BETTS HYDRO
CONSULTING ENGINEERS

PRESTON LANCASTER ROAD
GALGATE

FLOOD RISK ASSESSMENT AND DRAINAGE MANAGEMENT STRATEGY

For

Hollins Homes
1 King Street
Manchester
M2 6AW

HOLLINS
HOMES PEOPLE LOVE

SEPTEMBER 2022

This page has been intentionally left blank

**PRESTON LANCASTER ROAD,
GALGATE**

**FLOOD RISK ASSESSMENT AND
DRAINAGE MANAGEMENT STRATEGY**

Document Tracking Sheet

Document Reference:	HYD686_PRESTON.LANCASTER.ROAD_FRA&DMS
Revision:	1.1
Date of Issue:	08/09/22
Report Status:	FINAL

Prepared by:

Megan Berry BSc (Hons) MCIWEM
Flood Risk Analyst

Checked by:

Kirsty Williams BSc (Hons) MCIWEM
Associate

Authorised by:

Richard Nicholas BEng (Hons) MBA MSc MCIWEM
Director

Revision History:

Rev.:	Date:	Status:	Prepared by:	Checked by:	Issued by:
1.1	08/09/22	DRAFT	MB	RDN	MB
1.0	25/08/22	DRAFT	MB	RDN	MB
0	17/08/22	DRAFT	MB	RDN	MB

Old Marsh Farm Barns
Welsh Road, Sealand
Flintshire CH5 2LY
Telephone: 01244 289 041

www.betts-associates.co.uk

This page has been intentionally left blank

EXECUTIVE SUMMARY

This Flood Risk Assessment and Drainage Management Strategy was commissioned by Hollins Homes referred to hereafter as 'the client'. This report has been prepared to support a residential planning application on land to the west of Preston Lancaster Road in Galgate.

Flood Risk

The total site covers 2.97ha, however the proposed development area covers 1.27ha. The wider site extents are shown to be located within Flood Zones 1, 2 and 3 based on the Environment Agency Flood Zone Map, however the proposed residential development will be steered to the lowest flood risk areas and therefore located within Flood Zone 1. Residential development is classified as 'more vulnerable' in Table 2: Flood Risk Vulnerability Classification within the Planning Practice Guidance. The Planning Practice Guidance confirms that 'more vulnerable' development is appropriate to be located within Flood Zone 1, providing there is no increase in flood risk elsewhere.

This report has reviewed all sources of flood risk to and resulting from the proposed development. The primary flood risks to the overall site relate to the River Conder which bounds the eastern and southern boundary of the site. Parts of the wider site are located within the predicted floodplain extents; therefore, further consultation with the Environment Agency has been undertaken to gain more information regarding the proposed flood risk to the site. Additional hydraulic modelling has also been undertaken and included within this report to identify the proposed flood risk to the wider site area during the updated Climate Change flood risk events in both the existing and proposed scenarios.

The proposals will however adopt an intra-sequential approach to development and the more vulnerable development will be located in the lowest flood risk area. The development area has therefore been identified to remain flood free in the key return period events and the risk to the proposals would be low.

To ensure residential development remains safe, the primary mitigation is typically to set the finished floor levels for the proposed dwellings 600mm above the predicted top water level in the design event (fluvial defended 1 in 100yr plus 49% climate change event). The finished floor levels for the residential dwellings will vary across the site, however, a minimum finished floor level of 22.06mAOD is recommended.

Drainage Strategy

The effective management of surface water run-off is key to ensuring that no increased flood risk will result from the proposals, therefore this assessment has also considered sustainable management of surface water run-off in accordance with national and local policy. In accordance with the drainage hierarchy there are three methods that have been reviewed for the appropriate management and discharge of surface water, these have been applied in the order of priority: discharge via infiltration, to a watercourse and finally to public sewerage system.

Based on the ground conditions identified online, it can be considered that infiltration could potentially offer a viable drainage solution for part of the site based on infiltration characteristics. Soakaway Testing to BRE365 will be required to be undertaken to evidence that discharge to ground will be feasible. Should infiltration not offer a feasible solution then the next option should be discharge to a watercourse. The River Conder flows adjacent to the

eastern and southern boundaries of the site; this would potentially offer a suitable alternative point of discharge for surface water generated by the proposals. It is proposed that a new formal outfall to the Main River be created.

In accordance with the SuDS Manual (CIRIA 753) and the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) all sites should endeavour to achieve as close to pre-development greenfield rates as is viable. The proposals are therefore to discharge to the watercourse at greenfield rates, at present the pre-development QBAR rate of 7.3l/s has been calculated. The restricted flow will generate a storage requirement during periods of intense rainfall, this will need to be considered in terms of onsite attenuation as part of detailed design following confirmation of the feasibility of infiltration.

This report has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The report is considered to be commensurate with the scale and nature of the development proposals and in summary, the development can be considered appropriate in accordance with the Planning Practice Guidance.

CONTENTS

Document Tracking Sheet iii

EXECUTIVE SUMMARY v

Figures & Tables viii

Specialist Software ix

Abbreviations & Acronyms ix

1.0 INTRODUCTION 11

1.1 Planning Policy Context 11

1.2 Site Context 11

1.3 Consultation 11

2.0 EXISTING SITE LOCATION 12

2.1 Location 12

2.2 Existing and Historical Land Use 12

2.3 Topography 12

3.0 DEVELOPMENT PROPOSALS 13

3.1 Nature of the development 13

4.0 SOURCES OF FLOOD RISK 15

4.1 Fluvial Flood Risk 15

Environment Agency Data Review 16

Climate Change Allowances 16

Flood Displacement 18

Mitigation 19

Safe Access and Egress 20

4.2 Tidal Flood Risk 20

4.3 Flood Risk Vulnerability Classification and Flood Zone Compatibility 20

4.4 Surface Water Flood Risk 20

Predicted Flood Depths 21

Predicted Flood Velocities 21

Mitigation 21

Pluvial (Overland run-off) Flood Risk 22

Sewer Flood Risk 22

4.5 Groundwater Flood Risk 22

4.6 Artificial Sources of Flood Risk 23

Reservoirs 23

Canals 24

4.7 Historical and Anecdotal Flooding Information 24

4.8 Flood Risk Mitigation Measures & Residual Risks 25

Mitigation Measures 25

Residual Risks 26

5.0 SURFACE WATER MANAGEMENT 27

5.1 Pre-Development Surface Water Run-off 27
5.2 Post Development Surface Water Run-Off 27
5.3 Sustainable Drainage Systems (SuDS) 27
5.4 Methods of Surface Water Management 28
5.5 Discharge via Infiltration 29
5.6 Discharge to Watercourse 29
5.7 Discharge to Public Sewer Network 31
5.8 Climate Change 31

6.0 FOUL WATER MANAGEMENT 32

7.0 SUMMARY AND CONCLUSIONS 33

8.0 RECOMMENDATIONS 35

BIBLIOGRAPHY & REFERENCES 36
Web-based References 36

Figures & Tables

Figure 1: Site Location and Features (Betts Hydro, 2022) 12
Figure 2: Proposed Planning Layout (The Urbanists, 2022) 13
Figure 3: Fluvial/Tidal Flood Zone Map for Planning Extract (EA, 2022) 15
Table 1: Fluvial Onsite Top Water Levels and Depths (EA, 2022) 16
Figure 4: Existing Scenario 100yr plus 49% climate change (Betts Hydro, 2022) 17
Figure 5**:** Comparison of Flood Zone 3 and modelled 1 in 100yr extents (Betts Hydro, 2022) 18
Figure 6: Proposed Relative to existing scenario 100yr (Betts Hydro, 2022) 19
Figure 7: Surface Water Flood Map Extract (GOV.UK, 2022) 21
Figure 8: Reservoir Flood Extent Plan (Gov.UK, 2022) 23
Table 2: Pre-Development Surface Water Run-Off Rates (Betts Hydro, 2022) 27
Table 3: Post-Development Un-Restricted Run-Off Rates (Betts Hydro, 2022) 27
Figure 9: SuDS Photographs (SusDrain, 2012) 28
Figure 10: Proposed Drainage Strategy Plan Extract (Betts Hydro, 2022) 30
Table 4: Estimated Stormwater Storage Requirements (Betts Hydro, 2022) 30
Table 5: Change to Extreme Rainfall Intensity (Environment Agency, 2016) 31

APPENDIX A: NPPF EXTRACTS .....
APPENDIX B: EA INFORMATION & CORRESPONDENCE .....
APPENDIX C: UU CORRESPONDENCE .....
APPENDIX D: LPA/LLFA CORRESPONDENCE .....

APPENDIX E: LOCATION PLAN .....
APPENDIX F: TOPOGRAPHIC SURVEY .....
APPENDIX G: PROPOSED PLANNING LAYOUT .....
APPENDIX H: HYDRAULIC MODELLING ASSESSMENT .....
APPENDIX I: PFRA/SFRA PLANNING EXTRACTS.....
APPENDIX J: SURFACE WATER RUN-OFF CALCULATIONS .....
APPENDIX K: PROPOSED DRAINAGE PLANS.....
APPENDIX L: STORMWATER STORAGE ESTIMATES .....
APPENDIX M: TYPICAL SUDS DETAILS .....
APPENDIX N: NOTES OF LIMITATIONS.....

Specialist Software

- MicroDrainage WinDES (v.14.1) – Calculation of Greenfield run-off rates IH124/ICP-SUDS, Greenfield run-off volumes, rates of rainfall and stormwater storage estimates.

Abbreviations & Acronyms

AEP	Annual Exceedance Probability
BGS	British Geological Survey
CC	Climate Change
CSAI	Cranfield Soil and Agrifood Institute
EA	Environment Agency
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
FZ	Flood Zone
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
mAOD	Metres Above Ordnance Datum
NGR	National Grid Reference
NPPF	National Planning Policy Framework
NSRI	National Soil Resources Institute
OS	Ordnance Survey
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
QSE	Quick Storage Estimate
QBAR	Mean Annual Flood
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Urban Drainage Systems
TWL	Top Water Level
UU	United Utilities

This Page Has Been Left Intentionally Blank

1.0 INTRODUCTION

1.1 Planning Policy Context

1.1.1 All forms of flooding and their impact on the natural and built environment are material planning considerations. The National Planning Policy Framework (NPPF) sets out the Government's objectives for the planning system, and how planning should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change. Government policy with respect to development in flood risk areas is contained within the NPPF and the supporting Planning Practice Guidance (PPG) (refer to extracts in **Appendix A**).

