Site Infrastructure Services Limited

GLEESON HOMES CUMBRIA

Phase 2 - Ivy Mills

WHITEHAVEN

Flood Risk Assessment & Outline Surface Water Drainage Strategy

GHC-IM-W-FRA

May 2019

SIS GENERAL NOTES

Project No.:	GHC-IM-W-FRA
Site:	Ivy Mills Phase 2, Whitehaven
Title:	Flood Risk Assessment & Outline Surface Water Drainage Strategy
Client:	Gleeson Homes (Cumbria)
Date:	May 2022
Office:	Salford
Status:	Initial

Author	C Lynch
Signature	
Date:	May 2022

Issue No	Version/Details	Date issued	Author
-	Initial Issue	13.05.22	CML

Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

CONTENTS

1 INTRODUCTION 1
1.1 Context 1
1.2 Scope of work 2
2 SITE DESCRIPTION 3
2.1 Existing site 3
2.2 Development proposals 5
3 LEGISLATION, POLICY AND GUIDANCE 6
3.1 National policy 6
3.2 Local policy 7
3.3 Area guidance 8
3.4 Site-specific consultation 7
4 SOURCES OF FLOOD RISK 8
4.1 Criteria 8
4.2 Flooding from rivers (fluvial flood risk) 8
4.3 Flooding from the sea (tidal flood risk) 10
4.4 Flooding from the land (overland pluvial flood risk) 10
4.5 Flooding from groundwater 11
4.6 Flooding from sewers 12
4.7 Other sources of flooding 13
5 FLOOD MITIGATION MEASURES 15
5.1 Overview 15
5.2 Overland flood flow 15
5.3 Finished floor levels 15
5.4 Safe access/egress 15
6 PLANNING CONTEXT 16
6.1 Application of planning policy 16
6.2 Land use vulnerability 16
6.3 Sequential Test 16
7 SURFACE AND FOUL WATER DRAINAGE ASSESSMENT 17
7.1 Scope 17
7.2 Pre-development situation 17
7.3 Limiting discharge for design 18
7.4 Off-site discharge options and limits 18
7.5 Post-development situation 21
8 CONCLUSIONS AND RECOMMENDATIONS 22

APPENDICES

APPENDIX A – Existing Topographical Survey

APPENDIX B – Proposed Drainage Layout

APPENDIX C – Surface Water Simulations & Calculations

APPENDIX D – Greenfield Run-off Rate

MAY 2019

1 INTRODUCTION

1.1 Context

Site Infrastructure Services Ltd have been commissioned to carry out a Flood Risk Assessment (FRA) and drainage strategy for Gleeson Cumbria (the 'client'). The assessment is in support of the detailed planning submission for the residential development at Phase 2 Ivy Mills, Whitehaven (the 'site').

The assessment has been prepared in accordance with the National Planning Policy Framework (NPPF)[1] and its accompanying Planning Practice Guidance[2], the Interim Code of Practice for Sustainable Drainage[3], BS 8533-2011 Assessing and Managing Flood Risk in Development Code of Practice[4], BS 8582:2013 Code of practice for surface water management for development sites[5] and the Non-statutory technical standards for sustainable drainage systems[6], with site-specific advice from the Environment Agency, the Lead Local Flood Authority (LLFA), the Local Planning Authority (LPA), the architect and the client.

The NPPF sets out the criteria for development and flood risk by stating that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

The key definitions within the PPG are:

- "Flood risk" is a combination of the probability and the potential consequences of flooding from all sources – including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources;
- "Areas at risk of flooding" means areas at risk from all sources of flooding. For fluvial (river) and sea flooding, this is principally land within Flood Zones 2 and 3. It can also include an area within Flood Zone 1 which the Environment Agency has notified the local planning authority as having critical drainage problems.

For this site, the key aspects that require the assessment are:

- The Environment Agency 's indicative flood zone map shows that the site is located within Flood Zone 1; and
- The site area is approximately 2.186Ha therefore surface water drainage must be considered, and sustainable drainage systems (SuDS) incorporated, where possible.

[1] Communities and Local Government, 'National Planning Policy Framework', July 2019.

[2] Communities and Local Government, 'Planning Practice Guidance - Flood Risk and Coastal Change, ID 7', March 2014. http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

[3] DEFRA, 'Interim Code of Practice for Sustainable Drainage Systems' National SUDS Working Group, July 2004.

[4] BSI, 'BS 8533-2011 Assessing and managing flood risk in development Code of practice', October 2011.

[5] BSI, 'BS 8582:2013 Code of practice for surface water management for development sites', November 2013.

[6] DEFRA, 'Sustainable Drainage Systems - Non-statutory technical standards for sustainable drainage systems', March 2015.

1.2 Scope of work

A key element of project development is to prepare a FRA to establish the flood risk associated with the proposed development and to propose suitable mitigation, if required, to reduce the risk to a more acceptable level.

The scope of work relating to a FRA is based on the guidance provided in Section 14 of the NPPF and its accompanying Planning Practice Guidance.

A site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. The scope of this assessment therefore comprises the following elements:

- To review architect plans, planning information and other studies to determine existing site conditions;
- To obtain information on the hydrology and hydrological regime in and around the site;
- To obtain the views of the Environment Agency /LLFA including scope, location and impacts;
- To determine the extent of new flooding provision and the influence on the site;
- To assess the impact on the site from climate change effects and anticipated increases in rainfall over a 100 year period for residential uses/over a 60 year period for a commercial use/over a 25 year period for the design life of the development;
- To review site surface water drainage based on the proposed layout and, if necessary, to determine the extent of infrastructure required; and
- To prepare a report including calculations and summaries of the source information and elements reviewed.

Reliance has been placed on factual and anecdotal data obtained from the sources identified.

