



Counterpoint Properties Ltd.

94 - 100 HOOK LANE, BOGNOR REGIS

Flood Risk Assessment and Surface Water
Drainage Strategy





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Flood Risk Assessment and Surface Water Drainage Strategy

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QUALITY CONTROL

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1. INTRODUCTION

1.1. APPOINTMENT AND BRIEF

- 1.1.1. WSP was commissioned by Counterpoint Properties Ltd. to prepare a site-specific Flood Risk Assessment (FRA) including a drainage strategy for a Proposed Development at 94 – 100 Hook Lane [hereafter referred to as the 'Application Site' or the 'Proposed Development']. The site is approximately 0.28 hectares (ha) in size. A location plan is provided in Appendix A.

1.2. STUDY OBJECTIVES

- 1.2.1. The FRA has been produced in line with the requirements of the NPPF and the Environment Agency's Standing Advice, and in consultation with West Sussex County Council (WSCC), the Environment Agency and Arun District Council (ADC).
- 1.2.2. Climate change predictions have been considered over the lifetime of the Proposed Development. A key part of the FRA is a conceptual surface water drainage strategy for the site.

1.3. METHODOLOGY

- 1.3.1. The following tasks have been undertaken in the preparation of this FRA:

- A desk study and data research including review of relevant national and local policies and guidance (a summary of which is provided in Section 2);
- Consultation with regulatory bodies and third parties, including:
 - The Environment Agency;
 - West Sussex County Council; and
 - Arun District Council.

(Copies of correspondence exchanged with these stakeholders are provided in Appendix B.)

- An assessment of flooding to the Application Site and Proposed Development from the following sources: fluvial, pluvial, groundwater, sewers and man-made infrastructure;
- An assessment of the impact of the Proposed Development on local flood risks;
- An assessment of the residual flood risk to the Proposed Development and neighbouring property from local flood sources;
- An estimation of surface water flows based on the current conditions at the Application Site and existing drainage systems; and
- An estimation of post development surface water flows based on the development proposals, and a preliminary drainage strategy.

2. POLICY

2.1. NATIONAL POLICY AND GUIDANCE

NATIONAL PLANNING POLICY FRAMEWORK (NPPF), FEBRUARY 2019¹

- 2.1.1. The NPPF requires that a Flood Risk Assessment should be undertaken for all developments greater than 1 Hectare (ha) in size; for any development located in Flood Zone 2 or 3; and for sites less than 1 ha in Flood Zone 1, including a change of use in development type to a more vulnerable class (e.g. from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (e.g. surface water drains, reservoirs).
- 2.1.2. The NPPF requires a flood risk assessment to be undertaken to demonstrate that the Proposed 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.

NON-STATUTORY TECHNICAL STANDARDS FOR SUSTAINABLE DRAINAGE SYSTEMS, MARCH 2015²

- 2.1.3. The non-statutory technical standards document provides significant guidance regarding the management of sustainable drainage systems (SuDS). It states that the rate of discharge from the redevelopment must be as close as reasonably practicable to the greenfield runoff rate but should not exceed that of the pre-development condition.

FLOOD RISK ASSESSMENTS: CLIMATE CHANGE ALLOWANCES, JULY 2020³

- 2.1.4. A summary of the Environment Agency's climate change allowances is provided in Section 3. The revised guidance was published in February 2016 and last updated in July 2020, where information regarding peak river flow, sea level rise, wind speed, wave height and storm surge were updated and new allowances for extreme climate change scenarios, known as High++ (H++) were added.

¹https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf

²https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

³<https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

2.2. LOCAL POLICY

ARUN LOCAL PLAN 2011-2031, JULY 2018⁴

- 2.2.1. The Arun Local Plan was adopted in July 2018 and aims to manage future growth and encourage sustainable development within Arun District, excluding areas within the South Downs National Park (SDNP).
- 2.2.2. The Local Plan has several policies relating to flood risk which have been considered as part of this FRA, including:
- Policy ECC SP1: Adapting to Climate Change
 - Policy W SP1: Water
 - Policy W DM1: Water Supply and Quality
 - Policy W DM2: Flood Risk
 - Policy W DM3: Sustainable Urban Drainage Systems

ARUN DISTRICT COUNCIL SUPPLEMENTARY REQUIREMENTS FOR SURFACE WATER DRAINAGE PROPOSALS⁵

- 2.2.3. Arun District Council has provided further supplementary requirements for surface water drainage proposals that must be considered for any proposed surface water drainage scheme.
- 2.2.4. The guidance refers to CIRIA C753: The SuDS Manual, BS8582:2013 – Code of Practice for Surface Water Management for Development Sites, CIRIA R156 – Infiltration Drainage, the Approved Document H of the Building Regulations, and BRE 365 – Soakaway Design.

ARUN DISTRICT COUNCIL STRATEGIC FLOOD RISK ASSESSMENT (SFRA), AUGUST 2016⁶

- 2.2.5. The SFRA was commissioned to update the SFRA for the District outside of the National Park and replaces the Level 1 and Level 2 SFRA originally published by Arun District Council in February 2008.
- 2.2.6. The SFRA establishes flood risk within Arun District at a strategic level. It does not specifically assess flood risk to the Application Site but gives an overview of the flood risk within the area.

⁴ <https://www.arun.gov.uk/download.cfm?doc=docm93ijm4n12844.pdf&ver=12984>

⁵ <https://www.arun.gov.uk/surfacewater-> accessed 10th June 2021

⁶ <https://www.arun.gov.uk/download.cfm?doc=docm93ijm4n9414.pdf&ver=9270>

WEST SUSSEX PRELIMINARY FLOOD RISK ASSESSMENT (PFRA), MAY 2011⁷

- 2.2.7. The PFRA provides a high-level overview of flood risk from local flood sources (surface water, groundwater, ordinary watercourses and canals). It does not specifically assess flood risk to the Application Site.

