



Flood Risk Assessment Incorporating Surface & Foul Water Management Statement

Land at Woodgate Centre, Woodgate

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1 Introduction

1.1 Introduction

- 1.1.1 Charles & Associates Consulting Engineers Ltd (C&A) have been commissioned by Pye Homes Limited to prepare a Flood Risk Assessment (FRA) incorporating Surface and Foul Water Management for the proposed development of Land at Woodgate Centre, Oak Tree Lane, Woodgate PO20 3GU within West Sussex County Council (WSSCC), under the planning jurisdiction of Arun District Council (ADC) hereafter referred to as 'the site'. The location is shown on Figure 1-1.

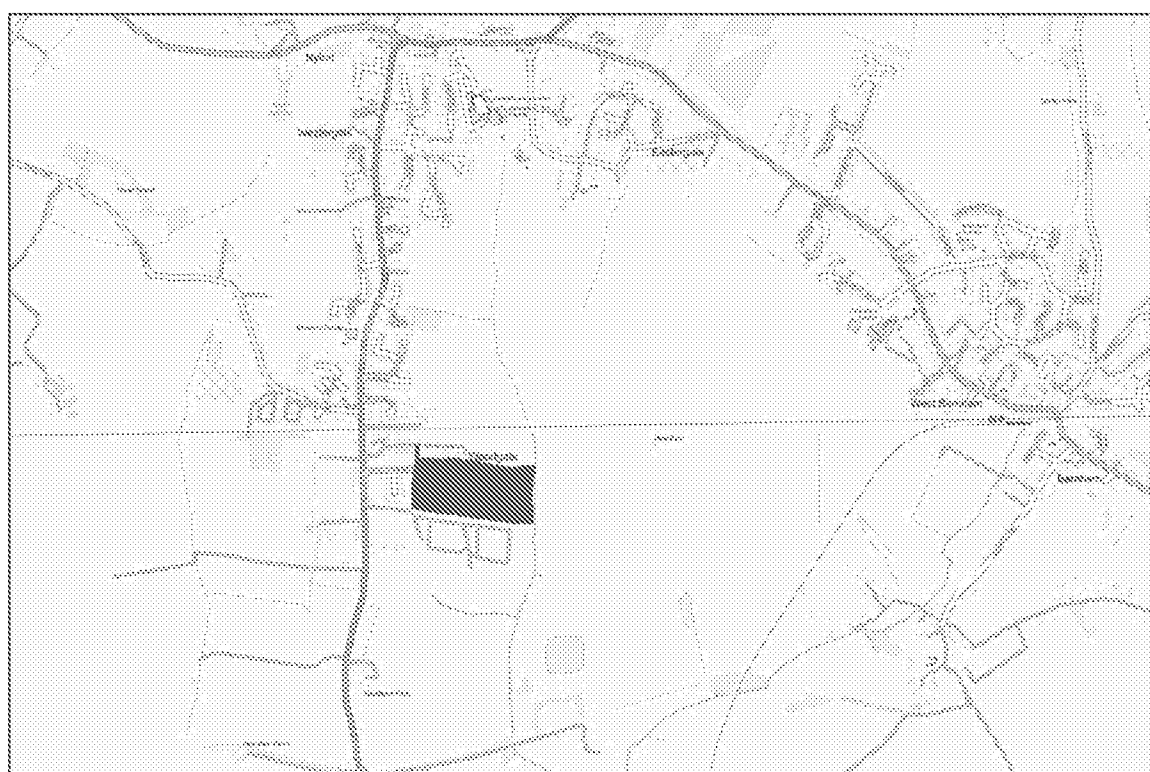


Figure 1 1: Site Location

- 1.1.2 This report will form a part of a full detailed planning application for 180 dwellings and includes a surface water drainage strategy, a foul water drainage strategy and accompanying calculations.

1.2 Purpose

- 1.2.1 The detailed planning application will seek permission for the construction of 180 dwellings with associated amenity and open space provision, landscaping and vehicle access. This report has been prepared as a means of demonstrating that flooding and drainage issues, both surface and foul water, will not constrain the development of the site or have any adverse effects on existing drainage networks. It also confirms that the site will conform to Defra's Non-Statutory Technical Standards for sustainable drainage systems (SuDS) and the local requirements set out by ADC and WSCC.
- 1.2.2 In respect of surface water drainage and the potential for flooding, it examines the site's suitability in regard to current planning policy and assesses the physical characteristics in order to determine solutions for dealing with surface water drainage following development of the site, thus ensuring it is drained in a sustainable manner without imposing any adverse impact on the surrounding area.
- 1.2.3 The provisions of the National Planning Policy Framework (NPPF) (Ref 1) have been considered in preparing this Flood Risk Assessment, together with The Flood & Water Management Act 2010 (Ref 2). Attention has also been paid to the National Planning Practice Guidance (NPPG) (Ref 3) and policies relating to both foul and surface water disposal within the ADC adopted Local Plan (Ref 4). Further consideration has been given to WSCC's Policy for the Management of Surface Water 2018 (Ref 5) and the Arun Strategic Surface Water Management Study 2016 (Ref 6).
- 1.2.4 The surface water drainage strategy (SuDS scheme) will be designed to conform to Defra's Non-Statutory Technical Standards for sustainable drainage systems 2015 (Ref 7) and the CIRIA SuDS Manual (Ref 8).

1.3 Report Limitations

- 1.3.1 The findings, recommendations and conclusions of this report are based on information obtained from a variety of external sources which are understood to be reputable. However, C&A cannot guarantee the authenticity or reliability of any data and/or records provided by third parties.