Site Infrastructure Services Ltd cannot be held responsible for the scope of work, or any omissions, misrepresentation, errors, or inaccuracies with the supplied information. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

2 SITE DESCRIPTION

2.1 Existing site

2.1.1 Location

Site Name and Address: Ivy Mills Phase 2, Whitehaven CA28 8TP

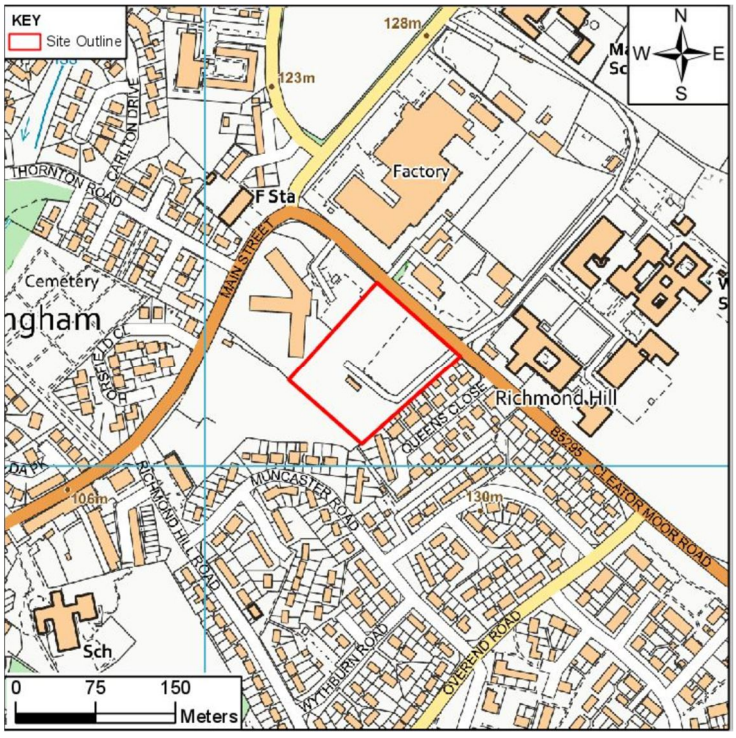
Site National Grid Reference: (E) 299018; (N) 517078

The site covers approximately 2.186 ha (21,860 m²), and at present is unused. The site is bounded by Cleator Moor Road (B5295) & Main Street to the immediate North-East, a care home to the North, Queens Close housing estate to the South-East and unused land to the South-West which has outline planning permission for residential dwellings.

Topographically the site gradually slopes from the east with levels of 129.10m, down to the west with levels of 114.30m

The site is accessed from Cleator Moor Road

Figure 2.1: Site location map



2.1.2 Land use and topography

The site covers approximately 2.186 ha (21,860 m²), and at present is unused.

Topographically the site gradually slopes from the east with levels of 129.10m, down to the west with levels of 114.30m

Appendix A.

2.1.3 Hydrology

The closest 'Main River' to the site is Snebra Beck, located approximately 400m west of the proposed site. Other 'Main Rivers' in the vicinity of the site include Midgey Gill, Pow Beck, and River Keele, all located over 1km from the proposed site. A culverted watercourse exists approximately 90m to the west of the site within Main Street.

2.1.4 Ground Investigation

Ground investigation was undertaken at the neighbouring site by GEO Environmental Engineering Ltd.

Intrusive ground investigations were carried out at the site in August 2019 where 10 mechanically excavated trial pits with in-situ geotechnical testing to depths of between 1.10m and 3.00m below ground level and 4 no. dynamic sampling boreholes to depths between 1.50m and 5.00m below ground level with gas and groundwater monitoring were carried out at various locations across the site.

As the site is on the location of the recently demolished workwear factory, made ground / crushed demolition rubble was encountered across the majority of the site area at variable depths up to 1.25m below ground level.

The ground conditions in the predominantly grassland areas to the east of the site consist of initially firm becoming stiff, occasionally soft, slightly sandy, slightly gravelly clay with occasional cobbles to a depth of 5.0m below ground level.

The strata below the made ground in the rest of the site was found to comprise of initially firm becoming stiff, slightly sandy, slightly gravelly clay with occasional cobbles to a depth of 4.2m below ground level.

No bedrock was encountered during the investigations.

Groundwater was encountered predominantly on the western side of the site in numerous trial pits at variable depths of between 0.40m and 2.20m below ground level and was noted within the demolition rubble, former foundation runs and the interface of the made ground and natural clay deposits.

Ground water monitoring recorded standing groundwater depths of between 0.35m and 2.58m below ground level at all the borehole locations with perched water most likely originating from the surface. It was also observed that the vegetated area in the east of the site was waterlogged following periods of heavy rainfall.

Based on the ground conditions encountered across the neighbouring site, the potential for permeable ground is considered negligible to very low and soakaways are not recommended as an appropriate solution and alternative methods should be considered for drainage of surface water run-off.

For reference refer to Geo Environmental Engineering Phase 2 Ground Investigation Report Ref 2019-3886

2.2 Development proposals

The proposed development is for a residential end use, details for the proposed development are included within Appendix B.

