



HBL ASSOCIATES
FRA & DRAINAGE STRATEGY REVIEW

For

**RESIDENTIAL DEVELOPMENT
LAND TO WEST OF BRIDGEMONT,
WHALEY BRIDGE, SK23 7PB
UNITED KINGDOM**

**On Behalf Of
TREVILLE PROPERTIES LTD**

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REV.04

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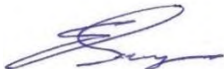
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Table of Contents

1 INTRODUCTION	5
Application Site Details.....	5
2 SITE LOCATION AND TOPOGRAPHY	6
3 EXISTING GROUND CONDITIONS	8
Geology - source: Peak Environmental Solutions Phase 1 Site Investigation 42056R1 April 2020.	8
Hydrology and Hydrogeology – source: Peak Environmental Solutions Phase 1 Site Investigation 42056R1 April 2020.	9
Controlled Waters Risk Assessment – source: Peak Environmental Solutions Phase 1 Site Investigation 42056R1 April 2020.	11
4 EXISTING DRAINAGE DETAILS	13
Public Sewers.....	13
5 PROPOSED DEVELOPMENT DETAILS	14
6 METHODOLOGY	14
Planning Policy and Legislation	14
Sources of Information and Consultations.....	15
7 GENERAL DEFINITION OF POTENTIAL FLOOD HAZARDS.....	16
8 PROBABILITY OF FLOODING.....	17
Fluvial Flood Risks - flooding from Main Rivers and Sea.	17
Fluvial Flood Risk - flooding from Ordinary Watercourses.....	18
Canal Flood Risk.....	20
Artificial Waterbodies – Reservoirs	21
Flooding from Local Sewers.....	23
Highway Drainage System	23
Ground Water Flooding Risk	24
Pluvial Flooding	25
Flood Risk Overview	26
9 APPROPRIATE LAND USE.....	28
Flood Zone Requirements	28
Identified Flood Risk – Drainage Strategy Mangement/Mitigation Measures.....	29
10 SUSTAINABLE URBAN DRAINAGE STANDARDS.....	30
11 EXISTING RUNOFF RATE	31
Wallingford Procedure Variables	31
Greenfield Runoff Rate.....	31
Greenfield Runoff Volume.....	32
12 PROPOSED RUNOFF RATE AND VOLUMES.....	32

Proposed Runoff Rate	32
Proposed Runoff Volume	32
13 PROPOSED RUNOFF DESTINATION	33
Discharge into the ground - infiltration expectations	33
Discharge to surface water body.....	35
Discharge to surface water sewer	35
Discharge to combined water sewer – Proposed Outfall.....	35
14 SuDS COMPONENTS.....	36
15 CLIMATE CHANGE ALLOWANCE.....	39
16 DESIGN FOR EXCEEDANCE	40
17 PRELIMINARY DRAINAGE STRATEGY.....	41
Preliminary surface water strategy	41
Attenuation storage volume estimation	42
Water quality.....	44
18 FOUL WATER DRAINAGE STRATEGY	45
Proposed outfall	45
Proposed foul water rates.....	45
EXECUTIVE SUMMARY.....	46
APPENDIX 1 - TOPOGRAPHICAL SURVEY	48
APPENDIX 2 - PROPOSED SITE PLAN – Option 1.....	49
APPENDIX 3 - BGS infiltration SuDS GeoReport BGS 317107/21928.....	50
APPENDIX 4 - PROPOSED CONTRIBUTING AREAS PLAN.....	51
APPENDIX 5 - SEWER RECORDS / UU CONSULTATIONS	52
APPENDIX 6 - PROPOSED DRAINAGE STRATEGY PLAN.....	53
APPENDIX 7 - HYDRAULIC CALCULATIONS	54
Greenfiel runoff volume – soil 2 (SPR 0.3).....	55
Storage Volume Estimate - Upper Catchment (0.4ha) - discharge to culverted watercourse.	57
APPENDIX 8 – NETWORK RAIL COMMENTS	63
APPENDIX 9 – DRAINAGE STRATEGY ADDENDUM – PROPOSED SITE LAYOUT - OPTION 2	64
FOUL WATER – Site Layout – Option 2.....	64
SURFACE WATER – Site Layout - Option 2.....	65
○ Upper Catchment Volumes - Site Layout Option 2.	65
○ Lower Catchment Volumes - Site Layout Option 2.	66
CALCULATIONS - SITE LAYOUT – OPTION 2	68
▪ Greenfield runoff rate – Soil Type 2(map value) & Soil Type 3 (edited basedon inifltration site testing) ..	68

- Quick Storage Estimate – Proposed Site Layout Option 2 – Upper catchment contributing area 0.56ha . 69
 - 1 in 1 yr return period attenuation volume discharging at 1 in 1 yr greenfield runoff rate:..... 69
 - 1 in 30 yr return period attenuation volume discharging at 1 in 30 yr greenfield runoff rate: 70
 - 1 in 100 yr return period +45% CC attenuation volume, discharging at 1 in 100yr greenfield runoff rate: 71
- Quick Storage Estimate – Proposed Site Layout Option 2 – Lower catchment contributing area 0.05ha.. 72
 - 1 in 1 yr return period attenuation volume proposed to discharge at 2l/s. to combined sewer:..... 72
 - 1 in 30 yr return period attenuation volume proposed to discharge at 2l/s. to combined sewer:..... 73
 - 1 in 100 yr return period +45%cc attenuation volume, discharge at 2l/s. to combined sewer: 74
- PROPOSED SITE LAYOUT - OPTION 2 - (311106.03 Rev.P02)..... 75

1 INTRODUCTION

Application Site Details

- 1.1. HBL Associates Ltd have been instructed to review/update previously submitted flood risk assessment and drainage statement prepared by Cole Easdon consultancy (CEC) in support of an outline planning application for housing development at Land to west of Bridgemont, Whaley Bridge, SK23 7PB.
- 1.2. Existing Site Details are summarised within Table 1 below.

Table 1 Site Information

SITE NAME	Land west to Bridgemont, Whaley Bridge
PROJECT DESCRIPTION	Housing Development - small scale major development 38 no residential units.
LOCATION	Land west to Bridgemont, Whaley Bridge, SK23 7PB
NGR (APPROXIMATE)	401209, 382381
APPLICATION SITE (HA) - RED BOUNDARY LINE	10,0041 sq m (1ha)
DEVELOPMENT TYPE	Greenfield
LOCAL PLANNING AUTHORITY	High Peak Borough Council
LOCAL LEAD FLOOD AUTHORITY	Derbyshire County Council Flood Risk Management Team, Scott Stone - Flood Risk Technician 01629538524, scott.stone@derbyshire.gov.uk flood.team@derbyshire.gov.uk
SEWERAGE UNDERTAKER IN THE AREA	United Utilities Group Plc.

- 1.3. Sources of flooding will be reviewed as part of this report for the proposed development in its current context.
- 1.4. This document is to be read in conjunction with all associated drawings, supported reports and documentation.
- 1.5. The report follows advice contained in the Department for Communities and Local Government's National Planning Policy Framework (NPPF) and Planning Practice Guidance, which provides advice to planning authorities, developers, the public and Environment Agency (EA) on development and flood risk.
- 1.6. In the preparation of this report, HBL Limited has followed accepted procedure, however, given the residual risk associated with any predictions and variability of date which can be experienced in flood conditions, we take no liability for and give no warranty against actual flooding of any property (client's or third party) or the consequence of the flooding in relation to the performance of this service. This report has been prepared as part of an outline planning application only and should not be relied upon or used for any other purpose

2 SITE LOCATION AND TOPOGRAPHY

- 2.1. The site is located west of Bridgemont, Whaley Bridge, High Peak, Derbyshire, SK23 7PB. The National Grid Reference for the site is 401209, 382381.
- 2.2. The location of the site is indicated in Figure 2.1 below.

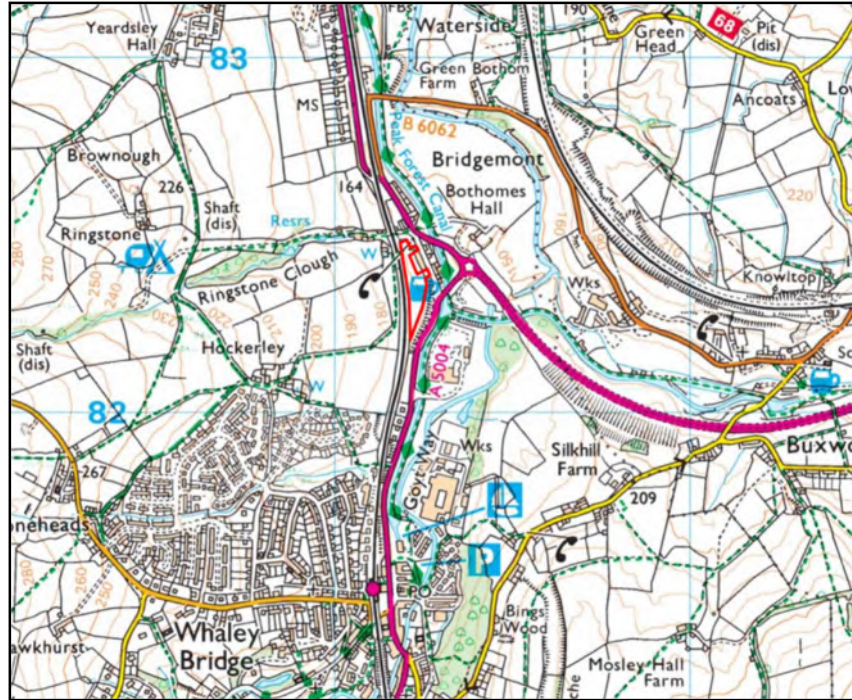


Figure 2.1 Site Location Plan

- 2.3. The site is currently an agricultural field with thick vegetation, see google map satellite imagery in Figure 2.2



Figure 2.2 Google maps satellite imagery.

- 2.4. The application site (approximately 1ha) is located ~0.9km to the north of the centre of Whaley Bridge.
- 2.5. The main access is via a driveway located in the north of the site between No52. Bridgemont and the Bridgemont Nursery school. Access to part of the site is also from Bridgemont to the south of No.32.
- 2.6. The site is an elongated, irregularly shaped undeveloped grassland located between railway lines to the west, a children's play area and a minor road Bridgemont to the north, residential dwelling, and nursery school to the east and area of woodland to the south.
- 2.7. Ground levels are generally rising from Bridgemont, the eastern areas of the site at a level of ~165m above Ordnance Datum (AOD) to the west of the site and the rail lines at a level of up to ~173m AOD. Ground levels also fall away less steeply to both the north and south.
- 2.8. The site is predominantly grassland with some small to medium trees along the western boundary. Hardstanding areas are only present in form of gravel surfaced driveway that slopes up from Bridgemont (immediately to the north of No.52) and asphalt surfaced car park south of No.36 Bridgemont.

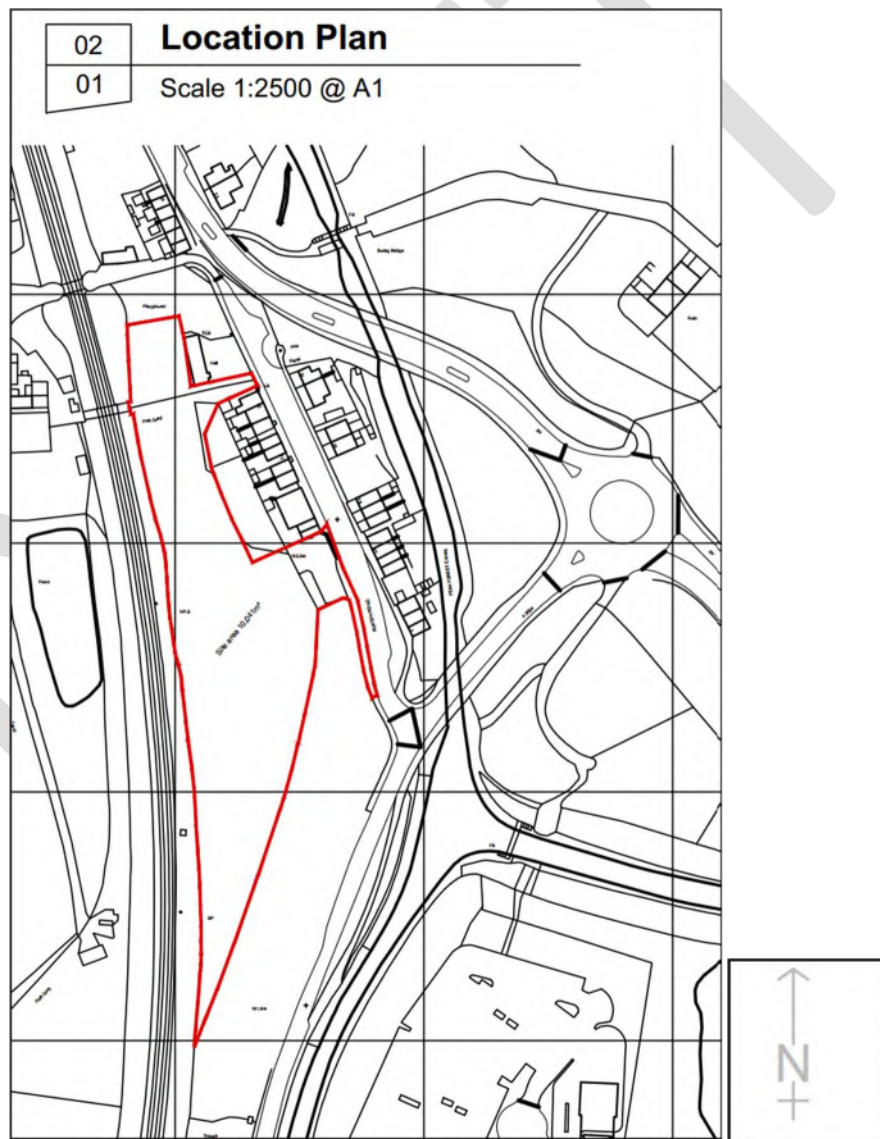


Figure 2.3 Location Plan (Source TADW Architects).

