7.8	O K
5760 min Summer	9.181	0.581	0.0	0.1	0.1	7.5	O K
7200 min Summer	9.154	0.554	0.0	0.1	0.1	7.1	O K
8640 min Summer	9.132	0.532	0.0	0.1	0.1	6.8	O K
10080 min Summer	9.112	0.512	0.0	0.1	0.1	6.6	O K
15 min Winter	8.847	0.247	0.0	0.1	0.1	3.2	O K
30 min Winter	8.948	0.348	0.0	0.1	0.1	4.5	O K
60 min Winter	9.066	0.466	0.0	0.1	0.1	6.0	O K
120 min Winter	9.154	0.554	0.0	0.1	0.1	7.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	117.275	0.0	2.6	19
30 min Summer	83.079	0.0	3.4	34
60 min Summer	56.245	0.0	5.4	64
120 min Summer	34.120	0.0	6.6	124
180 min Summer	25.411	0.0	7.3	182
240 min Summer	20.588	0.0	7.8	242
360 min Summer	15.263	0.0	8.5	362
480 min Summer	12.329	0.0	9.0	480
600 min Summer	10.441	0.0	9.3	600
720 min Summer	9.112	0.0	9.6	700
960 min Summer	7.342	0.0	9.9	808
1440 min Summer	5.412	0.0	10.1	1054
2160 min Summer	4.009	0.0	14.0	1468
2880 min Summer	3.251	0.0	15.2	1876
4320 min Summer	2.426	0.0	16.3	2720
5760 min Summer	1.983	0.0	18.6	3520
7200 min Summer	1.707	0.0	20.0	4320
8640 min Summer	1.517	0.0	21.3	5096
10080 min Summer	1.378	0.0	22.6	5856
15 min Winter	117.275	0.0	2.9	19
30 min Winter	83.079	0.0	3.7	33
60 min Winter	56.245	0.0	6.1	62
120 min Winter	34.120	0.0	7.3	122

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Meadowside Sharp Road Kendal Cumbria LA9 6NY	Low Road, Wigton Whitehaven House Type E Geocellular Crate	
Date 13/11/2020	Designed by CA	
File K36110 CRATE SOURCE CONTROL...	Checked by	
XP Solutions	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
180 min Winter	9.207	0.607	0.0	0.1	0.1	7.8	O K
240 min Winter	9.244	0.644	0.0	0.1	0.1	8.3	O K
360 min Winter	9.290	0.690	0.0	0.1	0.1	8.9	O K
480 min Winter	9.318	0.718	0.0	0.1	0.1	9.2	O K
600 min Winter	9.335	0.735	0.0	0.1	0.1	9.4	O K
720 min Winter	9.345	0.745	0.0	0.1	0.1	9.6	O K
960 min Winter	9.351	0.751	0.0	0.1	0.1	9.6	O K
1440 min Winter	9.350	0.750	0.0	0.1	0.1	9.6	O K
2160 min Winter	9.337	0.737	0.0	0.1	0.1	9.5	O K
2880 min Winter	9.315	0.715	0.0	0.1	0.1	9.2	O K
4320 min Winter	9.260	0.660	0.0	0.1	0.1	8.5	O K
5760 min Winter	9.208	0.608	0.0	0.1	0.1	7.8	O K
7200 min Winter	9.164	0.564	0.0	0.1	0.1	7.2	O K
8640 min Winter	9.127	0.527	0.0	0.1	0.1	6.8	O K
10080 min Winter	9.095	0.495	0.0	0.1	0.1	6.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180 min Winter	25.411	0.0	8.1	180
240 min Winter	20.588	0.0	8.6	238
360 min Winter	15.263	0.0	9.3	354
480 min Winter	12.329	0.0	9.8	468
600 min Winter	10.441	0.0	10.1	580
720 min Winter	9.112	0.0	10.4	690
960 min Winter	7.342	0.0	10.7	896
1440 min Winter	5.412	0.0	11.0	1114
2160 min Winter	4.009	0.0	15.7	1580
2880 min Winter	3.251	0.0	16.9	2044
4320 min Winter	2.426	0.0	17.9	2900
5760 min Winter	1.983	0.0	20.8	3752
7200 min Winter	1.707	0.0	22.4	4608
8640 min Winter	1.517	0.0	23.8	5368
10080 min Winter	1.378	0.0	25.3	6152