1.4 Planning Background

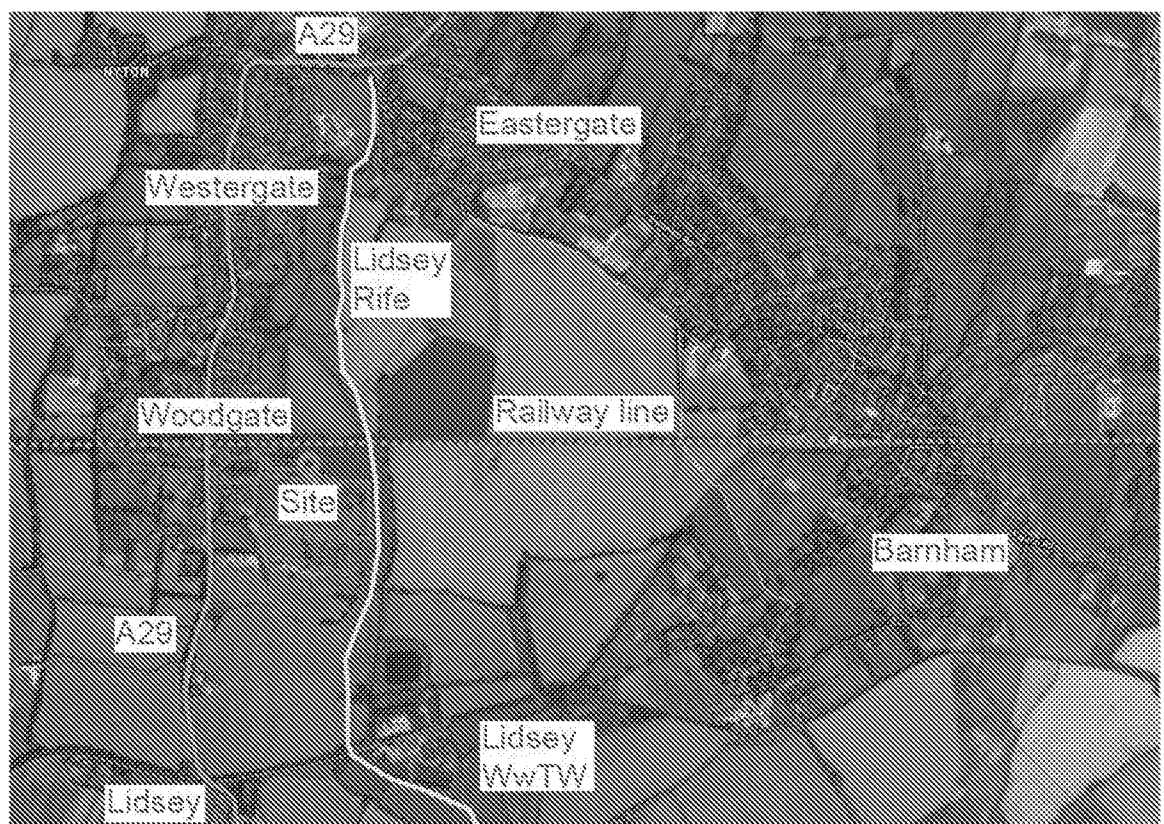
- 1.4.1 Adopted in 2018, the ADC Local Plan (Ref 4) sets the framework for development in the district until 2031. This site, known as Woodgate Centre, is allocated for residential development and is part of a wider strategic site known as SD5 Barnham/Eastergate/Westergate (BEW) which is allocated for at least 3000 homes alongside infrastructure including a new primary school, community facilities, public open space sports and retail provision.

2 Site Location & Environmental Setting

2.1 Site Location

- 2.1.1 The site is in the village of Woodgate, between Westergate to the north and Lidsey to the south. It is located east of the A29 Lidsey Road and south of the railway line running between Chichester and Barnham. It is bordered by farmland to the northern and eastern boundaries, the Willows Caravan Park to the south and residential development to the west, see Figure 2.1 below.

Figure 2-1: Site Location



- 2.1.2 Access can currently be taken from Woodgate Road to the west and Oak Tree Lane to the north, however only the Woodgate Road access will be utilised for the proposed development. The site is relatively flat except for the far eastern boundary which falls sharply towards the Lidsey Rife, which is classified as a main river.
- 2.1.3 There are currently mixed use premises on the site known as the Woodgate Centre. This essentially is a collection of small, poor quality buildings occupied by a variety of small businesses. There are also several horse paddocks located across the site.

2.1.4 There are a number of existing underground services on the site, mainly serving the existing buildings. There is also a large 450mm dia trunk watermain which runs centrally north/south across the site and a 225mm dia public foul sewer running centrally east/west across the site. These are shown on the utility trace survey included in **Appendix A**.

2.1.5 The site has an area of approximately 7.25ha and is generally rectangular in shape. Other than the Lidsey Rife on the eastern boundary and a shallow, man-made channel in the north-east corner, there are no formal surface water features on the site.

2.2 Topography & Existing Drainage

2.2.1 Topographical survey information shows that the site slopes from a high point in the north west corner of around 9.50m AOD (Above Ordnance Datum) towards the south eastern boundary at a gradient of around 1.0% for the majority of the site. The ground profile becomes much steeper in the eastern quarter of the site where the land falls sharply towards the Lidsey Rife, which flows north-south along the eastern boundary. The topographical survey plan is included in **Appendix A**.

2.2.2 Sewer records acquired from Southern Water, the incumbent Water company, indicate that there is a 225mm dia foul sewer running centrally across the site from west to east. According to the SW records there are no surface water sewers on the site, nor in the immediate vicinity of the site. Copies of these are included in **Appendix B**.

2.2.3 As there are no formal surface water drainage features on the site existing runoff will flow overland in an easterly direction towards and into the Lidsey Rife, following existing contours.

2.2.4 The Lidsey Rife which is just beyond the eastern site boundary connects into the Aldingbourne Rife at Felpham, which itself continues south through Bognor Regis and into the English Channel.

2.2.5 The overall site area can be described as previously developed land (PDL), but for the purposes of surface water and flood risk it is greenfield, draining overland towards the Lidsey Rife.

2.3 Geology

- 2.3.1 The published geological mapping for the site shows the presence of superficial drift deposits of River Terrace Deposits (undifferentiated) formed of sands, silts and clay. Towards the far eastern part of the site as the land falls towards the Lidsey Rife, there is a narrow band of Raised Beach Deposits.
- 2.3.2 The underlying bedrock geology comprises London Clay formation formed of clay, silt and sand, refer to Figures 2.3 and 2.4 in **Appendix C**.
- 2.3.3 These ground conditions were confirmed by an intrusive ground investigation undertaken in June 2019, see extract from report in **Appendix D**. This investigation included an infiltration test in one location. This showed very poor soakage rates and the report concluded that it would be unlikely that traditional soakaways would be viable as a means of surface water disposal.

2.4 Groundwater

- 2.4.1 The superficial River Terrace Deposits are classed by the Environment Agency as a Secondary 'A' Aquifer. The London Clay is classed as an unproductive stratum.
- 2.4.2 A review of the Department for Environment, Food & Rural Affairs (Defra) "Magic Map" confirms that the site is not located within a Groundwater Source Protection Zone. It is shown to be in a medium to low groundwater vulnerability zone and also noted as being in an area classified as a soluble rock risk.
- 2.4.3 Flood risk from groundwater will be discussed in **Section 6.6** of this report.

3 Development Proposals

- 3.1.1 The proposed development is a residential scheme for the construction of 180 dwellings together with associated amenity and open space provision, landscaping and vehicle access as shown on the preliminary Masterplan in **Appendix E**.
- 3.1.2 It is intended that the proposed development will be accessed from Woodgate Road to the west of the site, with an alternative access for emergency vehicles from Oaktree Lane to the north. While not forming part of the planning application, provision is also being made to safeguard land for a new foot/cycle bridge across the Lidsey Rife to provide a future link to the east as part of the wider BEW masterplan. Details of this are provided for information purposes only within **Appendix E**.
- 3.1.3 Surface water management and disposal in the form of a Sustainable Urban Drainage System (SuDs), arrangement for the proposed development is discussed in **Section 8** of this report.
- 3.1.4 Foul water disposal for the development is discussed in **Section 10** of this report.

4 National Policy, Local Planning Policy & SUDS Guidance

4.1 National Planning Policy

- 4.1.1 NPPF sets out a robust approach to the Sequential Test and is intended to provide a rigorous understanding of flood risk. Its aim is to steer new development to areas at the lowest probability of flooding (i.e. Flood Zone 1). The Sequential Test is by the Local Planning Authority (LPA) to inform the preparation of the Local Plan. Refer to section 4.3 below.