3 EXISTING GROUND CONDITIONS

Geology - source: Peak Environmental Solutions Phase 1 Site Investigation 42056R1 April 2020.

- 3.1. The available geological does not indicate presence of the artificial deposits in the site area.
- 3.2. The superficial deposits beneath the site are indicated as Quaternary Devensian Till.
- 3.3. The underlying bedrock geology is indicated as Carboniferous Pennine Lower Coal Measures formed of mudstones, siltstones, and sandstones with subordinate coal seams.
- 3.4. For further details please refer to:
 - Peak Environmental Solutions Site Investigation Report 42056R1,
 - Peak Environmental Solutions Mining Risk Assessment Report 42056R2
 - BGS GeoReport_317107/21928.

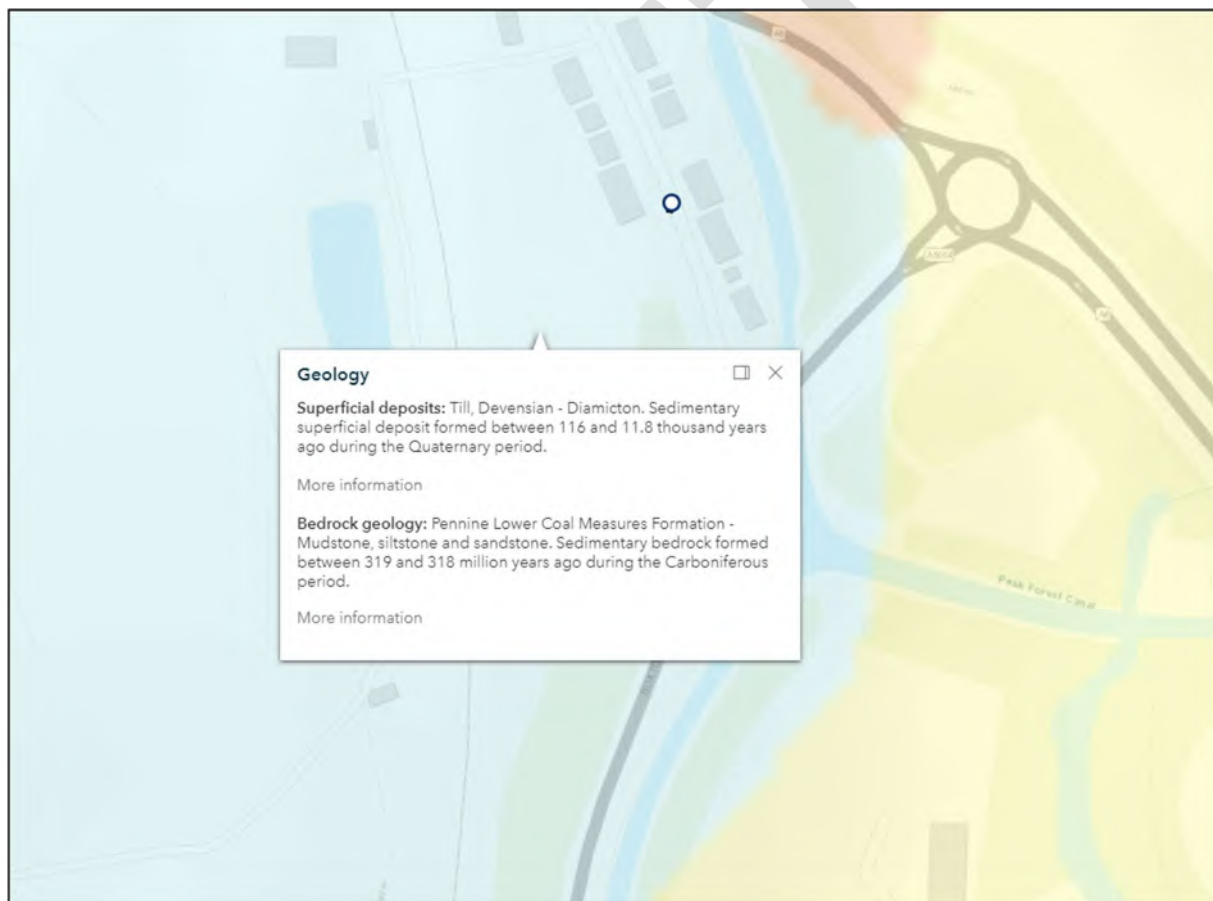


Figure 3.1 BGS Geology of Britain map.

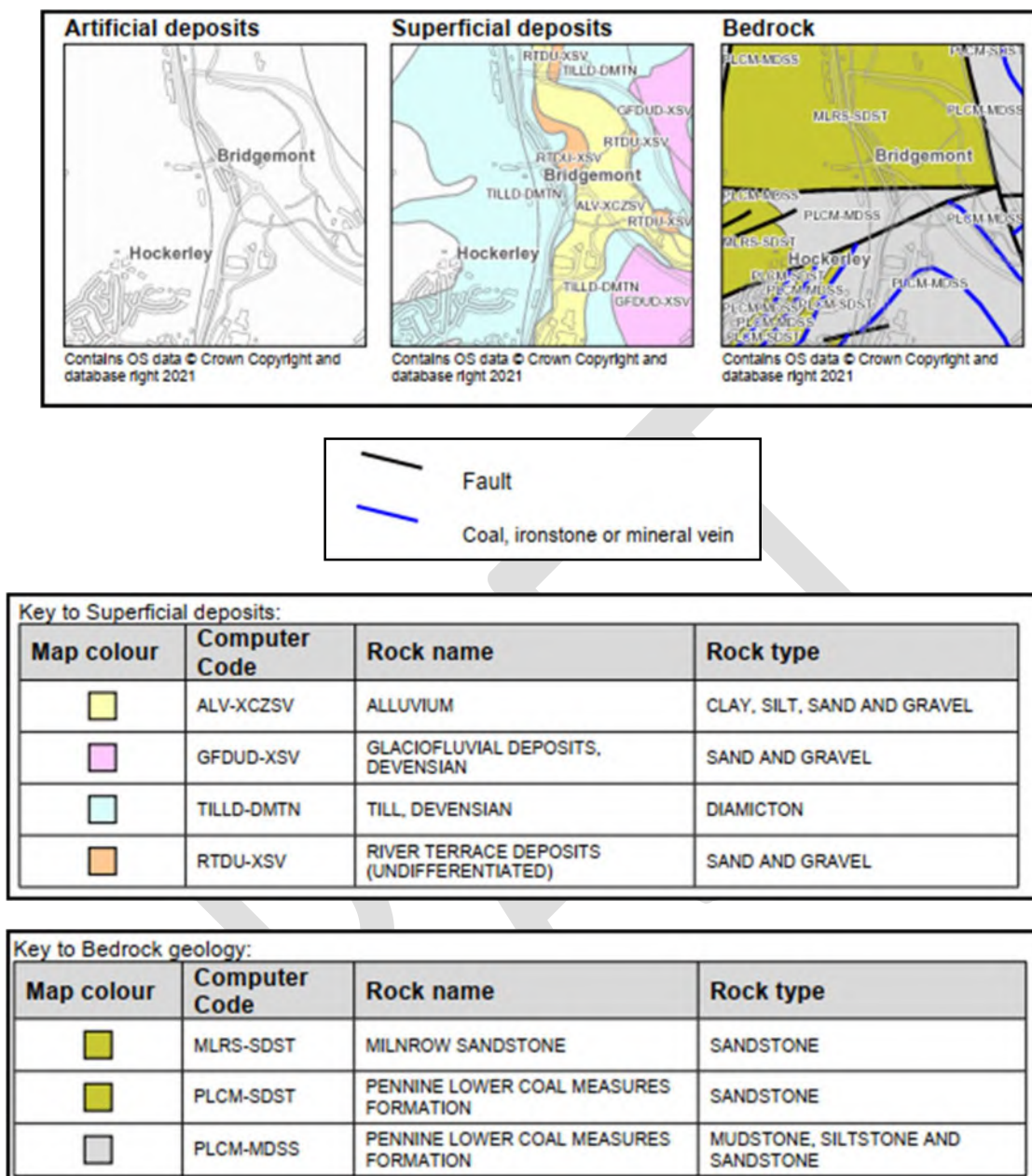


Figure 3.2 Source: BGS GeoReport_317107/21928.GS. (BGS)

- 3.5. The BGS hold borehole log records for the area provide additional ground condition information. The nearest log relates to a borehole within Bridgemont ~25m to the east of site. The drilling identified ~1.2m of made ground over ~2.5m of sandy clay over bands of mudstone, siltstone and sandstone extending to the full depth of the borehole at 20m below ground level (bgl).
- 3.6. A second borehole located to the north of the site, within the adjacent children's play area and also records ~3.2m of made ground underlain by gravel and cobbles extending to 6.8m bgl. Silty clay was identified beneath the gravel extending to the base of the borehole at 8m bgl.

Hydrology and Hydrogeology – source: Peak Environmental Solutions Phase 1 Site Investigation 42056R1 April 2020.

- 3.7. The nearest surface water course is a small stream within a culvert located ~15m to the north of the northern tip of the site beneath Bridgemont. The stream comes down the Ringstone Clough from the west and then disappears before emerging ~45m to the east of the site.
- 3.8. The nearest main river is the River Goyt located ~185m to the east at its closest point. The Goyt flows generally to the north, but meanders around the valley base.
- 3.9. There is also a pond located ~25m to the west of the site and on the far side of the railway lines.
- 3.10. The Toddbrook Reservoir is located some 800m south of the site at its closest point, south of the town of Whaley Bridge. The Toddbrook Reservoir is owned by the Canal & River Trust.

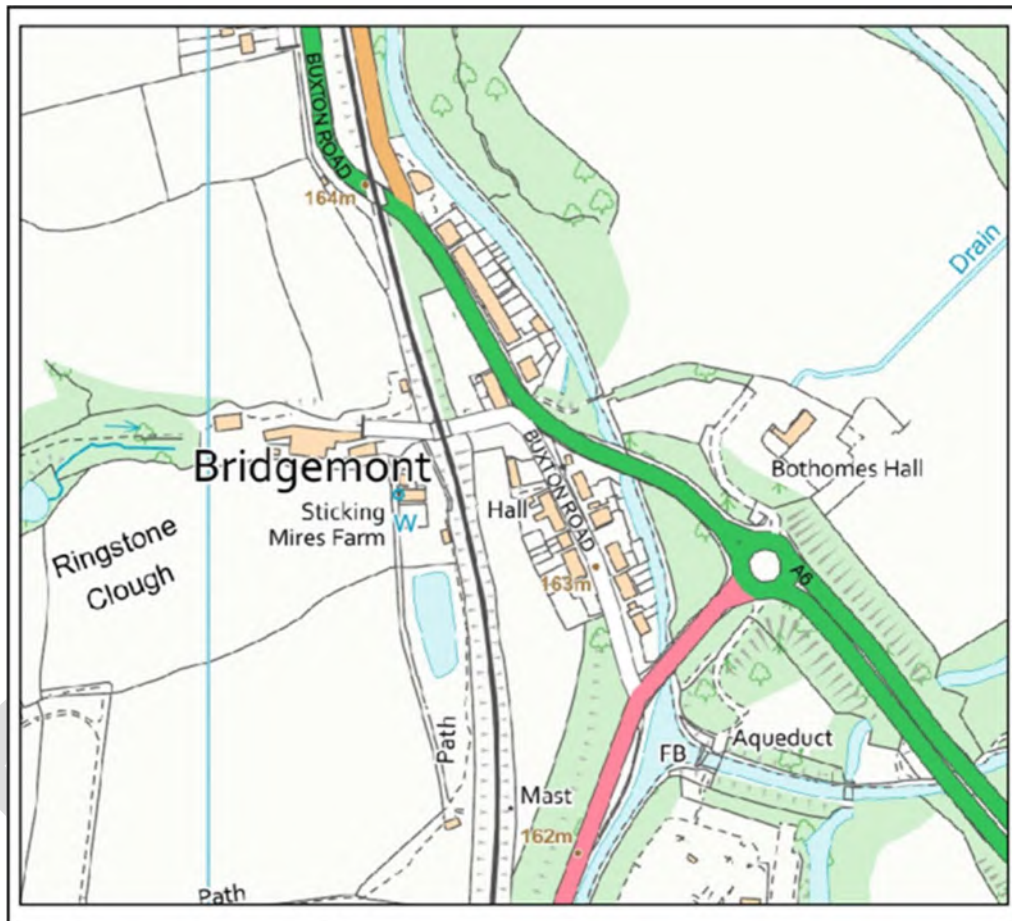


Figure 3.3. Existing Waterbodies in proximity of site. Source: High Peak Borough Council Interactive Planning Maps

- 3.11. BGS aquifer maps published by the EA record the superficial till deposits as a Secondary (Undifferentiated) Aquifer indicating that they are unlikely to support large scale groundwater abstraction. The Carboniferous Coal Measures are classified as a Secondary A aquifer: '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 aquifer'.
- 3.12. The EA groundwater vulnerability map records the site as being in an area of medium to low vulnerability where the near surface deposits offer reasonable protection to underlying groundwater resources.
- 3.13. The site is not located within an EA defined Source Protection Zone for the protection of important groundwater resources.