3 LEGISLATION, POLICY AND GUIDANCE

3.1 National policy

Table 3.1: National legislation and policy context

Legislation	Key provisions
National Planning Policy Framework (2019)	The aims of planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall.
Planning Practice Guidance (2014)	The NPPF is supported by an online Planning Practice Guidance, which provide additional guidance on flood risk.
Flood and Water Management Act 2010[7]	The Flood and Water Management Act (FWMA) aims to implement the findings of the 2007 Pitt Review and co-ordinate control of drainage and flood issues. There are a number of increased responsibilities within the Act that affect adoption of SuDS features and the role of the Environment Agency to expand on the mapping data they provide. The implementation of SuDS features has many beneficial impacts on the treatment of surface water during remediation works.
Water Resources Act 1991[8]	Section 24 – The Environment Agency is empowered under this Act to maintain and improve the quality of 'controlled' waters Section 85 – It is an offence to cause or knowingly permit pollution of controlled waters Section 88 – Discharge consents are required for discharges to controlled waters
Water Framework Directive (2000)[9]	The Water Framework Directive (WFD) requires all inland and coastal waters to reach 'good' chemical and biological status by 2015. Flood risk management is unlikely to have a significant impact on chemical water quality except where maintenance works disturb sediment (such as de-silting) or where pollutants are mobilised from contaminated land by floodwaters. The main impact of the WFD on flood risk management, both now and in the future, relates to the ecological quality of water bodies. Channel works, such as straightening and deepening, or flood risk management schemes that modify geomorphological processes can change river morphology. The WFD aims to protect conservation sites identified by the EC Habitats Directive and Birds Directive that have water-related features, by designating them as 'protected sites'.

[7] Flood and Water Management Act, 2010

[8] Water Resources Act, 1991

[9] EU Water Framework Directive, 2000

3.2 Local policy

Local policies ensures that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding and making development safe without increasing flood risk elsewhere and where possible, reducing flood risk.

Owing to the size of the development, it is classed as major development in accordance with The Town and Country Planning Order 2015[3], due to the development comprising more than 10 dwellings.

The area covered by the application is 1.2 ha (hectares) and by reference to the Environment Agency Flood Map, the site lies in Flood Zone 1.

Table 2 of the NPPF's Planning Practice Guidance [2] classifies each development into a vulnerability class, depending on the type of development. As residential dwellings the site is classified as 'More vulnerable'. 'More Vulnerable' development classes are deemed acceptable in terms of flood risk within Flood Zone 1. However due to the site being classed as major development a Flood Risk Assessment is required

3.3 Site-specific consultation

Discussions have been held with United Utilities pre-development Engineers & an agreed discharge rate of 10.0 litres per second for the overall site has been agreed (5.00 litres/per second for Phase 1 and 5.00 litres/per second for Phase 2).

4 SOURCES OF FLOOD RISK

4.1 Criteria

In accordance with the NPPF and advice from the Environment Agency, a prediction of the flood sources and levels is required along with the effects of climate change from the present for the design life of the development (in this case assumed to be 100 years).

Changes to climate change guidance in February 2016 indicate that increased allowances in peak river flow and rainfall intensity should now be incorporated within any assessment. The appropriate allowance for peak river flow is based on the sites location in the country, the lifetime of development, the relevant flood zone and the vulnerability of the proposed end use.

The flood risk elements that need to be considered for any site are defined in BS 8533 as the "Forms of Flooding" and are listed as:

- Flooding from rivers (fluvial flood risk);
- Flooding from the sea (tidal flood risk);
- Flooding from the land;
- Flooding from groundwater;
- Flooding from sewers (sewer and drain exceedance, pumping station failure etc); and
- Flooding from reservoirs, canals and other artificial structures.

The following section reviews each of these in respect of the subject site.

4.2 Flooding from rivers (fluvial flood risk)

4.2.1 Main river

The Environment Agency Flood Zone mapping study for England and Wales is available on their website at: https://flood-map-for-planning.service.gov.uk.

The latest published flood zone map (**Figure 4.1**), which does not take into account the effects of flood defences, shows the site to be located entirely in Flood zone 1 (representing between a greater than `a 1 in 1,000 annual probability of river flooding), indicating a **very low** risk of flooding, according to the Environment Agency maps.

In December 2013, the Environment Agency released an additional form of mapping 'Risk of Flooding from Rivers and Sea', which is available at:

https://flood-warning-information.service.gov.uk/long-term-flood-risk

The latest 'Risk of Flooding from Rivers and Sea' flood map (**Figure 4.2**), which shows the Environment Agency's assessment of the likelihood of flooding from rivers and the sea at any location and is based on the presence and effect of all flood defences, predicted flood levels, and ground levels, indicates that the site is considered to be at '**very low**' risk of flooding.

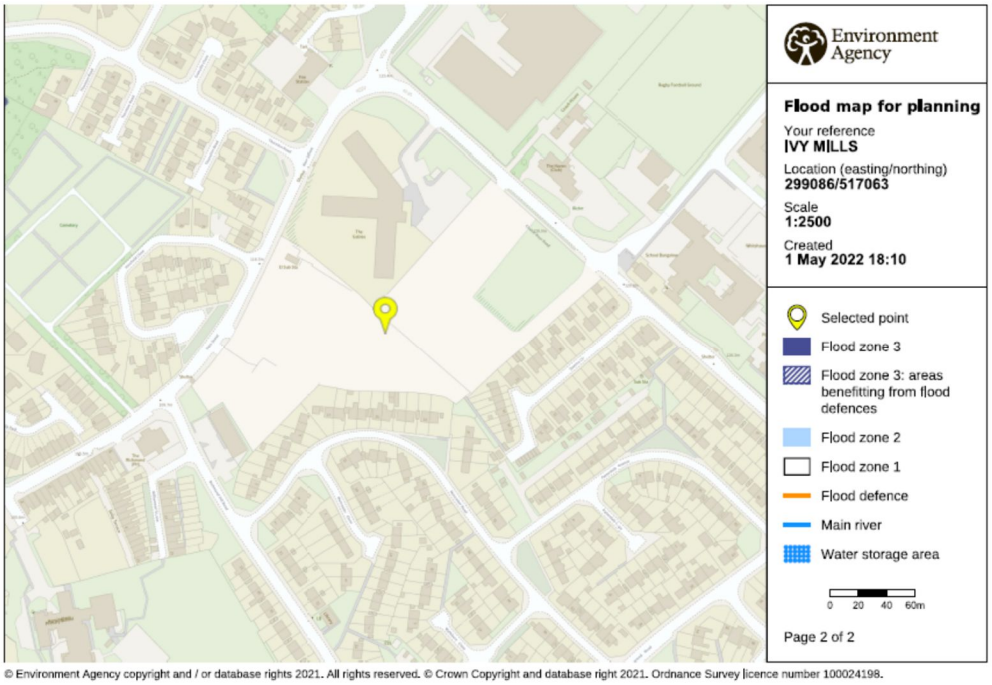


Figure 4.1 Environment Agency 'Flood map for planning'