1.1.2 A Flood Risk Assessment and Drainage Management Strategy (FRA&DMS) has been completed in accordance with NPPF/PPG to review all sources of flood risk both to and from the proposed development. The report also considers the most appropriate drainage options including the implementation of Sustainable Drainage Systems (SuDS) in line with the recent changes to national policy.

1.1.3 The proposals are 'residential' in nature and as such is classified as 'more vulnerable' in Table 2: Flood Risk Vulnerability Classification within the PPG. The wider site is located within Flood Zones 1, 2 and 3 however an intra-sequential approach has been adopted and the more vulnerable residential development will be located wholly within Flood Zone 1. The PPG confirms that this type of land use is appropriate for Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

1.2 Site Context

1.2.1 This FRA&DMS has been prepared to support a planning application for a residential development on land to the east of Preston Lancaster Road, Galgate. The proposals will be complete with access, car parking, external works and lighting, landscaping, boundary walls and fencing, external services and drainage.

1.2.2 Furthermore, the site is located adjacent to the River Condor within the village of Galgate, that has recently suffered flooding from this source. As part of the proposals, the developer is exploring opportunities to provide a flood alleviation scheme to try and improve flood risk downstream.

1.3 Consultation

1.3.1 The preparation of this report has been undertaken in consultation with the following interested parties including: the Environment Agency (EA), Lancashire County Council (LCC) and Lancaster City Council (Lancaster CC). Consultation responses can be seen in **Appendix B, C** and **D** respectively. The NPPF advises that Lancaster City Council as the Local Planning Authority (LPA) should consult with the EA who will provide advice and guidance on flood issues at a strategic level and in relation to planning applications.

2.0 EXISTING SITE LOCATION

2.1 Location

2.1.1 The site is located off Preston Lancaster Road in Galgate, the nearest Ordnance Survey National Grid Reference is E: 348382, N: 455842 and the nearest postcode is LA2 0JG. The total site covers 2.97ha and is edged in red in **Figure 1** (see location plan in **Appendix E**).

2.1.2 The site is currently greenfield and comprises of low-density vegetation with larger trees and shrubs along the boundaries. To the north of site is undeveloped greenfield land and located adjacent to the eastern and southern boundary is the River Conder, as illustrated in **Figure 1**. To the west is Preston Lancaster Road and newly proposed residential development which was granted planning permission in 2018 (ref: 17/00944/OUT).

Figure 1: Site Location and Features (Betts Hydro, 2022)

2.2 Existing and Historical Land Use

2.2.1 The preparation of this report has identified that the site is predominantly undeveloped at present. It is understood the site is currently used for agricultural purposes and no other historical uses have been determined.

2.3 Topography

2.3.1 A full topographical survey has been provided and is included within **Appendix B**. The onsite ground levels range from approximately 23.48mAOD within the north-western corner of the site, down to a level of 19.96mAOD within the south-western corner located adjacent to the Main River.

3.0 DEVELOPMENT PROPOSALS

3.1 Nature of the development

3.1.1 This planning application is for the construction of residential development on land to the west of Preston Lancaster Road in Galgate. The proposals will be complete with access, car parking, external works and lighting, landscaping, boundary walls and fencing, external services and drainage as illustrated in the indicative layout plan in **Figure 2** (**Appendix G**).

Figure 2: Proposed Planning Layout (The Urbanists, 2022)

3.1.2 The total site is 2.97ha in size and is located within Flood Zones 1, 2 and 3. The proposed residential development however will be steered to those areas of site at lesser flood risk. Therefore, the more vulnerable aspects of development will be located solely within Flood Zone 1. The proposed development area covers 1.27ha of the wider site extents.

3.1.3 A Main River runs adjacent to the eastern and southern boundary of the site, in accordance with the Environment Agency's standards, there will be a requirement to maintain a maintenance easement from the top of bank of the watercourse on either side. In terms of the easement this should allow for clear and unimpeded access incorporating a no build area up to 8m from the top of bank into the site. The proposals are to only locate residential development within Flood Zone 1 and as such the 8m easement area will inherently remain free from development.

3.1.4 The proposed planning layout illustrates the scope to incorporate a blue/green buffer adjacent to the Main River and easement to assist with ecology and water quality which will be confirmed during the next stage of the process. As part of the proposals, the developer is exploring opportunities to provide a flood alleviation scheme to try and improve flood risk downstream. This will be achieved by lowering levels onsite within areas of proposed public open space adjacent to the River Conder. It is proposed that these lowered areas which may potentially be part wetland will have the potential to encourage significantly increased biodiversity and when combined with a quality landscaping scheme would offer excellent amenity value. These lowered areas will be designed to capture some of the fluvial flood water when out of channel flooding occurs. When the scheme has been approved in principle by the EA additional details will be made available.

3.1.5 United Utilities sewer records identify there to be a public combined rising main onsite adjacent to the western boundary. It should be noted that there will be a requirement to provide a maintenance offset from the onsite public combined sewer rising main. The specific offset needs to be discussed with UU, as they vary depending on the size of the infrastructure and the depth at which it is laid.

3.1.6 National and local policy identifies that SUDS should be incorporated into new development where feasible. Opportunities to provide soft landscaping on the site would provide added benefits to water quality and ecology. Furthermore, as some areas of the site are not proposed to be developed there may be some opportunity to incorporate SuDS within the designated Public Open Spaces to assist with onsite attenuation and water quality improvement (areas within Flood Zone 2). Detailed design will be required to confirm, subject to ground investigation and a detailed levels review, refer to Section 5.0 for the proposed outline drainage strategy.

4.0 SOURCES OF FLOOD RISK

4.1 Fluvial Flood Risk

4.1.1 Information relating to flood risk at the site has been obtained from the Environment Agency and from the Gov.uk website. An extract of the EA's Flood Zone Map for Planning is shown in **Figure 3**, which illustrates that the existing residential dwelling is located within Flood Zones 1, 2 and 3.

4.1.2 Flood Zone 1 is an area at low risk of flooding from fluvial/tidal sources and Flood Zone 2 is an area at risk of flooding from fluvial/tidal sources in the undefended 1 in 1000yr return period event. Flood Zone 3 is an area at fluvial risk during the 1 in 100yr return period (1% Annual Exceedance Probability) event or the tidal 1 in 200yr (0.5% AEP) event.

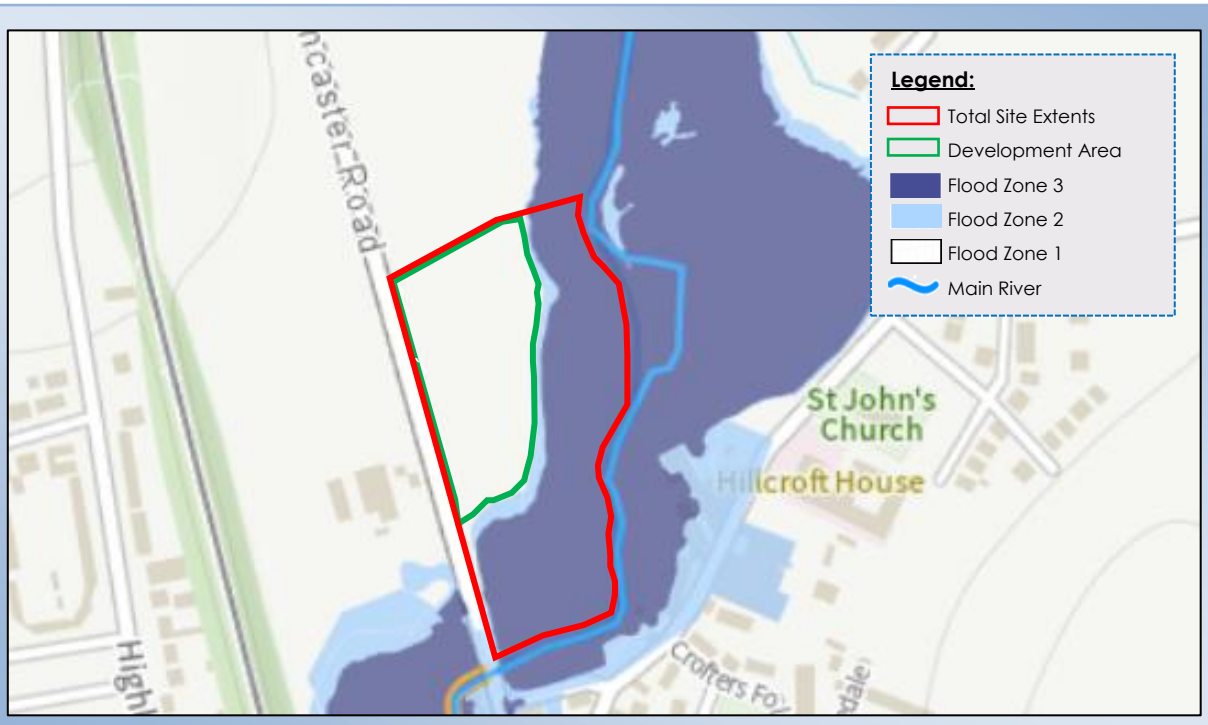

Figure 3: Fluvial/Tidal Flood Zone Map for Planning Extract (EA, 2022)

4.1.3 The site is neighboured to the east and south by the River Conder, a Main River which flows in a southerly direction. The primary source of flood risk to the site is therefore understood to be fluvial, given the proximity of the Main River. This is supported by the online fluvial flood risk mapping data included on the Gov.uk website, which has identified the site to be at very low to high fluvial flood risk. Full mapping datasets have been included within **Appendix B**.

4.1.4 The proposed residential development will however be located solely within Flood Zone 1 to adopt an intra-sequential approach to development and steer the more vulnerable aspects of the development to the areas of site at least flood risk. Given the wider sites location within Flood Zone 2 and 3, further consultation with the EA has therefore been undertaken to gain more information regarding the proposed flood risk to the site.

Environment Agency Data Review

4.1.5 The data provided by the EA was produced in March 2021 and is calibrated against the frequent flood events which have occurred in the village (although surface water flooding may have contributed greatly to some of these events). The latest model has been run in line with the latest guidance for hydrology and as a result is considered more accurate than the previous modelling, we have undertaken for the approved site located to the west of Preston Lancaster Road.

