West Cumberland Hospital Phase 2 Development

Flood Risk Assessment and SW Drainage Strategy

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1.0 Introduction

1.1 Project Background

In June 2021, Curtins were instructed by North Cumbria Integrated Care NHS Foundation Trust to undertake a Flood Risk Assessment and Outline Drainage Strategy of the site at West Cumberland Hospital, CA28 8JG. The site is centred on NGR 298950, 516040.

The report provides information on the nature of flood risk at the site and follows Government guidance with regards to development and flood risk and is based on currently available information.

Proposals contained or forming part of this report represent the design intent and may be subject to alteration or adjustment in completing the detailed design for this project. Where such adjustments are undertaken as part of the detailed design and are deemed a material deviation from the intent contained in this document, prior approval shall be obtained from the relevant authority in advance of commencing such works.

Where the proposed works to which this report refers are undertaken more than twelve months following the issue of this report, Curtins shall reserve the right to re-validate the findings and conclusions by undertaking appropriate further investigations at no cost to Curtins.

1.2 Scope of Assessment

The assessment is to be undertaken in accordance with the standing advice and requirements of the Environment Agency (EA) for Flood Risk Assessments as outlined in the Communities and Local Governments Planning Policy Guidance to the National Planning Policy Framework (NPPF).

The total redline site area is approximately 2.7 hectares (ha). Following scrutiny of the Environment Agency flood zone maps it has been identified that the existing site lies entirely within an area classified as Flood Zone 1 (FZ1) indicating that the probability of flooding from rivers or sea is low (less than 0.1% annual probability of river or sea flooding). Since the site is larger than 1 ha in Flood Zone 1, a Flood Risk Assessment is required to accompany a planning application to assess mechanisms of potential flood risk and taking into consideration the management of surface water run-off.

In July 2018, the Government made changes to the National Planning Policy Framework which made Sustainable Urban Drainage Systems (SuDS) a requirement for the determination of planning applications for ‘major’ developments. The requirements of a sustainable drainage system is set out in the government’s Non-statutory technical standards for sustainable drainage systems.

A Drainage Strategy will therefore be required as part of the Outline Planning Application for the development, as the site is considered to be ‘major’ development by the Town and Country Planning Order 2015 as total floor space will exceed 1,000m^2.

The assessment will:

- Investigate all potential risks of flooding to the site,
- Consider the impact the development may have elsewhere with regards to flooding,
- Consider proposals to mitigate any potential risk of flooding determined to be present; and
- Consider detailed drainage proposals to mitigate flood risk from the site.

This report reviews the following information:

- Environment Agency flood maps for rivers and sea flooding.
- UK Government Long Term Flood Risk Information for surface water flooding and reservoir flooding.
- Copeland Borough Council Strategic Flood Risk Assessment (SFRA), dated August 2007.
- Copeland Borough Council Core Strategy and Development Management Policies, submitted document including the Council's proposed minor modifications, dated October 2012.
- Topographic Survey by Survey Operations, ref 21B259/002, dated April 2021.
- Phase 1 Preliminary Risk Assessment by Curtins, dated August 2019.
- Phase 2 Ground Investigation Report by Curtins dated 2021.
- United Utilities Sewer Records.
- GPR survey undertaken by Sumo Services in 2009.

1.3 Proposed Development

There are two areas for development as part of the proposals, phase 2 and the waste compound and access road. Phase 2 includes the construction of an acute hospital building with associated hard landscaping and car parking. The other is the redevelopment of the waste compound, construction of an access road, widening of a section of the existing road to allow for 2-way traffic and a reconfigured entrance/ exit to the site. The access road is due to be constructed/ widened first, followed by the proposed building, car parking and associated hard landscaping and finally the waste compound. The proposed building will be set at a finished floor level (FFL) of 91.200 with banking required to the north to support the proposed access road which is approximately 4m above the building FFL.

The proposed development plans are contained within Appendix A.

2.0 Existing Site Details

2.1 History and Current Use

The site is currently occupied by the West Cumberland Hospital. Development on the site comprises several buildings associated with the Hospital, areas of hardstanding inclusive of car parks and foot paths, as well as areas of soft landscaping. Development on the site is largely is largely restricted to the original timeframe between 1959 and 1964, with a number of small piecemeal additions undertaken over the ensuing years.

The site is bounded by a mixture of residential and light industrial development to the north. Further to the north east the land use is in mainly a combination of arable farming and grazing. To the east, land use is primarily farmland. To the south and west, residential development and the A595 highway, the main road along the west coast of the county. Figure 2-1 shows the existing hospital site in its entirety along with the immediate surroundings. A number of the buildings in the vicinity of the proposed works have been demolished subsequent to the aerial photograph .

Figure 2.1: Site Location Plan

2.2 Existing Watercourses

No above ground watercourses have been identified within the proposed site

The following watercourses have been identified within the vicinity of the proposed site:

- An unnamed watercourse (main river) lies approximately 0.8km to the north and according to the Environment Agency mapping issues in open channel at the junction of Main Street and Egremont Road (NGR 298582mE 516787mN. This watercourse then flows generally west to join Pow Beck west of the railway (NGR 297925mE 516326mN)
- The Main River, Snebra Beck lies approximately 0.95km to the north of the site and crosses Egremont Road and the A595 main highway as it flows west to join Pow Beck to the west of the railway (NGR 297748mE 516582mN).
- The Main River, Pow Beck, lies approximately 0.95km to the west of the site and flows in a generally northern direction to discharge into Whitehaven Marina
- An unnamed watercourse is located approximately 0.6km to the southeast of the site, the head of which lies at NGR 299492mE 515635mN. The watercourse flows generally to the southwest to join a section of Pow Beck which flows south towards St Bees, and discharges to the seat at Sea Mill Lane, NGR 296923mE 510789mN.
- The Main River, River Keekle lies approximately 1.5km to the east of the site. The River Keekle flows generally south, to join the River Ehen at Wood End, NGR 301189mE 512894mN to then flow south through Egremont.

2.3 Existing Drainage

The public sewer records have been obtained for the development site and are enclosed in Appendix B. A GPR survey was undertaken in 2009 by Sumo Services that indicates an extensive amount of private drainage around the full site perimeter.

The records indicate that there are no public sewers within the site boundary, with the exception of both foul and surface water sewers lying just within the site boundary on Homewood Road.

The records indicate that the immediate areas northwest, west, south are well served by a predominantly separate foul and surface water networks:

- There is a 225mm diameter surface water sewer flowing southwest then west along Home Wood Road.
- There is a 150mm diameter foul sewer flowing to the northwest of Homewood Road, which then encroaches into the site before continuing west along Homewood Road.

The site is currently operational and is positively drained and the topographic survey has identified an extensive system of gullies, rainwater pipes, manholes and inspection chambers. Whilst manhole and

CCTV surveys have not been undertaken at the time of undertaking this assessment, it is clear that the onsite drainage discharges to the public sewer network.

2.4 Topography

As referred to above, a topographic survey has been undertaken and covers the key areas where redevelopment is proposed within the red line boundary. The survey can be found in Appendix C.

A broader figure, showing the general topography of the site and surrounding is presented in Figure 2-2 below, derived from the Environment Agency 1m resolution Light Detection and Ranging (LiDAR) Digital Terrain Model (DTM).