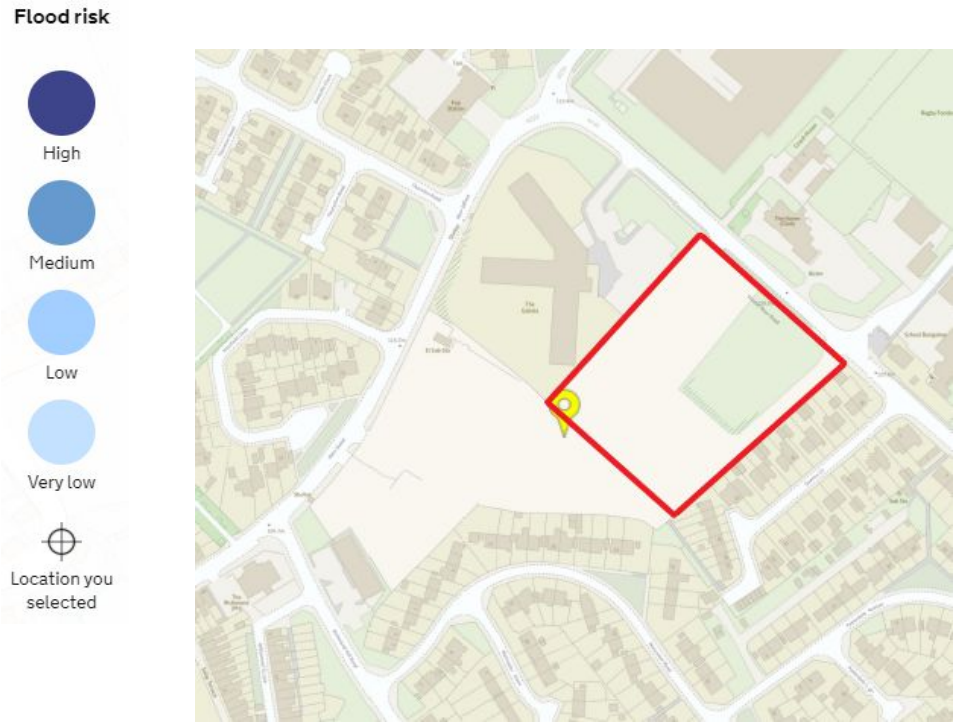


Figure 4.2 Environment Agency 'Flood risk from rivers or the sea' map (accessed May 2022)

4.2.2 Climate change

Fluvial flooding is likely to increase as a result of climate change. A greater intensity and frequency of precipitation is likely to raise river levels and increase the likelihood of a river overtopping its banks. Climate change guidance for river modelling was updated by the Environment Agency in February 2016. No model re-runs have been undertaken as part of this site-specific FRA. The impact upon the site should be negligible given its location within Flood Zone 1.

4.3 Flooding from the sea (tidal flood risk)

The site is not considered to be at risk from tidal flooding due to its inland location.

4.3.1 Climate change

Climate change is not considered to result in an increased risk of tidal flooding to the site.

4.4 Flooding from the land (overland pluvial flood risk)

If intense rain is unable to soak into the ground or be carried through manmade drainage systems, for a variety of reasons, it can run off over the surface causing localised floods before reaching a river or other watercourse.

Generally, where there is impermeable surfacing or where the ground infiltration capacity is exceeded, surface water runoff can occur. Excess surface water flows from the site are believed to drain naturally to the local water features, either by overland flow or through infiltration.

The Environment Agency 's surface water flood map (Figure 4.3) shows the site is at very low risk from pluvial flooding. There are isolated areas of low risk surface water flooding at the areas of hardstanding and at the low lying point of the western boundary.

Figure 4.3: Environment Agency 'Flood risk from surface water' map (accessed May 2022)

The risk of surface water flooding at the site is considered to be very low.

4.4.1 Climate change

Surface water flooding is likely to increase as a result of climate change in a similar ratio to fluvial flooding. Increased intensity and frequency of precipitation is likely to lead to reduced infiltration and increased overland flow. Climate change guidance for rainfall intensity has recently been updated by the Environment Agency in late February 2016. Revised allowances for climate change have been included in the indicative drainage strategy below.

4.5 Flooding from groundwater

Groundwater flooding occurs when water levels in the ground rise above the ground surface. It is most likely to occur in low lying areas underlain by permeable drift and rocks.

British Geological Survey (BGS) records (Figure 4.4) show the majority of the site lies within an area of 'Limited Potential for Groundwater Flooding to Occur'. Although the western corner of the sitelies within an area of 'Potential for Groundwater Flooding of Property Situated below Ground Level' there is no further evidence to suggest the development is at risk of groundwater flooding. In any case, there will be no development of property below the existing ground level and finished floor levels will be situated 150mm above ground level, and as such the development will be at low risk of groundwater flooding