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Meadowside Sharp Road Kendal Cumbria LA9 6NY	Low Road, Wigton Whitehaven House Type E Geocellular Crate	
Date 13/11/2020	Designed by CA	
File K36110 CRATE SOURCE CONTROL...	Checked by	
XP Solutions	Source Control 2020.1	

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 297535 516386 NX 97535 16386
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.013

Time (mins)	Area
From: To:	(ha)

0	4	0.013
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R G Parkins & Partners Ltd		Page 4
Meadowside Sharp Road Kendal Cumbria LA9 6NY	Low Road, Wigton Whitehaven House Type E Geocellular Crate	
Date 13/11/2020	Designed by CA	
File K36110 CRATE SOURCE CONTROL...	Checked by	
XP Solutions	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 10.000

Cellular Storage Structure

Invert Level (m) 8.600 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)
0.000	13.5	13.5	0.801	0.0	25.5
0.800	13.5	25.5			

Orifice Outflow Control

Diameter (m) 0.007 Discharge Coefficient 0.600 Invert Level (m) 8.600

R G PARKINS & PARTNERS LTD	CALCULATION		Job No.	K36110	Page	2 of 2
Meadowside	Job	Low Road	Drg no.		Date	20/10/2020
Shap Road		Whitehaven	Revision		Initial	CA
KENDAL LA9 6NY	Title	Sustainable Drainage - Treatment		Checked	TM	

POLLUTION HAZARD INDEX

		Pollution Hazard Indices		
Source of Runoff	Pollution Hazard	Suspended Solids	Metals	Hydro-carbons
Low traffic roads (e.g. residential roads and general access roads, < 300 traffic movements/day)	Low	0.5	0.4	0.4

POLLUTION MITIGATION INDEX

The receiving water body shall be: **Surface Water**

		Pollution Mitigation Indices		
	Suds Component	Suspended Solids	Metals	Hydro-carbons
1	Detention basin	0.5	0.5	0.6
2	None	0	0	0
3	None	0	0	0
4	None	0	0	0

Total Pollution Mitigation Index 0.5 0.5 0.6

ASSESSMENT OF TREATMENT PROPOSAL

Indices	Suspended Solids	Metals	Hydro-carbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.5	0.5	0.6
	Adequate	Adequate	Adequate

APPENDIX C: DRAINAGE SURVEYS



Project

Project Name: 2020-01-13076 RG Parkin Low Road Whitehaven

Project Date: 25/02/2020

Inspection Standard: MSCC4 Sewers & Drainage GB (SRM4 Scoring)



R. G. PARKINS & PARTNERS LTD
CONSULTING CIVIL & STRUCTURAL ENGINEERS



Table of Contents

Project Name	Project Number	Project Date
2020-01-13076 RG Parkin Low Road Whitehaven		25/02/2020

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Section: 2; MH6 > MH7 (MH6X)	2
Section: 3; MH1 > MH2 (MH1X)	3

**Drain Doctor**

Tel. 08000 266623

Project Information

Project Name	Project Number	Project Date
2020-01-13076 RG Parkin Low Road Whitehaven		25/02/2020

Client

Company: RG Parkin
Street: Moorside
Town or City: Kendal
County: LA9 6NY

Site

Company: RG Parkin
Street: Low Road
Town or City: Whitehaven

Contractor

Company: Drain Doctor
Phone: 08000 266623

Section Inspection - 25/02/2020 - MH3X

Section 1	Inspection 1	Date 25/02/20	Time 15:07	Client's Job Ref Not Specified	Weather Not Specified	Pre Cleaned Not Specified	PLR MH3X
Operator Not Specified		Vehicle Not Specified		Camera Not Specified	Preset Length Not Specified	Legal Status Not Specified	Alternative ID Not Specified