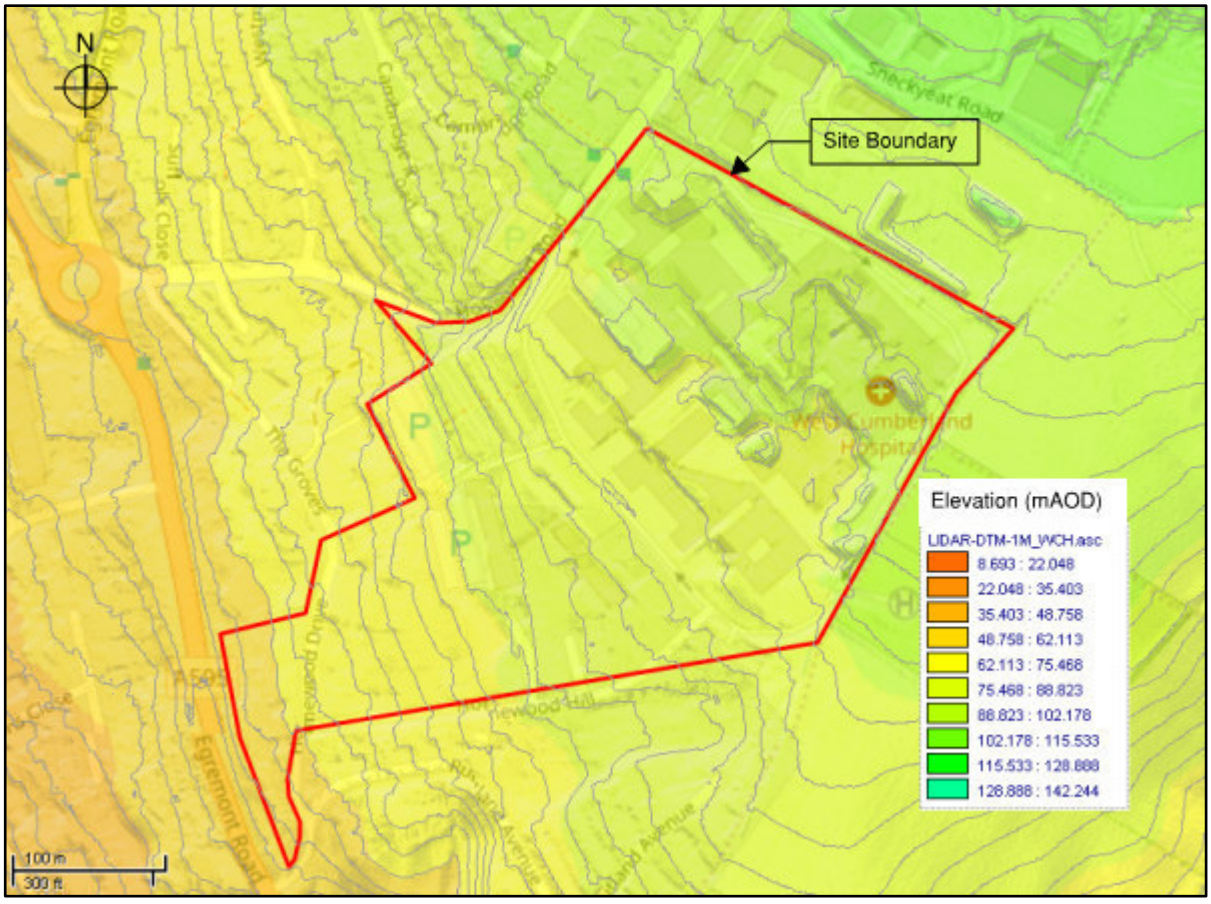

Figure 2.2: General Topography based on LiDAR DTM

The site slopes downwards from northeast to southwest. The contours indicate the north-eastern part be less steep, with an average gradient of 0.061m/m (1 in 16), with gradient increasing in the south-western area, 0.082m/m (1 in 12).

2.5 Geology and Hydrogeology

A study of the Envirocheck records, British Geological Survey (BGS) 1:50,000 mapping records (Bedrock and Superficial Editions) for Whitehaven (Sheet 028) (Ref.2) indicates the following geological and hydrogeological succession underlying the site.

Table 2.1: Geological/Hydrogeological Succession

Geology	Associated Hydrogeological Classification
Till, Devensian[1]	Secondary Undifferentiated[2]
Hensingham Grit[3]	Secondary A Aquifer[4]
Stainmore Formation[5]	Secondary A Aquifer[4]

Notes:

1. *Diamicton. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by ice age conditions.*
2. *Assigned in cases where it has not been possible to attribute either category A or B to a rock type*
3. *Sandstone. Sedimentary Bedrock formed approximately 328 to 329 million years ago in the carboniferous Period. Local environment previously dominated by rivers.*
4. *Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.*
5. *Mudstone, Siltstone and Sandstone. Sedimentary Bedrock formed approximately 319 to 329 million years ago in the Carboniferous Period. Local environment previously dominated by swamps, estuaries and deltas.*

The British Geological Society (BGS) identifies that superficial deposits of the Devensian Till underlies the entirety of the site. The solid geology comprises the Hensingham Grit which underlies a large proportion of the site. The south western areas of the site is underlain by the Stainmore Formation.

There are no known faults underlying the site directly, however there are numerous faults in the nearby vicinity. The orientation of the faults varies greatly however generally strike in an NW-SE orientation

Details from freely available borehole logs taken from the BGS within close proximity to the site are summarised in Table 2-2 below.

Table 2.2: Borehole Records

Reference	Location (NGR)	Details (depth to top of strata/details/thickness)
NX91NE50/52	298730,515980	0.40m bgl, Topsoil 3.75m bgl, Broken sandstone and sandy clay. 4.50m bgl, Grey sandstone. Borehole completed at 4.50m bgl.
NX91NE/80	299061, 516308	0.00m bgl, Firm to stiff brown sandy boulder clay. 1.50m bgl, Stiff brown sandy boulder clay. 3.20m bgl, Soft brown sandy clay and grey shale. 5.00m bgl, Dark grey weathered shale. *5.00m Borehole completed*
NX91NE/381	299890,515910	0.00m bgl, Sandy gravelly cobbly clay. 6.70m bgl, Sand and gravel with cobbles and boulders. 8.35m bgl, Dark reddish brown sandstone. 18.00m bgl, Dark red sandy clayey siltstone. *Borehole continues to 120m bgl prior to termination.*

The north eastern spur of the site is within a zone of low vulnerability due to the underlying Secondary Superficial Aquifer in respect to groundwater vulnerability. The large proportion of the site is considered high vulnerability due to the underlying Secondary Superficial Aquifer.

There are no groundwater abstraction points located within 1km of the site and the site is not located with an Environment Agency designated Source Protection Zone (SPZ).

3.0 Development and Flood Risk

3.1 National Planning Policy Framework (NPPF) and Planning Practice Guidance

In July 2018, the Ministry of Housing, Communities & Local Government published the revised National Planning Framework (NPPF). This document replaces the first National Planning Policy Framework published in March 2012 by the Department of Communities and Local Government. The Planning Practice Guidance (PPG) was published in March 2014 which provides guidance on how flood risk should be assessed during the planning and development process. This guidance remains current.