WEST SUSSEX LOCAL FLOOD RISK MANAGEMENT STRATEGY (LFRMS), MAY 2014⁸

- 2.2.8. The West Sussex LFRMS (2013 – 2018) sets out how West Sussex County Council carries out its flood risk responsibilities that are a statutory requirement of the Flood and Water Management Act 2010.
- 2.2.9. The Strategy states that all new development near areas of flood risk needs to be appropriate and requires building design and drainage to be scrutinised to ensure risk is managed. Development should not be granted permission if proposals will increase flood risk to others. Bognor Regis is one of the higher priority wet spots identified in the LFRMS where risk management authorities will initially prioritise work. It is predicted that 900 properties are at risk from surface water flooding, 1200 properties are at risk from fluvial and coastal flooding and 200 properties are at risk of both fluvial / coastal and surface water flooding.

BEACHY HEAD TO SELSEY BILL SHORELINE MANAGEMENT PLAN (SMP), MAY 2006⁹

- 2.2.10. The Beachy Head to Selsey Bill SMP sets the strategic policy for the management of the coastal defences that protect Bognor Regis. The policy for the next 100 years for the relevant policy unit (Felpham to Aldwick – Unit 23) is to 'Hold the Line' of the existing defences. Therefore, it is expected that the coastal defences that protect the Proposed Development will be maintained to their current standard for the next 100 years.

ARUN AND WESTERN STREAMS CATCHMENT FLOOD MANAGEMENT PLAN (CFMP), DECEMBER 2009¹⁰

- 2.2.11. The site is located within the Coastal Plains policy unit of the CFMP which sets the strategic policy for fluvial flood risk management.

⁷ https://www.westsussex.gov.uk/media/1626/west_sussex_pfra.pdf

⁸ https://www.westsussex.gov.uk/media/1595/local_flood_risk_management_strategy.pdf

⁹ <https://www.southdowns.gov.uk/wp-content/uploads/2018/04/TLL-19-Beachy-Head-to-Selsey-Shoreline-Management-Plan-2006.pdf>

¹⁰ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/293864/Arun_and_Western_Streams_Catchment_Flood_Management_Plan.pdf

- 2.2.12. The policy for the Coastal Plains policy unit is described as ‘Areas of low, moderate or high flood risk where flood risk is being effectively managed but where further actions may be necessary to keep place with climate change.’

WATER.PEOPLE.PLACES – A GUIDE FOR MASTER PLANNING SUSTAINABLE DRAINAGE INTO DEVELOPMENTS, SEPTEMBER 2013¹¹

- 2.2.13. This guidance outlines the process for integrating SuDS into the master planning of developments and provides techniques for employing SuDS for a range of sites, including those in a floodplain area, sites with surface water flooding issues and sites with poor permeability.

¹¹ https://www.susdrain.org/files/resources/other-guidance/water_people_places_guidance_for_master_planning_sustainable_drainage_into_developments.pdf

3. CLIMATE CHANGE

3.1. BACKGROUND INFORMATION

- 3.1.1. The NPPF Flood Risk and Coastal Change Planning Practice Guidance (PPG) states that the lifespan of residential development should be considered to be a minimum of 100 years.
- 3.1.2. The Government's Flood Risk Assessments: climate change allowances guidance states that for peak rainfall intensity, which is applied in the surface water drainage design for the Proposed Development, both the central and upper end allowances should be considered in order to understand the range of impacts that may occur as a result of climate change. Over 100 years, these allowances are 20% and 40% respectively (see Table 3-2). Refer to <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>.
- 3.1.3. The drainage strategy included within this FRA has been prepared on the basis of calculations using a 40% increase in peak rainfall intensity (Upper end allowance) to ensure that the design is robust and that no properties would flood as a result of surface water generated by the Proposed Development for all storm events up to and including this event.
- 3.1.4. The Government's Flood Risk Assessments: climate change allowances guidance states that for fluvial flows, the central allowance should be used as the development is classified as being more vulnerable and is situated within Flood Zone 3a.
- 3.1.5. The impacts of climate change on the Proposed Development are discussed in Section 8 of this FRA.
- 3.1.6. The climate change allowances for fluvial flows relevant to the site are summarised in Table 3.1 below.

Table 3.1 - Environment Agency Climate Change Allowances: Arun and Western Streams Management Catchment peak river flow allowances.

Climate Change Estimate	for the '2020s' (2015 to 2039)	for the '2050s' (2040 to 2069)	for the '2080s' (2070 to 2115)
Fluvial Flows: Upper	+27% (peak river flow)	+36% (peak river flow)	+64% (peak river flow)
Fluvial Flows: Higher	+16% (peak river flow)	+19% (peak river flow)	+36% (peak river flow)
Fluvial Flows: Central	+11% (peak river flow)	+13% (peak river flow)	+25% (peak river flow)

Table 3-2 - Peak rainfall intensity allowance in small catchments (less than 5km²) or urban drainage catchments (based on a 1961 to 1990 baseline)

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

Table 3-3 - sea level allowances for the South East river basin district for each epoch in mm per year (based on a 1981 to 2000 baseline), with total sea level rise shown in brackets for each epoch.

Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Higher central	5.7 (200)	8.7 (261)	11.6 (348)	13.1 (393)	1.20
Upper end	6.9 (242)	11.3 (339)	15.8 (474)	18.2 (546)	1.60

4. BACKGROUND

4.1. SITE LOCATION

- 4.1.1. The Application Site is situated off Hook Lane, Bognor Regis. The Ordnance Survey (OS) grid reference for the Application Site is (494296, 099738) and the nearest post code is PO22 8AT. Refer to Appendix A for the Site Location Plan.
- 4.1.2. The Application Site is bordered by Hook Lane to the north, by a residential dwelling to the west, and by the University of Chichester to the east and south. To the east of the site, is a recent extension of the University's Campus, which includes student accommodations, an academic building and car park spaces.