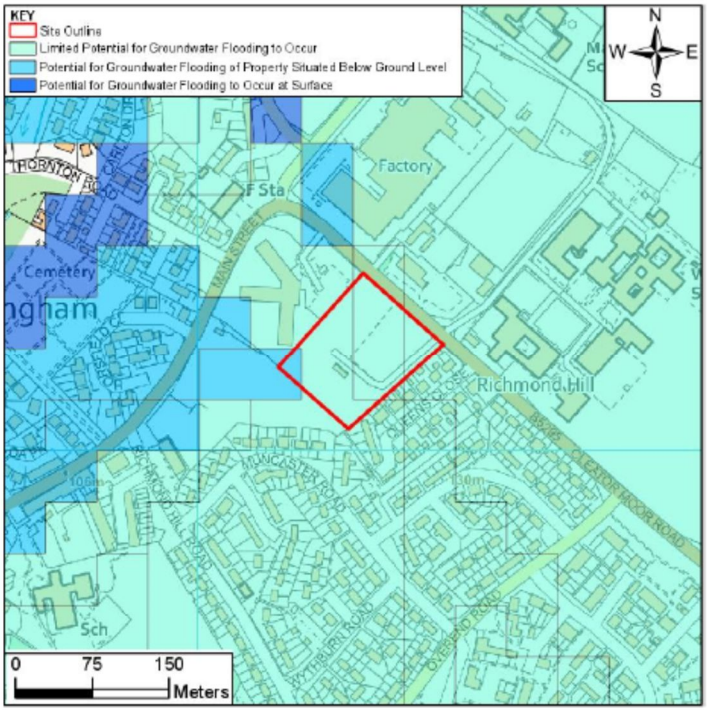


Figure 4.4: British Geological Society Ground Water Flood Map

4.5.1 Climate change

Climate change could increase the risk of groundwater flooding as a result of increased precipitation filtering into the groundwater body. If winter rainfall becomes more frequent and heavier, groundwater levels may increase. Higher winter recharge may however be balanced by lower recharge during the predicted hotter and drier summers. This is less likely to cause a significant change to flood risk than from other sources, since groundwater flow is not as confined. It is probable that any locally perched aquifers may be more affected, but these are likely to be isolated. The change in flood risk is likely to be low.

4.6 Flooding from sewers

Sewer details have been referenced from sewer record plans obtained from United Utilities The plans indicate the following network of sewers around the site:

- Combined;
  - It is known that a 225mm diameter combined sewer is located within the adopted highway to the south-west of the site adjacent to the entrance to Phase 1 and the EA mapping for reservoir flood risk does not show the site to be at risk. (Approval to discharge to the existing combined sewer has already been agreed with United Utilities).

There are no existing sewers shown onsite.

Flooding from artificial drainage systems occurs when flow entering a system, such as an urban storm water drainage system, exceeds its conveyance capacity, the system becomes blocked, or it cannot discharge due to a high-water level in the receiving watercourse. A sewer flood is often caused by surface water drains discharging into the combined sewer systems; sewer capacity is exceeded in large rainfall events causing the backing up of floodwaters within properties or discharging through manholes.

Most adopted surface water drainage networks are designed to the criteria set out in Sewers for Adoption[10]. One of the design parameters is that sewer systems be designed such that no flooding of any part of the site occurs in a 1 in 30 year rainfall event. By definition a 1 in 100 year event would exceed the capacity of the surrounding sewer network as well as any proposed drainage.

When exceeded, the surcharged pipe work could lead to flooding from backed up manholes and gully connections. This could lead to immediate flooding within highways surrounding the site.

Development has the potential to cause an increase in impermeable area, an associated increase in surface water runoff rates and volumes, and a consequent potential increase in downstream flood risk due to overloading of sewers, watercourses, culverts and other drainage infrastructure.

To ensure that sewer and surface water flooding is not exacerbated; surface water must be considered within the design of the site. This ensures that any additional surface water and overland flows are managed correctly, to minimise flood risk to the site and the surrounding area. The proposed surface water network on the site should be designed to ensure exceedance of the network has been considered.

The resultant sewer flood risk is considered to be **low**.

4.6.1 Climate change

The impact of climate change is likely to be negative regarding flooding from sewers. Increased rainfall and more frequent flooding put existing sewer and drainage systems under additional pressure resulting in the potential for more frequent surcharging and potential flooding. This would increase the frequency of local sewer flooding but would not be significant in terms of the proposed development.

[10] WRC, 'Sewers for Adoption' 7th Edition, August 2012

4.7 Other sources of flooding

4.7.1 Reservoirs

Flood events can occur from a sudden release of large volumes of water from reservoirs, canals and artificial structures.

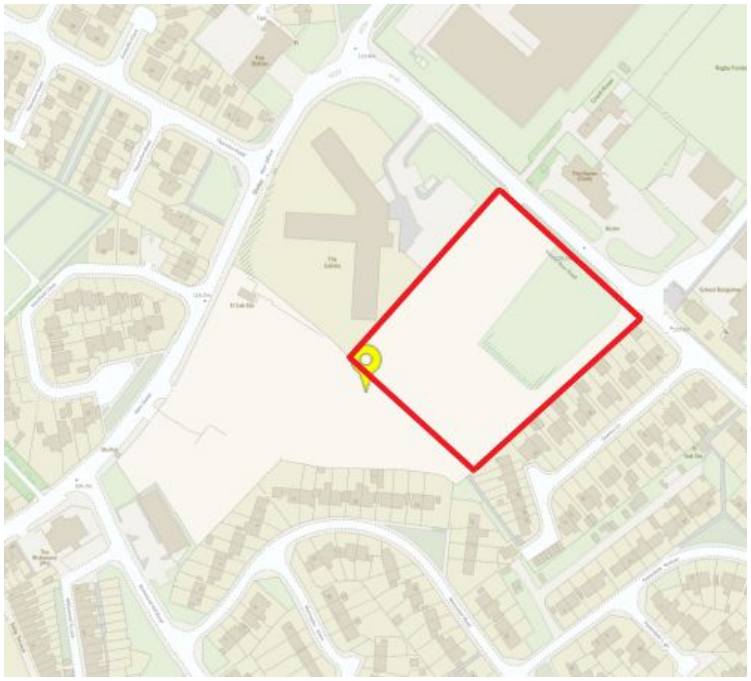


Figure 4.4) shows the largest area that might be flooded if a reservoir were to fail and release the water it holds. Since this is a prediction of a worst-case scenario, it is unlikely that any actual flood would be this large. According to the Environment Agency Reservoir flood maps the site is not at risk of flooding from reservoirs.