Table 1: (Extract from Planning Practice Guidance) Flood Zone Classifications

These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. They are shown on the Environment Agency's Flood Map for Planning (Rivers and Sea), available on the Environment Agency's web site, as indicated in the table below.

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	**This zone comprises land where water has to flow or be stored in times of flood.** Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

Table 2: (Extract from Planning Practice Guidance) Flood Risk Vulnerability Classification

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 operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').
More Vulnerable • Hospitals • Residential institutions such as residential care homes, children's homes, social services 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 educational 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 distribution; non-residential institutions not included in the 'More Vulnerable' class; and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill* and hazardous waste facilities).
- Minerals working and processing (except for sand and 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 and pumping stations.
- Sewage transmission infrastructure and pumping stations.
- Sand and gravel working.
- Docks, marinas and wharves.
- Navigation facilities.
- Ministry of Defence defence installations.
- Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.
- Water-based recreation (excluding sleeping accommodation).
- Lifeguard and coastguard stations.
- Amenity open space, nature conservation and 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 and evacuation plan.

Table 3: (Extract from Planning Practice Guidance) Flood Risk Vulnerability and Flood Zone Compatibility

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Notes to table 3:

- This table does not show the application of the Sequential Test which should be applied first to guide development to Flood Zone 1, then Zone 2, and then Zone 3; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea;
- The Sequential and Exception Tests do not need to be applied to minor developments and changes of use, except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site;
- Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.

† In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

* In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows and not increase flood risk elsewhere.

3.2 Sequential Test

Paragraph 155 of the NPPF states 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'.

This policy is implemented through the application of the flood risk Sequential Test which aims to steer new development to areas with the lowest probability of flooding.

3.3 Exception Test

If, following application of the Sequential Test, it is not possible for the development to be located in zones with a lower probability of flooding, the Exception Test can be applied, if appropriate. As detailed in paragraph 160 of the NPPF, for the Exception Test to be passed:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment (SFRA) where one has been prepared; and
- 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.

3.4 Local Planning Policy and Guidance

The Copeland Core Strategy and Development Management Policies (DPD)[1], adopted December 2012, falls under the umbrella title of the Local Development Framework. The DPD sets out the overall strategic direction for planning by providing policies to guide decisions on planning applications over the period 2013 to 2028.

The Core Strategy and Development Management Policies Document (DPD) contains a set of development management policies for the local planning authority area of Copeland. When a planning application is submitted, the Council uses development management policies (planning policies) alongside other policies in the Development Plan to help it assess whether or not the application should be granted planning permission.

The relevant policies of the DPD in respect to development and flood risk are identified as:

- Policy DM11 - Sustainable Development Standards and
- Policy DM24 - Development Proposals and Flood Risk

Policy DM11 and DM24 are reproduced as Figure 3-1 and Figure 3-2 below.

[1] https://www.copeland.gov.uk/sites/default/files/attachments/copeland_local_plan_2013_2028.pdf

Policy DM11 – Sustainable Development Standards

The Council will ensure that development proposals reach high standards of sustainability by:

A Requiring housing to be of an appropriate density – generally at least 30 dwellings per hectare. However, a lower density may be acceptable where it reflects the form and character of development in the surrounding area

B Encouraging developers to achieve high energy efficiency standards in relation to the Code for Sustainable Homes and BREEAM

C Requiring renewable energy generating technology on site in developments of 10 or more dwellings or 1,000m^2 non-residential development

D Orientating and designing buildings to maximise solar gain, so far as practicable without compromising wider design and quality of place objectives

E Encouraging construction materials to be sourced, where possible, from local and sustainable sources of production

F Requiring water saving technology, including grey water recycling to be incorporated in all developments

G Ensuring surface water is managed appropriately, with the inclusion of Sustainable Drainage Systems where possible

Support will also be given to proposals for improvements or alterations to existing buildings that include measures to increase energy efficiency and incorporate renewable energy generation with regard to the standards in this policy.

Development should not result in the unnecessary sterilisation of surface mineral resources, and wherever appropriate should incorporate remediation measures to ensure that the development is not at risk from ground instability arising from mining legacy or other former uses.

Figure 3.1: DPD Policy DM11

Policy DM24 – Development Proposals and Flood Risk

Where a proposed development is likely to be at risk from flooding or increases risk of flooding elsewhere, a Flood Risk Assessment (FRA) will be required to be submitted as part of the planning application.

Development will not be permitted where it is found that:

A There is an unacceptable risk of flooding; or

B The development would increase the risk of flooding elsewhere; or

C The development would cause interference with or loss of access to a watercourse

and the benefits of the development do not outweigh the risks of flooding.

Where a development requires the provision of additional flood defence and mitigation works, any costs, including maintenance, should be met by the developer.

Figure 3.2: DPD Policy DM24

3.5 Site Specific NPPF Flood Risk Categorisation

To assess the NPPF flood risk classification for the site, the first step was to inspect the Environment Agency web-based flood mapping data for flooding from rivers and seas, surface water and reservoirs. The rivers and sea flood map is used to inform planning of a sites Flood Zone(s); however, the surface water and reservoir flood maps should also be used to identify other flood risks.

From the Environment Agency flooding from rivers and seas map, it can be seen that the proposed site and the surrounding area are entirely located within an area classified as Flood Zone 1 (low risk of flooding from rivers or sea).

3.6 Site Specific Flood Zone Compatibility

The proposals for the development site are likely to fall within the following category:

- 'Hospitals'.
- 'Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.'

This type of development is classed as 'More Vulnerable' development in the Flood Risk Vulnerability Classification (Table 2).

The site is located within Flood Zone 1, for which 'More Vulnerable' development is deemed to be appropriate, and neither the sequential nor the exception test is required (refer to Table 3 for the Flood Zone compatibility table taken from NPPF technical guidance).

It is anticipated that the lifespan of the development will be 60 years. If operational in 2023, the design life will be to 2083.

4.0 Assessment of Flood Risk

4.1 Sources of Flood Risk

This study assesses the risk from different types of flooding to the development and the risk of flooding from the development, taking into consideration climate change, as well as how flood risks should be managed. The approach to assessing flood risk at the development site was informed by the requirements of NPPF in conjunction with the client and Environment Agency requirements.

4.2 Fluvial Flooding (Rivers and Streams)

From the Environment Agency flooding from rivers and seas map:

- Zone 1 Low Probability: Land having a less than 0.1% (1 in 1,000) annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
- Zone 2 Medium Probability: Land having between a 1% (1 in 100) and 0.1% (1 in 1,000) annual probability of river flooding; or land having between a 0.5% (1 in 200) and 0.1% (1 in 1,000) annual probability of sea flooding. (Land shown in light blue on the Flood Map).
- Zone 3a High Probability: Land having a 1% (1 in 100) or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding (Land shown in dark blue on the Flood Map).
- Zone 3b The Functional Floodplain: This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map). Notionally, Flood Zone 3b indicates there is a chance of flooding of greater than 1 in 30 (3.3%).