4.2. SITE DESCRIPTION

- 4.2.1. The Application Site is approximately 0.28ha and is situated at 94 – 100 Hook Lane, Bognor Regis. The site boundaries extend to the limits of the current curtilage, and the current use of the site is residential.

Table 4-1 - Application Site Characteristics

CHARACTERISTIC	DESCRIPTION	
Area	Approximately 0.28 ha	
General Topography	The site topography is predominantly flat; with ground levels ranging between approximately 1.2m AOD in the east to approximately 2.2m AOD in the north-west (refer to Drawing 42858-TOP-001 in Appendix A and Site Survey in Appendix D).	
Existing Surfacing	The site is covered by hardstanding (mainly the footprint of existing buildings) and gardens.	
Current Use	Residential	
Boundaries	North	Hook Lane
	South	University of Chichester campus
	East	University of Chichester campus
	West	Existing dwelling
Access	Vehicular access is understood to be provided via Hook Lane.	

4.3. TOPOGRAPHY AND SITE FEATURES

- 4.3.1. In June 2018 Stuart Bailey Land Surveyor completed a topographic survey for the Application Site. The topographical survey indicates levels on site range from 1.2m AOD in the eastern and south eastern part of the Site and 2.2m AOD in the north-western corner of the site.

- 4.3.2. The topographic survey did not cover the entirety of the site, i.e. the properties 96 and 98 Hook Lane were not surveyed.
- 4.3.3. The Environment Agency 1m Digital Terrain Model (DTM) provides the general topography of the surrounding area (refer to Drawing 47808-TOP-001 in Appendix A). The DTM indicates that the land to the north-west and south-west is slightly higher and the general ground levels reduce towards to the east, towards the Aldingbourne Rife.
- 4.3.4. The DTM also shows higher ground adjacent to the site. The topographic survey however indicates that this is due to a line of trees/vegetation which is not reflected in the DTM data and therefore it shows that the land slopes to the east at that location.

4.4. GEOLOGY AND HYDROGEOLOGY

- 4.4.1. British Geological Survey (BGS) mapping shows that the site is underlain by both bedrock and superficial deposits. Bedrock geology consists mainly of Chalk Formation which is classed as a Principal Aquifer by the Environment Agency. Lambeth Group (clay, silt and sand) is present in the southern part of the site and is classified as a Secondary A Aquifer by the Environment Agency. For the bedrock geology refer to Drawing 47808-BGS-001 in Appendix A.
- 4.4.2. Superficial deposits of raised marine deposits (clay, silt, sand and gravel) cover the site entirely (refer to Drawing 47808-BGS-002 in Appendix A).
- 4.4.3. Online Government sources (available at www.magic.gov.uk and accessed in June 2018) indicate that the Application Site is not within a Groundwater Source Protection Zone (SPZ).
- 4.4.4. British Geological Survey borehole records are not available for the Application Site. The closest BGS borehole record, SZ99NW42, is located approximately 150m to east of the site and situated in the raised marine deposits (refer to Appendix H). The ground materials found in this borehole indicate that the site is underlain by silty clay and sandy silt. Groundwater was found at approximately 2.5m below ground level (bgl).
- 4.4.5. Site specific ground investigations have not been undertaken at the site, however, a soil infiltration test for the adjacent University site indicated a low infiltration rate for the underlying geology. The publicly available FRA for the University of Chichester shows that groundwater monitoring was undertaken on three occasions in December 2015 and the groundwater levels 25m to 40m to the east of the site were between 0.6m bgl and 0.9m bgl.

4.5. EXISTING WATERCOURSES

- 4.5.1. The Aldingbourne Rife (Main River) runs south approximately 200m to the east of the eastern boundary of the site.
- 4.5.2. Appendix B of the Arun District Council SFRA (refer to Appendix I) indicates that an ordinary watercourse runs to the rear of the existing properties, south-east of the site. The watercourse is mapped starting approximately 200m to the west of the site. However, the Southern Water asset plan (refer to Appendix E) shows that this watercourse has been culverted by a 750mm surface water sewer. The outfall is located immediately downstream of the site. It continues running as an

open ditch, through the University of Chichester campus and joins another unnamed ordinary watercourse near Felpham Way.

4.6. EXISTING FLOOD DEFENCES

- 4.6.1. Environment Agency correspondence (Appendix C) confirms that no formal Environment Agency flood defences are in place to protect the Application Site from fluvial flooding. Tidal flood defences are in place along the coastal frontage and offer a standard of protection equivalent to the 0.5% annual probability tidal event.
- 4.6.2. The Arun District Council SFRA gives further details of the tidal defences and the associated Felpham pumping station. The Aldingbourne Rife usually discharges beneath the tidal flood defences and across the foreshore through two flapped gravity outfall structures. However, when tidal conditions and river flows dictate, the Felpham pumping station pumps water over the sea wall, discharging to a stilling basin on the upper foreshore.

4.7. EXISTING SEWER AND DRAINAGE INFRASTRUCTURE

- 4.7.1. Southern Water asset records (Appendix E), indicate that a 150mm diameter foul sewer runs along Hook Lane and continues next to the eastern site boundary in a north-south direction. Near the south-eastern boundaries the 150mm foul sewer follows a south-eastern direction.
- 4.7.2. A 600mm diameter foul sewer located south of the site boundary runs to the south-east.
- 4.7.3. A 750mm diameter surface water sewer is present at the southern site boundary which discharges into an unnamed watercourse to the southeast of the site (as discussed in 4.5.2). The flow direction of both the surface water sewer and the ditch is understood to be to the east.

4.8. HISTORIC FLOOD RECORDS

- 4.8.1. Table 4-2 summarises the historic flood records obtained through consultation and liaison with the various bodies contacted in the production of this FRA.

Table 4-2 - Historic Flood Records

Information Source	Flood records / Details
Environment Agency	Environment Agency correspondence confirms that they have no records of previous flood events affecting this site.
West Sussex County Council	The LLFA was contacted on 04 June 2021 regarding historic flood records and surface water drainage. A response was not received at the time of preparing this FRA.
Arun District Council	Arun District Council does not hold historic flood records at the site.

