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Flood Risk Assessment & Drainage Strategy

Housing Development – Cleator Moor Road, Hensingham, Whitehaven

Gleeson Homes & Regeneration

Ref: K38732.FRA/001

Version	Date	Prepared By	Checked By	Approved By
Original	27 October 2021	J. Brabbins	O. Sugden	O. Sugden

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3. CONTENTS

4. TABLE OF FIGURES

5. TABLE OF TABLES

6. GLOSSARY OF TERMS

AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
BGL	Below Ground Level
BGS	British Geological Society
CC	Climate Change
CCC	Cumbria County Council
DSM	Digital Surface Model
DTM	Digital Terrain Model
EA	Environment Agency
FEH	Flood Estimation Handbook
FFL	Finished Floor Level
FRA	Flood Risk Assessment
GIS	Geographical Information System
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
OS	Ordnance Survey
RGP	RG Parkins & Partners Ltd
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage System
UU	United Utilities

7. INTRODUCTION

7.1 BACKGROUND

This report has been prepared by R. G. Parkins & Partners Ltd (RGP) for Gleeson Homes and Regeneration in support of their proposal for a residential development comprising 38 dwellings at Cleator Moor Road, Hensingham, Whitehaven.

RGP has been appointed to undertake a Flood Risk Assessment and Surface and Foul Water Drainage Strategy in accordance with the National Planning Policy Framework (NPPF) to support a planning application that fulfils the requirements of the Local Planning Authority, Environment Agency and the Sewerage Undertaker.

The following study assesses flood risk to the site and proposed development and demonstrates the proposed development will not adversely affect flood risk elsewhere.

7.2 PLANNING POLICY

The NPPF [1] and its Planning Practice Guidance [2] states "a site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in the future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use."

7.3 THE DEVELOPMENT IN THE CONTEXT OF PLANNING POLICY

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 outlined in Table 7.1. 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.

Table 7.1 Vulnerability Classification

Vulnerability Classification	Development
Essential Infrastructure	Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. Essential utility infrastructure, which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines.
Highly Vulnerable	Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operation during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes, and park homes intended for permanent residential use. Installations requiring hazardous substances consent.
More Vulnerable	Hospitals. Residential institutions such as residential care homes, children's homes, prisons and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs, and hotels. Non-residential uses for health services, nurseries, and education establishments. Landfill and sites used for waste management facilities for hazardous waste. Sites used for holiday or short let caravans and camping, subject to a specific warning and evacuation plan
Less Vulnerable	Police, ambulance, and fire stations which are NOT required to be operational during flooding. Buildings used for shops; financial, professional, and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distributions; non-residential institutions not included in the 'more vulnerable' class; and assemble and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill & hazardous waste facilities). Minerals working & processing (except for sand & gravel working). Water treatment works which do not need to remain operational during times of flood. Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.
Water-Compatible Development	Flood control infrastructure. Water transmission infrastructure & pumping stations. Sewage transmission infrastructure & pumping stations. Sand & gravel working. Docks, marinas, and wharves. Navigation facilities. Ministry of Defence installations. Ship building, repairing & dismantling, dockside fish processing & refrigeration & compatible activities requiring a waterside location. Water based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation & biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category subject to a specific warning & evacuation plan.

8. SITE CHARACTERISATION

8.1 SITE LOCATION

The site is located off Cleator Moor Road (B5295), Hensinham, near Whitehaven at National Grid Co Ordinates 299153E 517091N as outlined in Figure 8.1.