The flood map also contains the following information:

- Flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, together with some natural or constructed entities which retain, store or channel water and which may protect against smaller floods.
- Areas benefiting from flood defences - areas that benefit from the flood defences shown, in the event of a river flood with a 1% (1 in 100) chance of happening each year, or a flood from the sea with a 0.5% (1 in 200) chance of happening each year. If the defences were not there, these areas would flood.

Flooding to the site from rivers and seas is indicated in Figure 4-1 below and it can be seen that the entire proposed site is located within an area classified as Flood Zone 1, therefore the site is considered to be at low risk from fluvial flooding.

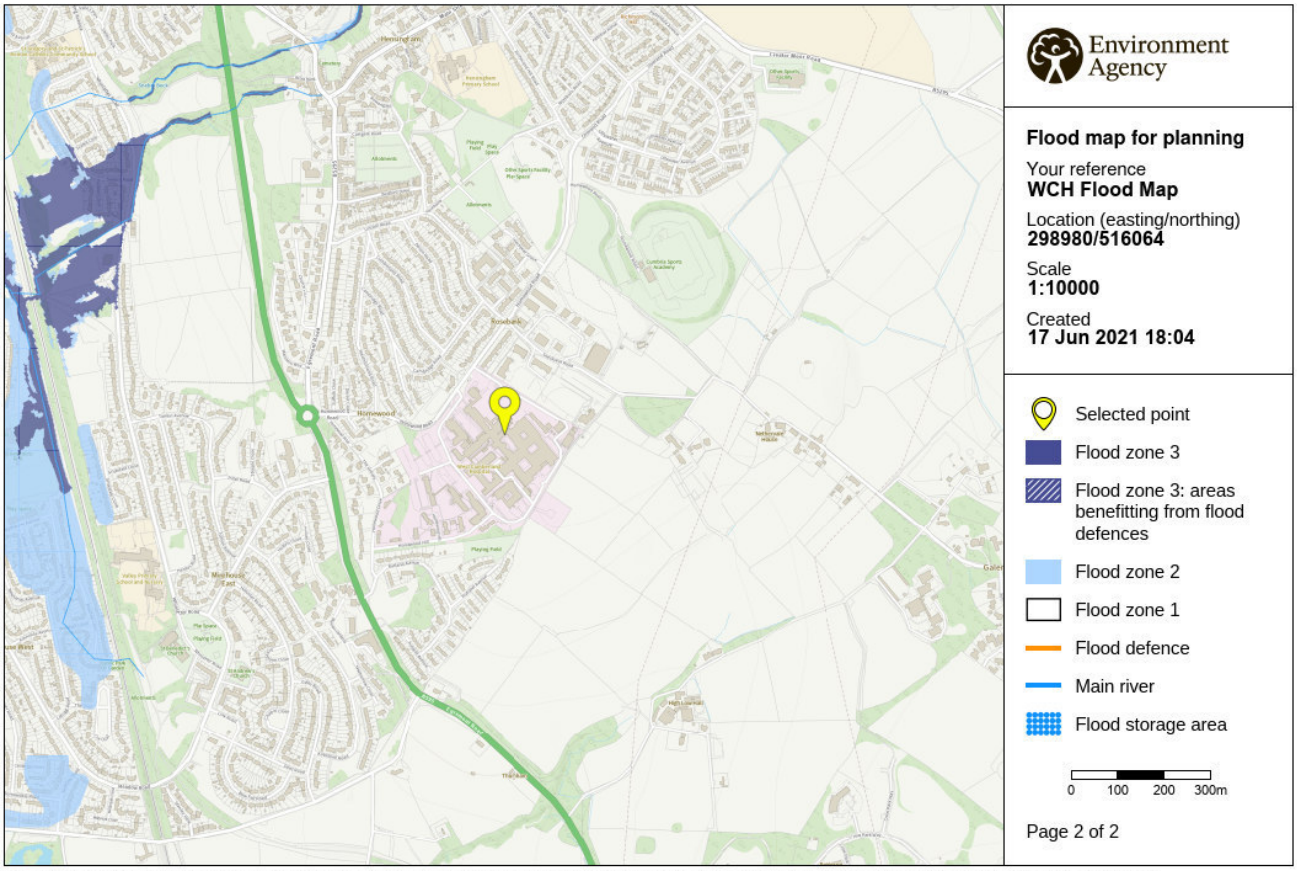

Figure 4.1: Environment Agency Flood Map for Planning (Rivers and Sea)

The Strategic Flood Risk Assessment[2] further confirms that there is no fluvial flood risk associated with the site.

4.3 Tidal Flooding (Coastal or Estuarine)

1.1.1 There is currently no flood risk identified on the Environment Agency flood maps for the site and it is therefore regarded to be at low risk from tidal flooding.

1.1.2 The Strategic Flood Risk Assessment[4] further confirms that there is no tidal flood risk associated with the site.

4.4 Reservoir Flooding

1.1.3 Reservoir flooding is extremely unlikely to happen and there has been no loss of life in the UK from reservoir flooding since 1925. The Environment Agency is the enforcement authority and ensures that reservoirs are inspected regularly, and essential safety work is carried out.

[2] Copeland Borough Council, *Strategic Flood Risk Assessment (SFRA)*, Jacobs, August 2007.

1.1.4 The Flood Warning Information Service Long Term Flood Risk from Reservoirs map indicates the site is not at risk from reservoirs in either the local or wider vicinity of the site.