5. PROPOSED DEVELOPMENT

- 5.1.1. Outline planning permission is sought for a Proposed Development comprising six residential units and an access road. The preliminary layout of the Proposed Development has been produced by Crossley Design Architecture and is included in Appendix C.
- 5.1.2. The residential housing development is proposed in the rear gardens of properties 96, 98 and 100 Hook Lane.
- 5.1.3. The proposals include the removal of the existing property on 94 Hook Lane for the construction of an access road for the new houses. The proposed residential dwellings comprise one bungalow and five 1.5 and 2 storey houses. Each property has a rear garden which extends to the site boundary.
- 5.1.4. A vehicular access will be provided through the access road connected to Hook Lane. The proposal also incorporates space for vehicle turning in the central part of the site.

6. SEQUENTIAL AND EXCEPTION TEST

6.1. INTRODUCTION

- 6.1.1. The purpose of the Sequential Test is to ensure that land use planning takes due regard of flood risks, to ensure that areas at low or no risk of flooding are developed in preference to areas at higher risk.

6.2. VULNERABILITY CLASSIFICATION

- 6.2.1. The vulnerability classification is defined in Table 2, as part of the PPG Flood Risk and Coastal Change. The purpose of the vulnerability classification is to identify appropriate land use activities relative to the level of flood risk. The Proposed Development is classified as 'More Vulnerable' as it provides residential development.

6.3. FLOOD ZONE DEFINITION

- 6.3.1. According to the Environment Agency's Flood Map for Planning, the Proposed Development is located in Flood Zone 3.

6.4. COMPATIBILITY TEST

- 6.4.1. The PPG identifies different land use vulnerabilities that are appropriate within each of the Flood Maps for Planning flood risk classification, see Table 6-1 below.

Table 6-1 - Flood risk vulnerability and flood zone compatibility (PPG Table 3)

Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	Development is appropriate	Development is appropriate	Development is appropriate	Development is appropriate	Development is appropriate
Zone 2	Development is appropriate	Exception test required	Development is appropriate	Development is appropriate	Development is appropriate
Zone 3A	Exception test required	Development should not be permitted	Exception test required	Development is appropriate	Development is appropriate
Zone 3B	Exception test required	Development should not be permitted	Development should not be permitted	Development should not be permitted	Development is appropriate

- 6.4.2. Arun District Council SFRA indicates that the Application Site is entirely within Flood Zone 3A (refer to Appendix I).

6.5. CONCLUSION ON THE SEQUENTIAL AND EXCEPTION TESTS

- 6.5.1. As the Proposed Development is allocated within Flood Zone 3A, and in order to develop this land, the Exception Test is required.

The Exception Test requires the proposed development to show that:

- It will provide wider sustainability benefits to the community outweigh flood risk and issues of wider sustainability benefits to the community are addressed by the wider supporting planning application documents;
- It will be safe for its lifetime without increasing flood risk elsewhere and where possible reduce flood risk overall.

6.5.2. Part 2 of the Exception Test is covered by this FRA. Part 1 should be considered by the Local Planning Authority on the basis of the supporting information presented in the planning application. Planning Consultants Luken Beck put forward the case for Part 1 of the Exception Test, which is included in Appendix J

7. OVERVIEW OF FLOOD RISK

7.1. INTRODUCTION

- 7.1.1. The following section provides an overview of flood risk to the Application Site, and the risk arising to and from the Proposed Development. An assessment has been undertaken for each source that could affect the Proposed Development in accordance with the NPPF and PPG.

7.2. RISK OF FLOODING TO AND FROM THE PROPOSED DEVELOPMENT

FLOODING FROM COASTAL AND TIDAL SOURCES

- 7.2.1. Tidal flooding occurs when sea levels rise above the level of the land or beyond the operational level of flood defences.

The National Planning Policy Framework (NPPF) categorises flood risk as follows:

- Zone 1 (low probability) is assessed as having less than a 1 in 1,000 annual probability of river or sea flooding (<0.1%);
- Zone 2 (medium probability) is assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year; and
- Zone 3 (high probability) is assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

- 7.2.2. The Environment Agency's detailed flood mapping (refer to Appendix A) shows the Application Site is within Flood Zone 3.

- 7.2.3. The Environment Agency's undefended tidal model *Ems to Littlehampton (Arun to East Head Model)* indicates that the site is within an area of high probability of tidal flooding. The undefended modelled flood levels for the 1 in 200 year event (0.5% AEP) are 3.03m AOD for the Application Site.

- 7.2.4. The Environment Agency has confirmed that the area of the Proposed Development benefits from flood defences in the form of an embankment which is in good condition and provide standard protection of 1 in 200 years (0.5 AEP). The upstream effective crest level of the flood defences is 5.64 mAOD and is over 2m higher than the undefended flood level at the site. Consequently, due to the presence of the flood defences the risk is considered to be low.

- 7.2.5. The risk of flooding from tidal and coastal sources to and from the Proposed Development is therefore considered to be low; no specific mitigation measures are required.

FLOODING FROM FLUVIAL SOURCES

- 7.2.6. Fluvial flooding occurs when flows within a watercourse exceed the capacity of the watercourse causing out of bank flows.

- 7.2.7. The Environment Agency flood zone map is provided in Appendix A and indicates that the site is located within Flood Zone 3. The data was provided in 2018 however confirmation was received from the Environment Agency in April 2021 that this remains the most up to date data.
- 7.2.8. The Environment Agency has provided a fluvial flood map for the site based on the modelling results of the *Aldingbourne model* (2015) which was modelled for both undefended and defended scenarios. The mapping indicates that the proposed residential units are within an area at risk of fluvial flooding in the 1 in 1000 year event. No other return period events are mapped.
- 7.2.9. The fluvial water levels within the site obtained from the defended model are 1.93 m AOD for the 1 in 1000 event (0.1% AEP). For correspondence with the Environment Agency refer to Appendix B.
- 7.2.10. The risk of flooding from fluvial sources to and from the Proposed Development is considered to be high based on available information.
- 7.2.11. Therefore, mitigation measures are required to protect the development over its design lifetime and ensure that offsite flood risk is not exacerbated. The proposed mitigation measures are described in Section 8.