4.1.6 The model was previously Hec-ras and was updated to flood modeller -tuflow in order to create a 1D-2D model for the previously approved site located to the west. Since this time, Hec-ras now has a 2D function and JBA have updated the Hec-ras model to include a 2D domain. The model has been run for a range of key return periods events up to and including the 1 in 100yr return period event.

4.1.7 The EA has also provided onsite fluvial top water levels (TWL) for the key flood risk events up, as shown within **Table 1,** these levels have been taken from the edge of the flood zone extents, where it is understood the development will be in proximity of. The key output mapping has also been included within **Appendix B**, to demonstrate the extent of the potential flood risk and the impact it may have on the development proposals.

	Return Period Events (mAOD)			
Fluvial Flood Risk	**1 in 100yr**	**1 in 100yr plus CC (30%)**	**1 in 100yr plus CC (70%)**	**1 in 1000yr**
TWL (mAOD)	21.49	21.70	21.93	21.83
Onsite Depths (m)	0.45	0.80	1.07	0.97

Table 1: Fluvial Onsite Top Water Levels and Depths (EA, 2022).

Blockage

4.1.8 In review of the EA datasets, it has also been identified that potential blockages of the have been modelled for tributaries downstream of the site. The impact of the potential blockages to the downstream culverts/bridges are shown to impact the wider site with increases in flood depth of up to 0.1m (only +0.01 at development boundary). The key output mapping for the blockage events has also been included within **Appendix B**, to demonstrate the extent of the potential residual flood risk and the impact it may have on the development proposals. Given the modelling results provided by the EA, this impact is understood to be very low to low.

Climate Change Allowances

4.1.9 The existing EA model has also been run to include for Climate Change allowances of 30%, 35% and 70%. According to the latest Climate Change guidance, the central 2080's allowance for the area is 49%. A hydraulic modelling exercise was therefore undertaken to support this assessment using the EA's existing modelling to assess in more detail the potential fluvial flood risks to the site from the River Conder

Hydraulic Modelling

4.1.10 An original model was constructed by Betts Hydro in 2018 in support development to the west of Preston Lancaster Road. An unsteady state 1D model of the watercourse was developed using Flood Modeller Professional version 4.5 in which cross section data was transferred from the EA's Lune Tributaries Flood Risk Mapping Study (2007) HEC-RAS model. This was dynamically linked with 2D flood plain model using TUFLOW.2018-01-AB-iSP-w64to create a hydrodynamic 1D-2D model of channel and flood plain. The full Hydraulic Assessment report (HYD685-RIVER-CONDOR-HYDRAULIC-

ASSESSMENT-11-L01) included within **Appendix H**, details the improvements made to the model and the full methodology.

4.1.11 The model has been simulated in the following existing scenarios using the latest site-specific topographic survey. The model inflow boundaries were also updated to meet latest climate change standards. The following simulations have been undertaken:

- 1 in 20 year fluvial event
- 1 in 100 year fluvial event
- 1 in 100 year fluvial event plus 49% climate change
- 1 in 1000 year fluvial event

4.1.12 Furthermore, to assess the potential impact of the development site, additional modelling of the proposed scenario was undertaken in the following simulations:

- Proposed 1 in 20 year fluvial event
- Proposed 1 in 100 year fluvial event
- Proposed 1 in 100 year fluvial event plus 49% climate change
- Proposed 1 in 1000 year fluvial event

Existing Scenario

4.1.13 The existing scenarios were run using the EA's hydraulic Model with the topographic survey modifications. The modelling identified during the 1 in 20-year existing fluvial event, there is a peak water level of 21.38mAOD located adjacent to developable area. When this level is compared against the topographic survey there is potential for flood depths up to 0.06m along the

4.1.14 In the 1 in 100-year fluvial event the peak water level has been identified to be 21.41mAOD. When this level is compared against the topographic survey there is potential for flood depths up to 0.21m, adjacent to developable area. The existing scenario for the 1 in 100-year fluvial event plus 49% climate change allowance was also run and identified a peak water level of 21.46mAOD, which results in potential flood depths of up to 0.59m adjacent to the eastern and southern boundaries of the developable area, as shown within **Figure 4**.

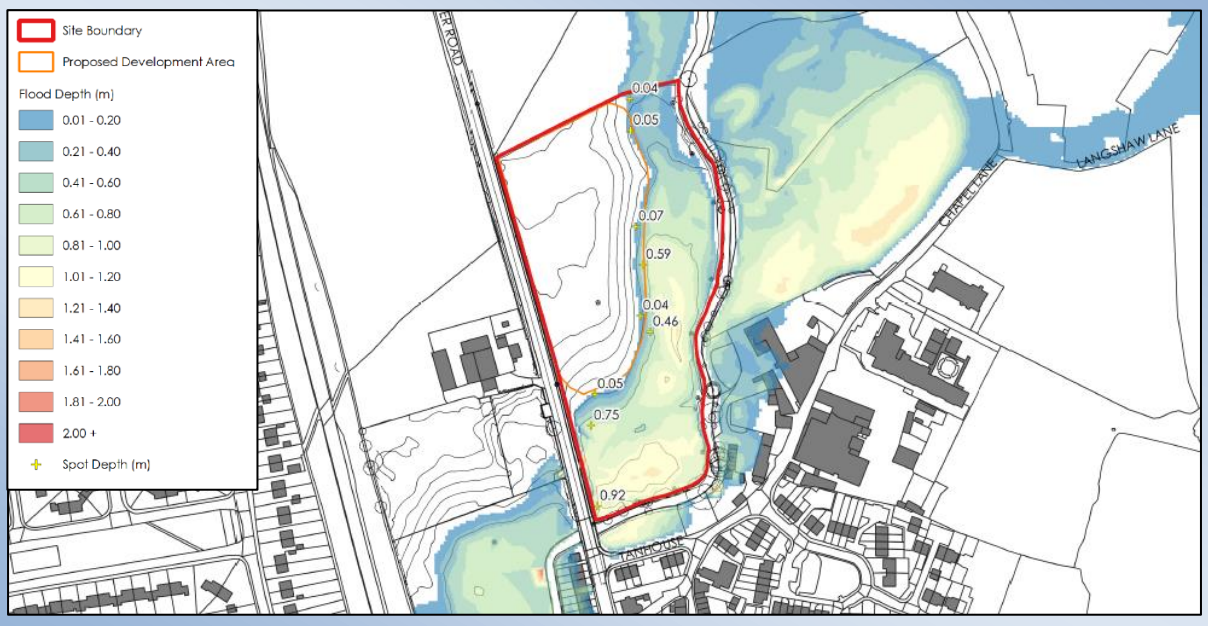

Figure 4: Existing Scenario 100yr plus 49% climate change (Betts Hydro, 2022)

4.1.15 In the more extreme 1 in 1000yr fluvial event an onsite top water level of 21.84mAOD has been identified which results in potential flood depths up to 0.56m adjacent to the developable area. Furthermore, the 1 in 100yr (delineates Flood Zone 3) and 1 in 1000yr (delineates Flood Zone 2) results have been compared against the EA's Flood Map for Planning and identified that the flood extent in the modelled 1 in 100yr and 1 in 1000yr events are shown to be less than the online Flood Map for Planning. **Figure 5** below shows the difference between the two extents in the 1 in 100yr.

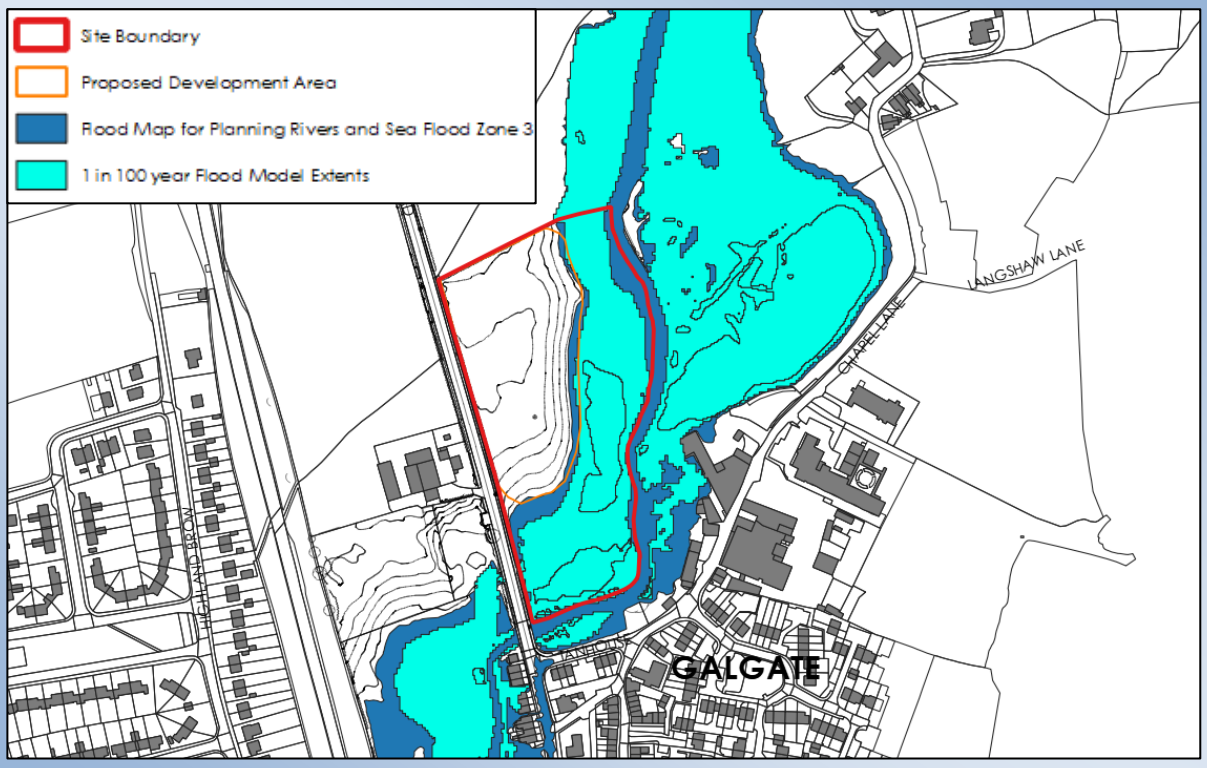

Figure 5: Comparison of Flood Zone 3 and modelled 1 in 100yr extents (Betts Hydro, 2022)

Proposed Scenario

4.1.16 A proposed scenario has been simulated in which the proposed developable area is raised sufficiently above the floodplain to represent a minimum floor level raising of 600mm which is typically required by the Environment Agency. The proposed scenario modelling has identified, during the 1 in 20yr, 1 in 100yr, 1 in 100yr plus 49% climate change allowance and the more extreme 1 in 100yr fluvial events, the peak water levels, potential flood depths and velocities located adjacent to the developable area will remain the same as the existing scenario post development. This is due to the intra-sequential approach which will be implemented onsite to steer the more vulnerable aspects of the development to the areas of site at least flood risk. Further details and mapping can be found within the full Hydraulic Assessment included within **Appendix H**.

