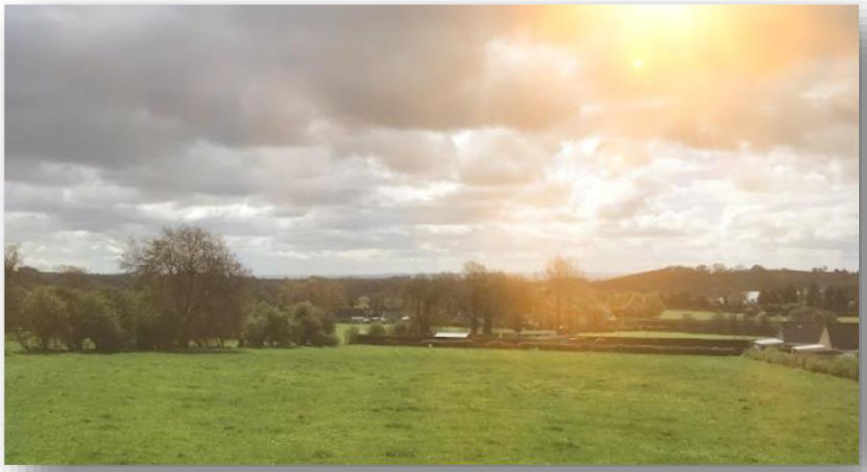
Detailed Flood Risk Assessment & Sustainable Drainage Strategy

Land South of Swineherd Lane
Kirbymoorside
North Yorkshire

Client : W&W Estates (Thornton Dale) Ltd



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Version Control

Revision	Remarks	Date
A	Preliminary	May 2018
B	Issue	June 2018
C	Changes to Site Layout	April 2019

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1. Introduction

Flood Risk Management Limited has been commissioned to prepare a detailed flood risk assessment (FRA) and a Sustainable Drainage Strategy (also known as a Drainage Impact Assessment) for a proposed new residential development to the south of Swineherd Lane, Kirbymoorside.

A report is required because part of the proposed development is over 1 hectare, this means that local and national planning policy requires an assessment which identifies and examines flood risk at the site level; and sets out measures to reduce the risk of flooding to the development and its occupants over its lifetime.

As sustainable drainage strategy is required because this is a major development, this means that national planning and Lead Local Flood Authority (LLFA) policy must be met to ensure the development has an approved scheme for the sustainable management of surface water run-off.

This is a supplementary document to a planning application; the conditions of a planning consent are likely to refer to this document, which means the applicant must comply with specific requirements set out in this report and consider its recommendations; in order to discharge any conditions of the consent.

2. Approach

2.1 National and Local Planning Policy (Flood Risk)

This report complies with the requirements set out in paragraphs 2 to 12 of the Technical Guide to the National Planning Policy Framework on flood risk and the North Yorkshire Strategic Flood Risk Assessment (SFRA). It clearly considers:

- The effect of a range of flooding events including extreme events on people and property.
- How people will be kept safe from flood hazards identified.

2.2 National Planning and LLFA Policy (Sustainable Drainage)

This report complies with the requirements set out in statement HCWA161 - Town and Country Planning Act, Development Management Procedure Order (DMPO): Dec 2014 (Commenced April 2015) which requires the LPA to determine that development includes sustainable drainage systems (SuDS) for the management of surface water run-off.

The LLFA is a statutory consultee for this development and have produced design guidance based on national non-statutory guidance and other best practice.

2.3 Land Drainage

The development is not in an internal drainage district so by default the development must meet the requirements set out in the Land Drainage Act 1991.

2.4 Statutory Sewerage Undertaker Requirements

The developer intends to enter into an agreement with Yorkshire Water for the adoption of both foul and surface water sewers via an agreement made under Section 104 of the Water Industry Act 1991.

The eventual detailed design of the sewerage system for this development will need to meet the technical standards of the WRC Sewers for Adoption and regional technical guidance.

2.5 Scope of Report

This report will:

- Assess the risk of flooding to the development.
- Assess the risk of flooding that this development might present elsewhere.
- Assess the existing site hydrology including infiltration and greenfield run-off.
- Assess the hydraulic impact of the proposed site layout for the design event.
- Give an estimate of required design storm-water attenuation volume.
- Propose an indicative layout of adoptable public sewers and/or SuDS apparatus.

This report will not:

- Set out any detailed engineering design.
- Set out detailed hydraulic calculations for engineering design purposes.