FLOODING FROM PLUVIAL / OVERLAND SOURCES

- 7.2.12. During extreme storms the ground may become saturated and the drains and sewers which carry away surface water may not be able to accommodate these flows, or may become blocked with debris, leading to surface water flooding.
- 7.2.13. The Environment Agency's Risk of Flooding from Surface Water map indicates that the risk of flooding from surface water at the Application Site ranges from 'Low' to 'Medium'. Areas at low risk of surface water flooding have an annual probability of between 0.1% (1 in 1,000) and 1.0% (1 in 100); areas at medium risk have an annual probability of between 1.0% and 3.33% (1 in 100 and 1 in 30); and areas at high risk have an annual probability of greater than 3.33%.
- 7.2.14. The "Low" to "Medium" risk from surface water flooding is associated with the surface water flow route that originates to the west of the site and runs eastward between Hook Lane and the current University of Chichester campus. The Environment Agency's map indicates some ponding at the site.
- 7.2.15. However, the topographic survey in Appendix D has been compared with the Environment Agency's Lidar DTM (Drawing 47808-TOP-001 in Appendix A) and indicates differences in ground level ranging from approximately 0.5m to 2.5m. This difference is caused by the presence of trees and dense vegetation along the eastern site boundary. Therefore, the flood risk associated with the surface water overland flow route is likely to be lower than the risk indicated on the Environment Agency's Risk of Flooding from Surface Water map.
- 7.2.16. By developing the Application Site, the risk of pluvial / overland flows from the Proposed Development could increase. This is due to an increase in impermeable surfaces covering the Application Site, which will result in greater volumes and rates of surface water discharging from the site. The risk of the Proposed Development exacerbating pluvial / overland flood risk prior to mitigation is therefore considered to be moderate to high.
- 7.2.17. The proposed surface water drainage strategy (SWDS) will incorporate sufficient attenuation to restrict run-off from the development to as close to existing Greenfield rates as reasonably

practicable, in accordance with the non-statutory technical standards for sustainable drainage. The SWDS will therefore mitigate the potential for the Proposed Development to exacerbate flood risk to and from pluvial / overland flow sources. The resultant risk from the Proposed Development will be low.

- 7.2.18. Further information on flood risk management measures to mitigate this risk is provided in Section 8 of this FRA.

FLOODING FROM GROUNDWATER SOURCES

- 7.2.19. Groundwater flooding occurs when the water table rises above the level of the ground, usually as the result of prolonged rainfall periods.
- 7.2.20. The site is underlain mainly by superficial deposits of raised marine deposits (clay, silt, sand and gravel) as shown on Drawing 47808-BGS-002 in Appendix A. Site specific ground investigations at the adjacent development site publicly available FRA for the University of Chichester campus extension¹² indicate low infiltration rate for the underlying geology.
- 7.2.21. Given the low permeability of the underlying strata, groundwater flooding is unlikely to occur at the site however high groundwater is possible in that area.
- 7.2.22. The risk of flooding from groundwater sources to and from the Proposed Development after the implementation of the proposed mitigation measures detailed in Section 8 is considered to be low.

FLOODING FROM SEWER AND DRAINAGE INFRASTRUCTURE SOURCES

- 7.2.23. Flooding from sewers is usually attributable to either a blockage or structural defect, or a storm event that overwhelms the capacity of the sewers.
- 7.2.24. Historical incidents of flooding are detailed by Southern Water in their DG5 register. Arun District Council SFRA shows the sewer flood incidents from Southern Water grouped by post code. The Application Site is within post code PO22 8 and there have been 12 recorded flood incidents for this post code.
- 7.2.25. Because of historic flood incidents in the post code area of the Application Site, the risk of sewer flooding to the site is considered to be moderate.
- 7.2.26. Improvements to the public surface and foul water sewers are the responsibility of the Sewer Authority. No specific mitigation for the Proposed Development is considered necessary as the risk of the proposed development exacerbating this flood risk is low.

¹² WSP (2015) *University of Chichester Engineering and Digital Technology Park. Flood Risk Assessment*. Available on Planning application portal Arun District Council. Reference No. BR/54/16/PL

FLOODING FROM ARTIFICIAL SOURCES

- 7.2.27. The Government's flood mapping indicates that the Application Site does not lie within the extreme inundation area of any reservoirs.
- 7.2.28. The Application Site is not located within the vicinity of a canal and is not influenced by canal infrastructure.
- 7.2.29. The risk of flooding from these sources to and from the Application Site is considered to be negligible.

7.3. OFFSITE IMPACTS

- 7.3.1. The Proposed Development will not increase the flood risk profile, and no adverse offsite effects are expected after the measures detailed in Section 8 are implemented. The inclusion of a SuDS drainage system and providing a restriction in runoff rate from the Proposed Development will ensure that flood risk offsite is not exacerbated.

8. FLOOD RISK MITIGATION MEASURES

8.1. INTRODUCTION

- 8.1.1. Following a review of the flood risks to and arising from the Proposed Development; the following section discusses the mitigation measures necessary to ensure the Proposed Development remains safe over its lifetime and does not exacerbate flood risk to neighbouring property (including allowances for the effects of climate change).

8.2. MITIGATION MEASURES

Tidal flood risk

- 8.2.1. The risk of flooding from tidal and coastal sources to and from the Proposed Development is therefore considered to be low; no specific mitigation measures are required.