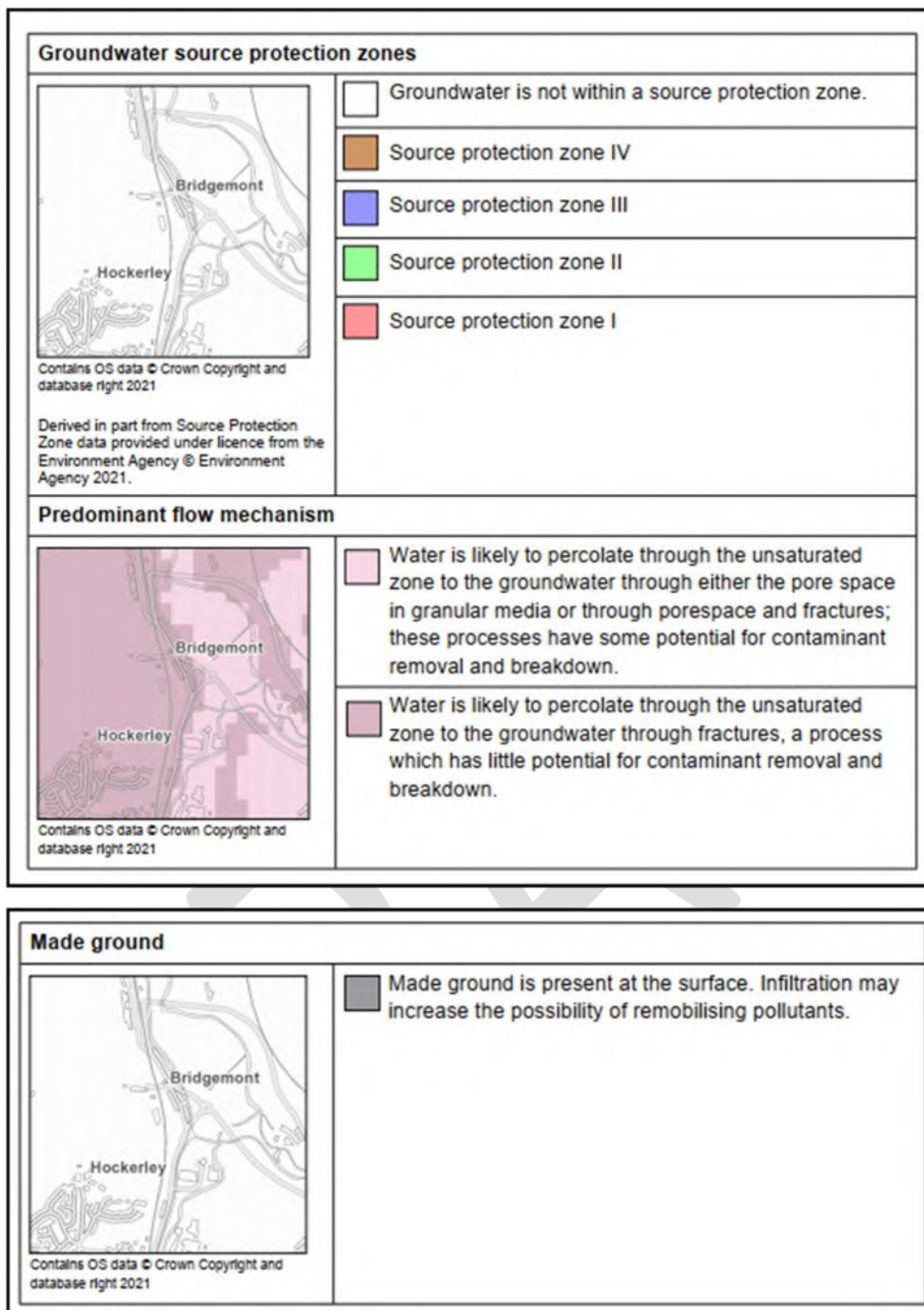


Figure 3.4 Source: BGS GeoReport_317107/21928.GS. (BGS)

3.14. Water is likely to percolate through the unsaturated zone to the ground water through fractures, which has little potential for any contaminants to be removed and breakdown, therefore if infiltration is to be proposed on site, pollution removal measures should be considered.

3.15. No abstractions from groundwater are currently recorded on the EA database within 1 km of the site.

Controlled Waters Risk Assessment – source: *Peak Environmental Solutions Phase 1 Site Investigation 42056R1 April 2020.*

- 3.16. Phase 1 Site Investigation 42056R1 April 2020 identifies Very Low to Low risks for the redeveloped use, however, recommendation for the Phase 2 investigation has been made to allow to reach a conclusion about the actual presence or severity of ground contamination at the site. (See recommendations within section 5.0 Phase 1 Report 42056R1).

DRAFT

4 EXISTING DRAINAGE DETAILS

Public Sewers

- 4.1. Sewers within the area are managed by United Utilities, public sewers records and UU consultations are included within APPENDIX 5.
- 4.2. There is an existing 225mm dia combined sewer within Buxton Road. Based on the United Utilities sewer records, details of the combined manhole within proximity of the site are as follows:
 - **2300 CL = 163.66 AOD IL = 160.54 AOD Depth to invert = 3.12m**
- 4.3. There sewer maps do not indicate presence of any public sewer crossing the site.

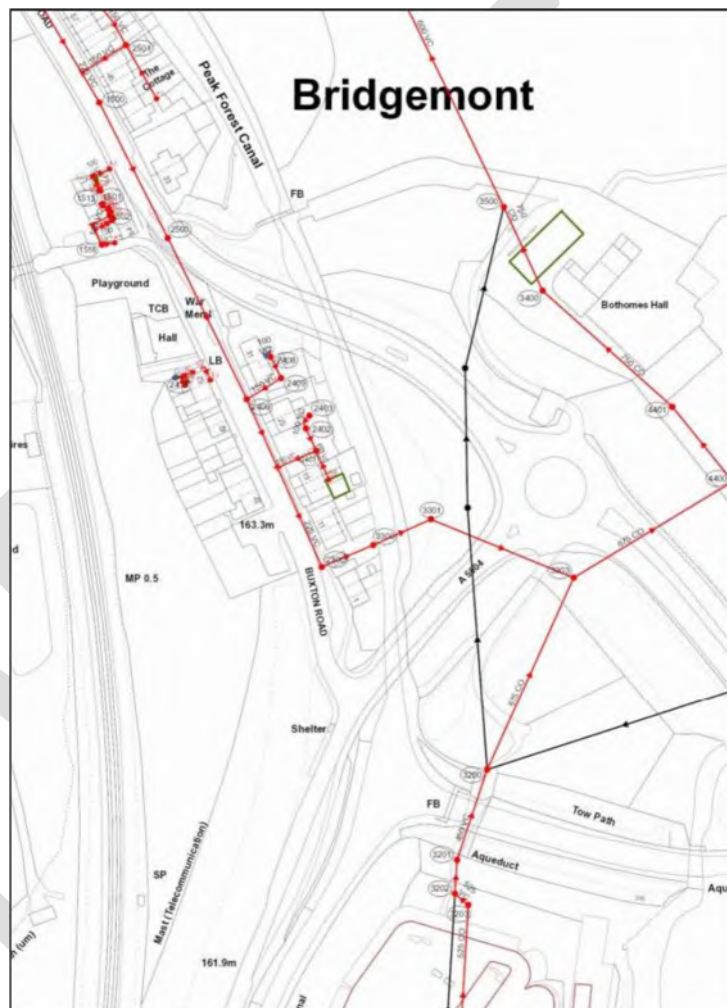


Figure 4.1 Extract from United Utilities Sewer Records

- 4.4. It is not expected that any sewer diversion will be required.
- 4.5. United Utilities has commented on the proposed development and their comments are included within APPENDIX 5 for reference.
- 4.6. All works near to public sewers will need to be agreed and approved by United Utilities prior to development.

5 PROPOSED DEVELOPMENT DETAILS

- 5.1. This document has been prepared in support of an Outline Planning Application for housing development at Land to west of Bridgemont, Whaley Bridge, SK23 7PB.
- 5.2. The proposal residential development consists of mixture of dwellings and flats with associated car parking, access road and landscaping as outlined in proposed site plans in APPENDIX 2.
- 5.3. Proposed contributing areas positively drained have been calculated, within the application site and are summarised in Table 2, and are to be read in conjunction with 'Proposed Site Contributing Areas Plan' included in APPENDIX 4.

Table 2 Proposed site areas.

Area	m ²	ha
Application Site Area Total	10,041	1
Proposed impermeable areas positively drained. (10% urban creep allowance included)	3844	0.38
Percentage of Impermeable (PIMP) within application site	38%	

6 METHODOLOGY

- 6.1. Developer and Local Authorities should seek opportunities to reduce the overall level of flood risk through the layout design and form of development and the appropriate application of sustainable techniques.
- 6.2. The key objective is to manage the flow rate and volume of surface runoff to reduce the risk of flooding and water pollutions as well as to improve biodiversity and local amenity.
- 6.3. This assessment will identify and assess the risks of all forms of flooding to the proposed development as well as demonstrate how these flood risks should be mitigated, taking the potential effects of climate change into account.

Planning Policy and Legislation

- 6.4. This assessment has been carried out in line with:
 - The National Planning Policy Framework,
 - Planning Practice Guidance – Technical Guidance (Flood Risk and Coastal Change),
 - Non-statutory technical standards for sustainable drainage systems,
 - Derbyshire's Local Flood Risk Management Strategy & related guidance.

Sources of Information and Consultations

6.5. Reference has been made to:

- Gov.uk long term flood risk information.
- British Geological Survey site online data (BGS).
- Level 1 SFRA Flood Risk Mapping figures.
- Peak Environmental Solutions Site Investigation Report 42056R1,
- Peak Environmental Solutions Mining Risk Assessment Report 42056R2,
- BGS GeoReport_317107/21928.
- Topographical Survey and TADW architects proposed site plan 3111106/02/P14.
- FRA QMF 09.20 issue 3 by Cole Easdon Consultants (CEC),
- Peak Environmental Solutions Report in respect of Preliminary Trial Pitting for Infiltration Testing Purposes dated 29.11.2021 ref: 42056R4/Rev.A.
- UU consultation/response for planning ref: HPK/2020/0180

7 GENERAL DEFINITION OF POTENTIAL FLOOD HAZARDS

- 7.1. The potential sources of flooding which could affect the site have been identified in this section. Their influence on the proposed development and any mitigation measures will be discussed within this report.
- 7.2. Fluvial Flood Risk – This type of flooding can occur through the inundation of the flood plain, overtopping and breaching of defences and blockages of culverts of flood channels.
- 7.3. Tidal/Coastal Flood Risk – This flooding is due to the accumulation of water along the coast caused by rising sea water above normal levels. Coastal flooding can result from a combination of high tides, stormy weather conditions and tidal surges in times of low atmospheric pressure.
- 7.4. Canal Flood Risk - Flooding can occur from man-made channels such as canals. This is usually due to the failure of canal embankment.
- 7.5. Flooding from Artificial Waterbodies - Identifies areas that are most likely to flood following the sudden catastrophic failure of a reservoir. The EA states that the possibility of reservoir flooding is extremely unlikely and there has been no loss of life in the UK from reservoir flooding since 1925. Since then, reservoir safety legislation has been introduced to make sure reservoirs are well maintained
- 7.6. Flooding from Local Sewers - Extreme rainfall events may overwhelm sewer systems and cause local flooding. This is not something that can be predicted/modelled.
- 7.7. Ground Water Flooding - Occurs when the water table rises above normally expected and anticipated levels and intersects with the surface, this is usually after long periods of sustained rainfall. This is most likely to occur in low lying areas that are underlain by permeable rock such as chalk or sandstone and are classified as regional aquifers. Groundwater flooding may also rise from localised sands and gravels in valley bottoms underlain by less permeable rocks. Generally, the water table rises in wet winter months and falls in summer months as the water migrates to the surface water courses. Datasets show the susceptibility indication, which identifies areas where geological conditions may result in flooding and where groundwater may come close to the surface. It is not an indication of flood risk, i.e., an indication of likelihood of such flooding occurring (it doesn't provide information on the depth of the flood or the likelihood of occurrence of an event of a particular magnitude). It does show if the area is susceptible to groundwater flooding occurring based on the geological conditions. Properties with basements are more likely to be affected by groundwater flooding.
- 7.8. Surface Water Flooding - Also known as pluvial flooding results from overland flow before the runoff enters a watercourse or sewer. Surface water flooding occurs when drainage systems have insufficient capacity to deal with the volume of rainfall. The critical factors in surface water flooding are the volume and intensity of rainfall and the topography and permeability of the surface that the rainfall falls onto (PPS25 Practice Guidance). It is usually the result of high intensity rainfall but can occur with lower intensity rainfall when the land has a low permeability and/or is already saturated, frozen, or developed. As a result, surface water flooding can occur quickly and is often difficult to predict. In urban areas, rainwater is often drained into combined sewers. Combined sewers accept foul water and surface water. It should be noted that if the capacity of drainage systems is exceeded. Flood water will be contaminated with raw sewage. In addition, sudden and intense rainfall cannot drain away freely due to the impermeable surfaces of roads, footpaths, and car parking. Therefore, surface water can also arise from sheet run-off from adjacent land.

8 PROBABILITY OF FLOODING

Fluvial Flood Risks - flooding from Main Rivers and Sea.

8.1. The site is classified within Environmental Agency Flood Zone 1 an area with low probability of flooding representative of land having less than 1 in 1000 (0.1% AEP) of river or sea flooding in any year.