Flood Displacement

4.1.17 The proposed scenario is shown to displace a small area of the existing floodplain in the 1 in 100yr event plus 49% climate change, due to raising site levels to ensure the development remains flood free. The proposed scenario and existing scenario depth

results have been compared and identified that the proposed scenario results in large areas of reduction in the flood depths to residential areas, as shown in **Figure 6** below.

4.1.18 The mapping however does show there to be an increase in flood depth at undeveloped land to the west of Galgate in which flood depth this is due a small instability at the peak flow at this location. There is no discernible increase in peak flow at this location in-channel between the proposed and existing scenario and therefore the increase is considered negligible.

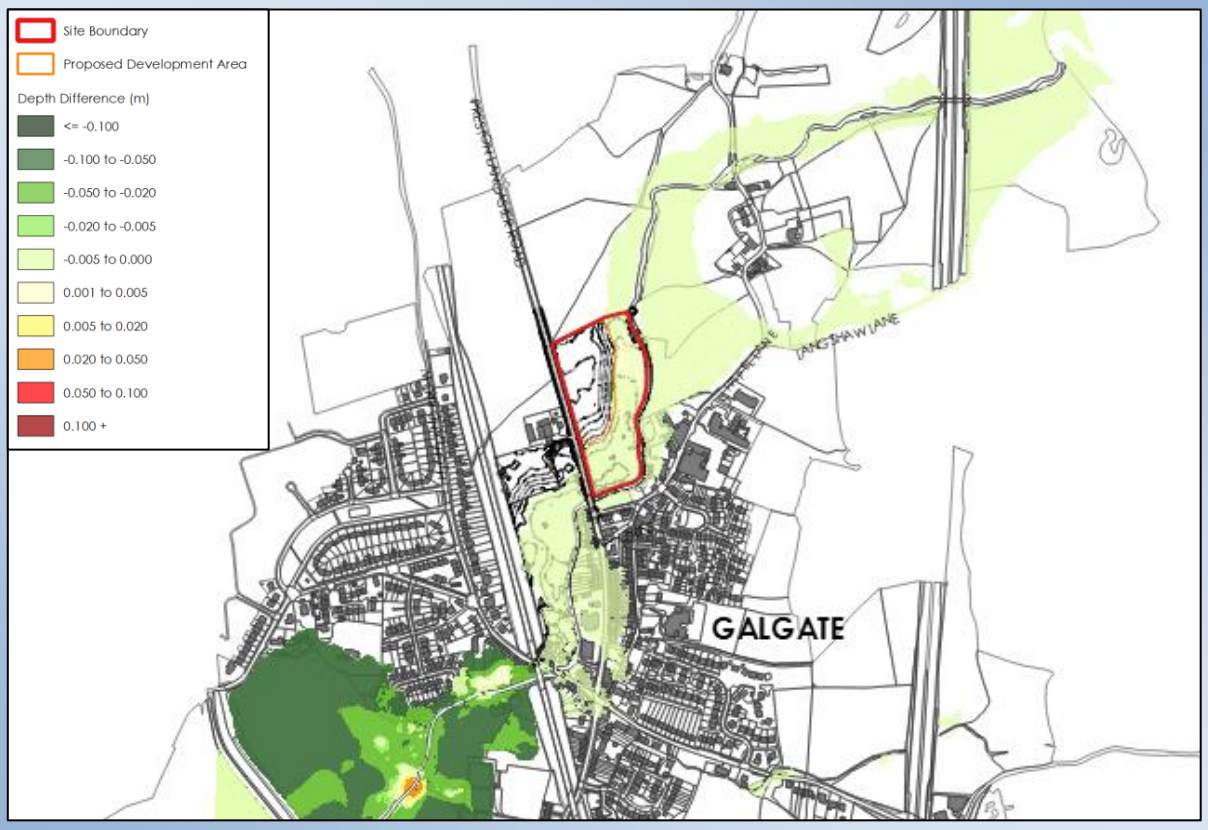

Figure 6: Proposed Relative to existing scenario 100yr 49% climate change (Betts Hydro, 2022)

Mitigation

4.1.19 To ensure residential development remains safe, the primary mitigation is typically to set the finished floor levels for the proposed dwellings (FFL) 600mm above the predicted top water level in the design event (fluvial defended 1 in 100yr plus 49% climate change event). The FFLs for the residential dwellings will vary across the site, however, a minimum FFL of 22.06mAOD is recommended.

4.1.20 As part of the proposals, the developer is exploring opportunities to provide a flood alleviation scheme to try and improve flood risk downstream. Whilst this is not actually required to support the planning application it is recognised as an ideal opportunity. The strategy is currently being developed by Betts Hydro in close consultation with the Environment Agency. The aim of the alleviation scheme is to try to reduce the frequency and severity of fluvial flooding.

4.1.21 It is recognised that in the most extreme events the volumes of flood water mean it is unlikely all of the existing flood risk to Galgate can be eliminated, however the depths and frequency in which flooding occurs may be reduced. This is principally achieved by lowering levels onsite within areas of proposed public open space adjacent to the River Conder. These lowered areas will be designed to capture some of the fluvial flood water when out of channel flooding occurs. When the scheme has been approved in principle by the EA additional details will be made available.

Safe Access and Egress

4.1.22 The proposals are to locate the more vulnerable residential development within Flood Zone 1 and the proposed dwellings will therefore remain flood free in the 1 in 100yr, 1 in 1000yr and 1 in 100yr plus CC return period storm events. The Lancaster CC SFRA notes that the village of Galgate has an existing Flood Emergency Plan which is available to view on the Lancaster Council website. This details the procedures for emergency services in the event of a future flood and could be used by future residents to provide guidance in the future if required (refer to **Appendix I** for extracts).

4.2 Tidal Flood Risk

4.2.1 The coastline is located more than 9km north-west of the development site. The River Lune estuary is approximately 5km to the west of the site. The associated tidal flood risks to site are considered to be 'low' given the proximity between site and these sources.

4.3 Flood Risk Vulnerability Classification and Flood Zone Compatibility

4.3.1 The proposals are solely 'residential' in nature and as such is classified as 'more vulnerable' in Table 2: Flood Risk Vulnerability Classification within the PPG. The wider site is considered to be located within Flood Zones 1, 2 and 3 however an intra-sequential approach to development has been adopted and the more vulnerable residential development will be located wholly within Flood Zone 1 to reduce any associated vulnerability. The Flood Risk Vulnerability and Flood Zone 'Compatibility' table within the PPG confirms that this type of land use is appropriate for Flood Zone 1, providing there is no increase in flood risk elsewhere due to the proposals.

4.4 Surface Water Flood Risk

4.4.1 Surface water flooding occurs when rainwater is unable to drain away through the normal drainage systems or soak into the ground but lies on or flows over the ground instead. The risk associated with surface water run-off is indicated by the long-term flood mapping (extract shown in **Figure 7**).

4.4.2 As indicated in **Figure 7**, the wider planning application boundary is shown to be at varying risk from surface water flooding. The area's most susceptible to surface water flooding are shown on the mapping to coincide with the naturally lower areas of the site, near to the River Conder. As noted previously not all of the sites will be residentially developed and from review of the indicative proposals the residential development will be located in the north-western portion of the site, with public open space occupying the eastern and southern areas (refer to **Appendix G**).

Predicted Flood Depths

4.4.3 The long-term flood risk mapping provides estimated flood depths and velocities of surface water flooding based on the level of risk identified. In those areas on site at highest surface water flood risk, the potential depths of flooding would over 900mm particularly in the lowest areas adjacent to the watercourse. In terms of the majority of at-risk areas within the site the potential depths of flooding range from 300mm to 900mm. In terms of the proposed residential development area, the majority of this area is shown to be predominantly at very low risk from surface water flooding.

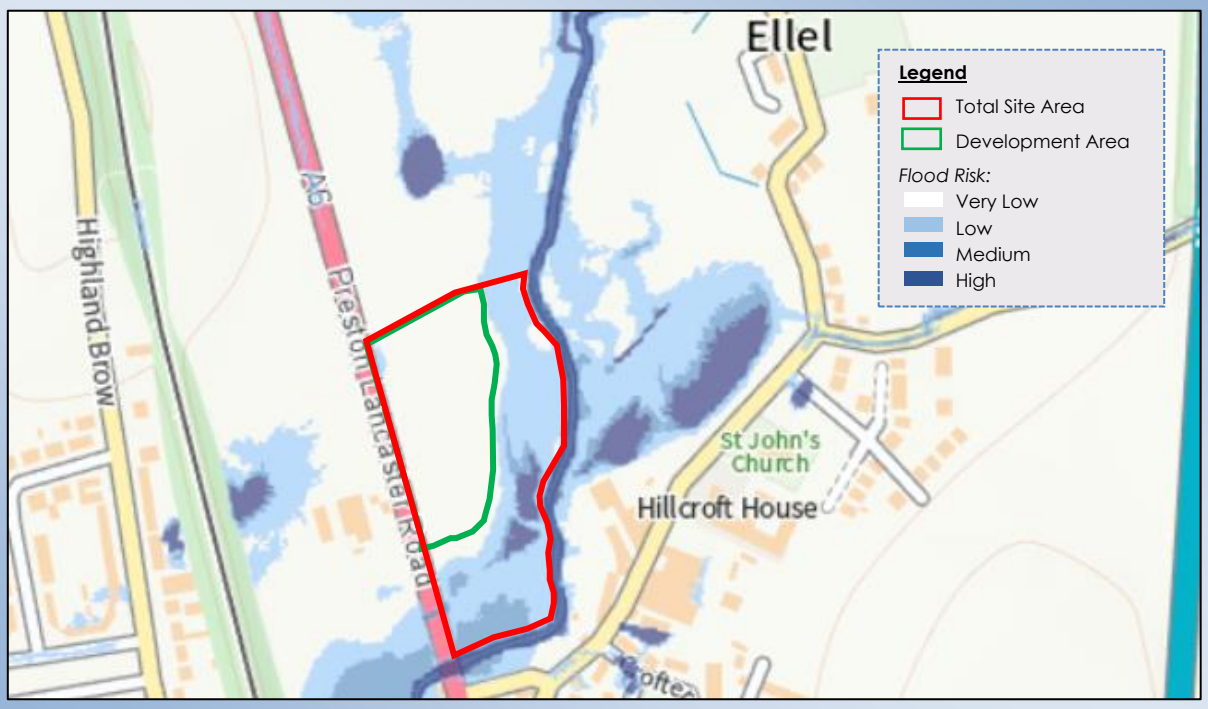

Figure 7: Surface Water Flood Map Extract (GOV.UK, 2022)

