

Woodcroft Farm, Havant

Flood Risk Assessment

On behalf of

grainger plc

Project Ref: 21834/022 | Rev: 1 | Date: July 2013



Document Control Sheet

Project Name: Woodcroft Farm, Havant

Project Ref: 21834/022

Report Title: Flood Risk Assessment

Doc Ref: R002

Date: July 2013

	Name	Position	Signature	Date
Prepared by:	C. Brown	Senior Engineer		05.07.2013
Reviewed by:	D. Hayes	Director		05.07.2013
Approved by:	S. Witchalls	Partner		05.07.2013
For and on behalf of Peter Brett Associates LLP				

Revision	Date	Description	Prepared	Reviewed	Approved
0	26.04.2013	Draft for comment	CMB	DTH	SW
1	05.07.2013	1 st Issue	CMB	DTH	SW

Peter Brett Associates LLP disclaims any responsibility to the Client and others in respect of any matters outside the scope of this report. This report has been prepared with reasonable skill, care and diligence within the terms of the Contract with the Client and generally in accordance with the appropriate ACE Agreement and taking account of the manpower, resources, investigations and testing devoted to it by agreement with the Client. This report is confidential to the Client and Peter Brett Associates LLP accepts no responsibility of whatsoever nature to third parties to whom this report or any part thereof is made known. Any such party relies upon the report at their own risk.

© Peter Brett Associates LLP 2013

Contents

1	Introduction.....	1
2	Proposed Development Site	2
2.1	Site Location and Plan	2
2.2	Development Proposals	2
3	Flood Risk Assessment	3
3.1	Strategic Flood Risk Assessment	3
3.2	Flood Zone	3
3.3	Vulnerability	4
3.4	Groundwater	5
3.5	Other Potential Sources of Flooding	6
3.6	Climate Change	7
3.7	Impact of the Development on Site Permeability.....	7
3.8	The Sequential Test and Exception Test	7
4	Surface Water Drainage Strategy	8
4.1	Managing Surface Water and SuDS.....	8
4.2	Existing Surface Water Drainage.....	8
4.3	Building Regulations Surface Water Drainage Hierarchy	8
4.4	Sustainable Drainage Systems (SuDS)	8
4.5	Proposed Surface Water Drainage Strategy	9
5	Foul Drainage Strategy	12
5.1	Existing Foul Drainage Strategy	12
5.2	Proposed Foul Drainage Strategy	12
6	Summary	13

Appendices

Appendix 1 – Site Location Plan

Appendix 2 – Proposed Site Layout

Appendix 3 – Environment Agency Flood Zone Mapping

Appendix 4 – Partnership for Urban South Hampshire Strategic Flood Risk Assessment Mapping

Appendix 5 – Natural Surface Water Catchments

Appendix 6 – Southern Water Asset Records

Appendix 7 – Geotechnical Features Location Plan

Appendix 8 – Environment Agency Land Drainage Consent

Appendix 9 – Greenfield Discharge Rate Calculations

Appendix 10 – Proposed Surface Water Drainage Strategy

Appendix 11 – Proposed Surface Water Drainage MicroDrainage Calculations

Appendix 12 – Proposed Foul Drainage Strategy

This page is intentionally blank

1 Introduction

Peter Brett Associates LLP (PBA) has been commissioned by Grainger plc. to prepare a Flood Risk Assessment (FRA) to support its proposals for development at Woodcroft Farm, Havant. A site location plan is contained in **Appendix 1**.

PBA has many years of experience in, amongst other areas, the assessment of flood risk, hydrology, flood defence and river engineering.

This FRA has been prepared in accordance with relevant national, regional and local planning policy and statutory authority guidance as follows:

- National policy regarding flood risk as contained within National Planning Policy Framework (NPPF), dated March 2012, and the accompanying Technical Guidance to the NPPF, also dated March 2012.
- Partnership for Urban South Hampshire (PUSH) Strategic Flood Risk Assessment, December 2007.
- Partnership for Urban South Hampshire (PUSH) Intergrated Water Management Strategy, December 2008.