4.2 Sequential Test

- 4.2.1 Product 4 Data, detailed flood mapping information, obtained from the Environment Agency shows that the majority of the site is within Flood Zone 1. The far eastern edge of the site falls within Flood Zones 2 and 3, see EA's flood map for planning, **Figure 4.1** below. All of the built form of the proposed development will be constructed outside of these flood areas and be within Flood Zone 1. The full Product 4 information is included as **Appendix A**, together with drawing 20-061-024 which shows these flood zones in the context of the proposed development. .

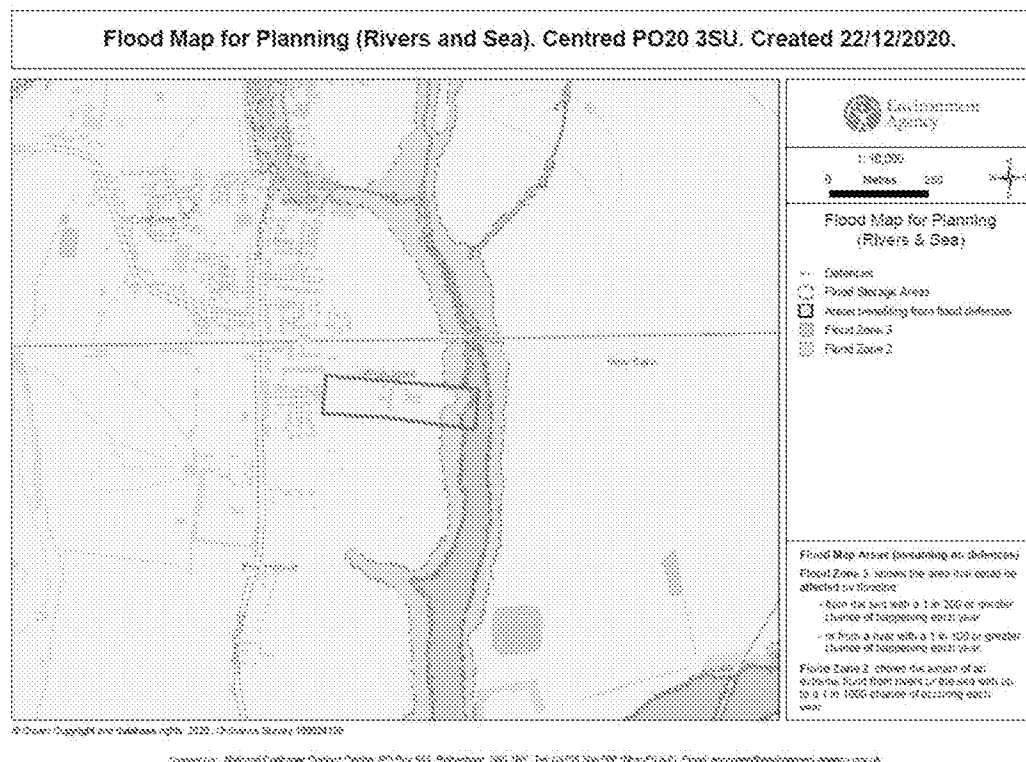


Figure 4.1 EA Flood Map for Planning

4.2.2 The Development is allocated within the ADC Local Plan and the built form of the Development is fully in Flood Zone 1 (little to no risk of flooding), the site therefore passes the Sequential Test and the application of the Exception Test does not apply.

4.2.3 The proposed development is residential in nature, and is therefore, classified as 'More Vulnerable' in Table 2 of the Technical Guidance accompanying the NPPF (NPPG). It is consistent with the appropriate uses for Flood Zone 1, as outlined in Table 3 of NPPG.

4.3 Arun District Council Local Plan 2018

4.3.1 The Arun Local Plan 2011-2031 was adopted in 2018 and includes a number of policies relating to flood risk and sustainable drainage. The site is allocated for residential development within this plan.

4.3.2 Chapter 3 Spatial Portrait, with section 3.11 highlights that;

"Arun District is affected to varying degrees by the threat of flooding, principally from fluvial (rivers), tidal (sea) and groundwater. A large proportion of developable land in Arun also suffers from potential ground water flooding."

4.3.3 Sections 3.31 and 3.32 refer to addressing climate change in the context of flood risk;

"The Arun Strategic Flood Risk Assessment shows that large parts of Arun are already susceptible to flood risk from the sea, rivers, watercourses, groundwater, and other sources, and this will increase with climate change. Care must be taken to ensure that development is not inappropriately located in terms of flood risk, and does not exacerbate flood problems."

"The potential impacts of climate change need to be taken into account in planning for all new development, both in terms of location and design. This will include locating major development away from areas of high flood risk..."

4.3.4 Section 18 also discusses climate change;

"Climate change is also likely to increase the risk of flooding in the District from rivers and the sea. Development must adapt to this by being suitably located away from areas at risk from flooding and by incorporating measures to mitigate against the impact of flooding such as sustainable drainage systems which reduce the volume of surface water rapidly entering groundwater flows which can result in surface water flooding and water pollution."

4.3.5 Policy W SP1 Water in the ADC Local Plan requires the following;

“The Council will also support development that;

- a) is appropriately located, taking account of flood risk and promotes the incorporation of appropriate mitigation measures into new development, particularly Sustainable Drainage Systems that reduces the creation and flow of surface water and improves water quality.”*

4.3.6 Policy W DM2 Flood risk in the ADC Local Plan requires the following;

“Development in areas at risk from flooding, identified on the latest Environment Agency flood risk maps and the Council’s Strategic Flood Risk Assessment (SFRA) , will only be permitted where all of the following criteria have been satisfied:

- a. The sequential test in accordance with the National Planning Policy Guidance has been met.*
- b. A site specific Flood Risk Assessment demonstrates that the development will be safe, including access and egress, without increasing flood risk elsewhere and reduce flood risk overall.*
- c. The sustainability benefits to the wider community are clearly identified.*
- d. The scheme identifies adaptation and mitigation measures.*
- e. Appropriate flood warning and evacuation plans are in place; and*
- f. New site drainage systems are designed to take account of events which exceed the normal design standard i.e. consideration of flood flow routing and utilising temporary storage areas.*

The reports prepared as part of the criteria above must take into account contingency allowances, taking climate change into account as set out in Flood Risk Assessments: climate change allowances section of the NPPG.”

4.3.7 Policy W DM3 Sustainable Urban Drainage Systems in the ADC Local Plan requires the following;

“Proposals for both major and minor development proposals must incorporate SUDS within the private areas of the development in order to provide source control features to the overall SUDS design.”

“Proposals for major development must also integrate SUDS within public open spaces

and roads, reflecting discussion with the appropriate bodies. SUDS must therefore be integrated into the overall design of a development.”

“In order to ensure that SUDS discharge water from the development at the same or lesser rate, as prior to construction, developers must:

- f. Follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations and the SUDS manual produced by CIRIA.*
- g. Undertake up to six months groundwater monitoring within the winter period.*
- h. Undertake winter percolation testing in accordance with BRE365.*
- i. The proposed drainage system must be designed to ensure that there is no flooding on a 1 in 30 year storm event.*
- j. The design must also take account of the 1 in 100 year storm event plus 30% allowance for climate change, on stored volumes, to ensure that there is no flooding of properties or the public highway or inundation of the foul sewerage system. Any excess flows must be contained within the site boundary, and within designated storage areas.”*

4.3.8 Section 18 discusses wastewater infrastructure within the Arun District;

“Public wastewater networks and treatment facilities are the responsibility of Southern Water throughout the whole of Arun District. Southern Water have indicated that there is little spare capacity in the foul water network and pumping mains to the Waste Water Treatment Works (WWTW) serving the District at Ford, Lidsey and Pagham. Upgrading will therefore be required by developers, through existing arrangements under the Water Industry Act, in line with network modelling of site specific requirements”.