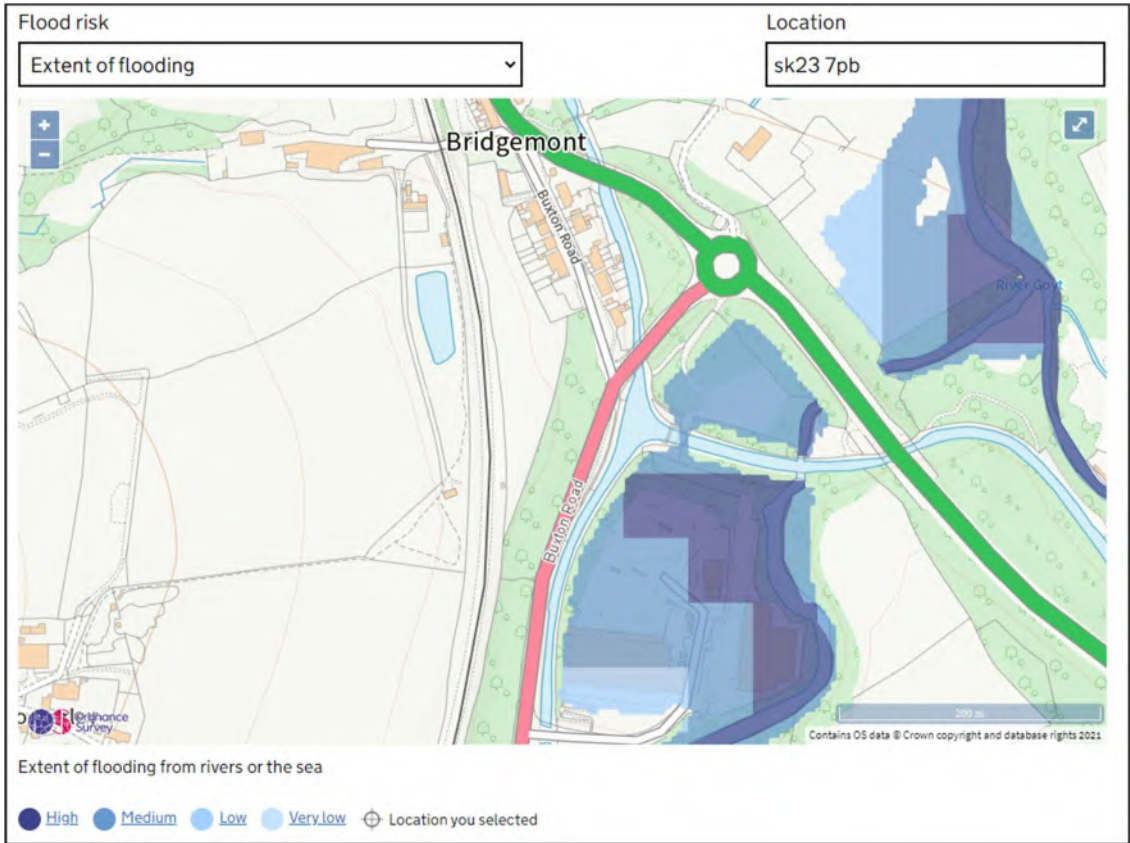


Figure 8.1 Environmental Agency - Flood Map for Planning (Gov.uk)

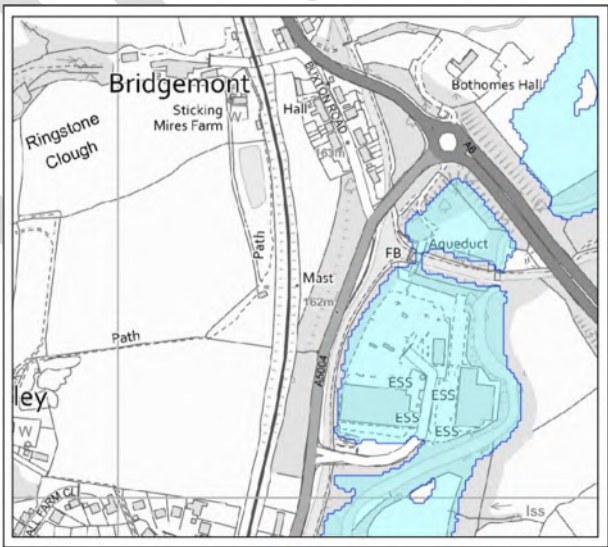


Figure 8.2 Extend of Flood Zone 2. Source: High Peak Borough Council Interactive Planning Maps.

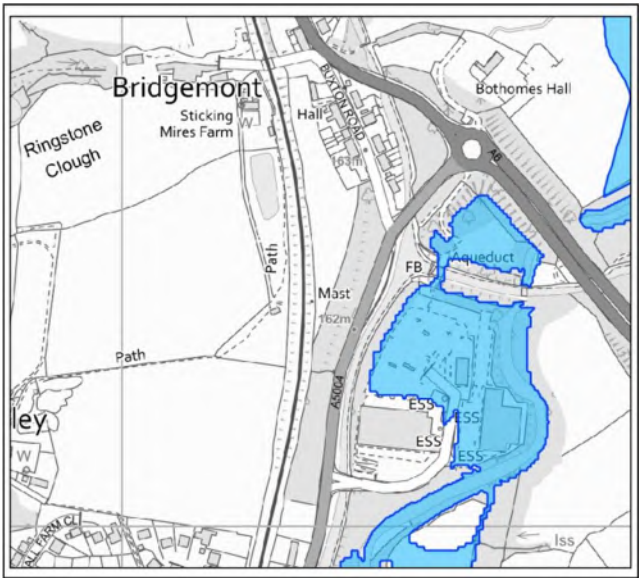


Figure 8.3. Extend of Flood Zone 3. Source: High Peak Borough Council Interactive Planning Maps.

8.3. The River Goyt is located 185m east of the site at its closest point, and at a lower topographical level than the site. Fluvial flood risk to the site is therefore considered to be Low

Fluvial Flood Risk - flooding from Ordinary Watercourses.

- 8.4. Flood and Water Management Act 2010 defines “Ordinary Watercourse” as a “watercourse” that does not form part of a “main river” and can include rivers, streams, ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers within the meaning of the Water Industry Act 1991), ponds and passages through which water flows.
- 8.5. The maintenance of Ordinary watercourses is the responsibility of the landowner.
- 8.6. Local Lead Authority has a power to regulate i.e., powers associated with the prevention, mitigation and remedying of flood damage.
- 8.7. The map in below indicate that the nearest identified open watercourse is the Ringstone Clough stream to the northwest of the application site.
- 8.8. The Ringstone Clough appears to be culverted under the Bridgemont to the North of the site, crossing under the existing railway embankment, the playground of the existing Nursery, (~15m north of the site boundary), and under Buxton Road, before emerging ~45m to the east of the site.

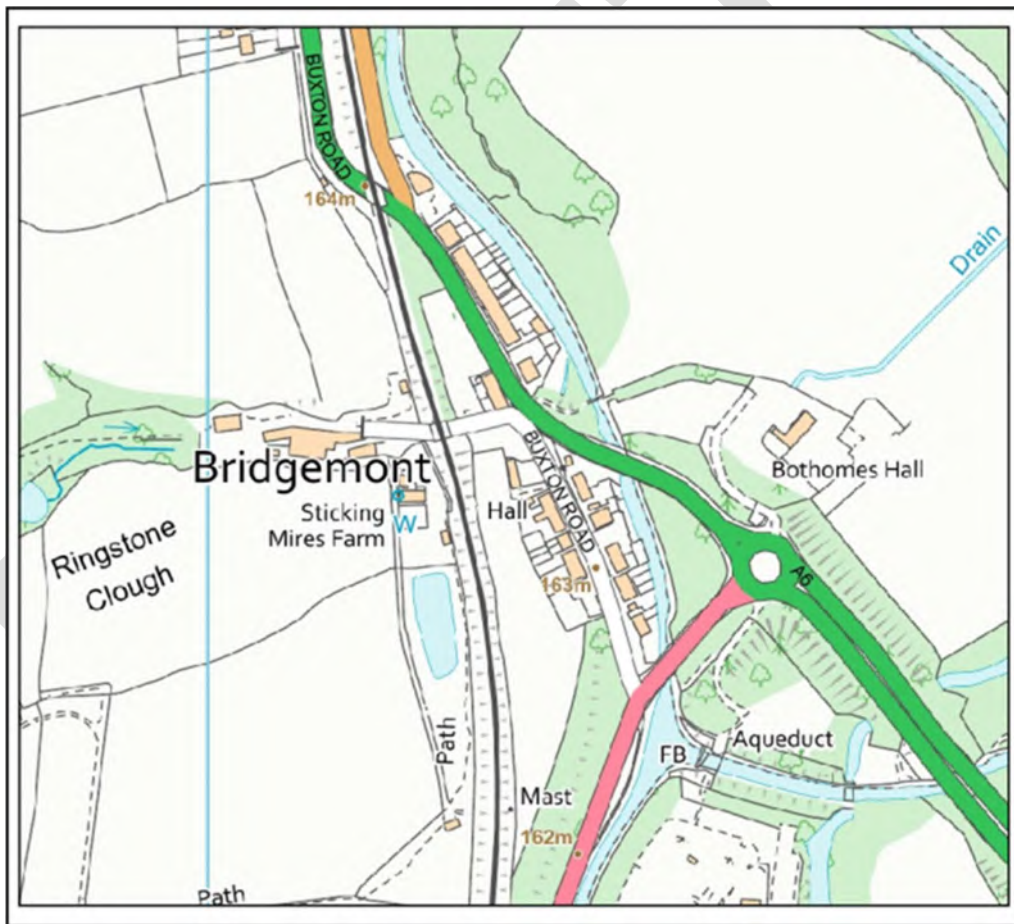


Figure 8.4. Existing Waterbodies in proximity of site. Source: High Peak Borough Council Interactive Planning Maps

- 8.9. There are no confirmed ordinary watercourses crossing the application site.
- 8.10. Based on the flood mapping available to date and the topography of the site, it can be concluded that the site is at Low risk from fluvial flooding generated by ordinary watercourses.

Canal Flood Risk

8.11. Local Waterway map provided by Canal and River Trust indicates that the nearest waterway is the Peak Forest Canal located 63m to the northeast of the application site.

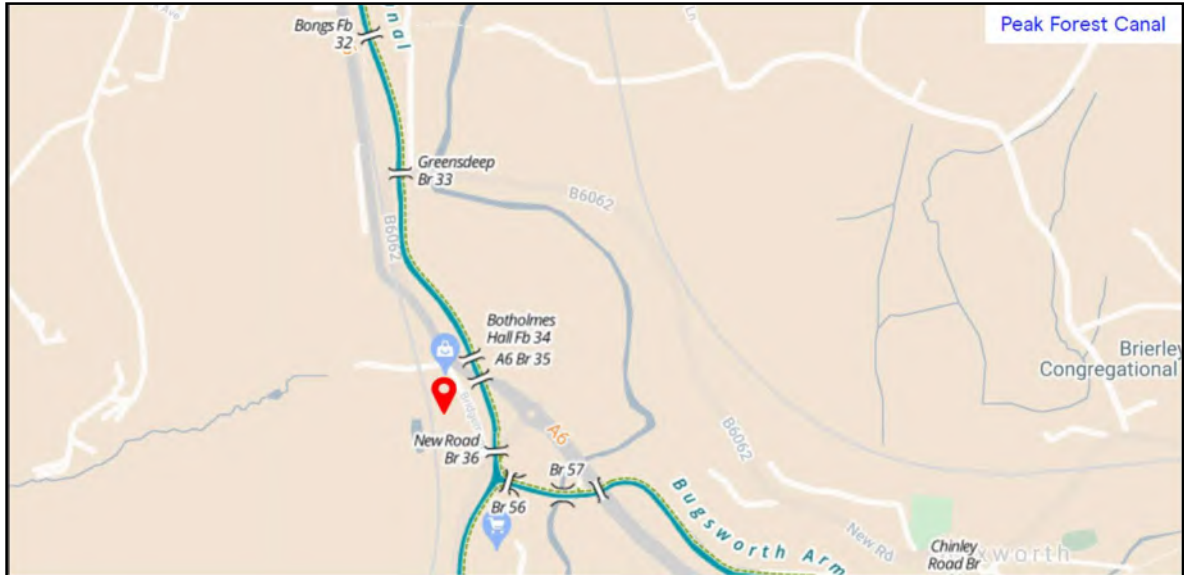


Figure 8.5 Local Waterway map - Canal and River Trust

8.12. Canal failure mapping includes two types of failure:

- Breach of raised canal embankments - failure of the embankment due to weaknesses; these are typically caused by erosion or animal burrowing but can also arise from poor maintenance.
- Aqueduct failure - an aqueduct is where the canal passes over infrastructure such as roads, railways and subways, or over other canals and rivers. Failures of these are typically caused by the collapse of the underlying culvert.

8.13. Canal systems are maintained, improved, and regularly inspected by British Waterways, therefore flood risk from this source is generally considered to be low.

8.14. The Peak Forest Canal is located approximately 50m East of the site to the east of the site boundary, at lower topographical level than the site.

8.15. Information regarding the Canal Failure Impact Modelling is not available at the time of writing this report but considering the location and topography of the area the risk from flood due to Canal Failure are considered Low.

Artificial Waterbodies – Reservoirs

- 8.17. Reservoir flood plans are prepared by their owners, however as these documents are considered sensitive due to national security, only indicative plans are made available by the Environmental Agency.
- 8.18. The EA map below shows that the application site lies just outside of the area at risk of flooding from nearby reservoirs.