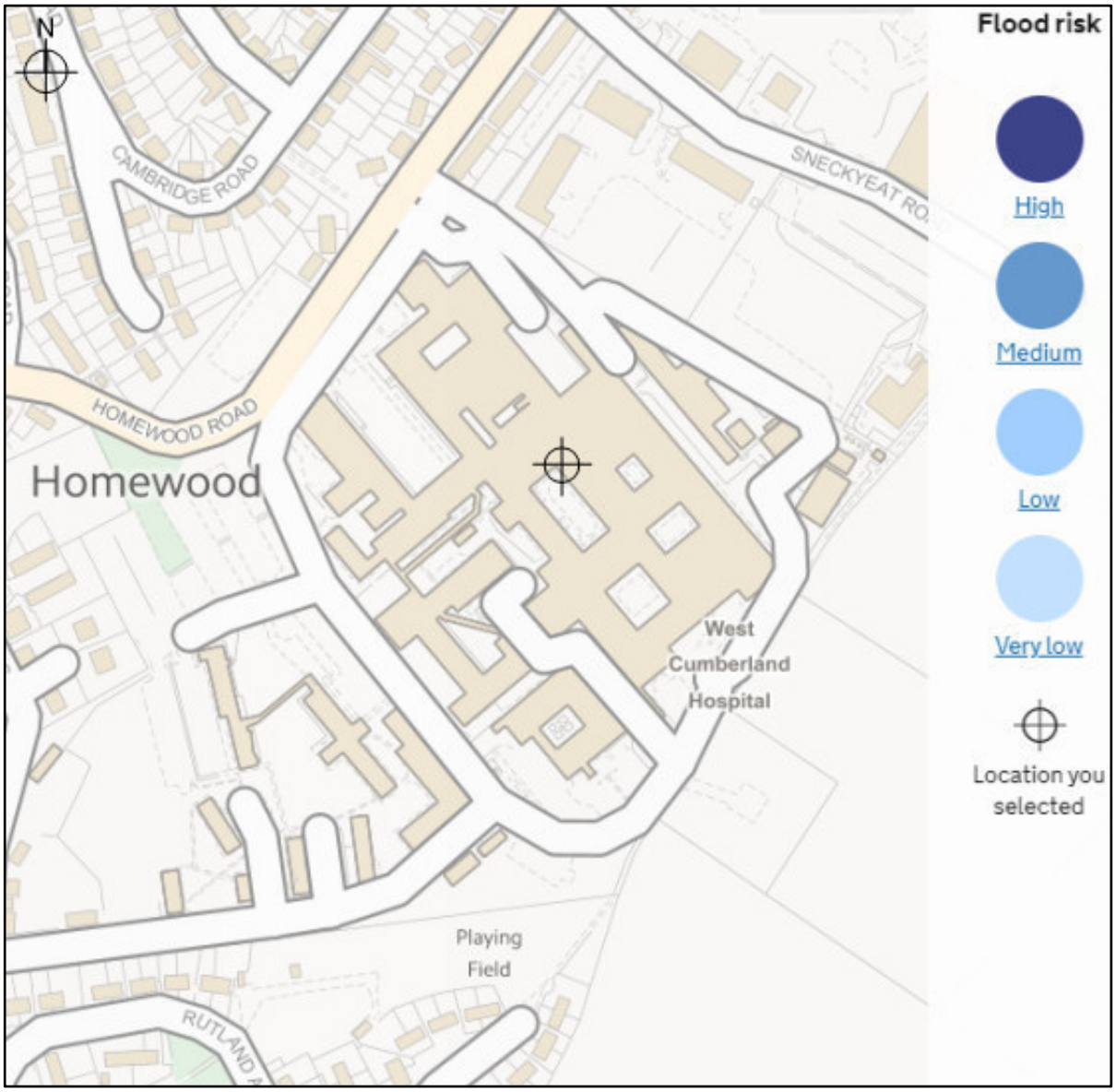

Figure 4.2: Risk of Flooding from Reservoirs - Extent of Flooding

4.5 Canal Flooding

There are no canals in the vicinity of the site.

4.6 Groundwater Flooding

The SFRA[3] indicates a limited potential for groundwater flooding exists in the Borough. If further states that Groundwater flooding can and does occur throughout the Borough and cannot always be predicted.

The Phase 2 Geoenvironmental assessment[4] by Curtins accessed the British Geological Survey (BGS) groundwater flooding vulnerability maps, reproduced as Figure 4-1 below. The map shows a Limited Potential for Groundwater Flooding to Occur on the site.

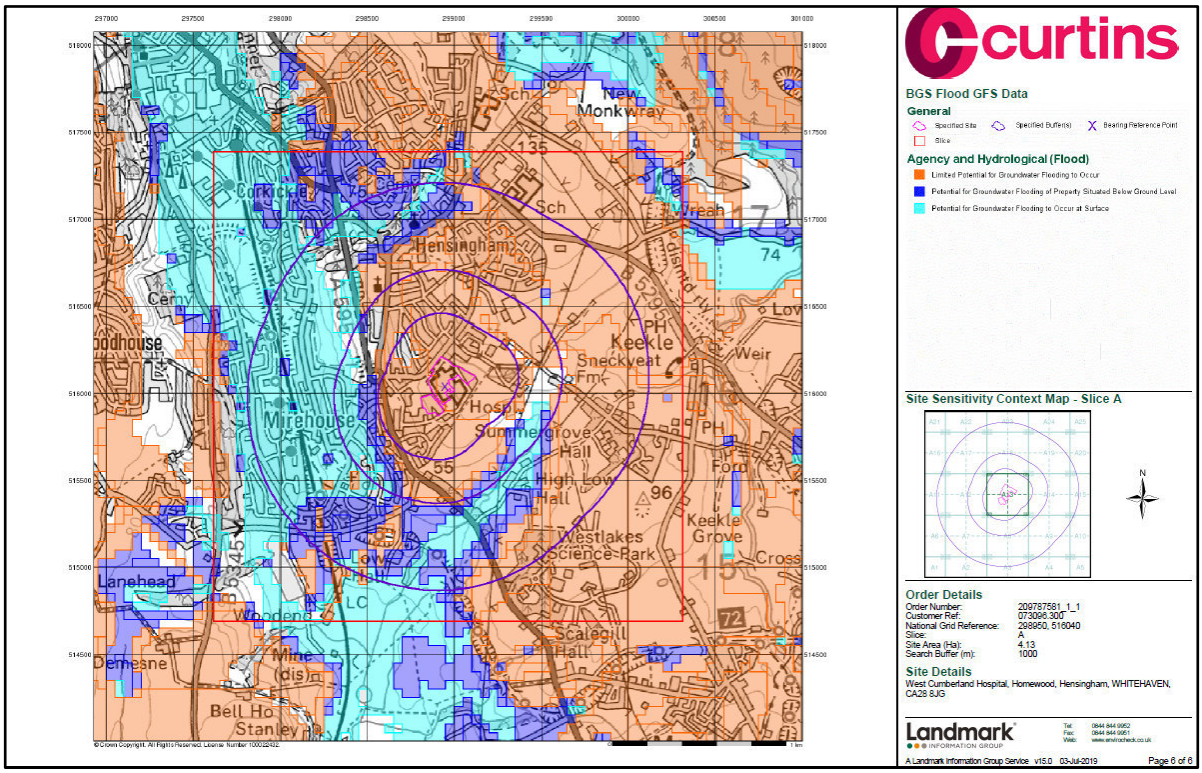

Figure 4.3: BGS Susceptibility to Groundwater Flooding

The Phase 2 intrusive investigations recorded ground water strike at 11m bgl at BH02A where weakened/ fractured bedrock had been discovered. Perched water was discovered within WS03 & WS05 a depths between 0m to 2.05m bgl. The SI confirms the previous assessment of flood risk from ground water and is not considered a risk.

4.7 Public Sewers, Highway Drainage Flooding and Infrastructure Failure

United Utilities are responsible for the public sewer systems in Whitehaven and records of the public sewers have been obtained and are provided in Appendix B. The records shown a minor intrusion of the public sewers into the development site.

[3] Copeland Borough Council, *Strategic Flood Risk Assessment (SFRA)*, Jacobs, August 2007.
[4] 073096-CUR-00-XX-RP-GE-002-V01, West Cumberland Hospital Phase 2 Preliminary Risk Assessment, 25 March 2021.

The site contains extensive private foul and surface water drainage systems which are understood to connect to the public sewer system. These serve buildings and hard standings and highways within the site.

There is no record of historic flooding within these private systems. And where possible, this existing drainage infrastructure is to remain.

The Sneckyeat Road car park has been recently altered to the north east of the site which has caused some localised flooding within the north eastern portion of the site and near to where the waste compound is situated. This has occurred because there is no formal drainage within the car park and all of the surface water runs onto the site which creates flow greater than the capacity of the private drainage system. The car park is due to altered again in the near future with a planning application being required which will require a drainage strategy, alleviating the strain on the hospitals drainage system in this area.

The hydraulic design standard of the existing surface water drainage system has not been assessed. However, the demolition of some existing buildings within the vicinity of phase 2 and the waste compound which were drained by the private system and the proposed reduction in flow from the proposed buildings will reduce the flow into the system.