Predicted Flood Velocities

4.4.4 In terms of the predicted velocities of surface water flooding within the wider site, the long-term mapping identifies that the highest risk areas could be susceptible to velocities over 0.25m/s. These higher risk areas are however situated adjacent to the eastern and southern boundaries of the site near the Main River. The development area will however remain safe from surface water flooding.

Mitigation

4.4.5 At present the development site is predominantly undeveloped, those areas at highest surface water risk within the proposed development area, are undeveloped and low-lying. During extreme events, run-off is unable to naturally drain away from the low-lying areas (due to the surrounding topography) and the ground would become saturated limiting the potential for natural infiltration). The risk to the proposals from surface water will be inherently reduced, post-development through the design and implementation of a suitable surface water drainage regime.

4.4.6 It would be recommended that an intra-sequential approach be adopted to surface water also, where more vulnerable development be steered to the lesser flood risk areas on site. In order to mitigate any potential residual flood risk from surface water

following the implementation of onsite formal drainage infrastructure, it is advised that finished floor levels are raised a minimum of 150mm above the external levels (following any re-grade of the site) to provide overland flood routes for excess surface water run-off. This will help protect properties from excess surface water run-off.

Pluvial (Overland run-off) Flood Risk

4.4.9 Intense rainfall that is unable to soak into the ground or enter drainage systems can run-off land and result in flooding. Local topography and the land use can have a strong influence on the direction and depth of flow. The volume and rate of overland flow from land can be exacerbated if development increases the percentage of impermeable area. Any overland flows generated by the development must be carefully controlled; safe avenues directing overland flow away from adjacent dwellings is advised.

Sewer Flood Risk

4.4.10 In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and wastewater known as 'combined sewers. Foul water flooding often occurs in areas prone to overland flow and can result when the sewer is overwhelmed by heavy rainfall and will continue until the water drains away.

4.4.11 United Utilities sewer records identify there to be sewer infrastructure within the vicinity of the site. The records have identified there to be a public combined rising main onsite adjacent to the western boundary. The nearest public gravity sewers are located within the main areas of Galgate to the south-east of the River Conder. We have contacted UU regarding the possibility of previous sewer flooding close to the site, they have confirmed there has been no recorded historical sewer flooding issues in the vicinity, refer to **Appendix C** for correspondence.

4.4.12 It should be noted that there will be a requirement to provide a maintenance offset from the onsite public combined sewer rising main. The specific offset needs to be discussed with UU, as they vary depending on the size of the infrastructure and the depth at which it is laid.

4.5 Groundwater Flood Risk

4.5.1 High groundwater levels are usually the key source of groundwater flooding, which occurs when excess water emerges at the grounds surface (or within manmade underground structures such as basements). Groundwater flooding is often more insistent than surface water flooding and would typically last for weeks/months rather than days meaning the result to property is often more severe.

4.5.2 In general terms groundwater flooding can occur from three main sources:

- If groundwater levels are naturally close to the surface, then this can present a flood risk during times of intense rainfall. No groundwater flood risk has been identified during consultation with the various interested parties, including review of the Lancaster CC Strategic Flood Risk Assessment (SFRA).
- Seepage and percolation occur where embankments above ground level hold water. In these cases, water travels through the embankment material and emerges on the opposite side of the embankment. At present there are no reported problems with groundwater flooding.

- Groundwater recovery / rebound occurs where the water table has been artificially depressed by abstraction. When the abstraction stops the water table makes a recovery to its original level. There is the potential for groundwater flooding in low lying areas where groundwater levels have been depressed below their pre-pumping conditions, where these were at or close to ground level. As with the seepage scenario the likelihood of flooding from this source is low.

4.5.3 The EA mapping data for groundwater shows that the site is underlain by a Secondary A bedrock aquifer with some Secondary A deposits (**Appendix B**). The site is located within an 'Intermediate Vulnerability Zone' to a minor aquifer and no historical groundwater flooding of the site has been identified during consultation with interested parties. Irrespective, it is advised that external levels fall away from the property (where feasible) to minimise the flood risk from a variety of sources. By keeping the finished floor levels elevated relative to the externals, this should help create an overland flow route.

4.6 Artificial Sources of Flood Risk

4.6.1 National policy states that an FRA should consider the potential risks from a variety of other flood sources including artificial sources (such as risks from reservoirs and canals).

Reservoirs

4.6.2 The EA recognises reservoirs as bodies of water over 25,000cu.m and the long-term flood mapping is included in **Appendix B** which shows the extents of flooding associated with reservoirs; an extract of such is in **Figure 8**. The overall site is shown to be at some flood risk from a breach in the neighbouring reservoirs, there is also a potential flood risk to the proposed development area however this risk is considered to be less given the development areas distance from the Main River channel (which would likely act as a conduit during a reservoir breach event).

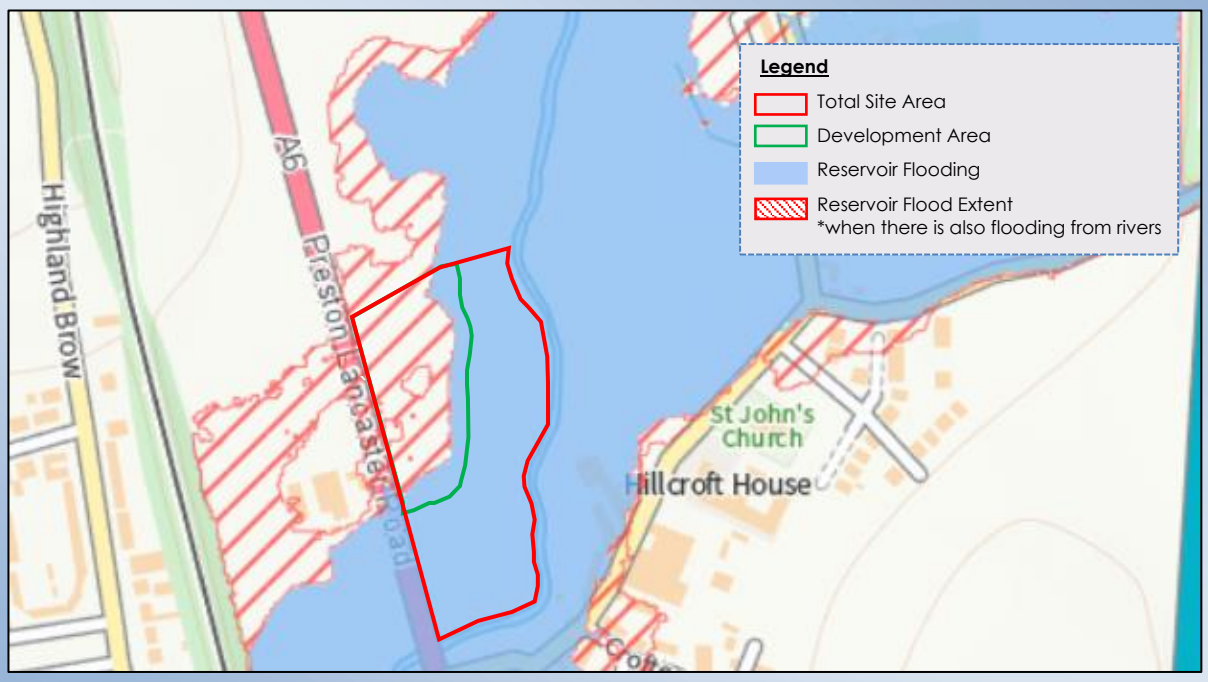

Figure 8: Reservoir Flood Extent Plan (Gov.UK, 2022)

4.6.3 It is understood that should a failure occur in an upstream reservoir; a large body of water would potentially escape at once and flooding could occur with little warning. The Reservoirs Act 1975 means that the EA ensure reservoirs (over 25,000 cu.m) are regularly inspected and safety work is carried out thus meaning a failure or breach in one of these assets is considered to be highly unlikely.

4.6.4 Although reservoir flooding is 'extremely unlikely', if a failure was to occur there would be little or no warning therefore preparedness is key. The long-term flood mapping data provides estimates of the potential flood depths and velocities associated with reservoir flooding. For the proposed development area, the estimated reservoir flood depths are between 0.3m and 2m, with the estimated speed of reservoir flooding being predominately below 0.5m/s.

Canals

4.6.5 The nearest canal to site is the Lancaster Canal which flows approximately 500m to the west of the site. No reports of canal related flooding to the site have been identified from our consultations or review of the Lancaster Council Strategic Flood Risk Assessment. Furthermore, due to the catchment characteristics and the location of the raised railway in relation to the canal and site the flood risk associated with the Lancaster Canal is considered to be 'low'.

4.6.6 Irrespective, it is advised that external levels fall away from the property (where feasible) to minimise the flood risk from a variety of sources. By keeping the finished floor levels elevated relative to the externals, this should help create an overland flood flow route in the event of a breach or any other source of flooding that could lead to overland flows including reservoir or canal flooding.