Town or Village:	Whitehaven	Inspection Direction:	Downstream	Upstream Node:	MH3
Road:	Low Road	Inspected Length:	17.60 m	Upstream Pipe Depth:	1.180 m
Location:		Total Length:	17.60 m	Downstream Node:	MH2
Surface Type:		Joint Length:	0.00 m	Downstream Pipe Depth:	4,970.000 m
Use:	Combined		Pipe Shape:	Circular	
Type of Pipe:			Dia/Height:	225 mm	
Year Constructed:			Pipe Material:	Vitrified clay pipe (i.e. all clayware)	
Flow Control:			Lining Type:	No Lining	
Inspection Purpose:			Lining Material:	No Lining	

Comments:

Recommendations:

Scale:	1:154	Position [m]	Code	Observation	MPEG	Photo	Grade
Depth: 1.18 m MH3							
	0.00	MH	Start node type, manhole, reference number: MH3	00:00:00			
	0.01	WL	Water level, 0% of the vertical dimension				
	2.94	WL	Water level, 10% of the vertical dimension	00:00:48			
	17.60	MHF	Finish node type, manhole, reference number: MH2: Backdrop	00:02:13			
Depth: 4970.00 m MH2							

Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	STR Peak	STR Mean	STR Total	STR Grade	SER No. Def	SER Peak	SER Mean	SER Total	SER Grade
0	00	00	00	10	0	00	00	00	10

Section Inspection - 25/02/2020 - MH6X

Section 2	Inspection 2	Date 25/02/20	Time 15:11	Client's Job Ref Not Specified	Weather Not Specified	Pre Cleaned Not Specified	PLR MH6X
Operator Not Specified		Vehicle Not Specified		Camera Not Specified	Preset Length Not Specified	Legal Status Not Specified	Alternative ID Not Specified

Town or Village:	Whitehaven	Inspection Direction:	Downstream	Upstream Node:	MH6
Road:	Low Road	Inspected Length:	8.55 m	Upstream Pipe Depth:	2.490 m
Location:		Total Length:	8.55 m	Downstream Node:	MH7
Surface Type:		Joint Length:	0.00 m	Downstream Pipe Depth:	5.030 m
Use:	Surface water	Pipe Shape:	Circular		
Type of Pipe:		Dia/Height:	300 mm		
Year Constructed:		Pipe Material:	Vitrified clay pipe (i.e. all clayware)		
Flow Control:		Lining Type:	No Lining		
Inspection Purpose:		Lining Material:	No Lining		

Comments:

Recommendations:

Scale: 1:75 Position [m] Code Observation MPEG Photo Grade

Code	Observation	MPEG	Photo	Grade
MH	Start node type, manhole, reference number: MH6	00:00:00		
WL	Water level, 0% of the vertical dimension			
WL	Water level, 10% of the vertical dimension	00:00:13		
MHF	Finish node type, manhole, reference number: MH7: Backdrop	00:00:47		

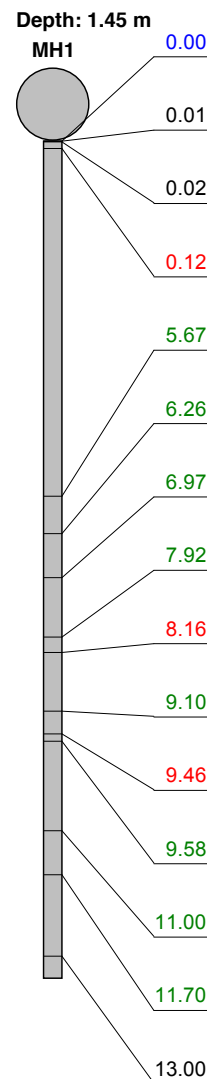
Construction Features					Miscellaneous Features				
Structural Defects					Service & Operational Observations				
STR No. Def	STR Peak	STR Mean	STR Total	STR Grade	SER No. Def	SER Peak	SER Mean	SER Total	SER Grade
0	0.0	0.0	0.0	1.0	0	0.0	0.0	0.0	1.0