4.3.9 Policy W DM1 part 3 is relevant to all development within the Lidsey Wastewater Treatment Works Catchment Area;

“Major development within this area must also be accompanied by a full Drainage Impact Assessment which must take account of surface water disposal and foul water disposal. Although minor developments are unlikely to raise significant flood risk due to the cumulative impact all development within this area must also be accompanied by a Drainage Impact Assessment that must take account of both the individual and cumulative impact upon foul water disposal; flood storage capacity and surface water drainage or

flood flows within the Lidsey Wastewater Treatment Works Catchment Area”.

- 4.3.10 Section 22 of the ADC Local Plan deals with Infrastructure Provision and Implementation, with clauses 22.1.17 and 22.1.18 being in relation to wastewater;

“22.1.17 The water industry’s investment planning is scheduled on a 5 yearly basis and from 2018 there will be a flat rate applied per new dwelling, by utility providers. This timing allows for repeated opportunities throughout the lifetime of the Plan to review the requirements at Ford wastewater treatment plant.

22.1.18 Funding of the expected connection from the BEW allocation to the Ford treatment works would be anticipated to be funded jointly by Southern Water and the developers, on the basis of the developers overall contribution to the 2300 homes allocated to the site in the Plan period.”

4.4 Arun District Council Level 1 and Level 2 Strategic Flood Risk Assessment

- 4.4.1 A Level 1 and Level 2 Strategic Flood Risk Assessment (SFRA) for ADC was undertaken by JBA Consulting in November 2016 (Ref 9). At Level 1 this document provided *“high level screening of proposed development sites against flood risk information”*, while Level 2 included *“detailed assessments of potential development sites taken forward for further assessment”*.
- 4.4.2 This document includes assessments of strategic sites allocated for development, including the BEW site and determines that subject to applying flood management policies as set out in ADC’s Local Plan these sites are suitable for development.

4.5 Arun District Council Strategic Surface Water Management Study

- 4.5.1 A Strategic Surface Water Management Study (SSWMS) for ADC was undertaken by Mott MacDonald in October 2016 (Ref 10). This comprised three stages for all 6 strategic sites identified by ADC in their Local Plan, including BEW. The three stages were:

Stage 1: Data Collection and Context of the study, and identification of surface water storage volumes required at each strategic site.

Stage 2: Development of appropriate surface water drainage measures (SuDS).

Stage 3: Summary of the recommended measures and costings.

4.5.2 The Stage 3 summarised proposed SuDS measures in the overall BEW masterplan as follows: “Due to high groundwater levels, flat topography and large storage volume required, the preferred measure is the use of several shallow cascading attenuation features across the site to control the flow of surface water draining towards the existing watercourse.”

4.6 West Sussex County Council LLFA Policy for the Management of Surface Water

4.6.1 WSCC have produced a Policy statement regarding the management of surface water, November 2018 (Ref 5). The purpose of this policy statement is to set out how WSCC, as the LLFA and statutory consultee, will review drainage strategy strategies and surface water management provisions associated with applications for major development.

4.6.2 This document, along with the SFRA and SSWMS produced by ADC, were referred to during preparation of this report. To obtain advice on surface water management within the proposed site, C&A have consulted both WSCC and ADC and relevant correspondence from them is included within **Appendix F** of this report.

4.6.3 The use of Sustainable Drainage techniques for the attenuation of surface water runoff will be discussed in **Section 8** of this report. This will ensure that policies and guidance required under the Local Plan, National Planning Policies, the Flood & Surface Water Management Act 2010, WSCC’s Policy for the Management of Surface Water, ADC’s Strategic Flood Risk Assessment and Strategic Surface Water Management Study, plus Defra’s Non-Statutory Technical Standards for SuDS are all met and satisfied.

4.7 Aldingbourne Neighbourhood Plan

4.7.1 Aldingbourne Neighbourhood Plan was produced in 2016 and has been consulted in the preparation of this FRA. The plan contains a number of Policies relating to Flooding and Drainage.

4.7.2 Policy EH4 Protection of watercourses

Proposals that support and promote river catchment management, wildlife conservation and reduce flood risk will be supported

4.7.3 Policy EH5 Surface Water Management

New development within areas at risk from flooding, will not be permitted unless it is supported by a site specific Flood Risk Assessment which provides clear evidence to demonstrate that the proposal:

- a) Would not give rise to additional risk of flooding, either to the development site or to land, arising from the carrying out or use of the development
- b) Would make appropriate provision for accommodating the surface water and foul water arising from the development.

5 Definition of Flood Hazard

5.1.1 Flood Zones are defined in Table 1 of NPPF – Technical Guidance Document. The Flood Zones refer to the probability of flooding from rivers, the sea and tidal sources and ignore the presence of existing defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development.

5.1.2 Flood Zone 1, as described in Table 1 of NPPF (Ref 1), has a low probability of flooding and comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

5.2 Sources of Flooding

5.2.1 NPPF identifies six potential sources of flooding that require investigation:

- Flooding from rivers or fluvial flooding;
- Flooding from the sea or tidal flooding;
- Flooding from land;
- Flooding from groundwater;
- Flooding from sewers; and
- Flooding from reservoirs, canals, and other artificial sources.

5.3 Flooding from Rivers or Fluvial flooding

5.3.1 The Lidsey Rife is located on the eastern boundary of the site and is classed as a main river. During times of severe storm events, water levels rise to cause fluvial flooding. Probability of flooding occurring on this site due to fluvial sources will be discussed in Section 6.3 below.

5.4 Flooding from the Sea or Tidal flooding

5.4.1 Tidal flooding in general happens when there are exceptionally high tides due to storm surges. Storm surges are generally associated with increases in water levels due to the changes in atmospheric pressure and wind generated by storms.

5.4.2 Probability of flooding occurring on this site due to tidal sources will be discussed in Section 6.4 below.

5.5 Flooding from Land (Local Surface Water Flooding)

5.5.1 Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. Increased run-off from developed areas consisting of impermeable surfaces can increase overland flows. If the flow paths of these overland flows are not carefully considered during the detail design and planning stages, flooding from overland flows could occur. Probability of surface water flooding is discussed in Section 6.5 below.

5.6 Flooding from Sewers

5.6.1 Local urban drainage should be considered, as every drainage system has a design capacity, which at some point can be exceeded. Sewer and surface water flooding generally results in localised short-term flooding caused by intense rainfall events which overload the capacity of sewers or runs off adjacent land as sheet flow. Flooding can also occur as a result of blockage, poor maintenance, or structural failure.

5.6.2 There are no surface water sewers on site, however an existing foul water public sewer does cross west to east. All new foul pipe networks will be independent of any surface water drainage and will be offered for adoption to Southern Water. Probability of sewer flooding is discussed within Section 6.6 below.