Fluvial flood risk

- 8.2.2. The water level within the site obtained from the defended fluvial model is 1.93m AOD for the 1 in 1000 event (0.1% AEP). As the existing model does not specifically include climate change uplifts, it is assumed that the 0.1% AEP event is a conservative estimate and can be used as a proxy for the 1% plus climate change event. Following consultation with the Environment Agency in August 2018 (see Appendix B) it was agreed that an undefended fluvial flood level of 2.19 m AOD in a 0.1% AEP event would be appropriate to address combined fluvial and surface water risks to be mitigated at the site.
- 8.2.3. In accordance with the NPPF, it is necessary to mitigate the fluvial flood risk to and from the proposed residential development. To mitigate fluvial flood risk to the proposed dwellings and future residents, the buildings will need to be raised above the predicted flood water level. The finished floor levels (FFL) of these buildings will be elevated further to accommodate freeboard and the floor construction.
- 8.2.4. Finished floor levels will be set at approximately 2.69m AOD based on the following:
- modelled undefended 0.1% annual probability flood level at 2.19m AOD;
 - 0.3m freeboard; and,
 - 0.2m floor construction allowance.
- 8.2.5. Finished floor levels will be set to provide resilience against flood events in exceedance of the design event and enable safe occupation by providing backup power and clean water in each building.
- 8.2.6. The Environment Agency's fluvial model outputs indicate that the Application Site is mostly within the model flood extent for the 1 in 1000 years from the Aldingbourne Rife. Therefore, compensation of the potential displaced volume of water during a flood event will need to be provided in order to mitigate the risk of fluvial flooding arising from the Proposed Development to the neighbouring properties.
- 8.2.7. The flood compensation volume which will be required for the Proposed Development is calculated based on the following assumptions:

- The piers of the proposed buildings are 450 mm in diameter;
- 6 no. piers will be required per proposed building.

- 8.2.8. Drawing 47808-FCA-001 shows the location of the proposed compensation area. The ground levels will be re-profiled in the northern part of the site by lowering them to approximately 1.3m AOD which is the existing ground level at the proposed buildings. The proposed flood compensation area will therefore accommodate the volume of water displaced by the piers for flood events up to 1 in 1000 years return period (0.1% AEP) and provide a compensation area of 10% more than the proposed footprint of the piers.
- 8.2.9. It is therefore proposed that floodplain compensation will be achieved by lowering an area of approximately 25.2m² in the northern section of the site, i.e. located immediately outside the flood extent (refer to Drawing 47808-FCA-001 in Appendix F). This total area is equivalent to the footprint of the piers plus an additional 10% allowance. In addition, a revised topographic survey has taken place which identifies a number of hard structures such as sheds, which would be removed as part of the redevelopment allowing for an improvement in flood plain storage over and above the proposed compensation.
- 8.2.10. As part of the detailed design of the site, a detailed management and maintenance plan will be developed for the proposed underfloor voids and flood compensation area including identification of management responsibility.
- 8.2.11. An appropriate flood warning and evacuation plan should also be produced for the Proposed Development.

Pluvial flood risk

- 8.2.12. The flood risk from pluvial sources pre-mitigation is considered moderate due to an existing flow route across the site. Leaving space under the proposed buildings will mitigate the risk of surface water to the proposed residential units as it will allow the surface water flow to pass under the proposed properties. As noted in 8.2.2, it has been agreed with the Environment Agency that the design levels of 2.19m would be considered a suitable proxy for combined fluvial and surface water risk.
- 8.2.13. Landscaping will be designed to direct flows away from buildings as is shown on Drawing 47808-DS-001 in Appendix G.

Groundwater flood risk

- 8.2.14. The risk of flooding from groundwater is considered to be low. In addition, it is proposed that the future buildings will be raised above the ground level and therefore, no further mitigation measures are required for the site.

Flood risk from sewer and drainage infrastructure

- 8.2.15. Improvements to the Public Surface Water Sewers are the responsibility of the Sewer Authority and therefore, no specific mitigation for the Proposed Development is considered necessary as the risk of the Proposed Development exacerbating this flood risk is low.

Flood risk from artificial sources

- 8.2.16. The risk of flooding from artificial sources is considered negligible and therefore flood mitigation measures are not required.

9. INDICATIVE SURFACE WATER DRAINAGE STRATEGY

9.1. EXISTING DRAINAGE REGIME

EXISTING CATCHMENTS AND DISCHARGE LOCATIONS

- 9.1.1. The Application Site is predominantly a Greenfield site, with a gross area of 0.28ha.
- 9.1.2. The Application Site currently drains via overland flow to the small watercourse that runs from west to east at the southern end of the site.
- 9.1.3. The topographical survey and the Environment Agency's LiDAR data indicate that levels at the Application Site range from approximately 2.20m AOD in the north-western corner of the site to approximately 1.05m AOD in the open ditch at the eastern boundary of the site.
- 9.1.4. In accordance with current national guidance, the Institute of Hydrology (IoH) Report 124 Flood Estimation for Small Catchments (1994) method has been used to estimate the peak greenfield runoff rates currently generated by the site.
- 9.1.5. Table 9-1 summarises the estimated peak greenfield runoff rates for the site obtained from the UK SuDS Tools¹³.

Table 9-1 – Summary of Peak Greenfield Runoff Rates

Return Period (Year)	Peak Greenfield Runoff Rate – Site (l/s)
QBAR	0.81
1	0.69
30	1.86
100	2.58

9.2. PROPOSED WATER QUANTITY MANAGEMENT

DISCHARGE LOCATIONS

Part H of the Building Regulations: Drainage and Waste Disposal establishes a hierarchy for surface water disposal, which encourages a SuDS based approach. This hierarchy stipulates that surface water runoff not collected for reuse must be discharged to one of more of the following in order of priority:

- Discharge into the ground (infiltration); or, where not reasonably practicable;
- Discharge to a surface water body; or, where not reasonably practicable;

¹³ HR Wallingford (2018) *UK SuDS Tools*; accessed April 2018 from <http://www.uksuds.com>

- Discharge to a surface water sewer, highway drain, or another drainage system; or, where not reasonably practicable,
- Discharge to a combined sewer.