In that sense, the proposed development will reduce the risk of flooding from the on-site surface water system.

4.8 Surface Water Flooding to the site

Surface water flooding can be caused when rainwater during extreme rainfall events does not drain away through the normal drainage system or soak into the ground with flooding occurring, principally from manholes and gullies. Surcharging sewers can result in overland flows which if originating at a higher elevation than a development site can potentially pose a flood risk.

From the UK Government's Flood Risk from Surface Water, (extent of flooding) map, level of surface water flood risk is expressed as;

- Very low risk – meaning that that each year this area has a chance of flooding of less than 0.1%.
- Low risk - meaning that each year this area has a chance of flooding of between 0.1% and 1%.
- Medium risk means that each year this area has a chance of flooding of between 1% and 3.3%
- High risk means that each year this area has a chance of flooding of greater than 3.3%.

The extent of flooding to the site from surface water is indicated in Figure 4-4 along with indicative flood depths for the standard risk scenarios.

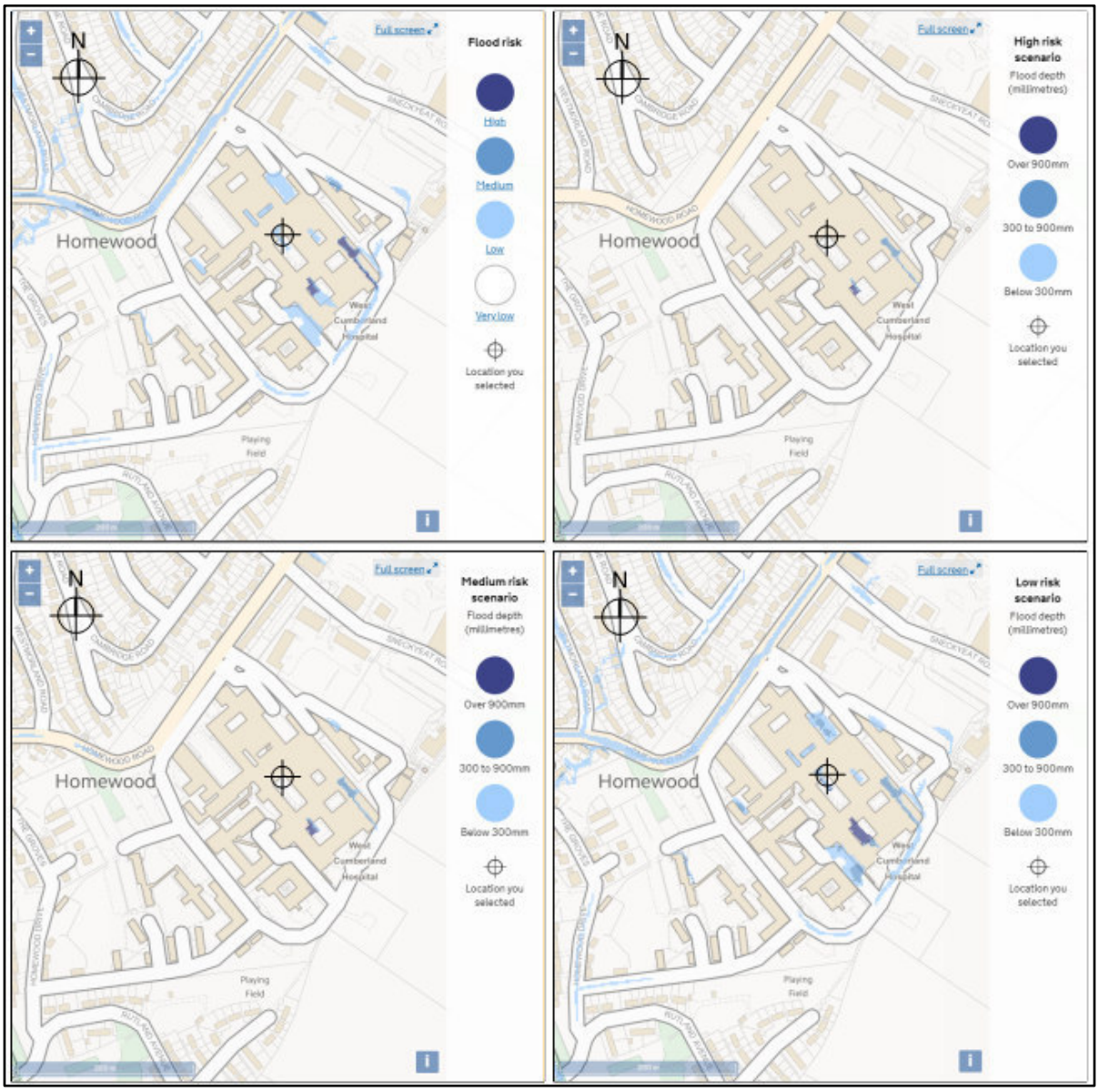

Figure 4.4: Risk of Flooding from Surface Water - Extent of Flooding

There are areas identified as at risk from surface water flooding both within and outside the site boundary. Those areas within the site are attributed to localised low spots in the topography and are focussed around existing buildings. However, the topography used in the surface water mapping relies on a digital terrain model rather than ground survey and, whilst it is understood that some modification is also made to account for positively drained areas, it is likely that the algorithms do not fully account for localised positive drainage as is known to existing within the site.

The development proposals include for an element or landscaping of the hospital grounds and where possible, external levels should be set to fall away from the buildings.

Considering the above information, the risk of surface water flooding to the redeveloped site is generally considered low. Mitigation measures to ensure the risk remains low are proposed in Section 5.

4.9 Surface Water Flooding from the site

Developers are responsible for ensuring that new development does not increase the flood risk elsewhere. The proposed surface water drainage network directly relating to the development proposals shall be designed to not flood for the critical 1 in 30-year storm event and flood water generated up to the critical 1 in 100-year plus climate change storm event shall be constrained within areas on site so as not to cause damage to buildings, essential services or adjoining developments and services.

New development has the potential to increase flood risk where any increase in impermeable areas results in additional run-off from proposed roads, car parks and building roofs being discharged freely into the downstream drainage network. It is therefore encouraged to propose permeable areas, landscaping areas and incorporate sustainable drainage features utilising infiltration or attenuation where possible.

Mitigation measures to ensure the risk remains low are proposed in Section 5 and an assessment of the proposed surface water flows is carried out within the drainage strategy within section 6 of this report.

4.10 Historical Flooding

No historic flood events have been identified in the SFRA.

4.11 Summary of Flood Risk

From the evidence collated and subsequent correspondence and meetings, the main types of flooding that may apply to the proposed development site are as follows:

- Fluvial / Tidal flooding to the site (No potential)
- Reservoir flooding to the site (No potential)
- Groundwater flooding to the site (Low potential)
- Surface water flooding to the site (Low potential / Isolated High Potential)
- Surface water flooding from the site (Low potential).

5.0 Mitigation

5.1 Fluvial/Tidal Flood Mitigation

The development site lies entirely within Flood Zone 1 and therefore is at no risk of fluvial and tidal flooding. No specific measures are required at this location to mitigate against fluvial and tidal flooding.