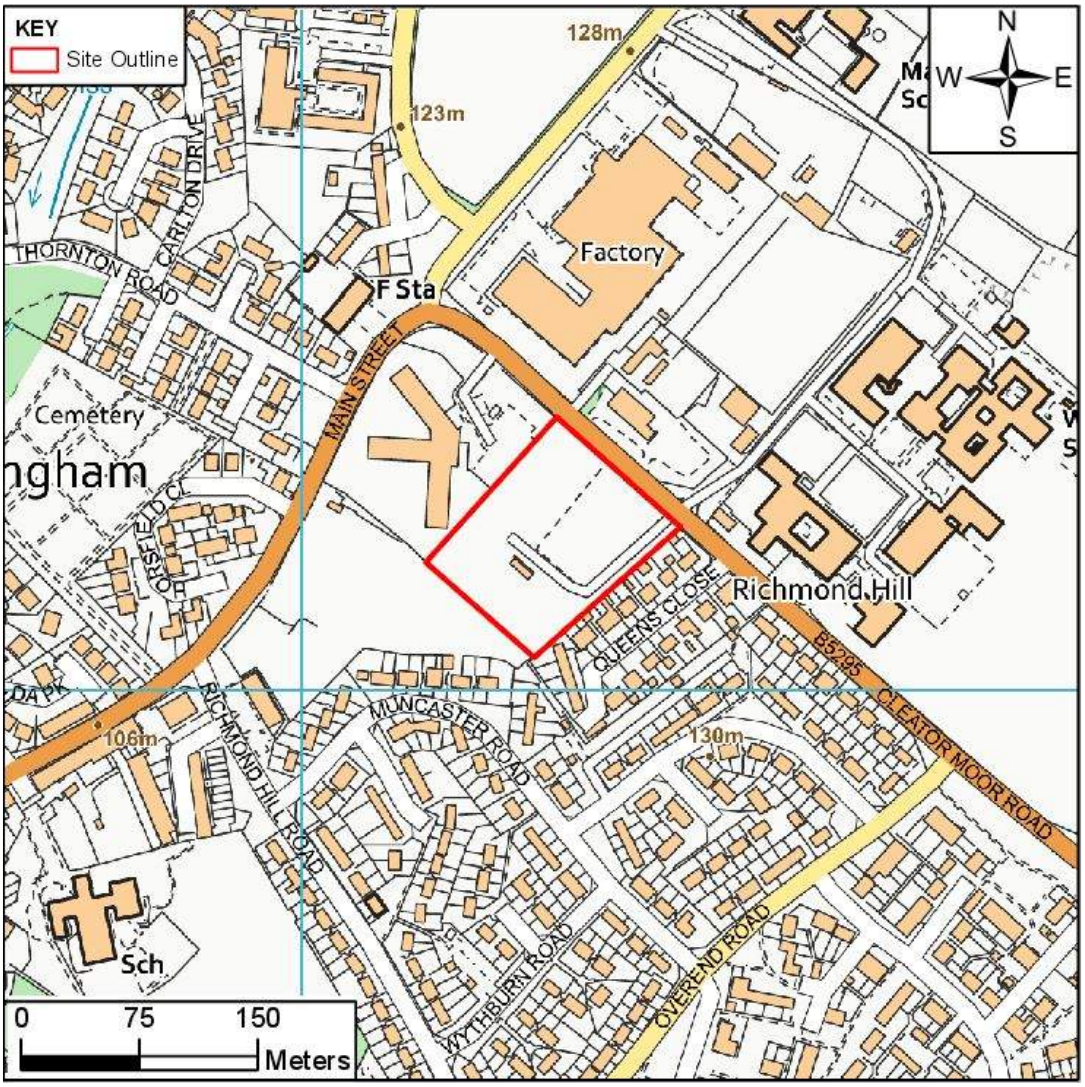

Figure 8.1 Site Location

8.2 SITE DESCRIPTION

The site covers approximately 1.2 ha (12,000 m²), and at present is unused. The site is bounded by Cleator Moor Road (B5295) to the immediate north-east, a care home to the north-west, 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 c. 129.1, down to the west with levels of c. 121.8.

The site is accessed from Cleator Moor Road.

8.3 GEOLOGY & HYDROGEOLOGY

British Geological Survey (BGS)[4] and Land Information Systems (LandIS)[5] mapping indicates the site is underlain by the geological sequences outlined in Table 8.1. The DEFRA Magic Map Application[6] indicates the site overlies an area of medium – low groundwater vulnerability.

Table 8.1 Site Geological Summary

Geological Unit	Classification	Description	Aquifer Classification
Soil	Soilscape 6	Freely draining slightly acid loamy soils	N/A
Drift	Till, Devensian	Diamicton	Summary: Secondary (undifferentiated)
Solid	• Bees Sandstone Member • Pennine Middle Coal Measures Formation • Hensingham Grit	Mudstone, Siltstone, Sandstone	Summary: Principle/Secondary A

8.4 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 90 m to the west of the site within Main Street.

8.5 EXISTING SEWERS

Reference to the United Utilities sewer records indicates there are a number of surface, foul and combined water public sewers within the vicinity of the site. United Utilities sewer records also indicate that there are no public sewers within the site itself.

8.6 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

9. ASSESSMENT OF FLOOD RISK

9.1 BACKGROUND

The following risk assessment has been carried out in accordance with the National Planning Policy Framework [1] and its Planning Practice Guidance [2] on Flood Risk. The broad aim of the guidance is to reduce the number of people and properties within the natural and built environment at risk of flooding. To achieve this aim, planning authorities are required to ensure that flood risk is properly assessed during the initial planning stages.

Responsibility for this assessment lies with the developers and they must demonstrate:

- Whether the proposed development is likely to be affected by flooding.
- Whether the proposed development will increase flood risk in other parts of the hydrological catchment.
- That the measures proposed to deal with any flood risk are sustainable.

The developer must prove to the Local Planning Authority and the Environment Agency that the existing flood risk or the flood risk associated with the proposed development can be satisfactorily managed.

9.2 FLOOD RISK TERMINOLOGY

Flood risk considers both the probability and consequence of flooding.

Flood events are often described in terms of their probability of recurrence or probability of occurring in any one year. The threshold between a medium flood and a large flood is often regarded as the 1 in 100-year event. This is an event which statistical analysis suggests will occur on average once every hundred years. However, this does not mean that such an event will not occur more than once every hundred years. Table 9.1 shows the event return periods expressed in years and annual exceedance probabilities as a fraction and a percentage.

For example, a 1 in 100-year event has a 1% probability of occurring in any one year, i.e. a 1 in 100 probability. A 1000-year event has a 0.1% probability of occurring in any one year, i.e. a 1 in 1000 probability.

Table 9.1 Flood Return Periods & Exceedance Probabilities

Return Period (years)	Annual Exceedance Probability (AEP)	
	Fraction	Percentage
2	0.5	50%
10	0.1	10%
25	0.04	4%
50	0.02	2%
100	0.01	1%
200	0.005	0.5%
500	0.002	0.2%
1000	0.001	0.1%

9.3 DATA COLLECTION

The following information was referred to for the Flood Risk Assessment:

- Environment Agency Flood Map for Planning covering the site and adjacent area
- Environment Agency Surface Water Flood Risk Map
- Environment Agency Reservoir Flood Risk Map
- Environment Agency Historic Flood Map
- United Utilities sewer records
- Copeland Borough Council Strategic Flood Risk Assessment
- Development layout plan
- Topographic survey

9.4 STRATEGIC FLOOD RISK ASSESSMENT

In 2007, Copeland Borough Council published a Strategic Flood Risk Assessment (SFRA)[8]. This provides flood risk maps for several towns and villages across the Copeland Borough area.

The SFRA states there are several historic flooding incidents in Whitehaven, but these are generally attributed to tidal flooding due to the proximity of the town centre to the coastline. Some properties are at risk from the main watercourse Pow Beck, which bisects the town and during extreme events flooding can be exacerbated in certain areas by insufficient sewer capacities.

This site however is located away from the historically affected areas and is not shown to be at risk of fluvial or tidal flooding or to suffer from localised drainage issues.

Since 2007, the understanding of flood mechanisms and risks has developed, and the EA has carried out new modelling to define flood risks. The SFRA maps are therefore regarded as superseded by new EA Flood Map for Planning.