2.6 Sources of Data

The following publications and data sources were used in the production of this report:

- National Flood Risk Map for Planning – Rivers and Sea
- National Map for Risk of Flooding from Surface Water
- North Yorkshire Strategic Flood Risk Assessment (SFRA)

- National Planning Policy Framework (NPPF): MHCLG: 2018
- Technical Guidance to NPPF: MHCLG: 2012
- Planning Practice Guidance (Planning and Flood Risk): MHCLG: 2014
- Flood Risk Assessments Guide for New Development (FD2320/TR2): EA: 2005
- Flood Risk Assessments: Climate Change Allowances: EA 2016 (2019 Update)
- SuDS Design Guidance: NYCC LLFA: 2015 (Rev 4)
- Sewers for Adoption: WRC: 2015
- Flood Estimation Handbook: CEH: 2013
- IH124 Flood Estimation for small Catchments: Institute of Hydrology: 1994

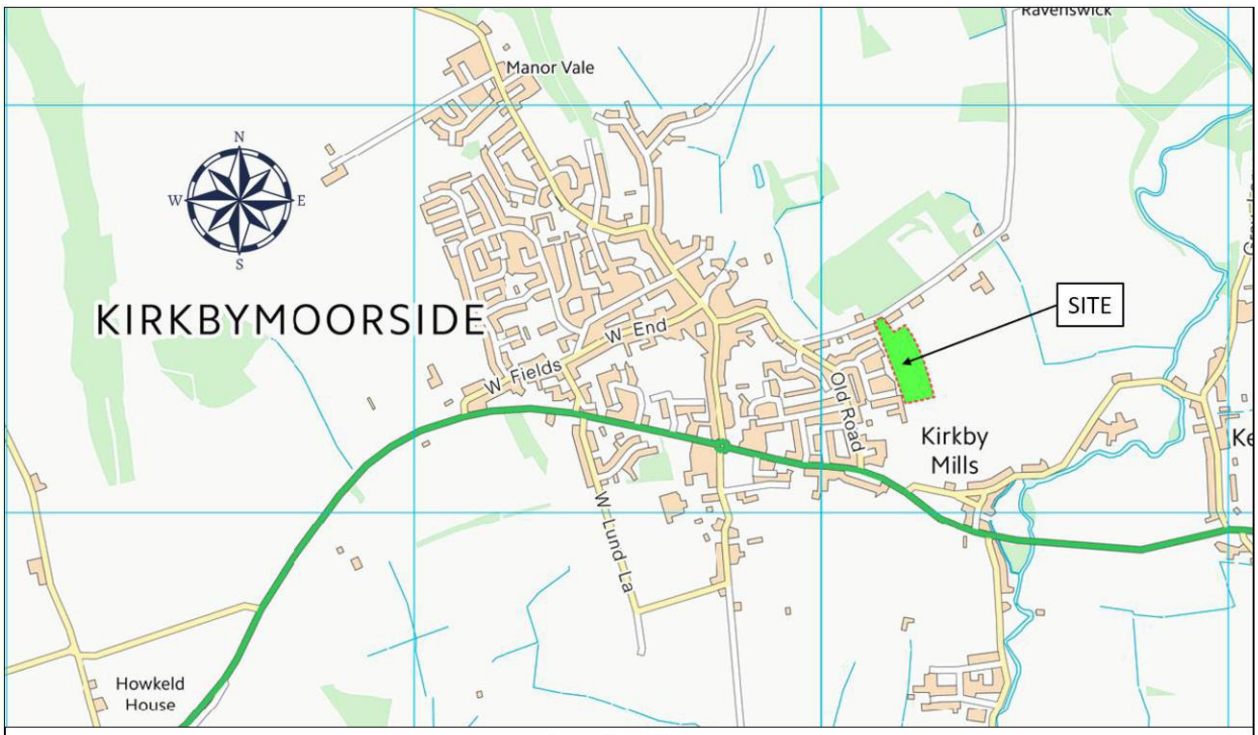
2.7 Licence Information

3. Context

3.1 Location

The proposed development is situated to the east of the village of Kirbymoorside, the site entrance is off Swineherd lane.

The National Grid Reference for the site is **SE 702 863**



Location Plan

3.2 Study Area

The study area will be the village of Kirbymoorside and will consider impact to and from the surrounding area including the river Dove and its tributaries.