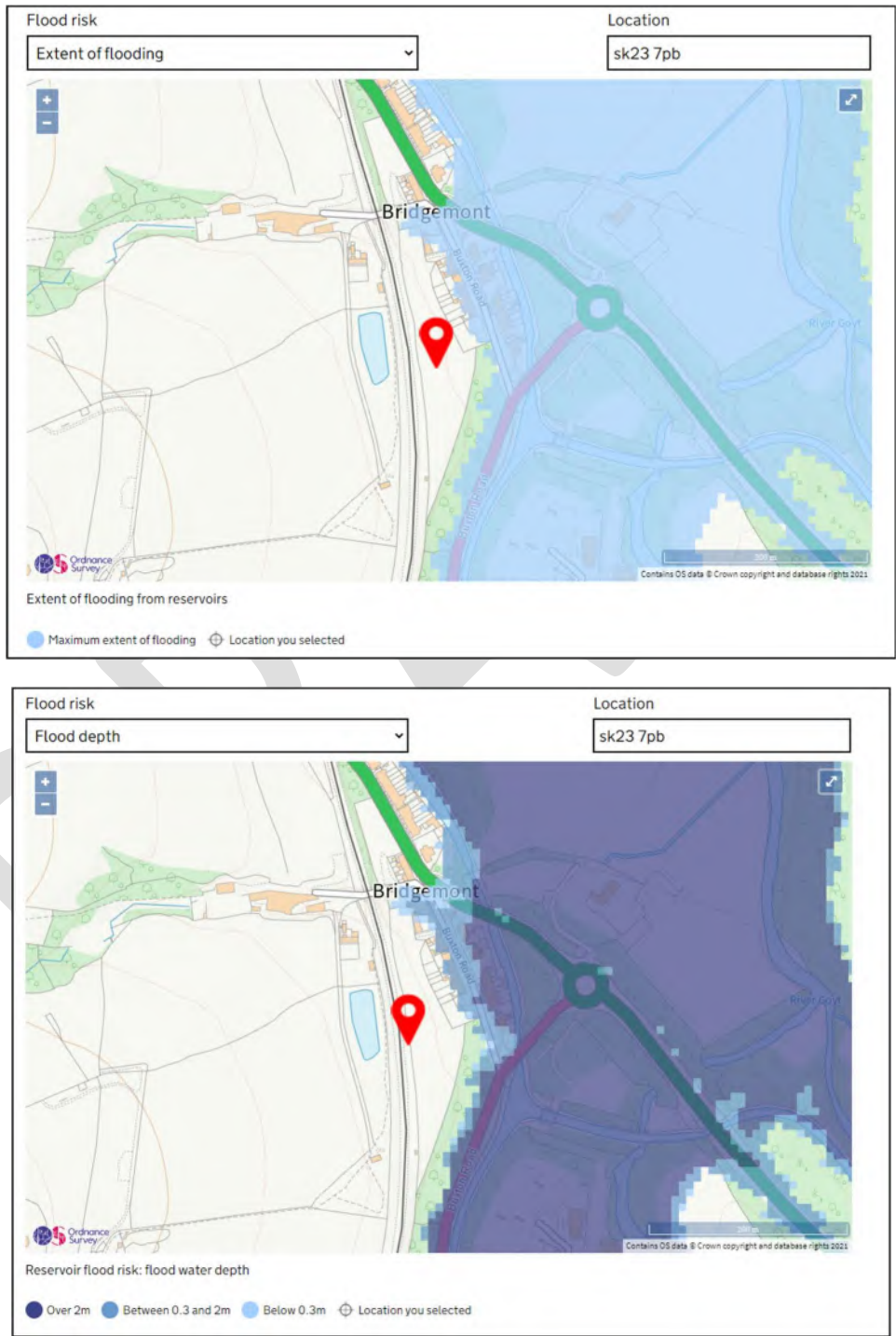


Figure 8.6 Flood risk from reservoirs (Gov.uk).

- 8.19. The 'EA Risk of Flooding from Reservoirs' Map indicates that the northern end of the site is at risk of inundation in the event of a breach of the Toddbrook Reservoir, to a maximum depth of 0.3m, whilst the road immediately east of the site is at risk of inundation to a maximum depth of 2m.
- 8.20. Flood risk to the site in the event of a breach of the Toddbrook Reservoir is therefore considered to be moderate for access road the site and dwellings 1 & 2.
- 8.21. If possible, finished floor levels within the northern end of the site should be set at 167.65mAOD, some 300mm above the estimated flood level. Similarly, the finished floor levels for proposed Dwellings 1 & 2 should be raised above the estimated flood level where feasible and flood resilient construction measures should be implemented. For flood resilient Construction details refer to CEC Flood Risk Assessment Report QMF09.20.
- 8.22. Flooding from reservoirs is considered extremely unlikely. There has been no loss of life in the UK from reservoir flooding since 1925. On this basis, the site is at Moderate to Low risk of flooding from this source.

Flooding from Local Sewers

- 8.23. Sewers in the area are owned and maintained by United Utilities and Highways.
- 8.24. UU assets record indicate presence of a 225mm diameter combined sewer within Bridgemont public highway. See sewer maps included within APPENDIX 5 for reference.
- 8.25. The site and surrounding area topography fall from south-west to north-east, therefore, this sewer is at a lower topographical level than the site. If the sewer beneath Ridgemont were to surcharge and flood, the floodwater would follow the area contours and flow away from the site following the falls within the highway.
- 8.26. Properties 1 & 2 could be at risk of flooding from surcharged sewers within Bridgemont highway therefore mitigation measures such as raised thresholds as well as flood resilient construction measures should be implemented. For flood resilient Construction details refer to CEC Flood Risk Assessment Report QMF09.20. Construction details refer to CEC Flood Risk Assessment Report QMF09.20.
- 8.27. Flood risk from existing sewers is therefore considered to be Moderate to Low.

Highway Drainage System

- 8.28. The site is currently bounded by Bridgemont to the east.
- 8.29. Based on local information, photo and video evidence provided by Treville Properties, there is localised highway flooding occurring within Bridgemont. The evidence suggest that the flooding issues are associated with high siltation occluding in the area and possible low frequency of the maintenance of the road gullies. Majority of the road gullies were blocked/ full of silt/leaves, not performing to their design capacity.
- 8.30. Units 1 & 2 (cottage flats) with proposed access directly from Bridgemont should have raised thresholds as well as flood resilient construction. For flood resilient Construction details refer to CEC Flood Risk Assessment Report QMF09.20. Construction details refer to CEC Flood Risk Assessment Report QMF09.20.
- 8.31. As Bridgemont is situated substantially lower than most of the proposed application site, the likelihood of flooding from this source is deemed low for majority of the site, moderate for units 1 & 2, where mitigation measures should be considered.

Ground Water Flooding Risk

8.32. The BGS Report 317107/21928 indicates that Groundwater is likely to be less than 3m below the ground surface for at least part of the year especially within the northern part of the site.

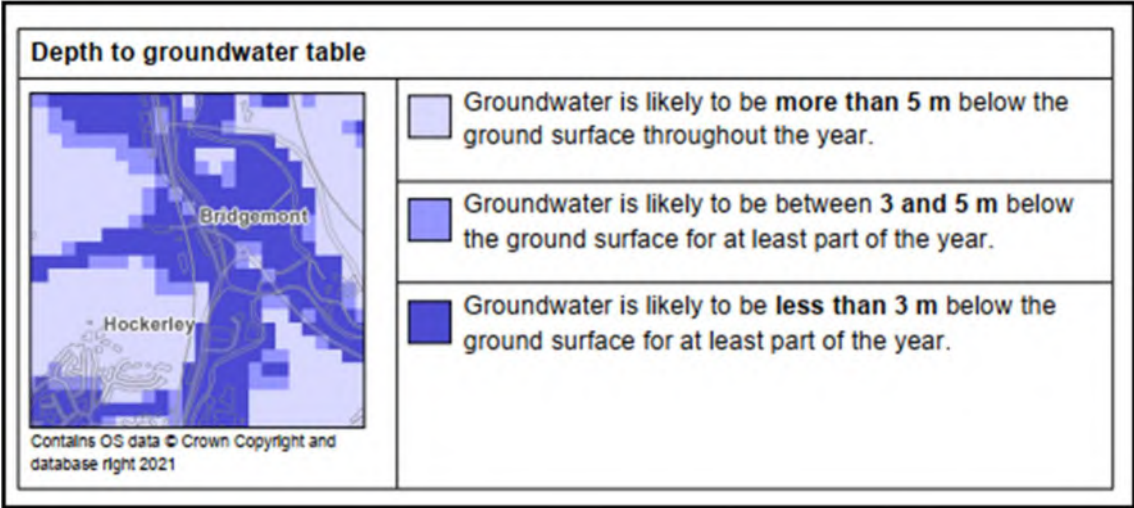


Figure 8.7 BGS Depth to Groundwater Table.

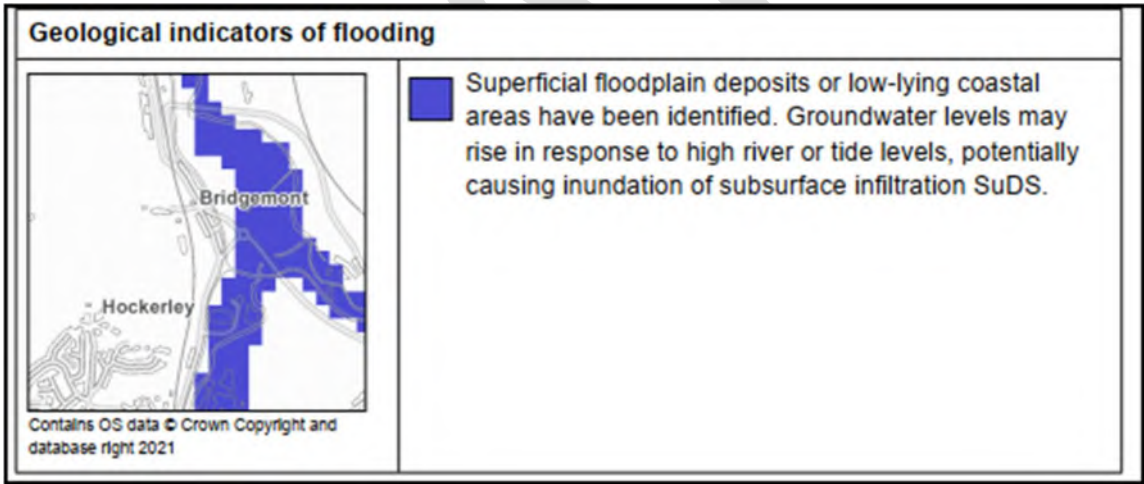


Figure 8.8 BGS Depth to Groundwater Table.

- 8.33. Based on the information presented in the BGS report, it is considered that the application has Low risk of ground water flooding to occur on surface, but groundwater levels should be considered if any subsurface infiltration SuDS features are to be considered for this application site.
- 8.34. Preliminary trial pit testing undertaken for infiltration testing purposes on 4th of November 2021 identified cohesive clayey ground at very shallow depths, with resting water levels (in early winter) at around 1.5mbgl.

Pluvial Flooding

- 8.35. Flooding from overland flows can occur if a significant volume of intercepted rainfall or surface runoff does not reach any drainage channel or permeable ground and is able to form significant surface accumulations.
- 8.36. It is usually associated with high intensity rainfall events but can also occur during low-intensity events when the ground is saturated / frozen or has low permeability.
- 8.37. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.
- 8.38. Flood risk from surface water map provided by Gov.UK in Figure 8.9 shows critical flow paths and areas situated in topographical depressions, which could flood following an extreme rainfall event.

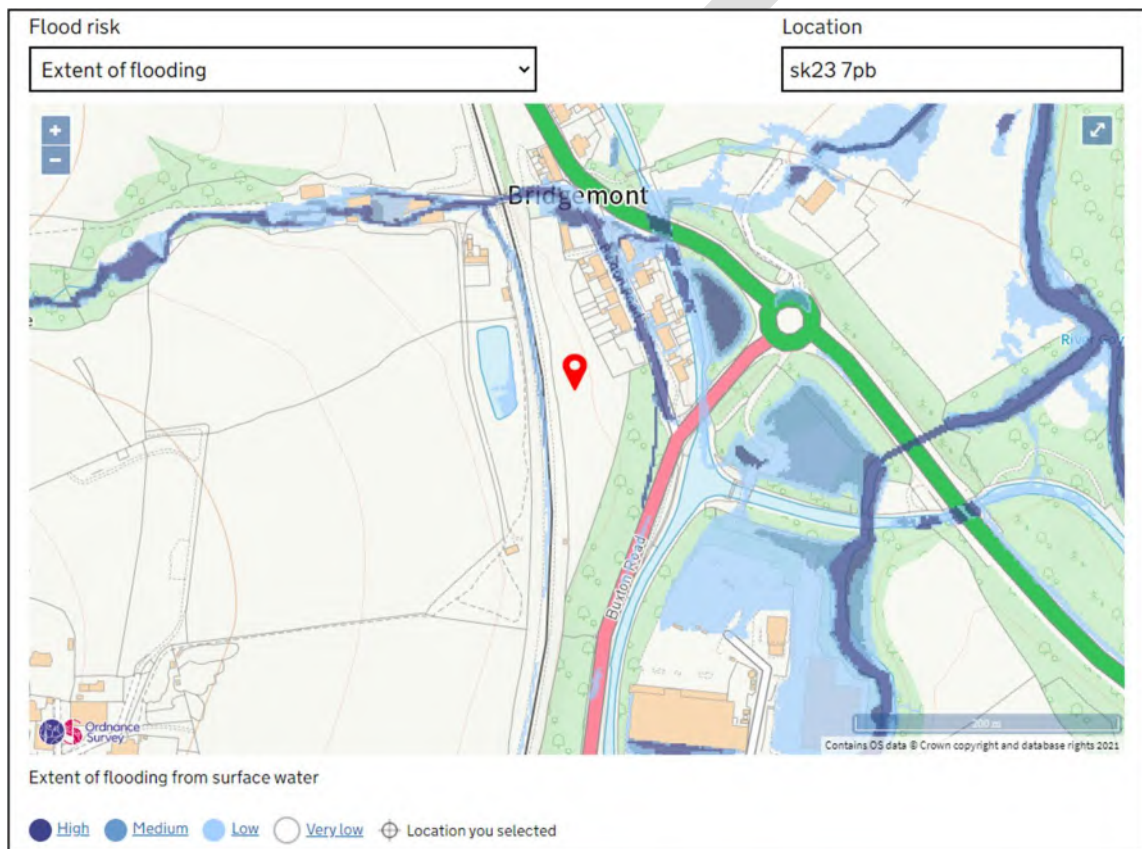


Figure 8.9 Flood Risk from Surface Water - Extend of Flooding (Gov.uk).