9.5 ENVIRONMENT AGENCY FLOOD MAP FOR PLANNING

Figure 9.1 is an extract from the EA's Flood Map for Planning[9]. This map identifies the extent of Flood Zones 2 and 3. Flood Zone 3 (darker blue) is the area that could be affected by flooding up to and including a river flow rate with an annual exceedance probability of 1% or an area that could be affected by flooding from the sea with an annual exceedance probability of 0.5%. Flood Zone 2 (lighter blue) is the area that would be affected by more extreme events with an AEP of 0.1%. Areas which are not coloured are Flood Zone 1, i.e. areas where flooding is highly unlikely.

The Flood Map for Planning shows that the site is located within Flood Zone 1. It Is considered that there is a ''Low Probability'' (less than 0.1% annual probability) of fluvial and tidal flooding.

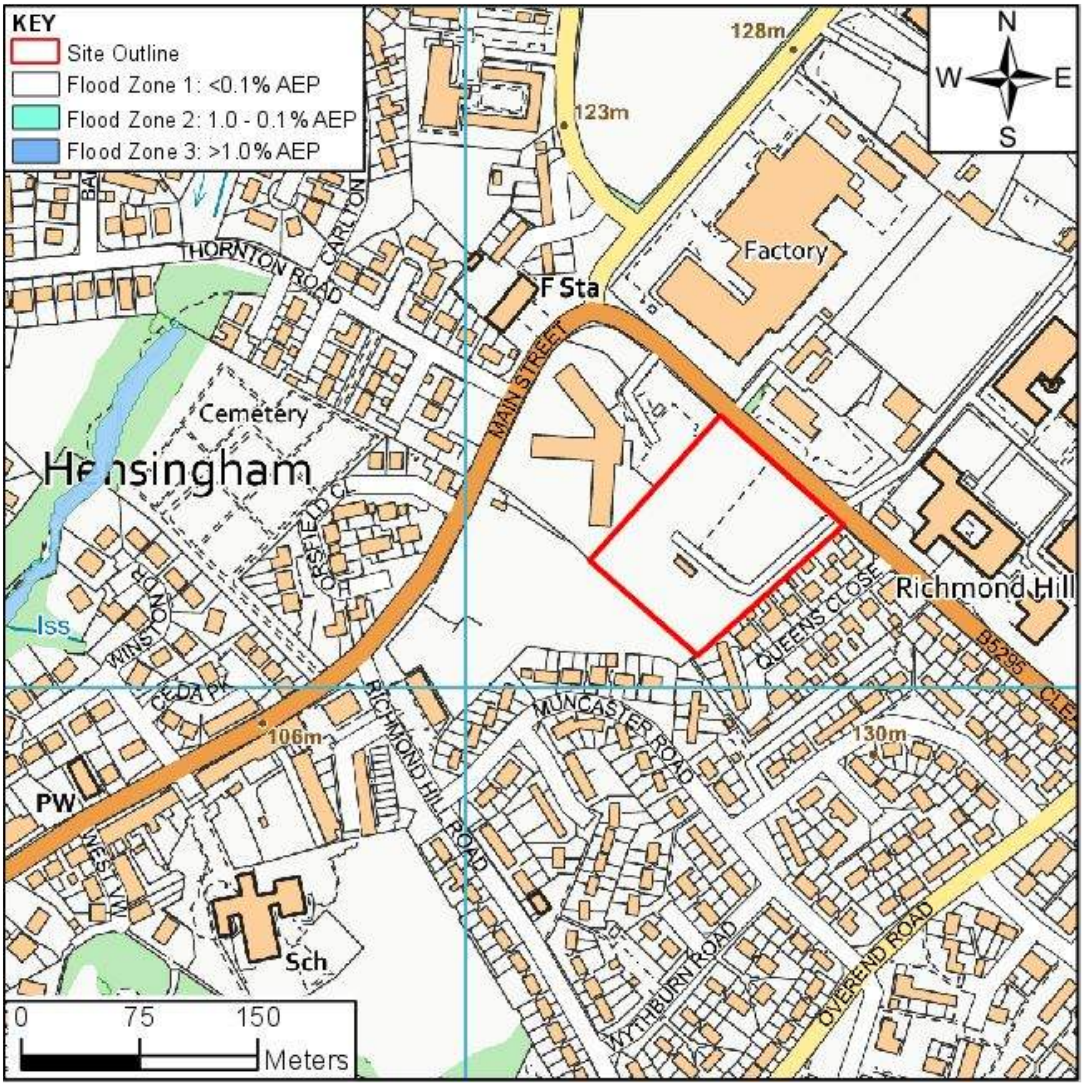

Figure 9.1 Environment Agency Flood Map for Planning

9.6 SURFACE WATER FLOOD RISK

Surface water flooding is that which results from extreme rainfall rather than overflowing rivers. This type of flooding typically occurs when extreme rainfall causes water to run down slopes and collect in depressions in the landscape or where runoff is focussed into an area where drainage is insufficient. It can also cause erosion resulting in the partial or complete blockage of drains or culverts.

Figure 9.2 shows an extract from the EA surface water flood risk map[9]. This has four risk classifications from very low probability (<0.1% AEP) to high probability (>3.3% AEP). The EA's map shows that the whole site has a very low probability of surface water flooding.