- 9.2.1. Based on the underlying geology described in Section 4.4, it has been assumed that the disposal of the surface water generated by the Proposed Development to ground using infiltration-based SuDS features will not be feasible, because of a high water table and poor infiltration rates. Consequently, non-infiltrating SuDS techniques are assessed in order to manage surface water within the Proposed Development. If detailed infiltration testing demonstrates that infiltration is practicable, this will reduce or eliminate offsite runoff.
- 9.2.2. As it has been assumed surface water cannot be discharged to ground, it will be preferable to be discharged to an open watercourse, in accordance with the hierarchy set out above. Adjacent to the eastern site boundary, there is a ditch as shown in the Topographic Survey (Appendix D). Due to dense vegetation cover, the discharge point of the ditch was not confirmed, it is likely however to be connected to the Southern Water 750mm diameter surface water sewer at the southern-eastern part of the site. For the surface water sewer network refer to Appendix E).
- 9.2.3. If during site investigation it is established that the ditch along the eastern boundary is not connected to the surface water or to other watercourse, then a direct connection to the Southern Water surface water sewer will be required.
- 9.2.4. The Arun District Council Supplementary Requirements for Surface Water Drainage Proposals requires that all surface water runoff generated on site discharge is limited to the estimated mean annual maximum greenfield runoff rate (Qbar) of 0.81 l/s (refer to calculations in Appendix G). However, for small development sites, this requirement could be difficult to meet. Hence, Building Research Establishment (BRE) identify that surface water flow controls shall be designed to restrict surface water flows to a minimum of 5 l/s in order to reduce the risk of blockage within the drainage system.

IMPERMEABLE AREAS AND REQUIRED STORAGE VOLUMES

- 9.2.5. In order to manage the increase in peak runoff rates generated by the Proposed Development that would result from the proposed increase in impermeable areas, flows will be restricted to the peak greenfield runoff rates. This will necessitate the use of attenuation features within the Proposed Development.
- 9.2.6. Table 9-2 shows the approximate areas of the Proposed Development and attenuation required based on the Development Proposal (refer to Appendix C). The Application Site is approximately 0.28ha in size, comprising approximately 0.18ha of open space and 0.1ha of impermeable surfaces.

Table 9-2 – Indicative impermeable areas and total required attenuation storage

Proposed Development Impermeable areas	Impermeable Area (ha)	Total Required Attenuation Volume for 1 in 100 + 40% (m3)
Access Road	0.024	28
Parking spaces and driveways	0.033	
Building	0.046	

- 9.2.7. The attenuation volumes required to limit runoff generated by the Proposed Development to the peak allowable discharge rates for the 100 year plus 40% climate change event have been calculated using the UK SuDS Tools¹⁴. The total indicative attenuation storage volume required for the Proposed Development is 28 m³, based on the minimum discharge of 5 l/s.

PROPOSED SUDS FEATURES

- 9.2.8. Following a review of the potential use of SuDS techniques available for incorporation into the Proposed Development, it is proposed that permeable paving will be used to attenuate surface water runoff within the Proposed Development.
- 9.2.9. Permeable paving can be designed to collect surface water runoff and attenuate, prior to discharge to an open watercourse or to the sewer without exceeding the runoff rates of 5l/s.
- 9.2.10. A void ratio of 30% and permeable paving depth of 400mm have been assumed for the calculation of surface water attenuation volume which can be accommodated within the site.
- 9.2.11. An indicative surface water storage requirement of 28m³ has been calculated for the site for the 1 in 100 year plus climate change event (refer to Appendix G). The proposed access road and parking spaces provide 330m² of potential permeable paving. If 400mm of permeable paving depth is applied, the storage capacity of this SuDS feature is 39.3 m³ compared to a requirement of 28m³.
- 9.2.12. The final depth of the permeable paving sub-base will depend on the final site gradients and the structural requirements (based on the surface loading and ground CBR value), as well as existing underground services or the depth required for surface water attenuation purposes. A detailed design will further confirm the exact form and depth that is considered feasible to meet the attenuation volume requirement at the site.

¹⁴ HR Wallingford (2018) *UK SuDS Tools*; accessed April 2018 from <http://www.uksuds.com>

- 9.2.13. The surface water gradients on site are expected to be low, as the site is on a relatively flat area. However, permeable paving will be used as the main SuDS feature and it will act as a filter and intercept sediments to minimise the risk of blockage to the flow control device.
- 9.2.14. Due to the low gradients on site, it is recommended the installation of non-return valves along the drainage network to prevent potential water backing up into the future properties.
- 9.2.15. By controlling run-off, the downstream areas can be better protected from the variability of rainfall events.