4.7 Historical and Anecdotal Flooding Information

4.7.1 Review of Lancaster City Council Strategic Flood Risk Assessment has indicated that Galgate has experienced fluvial related flooding associated with the River Conder in 1995, 1998 and 2004. Flooding impacted houses and buildings and is understood to be associated with obstruction risks linked to the University development. The SFRA also identifies historical flooding associated with Whitley Beck in 1998 (which is downstream of the site). The SFRA identifies that the Galgate area has no reported canal related flood events (see extracts in **Appendix H**). Consultation with United Utilities failed to highlight any historical flooding within the proposed development areas on the site (correspondence in **Appendix C**).

4.7.2 Consultation with the EA also confirmed some historic flooding onsite was experienced in August 2016 & 2017 (see historical flood mapping in **Appendix B**). Torrential rain fell across many parts Lancashire in the week commencing 20th November 2017, this led to water levels rising in the River Conder which meanders south through Galgate town. By Wednesday (22nd) the Environment Agency had issued flood warnings for the River Conder, Whitley Beck and Ou Beck which all flow through Galgate and the risk of localised flooding was anticipated in the town. Lancashire County Council and Lancaster City Council had issued warnings to residents on Vernon Crescent, Stoney Lane, Main Road, Salford Road and Chapel Lane, as their properties were near to the anticipated flood areas. On the evening of 22nd November and resulted in flooding to at least 100 homes and businesses in Galgate.

4.7.3 In terms of this recent flood event, the conclusion is that the proposed development proposals will however remain outside of those areas which experienced flooding in November 2017. Those areas reported to have flooded during the November 2017 floods were predominantly located adjacent to the eastern and southern boundary of the site where there is naturally low-lying land directly adjacent to the watercourse route and shown to be located within Flood Zone 2 and 3. Development is already not proposed in these areas of site and any natural flooding in this area will continue to occur as it would do naturally.

4.8 Flood Risk Mitigation Measures & Residual Risks

4.8.1 The overall site is located within Flood Zones 1, 2 and 3 based on the mapping information, however an intra-sequential approach to development has been adopted and the more vulnerable residential development will be located solely within Flood Zone 1. Irrespective to observe a more conservative approach, some mitigation measures have been discussed below in accordance with NPPF to consider the uncertainties of future climate changes.

Mitigation Measures

4.8.2 To ensure residential development remains safe, the primary mitigation is typically to set the finished floor levels for the proposed dwellings (FFL) 600mm above the predicted top water level in the design event (fluvial defended 1 in 100yr plus 49% climate change event). The FFLs for the residential dwellings will vary across the site, however, a minimum FFL of 22.06mAOD is recommended.

4.8.3 Raising the FFL's will allow for safe overland flow routes within the development and minimise any associated flood risks from overland flows. Any overland flows generated by the development must also be carefully controlled, safe avenues directing overland flow way from any existing and proposed buildings is advised.

4.8.4 As part of the proposals, the developer is exploring opportunities to provide a flood alleviation scheme to try and improve flood risk downstream. The strategy is currently being developed by Betts Hydro in close consultation with the Environment Agency. The aim of the alleviation scheme is to try to reduce the frequency and severity of fluvial flooding. This is principally achieved by lowering levels onsite within areas of proposed public open space adjacent to the River Conder. These lowered areas will be designed to capture some of the fluvial flood water when out of channel flooding occurs. When the scheme has been approved in principle by the EA additional details will be made available.

4.8.5 The River Conder is considered to be Main River by the Environment Agency and in accordance with their standards and there will be a requirement to maintain an easement from the top of bank of the watercourse for future maintenance. In terms of the easement this should allow for clear and unimpeded access, incorporating a no build area up to 8m from the top of bank into the site. The development area will be located within Flood Zone 1 only, which is shown to be significantly outside of the 8m easement requirement.

4.8.6 United Utilities sewer records identify there to be a public combined rising main onsite adjacent to the western boundary. It should be noted that there will be a requirement to provide a maintenance offset from the onsite public combined sewer rising main. The specific offset needs to be discussed with UU, as they vary depending on the size of the infrastructure and the depth at which it is laid.

4.8.7 To minimise the flood risk to the neighbouring properties it is recommended that the surface water run-off generated by the proposals be managed effectively with the peak rates of run-off being restricted to the equivalent of the pre-development situation (with betterment where required).

4.8.8 The proposed onsite surface water drainage system will need to be sized to contain the 1 in 30yr return period event below ground with exceedance from storm events up to and including the 1 in 100yr return period storm event with a 40% allowance for climate change being contained onsite.

4.8.9 As with any drainage system blockages within either the foul or surface water system have the potential to cause flooding or disruption. It is important that should any drainage systems not be offered for adoption to either the Water Company or the Local Authority then an appropriate maintenance regime should be scheduled with a suitably qualified management company for these private drainage systems.

Residual Risks

4.8.10 If an extreme rainfall event exceeds the design criteria for the drainage system it is likely that there will be some overland flows that are unable to enter the system, it is important that these potential overland flows are catered for within the proposed planning layout in the event that the capacity of the drainage system is exceeded.

5.0 SURFACE WATER MANAGEMENT

5.1 Pre-Development Surface Water Run-off

5.1.1 The total site covers 2.97ha, however the proposed development area covers a smaller portion of this at 1.27ha. At present the development site naturally drains to the low points within the site, where some localised infiltration takes place (over extended time) and ultimately discharges via overland flows into the Main River located adjacent to the eastern and southern boundary of site.

5.1.2 The peak rates and volumes of run-off generated by the development area have been calculated for the peak greenfield events using the FEH Statistical Method, as note in **Table 2** (full details **Appendix J**).

Site Area	Run-Off Rates				Run-Off Volumes	
	1 In 1 Year	1 In 30 Year	1 In 100 Year	QBar	1 In 1 Year	1 In 100 Year
1.27ha	6.3l/s	12.4l/s	15.2l/s	7.3l/s	120.3cu.m	362.8cu.m

Table 2: Pre-Development Surface Water Run-Off Rates (Betts Hydro, 2022)

5.2 Post Development Surface Water Run-Off

5.2.1 At present the indicative proposals show the development area to cover 1.27ha of the wider planning application boundary. On this based of the planning layout we have assumed that the post-development impermeable areas will cover approximately 55% of the development area (0.70ha).

Positively Drain Impermeable Area	Run-Off Rates		
	1 In 1 Yr	1 In 30 Yr	1 In 100 Yr +CC
0.70ha	33.9l/s	66.3l/s	125.7l/s

Table 3: Post-Development Un-Restricted Run-Off Rates (Betts Hydro, 2022)

5.2.2 The unrestricted post-development run-off rates have been detailed in **Table 3,** based on an impermeable area of 0.7ha (55%). The proposals however will be to restrict the rate of discharge from the development to mimic a pre-development greenfield scenario, betterment in the form of permeable surfaces will also be considered as part of detailed design where feasible to reduce surface water run-off rates.

5.3 Sustainable Drainage Systems (SuDS)

5.3.1 In accordance with national and local planning policy, including the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) and the SuDS Manual (CIRIA 753), peak surface water discharge rates from new development should be appropriately managed and where possible reduced.

5.3.2 To manage surface water run-off policy shows that preference should always be given to Sustainable Drainage Systems (SuDS) over the traditional methods of buried sewers wherever possible and practical. SuDS can (if designed and situated appropriately) address the four key sustainability objectives embedded in planning policy including providing space for water (water quantity), improving water quality and biodiversity,

along with providing valuable amenity/recreational space within new development sites. These benefits depend on the type of SuDS features being proposed.

5.3.3 Opportunities should also be taken to provide soft landscaping where at all possible on site to assist in minimising surface water run-off. It would also be recommended that permeable surfacing and bio-filtration (tree pits) be considered in non-adopted areas where at all feasible. By including measures such as these the surface water run-off is being dealt with at source and this will assist locally with surface water management (subject to optimum ground conditions).

Figure 9: SuDS Photographs (SusDrain, 2012)

5.3.4 Promoting SuDS to deal with surface water at the source, will limit the required attenuation and in turn reduce the volume of surface water in the nearby watercourse and sewer infrastructure. The presence of the permeable surfaces will allow the first 5mm of rainfall to be dealt with at source as identified in the SuDS Manual (CIRIA 753). Detailed design should confirm suitability for incorporation of SuDS following more detailed analysis of levels, ground conditions and attenuation requirements.

5.3.5 As part of the proposals, the developer is exploring opportunities to provide a flood alleviation scheme to try and improve flood risk downstream. This is principally achieved by lowering levels onsite within areas of proposed public open space adjacent to the River Conder. It is proposed that these lowered areas which may potentially be part wetland will have the potential to encourage significantly increased biodiversity and when combined with a quality landscaping scheme would offer excellent amenity value. When the scheme has been approved in principle by the EA additional details will be made available.

5.4 Methods of Surface Water Management

5.4.1 There are three methods that have been reviewed for the management and discharge of surface water. These may be applied individually or collectively to form a complete strategy and should be applied in the order of priority listed below:

- Discharge via infiltration
- Discharge to watercourse
- Discharge to public sewerage system

5.5 Discharge via Infiltration

5.5.1 Any impermeable areas that can drain to soakaway or an alternative method of infiltration would significantly improve the sustainability of any surface water systems. The Cranfield Soil and AgriFood Institute (CSAI), Soilscapes viewer identifies the soil within the area of the site to be freely draining, floodplain soils. The British Geology Survey (BGS) mapping data indicates that ground conditions are made up of Mudstone, Siltstone and Sandstone, with superficial deposits of sand and gravel. There are no BGS exploratory hole records within a relevant distance of the site.

5.5.2 The underlying strata appears to suggest that permeability is low to medium, and the FEH soil factor of 0.47 suggests a low permeability for the area (0.1 is very high and 0.5 is very low permeability). Furthermore, a Phase I Geo-Environmental Assessment Report (AN/C4901/11235) has been undertaken onsite in 2022 and identified that infiltration may be feasible in part due to the presence of permeable River Terrace deposits, subject to the depth to the groundwater and test results.

5.5.3 Based on the ground conditions identified by the online datasets, it can be considered that infiltration may be able to provide a viable surface water drainage solution for the proposals in part, subject to the depth to the groundwater and test results. In accordance with the drainage hierarchy discharge to ground (infiltration) should be the primary surface water management option to be explored given the characteristics identified above. Further investigation as part of the detailed design stage will be required to confirm this approach including Soakaway Testing to BRE365 in accordance with the LPA and UU's standard requirements.