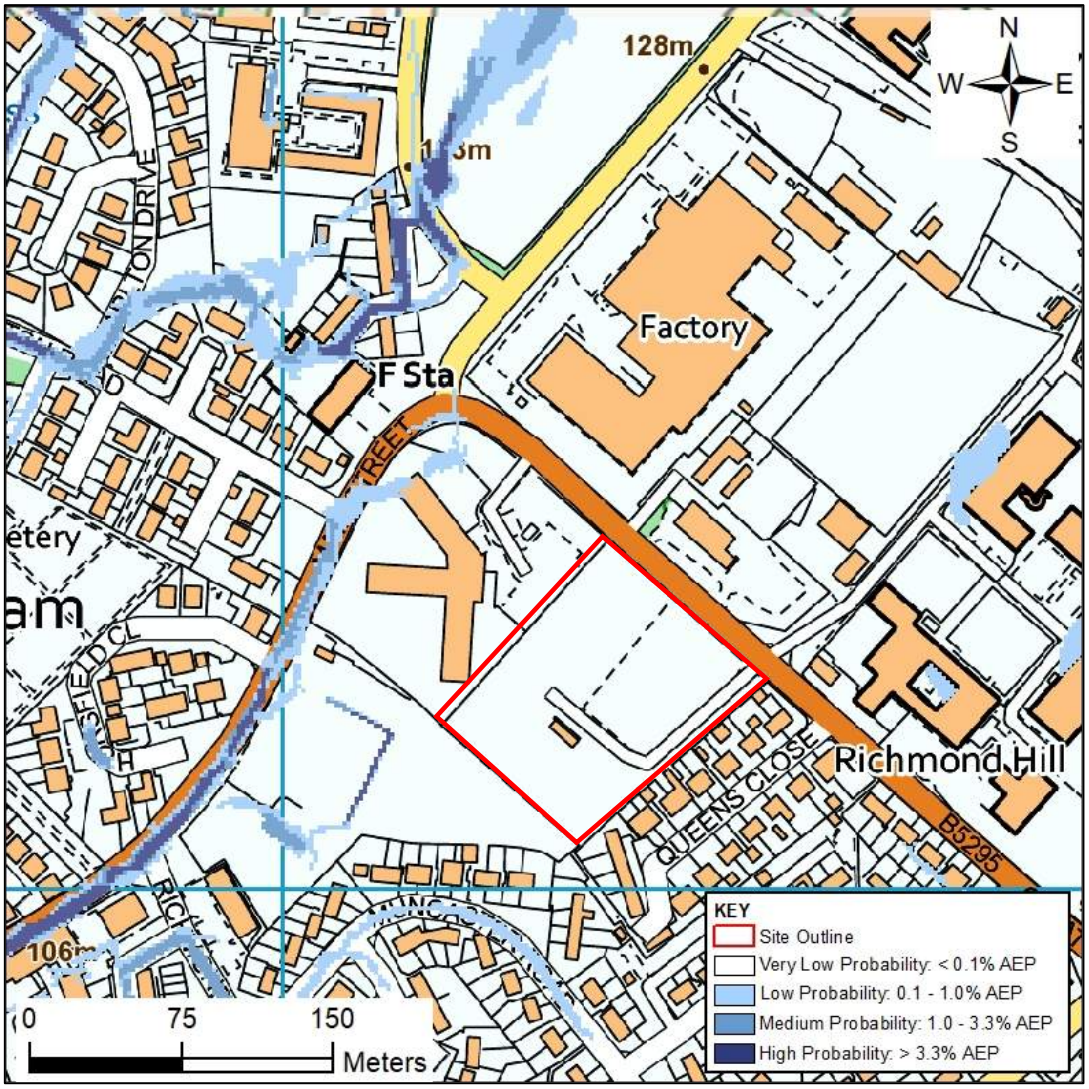

Figure 9.2 Environment Agency Surface Water Flood Map

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9.7 GROUNDWATER FLOOD RISK

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 9.3) show the majority of the site lies within an area of 'Limited Potential for Groundwater Flooding to Occur'. Although the western corner of the site lies 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.