5.2 Reservoir Flooding Mitigation

There are no reservoirs within the wider vicinity of the site and therefore the site is considered as being no risk of reservoir flooding. No specific measures are required at this location to mitigate against reservoir flooding

5.3 Groundwater Flood Mitigation

Groundwater flooding tends to be more persistent than other sources of flooding, typically lasting for weeks or months rather than hours or days. Groundwater flooding does not generally pose a significant risk to life due to the slow rate at which the water level rises; however, it can cause significant risk to property.

The site is considered at low risk of groundwater flooding based on no recorded instances of flooding from this source. In the Phase 2 report it states that ground water was encountered at 11m bgl at BH02A where weakened/ fractured bedrock had been discovered. Perched water was discovered within WS03 & WS05 a depths between 0m to 2.05m bgl.

Finished floor levels for the development should be set above the highest groundwater level.

External ground levels across the site should fall away from the proposed buildings and ensure that the creation of low points are avoided (other than those used intentionally for drainage features) in order that in the unlikely event of groundwater flooding, the flood water is safely routed away from the buildings on site.

Providing the above mitigation measures are imposed, the risk from groundwater flooding would be considered low post development.

5.4 Surface Water Flooding to the site Mitigation

The UK Government surface water flood maps indicate that there are localised areas of high - low risk of surface water flooding, predominantly adjacent to existing buildings. Where locations of surface water flooding is predicted, a positive drainage system is known to exists.

Whilst the site is to be redeveloped, the existing drainage systems where possible will be retained. As part of the drainage design the existing site drainage should be reviewed and where retained, continue to be maintained.

Providing the above measures are implemented the flooding risk to the development site from surface water is therefore considered low post development.

5.5 Surface Water Flooding from the site Mitigation

Any new development site drainage should be designed in accordance with current best practice to provide adequate capacity not to flood for the critical 1 in 30-year storm event and flood water generated from up to the critical 1 in 100-year plus climate change storm event shall be constrained within the areas on site so not to cause damage to buildings, essential services or adjoining developments & services.

The Environment Agency released updated climate change allowances for peak rainfall intensities in July 2020. These should be applied to new developments. Table 4 demonstrates the climate change allowances with central and upper end allowances being considered.

Based on the nature of the development, a lifespan in excess of 60 years is anticipated. Therefore, the potential climate change allowance for 2070-2115 ranges between 20% for the central allowance and 40% for the upper end allowance. As such, an allowance of 40% for climate change on peak rainfall intensity will be included in calculations.

Table 5.1: (Extract Environment Agency Guidance) Peak Rainfall Intensity Allowance in small and urban catchments

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

In following the standard hierarchy of drainage solutions, consideration should firstly be given to the discharge of surface water runoff by sustainable methods such as infiltration.

Section 6 reviews the surface water discharge options and based on the site information obtained it is concluded that an infiltration-based solution will not be appropriate for this site.

To minimise localised flooding within the site, the drainage design should ensure that gullies, drainage channels and drains are all suitably sized to accommodate peak storm flows. Also, all inlet features should have suitably sized sumps to catch silts and should be subject to a documented routine maintenance and cleansing regime.

The surface water should be constrained within the site and this could be attained by enhanced landscaping features where suitable.

Flood water exceedance routes should be identified, both on and off site as detailed design progress.

For any sustainable drainage systems employed in the development, an appropriate management and maintenance plan for the sustainable drainage system for the lifetime of the development should be submitted which should include:

- Any arrangements for adoption by an appropriate public body or statutory undertaker, management and maintenance by a Residents' Management Company
- Arrangements concerning appropriate funding mechanisms for its on-going maintenance of all elements of the sustainable drainage system (i.e. inspections, regular maintenance)
- Means of access for maintenance and easements where applicable

Assuming that the proposed drainage system is designed to provide adequate capacity, and that the system will be correctly maintained, it can be assumed risk of flood from blockage or overloading is minimal.

The final design of the drainage networks shall be in accordance with the legislation set by the Copeland Borough Council and Cumbria County Council.

6.0 Outline Surface Water Drainage Strategy

6.1 Overview

The proposed development is split over two sites; the waste compound, including the access road, and the phase 2 building, associated hard landscaping and car parking. These 2 sites will be constructed as two phases. The access road will be constructed first, followed by the waste compound. The phase 2 building will then be constructed with a section of car parking with the remaining car parking spaces to follow. Both sites will be served by separate drainage networks which have an allowance for the phasing.

The sections being constructed first include a flow control device suitable for both phases of each site, i.e. waste compound and access road, and an attenuation tank sized for the first phases surface water run-off, i.e. just the access road.

When the second phase of the works are completed an additional attenuation tank will be added to the system to take the flow from the second phase of works.

The proposed flows from the site are restricted to the greenfield Q100 flow, 18.66l/s/Ha for the proposed contributing areas. The access road and waste compound have a contributing area of 0.241Ha making the discharge rate 4.5l/s.

For the phase 2 works the contributing area is 1.086Ha giving a discharge rate of 20.3l/s. The waste compound has one flow control device to serve the network, phase 2 has two, one for the proposed building and small area of car parking and one for the southern section of car parking.

The calculation for the discharge rates and the surface water networks can be seen in Appendix D. The Drainage Strategy is shown in Appendix E.

6.2 Surface Water Disposal

In accordance with the National Planning Policy Framework (NPPF), SuDS Guidance and Part H of the Building Regulations, the surface water disposal hierarchy should in the first instance be discharged to the ground by infiltration. If ground conditions prevent this, surface water should be disposed of to a watercourse or waterbody. If this is not possible, surface water should be discharged to a surface water sewer or drain and only as a very last resort to a combined sewer.

Infiltration

The Phase 2 Site Investigation[5] undertaken in 2021 by Curtins has identified the soils to be generally made ground over boulder clay/glacial till (up to a depth of 4.8 m bgl) over mud/sand /siltstone bedrocks and with a high (possibly perched) water table within 2.1 m of the surface. This would suggest that

[5] 073096-CUR-00-XX-RP-GE-002-V01, West Cumberland Hospital Phase 2 Preliminary Risk Assessment, 25 March 2021.

infiltration to ground is unlikely to be feasible, however this should be confirmed during the detailed design stage with BRE 365 infiltration tests undertaken at the location and depths of the proposed attenuation tanks.

Watercourses

There are no watercourses identified within the vicinity of the site.

Discharge to Surface Water Sewer

United Utility (UU) sewer maps indicate that a 225 mm diameter surface water sewer is present in Homewood Road to the north of the project. Utility mapping of the existing hospital indicates that the existing surface water drainage leaves the site at 3 locations along the southern and western boundaries of the site.

It is proposed to drain the attenuated surface water flows from the proposed development into the existing Surface Water MH on the western boundary of the site which appears to be directed towards the UU sewer in Homewood Road, however the utility mapping does not extend beyond the hospital boundary there this will be subject to confirmation by CCTV during the detailed design stage.

6.3 Storage Volumes

There are four attenuation structures proposed for the two sites, two for each, with one structure being required for each phase of the works. The attenuation structures proposed will take the form of below ground geocellular structures.

The access road requires a tank of 36m^3 and the waste compound 42.75m^3 based on 97% void ratio (VR) The proposed building and small parking area requires a tank of 255m^3 and the additional parking requiring 180m^3 based on 95% VR.