Figure 4.4: Environment Agency 'Flood risk from reservoirs' map (accessed May 2022)

Reservoir flooding is also extremely unlikely. There has been no loss of life in the UK from reservoir flooding since 1925. Since then reservoir safety legislation has been introduced to ensure reservoirs are maintained.

The resultant flood risk is considered to be **low**.

Reservoirs can be managed over time, controlling inflow/outflow of water and therefore there is the capacity to control the effects of climate change. Increased rainfall has the potential to increase base flow, but this should be minimal. It is unlikely that there will be a substantial change to the risk of flooding for this site.

4.7.2 Canals

There are no Canal & River Trust owned canals within the area.

4.7.3 Blockages of artificial drainage systems

There is a possibility that flooding may result due to culverts and/or sewers being blocked by debris or structural failure. This can cause water to backup and result in localised flooding, as well as placing areas with lower ground levels at risk.

Besides the existing sewers underlying the site there are no known artificial drainage systems on site.

The risk of flooding from artificial drainage systems is considered to be **low**.

Climate change is unlikely to affect the flooding risk to the site from such blockages.

5 FLOOD MITIGATION MEASURES

5.1 Overview

The developable area lies wholly within Flood Zone 1. To facilitate the development of the site a surface water drainage network will be designed.

5.2 Overland flood flow

No further overland flow control measures are proposed as all surface water runoff up to the 1 in 100 year climate change storm will be stored on site and discharged into the existing adopted combined sewer beneath Picow Farm Road. Surface flows may be generated due to drainage capacity exceedance, which can be conveyed into the open spaces via surface flows along the new roads.

5.3 Finished floor levels

As this site will not be affected by fluvial flooding there is no need to incorporate any freeboard levels into the finished floor levels of the design. Low lying areas that could lead to ponding of surface flows will be avoided by careful design of finished levels.

5.4 Safe access/egress

As the proposed site access lies outside of the 1 in 1000 year climate change flood extent, safe access and egress will be available up to this storm event. For extreme events above this, it is considered appropriate that site users should be able to safely escape to an area away from the watercourse. In addition, the proposed buildings will be set above the existing ground level and will likely contain an internal access to the first floor.

6 PLANNING CONTEXT

6.1 Application of planning policy

Section 14 of the NPPF includes measures specifically dealing with development planning and flood risk using a sequential characterisation of risk based on planning zones and the Environment Agency Flood Map. The main study requirement is to identify the flood zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

6.2 Land use vulnerability

Planning Practice Guidance (PPG) includes a list of appropriate land uses in each flood zone dependent on vulnerability to flooding. In applying the Sequential Test, reference is made to Table 6.1 below, reproduced from Table 3 of PPG.

Table 6.1: Flood risk vulnerability and flood zone 'compatibility'

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	Appropriate	Appropriate	Appropriate	Appropriate	Appropriate
	Zone 2	Appropriate	Appropriate	Exception Test Required	Appropriate	Appropriate
	Zone 3a	Exception Test Required	Appropriate	Should not be permitted	Exception Test Required	Appropriate
	Zone 3b functional floodplain	Exception Test Required	Appropriate	Should not be permitted	Should not be permitted	Should not be permitted

With reference to Table 2 of the PPG, the proposed development, based on its residential use, is classed as 'More Vulnerable'. This classification of development is appropriate for areas within Flood Zone 1 and therefore appropriate for the subject site.

6.3 Sequential Test

The Sequential Test is required to assess flood risk and the PPG recommends that the test be applied at all stages of the planning process to direct new development to areas with the lowest probability of flooding (Flood Zone 1).

The site is located within Flood Zone 1 and passes the Sequential Test; therefore, there is no requirement for the Exception Test to be satisfied.

7 SURFACE AND FOUL WATER DRAINAGE ASSESSMENT

7.1 Scope

As the development will be located in Flood Zone 1 and it is greater than 1ha in size, the Environment Agency requires such development to focus on the management of surface water run-off. This section discusses the potential quantitative effects of the development on both the risk of surface water flooding on-site and elsewhere within the catchment, as well as the type of potential SuDS features that could be incorporated as part of the masterplan.

In accordance with the Defra Non-Statutory Technical Standards, the surface water drainage strategy should seek to implement a SuDS hierarchy that aspires to achieve reductions in surface water runoff rates to greenfield rates. Where a reduction to the greenfield rate is not practicable, the proposed surface water drainage strategy should not exceed the existing runoff rate.

In addition, Building Regulations Part H[11] requires that the first choice of surface water disposal should be to discharge to an adequate soakaway or infiltration system, where practicable. If this is not reasonably practicable then discharge should be to a watercourse, the least favourable option being to a sewer (surface water before combined). Infiltration techniques should therefore be applied wherever they are appropriate.

7.2 Pre-development situation

The existing site area is approximately 2.186ha.

The pro-rata IoH 124 method has been used to estimate the Greenfield surface water runoff for the existing permeable areas on the site. Calculations are contained in Appendix E.

Greenfield runoff calculations have been undertaken to predict the current rate of runoff from the site. As the site covers an area of less than 200 ha, (2.5 ha) the Greenfield calculations have been undertaken in accordance with methodology described in IoH 124[21]. For catchments of less than 50 ha the Greenfield runoff rate is scaled according to the size of the catchment in relation to a 50-hectare site.

Full details of the calculations and the methodology for deriving the Peak Rate of Runoff are in included. A summary of the results is included in Table 7.1.

Without attenuation or infiltration, the proposed development would increase the Rate of Runoff from the developed areas of the site.

A Sustainable Drainage System (SuDS) is therefore proposed to attenuate and control discharge from the both phases of the site at a rate not exceeding 10l/s as agreed with United Utilities.