- 8.39. The EA Map 'Risk of Flooding from Surface Water' indicates that the proposed application site is at very low risk of surface water flooding.
- 8.40. Surface water flood flow paths are indicated to the north and east of the site, which broadly follows the Bridgemont highway and the route of the culverted Ringstone Clough to the north.
- 8.41. The proposed application site is sited higher than the area shown on map as the extend of surface water flooding. Therefore, the risk of surface water flood flows entering the site are considered Low for majority for the application site, Moderate in relation to Unit 1 &2 with proposed access from Bridgemont highway.

- 8.42. Units 1 & 2 (cottage flats) with proposed access directly from Bridgemont should have raised thresholds as well as flood resilient construction. For flood resilient Construction details refer to CEC Flood Risk Assessment Report QMF09.20. Construction details refer to CEC Flood Risk Assessment Report QMF09.20.
- 8.43. The Strategic Flood Risk Assessment (SFRA) (September 2008) for HPBC and the Local Flood Risk Management Strategy (LFRMS) (July 2015) for Derbyshire record that surface water flood risk is an issue within the HPBC district. However, no surface water flooding incidents have been recorded in the vicinity of the site. Source: CEC FRA 2020.
- 8.44. New developments can increase the volume and rate of surface water run-off discharged, which could cause an increase in surface water flood risk both on site and elsewhere in the catchment. Therefore, the surface water runoff generated as a result of the development should be managed using Sustainable Urban Drainage Systems (SUDS) to minimise the rate of discharge, volume, and environmental impact of surface water runoff.
- 8.45. The design of surface water drainage should ensure that there are no uncontrolled off-site overland flood flows created by the proposed development. Where possible, site surfaces should be modelled so that flood flows generated on site from events beyond the stipulated drainage design criteria will flow to, and be contained on site within, landscaped or paved areas such that there is no increased risk of flooding to buildings and other vulnerable areas. Flood flows up to the critical 1% AEP event will not be allowed to flow from the site onto adjoining property or highways.

8.46. The potential sources of flooding identified above have been summarised in Table 3 Potential Sources of Flooding - Overview . Those posing the greatest flood risk to the site will be investigated further in Section 9 to determine possible mitigation measures.

Table 3 Potential Sources of Flooding - Overview

SOURCES OF FLOODING	POTENTIAL SOURCES OF FLOODING				
	HIGH	MEDIUM	LOW	NO INFORMATION	COMMENTS
FLUVIAL			✓		Flood Zone 1
CANAL			✓		
ARTIFICIAL WATERBODIES			✓		The site is at risk of being affected in the event of reservoir failure, although the risk is considered by The Environment Agency to be very low.
SEWERS			✓		
HIGHWAY DRAINAGE		✓	✓		Medium to plots accessed/facing the existing highway/ Bridgemont.
GROUND WATER		✓	✓		
PLUVIAL RUNOFF		✓	✓		Medium to plots accessed/facing the existing highway/ Bridgemont.

9 APPROPRIATE LAND USE

Flood Zone Requirements

- 9.1. This report has been prepared for residential development at Land off Bridgemont, SK23 7PB as outlined in proposed site plan in APPENDIX 2.
- 9.2. The National Planning Policy Framework (NPPF) encourages a sequential risk-based approach to determine the suitability of land for development in flood risk areas. It advises local planning authorities to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.
- 9.3. In areas at risk of river flooding, the NPPF advises that preference be given to new development in Flood Zone 1. If there are no reasonably available sites in Flood Zone 1 the flood vulnerability of the development can be considered in locating development in Flood Zone 2 and then Flood Zone 3. Within each flood zone new development should be directed to sites at the lowest probability of flooding from all sources.
- 9.4. The Environment Agency (EA) 'Flood Map for Planning – Rivers and Sea', included in APPENDIX 3, shows that the site is wholly located within Flood Zone 1 – an area outside of the extreme flood extent and considered to have a less than 1 in 1000 (0.1% AEP) annual probability of flooding from rivers or the sea in any year.
- 9.5. Flood Risk Vulnerability Classification in Table 4 indicates that all land uses are appropriate in Flood Zone 1 and Sequential Test is not required.
- 9.6. There are no Finished Floor Requirements in the Flood Zone 1 for the proposed Development, however, raised door threshold approx. 150mm above external ground level is recommended to minimise the risk to people and property in exceedance events.

Table 4 Flood Risk Vulnerability Classification

Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone Classification	Zone 1	✓✓	✓✓	✓✓	✓✓	✓✓
	Zone 2	✓✓	✓✓	Exception test required	✓✓	✓✓
	Zone 3a	Exception test required	✓✓	xx	Exception test required	✓✓
	Zone 3b	Exception test required	✓✓	xx	xx	xx

Identified Flood Risk – Drainage Strategy Mangement/Mitigation Measures.

- 9.7. Initial Flood Risk Overview identified Low to Moderate Flooding Risk to the application site.
- 9.8. With identified ground water levels resting (in early winter) at around 1.5mbgl (during preliminary trial pit testing undertaken for infiltration testing purposes on 4th of November 2021) consideration should be given during detailed design stage to mitigate the risks as far as reasonably possible by:
- basements should be avoided,
 - waterproofing where construction below ground levels.
 - consideration should be given during design and construction of retaining walls with regards to drainage and water pressure.
- 9.9. The existing risks of pluvial flooding within the vicinity of the site, within Bridgemont will remain after development and consideration should be given to mitigation of these risks as far as reasonably possible.
- 9.10. Any flood flows onto the site from adjoining property will either be retained on site safely or be encouraged to pass across the site such that there is no increased risk of flooding to buildings and other vulnerable areas.
- 9.11. Setting finished floor level of buildings at least 150mm above surrounding external ground, shedding surface water away from the buildings, will avoid the risk of damage to buildings and contents as a result of overland flood flows around the site.
- 9.12. The proposed on-site surface water drainage design will ensure that there are no uncontrolled off-site overland flood flows created by the proposed development. Where possible, site surfaces will be modelled so that flood flows generated on site from events beyond the stipulated drainage design criteria will flow to, and be contained on site within, landscaped or paved areas such that there is no increased risk of flooding to buildings and other vulnerable areas. Flood flows up to the critical 1% AEP event will not be allowed to flow from the site onto adjoining property or highways.
- 9.13. Proposed on-site drainage will be designed and constructed in accordance with current best practice and The Building Regulations as appropriate.
- 9.14. Development owners or Private Management Company will be responsible for the maintenance of the private drainage system on site to ensure satisfactory performance.
- 9.15. United Utilities will be responsible for maintenance of public sewers.
- 9.16. The highway authority will be responsible for the maintenance of any highway drainage.
- 9.17. In the event of extreme emergency, the local authority and other emergency services have contingency plans for dealing with the consequences of flooding.
- 9.18. The following sections of this report will consider a strategy for the management of surface water runoff to ensure that via resilient design, construction and maintenance of the sustainable drainage systems and water retention measures, there will be no significant off-site impacts as a result of this development, therefore the proposal will satisfy paragraph 103 of the Framework.

10 SUSTAINABLE URBAN DRAINAGE STANDARDS

- 10.1. The National Standards for Sustainable Drainage systems (NSSDS 2011) and Non-Statutory Technical Standards for Sustainable Drainage (NSTSSD 2015) require that 'the development must not increase the risk of flooding elsewhere'.
- 10.2. 'For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1-year rainfall event and the 1 in 100-year rainfall event should never exceed the peak greenfield runoff rate for the same event'. (S2 - NSTSSD 2015)
- 10.3. 'Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100-year, 6-hour rainfall event should never exceed the greenfield runoff volume for the same event'. (S4 NSTSSD 2015)
- 10.4. Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer, or surface water body in accordance with S4 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk. (S6 NSTSSD 2015)
- 10.5. In practical terms, the above guidelines mean, that the proposed development runoff rate must provide betterment or be equal to the calculated existing greenfield runoff rate where reasonably possible.

11 EXISTING RUNOFF RATE

Wallingford Procedure Variables

11.1. The Wallingford Procedure Variables Values for the site are included in Table 5.

Table 5 Wallingford Procedure Values for the site.

Variable	Map Values	Edited values based on site investigation
Average Annual Rainfall (SAAR)	1092	
M5-60-minute rainfall depth	18.000mm	
Ratio of M5-60 to M5-2-day rainfall	0.3	
Average Intensity (mm/hr) 100yr 6hr	10.177	
Rainfall 100 years 6 hrs.	61.5 mm	
Soil Type (SOIL)	2	3
SPR Standard Percentage Runoff	0.3	0.37
Soil Characteristics	Moderate (The superficial deposits >3m Superficial deposits likely to permit moderate infiltration permeability.	cohesive clayey ground - low infiltration, ground/perched water at 1.5Mbg identified during preliminary trial pitting

Greenfield Runoff Rate

11.2. An assessment of the greenfield runoff rates has been undertaken using IH124 Methodology and the results based on default generated soil type 2 and edited Type 3 more in line with the soil properties identified via initial soil investigation are summarised below. Calculations are included within APPENDIX 7.

Table 6 Greenfield runoff rate for range of return periods.

	Greenfield Runoff Rate (application site 1ha)	
	UK SuDS Soil Type 2	UK SuDS Soil Type 3
QBAR (rural)	3.0	4.8
Q1 Y (100%)	2.7	4.2
Q30 Y (3.33%)	5.2	8.2
Q100 Y (1%)	6.4	10.0

Greenfield Runoff Volume

11.3. An assessment of the greenfield runoff volume has been undertaken using Micro Drainage and the results are summarised below. Calculations are included within APPENDIX 7.

Table 7 Greenfield Volume for 100yr return period 6 hour storm duration.

	Application Site (1 ha) Soil 2 (SPR = 0.3)	Application Site (1 ha) Soil 3 (SPR = 0.37)
Percentage Runoff (%)	33%	40%
Greenfield Runoff Volume (m ³)	205.746	249.053

12 PROPOSED RUNOFF RATE AND VOLUMES

Proposed Runoff Rate

12.1. 'For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1-year rainfall event and the 1 in 100-year rainfall event should never exceed the peak greenfield runoff rate for the same event'. (S2 - NSTSSD 2015)

Proposed Runoff Volume

12.2. 'Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100-year, 6-hour rainfall event should never exceed the greenfield runoff volume for the same event'. (S4 NSTSSD 2015).

12.3. The proposed development will introduce approximately 4479m² (0.44 ha) of contributing areas positively drained (roofs and hardstandings).

12.4. The proposed runoff volume in the 1 in 100-year, 6-hour rainfall event can be calculated as follows:

$$V = R \times C \times A = 0.061m \times 0.95 \times 4479m^2 + 0.061m \times 0.40 \times 5521m^2 = 259.56 + 134.71 = 394.272m^3$$

Where:

V – volume in m³

C – Coefficient of run off (0.95 has been allowed for impermeable areas and 0.4 for permeable areas (soil type 3 as per trial pitting report in Appendix 3.)

R – rainfall 100 years 6 hour in m

A – Contributing area in m²

$$R = I_{(100/6hr)} \times 6 = 10.177mm/hr. \times 6hr = 61.06mm = 0.061m$$

Table 8 Post-Development runoff volume for 100yr return period 360min storm duration

	Volume
Greenfield Runoff Volume (m ³)	249.053
Post Development Runoff Volume (m ³)	394.272m ³
Increase in runoff volume post development (m ³)	145.219

12.5. Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer, or surface water body in accordance with S4, the runoff volume must be discharged at a rate that does not adversely affect flood risk. (S6 NSTSSD 2015).

12.6. In practical terms, the above guidelines mean, that the proposed development runoff rate must provide betterment or be equal to the calculated existing greenfield runoff rate.

12.7. The comparison of greenfield and proposed runoff rates has been included within the Table 9.

Table 9 Greenfield and Proposed runoff rate comparison.

Return Period (Yr.)	Runoff Rate (l/s) Application Site (1 ha)	Runoff Rate (l/s) Application Site (1 ha)	Proposed Discharge Rate to watercourse
	UK SuDS Soil 2	UK SuDS Soil 3	
	l/s.	l/s	l/s
QBAR (rural)	3.1	4.8	
Q1 Y (100%)	2.7	4.2	2.7
Q30 Y (3.33%)	5.2	8.2	5.2
Q100 Y (1%)	6.4	10.0	6.4

12.8. Proposed discharge rates below are considered meeting the volume control standard (S6 NSTSSD 2015).

13 PROPOSED RUNOFF DESTINATION

13.1. According to National Standards for sustainable drainage systems Part II Section A – Runoff destination from the following destinations must be considered for surface runoff in order of preference:

- Discharge into the ground
- Discharge to surface water body
- Discharge to a surface water sewer
- Discharge to a combined sewer

13.2. Subject to complying with these National standards, different destinations may apply for different parts of the site.

Discharge into the ground - infiltration expectations

13.3. Five classes of soil are recognised in England as shown in the Soil Classification table below.

13.4. The soil Index SOIL is based on the Winter Rain Acceptance Parameter (WRAP) included in the Flood Study Report and broadly describes the infiltration potential of the soil derived by consideration of soil permeability, topographic slope, and the likelihood of impermeable layers.

13.5. The soil classification (BGS) for the site is indicated to be of Type 2 - indicating high potential for infiltration.

13.6. BGS_317107 reports included in Appendix 3 provide an initial desk study-based assessment of the infiltration opportunities for the site.

13.7. Preliminary trial pitting has been undertaken on site to establish whether shallow/near surface (<2m) soil/groundwater conditions could be considered suitable for further BRE365 compliant infiltration testing for soakaway/SuDS design purposed.

13.8. Cohesive clayey ground has been identified at very shallow depth, with resting water levels (in early winter 5-8th November 2021) at around 1.5 mbgl.

13.9. Based on the preliminary trial testing undertaken on site as described in Peak Solution Environmental Report ref: 42056R4 Rev.A included in Appendix 3, it is considered that soils characteristics on site are more representative of those for the Soil Type 3 or 4 in the table below, therefore opportunities for discharge via infiltration maybe limited.

13.10. Proximity of railway and Network Rail requirements should also be considered during detailed design stage in respect of infiltration features.