5.7 Flooding from Groundwater

5.7.1 Groundwater flooding generally occurs when water levels in the ground rise above surface elevations. Severe storm events could cause groundwater levels to rise above ground level. Underlying geology is the principal factor that effects groundwater flooding. Groundwater flooding most commonly occurs in low lying areas which are underlain by permeable rocks or aquifers. Probability of groundwater flooding will be discussed within Section 6.7 below.

5.8 Flooding from Reservoirs, Canals and other Artificial Sources

5.8.1 The main cause for flooding from a reservoir would be a structural failure in the walls of the reservoir or some form of accident-causing significant damage to the structure of the reservoir. Environment Agency maps do not show the site to be at risk of reservoir flooding in the event of failure. Therefore, flooding from this source is considered negligible.

6 Probability of Flooding

6.1 Flood Zone

- 6.1.1 Flood maps published by the EA and further flood modelling information provided by the Agency indicate that the majority of the site lies within 'Flood Zone 1, low probability flooding from fluvial sources, as defined by Table 1 of NPPF. Approximately one quarter of the site to the east is within Flood Zones 2 and 3, however this is excluded from the built form of the proposed development, see **Figure 4.1** above and drawing 21-061-024 in **Appendix G**.

6.2 Vulnerability Classification

- 6.2.1 Table 2 of NPPF Technical Guidance classifies the proposed development as a 'More Vulnerable' land use. As noted above the built development is located fully within Flood Zone 1 and the site is therefore deemed suitable for residential development.

6.3 Flooding from Rivers or Fluvial Flooding

- 6.3.1 The majority of the site is located within Flood Zone 1 and has therefore little or no risk of fluvial flooding. All the built development area is confined to Flood Zone 1.
- 6.3.2 The eastern part of the site, close to the Lidsey Rife is within Flood Zones 2 and 3 and excluded from the built form of the development. **Figure 4.1** above shows the indicative EA flood mapping adjacent to the site. Product 4 data (see **Appendix G**) has also been obtained from the EA which includes modelled levels along the Lidsey Rife. The respective Flood Zones plotted from these levels are shown on drawing 20-061-024 in **Appendix G**. The risk of fluvial flooding on the developable area of the site is therefore assessed as low.
- 6.3.3 As noted in Section 3 above land is being safeguarded within the development for a future foot/cycle bridge across the Lidsey Rife to provide access to the wider development to the east. Drawing no 20-016-27 in Appendix N shows an indicative route for this bridge. As the bridge will cross part of Flood Zone 3, associated with the Lidsey Rife, provision has been made for flood compensation due to the incursion of the bridge piers into the flood zone.
- 6.3.4 The total worst case volume of flood plain lost by the bridge piers on the western (Development) side of the river is 6.17m³. Compensation for this loss will be provided by regrading a small area of existing ground above the Flood Zone 3 level. This is shown on the drawing referenced above.

6.4 Flooding from the Sea or Tidal Flooding

6.4.1 Data included within the Product 4 information received from the EA provides predicted tidal flood levels at the site for periods up until 2115. These range from a current 1 in 200 year (0.5%) flood level of 1.95m AOD to a predicted 0.5% flood level in 2115 of 3.45m AOD.

6.4.2 This level is well below the minimum built development level and therefore the risk of the Development flooding from tidal flows is negligible.

6.5 Flooding from Land (Surface water flooding)

6.5.1 The latest Environment Agency's surface water flood map for the site and surrounding area (Figure 6-1) shows surface water flooding adjacent to the Lidsey Rife within the area covered by fluvial Flood Zones 2 and 3. The built form of the development remains fully outside of Flood Zones 2 and 3 and hence outside those areas at risk of surface water flooding.

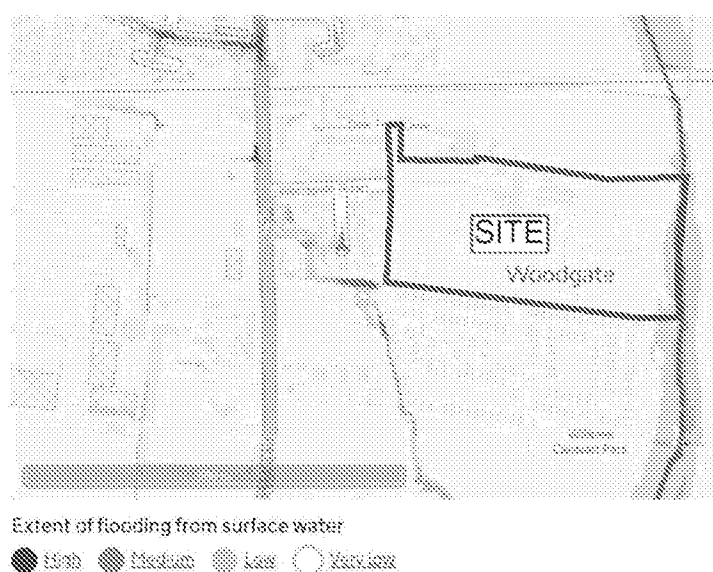


Figure 6.1 EA Surface Water Flood Map

6.5.2 Surface water flood mapping in the SFRA also correlates with this EA mapping, see Appendix H. The surface water risk on the site is therefore assessed as low.

6.6 Sewer Flooding

6.6.1 Southern Water is responsible for managing the sewer network in and around the proposed development area. There is a public foul water sewer crossing west to east within the proposed development boundary. This sewer will be incorporated into the new development layout and new sewers within the Development will be offered for adoption to Southern Water. The probability of flooding from a failure in the existing or proposed sewers is therefore assessed as low.

6.6.2 All new foul sewer pipe networks will be independent to any surface water drainage and will be offered to Southern Water for adoption. The surface water networks will also be offered to Southern Water for adoption. Where Southern Water will not adopt the SuDS features these will be maintained for the lifetime of the development by a management company.

6.7 Flooding from Groundwater

6.7.1 The underlying superficial deposits are classified on Defra's 'Magic Map' as a Secondary A Aquifer. The bedrock geology is classified as Unproductive Stratum. The site does not fall within a groundwater source protection zone.

6.7.2 The published groundwater vulnerability map from 'Magic Map', (Figure 6.2) shows that the majority of the site is considered to be at medium to low vulnerability.