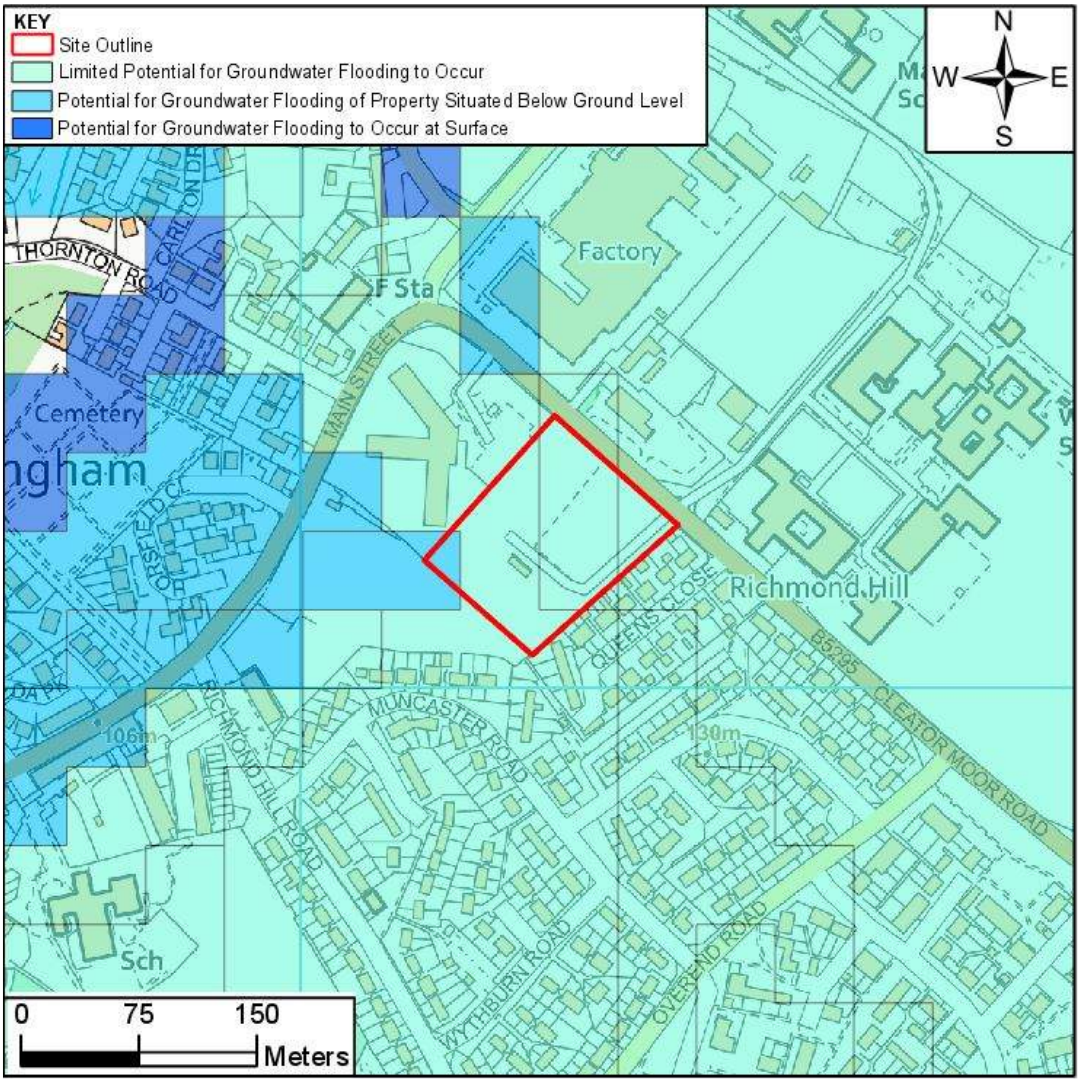

Figure 9.3 British Geological Society Ground Water Flood Map

9.8 FLOODING FROM RESERVOIRS, CANALS OR OTHER ARTIFICIAL SOURCES

The likelihood of reservoir flooding is, however considered to be much lower than other forms of flooding. Current reservoir regulation, which has been further enhanced by the Flood and Water

Management Act, aims to make sure that all reservoirs are properly maintained and monitored to detect and repair any problem.

The Ordnance Survey map indicates that there are no reservoirs, canals or artificial structures in the close proximity of the proposed development site and the EA mapping for reservoir flood risk does not show the site to be at risk.

9.9 FLOODING FROM SEWERS

United Utilities (UU) do not provide information on flood risk from their assets and there have been no reports within the SFRA. It is known that a 100 mm diameter combined sewer is located within private land to the north of the site, near the site entrance. Should this sewer fail, flooding would be predicted to remain within Cleator Moor road and, therefore, not affecting the proposed site.

10. SURFACE WATER DRAINAGE STRATEGY

10.1 INTRODUCTION

The principal aim of the following drainage strategy is to design the development to avoid, reduce and delay the discharge of rainfall to public sewers and watercourses in order to protect watercourses and reduce the risk of localised flooding, pollution and other environmental damage.

In order to satisfy these criteria this surface water runoff assessment and drainage design has been undertaken in accordance with the following reports and guidance documents:

- SuDS Manual, CIRIA Report C753, 2015[14]
- Code of Practice for Surface Water Management, BS8582:2013, November 2013[15]
- Rainfall Runoff Management for Developments, Defra/EA, SC030219, October 2013[16]
- Designing for Exceedance in Urban Drainage – Good Practice, CIRIA Report C635, 2006[17]
- Flood Estimation Handbook (FEH)[18]
- Flood Studies Report (FSR), Volume 1, Hydrological Studies, 1993[19]
- Flood Studies Supplementary Report No 14 (FSSR14), Review of Regional Growth Curves, 1983[20]
- Flood Estimation for Small Catchments, Marshall & Bayliss, Institute of Hydrology, Report No. 124 (IoH 124), 1994[21]
- Department for Environment, Food and Rural Affairs, Non-Statutory Technical Standards for Sustainable Drainage Systems, March 2015[22]
- Water UK, Design and Construction Guidance for Foul & Surface Water Sewers, Approved Version 2.0, March 2020[23]

The following assessment and drainage strategy are based on the latest site layout plan. Any alterations to the site plan resulting in changes to impermeable areas will require the drainage strategy to be revisited.

10.2 SITE AREAS

To support the exploration of options for site drainage, the spatial extent of different types of proposed land cover on the site have been measured. Table 10.1 shows the measured proposed land cover areas. The highest percentage is garden area covering 46% of the total site area. The roof areas cover 29%, parking and paved areas 12% and site road areas 14%.

Table 10.1 Land Cover Areas

Land Cover	Area		Percentage of total site area
	m^2	Ha	
Total housing roof area	3450.0	0.345	29%
Total parking and paved area	1447.0	0.145	12%
Total road area	1688.0	0.169	14%
Garden areas	5504.0	0.550	46%

The site can be subdivided into land cover that could be permeable and that which could be impermeable. Potential impermeable areas are regarded as housing, parking, roads, driveways and walkways. All other areas (principally gardens) are regarded as having a permeable surface. Table 10.2 gives the areas of potentially permeable and impermeable land cover and this shows that impermeable areas could cover 54% of the site and permeable areas 46%.

Table 10.2 Area of Potentially Impermeable & Permeable Land Cover

Land Cover	Area		Percentage of total site area
	m^2	Ha	
Total impermeable area	6585.0	0.659	54%
Remaining permeable area	5504.0	0.550	46%

10.3 SURFACE WATER DISPOSAL

Surface water disposal has been considered in line with the hierarchy outlined in the SuDS Manual[14]. The approach considers infiltration drainage in preference to disposal to watercourse, in preference to discharge to sewer.

Infiltration testing at the neighbouring site confirmed that underlying soils had insufficient permeability to facilitate infiltration drainage.

Due to the insufficient permeability of underlying soils, the entire impermeable area of the site will require a positive drainage solution. In line with the SuDS hierarchy discharge to a watercourse has been investigated. A watercourse within the neighbouring site is located at a high level and a gravity connection to this cannot be achieved within the boundary of the neighbouring site. A gravity connection to this watercourse further downstream is technically possible but would require a significant length of new sewer crossing the highway and public open space. This watercourse currently causes significant flood risk to property and is undersized. Its route through a cemetery and under private property result in any works to increase its conveyance capacity being involved and prohibitively expensive. There is currently no formal surface water drainage for the proposed site, therefore any connection to the watercourse would contribute additional flow to an under-capacity culvert, increasing flood risk in contravention of NPPF. Both Copeland Borough Council and the LLFA have previously advised that connection to this watercourse is not advisable / permissible when considering the neighbouring site.