Table 10 Soil Classification

SOIL	WRAP	RUNOFF	SOIL VALUE	SPR	SOIL CHARACTERISTICS
1	Very High	Very low	0.15	0.10	Well drained permeable sandy or loamy soils and shallower analogues over highly permeable limestone, chalk, sandstone, or related drifts. Earthy peat soil drained by dikes and pumps. Less permeable soils in valleys.
2	High	Low	0.3	0.30	Very permeable soils with shallow groundwater. Permeable soils over rock, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils. Moderately permeable soils, some with slowly permeable subsoils.
3	Moderate	Moderate	0.4	0.37	Relatively impermeable soils in boulder and sedimentary clays and in alluvium, especially in eastern England. Permeable soils with shallow groundwater in low lying areas. Mixed areas of permeable and impermeable soils in approximately equal proportions.
4	Low	High	0.45	0.47	Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.
5	Very Low	Very High	0.5	0.53	Soils of the wet upland with peaty or humose surface horizons and impermeable layers at shallow depth. Deep raw peat associated with gentle upland slopes or basin sites. Bare rock cliffs and screes. Shallow, permeable rocky soil on steep slopes

Discharge to surface water body

- 13.11. The Map in Figure 8.4 below indicates that the nearest identified waterbody in proximity of the site is a culverted section of the Ringstone Clough watercourse to the north of the application site (~15m north of the site boundary) flowing in direction of the River Goyt to the east.
- 13.12. The culverted watercourse is located within third party land (Nursery Playground) with two access chambers present within this area and it appears to be a culverted section of the Ringstone Clough crossing under the existing railway embankment to the north of the site in direction of the River Goyt.
- 13.13. Discharge at controlled rate to the existing culverted watercourse should be considered, subject to approvals by LLFA and permission from third party landowner.
- 13.14. Capacity and condition survey of the culverted watercourse should be undertaken prior to detailed design.

Discharge to surface water sewer

- 13.15. There are no surface water sewers in proximity of the site.

Discharge to combined water sewer – Proposed Outfall

- 13.16. Connection to existing 225mm diameter VC combined water sewer within Bridgemont is proposed for foul water from the proposed development.
- 13.17. Due to topography of the site surface water from relatively small (low lying) area of the application site (units 1 & 2) and section of the proposed access road may need to be discharged to the combined sewer at greenfield runoff rate or highway drain. All subject to agreement with United Utilities and confirmation of the proposed outfall invert levels.
- 13.18. Proposed outfall - combined manhole 2300 within Bridgemont Road (225mm dia combined sewer).

2300

CL = 163.66 OAD - TBC

IL = 160.54 AOD - TBC

Depth to invert = 3.12m - TBC

14 SuDS COMPONENTS

- 14.1. Satisfactory collection, control, and discharge of storm water is now a principal planning and design consideration. This is reflected in recently implemented guidance, the National SuDS Standards, Ciria C753 The SuDS Manual (2015), as well as Part H of the Building Regulations 2015.
- 14.2. It is policy for all proposed surface water systems to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local run-off profile by using systems that can either attenuate run-off and reduce peak flow rates or positively impact on the existing flood profile.
- 14.3. The most appropriate attenuation systems should ideally satisfy four main characteristics:
- Provide the required volume of storage while minimising the loss of developable land.
 - Improve Water Quality
 - Where possible provide opportunities to create additional amenity space.
 - Where possible provide opportunities to promote biodiversity through the creation of new habitats.
- 14.4. Systems which best meet the above criteria are often referred to as Sustainable Drainage Systems (SuDS). SuDS aim to mimic the natural run off profile of the original catchment.
- 14.5. Initial assessment of the SuDS techniques is summarised in the Table below.

Table 11 Types of SuDS Components - Ciria SuDS Manual 2015.

Component Type	Description and Proposed Development Suitability	
Rainwater harvesting systems	Description	Rainwater is collected from the roof of a building or from other paved surfaces in an over ground or underground tank for use on site. Depending on its intended use, the system may include treatment elements. The system should include specific storage provision if it is to be used to manage runoff to a design standard.
	Suitability	Provision of Water butts should be considered at details design stage.
Green Roofs/ Blue Roofs	Description	A planted soil layer constructed on the roof of a building to create a living surface. Water is stored in the soil layer and absorbed by the vegetation. Blue roofs store water at roof level, without the use of vegetation.
	Suitability	Not viable for the proposed development – Pitched Roofs.
Infiltration systems	Description	These systems collect and store runoff allowing it to infiltrate into the ground. Overlaying vegetation and underlaying unsaturated solid can offer protection to ground water from pollution risks.
	Suitability	Opportunities for discharge via infiltration, based on the soil properties, site levels and proximity of the railway are limited for this site.
Filter Strips	Description	Runoff from impermeable area is allowed to flow across a grassed or otherwise planted area to promote sedimentation and filtration.
	Suitability	Will be further considered during detailed design stage.
Filter drains	Description	Runoff is temporarily stored below the surface in a shallow trench filled with stone/gravel, providing attenuation, conveyance, and treatment (via filtration).
	Suitability	Will be further considered during detailed design stage.

Swales	Description	A vegetation channel is used to convey and treat runoff. Shallow naturally landscaped channels that convey and/or infiltrate the runoff (via infiltration). These can be 'wet', where water is designed to remain permanently at the base of the swale, or 'dry' where water is only present in the channel after rainfall events. It can be lined, or unlined to allow infiltration.
	Suitability	Not likely to be suitable due to the development layout.
Bioretention systems	Description	A shallow landscaped depression allows runoff to pond temporarily on the surface, before filtering through vegetation and underlying soils prior to collection or infiltration. In its simplest form it is often referred to as a rain garden. Engineered soils (gravel and sand layers) and enhanced vegetation can be used to improve treatment performance.
	Suitability	Rain gardens will be incorporated within landscaped areas/ecological enhancement areas and during detailed design.
Trees	Description	Trees can be planted within a range of infiltration SuDS components to improve their performance, as root growth and decomposition increase soil infiltration capacity. Alternatively, they can be used as standalone features within soil-filled tree pits, tree planters or structural soils, collection and storing runoff and providing treatment (via infiltration and phytoremediation).
	Suitability	Existing trees will be retained where possible. Landscaping proposal should consider specification broad leaf trees with high water interception and tree cells.
Pervious Pavements	Description	Runoff is allowed to soak through structural paving. This can be paving blocks with gaps between solid blocks, or porous paving where water filters through the block itself. Water can be stored in the subbase and potentially allowed to infiltrate into the ground.
	Suitability	Permeable surfaces with storage layer will be considered for all light trafficked areas to aid treatment and interception at source, before controlled discharge to the next element of drainage system.
Attenuation storage	Description	Large below ground voided spaces can be used to temporarily store runoff before infiltration, controlled release, or use. The storage structure is often constructed using geocellular or other modular storage systems, concrete tanks, or oversized pipes.
	Suitability	Attenuation for rainfall events up to and including 30yr events will be provided in large diameter pipes under the access road. Private attenuation storage tank/s will be utilized as part of the drainage proposal for rainfall events in excess of 30yr. Type and size of the required storage will be confirmed during detailed
Detention Basin	Description	During a rainfall event, runoff drains to a landscaped depression with an outlet that restricts flows, so that the basin fills and provides attenuation. Generally, basins are dry, except during and immediately following the rainfall events. If vegetated, runoff will be treated as it is conveyed and filtered across the base of the basin. Naturally, vegetated depressions designed to store runoff temporarily.
	Suitability	Not suitable for the Proposed Development Layout.
Ponds and wetlands	Description	Features with a permanent pool of water can be used to provide attenuation and treatment of runoff, where outflows are controlled, and water levels are allowed to increase following rainfall. They can support emergent and submerged vegetation along their shoreline and in shallow. Marshy zones, which enhance treatment processes and biodiversity.
	Suitability	Not suitable for the Proposed Development Layout.

14.6. It is proposed to adopt appropriate SuDS throughout the new development wherever possible, with specific target areas being:

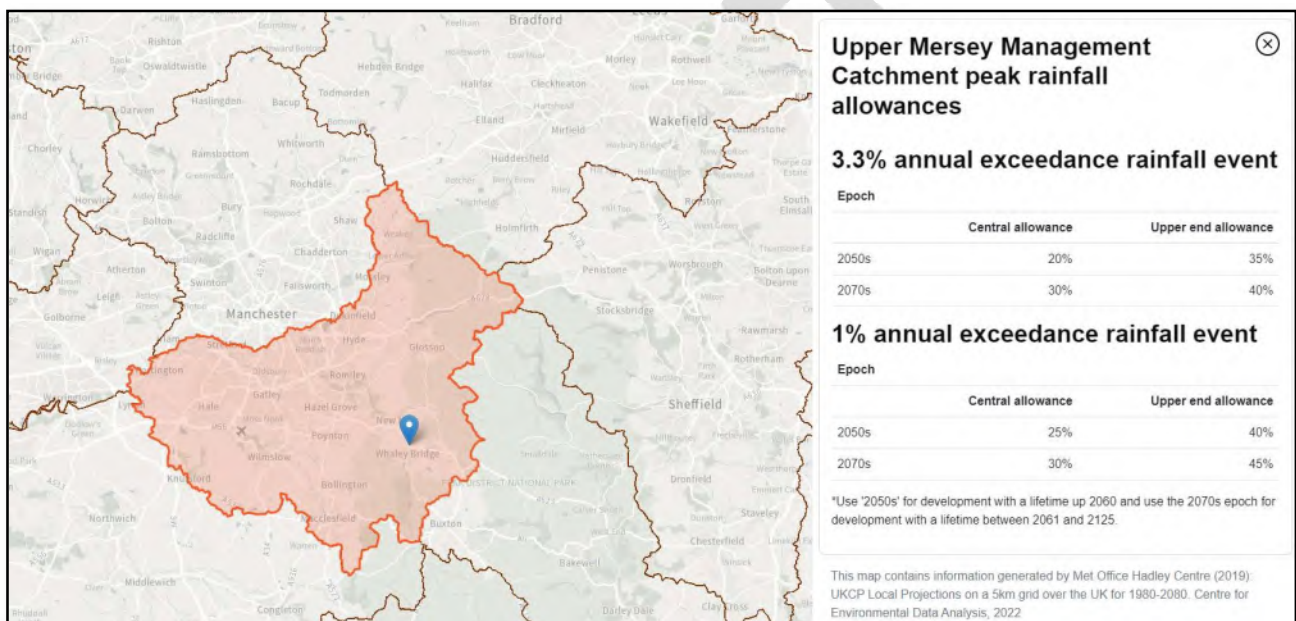
- 1 in 1-year storage should be provided by Source Control SuDS techniques, such as :
 - rain gardens with broadleaves high water interception species,
 - trees cells,
 - permeable surfaces with overflow to next stage of drainage system.
- Site - control - attenuation and reduction in peak flows (controlled discharge) to proposed outfalls, thereby not increasing flood risk downstream of connection.
- Improvement of water quality arriving at outfall (passive removal of pollutants through permeable surfaces and filter chambers), thereby reducing potential for pollution downstream of the connection point.

DRAFT

15 CLIMATE CHANGE ALLOWANCE

- 15.1. It is anticipated that climate change will bring an increase in rainfall intensity in the future and therefore an allowance for climate change should be included to help minimise vulnerability and provide resilience to flooding and coastal change in the future. Both the 'central' and 'upper end' allowance should be assessed to understand the range of impact.
- 15.2. The 'Central' allowance should be applied to the surface water drainage network/design to assess its performance and ability to contain critical events. The 'Upper End' allowance should be applied to assess the potential flood risk implications to the site and to ensure that flooding is wholly contained onsite.
- 15.3. The Environment Agency Guidance in Table 12 shows anticipated changes in extreme rainfall intensity across the country. Over the next 100years, the increase in extreme rainfall intensity is expected to be between 30-45%.

Table 12 Peak rainfall intensity allowance Upper Mersey Management Catchment



- 15.4. With an estimated design life of 100 years for residential development, any necessary onsite designs for drainage, soakaways or other suitable disposal methods limiting surface water disposal flows will incorporate rainfall intensities that have been increased by 45% to take account of the effects of climate change.
- 15.5. It is recommended that for the proposed development the drainage is designed to contain (without surface flooding) a 1 to 100 year 6-hour rainfall event with an 'Upper End' allowance included i.e., + 45% CC (Climate Change).

16 DESIGN FOR EXCEEDANCE

- 16.1. The drainage system will be designed so the flooding does not occur on any part of the site for 1:100yr rainfall event plus 40% climate change +10% urban creep allowance.
- 16.2. The design will consider flows resulting from rainfall in excess of the 1:100yr rainfall event. The exceedance routes will be directing the water towards landscaped and porous paving areas or designated hard standing areas away from buildings to minimize the risk to people and property via range of measures:
- Slope of footpaths/driveways to direct surface water away from buildings,
 - Raised and dropped kerb to direct flow away from vulnerable areas,
 - Proposed site layout allowing exceedance flows to pass safely through the site without increasing risk elsewhere as reasonably possible.

17 PRELIMINARY DRAINAGE STRATEGY

- 17.1. As part of any development, it is necessary to provide a suitably designed storm water drainage system to collect, convey and attenuate any additional runoff that may be generated by the development itself. The net result is that there should be no increase in flood risk either downstream or to any neighbouring properties because of the scheme.
- 17.2. The current proposed layout for the site is included within APPENDIX 2 and shows that there will be an increase in impermeable area as part of this development.
- 17.3. The total site is approximately 1ha in area with the proposed impermeable areas identified accordingly:
- Building roofs including 10% urban creep allowance = 1969m²
 - Proposed impermeable hardstandings = 1875m²
 - Proposed permeable driveways with overflow = 635m²
- 17.4. For the purpose of this report remaining areas will be either classed as permeable and will be in form of landscaped gardens or rain gardens/ecologically enhances spaces with improved water retention soils and specification of sympathetic broad-leaved plants with high rainfall interception and water demand.
- 17.5. Increase in impermeable areas as a result of the proposed development is likely to generate large amounts of storm water runoff, which without satisfactory collection, attenuation, and controlled discharge, could pose risk to both the development site and the areas downstream.
- 17.6. A preliminary drainage strategy has been undertaken to establish principles of the design for foul and surface water drainage for the proposed development.
- 17.7. All recommendations are subject to detailed design and calculation following further site investigation and consultations with the Lead Local Flood Risk Authority and United Utilities.