5.6 Discharge to Watercourse

5.6.1 As testing is yet to be undertaken at the site, this assessment has considered an alternative drainage strategy at this stage in accordance with the drainage hierarchy. Should testing at the site identify that infiltration will not offer a full/part feasible surface water management solution then the next method in the hierarchical approach should be to discharge to watercourse.

5.6.2 The site is bounded to the east and south by the River Conder, which flows in a southerly direction under Preston Lancaster Road. This Main River would offer a potential alternative point of outfall should infiltration not be feasible for all of the development. The proposals are therefore to formally connect into the River conder to the south of site, as illustrated within **Figure 10**.

5.6.3 Detailed design will be required however to confirm feasibility of this option, following discussion with the relevant parties at an early stage. Consents from the EA will be required for outfall into the River Conder and the Lead Local Flood Authority (Lancashire County Council) will need to be agreement with the proposed rates of discharge.

Proposed Discharge Rates

5.6.4 In accordance with the SuDS Manual (CIRIA 753) and the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) all sites (greenfield and brownfield) should endeavour to achieve as close to pre-development greenfield rates as is viable. The proposals are to mimic therefore restrict surface water to mimic

a pre-development greenfield situation, the pre-development greenfield rate (QBar) is calculated to be 7.3/s using the FEH Method (see summary in **Appendix I**).

Figure 10: Proposed Drainage Strategy Plan Extract (Betts Hydro, 2022)

This drawing is not a drainage 'design' it is a preliminary drainage strategy. The location and sizes of proposed assets are not to scale or in fixed locations.

5.6.5 The restricted flow will generate a storage requirement during the extreme storm events. The stormwater storage figures quoted in **Table 4** are estimates only and the detailed drainage design will determine with accuracy the stormwater storage requirements.

Impermeable Area (0.70ha)	**1 In 1 Year**	**1 In 30 Year**	**1 In 100 Year + 40% CC**
Restricted Run-Off Rate	**7.3l/s**	**7.3l/s**	**7.3l/s**
Estimated Stormwater Storage Volume	59cu.m-113cu.m	176cu.m-280cu.m	428cu.m-606cu.m

Table 4: Estimated Stormwater Storage Requirements (Betts Hydro, 2022)

5.6.6 It would be beneficial to implement SuDS features including permeable surfaces and bio-filtration where at all feasible (subject to ground investigation and a detailed level review). Detailed design will be required to confirm whether SuDS can be incorporated.

5.7 Discharge to Public Sewer Network

5.7.1 Given the ground conditions identified onsite and the location of the watercourse in relation to the development sit, there are no proposals at this time to connect surface water generated by the development to the public sewer network.

5.8 Climate Change

5.8.1 There are indications that the climate in the UK is changing significantly, and it is widely believed that the nature of climate change will vary greatly by region. Current expert opinion indicates the likelihood that future climate change would produce more frequent short duration and high intensity rainfall events with the addition of more frequent periods of long duration rainfall. It is believed that the impact of climate change means there is likely to be a long-term increase in the average sea levels, with an expectation that sea levels will rise gradually.

5.8.2 In light of the future uncertainties Climate Change should be accounted for within the design of all new developments. Climate change factors have been considered and any increase in the level of flood risk (to the site) from climate change is likely to be related to the increase in rainfall intensity and duration and its impact upon the surface water drainage system.

5.8.3 In accordance with the updated Climate Change projections provides estimated changes to rainfall intensity (**Table 5**) and based on the design life of the development (100yrs) the "total potential change figures for the 2080's" has been utilised.

PROJECTIONS	TOTAL POTENTIAL CHANGE ANTICIPATED FOR THE 2080'S
Upper End Estimate	40%
Central Change Factor	20%

Table 5: Change to Extreme Rainfall Intensity Compared to 1961-1990 Baseline (Environment Agency, 2016)

6.0 FOUL WATER MANAGEMENT

6.1 Review of the United Utilities sewer records identify there to be a public combined rising main onsite located adjacent to the western boundary (**Appendix C**). Given its nature this system will not be suitable to cater for the foul water flows generated on the site and the next nearest system for a gravity connection from the site would be the public combined gravity system running south within Preston Lancaster Road (adjacent to the junction with Chapel Lane).

6.2 The foul water flows generated by the development are proposed to connect into the public combined sewer within Preston Lancaster Road approximately 80m to the south of the site boundary. A connection to UU manhole ref: 3602 is currently proposed (refer to preliminary proposed drainage strategy plan in **Appendix K**). Due to the topography of site and current understanding of this combined sewer (based on the UU records), a site wide gravity connection could be feasible. A pre-application enquiry has been undertaken with UU; however, a response is currently outstanding (see correspondence in **Appendix C**).

6.4 Detailed design will also be required to confirm feasibility of the strategy and to confirm whether a full gravity connection can be achieved. Any offsite asset routing works will also need to be considered in terms of consents with the relevant landowners (Highways Authority). Consent for work to the public sewer network will be required from UU at an early stage, this includes consent for the proposed rates of discharge and the points of connection.

7.0 SUMMARY AND CONCLUSIONS

7.1 This report has been prepared to support a residential planning application on land to the west of Preston Lancaster Road in Galgate. The total site is 2.97ha in size, however the proposed development area covers 1.27ha. The wider site extents are shown to be located within Flood Zones 1, 2 and 3 based on the Environment Agency Flood Zone Map, however the proposed residential development will be steered to the lowest flood risk areas and therefore located within Flood Zone 1.

Flood Risk

7.2 Residential development is classified as 'more vulnerable' in Table 2: Flood Risk Vulnerability Classification within the Planning Practice Guidance. The Planning Practice Guidance confirms that 'more vulnerable' development is appropriate to be located within Flood Zone 1, providing there is no increase in flood risk elsewhere.

7.3 This report has reviewed all sources of flood risk to and resulting from the proposed development. The primary flood risks to the overall site relate to the River Conder which bounds the eastern and southern boundary of the site. Parts of the wider site are located within the predicted floodplain extents; therefore, further consultation with the Environment Agency has been undertaken to gain more information regarding the proposed flood risk to the site. Additional hydraulic modelling has also been undertaken and included within this report to identify the proposed flood risk to the wider site area during the updated Climate Change flood risk events in both the existing and proposed scenarios.

7.4 The proposals will however adopt an intra-sequential approach to development and the more vulnerable development will be located in the lowest flood risk area. The development area has therefore been identified to remain flood free in the key return period events and the risk to the proposals would be low.

7.5 To ensure residential development remains safe, the primary mitigation is typically to set the finished floor levels for the proposed dwellings 600mm above the predicted top water level in the design event (fluvial defended 1 in 100yr plus 49% climate change event). The finished floor levels for the residential dwellings will vary across the site, however, a minimum finished floor level of 22.06mAOD is recommended.

Drainage Strategy

7.6 The effective management of surface water run-off is key to ensuring that no increased flood risk will result from the proposals, therefore this assessment has also considered sustainable management of surface water run-off in accordance with national and local policy. In accordance with the drainage hierarchy there are three methods that have been reviewed for the appropriate management and discharge of surface water, these have been applied in the order of priority: discharge via infiltration, to a watercourse and finally to public sewerage system.

7.7 Based on the ground conditions identified online, it can be considered that infiltration could potentially offer a viable drainage solution for part of the site based on infiltration characteristics. In accordance with LPA's and UU requirements, Soakaway Testing to BRE365 will be required to be undertaken to evidence that discharge to ground will be

feasible (prior to exploring other methods in the drainage hierarchy). Should infiltration not offer a feasible solution then the next option should be discharge to a watercourse.

7.8 The River Conder flows adjacent to the eastern and southern boundaries of the site; this would potentially offer a suitable alternative point of discharge for surface water generated by the proposals. It is proposed that a new formal outfall to the Main River be created, detailed design will be required to confirm feasibility of this approach. Consents from the Environment Agency will be required for works to the Main River (particularly due to the presence of existing flood defences along the watercourse stretch). Agreement of the proposed rates of discharge will be required from the Lead Local Flood Authority (Lancashire County Council).

7.9 In accordance with the SuDS Manual (CIRIA 753) and the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) all sites should endeavour to achieve as close to pre-development greenfield rates as is viable. The proposals are therefore to discharge to the watercourse at greenfield rates, at present the pre-development QBAR rate of 7.3l/s has been calculated. The restricted flow will generate a storage requirement during periods of intense rainfall, this will need to be considered in terms of onsite attenuation as part of detailed design following confirmation of the feasibility of infiltration.

7.10 It would be beneficial to implement SuDS features including permeable surfaces and bio-filtration where at all feasible. If designed appropriately the SuDS features could potentially aid in the attenuation requirements for the proposals and provide added benefits in terms of water quality. Detailed design will be required to confirm whether SuDS can be incorporated.

7.11 This report has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The report is considered to be commensurate with the scale and nature of the development proposals and in summary, the development can be considered appropriate in accordance with the Planning Practice Guidance.

8.0 RECOMMENDATIONS

8.1 To ensure residential development remains safe, the primary mitigation is typically to set the finished floor levels for the proposed dwellings (FFL) 600mm above the predicted top water level in the design event (fluvial defended 1 in 100yr plus 49% climate change event). The FFLs for the residential dwellings will vary across the site, however, a minimum FFL of 22.06mAOD is recommended.

8.2 Raising the FFL's will allow for safe overland flow routes within the development and minimise any associated flood risks from overland flows. Any overland flows generated by the development must also be carefully controlled, safe avenues directing overland flow way from any existing and proposed buildings is advised.

8.3 As part of the proposals, the developer is exploring opportunities to provide a flood alleviation scheme to try and improve flood risk downstream. The strategy is currently being developed by Betts Hydro in close consultation with the Environment Agency. The aim of the alleviation scheme is to try to reduce the frequency and severity of fluvial flooding. This is principally achieved by lowering levels onsite within areas of proposed public open space adjacent to the River Conder. These lowered areas will be designed to capture some of the fluvial flood water when out of channel flooding occurs. When the scheme has been approved in principle by the EA additional details will be made available.