Surface water sewers exist to the south and south-east of the proposed development site in the vicinity of Muncaster Road, Richmond Hill Road, and Patterdale Avenue. There is no possible route

from the development site through third party land to allow connection to this sewer due to construction of extensions and outbuildings.

A surface water sewer located at the SPAR supermarket to the south of the development site discharges to the combined sewer.

There are no existing surface water sewers accessible to allow connection.

There are highway gullies located within the adjacent highway, however it is predicted that the gullies discharge to the combined sewer.

Surface water disposal for the neighbouring site shall be served by the nearby combined sewer, retaining its existing surface water drainage connectivity from the now demolished buildings. This is proposed until a point in time when a surface water sewer is available following work by the Lead Local Flood Authority / Highway Authority (CCC) to install a new sewer within Main Street. It is therefore proposed to discharge surface water from the proposed development via the neighbouring sites drainage system. The neighbouring site's flow control will require alteration once the Cleator Road site is connected.

10.4 PRE-DEVELOPMENT RUNOFF ASSESSMENT

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 in Appendix B. A summary of the results is included in Table 10.3.

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 site to match the greenfield Qbar rate of 6.0 l/s.

Table 10.3 Pre-Development Peak Runoff Rates

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

10.5 SURFACE WATER DISPOSAL

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 6 l/s.

The adjacent site discharge rate will be set to 5l/s, also controlled by Hydrobrake flow control. Following connection of the Cleator Road site this flow shall be increased to 11 l/s to accommodate the flow from this development.

10.6 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%) and urban creep (10% to housing area only) 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 serving plots 23 – 38 shall be formed using Type B permeable paving.

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.

10.7 ATTENUATION

Due to space restrictions, it is proposed to provide separate attenuation components comprising box culverts, oversized pipes, and a detention basin to attenuate the surface water runoff from both the highways and plot drainage.

To control surface water runoff from Plots 1-7 and 36-38 and a section of the proposed highway, upstream storage will be provided by a box culvert situated within the proposed access road with a flow control device regulating flow to the downstream surface water network.

To control surface water runoff from Plots 12-22, the shared access road and a section of the proposed highway, upstream storage will be provided by oversized pipes situated within the proposed highway and shared access road with a flow control device regulating flow to the downstream detention basin.

The surface water runoff from the upstream network passes through a detention basin to provide further attenuation and treatment. A Hydrobrake optimum vortex type flow control device will then limit discharge from the detention basin to a rate equal to the greenfield Qbar rate for this part of the proposed site, 5.5 l/s.

Plots 23-28 shall be served by an oversized pipe located within the front curtilages of the plots. The runoff from these plots shall be restricted by a flow control before discharging into the new surface water drainage system downstream of the detention basin at a rate of 0.5 l/s.

For further detail refer to the Drainage Layout Plan (K38732/010) and catchment area plan (K38732/011) included in Appendix A.

10.8 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, the calculations are included in Appendix B. For the three categories of runoff areas served by the drainage system, Roof areas, residential parking and residential roads, treatment is proposed by use of a detention basin. For Plots 23-28 where runoff shall enter the system downstream of the detention basin, driveways/parking areas shall be constructed of Type B permeable block paving to provide the necessary treatment. Table 10.4 to Table 10.7 summarise the pollution hazard and mitigation indices for this type of runoff.

Table 10.4 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 10.5 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 10.6 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 10.7 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**

The detention basin shall contain permeable berms to retain pollutants and aid treatment.

10.9 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.

11. FOUL WATER DRAINAGE STRATEGY

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 south-west of the site.

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.

Preliminary foul water discharge calculations have been undertaken for the whole site in accordance with the Design and Construction Guidance for Foul and Surface Water Sewers[23], see Table 11.1.

Table 11.1 Peak Foul Flow Rates

Sewerage Sector Design and Construction Guidance Clause B3.1	
Peak Load based on number of dwellings, 38 No units @ 4000l/day (l/day)	152,000
Total Foul Flow Rate from Site (l/s)	1.76

The estimated peak foul flow rate from the development is 1.76 litres/second.

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 A.

12. CONCLUSIONS AND RECOMMENDATIONS

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 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.

13. REFERENCES

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[19] Institute of Hydrology, Flood Studies Report, Volume 1, Hydrological Studies, 1993.

[20] Institute of Hydrology, Flood Studies Supplementary Report No 14 – Review of Regional Growth Curves, August 1983.

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[23] Water UK, Design and Construction Guidance for Foul & Surface Water Sewers Offered for Adoption Under the Code for Adoption Agreements for Water and Sewage Companies Operating Wholly or Mainly in England, Approved Version 10, October 2019

APPENDIX A

PRELIMINARY SITE PLAN & DRAINAGE LAYOUT

N

Cleator Moor Road

MHF03
1200ø
CL 126.850
IL 124.550

Box Culvert (03)
CL 126.823
IL 124.145

MHF02
1200ø
CL 127.340
IL 124.730

MHS02
1350ø
CL 127.348
IL 125.998

F1.001 150ø uPVC
14.384 1:80

S1.001 150ø uPVC
13.645 1:16

S1.000 150ø uPVC
46.664 1:57.5

F1.000 150ø uPVC
29.766 1:38

MHF01
1050ø
CL 128.105
IL 126.755

MHS01
1050ø
CL 128.857
IL 127.507

F1.002 150ø uPVC
31.279 1:43

S1.002 1200 x 1860 PVC Box Culvert 34m 1:300

Box Culvert (04)
1500ø
CL 126.118
IL 124.031

MHF04
1200ø
CL 126.285
IL 123.815

S1.003
300ø uPVC
1:300

MHS05
1800ø
Hydrobrake 28l/s
CL 126.239
IL 124.025

S1.004 300ø uPVC 34.171 1:300

F1.003 150ø uPVC
55.138 1:150

MHS06
1500ø
CL 125.322
IL 123.915

MHS25
1800ø
CL 124.700
IL 122.900

Drop Kerb to facilitate exceedance flow route to basin

HW07
Althon H3C headwall
IL 123.713

HW08
Althon H3C headwall with cranked grating
IL 123.546

Permeable bund (Foreboy) to prevent direct flow to outlet and maximise sediment capture treatment of contaminants