3.3 Description of Proposed Development

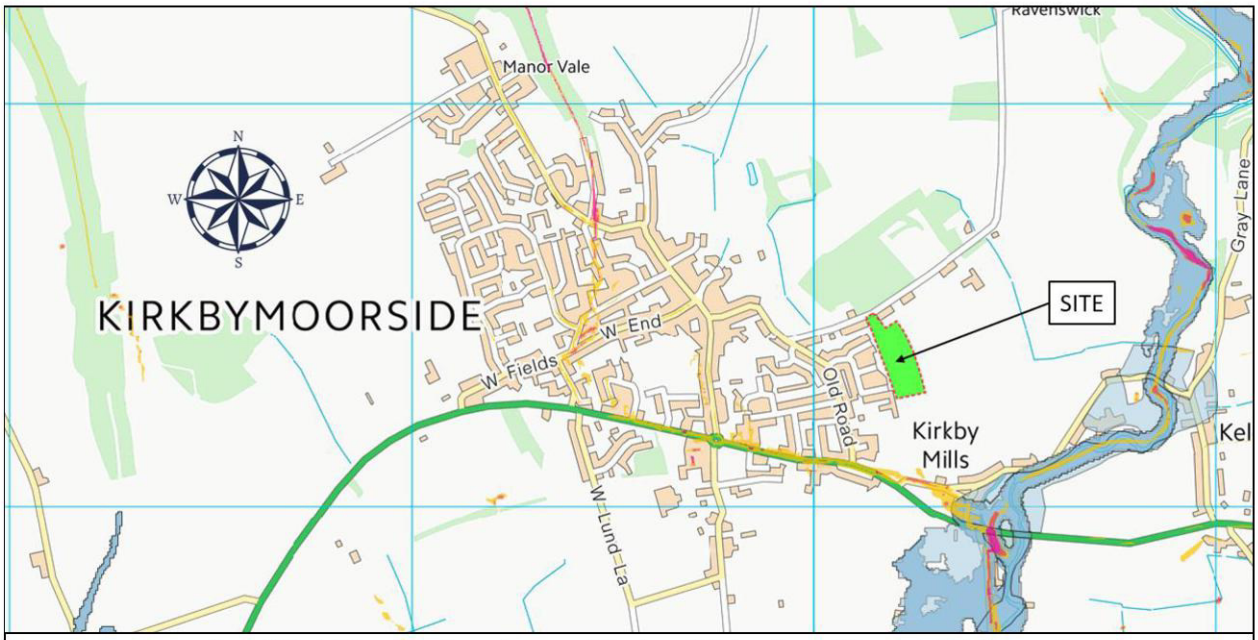
The proposal is for C3 residential property and means of access.

3.4 Topography

A topographical survey has been undertaken. The site slopes from the north west at around **63mAOD** (Meters Ordnance Datum Newlyn) to the south east corner which is **48mAOD** at an average gradient of **1 in 8.**

Flood Risk Information

3.5 Flood Risk Maps



Flood Risk Map for Planning and Surface Water Flood Hazard 1% (Large Scale)

Flood Risk Map for Planning and Surface Water Flood Hazard 1% (Small Scale)

4. Flood Risk Map Commentary

The National map for planning clearly shows that all the development is in flood risk zone 1. This means the risk of flooding from rivers and sea has been assessed to be less than **0.01% AEP (Annual Exceedance Probability).**

The National mapping product for surface water flooding clearly shows that there is a very low hazard from surface water flooding.

5. Detailed Analysis of Flood Risk

5.1 Historic Flooding

Analysis of publicly available records suggest flooding has occurred in Kirbymoorside and Kirby Mills on more than one occasion, due to both high intensity surface water events and river flooding.

Comparison of the location of these reported events coincides with the surface water flood flow pathways and fluvial pathways shown on the flood risk maps above.

No evidence has been found that the site of the proposed development has flooded.

5.2 Flooding from Rivers and Large Watercourses (Fluvial Flooding) including climate change

The nearest significant fluvial source is to the south east of the development on the River Dove.

At its closest point the fluvial flood extent is **278m** away from the development.

Climate change allowances for the Humber hydraulic region suggest a **30%** increase in peak river flow allowances. In broad terms this translates to an approximate rise of **20%** in peak levels for the **1%AEP** design event. Taking a very conservative estimate of a **5m** depth above baseflow, this would only result in a depth increase of **1m** over the next **100 years**. Given the development site is several metres above the level of the existing flood extent, fluvial flooding will not present a risk to the development over its lifetime.