Section Inspection - 25/02/2020 - MH1X

Section 3	Inspection 3	Date 25/02/20	Time 15:13	Client's Job Ref Not Specified	Weather Rain	Pre Cleaned No	PLR MH1X
Operator Not Specified		Vehicle Not Specified		Camera Not Specified	Preset Length Not Specified	Legal Status Not Specified	Alternative ID Not Specified

Town or Village:	Whitehaven	Inspection Direction:	Downstream	Upstream Node:	MH1
Road:	Low Road	Inspected Length:	13.70 m	Upstream Pipe Depth:	1.450 m
Location:		Total Length:	13.70 m	Downstream Node:	MH2
Surface Type:		Joint Length:	0.00 m	Downstream Pipe Depth:	4.970 m
Use:	Combined	Pipe Shape:	Circular		
Type of Pipe:		Dia/Height:	150 mm		
Year Constructed:		Pipe Material:	Vitrified clay pipe (i.e. all clayware)		
Flow Control:	No flow control	Lining Type:	No Lining		
Inspection Purpose:	Routine inspection of condition	Lining Material:	No Lining		

Comments:
Recommendations:

Scale:	1:117	Position [m]	Code	Observation	MPEG	Photo	Grade
							
Depth: 1.45 m		0.00	MH	Start node type, manhole, reference number: MH1	00:00:00		
		0.01	WL	Water level, 15% of the vertical dimension			
		0.02	REM	General remark: Pushrod camera used as crawler wouldnt pass joints	00:00:14		
		0.12	JDM	Joint displaced, medium	00:00:18	MH1X_e8 2f07f4-427 8-4096-a4	1
		5.67	DEEJ	Attached deposits, encrustation at joint from 01 o'clock to 06 o'clock, 20% cross-sectional area loss	00:00:47	MH1X_53f 2d50c-f3e 5-431f-b10	3
		6.26	DEEJ	Attached deposits, encrustation at joint from 06 o'clock to 10 o'clock, 10% cross-sectional area loss	00:00:54		3
		6.97	DEEJ	Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 5% cross-sectional area loss	00:00:57	MH1X_6d 548981-5f 12-419a-b	2
		7.92	DEEJ	Attached deposits, encrustation at joint from 02 o'clock to 09 o'clock, 15% cross-sectional area loss	00:01:05	MH1X_48 eec4de-90 4f-4be5-ba	3
		8.16	CL	Crack, longitudinal at 11 o'clock	00:01:06	MH1X_60 aa83a6-cc 65-408f-b8	2
		9.10	DEEJ	Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 10% cross-sectional area loss	00:01:14	MH1X_f37 de10b-7df 3-403f-99d	3
		9.46	CL	Crack, longitudinal at 12 o'clock	00:01:15	MH1X_7e d44ac0-38 be-47e1-a	2
		9.58	DEEJ	Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 10% cross-sectional area loss	00:01:16	MH1X_10 743e70-1b dd-4d25-af	3
		11.00	DEEJ	Attached deposits, encrustation at joint from 12 o'clock to 12 o'clock, 5% cross-sectional area loss	00:01:22	MH1X_d0 9dd2a7-31 95-485d-a	2
		11.70	DEEJ	Attached deposits, encrustation at joint from 02 o'clock to 06 o'clock, 10% cross-sectional area loss	00:01:25	MH1X_30 e8334b-38 29-497f-ab	3
		13.00	WL	Water level, 25% of the vertical dimension	00:01:37		