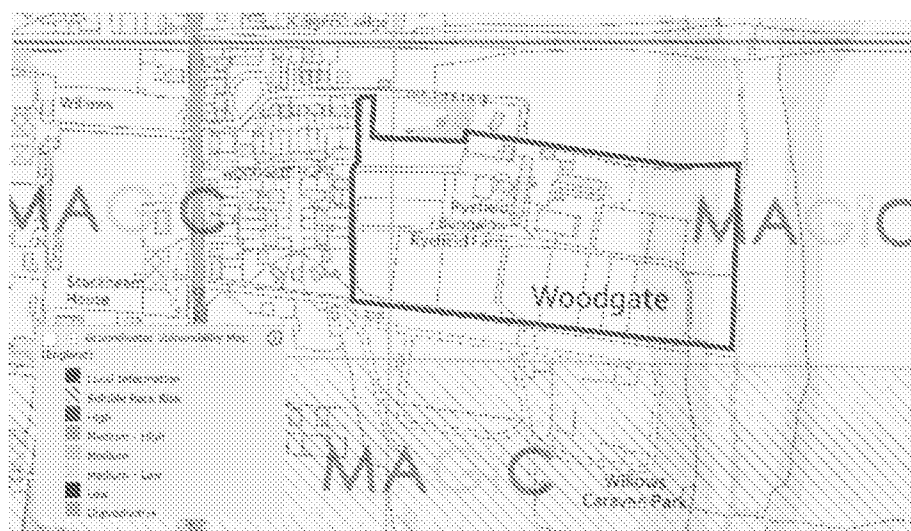


Figure 6.2 Groundwater Vulnerability

- 6.7.3 Mapping within the SFRA shows areas which are susceptible to groundwater flooding, see **Appendix H**. This mapping is produced at a strategic level and based on 1 Km square grids across the whole district. These maps show the proportion of each grid square which may be susceptible to this flooding. The grid covering this site is shown to potentially have a greater than 75% risk of groundwater flooding.
- 6.7.4 The SFRA notes however that as these susceptibility maps are derived at a strategic level and cover large areas they should be used only in combination with other information such as local monitoring and historical data. They don't necessarily indicate groundwater flooding in a specific area but rather provide an indication of potential risk.
- 6.7.5 A ground investigation was undertaken in June 2019 by T&P Regen, which included 4no. monitoring wells. At the time of the investigation groundwater was struck in most of the boreholes and trial pits at depths ranging between 1.0m and 2.5m below ground level (mBGL). Subsequent monitoring readings in July and August 2019 ranged from 1.2m to 3.1 mBGL.
- 6.7.6 Monitoring was restarted in December 2020, however only one of the 4no. monitoring wells (WS01) could be located. Three readings were taken with the highest groundwater level measuring 0.41 mBGL on 22nd December 2020.
- 6.7.7 In January 2021 another one of the original monitoring wells was located (WS02) and four additional monitoring wells were drilled. These wells together with the original ones were monitored through to early February 2021. The results are shown in Figure 6.3 below.

Depth to Groundwater in Monitoring Wells at the Woodgate Centre, Westergate (m bgl)						
Date	WS01	WS02	WS W1	WS W2	WS W3	WS W4
22/07/2019	1.20	3.10				
30/07/2019	1.78	2.02				
07/08/2019	1.88	-				
11/12/2020	0.46	UL				
22/12/2020	0.41	UL				
11/01/2021	0.90	0.92				
18/01/2021	0.73	0.77				
25/01/2021	0.74	0.72	0.66	0.77	1.15	0.26
29/01/2021	0.35	0.33	0.32	0.41	0.92	0.11
03/02/2021	0.09	0.15	0.00 (GL)	0.12	0.92	0.05

UL=Unable to locate

Notes:

WS01 and 02 drilled and monitored to 07/08/19 by T&P Regen. All other monitoring by E&L.

WS W1-4 were drilled and installed by E&L on 18th January 2021

Figure 6.3 Groundwater Monitoring Results

- 6.7.8 The results of this monitoring over the winter period show that groundwater levels to be closer to the surface towards the end of the period which is expected. The implications of these results on the design of the drainage strategy for the development is discussed in Section 8.3 below.

7 Effect of Climate Change

7.1 Climate Change

- 7.1.1 Based on the most recent advice on climate change reported in NPPG, peak rainfall intensity, sea level, peak river flow, offshore wind speed and extreme wave heights are all expected to increase in the future. It is recommended that considerations for future climate change are included in Flood Risk Assessments for proposed developments.
- 7.1.2 In February 2016, the Environment Agency (EA) published new guidance on how to use climate change allowances in flood risk assessments and drainage strategies. It is recommended that designs accommodate the 1 in 100 year storm with a 20% allowance for climate change and an additional analysis is undertaken to understand the flooding implications for a greater climate change allowance of 40%.
- 7.1.3 ADC's Local Plan Policy W DM3, asks that the sustainable drainage system is designed to take account of the 1 in 100 year flood event plus a 30% allowance for climate change, to ensure no flooding of properties or the public highway, with excess flows being contained within the site boundary and within designated storage areas.
- 7.1.4 The drainage strategy to serve the proposed development has therefore been designed to cater for the 1 in 100 year plus 30% rainfall event and also with a sensitivity check at 40% to understand the implications of the additional rainfall intensity on the network.

8 Surface Water Management Proposals

8.1 Development Proposal

- 8.1.1 The proposed development is a residential scheme for the construction of 180 residential dwellings together with vehicular and pedestrian access, public open space, car parking and landscaping as shown on the preliminary Masterplan (Appendix E).

8.2 Existing Surface Water Drainage

- 8.2.1 There are no public surface water sewers on or close to the site and no formal drains or other surface water features on the site. Currently run off from the site discharges to the Lidsey Rife a designated main river running along the eastern boundary of the site.
- 8.2.2 The total proposed developable area of the Site has been assessed as 5.68 hectares and Microdrainage software has been used to calculate the Greenfield run-off rates from the existing site. These rates are shown in Table 8.1 below.

Return Period Storm	Run-Off l/s
1 in 1 year	17.5
1 in 30 years	46.7
1 in 100 years	65.8
QBAR	20.6

Table 8.1 Run-Off Rates

8.3 Proposed Surface Water Drainage

- 8.3.1 Following a series of pre-applications with Arun District Council's Principal Drainage Engineer, a comprehensive sustainable drainage system has been developed which will be implemented to prevent runoff from the development increasing flood risk to other areas. This will be fully detailed at the detailed construction drainage design stage of the proposed development, although a strategy to demonstrate that SuDS can be delivered in accordance with the Council's and LLFA's requirements is described below.

- 8.3.2 Arun District Council set out a series of sustainable drainage principles in their Supplementary Requirements for Surface Water Drainage Proposals. These follow the hierarchy set out in the SuDS Manual, which must be considered when preparing any surface water drainage strategy. These require the following discharge hierarchy to be applied;
- Discharge into the ground (infiltration);
 - Controlled discharge to a surface water body;
 - Controlled discharge to a surface water sewer.
- 8.3.3 As described in Section 2.3 above, an initial site investigation, which included ground water monitoring, was undertaken that summarised that traditional infiltration techniques were unlikely to be viable as a means of surface water disposal. This is due to relatively shallow groundwater levels preventing the conventional 1.0m separation distance between base of soakaways and the highest recorded groundwater level and the poor permeability of the underlying soils.
- 8.3.4 The site investigation by T&P Regen was undertaken in June 2019, with groundwater monitoring readings in July and August of that year. The highest groundwater reading at WS05 was 0.87m BGL.
- 8.3.5 During pre-application discussions with Arun District Council, they requested that further groundwater monitoring be undertaken to establish the winter peak, as this would inform whether shallow infiltration measures such as permeable paving would be possible. As noted in Section 6.6 above groundwater monitoring was undertake from December 2020 through to early February 2021.
- 8.3.6 The results of this monitoring are presented in Figure 6.3 above and these show that groundwater levels peaked close to the surface which confirmed that shallow infiltration measures would not be viable on this Development.
- 8.3.7 Following subsequent discussions with ADC (see **Appendix F**) it was agreed that infiltration is not suitable as a disposal method on this site. A surface water management strategy incorporating on site attenuation with restricted discharge to the Lidsey Rife was therefore developed as described below.
- 8.3.8 Refer to **Appendix I** for the Proposed Surface Water Drainage Strategy drawings. The strategy is further explained below.
- 8.3.9 Microdrainage calculations supporting this strategy are included in **Appendix J**. These have been provided for the 1 in 100 year event with a 30% allowance for climate change, in accordance with ADC's policy with a further sensitivity test undertaken for the 1 in 100 year with a 40% allowance for climate change.