5.3 Flooding from Surface Water (Pluvial Flooding)

The National map for surface water flooding hazard shows that the site is not at risk in the design event, this concurs with examination of local topography that shows that the site sits on high ground, with dry and fluvial valleys to the west and east.

Climate change over the lifetime of the development is predicted to result in peak rainfall intensity of **30%.** Although this will certainly result in increased flood depth in the dry valley in the centre

of the village, it is unlikely to make a significant difference at the development site, this is because rainfall on land to the north will likely cascade west.

5.4 Flooding from Groundwater

This area's geology is largely made up of Kimmeridge Clay interspersed with sandstone and limestone to the north. With thin overburdens, this suggests that groundwater emergence at the development site is unlikely. More probable is occasional springs (Kelds) to the north which are unlikely to impact the site.

5.5 Flooding from other Local Sources

Construction of new vehicular access to the development site may result in redirection of some surface water flood flows from Swineherd Lane. Careful consideration should be given to this in the design of the estate road.

There are no other significant risks from other local sources identified.

5.6 Flooding from the Development Site Itself

The policies of all the relevant regulators requires that the development is designed to ensure the surface water runoff in the design event for planning **(1%AEP (1 in 100 year) + climate change),** is as a minimum restricted to the existing runoff rate for the development site. Furthermore, the LLFA require that if this is a greenfield site, the runoff rate is restricted to the existing **100%AEP (1 in 1 year)** runoff rate.

The layout of the development must not redirect flood flows so that any land outside of the development has an increased risk of flooding.

6. Sustainable Drainage - Management Approach

6.1 Management of water on site

The developer shall take the following approach to sustainable drainage:

Approach		**Comments**
Prevention	**YES**	Unbound surfaces where possible. Side and rear paths to cascade to garden areas.
Source Control	**YES**	Planting using sandy soil (45%) mix, around drives, property frontages and adjacent to adoptable highway.
Site Control	**NO**	Options limited due to local topography.
Regional Control	**YES**	Regional attenuation solution proposed under public open space.

6.2 Management of water leaving the site

The following hierarchical approach to downstream discharge shall been taken for this site:

Approach		**Comments**
Discharge to Soakaway (Infiltration)	**NO**	BRE 365 Test – Low Infiltration Rate– Ruled out presently -See Appendix D.
Discharge to Watercourse	**YES**	Preferred approach.
Discharge to Surface Water Sewer	**NO**	Alternative at detailed design stage – Ruled out presently.
Discharge to Combined Sewer	**NO**	Ruled out due to local capacity issues.

6.3 Future Management of Assets

Most of the drainage apparatus shall be offered for adoption to Yorkshire Water under a Water Industry Act 1991, Section 104 Agreement.

7. Hydraulic Assessment

7.1 Method

The assessment will establish any increased flood volume due to the introduction of new impermeable buildings, roads and parking on what is presently a greenfield site, this will be assessed against the design event for planning purposes which is **1%AEP (100 Year) + 30% Allowance** for climate change, over the lifetime of the development.

The probabilistic data set used for this assessment will be the Centre for Hydrology and Ecology (CEH), Flood Estimation Handbook (FEH) 2013.

The tool for estimating greenfield runoff will be the Institute for Hydrology report 124 (IH124). This will be factored to the current greenfield area of the proposed development to establish the **43% (2.3 year)** event (Qbar) this will then be factored to the **100% (1 year)** event to establish the control discharge rate which is required by the LLFA, or as close to this figure as commercially available flow control apparatus permit.

The volume discharged is calculated against progressing time series data at **15 min** intervals with increasing time and probabilistic rainfall volumes (showing intensity) netted off against cumulative discharge volume to establish the maximum flood volume that results due to the proposed development; this will show the design attenuation required and critical duration for the development.

For the purposes of this report the critical duration will be used as well as the **6-hour** duration event which is specified by some technical regulators.

7.2 Assumptions and Qualifications

Impermeable area is based on an indicative layout produced for planning purposes. This may change through planning and detailed design stage. A detailed breakdown of the impermeable area considered can be found at *Appendix A.*

Because this is a residential development it is likely that the overall impermeable footprint will increase over time due to the introduction of things like conservatories, extensions and additional paved areas. This phenomenon is known as 'urban creep', the LLFA recommend a **10%** allowance is added to the total estimated impermeable area to account for this.