S1.005 300ø uPVC
9.617 1:300

MHS19
1350ø
CL 125.450
IL 124.025

S2.000 150ø uPVC
16.539 1:150

MHF05
1200ø
CL 125.452
IL 123.447

S2.001 150ø uPVC
35.613 1:200

S1.006 150ø uPVC
19.684 1:150

F1.004 150ø uPVC
15.965 1:37

MHF06
1200ø
CL 125.150
IL 122.950

MHS09
1350ø
Hydrobrake 5.5 l/s
CL 125.153
IL 123.483

Basin
Crest Level 125.2
IL 123.546

S3.002 225ø uPVC
27.309 1:150

HW23
Althon H3C headwall
IL 123.750

MHS22
2400ø
Hydrobrake 4.8 l/s
CL 125.800
IL 123.835

S3.000 150ø uPVC 16.352 1:200

S1.001 150ø uPVC
7.230 1:400

MHS20
2400ø
CL 127.324
IL 124.168

MHF13
1050ø
CL 127.330
IL 125.980

MHS21
2700ø
CL 126.677
IL 123.835

MHS26
1800ø
Hydrobrake 0.5l/s
Emergency overflow fitted to direct exceedence to MHS10
CL 125.000
IL 122.722

F1.001 150ø uPVC
7.276 1:10

F1.005 150ø uPVC
25.586 1:33

S1.008 150ø uPVC
40.787 1:198

MHS10
1200ø
CL 125.100
IL 122.697

S4.000 1500ø uPVC 18.847 1:400

S2.000 150ø uPVC
34.645 1:15

MHF14
1050ø
CL 126.280
IL 123.724

MHS24
2100ø
CL 126.274
IL 123.882

MHF07
1050ø
CL~122.200
IL~120.650

MHS11
1050ø
CL~122.350
IL~121.000

OUTLINE DRAINAGE KEY

- Proposed Surface Water Drainage
- Precast Concrete Box Culvert
- Proposed Foul Water Sewer
- Highways Drainage
- Exceedence Flows

R G PARKINS
Kendal | 01539 729393 Lancaster | 01524 32548

Client: GLEESON HOMES & REGENERATION	Scale @ A1: 1:200	First Issue: 27/10/21	Office of Origin: KENDAL
Project: CLEATOR ROAD	Drawn by: OS	Checked by: CA	Approved: OS
Drawing Title: DRAINAGE LAYOUT PLAN	Project No: K38732	Drawing No: 010	Rev:
	BIM No:		

Cleator Moor Road

S1.001 150ø uPVC 13.645 1:16

S1.002 1200 x 1800 PC Box Culvert 34m 1:300

S1.003 300ø uPVC 1:300

S1.004 300ø uPVC 34.171 1:300

S1.005 450ø uPVC 5.917 1:300

S2.000 150ø uPVC 16.539 1:150

S3.000 1500ø uPVC 16.332 1:200

S3.001 1500ø uPVC 7.309 1:400

S3.002 225ø uPVC 7.309 1:150

S4.000 1500ø uPVC 18.847 1:400

S1.006 150ø uPVC 7.194 1:150

S1.007 150ø uPVC 7.216 1:16

S1.008 150ø uPVC 40.767 1:19.8

S5.000 1200ø uPVC 35.013 1:200

S1.000 150ø uPVC 48.084 1:30.5

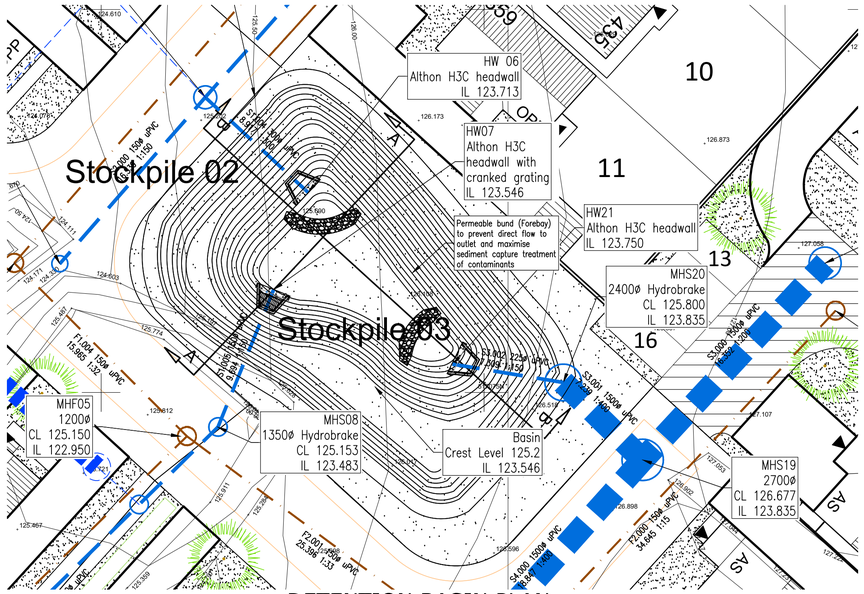
KEY:

PN 1.000		– 0.0551 Ha (551m²)
PN 1.001		– 0.0573 Ha (573m²)
PN 1.002		– 0.0948 Ha (948m²)
PN 1.003		– 0.1279 Ha (1279m²)
PN 1.004		– 0.0285 Ha (285m²)
PN 2.000		– 0.0386 Ha (386m²)
PN 3.000		– 0.0863 Ha (863m²)
PN 3.001		– 0.0181 Ha (181m²)
PN 4.000		– 0.1467 Ha (1467m²)
PN 5.000		– 0.0675 Ha (675m²)