[11] HM Government (2010 with 2013 amendments), 'The Building Regulations 2010: Approved Document H - Drainage and Waste Disposal (2002 Edition incorporating 2010 amendments)'

Table 7.1: IOH 124 surface water runoff (2.186 Ha of existing greenfield)

Rate of Run-Off (l/s)			
Event	Greenfield (adoptable)	Greenfield (Private)	Total Greenfield Runoff
Q1	4.7	0.5	5.2
QBAR	5.4	0.6	6.0
Q10	7.5	0.8	7.5
Q30	9.2	1.0	9.2
Q100	11.3	2.1	13.4
Q100 + 40% CC	15.8	2.9	18.7

7.3 Limiting discharge for design

The discharge from the proposed development should be restricted to QBar runoff rates.

The current proposals limit the post development runoff to & an agreed discharge rate of 10.0 litres per second for the overall site (5 litres/per second for Phase 1 and 5 litres/per second for Phase 2)

7.4 Off-site discharge options and limits

7.4.1 Infiltration

Infiltration should be considered as the primary option to discharge surface water from the developed site. The effectiveness of infiltration is completely dependent on the physical conditions at the site. Potential obstacles include:

- Local variations in permeability preventing infiltration – It is understood from the local geology that the site is situated on an area of till, which is not considered suitable for the use of soakaways due to its low permeability;
- Shallow groundwater table - For infiltration drainage devices, Building Regulation approved document H2 states that these “should not be built in ground where the water table reaches the bottom of the device at any time of the year”. Groundwater is not considered to be a limiting factor;
- Source Protection Zones - As discussed above, the site is not located within a Groundwater Source Protection Zone.

From the information available infiltration is not considered a viable option as part of the drainage strategy.

7.4.2 Discharge to watercourse

Discharging surface water directly to a local watercourse is not considered feasible as there are no watercourses within close proximity of the site.

7.4.3 Drainage Network

The proposed surface water network serving the impermeable access roads and plots has been modelled using Causeway Flow.

The drainage system has been sized to convey and attenuate a future 1% AEP event of critical duration. Future climate change (40%) is accounted for in the design

Roof water will connect directly into the surface water pipe network. This will require ground levels to fall consistently around the site in order to enable a gravity connection into the drainage system.

A series of gullies will be located within the site roads to collect and discharge highways run off into the new surface water drainage system. A shared access road and drives shall be formed.

The surface water drainage network for the positively drained areas shall be constructed to adoptable standards wherever possible despite the fact that some of the proposed network will remain private.

7.4.4 Attenuation

Due to space restrictions, it is proposed to provide separate attenuation components comprising oversized pipes and offline geo cellular tank systems to attenuate the surface water runoff from both the highways and plot drainage.

For further detail refer to the Drainage Layout Plan (GHC-IM-C2-10-01)

7.4.5 Surface Water Quality

The treatment of surface water is not a statutory requirement. Water quality remains a material consideration but there are no prescriptive standards to be imposed in terms of treatment train management. In the absence of a design standard, the SuDS manual has been used which outlines best practice.

Pollutants such as suspended solids, heavy metals and organic pollutants may be present in surface water runoff, the quantity and composition of the runoff is highly dependent upon site use. For housing developments, the pollutant load is very low.

The SuDS Manual[14] outlines best practice with regards to treatment of surface water by SuDS components prior to discharge to the environment. SuDS components can be effective in reducing the amount of pollutants within the surface water discharged and therefore environmental impact of the development. SuDS components may be installed in series to form a treatment train to treat the runoff.

The simple index approach as outlined in the SuDS manual has been used to assess the pollution hazard indices and proposed treatment components.

Table 7.2: Pollution Hazard & Mitigation Indices- Roof Areas

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.2	0.2	0.05
Pollution Mitigation	0.5	0.5	0.6
Treatment Suitability	ADEQUATE	ADEQUATE	ADEQUATE

Table 7.3: Pollution Hazard & Mitigation Indices- Residential Parking Areas (Detention Basin)

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.5	0.5	0.6
Treatment Suitability	ADEQUATE	ADEQUATE	ADEQUATE

Table 7.4: Pollution Hazard & Mitigation Indices- Residential Highway Areas (Detention Basin)

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.5	0.5	0.6
Treatment Suitability	ADEQUATE	ADEQUATE	ADEQUATE

Table 7.4: Pollution Hazard & Mitigation Indices- Residential Parking Areas (Permeable Paving)

Indices	Suspended Solids	Metals	Hydrocarbons
Pollution Hazard	0.5	0.4	0.4
Pollution Mitigation	0.7	0.6	0.7
Treatment Suitability	ADEQUATE	ADEQUATE	ADEQUATE

7.4.6 Operations & Maintenance Responsibility

Adoption of surface water drainage systems and SuDS components by the sewerage undertaker and/or the highways authority is intended wherever possible. During the detailed design stage a full review and consideration of UU requirements shall ensure the maximum practical extent of adoptable drainage in accordance with the Design and Construction Guidance for Foul and Surface Water Sewers[18] and subject to a Section 104 Agreement.

Any private individual plot drainage is to be maintained by the property owners. Where required a private management company will be responsible for maintenance of any non-adoptable drainage runs or storage systems. Highways gullies and associated pipework will be put forward for adoption by Cumbria County Council under a Section 38 Agreement

In addition to the above measures, where applicable, a *SuDS Operations & Maintenance Plan* will be made available to the site owners upon request detailing the requirements for future maintenance of the drainage system.

7.4.7 Discharge to surface water sewer

There is no potential to dispose of surface water within the site therefore it will be necessary to dispose of surface water in accordance with the long term storage method, attenuating runoff at a rate matching greenfield Qbar for all events up to and including the 1% AEP event plus climate change allowance design storm. Discharge rate from the site will therefore be restricted to a rate of 5.0 litres/second for Phase 1 and 5.0 litres/second for Phase 2 as agreed with United Utilities.