A minimum discharge rate of **3.5l/s** is assumed. This is based on a near constant head to discharge rate using a vortex flow control device such a ©Hydrobrake. It is understood that this is the approximate minimum discharge rate accepted by Yorkshire Water based on a **75mm** orifice, as smaller orifices may block, which increases blockage and therefore flood risk.

Sufficient gradient and cover can be achieved to the pipes network.

7.3 Hydraulic Calculations

The hydraulic calculations are set out at *Appendix B.*

The design basis at this stage shall be based on the critical storm. As part of the detailed design for the Section 104 agreement the undertaker will require a 1D computer mathematical model of the piped network, this may give different results than those given in this report, although It should be noted that the method used in this report is simple and likely to overestimate required attenuation.

7.4 Results

The **6-hour** duration storm gives a design attenuation volume of **722m3**, the critical duration is **28 hours**, giving a design attenuation volume of **866m3.**

8. Technical Solution

8.1 Adoptable Surface Water Sewer

The adoptable surface water sewer can be designed for the critical **1% AEP** event plus climate change. Flows shall be restricted to **3.5 l/s** before discharging into an ordinary watercourse on the eastern side of the development. To meet the requirements of the LLFA and Yorkshire Water, flows shall be attenuated using a modular precast underground concrete tank which shall be situated

entirely under public open space. An indicative layout which also shows the approximate route of the adoptable foul sewer is shown at *Appendix C*.

9. Conclusion

This site is at very low risk of flooding from external sources over its lifetime.

A scheme for managing surface water can be implemented in line with national and local planning policies and technical standards of regulators.

This report demonstrates that measures can be implemented that mitigate any increased flood risk to the surrounding area due to the proposed development.

Report Ends

Appendix A – Impermeable Area Tables

IMPERMEABLE AREA DISCHARGING TO ADOPTABLE PUBLIC SURFACE WATER SEWER

	Roof (m2)	Parking (m2)	Garage (m2)	Other (m2)	Sub Total (m2)
Plot 1	100	24		124	248
Plot 2	93	24			117
Plot 3	79	24			103
Plot 4	79	24			103
Plot 5	79	24			103
Plot 6	108	17	20		145
Plot 7	108	17	20		145
Plot 8	79	24			103
Plot 9	93	24			117
Plot 10	93	24			117
Plot 11	58	24			82
Plot 12	58	24			82
Plot 13	28	24			52
Plot 14	93	24			117
Plot 15	93	24			117
Plot 16	128	24			152
Plot 17	128	24	20		172
Plot 18	112	24	20		156
Plot 19	112	24	20		156
Plot 20	79	24			103
Plot 21	79	24			103
Plot 22	139	24	20		183
Plot 23	119	24	20		163
Plot 24	119	24	20		163
Plot 22 to 24 Unadopted Access			130		130
Plot 25	127	24	20		171
Plot 26	127	24	20		171
Plot 27	119	24	20		163
Plot 28	119				119
Plot 28 Drive and Garage Only		24	20		44
Plot 29	112	24	20		156
Plot 28 and 29 Unadopted Access				38	38
Plot 30	112	60	20		192
Plot 31	112	60	20		192
Plot 32	112	60	20		192
Plot 33	116	60	20		196
Plot 34	116	60	20		196
Plot 35	108	60	20		188
Plot 36	93	24			117
Plot 37	93	24			117
Plot 38	79	24			103
Plot 39	108	24			132
Plot 40	108	24	20		152
Plot 41	79	24			103
Plot 42	79	24			103
Plot 43	79	24			103
Plot 44	93	24			117
Plot 45	79	24			103
Adoptable Highway				2635	2,635
TOTAL					**9,035**

SUMMARY

Total Site Area in Adoptable Area (m2)	14,975
Total Impermeable Area Discharging to Adoptable Public Surface Water Sewer (m2)	9,035
Net Greenfield Area in Adoptable Area	5,940