8.4 The River Conder is considered to be Main River by the Environment Agency and in accordance with their standards and there will be a requirement to maintain an easement from the top of bank of the watercourse for future maintenance. In terms of the easement this should allow for clear and unimpeded access, incorporating a no build area up to 8m from the top of bank into the site. The development area will be located within Flood Zone 1 only, which is shown to be significantly outside of the 8m easement requirement.

8.5 United Utilities sewer records identify there to be a public combined rising main onsite adjacent to the western boundary. It should be noted that there will be a requirement to provide a maintenance offset from the onsite public combined sewer rising main. The specific offset needs to be discussed with UU, as they vary depending on the size of the infrastructure and the depth at which it is laid.

8.6 Detailed drainage design will be required to confirm feasibility of the drainage strategy following more in-depth levels and layout review. Early discussion with all relevant parties including the EA and LLFA, for the connection to watercourse is advised. Early discussions with relevant parties will identify any additional considerations including access, points of connection and downstream capacity constraints.

8.7 Consideration is recommended into the stormwater attenuation requirements due to restricting the surface water discharge from the site. The proposed onsite surface water drainage system will need to be sized to contain the 30yr return period event wholly below ground with overland run-off from storm events up to and including the 1 in 100yr return period storm event with an allowance for climate change being contained onsite. Based on the design life this allowance for CC is in the form of a 40% increase in rainfall intensity.

BIBLIOGRAPHY & REFERENCES

Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities – Environment Agency/DEFRA 2016
CIRIA 522: Sustainable urban drainage systems – design manual for England and Wales (2000).
CIRIA 523: Sustainable urban drainage systems – best practice manual (2001).
CIRIA 609: Sustainable drainage systems. Hydraulic, structural and water quality advice (2004).
CIRIA 624: Development and flood risk – guidance for the construction industry (2004).
CIRIA 635: Designing for Exceedance in urban drainage: Good practice (2006).
CIRIA 644: Building Greener (2007).
CIRIA 753: The SUDS manual (2015).
Flood Risk to People – Phase 2 (FD2321/TR2), DEFRA and the Environment Agency (2006).
Flood estimation for small catchments: Institute of Hydrology Report No.124, NERC (1994).
Flood Estimation Handbook, Centre for Ecology and Hydrology (1999).
Planning Policy Statement 25: Development and Flood Risk (2006).
Sewers for Adoption 7th Edition, WRc (2012).
Technical Guidance to the National Planning Policy Framework, CLG (2012).

Web-based References

Bingmaps – http://www.bing.com/Maps/
British Geological Survey – http://www.bgs.ac.uk/opengeoscience/home.html
Chronology of British Hydrological Events – www.dundee.ac.uk/
CIRIA – http://www.ciria.org/
Cranfield University – http://www.landis.org.uk/soilscapes/
Environment Agency – www.environment-agency.gov.uk/
FloodProBE – http://www.floodprobe.eu/
Flood Forum – http://www.floodforum.org.uk/
Flood London – http://www.floodlondon.com/
Google Maps – http://maps.google.co.uk/
Streetmap – http://www.streetmap.co.uk/
United Utilities - http://www.unitedutilities.com/default.aspx

APPENDIX A: NPPF EXTRACTS

This page has been left intentionally blank

14. Meeting the challenge of climate change, flooding and coastal change

152. The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.

Planning for climate change

153. Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures[53]. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

154. New development should be planned for in ways that:

a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and

b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

155. To help increase the use and supply of renewable and low carbon energy and heat, plans should:

a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);

b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and

---

[53] In line with the objectives and provisions of the Climate Change Act 2008.

c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

156. Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

157. In determining planning applications, local planning authorities should expect new development to:

a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and

b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

158. When determining planning applications for renewable and low carbon development, local planning authorities should:

a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and

b) approve the application if its impacts are (or can be made) acceptable[54]. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

Planning and flood risk

159. Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

160. Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.

---

[54] Except for applications for the repowering of existing wind turbines, a proposed wind energy development involving one or more turbines should not be considered acceptable unless it is in an area identified as suitable for wind energy development in the development plan; and, following consultation, it can be demonstrated that the planning impacts identified by the affected local community have been fully addressed and the proposal has their backing.

161. All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

a) applying the sequential test and then, if necessary, the exception test as set out below;

b) safeguarding land from development that is required, or likely to be required, for current or future flood management;

c) using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management); and

d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.

162. The aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

163. If it is not possible for development to be located in areas with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in Annex 3.

164. The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. To pass the exception test it should be demonstrated that:

a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

b) 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.

165. Both elements of the exception test should be satisfied for development to be allocated or permitted.

166. Where planning applications come forward on sites allocated in the development plan through the sequential test, applicants need not apply the sequential test again. However, the exception test may need to be reapplied if relevant aspects of the proposal had not been considered when the test was applied at the plan-

making stage, or if more recent information about existing or potential flood risk should be taken into account.

167. When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment[55]. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;

b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;

c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;

d) any residual risk can be safely managed; and

e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

168. Applications for some minor development and changes of use[56] should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 55.

169. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a) take account of advice from the lead local flood authority;

b) have appropriate proposed minimum operational standards;

c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and

d) where possible, provide multifunctional benefits.

Coastal change

---

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

[56] This includes householder development, small non-residential extensions (with a footprint of less than 250m^2) and changes of use; except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the sequential and exception tests should be applied as appropriate.

170. In coastal areas, planning policies and decisions should take account of the UK Marine Policy Statement and marine plans. Integrated Coastal Zone Management should be pursued across local authority and land/sea boundaries, to ensure effective alignment of the terrestrial and marine planning regimes.

171. Plans should reduce risk from coastal change by avoiding inappropriate development in vulnerable areas and not exacerbating the impacts of physical changes to the coast. They should identify as a Coastal Change Management Area any area likely to be affected by physical changes to the coast, and:

a) be clear as to what development will be appropriate in such areas and in what circumstances; and

b) make provision for development and infrastructure that needs to be relocated away from Coastal Change Management Areas.

172. Development in a Coastal Change Management Area will be appropriate only where it is demonstrated that:

a) it will be safe over its planned lifetime and not have an unacceptable impact on coastal change;

b) the character of the coast including designations is not compromised;

c) the development provides wider sustainability benefits; and

d) the development does not hinder the creation and maintenance of a continuous signed and managed route around the coast[57].

173. Local planning authorities should limit the planned lifetime of development in a Coastal Change Management Area through temporary permission and restoration conditions, where this is necessary to reduce a potentially unacceptable level of future risk to people and the development.

---

[57] As required by the Marine and Coastal Access Act 2009.

Revision date: 06 03 2014

What should be considered if bringing forward a Neighbourhood Development Order/Community Right to Build Order in an area at risk of flooding?

The general approach and requirements for site-specific flood risk assessments should be applied to developments in areas at risk of flooding to be permitted by Neighbourhood Development/ Community Right to Build Orders. This means that for any development proposals:

- in Flood Zone 2 or 3;
- or of at least 1 hectare;
- or in an area that has critical drainage problems (as notified to the local planning authority by the Environment Agency);
- or that may be subject to other sources of flood risk;

a site-specific flood risk assessment should support the draft Order. The flood risk assessment checklist may be helpful in this respect.

Where the neighbourhood planning area is in Flood Zone 2 or 3, or is in an area with critical drainage problems, advice on the scope of the flood risk assessment required should be sought from the Environment Agency. Where the area may be subject to other sources of flooding, it may be helpful to consult other bodies involved in flood risk management, as appropriate.

Where a Neighbourhood Development/Community Right to Build Order is under consideration for a site/area in Flood Zone 2 or 3, which has not been allocated in the development plan through the Sequential Test, and if necessary the Exception Test, it will be necessary for those proposing the development, in having regard to the National Planning Policy Framework's policies on flood risk, to demonstrate why the development cannot reasonably be located in areas of lower flood risk.

In all cases where new development is proposed, the sequential approach to locating development in areas of lower flood risk should still be applied within a neighbourhood planning area.

Neighbourhood Development/Community Right to Build Orders that propose new development that would be;

- contrary to the flood risk vulnerability and flood zone compatibility table (Table 3), or;
- within areas at risk of flooding where sequential testing shows there to be places at lower flood risk which are suitable and reasonably available for the development proposed,

should not be considered appropriate, having regard to the national policies on development and flood risk.

Paragraph: 064 Reference ID: 7-064-20140306

Revision date: 06 03 2014

Flood Zone and flood risk tables

- Table 1: Flood Zones
- Table 2: Flood risk vulnerability classification
- Table 3: Flood risk vulnerability and flood zone 'compatibility'

Table 1: Flood Zones

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 (https://flood-map-for-planning.service.gov.uk/)), 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)

Note: The Flood Zones shown on the Environment Agency's Flood Map for Planning (Rivers and Sea) do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding. Reference should therefore also be made to the Strategic Flood Risk Assessment when considering location and potential future flood risks to developments and land uses.

Paragraph: 065 Reference ID: 7-065-20140306

Revision date: 06 03 2014

Table 2: 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.

" * " Landfill is as defined in Schedule 10 of the Environmental Permitting (England and Wales) Regulations 2010 (http://www.legislation.gov.uk/uksi/2010/675/schedule/10/made).

Paragraph: 066 Reference ID: 7-066-20140306

Revision date: 06 03 2014

Table 3: Flood risk vulnerability and flood zone 'compatibility'

Table 3: flood risk vulnerability and flood zone ‘compatibility'
(https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/575184/Table_3_-_Flood_risk_vulnerability_and_flood_zone__compatibility_.pdf) (PDF, 58.1KB, 1 page)

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.

Paragraph: 067 Reference ID: 7-067-20140306

Revision date: 06 03 2014

Site-specific flood risk assessment: Checklist

1 - Development site and location

You can use this section to describe the site you are proposing to develop. It would be helpful to include, or make reference to, a location map which clearly indicates the development site.

a. Where is the development site located? (eg postal address or national grid reference)

b. What is the current use of the site? (eg undeveloped land, housing, shops, offices)

c. Which Flood Zone (for river or sea flooding) is the site within? (ie Flood Zone 1, Flood Zone 2, Flood Zone 3). As a first step, you should check the Flood Map for Planning (http://apps.environment-agency.gov.uk/wiyby/37837.aspx) (Rivers and Sea). It is also a good idea to check the Strategic Flood Risk Assessment for the area available from the local planning authority.

2 - Development proposals