Preliminary surface water strategy

- 17.8. All drained areas will be designed to meet the Statutory Requirements as follows:
- The 1 in 1-year storage will be provided via Source Control SuDS techniques such as rain gardens, tree cells, permeable surfaces to driveways and pathways with overflow to next drainage element.
 - Drainage system will be designed for the critical 100-year (1%) rainfall event with climate change and 10 urban creep allowance, therefore there will be no risk of uncontrolled flooding on site for all rainfall events up 100-year return +45% climate change and including 10% urban creep allowance.
 - All exceedance flows beyond those for which the drainage system is designed will either infiltrate to ground (rain gardens with improved water retention properties) or will be directed thought the site, as such that there will be no risk of flooding of vulnerable or critical areas and there will be no risk of flows from the site causing flooding to other nearby areas.
- 17.9. Permeable surfaces will be encouraged throughout the development to provide interception and pollution removal, storage within the sub-base layer with an overflow to the next element of drainage system i.e., attenuation structures. Due to proposed site levels baffles might be required within permeable subbase storage layer.
- 17.10. All recommendations will be investigated/developed further during the detailed design stage following consultation with Lead Local Flood Risk Authority, United Utilities. Network Rail and further site investigation and surveys.

Attenuation storage volume estimation

- 17.11. Based on preliminary site testing undertaken on site and as described with Peak Environmental Solutions report included within APPENDIX 3 opportunities for discharge via infiltration for this site are considered to be limited.
- 17.12. Total contributing areas positively drained including 10% urban creep allowance are approx. 4497m² (0.45ha) as shown on Proposed Surface Water Contributing Area plan in APPENDIX 4.
- 17.13. Permeable surfaces to driveways, parking bays and paths will provide interception and pollution removal at source as well as attenuation within subbase storage layer (30% void) with an overflow to the next element of drainage network. Partial infiltration can be expected in some areas of the site; therefore, an unlined permeable surface system will be proposed. All subject to detailed design and further site investigation.
- 17.14. Runoff from Impermeable areas (roofs including 10% urban creep allowance, access roads and footpaths) will be collected via underground pipe network and directed to attenuation structures (large diameter storage pipes and tanks) for controlled discharge at maximum pass forward rate of 5l/s via vortex flow control (hydrobrake or similar approved).
- 17.15. Due to the site layout and topography, it is proposed to split the drainage strategy into two distinct areas/catchments:
- upper catchment (majority of the site, impermeable areas 0.4ha) - controlled discharge to existing culverted watercourse to the north of the site.
 - lower catchment (units 1 & 2 and small section of low-lying access road and footway at junction with Bridgemont – impermeable area 0.05ha) - controlled discharge to combined public sewer within Bridgemont Road.
- 17.16. All subject to statutory and United Utilities approvals, detailed design, and calculations.
- 17.17. The attenuation volumes in Table 13 (upper catchment) was calculated using WinDes MicroDrainage software for the runoff from the upper catchment discharging at greenfield runoff rate (estimated for soil Type 2/ map value) to existing culverted watercourse. The storage volumes estimated are indicative only and will be confirmed during the detailed design stage. See APPENDIX 7 – MicroDrainage Calculations.

Table 13. Estimated Attenuation Storage Volumes Requirements
Upper Catchment - discharge to watercourse (impermeable area 0.4ha)

	Proposed Discharge Rate	Storage Required Based on contributing areas (0.4ha)	
	Q (litres/sec)	V (m3)	V (m3)
YR 1 (100% AEP)	2.7	31 < V < 57	44
YR 30 (3.3% AEP)	5.2	80 < V < 129	104.5
YR 100 CC (1% AEP) + 45%CC	6.4	183 < V < 275	229

- 17.18. The estimated storage volumes for the upper catchment area are proposed to be provided within attenuation structures as follows:
- 1 in 30-year return period attenuation storage (approximately 104.5m³) to be provided within large diameter pipes under new access road (constructed to adoptable standards). All subject to detailed design following consultation with Lead Local Flood Risk Authority, United Utilities. Network Rail and further site investigation and surveys.
 - 1 in 100-year return period plus 45% climate change allowance attenuation storage, approximate 124.5 m³ to be provided within private attenuation storage system (attenuation tank 95% void ratio).

17.19. The lower catchment (units 1 & 2 and small section of low-lying access road and footway at junction with Bridgemont – impermeable area 0.05ha) is proposed to discharge at controlled discharge of 2l/s to the combined public sewer within Bridgemont Road. The total proposed discharge rate from the site is below the estimated greenfield runoff rate based on Soil Type 3 in line with soil properties identified by site investigation/infiltration testing.

Table 14. Estimated Attenuation Storage Volumes Requirements
Lower Catchment - discharge to combined sewer (impermeable area 0.05ha)

	Proposed Discharge Rate	Storage Required Based on contributing areas (0.05ha)	
	Q (litres/sec)	V (m3)	V (m3)
YR 1 (100% AEP)	2	0.9 < V < 2.8	1.85
YR 30 (3.3% AEP)	2	5.5 < V < 10	7.75
YR 100 CC (1% AEP) + 45%CC	2	15 < V < 25	20

17.20. The estimated storage volumes for the lower catchment are proposed to be provided within attenuation structures as follows:

- 1 in 30-year return period storage (approximately 7.75 m³) to be provided within large diameter pipe under new access road (constructed to adoptable standards). All subject to detailed design following consultation with Lead Local Flood Risk Authority, United Utilities. Network Rail and further site investigation and surveys.
- 1 in 100-year return period plus 45% climate change allowance storage, approximate further 12.25 m³ to be provided within private attenuation storage system (attenuation tank 95% void ratio).

17.21. Preliminary Drainage Strategy Plan is included within APPENDIX 6.

Water quality

17.22. With reference to water quality, the simple index approach can be used to assess the pre-and post-treatment pollution index (Table 26.2 and 26.3 from CIRIA SuDS Manual)

Area	Pollution hazard level	Pre-Treatment Pollution Index	Attenuation Feature	Mitigation Indices	Sufficient Treatment Provided
Residential Roofs	Very low	Total Suspended Solids = 0.2 Metals = 0.2 Hydrocarbons = 0.05	Proprietary treatment system upstream of site outfall.	Proprietary treatment system will be included as a treatment stage to provide specific measures to remove oils and other pollutants such as heavy metals.	yes
Driveways and shared access road	Low	Total Suspended Solids = 0.5 Metals = 0.4 Hydrocarbons = 0.4	Permeable surfaces	Total Suspended Solids = 0.7 Metals = 0.6 Hydrocarbons = 0.7	yes
Access Road and Footpaths build to adoptable standard	Low	Total Suspended Solids = 0.5 Metals = 0.4 Hydrocarbons = 0.4	Proprietary treatment system of site outfall.	Proprietary treatment system will be included as a treatment stage to provide specific measures to remove oils and other pollutants such as heavy metals.	yes

Proprietary treatment systems (including catch pits and interceptors where applicable) will be specified at the detailed design stage to 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 concentration relevant to the contributing drainage area.

18 FOUL WATER DRAINAGE STRATEGY

Proposed outfall

18.1. Proposed outfall details: 225mm dia combined public sewer within Bridgemont.

2300

CL =163.66 OAD - TBC

IL = 160.54 AOD - TBC

Depth to invert = 3.12m - TBC

Proposed foul water rates

18.2. Design and Construction Guidance for foul and surface water sewers offered for adoption under the Code for adoption agreements for water and sewerage companies operating wholly or mainly in England ("the Code") recommends that drainage designs for residential developments should be based on 4000 litres per dwelling per day.

Q Foul Water (litres) = 4000 litres per dwelling per day

Proposed Dwellings = 38

Q Foul Water (l per day) = $38 \times 4000 = 152,000$ litres

Q Foul Water (l/s) = $152,000 \div (24 \times 60 \times 60) = 1.8$ l/s

18.3. The proposed flow rate and outfall is subject to agreement with United Utilities.

18.4. Any proposed drainage will be designed in accordance with Building Regulations Document H1 and British Standards and where intended for adoption in accordance with "the Code".v.2.1 May 2021.

EXECUTIVE SUMMARY

- 18.5. The proposed residential development lies within Flood Zone 1, there is no requirement to satisfy either the Sequential Test or the Exception Test.
- 18.6. Sources of flooding have been assessed as part of the Drainage Strategy for the proposed development in its current context. Flood Risk Overview established that northern part of the site is at risk of being affected in the event of reservoir failure, although the risk is considered by The Environment Agency to be very low.
- 18.7. Low to moderate risk of groundwater flooding was identified and possible mitigation measure discussed in paragraph 9.8.
- 18.8. The existing low to moderate risks of pluvial flooding within the vicinity of the site, within Bridgemont will remain after development, however, as the new residential development will have a properly designed drainage system, it is not envisaged that there will be an increased risk of flooding as a result of the development.
- 18.9. Thresholds drain to doors or minimum 150 mm raised door threshold should be utilised throughout the application site as well as flood resilient construction measures should be implemented in low lying areas (unit 1 & 2).
- 18.10. An indicative surface water drainage strategy has been prepared in July 2020 as part of the Cole Easdon Consultants FRA report QMF09.20 proposing attenuation within a tanked permeable paving SuDS system, cascaded to suit the topography of the site with overflow to combined public sewer in Bridgemont.
- 18.11. Following Network Rail comments (included in Appendix 8) and initial LLFA comments, HBL Associates Ltd was instructed to provide an updated FRA and alternative drainage strategy considering opportunities for disposal via infiltration and/ or discharge to nearby watercourse.
- 18.12. BGS infiltration SuDS GeoReprt BGS 317107/21928 (included in Appendix 3) indicated opportunities for bespoke infiltration SuDS, however, preliminary trial pitting carried out in November 2021 identified cohesive clayey ground at very shallow depth, with resting water levels (in early winter 5-8th November 2021) at around 1.5 mbgl.
- 13.9. Based on the preliminary trial testing undertaken on site and as described in Peak Solution Environmental Report ref: 42056R4 Rev.A included in Appendix 3, it is considered that soils characteristics on site do not present opportunities for discharge via total infiltration. The soil is consistent with soil Type 3 or 4.
- 18.13. Lined and unlined permeable surfaces (where appropriate) will be encouraged throughout the development within private access road and drives, providing interception and pollution removal, attenuation storage within the sub-base storage layer with an overflow to downstream drainage structure.
- 18.14. A preliminary drainage strategy was produced, and attenuation volumes calculated using the source control module of MicroDrainage.
- 18.15. Due to the site layout and topography, it is currently proposed to split the drainage strategy into two distinct areas:
- upper catchment (majority of the site, impermeable areas 0.4ha) - controlled discharge to existing culverted watercourse to the north of the site at greenfield runoff rate , i.e.:
 - 2.7 l/s for 1 in 1yr return period rainfall,
 - 5.2 l/s for 1 in 30yr return period rainfall,
 - 6.4 l/s for 100yr return period rainfall + 45% climate change allowance,
 - 1 in 30-year return period storage (approximately 104.5 m³) to be provided within large diameter pipes under new access road (constructed to adoptable standards).

- 1 in 100-year return period plus 45% climate change allowance storage, approximate additional 124.5m³ to be provided within private attenuation storage system (attenuation tank 95% void ratio).
- lower catchment (units 1 & 2 and small section of low-lying access road and footway at junction with Bridgemont – impermeable area 0.05ha) - controlled discharge to 225mm dia combined public sewer within Bridgemont at maximum pass forward rate of 2l/s for all return periods including critical 1 in 100-year event +45% climate change.
 - 1 in 30-year return period storage (approximately 7.75m³) to be provided within large diameter pipe under new access road (constructed to adoptable standards).
 - 1 in 100-year return period plus 40% climate change allowance storage, approximate further 12.25m³ to be provided within private attenuation storage system (attenuation tank 95% void ratio).

18.16. Preliminary Drainage Strategy Plan is included within APPENDIX 6.

18.17. Silt chambers should be installed upstream of all attenuation to prevent siltation of attenuation structures and downstream network. All channel drains should be installed with build in sump units.

18.18. Drainage design considers flows resulting from rainfall in excess of the 1 in 100-year rainfall event plus 45% climate change. Site surfaces will be modelled so that flood flows generated on site from events beyond the stipulated drainage design criteria will flow away from buildings and other sensitive areas and will be contained on site as reasonably practicable.

18.19. Detailed drainage design and calculations will be prepared at detailed design stage, following LLFA, United Utilities and Network Rail consultations and further site investigation and testing.

18.20. Foul drainage is proposed to be discharged to the combined surface water sewer in Bridgemont at estimated rate of 1.8 l/s estimated based on 4000 litres per dwelling per day as per “the CODE” v.2.1 guidance.

18.21. Any proposed on-site drainage should be designed and constructed in accordance with current Building Regulation and best practice.

18.22. Drainage network within any road should be constructed to adoptable standards.

18.23. All SuDS on site should be designed and installed with full consideration to long term maintenance. Typical maintenance schedule has been prepared to accompany this report, however, as part of the detailed design process consideration should also be given to the maintenance requirements of the drainage system and information relating to this included with any supporting information provided at handover.

18.24. Private management company will be set up to provide ongoing maintenance for the site drainage for longevity of the development.

18.25. This Flood Risk Assessment has demonstrated that either by assessment or by design as part of the development, all residual flood risks to the development on site are considered to be low and there will be no significant off-site impacts as a result of this development, therefore the proposal satisfies paragraph 103 of the Framework.