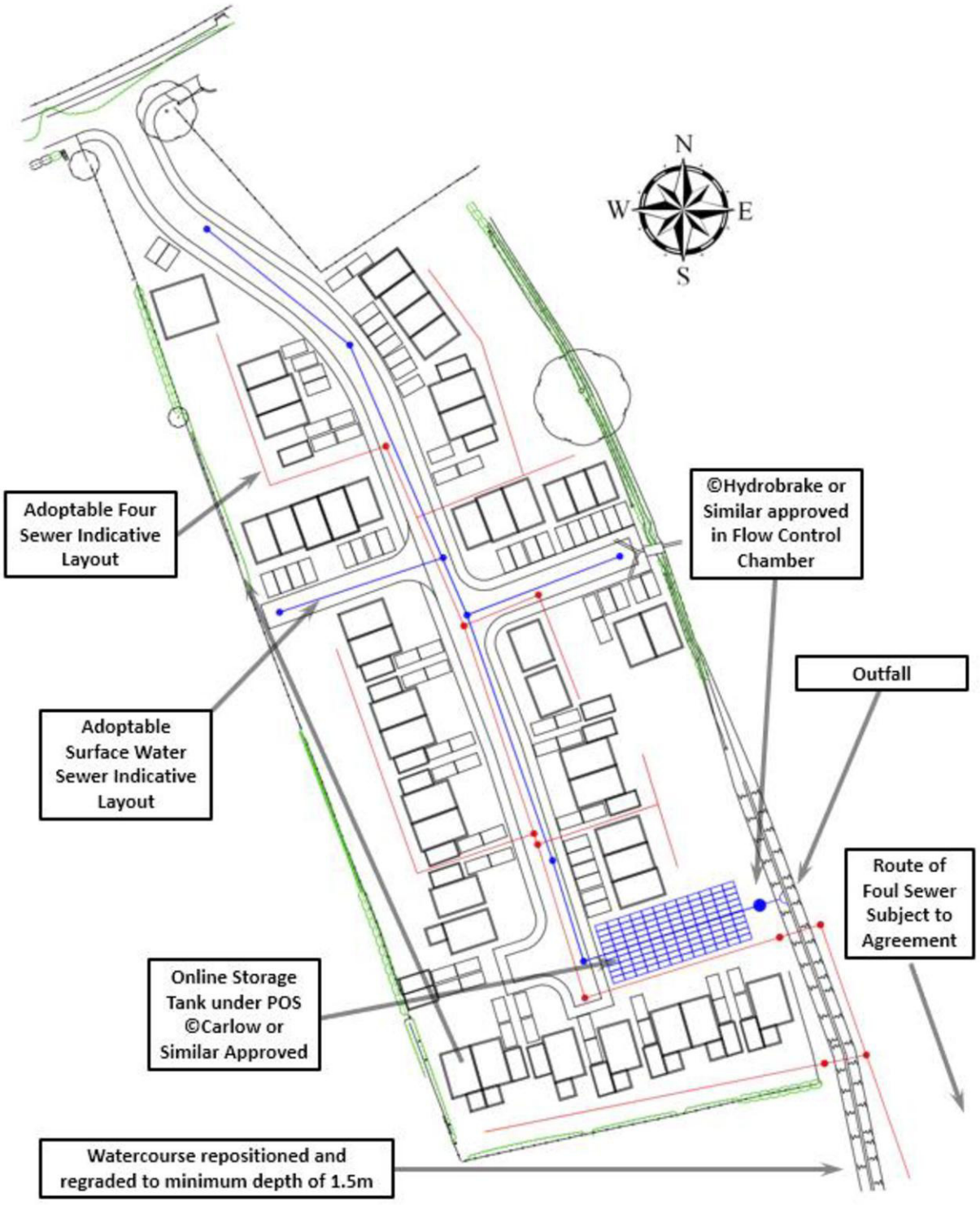
Adoptable (S104) Surface Water Sewer Calculations and Results

Rainfall Profile	FEH 2013
Greenfield Method	IH124
Existing Greenfield Area	1.4975 Ha
Proposed Impermeable area with positive drainage	0.9938 Ha
Urban Creep Allowance @ 10%	0.0999 Ha
Design Impermeable Area	0.9939 Ha
SAAR 6190	615 mm
Soil type used (FSR)	3
SPR	0.37
Qbar (2.3 year)	1.566 l/s/ha
Qbar 2.3 to 1-year growth factor	0.86
Qbar 1 year	1.348 l/s/ha
Existing Greenfield Discharge	1.725 l/s
Minimum Achievable Discharge Rate	3.5 l/s