The drainage system shall be designed to adoptable standards to allow adoption by United Utilities under Section 104 of the Water Industry Act 1991.

7.4.8 Discharge to foul water sewer

It is proposed that foul water from the development shall be drained via gravity within the site before being connected to the proposed foul drainage within the neighbouring site to the Southwest of the site. A non-return valve shall be installed into manhole C1 as requested by United Utilities.

Under Section 106 of The Water Industry Act 1991, 'the owner / occupier of any premises shall be entitled to have his drain or sewer communicate with the public sewer of any sewerage undertaker and thereby to discharge foul water and surface water from those premises or that private sewer.' Unless 'the making of the communication would be prejudicial to the undertaker's sewerage system'.

The drainage system shall be designed to adoptable standards to allow adoption by United Utilities under Section 104 of the Water Industry Act 1991.

A drainage connection via gravity to the proposed foul drainage within the neighbouring site is achievable. For further detail refer to the Drainage Layout Plan included in Appendix B.

7.5 Post-development situation

Development of the site will increase impermeable area, which will result in an increase in surface water across the site. It will therefore be necessary to manage surface water on-site in order to limit the discharge of surface water off-site to an agreed rate (as above), to provide sufficient on-site attenuation up to the 1 in 100 year climate change rainfall event and should seek to provide improvements to water quality through appropriate source treatment.

7.5.1 Proposed drainage strategy

In principle, the strategy contains the following features and criteria:

- It is considered that infiltration techniques will not be suitable on-site due to the ground conditions beneath the site according to British Geological Survey data. Therefore, soakaways or other infiltration based SuDS will not be incorporated into the drainage design;
- The surface water discharge is proposed to discharge to the combined water sewer within Main Street at an agreed rate with United Utilities
- The proposed surface water storage will be contained within oversized pipes and a tank system for the proposed development. A copy of the proposed drainage layout is contained within Appendix B.

By incorporating these attenuation and discharge features into the drainage design then the development will not increase flooding to the development or to others downstream of the development.

Temporary drainage should be established for the construction phase of development to prevent silt mobilisation, potentially impacting on flow regimes and silt pollution downstream. The construction of SuDS should be considered in the early stages of site design.

8 CONCLUSIONS AND RECOMMENDATIONS

This FRA complies with the NPPF and Planning Practice Guidance and demonstrates that flood risk from all sources has been considered in the proposed development. It is also consistent with the Local Planning Authority requirements with regard to flood risk.

The proposed development site lies in an area designated by the Environment Agency as Flood Zone 1 and is outlined to have a chance of flooding of less than 1 in 1,000 (<0.1%) in any year.

NPPF sets out a Sequential Test, which states that preference should be given to development located within Flood Zone 1. This flood risk assessment demonstrates that the requirements of the Sequential Test have been met, with the location of the site within Flood Zone 1 and 'Less Vulnerable' classification of the development.

This flood risk assessment has considered multiple sources of flooding and concluded the following:

Table 8.1: Flood risk summary

Source	Level of risk	Mitigation
Fluvial	Low/Flood Zone 1	The proposed development will remain in Flood Zone 1.
Tidal	Low/Flood Zone 1	The proposed development will remain in Flood Zone 1.
Surface water	Low	Existing risk on site is low. This will not increase as a result of the development.
Groundwater	Low	There is no known risk from Groundwater flooding.
Sewers	Low	There is no known risk from existing sewers. New sewers will be designed to ensure exceedance is considered.
Artificial sources	Low	There are no artificial sources that pose a flood risk to the site.

In consideration of the Flood Risk Assessment and proposed Drainage Strategy for the site the following conclusions and recommendations are made:

- The EA Flood Map for Planning shows the site lies within Flood Zones 1 and is therefore at low risk of fluvial and tidal flooding. National guidance states that the development of sites for 'more vulnerable' development is acceptable in Flood Zone 1.
- The EA Surface Water Flood Map indicates that the site is at very low risk of surface water flooding.
- BGS Groundwater Susceptibility mapping predicts the majority of the site has limited potential for groundwater flooding to occur with a small area in the west of the site in an area with potential for groundwater flooding of property situated below ground level.

- Below ground habitable spaces are not proposed, therefore the risk of ground water flooding is predicted to be low.

- The risk of flooding from sewers is predicted to be low, with few sewers in the vicinity of the site, and where sewers exist near the site, flooding would remain within the highway and would be unlikely to affect the proposed site due to topography.

- Ground investigations within the neighbouring site confirmed that underlying soils were unsuitable for infiltration drainage. Surface water runoff from the site shall therefore be positively drained and attenuated prior to discharge. The discharge rate will be controlled to be restricted to a rate similar to that of the pre-development Greenfield Qbar rate.

- In line with the SuDS hierarchy discharge shall be to the public combined sewer in absence of any suitable alternatives. However, the surface water drainage shall be designed to allow easy diversion of flow to a new highway drain which may be installed by Cumbria County Council in future.

- Both foul and surface water from the site shall discharge to the proposed networks within the first phase of the clients neighbouring site.

- The drainage system will be designed to ensure that there is no increased flood risk on or off the site as a result of extreme rainfall, lack of maintenance or blockages. A series of safety features within the development and careful design of building layout will mitigate against this.

- In addition to these measures, a SuDS Operations and Maintenance Plan will be made available to the site owners detailing future maintenance requirements of all sustainable drainage systems.

APPENDIX A
TOPOGRAPHICAL SURVEY

MAY 2022

APPENDIX B
PROPOSED DRAINAGE LAYOUT

MAY 2022

APPENDIX C
SURFACE WATER SIMULATIONS & CALCULATIONS.

MAY 2022

APPENDIX D
GREENFIELD RUNOFF CALCULATIONS

MAY 2022