8.4 Proposed SuDS

- 8.4.1 As detailed design of the development proposals have not yet been finalised the masterplan in **Appendix E** was used to prepare the drainage strategy for the Development.
- 8.4.2 Run off from the proposed development will be restricted to the QBar values as noted in Table 8.1 above. This provides considerable betterment than occurs in the current situation, where run off during higher intensity storms can be much greater than these levels.
- 8.4.3 The attenuation required to restrict run off to these Qbar rates will be provided by a series of attenuation features including lined permeable paving, swales and open storage ponds which will be within open space areas.
- 8.4.4 Private parking courts will have run off controlled at source through permeable paving. A small open pond will be located in the south western corner of the Development which will provide storage for run off from the western part of the Development. From this pond a conveyance swale will transport flows along the southern and eastern boundaries of the site to second pond in the north eastern corner of the site.
- 8.4.5 Flows from this pond will discharge at restricted QBAR rates into the adjacent river, the Lidsey Rife.
- 8.4.6 Due to the relatively high winter groundwater levels all of these SuDS features, permeable paving, ponds etc. will be constructed with impermeable liners to prevent the ingress of groundwater.
- 8.4.7 SuDS guidance (CIRIA C753) recommends an inclusion of additional 10% impermeable area to account for potential future development (Urban creep). The current masterplan was used to assess the impermeable areas on the developed site and run off rates calculated on the basis of this layout, allowing an additional 10%. At detailed construction design stage of the Development drainage calculations will be further refined using final design drawings.
- 8.4.8 As requested by ADC the drainage design allows for a 1 in 100 year storm event, plus a 30% allowance for climate change. Also as recommended in current national guidance a further sensitivity check allowing for a 40% increase in rainfall intensity has been included in the calculations. This check shows some minor flooding within part of the drainage system. In the event of an extreme event of this magnitude this flooding will be directed towards the landscaped areas, well away from any built development.

- 8.4.9 This SuDS strategy will ensure that the surface water runoff from the future development will not increase the flood risk either on site or elsewhere for the lifetime of the development.
- 8.4.10 The preliminary SuDS system for the development has been designed in accordance with best practice SuDS guidance as set out in the SuDS Manual and also in accordance with WSCC's guidance, as LLFA and as requested by ADC's drainage team. This guidance will be followed through to the detailed design stages.

9 Pollution Control Measures

- 9.1.1 Table 4.3 of the SuDS manual (C753) sets out minimum water quality requirements for discharges to receiving surface waters and groundwater. Roof areas of residential dwellings and driveways/low traffic roads have 'very low' and 'low' pollution risks, respectively. These will require at least one type of SuDS source/site control component to be implemented on site to provide the required treatment prior to discharge. It is intended that this will be a minimum design parameter for any future detailed design, however suggested treatment trains beyond this are set out below.
- 9.1.2 A comprehensive SuDS system will be incorporated into the masterplan to provide a 'treatment train' approach to maintain a high water quality prior to discharging to the river. Typical SuDS components that have been implemented on-site in the preliminary design, to reduce total suspended solids, heavy metals and hydrocarbons from the runoff and to provide the necessary water quality treatment are as follows:
- 9.1.3 Roofs – All roof areas will include some pre-treatment to remove leaves and other roof debris at source. All roofs will reach Level 1 on the treatment train as a minimum, before discharging into the pipe system.
- 9.1.4 Communal car parking Areas – These areas will include source control pre-treatment such as porous paving and/or petrol/oil interceptors (which could be taken as an additional component on the treatment train). Two levels of treatment will be included as the minimum.
- 9.1.5 Roads – Runoff from highways will be routed to the attenuation features via catch-pit gullies, grass filter strips and/or swales, where technically possible. This effectively reduces total suspended solids, heavy metals and hydrocarbons from the runoff, providing the necessary water quality treatment. All roads will reach a minimum of three level of treatments.
- 9.1.6 The level of treatment that will be achieved via each SuDS component is summarised below.
- 9.1.7 **Interception/Primary treatment (level 1)** – rainwater harvesting, downpipe filters, silt traps for driveways, catch-pit gullies, permeable paving, petrol interceptors
- 9.1.8 **Secondary treatment (level 2)** – permeable paving, swales
- 9.1.9 **Tertiary treatment (level 3)** – swales, attenuation structures

10 Foul Water Management Proposal

10.1 Foul Water Drainage

- 10.1.1 The sewerage undertaker for the site is Southern Water. Existing records of Southern Water's network within the area were obtained and included in **Appendix B** of this report.
- 10.1.2 These records show a 225mm diameter vitrified clay (VC) public foul sewer running west to east through the site. This sewer flows into the site from the end of Woodgate Road and through the site where it connects to a 450mm diameter foul water sewer just beyond the eastern boundary of the site. This 450mm diameter sewer runs south, along the eastern edge of the Lidsey Rife, and outfalls to Lidsey Wastewater Treatment Works approximately 1km further south.
- 10.1.3 A foul water Environmental Assessment Statement is required if the proposed Development is not connecting to a public sewerage network. In this case proposed Development will be connected to the existing public network, as demonstrated by the strategy in **Appendix L** of this report. A foul water Environmental Assessment Statement is therefore not required.
- 10.1.4 In correspondence from Southern Water in **Appendix K** they confirm that they can accept flows from the development into their public drainage system.
- 10.1.5 The development proposals will require a partial diversion of the foul water sewer within the site to facilitate the development. The diverted section of the sewer is within the proposed spine road and will be undertaken under Section 185 of the Water Industry Act 1991. The retained section of sewer will be within proposed public open space within the Development.
- 10.1.6 A utilities trace survey of the site shows that the existing buildings on the site discharge to this sewer including a number of rainwater pipes from some of the buildings and also some external yard gullies. This survey included in **Appendix A**. The outfall from Ryefield Farmhouse, just to the north of the site appears to connect to this drainage system.
- 10.1.7 Under the transfer of ownership rules, the foul water drain entering the site from Ryefield Farmhouse is classified as a public sewer to its point where it connects to the 225mm dia sewer crossing the site. The foul drainage strategy proposed for the development allows for diverting these flows into the new development foul water network.

- 10.1.8 In response to a Level 1 capacity check request for the Development Southern Water noted that there currently isn't capacity within the local network to serve the Development, see correspondence in **Appendix K**. They confirmed however that under the current infrastructure charging system they have a duty to provide network capacity from a point of practical connection (point of equivalent or larger pipe) and noted that they aim to provide such upgrades within two years of granting of planning permission.
- 10.1.9 A foul water drainage strategy for the site has been produced and has been included in **Appendix L** of this report. This shows foul drainage connections from the development onto the existing 225mm diameter foul water sewer as well as to the proposed Section 185 diversion and retained sections of the existing foul sewer across the site, set in the context of the proposed Masterplan.
- 10.1.10 MicroDrainage calculations for the proposed foul drainage network are included in **Appendix M** showing the additional flows from the development connecting into the existing public foul sewer network.
- 10.1.11 Following the procedures of the Water Industry Act, the developer will apply for Section 106 consent for the physical connections onto the existing sewer network and will also the appropriate Infrastructure Charges to Southern Water.