Duration hours	Duration Seconds	100 year rainfall (m)	100 year rainfall (m) With Climate Change at 30%	Impermeable Area (m)	Rainfall Volume (m3)	Design Discharge Rate (m3/s)	Dischage Volume over Storm Duration	Design Attenuation Volume	
5	18000	0.05893	0.076609	9938.5	761.3785465	0.0035	63	698.3785465	
5.25	18900	0.05968	0.077584	9938.5	771.068584	0.0035	66.15	704.918584	
5.5	19800	0.0604	0.07852	9938.5	780.37102	0.0035	69.3	711.07102	
5.75	20700	0.0611	0.07943	9938.5	789.415055	0.0035	72.45	716.965055	
6	21600	0.06177	0.080301	9938.5	798.0714885	0.0035	75.6	722.4714885	6 Hour
6.25	22500	0.06243	0.081159	9938.5	806.5987215	0.0035	78.75	727.8487215	
6.5	23400	0.06307	0.081991	9938.5	814.8675535	0.0035	81.9	732.9675535	
6.75	24300	0.0637	0.08281	9938.5	823.007185	0.0035	85.05	737.957185	
7	25200	0.0643	0.08359	9938.5	830.759215	0.0035	88.2	742.559215	

27	97200	0.09338	0.121394	9938.5	1206.474269	0.0035	340.2	866.274269	
27.25	98100	0.09363	0.121719	9938.5	1209.704282	0.0035	343.35	866.3542815	
27.5	99000	0.09388	0.122044	9938.5	1212.934294	0.0035	346.5	866.434294	
27.75	99900	0.09412	0.122356	9938.5	1216.035106	0.0035	349.65	866.385106	
28	100800	0.09437	0.122681	9938.5	1219.265119	0.0035	352.8	866.4651185	Critical
28.25	101700	0.09461	0.122993	9938.5	1222.365931	0.0035	355.95	866.4159305	
28.5	102600	0.09485	0.123305	9938.5	1225.466743	0.0035	359.1	866.3667425	
28.75	103500	0.09509	0.123617	9938.5	1228.567555	0.0035	362.25	866.3175545	
29	104400	0.09532	0.123916	9938.5	1231.539166	0.0035	365.4	866.139166	

Appendix C – Indicative Drainage Layout



Appendix D – BRE 365 Soakaway Test

PERCOLATION TEST FOR DEVELOPMENT AT LAND OFF SWINEHERD LANE, KIRKBY MOORSIDE FOR THORNTON LE DALE HOMES

∴Volume outflow between 75% and 25% effective depth v_p75

v_p 75-25 = 0.85 x 1.100 x (0.390 - 0.240) = 0.1403m^3

The main surface area through which the outflow occurs, taken to be the pit sides to 50% effective depth and including the base of the pit (0.390 - 0.240)/2 = 0.150/2 = 0.075m

a_p50 = (0.85 x 0.075 x 2) + (1.100 x 0.075 x 2) + (0.85 x 1.100) = 1.228m^2

The time for the outflow between 75% and 25% effective depth

t_p 75-25 = 82 - 27 = 55 minutes

∴ soil infiltration rate, f = 0.1403/1.228 x 55 x 60 = 3.46 x 10^{-5}m/s

b) Trial pit 2

Trial pit = 900 x 1000 x 1000 deep

Trial pit filled with water to a depth of 300mm and allowed to drain to 225mm. Record of depth against time take at 10 minute intervals as shown below

		t_p75					t_p25		
Time (min)	0	10	20	30	40	50	60	70	80
Depth (mm)	300	285	280	275	275	260	250	240	225
Diff (min)		15	5	5	0	5	10	10	15

∴ Volume outflow between 75% and 25% effective depth v_p75

v_p 75-25 = 0.90 x 1.0 x (0.280 - 0.250) = 0.0300m^3

The main surface area through which the outflow occurs, taken to be the pit sides to 50% effective depth and including the base of the pit (0.280 - 0.250)/2 = 0.030/2 = 0.0150m

PERCOLATION TEST FOR DEVELOPMENT AT LAND OFF SWINEHERD LANE, KIRKBY MOORSIDE FOR THORNTON LE DALE HOMES

$a_p50 = (0.90 \times 0.0150 \times 2) + (1.0 \times 0.0150 \times 2) + (0.90 \times 1.0) = 0.957m^2$

The time for the outflow between 75% and 25% effective depth

t_p 75-25 = 60 - 20 = 40 minutes

∴ soil infiltration rate, $f = 0.0300/0.957 \times 40 \times 60 = 1.31 \times 10^{-5}m/s$

Average Soil Infiltration rate = $2.38 \times 10^{-5}m/s$