10. CONCLUSIONS

- 10.1.1. An outline planning permission is sought for a Proposed Development of six residential units with parking spaces and an access road. The Proposed Development is located in the rear gardens of the Nos. 94 - 100 Hook Lane and it is approximately 0.28 hectares (ha) in total.
- 10.1.2. Flood risk to and from the Proposed Development from all sources prior to mitigation is considered to be as follows:
- Tidal - low
 - Fluvial – high
 - Pluvial – low to moderate
 - Groundwater – low
 - Sewers and Drainage Infrastructure - moderate
 - Artificial Sources – negligible
- 10.1.3. The Environment Agency confirmed that the site is defended from tidal flood risk for the 1 in 200 year event, and therefore tidal flood risk is considered to be low.
- 10.1.4. To mitigate the risk of fluvial and pluvial flooding to future residents, the buildings will need to be raised above 2.19m AOD which is the modelled undefended fluvial flood levels for 0.1% annual probability. The units will therefore be built on piers with void space underneath. The finished floor levels of these buildings will be elevated further above the design flood level to accommodate freeboard (0.3m) and the floor construction (0.2m), i.e. finished floor levels of 2.69m AOD.
- 10.1.5. Finished floor levels will be set to provide resilience against flood events in exceedance of the design event and enable safe occupation by providing backup power and clean water in each building.
- 10.1.6. The Environment Agency's fluvial model outputs indicate that the Application Site is mostly within the modelled fluvial flood extent for the 1 in 1000 event associated with the Aldingbourne Rife. Therefore, compensation for the potential displaced volume of water during a flood event will need to be provided in order to mitigate the risk of fluvial and pluvial flooding arising from the Proposed Development to neighbouring properties. This will be achieved by lowering an area equivalent to the footprint of the buildings outside the flood footprint. For the Proposed Development the Flood compensation Area includes an addition of 10% to the total footprint.
- 10.1.7. The surface water drainage strategy will mitigate the flood risk from surface water caused by the increasing hardstanding of the Proposed Development. As it has been assumed that surface water generated by the Proposed Development cannot be discharged to ground, a solution has been assessed whereby surface water is discharged to the open ditch at the eastern site boundary or the surface water sewer at the southern site boundary in accordance with the drainage hierarchy.
- 10.1.8. The required surface water storage to attenuate on site has been calculated for the 1 in 100 plus climate change event. Permeable paving as a main SuDS feature can be installed along the proposed access road and parking areas to meet the surface water storage requirement. Preliminary calculations indicate that by using permeable paving at the site, the required surface water attenuation is met.

- 10.1.9. The risk of sewer flooding to the site is considered to be moderate because of historical incidents recorded in the post code area of the Application Site included in Arun District Council's SFRA. Improvements to the Public Surface and Foul Water Sewers are the responsibility of the Sewer Authority and therefore, no specific mitigation for the Proposed Development is considered necessary as the risk of the proposed development exacerbating this flood risk is low.
- 10.1.10. Therefore, this FRA demonstrates how the Proposed Development can be delivered in accordance with the NPPF with regards to flood risk and drainage.

Appendix A

DRAWINGS



Appendix B



STAKEHOLDERS CORRESPONDENCE

Appendix B.1

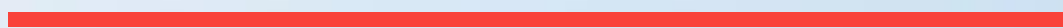


Appendix B.2

ARUN DISTRICT COUNCIL



Appendix C



DEVELOPMENT PROPOSAL

Appendix D

TOPOGRAPHIC SURVEY 

Appendix E

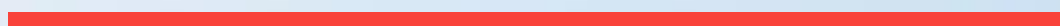
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SOUTHERN WATER ASSET PLAN

Appendix F

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FLOOD COMPENSATION AREA

Appendix G



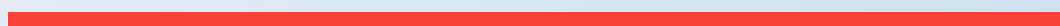
SURFACE WATER DRAINAGE STRATEGY

Appendix H

BGS BOREHOLE SCAN

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Appendix I



SFRA MAPS

Appendix J

APPENDIX TITLE



EXCEPTION TEST PART 1

Planning Consultants Luken Beck put forward the below case for Part 1 of the Exception Test, as assessed in July 2021:

Having regard to the objectives in the NPPF (at paragraphs 159, 160, and 161) and government advice set out in Planning Practice Guidance, in order for the Exception Test to be passed the development must meet the following criteria:

- *it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and*
- *a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

In terms of the former of the criteria there are a number of wider sustainability benefits that development of this site would provide. These include;

- ***Within the area of search prescribed by Arun District Council officers there are no sequentially preferable sites:*** The area of search selected is based upon the Built-Up Area Boundary (BUAB) of Bognor Regis, and so reflects the area in which Local Plan policies support housing within the settlement as sustainable locations.
- ***Urgent contribution to housing supply:*** The Council has accepted that it is unable to demonstrate an adequate housing land supply. ADC's Annual Monitoring Report (December 2020) identifies a 3.3 year supply, representing an acute shortfall. The proposals will make a meaningful contribution to housing supply in the immediate years. The Council will be familiar with Paragraph 68 of the NPPF highlights that; "Small and medium sized sites can make an important contribution to meeting the housing requirement of an area, and are often built-out relatively quickly." The contribution of the site to meeting the housing supply shortfall, especially given the size of the shortfall, is in itself something that should be afforded significant weight.
- ***Previously developed land, sustainable location:*** These proposals would secure the re-development of previously developed land in a sustainable location supported in principle by local plan policies. The site lies within convenient walking distance of the full range of amenities; these include Bognor Regis town centre shopping, Bognor railway station, primary and secondary schools, healthcare facilities (Bognor Medical Practice), Arun Leisure centre and a range of other amenities including Felpham Play Area and Aldwick Cricket Club. The site is therefore in a highly accessible location encouraging modal shift away from private car trips and which ultimately places less pressure on the local road network and on other services.
- ***Reduced pressure on less sustainable greenfield sites:*** By contrast to address the housing land supply shortfall and significantly boost housing provision the Council has accepted there to be insufficient sites likely to come forward in areas supported by Local Plan policies and is encouraging speculative applications on 'deliverable' sites identified by the HELAA (Housing and Economic Land Availability Assessment) under an (Interim Housing Statement, published 24th March 2021. While these are a necessary means to an end for the Council, those sites are inherently less accessible or sustainable and have adverse effects upon the intrinsic character of undeveloped countryside. The development of this site will contribute meaningfully to local housing supply and be preferential to the



development of greenfield sites beyond the BUAB. The development will contribute to reducing pressure on greenfield site release.

- **Site suitability and policy compliance:** *Other than in respect of flood risk matters the Council has previously confirmed the site is suitable and there are no conflicts with development plan policies.*

On the basis that the proposed development will provide much needed residential properties in a sustainable and accessible location, the first criteria is therefore deemed to be passed.

The remainder of this FRA report deals with the second criteria and demonstrates the development proposals if granted planning permission and implemented would be safe for their lifetime.



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