11 Flood Risk Management Measures

- 11.1.1 NPPG requires that the safety of people and the proposed development be considered against each source of flooding identified in **Section 6**.
- 11.1.2 This residential development is to be located within Flood Zone 1 and therefore, even with the potential for climate change, properties will not be at risk of fluvial flooding throughout the lifetime of the development.
- 11.1.3 A preliminary surface water drainage strategy incorporating SuDS has been proposed to manage the increase in run-off from the site over the lifetime of the development, such that it will not place properties at risk of surface water flooding.
- 11.1.4 The SuDS system will be maintained by a suitably qualified Management Company for the lifetime of the development, such that it will not place properties either on the site or elsewhere at an increased risk of surface water flooding. This complies with NPPF guidance and the Arun Local Plan.
- 11.1.5 The flood risk to the proposed development and surrounding area, as a consequence of the development is therefore considered to be low and no specific flood risk management measures will be required.

12 Off Site Impacts

12.1 Flood Risk elsewhere

- 12.1.1 As the built form of the proposed development is located entirely within a Flood Zone 1 designation, it will not have any adverse impact on the flood risk to others by virtue of obstruction to flood flows or the reduction of flood plain storage.A
- 12.1.2 As noted in Section 6.3 above if in the future a bridge is constructed within the safeguarded land then appropriate flood compensation will be provided to allow for the impact of the bridge on the flood plain.

12.2 Surface Water Management

- 12.2.1 NPPG, Paragraph F6 states;

“Surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.”

- 12.2.2 The development proposals, within the indicative surface water drainage strategy, presented in Section 8 above, confirm that the site can be drained in a sustainable manner.
- 12.2.3 Run-off from the developed site will be reduced by the implementation of sustainable drainage methods to that of the undeveloped site or better, thus reducing further any potential flood impact from the site.

13 Residual Risks

13.1 Residual Flood Risk

- 13.1.1 As the built form of the development will be fully located in Flood Zone 1, properties will not be at significant risk of flooding, even with allowance for climate change.
- 13.1.2 Extreme rainfall events are generally predictable, but by their nature predictions are based on probability and thus subject to uncertainty. Therefore, an unquantifiable residual risk remains that events exceeding those predicted may occasionally occur, which could lead to surcharging or blocking of sewers or gullies.
- 13.1.3 If the drainage system is overwhelmed, either by a storm event with a magnitude greater than that designed for or due to a blockage, the design of the finished site levels will direct flows away from dwellings and ensure that there is no risk of floodwaters ponding to any significant depth. In addition, the overland flow paths for any such exceedance storm events will be designed to route overland flows towards open space areas.
- 13.1.4 Monitoring on site found that groundwater in some areas peaked close to existing ground level following the winter season. All finished floor levels will be set above existing ground level by a minimum of 150mm.

13.2 Management

- 13.2.1 The traditional piped networks of the SuDS system for proposed development will be offered for adoption to Southern Water or another approving body under a standard Section 104 agreement of the Water Industry Act. For all other SuDS elements, details of these will be approved under discharge of planning conditions by WSCC as the Lead Local Flood Authority (LLFA), in conjunction with ADC's drainage team. These SuDS features will be managed and maintained in perpetuity by a management company.

14 Conclusions & Recommendations

14.1 Background

- 14.1.1 This report has been prepared to assess the implications of Flood Risk for the proposed development of land known as Woodgate Centre. It is proposed to provide up to 176 residential dwellings together with associated amenity and open space provision, landscaping and vehicle access.
- 14.1.2 The entire developable area of site lies in Flood Zone 1 'Low Probability' flood area as defined by Table 1 of NPPG. The proposed residential development is considered as 'More Vulnerable' when utilising Table 2 of NPPG. The development being proposed is consistent with the appropriate uses for Flood Zone 1, as outlined in Table 3 of Planning Practice Guidance.

14.2 Sequential and Exception Tests

- 14.2.1 The Development is part of an allocated site known as SD5 Barnham/Eastergate/Westergate (BEW) within the Arun District Council's adopted Local Plan. Although the far eastern part of the site falls within Flood Zones 2 and 3, the proposed built development is fully located within Flood Zone 1 (little to no risk of flooding). Therefore, the proposed development passes the Sequential Test and application of the Exception Test is not necessary.
- 14.2.2 A section of land is being safeguarded for the possible construction of a pedestrian bridge across the Lidsey Rife. This does not form part of the current application proposals. Suitable mitigation measures by way of flood compensation have been identified which in the event of the bridge being constructed can be implemented.

14.3 Probability of Flooding

- 14.3.1 All potential sources of flood risk to and from the site, as listed in NPPF, have been assessed and the risks of flooding occurring have all been assessed as low. In assessing the flood risk, the impacts of climate change have been considered for the lifetime of the proposed development and are also considered acceptable.

14.4 Flood Risk Management

- 14.4.1 As the proposed residential development will lie within Flood Zone 1, the risk of flooding from all sources is assessed to be low and the safety of people is considered acceptable for all foreseeable flooding events. No specific flood management measures beyond that of regular maintenance are considered to be necessary.

14.5 Offsite Impacts

- 14.5.1 The Preliminary Surface Water Drainage Strategy set out in this assessment proposes management of surface water run-off from the development through the use of sustainable drainage techniques which will provide an improved surface water drainage regime and flood risk profile. Consequently, this will, reduce surface water run-off flows from the site, for storm return periods up to the 1 in 100year event, plus an allowance for the detrimental effects of climate change. The proposed development will not increase the risk of flooding elsewhere. The implementation of the SuDs scheme as proposed, is likely to reduce any existing risk of downstream flooding.

14.6 Residual Risks

- 14.6.1 A residual risk remains that in the unlikely event of a storm exceeding the design parameters used in designing the drainage system, the capacity may be exceeded, resulting in flood waters exiting from the drainage system or part of the drainage system may failing due to a blockage. The finished site levels however are designed to ensure that in such extreme events there is no risk of floodwaters ponding to any significant depth and the overland flow paths for any such exceedance storm events will be directed to open space areas.
- 14.6.2 In addition, the employment of a management company for the life of the development to maintain the surface water management train will ensure the scheme will operate at its maximum efficiency at all times.

14.7 Recommendations

- 14.7.1 Due to the positive outcome of these assessments, there is no reason why the site should not continue through the planning process and be approved for residential development in respect of flood risk and surface water drainage.

15 References

1. National Planning Policy Framework, Department for Communities and Local Government, 2019.
2. The Flood & Water Management Act 2010 (TFWMA), DEFRA, April 2010
3. National Planning Practice Guidance, Department for Communities and Local Government 2019.
4. Adopted Arun Local Plan 2011-2031 (July 2018)
5. WSCC Policy for Management of Surface Water
6. Arun Strategic Surface Water Management Plan
7. Defra's Non-Statutory Technical Standards
8. CIRIA SuDS Manual
9. Arun District Council Level 1 and Level 2 SFRA JBA Consulting November 2016
10. Arun District Council Strategic Surface Water Management Study (SSWMS) Mott MacDonald October 2016
11. Aldingbourne Neighbourhood Plan