R G PARKINS

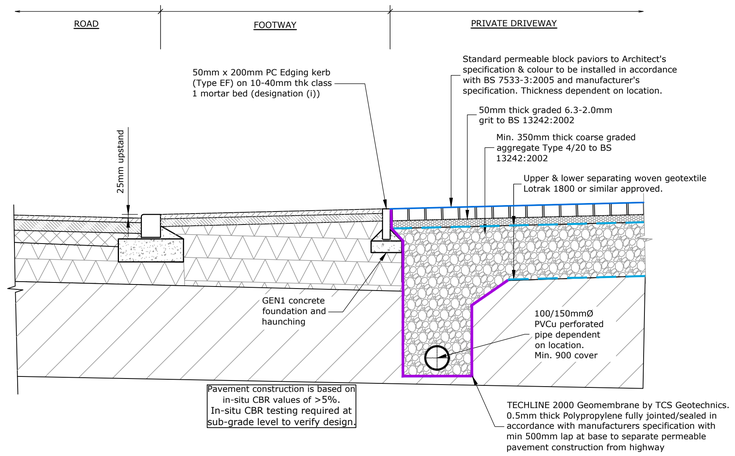
Kendal | 01539 729393 Lancaster | 01524 32548

Client:	GLEESON HOMES & REGENERATION		
Project:	CLEATOR ROAD		
Drawing Title:	SURFACE WATER CATCHMENT PLAN		
Scale @ A1: 1:200	First Issue: 27/10/21	Office of Origin: KENDAL	
Drawn by: OS	Checked by: CA	Approved: OS	
Project No: K38732	Drawing No: 011	Rev:	
BIM No:			



DETENTION BASIN PLAN

SCALE 1:200



TYPICAL SECTION THROUGH PRIVATE DRIVEWAY - PERMEABLE PAVING

SCALE 1:20

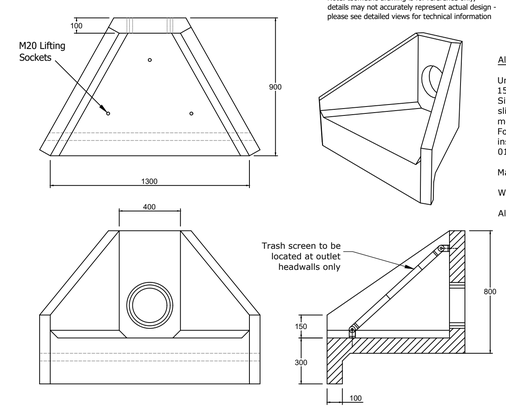
H3C Specification Information

- Opening in back all cast to suit outside diameter of the pipework
- Invert level of pipe can be set to your specification
- H3C suitable for pipework up to 300mm ID twin wall or clay / 225mm ID concrete

Sloped Grating Specification Information

- Sloped grating manufactured from 40 x 10 galvanised steel flats at 75mm centres

Note: Isometric drawing is for reference only, details may not accurately represent actual design - please see detailed views for technical information



Althon H3C Headwall Installation

Units should be bedded on 150mm of semi-dry concrete. Sit the headwall level or with a slight fall 1:50 from pipe to spill mouth.
For full detailed installation instructions contact ALTHON Ltd, 01603 488700

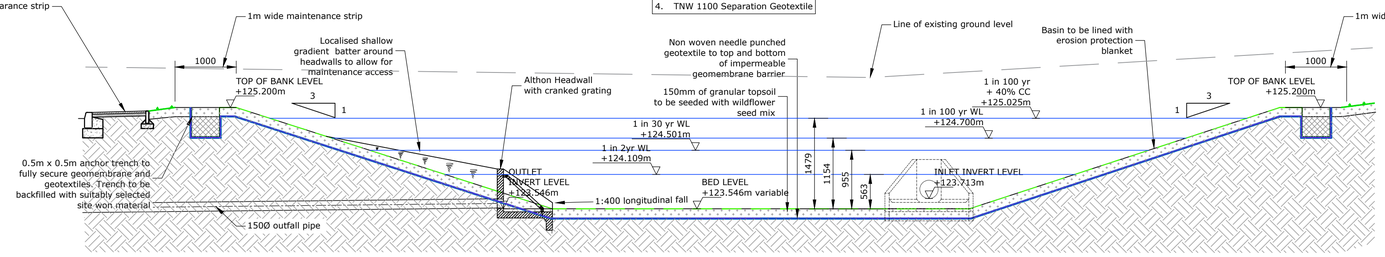
Material: Reinforced concrete

Weight approximately 540kg

All dimensions in mm

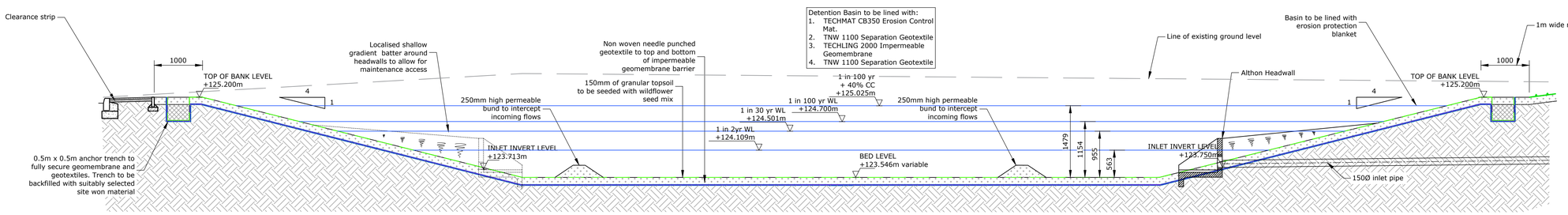
ALTHON H3C HEADWALL DETAILS

SCALE 1:20



SECTION A-A THROUGH DETENTION BASIN

SCALE 1:50



SECTION B-B THROUGH DETENTION BASIN

SCALE 1:50

R G PARKINS

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Scale @ A1: As shown	First Issue: 26/10/21	Office of Origin: KENDAL	
Drawn by: CA	Checked by: OS	Approved: OS	
Client: GLEESON HOMES & REGENERATION	Project No: K38732	Drawing No: 012	Rev:
Project: CLEATOR ROAD			
Drawing Title: DETENTION BASIN DETAILS	BIM No:		