The attenuation requirements have been calculated using Causeway Flow hydraulic modelling software The results can be seen in Appendix D.

6.4 Attenuation Methods

It is recommended that sustainable methods of attenuation are implemented where possible; this can be achieved using a combination of ponds, swales, permeable paving with high voids sub-base and percolation pipes. Use of ponds, swales and permeable paved areas would also be considered as methods of filtration to improve water run-off quality.

The site has a number of constraints, primarily related to ground conditions including both made ground and the unlikely ability to infiltrate, the steep slope across the site and the requirement to provide adequate car parking on the site.

It is therefore proposed to provide attenuation using below ground cellular storage and flow control devices. The locations for these drainage features are indicated in Appendix E. The exact volume and the attenuation structures will be determined during the detailed design phase of the project.

Surface Water run-off from hard paved areas at risk from contamination should receive water quality treatment. Non-residential car parks and in-site access roads, typical for hospitals, are considered Medium hazard in terms of contamination. Figure 6-1 illustrates the pollution hazard indices for different land use classifications from The CIRIA SuDS Manual C753 (2015).

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Figure 6.1: Pollution Hazard indices for land use classification (Table 26.2 the CIRIA SuDS manual 2015)

Treatment could be provided using sustainable methods such as: filter strips, filter drains, swales, bio-retention systems, and/or permeable paving. Figure 6-3 illustrates the SuDS Component mitigation indices from The CIRIA SuDS Manual C753 (2015).

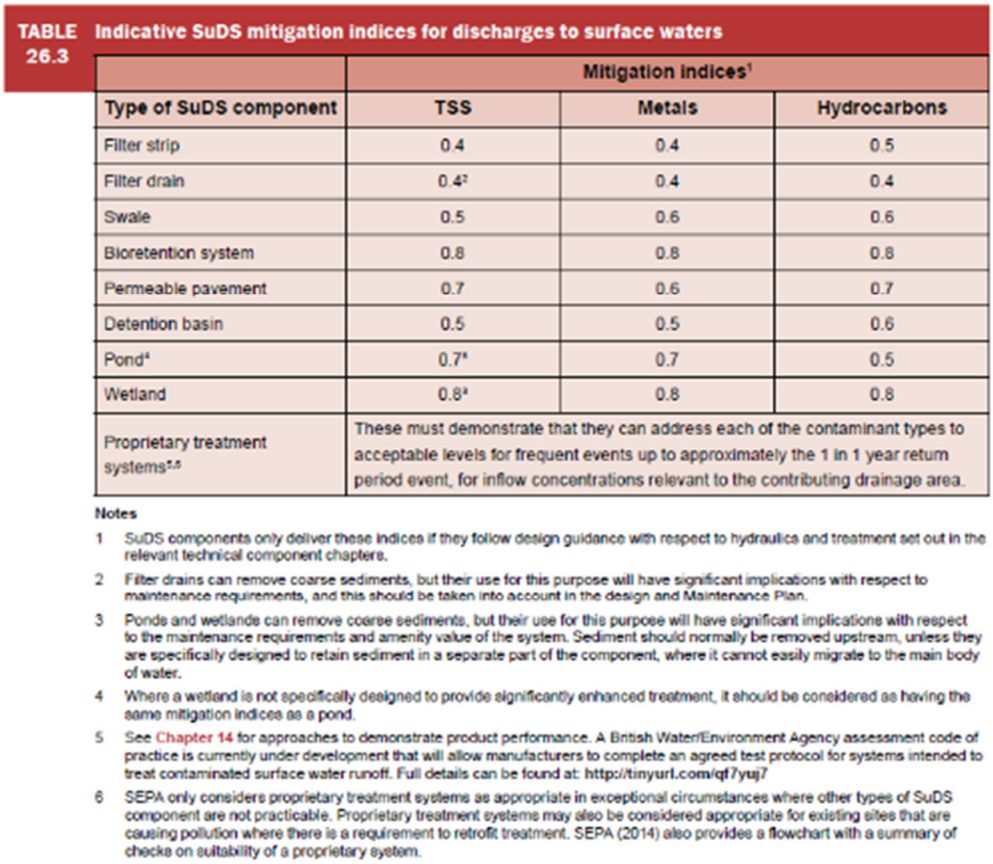

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

	Mitigation indices[1]		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[4]	0.7	0.5
Wetland	0.8[4]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Notes

1 SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.

2 Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.

3 Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.

4 Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.

5 See Chapter 14 for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: http://tinyurl.com/qf7yuj7

6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

Figure 6.2: Indicative SuDS mitigation indices (Table 26.3 the CIRIA SuDS manual 2015)

The selection of treatment should ensure that the SuDS mitigation component index (Figure 6-1) exceeds the pollution hazard index (Figure 6-2). Where two stages of treatment are required, the second stage of treatment should account for reduced performance due to lower inflows; therefore 0.5 (mitigation index) should be used.

The type(s) of mitigation should be considered as the site design is finalised i.e. paving surfaces etc. The proposals for pollution protection should be agreed with Cumbria County Council, Lead Local Flood Authority. It is proposed that a permeable surface will be used in all parking bays as part of the phase 2 site, table 6.1 shows how the mitigation indices compare to the pollution indices.

Table 6-1: Summary of Pollution vs Mitigation Indices for Permeable Non Residentual Drives

Private Drive vs Permeable Paving	TSS	Metals	Hydrocarbons
Pollution Indices	0.7	0.6	0.7
Mitigation Indices	0.7	0.6	0.7

The combination of the permeable paving and catchpit manholes should provide adequate mitigation for the pollution potential of the car park.

For the waste compound and access road an interceptor is being proposed due to the space constraints and heavy loading on the site.

7.0 Conclusions and Recommendations

The Flood Risk Assessment (FRA) has determined the level of risk associated with the proposed development.

From the evidence collated the main types of flooding that may apply to the proposed development site are as follows:

- Fluvial / Tidal flooding to the site (No potential)
- Reservoir flooding to the site (No potential)
- Groundwater flooding to the site (Low potential)
- Surface water flooding to the site (Low potential / Isolated High Potential)
- Surface water flooding from the site (Low potential).

In respect to flood risk, the following recommendations are made:

- Proposed external ground levels across the site should fall away from the proposed buildings in a manner which does not create low points where water might collect unintentionally.

In respect to surface water drainage, the assessment has concluded that:

- Whilst no Infiltration testing has been undertaken, site investigation results indicate that infiltration drainage is not appropriate for the site.
- There are no nearby watercourses in which to discharge surface water.
- The existing development is discharged to the public surface water sewer system.

It is recommended that:

- The below ground surface water drainage system should be designed to accommodate the 100-year plus 40% increase in peak rainfall event on the 100-yr design rainfall.
- In respect to exceedance flows, i.e. flows in excess of the 100-yr plus climate change design flows, that finished floor levels are set above external levels to minimise risk of internal flooding.
- An operation and maintenance plan is produced and adhered to.

8.0 Appendices

Appendix A **Proposed Development Plans**

Appendix B **Sewer Records**

Appendix C **Topographical Survey**

Appendix D **Surface Water Run-off Calculations**

Appendix E **Drainage Strategy Drawing**

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