Havant Borough Council (HBC) has the final decision with regard any planning application as the Local Planning Authority (LPA). The Environment Agency (EA) is a designated consultee under Statutory Instrument 2006 No. 2375 The Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006. Whilst the LPA has the final decision on planning applications they are required to consult the EA in flood risk areas for advice.

This report summaries the risk from all forms of flooding that may affect the development.

2 Proposed Development Site

2.1 Site Location and Plan

Woodcroft Farm is located adjacent the existing residential suburbs of Wecock and Cowplain and to the north of Waterloooville (2km) and Havant Town Centres (6km). The site covers an area of approximately 10.5ha and has been predominantly used as agricultural pasture for grazing. The existing farmhouse and farmyard are situated within the south western corner of the site.

A site location plan is contained in [Appendix 1](#).

2.2 Development Proposals

The proposed development will provide 293 residential units, retained farmhouse and associated public amenity space.

A plan showing the proposed layout is contained in [Appendix 2](#).

3 Flood Risk Assessment

The NPPF requires a site specific FRA to be carried out to support the planning application. The degree of detail that an FRA should include depends upon the scale and potential impact of the proposed development. The FRA should consider the risk to the development from all sources of flooding and the off-site impacts on the downstream flood risk to others. An assessment of climate change should also be included.

3.1 Strategic Flood Risk Assessment

LPAs should prepare Strategic Flood Risk Assessments (SFRA) in consultation with the Environment Agency (EA). This is then used by the LPAs to inform sustainability appraisals and Local Development Documents (LDDs). The SFRA is initially used to refine information on areas that may flood, taking into account all sources of flooding and the impacts of climate change, in addition to the information depicted on the EA Flood Zone Mapping.

The Partnership for Urban South Hampshire Councils (PUSH), of which HBC is a member, has prepared an SFRA which was issued in December 2007. This FRA has been compiled taking account of the information therein.

3.2 Flood Zone

The initial phase of identifying whether a site is potentially at risk of flooding is to consult the EA's Flood Maps, available on the EA's website.



Figure 1: Extract of Flood Map from EA Website

This mapping shows the site to lie in Flood Zone 1; land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%). Detailed Flood Zone mapping for the site was also obtained from the EA which confirms the site is situated within Flood Zone 1. A copy of this mapping is contained in **Appendix 3**.

Zone 1 – Low probability

Definition

This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%)

Appropriate Uses

All uses of land are appropriate in this zone

Flood Risk Assessment Requirements

For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a Flood Risk Assessment. This need only be brief unless the factors above or other local considerations require particular attention.

Policy Aims

In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems.

NPPF Technical Guidance Table 1: Flood Zones

The PUSH SFRA confirms that the site lies within Flood Zone 1. Extracts from the PUSH SFRA are contained in **Appendix 4**.

3.3 Vulnerability

The NPPF follows a sequential risk based approach in determining the suitability of land for development in flood risk areas, with the intention of steering all new development to the lowest flood risk areas.

NPPF Table 2, below, taken from the Technical Guidance to the NPPF confirms the '*flood risk vulnerability classification*' of a site depending on the proposed usage. This classification is subsequently applied to NPPF Table 3, below, to determine whether:

- the proposed development is suitable for the flood zone in which it is located, and
- whether an Exception Test is required for the proposed development.

In this case the proposed development is for a residential development (293 units) and public amenity space.

More Vulnerable	Buildings used for dwelling houses , student halls of residence, drinking establishments, nightclubs and hotels. Non-residential uses for health services, nurseries and educational establishments.
Water Compatible	Amenity open space , nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.

NPPF Technical Guidance Table 2: Flood Risk Vulnerability Classification

Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓

NPPF Technical Guidance Table 3: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Review of NPPF Tables 2 and 3, above, shows that development classed as '*more vulnerable*' and '*water compatible*' is appropriate for Flood Zone 1.

3.4 Groundwater

The EA's Groundwater Source Protection Zone Maps, available on the EA's website, indicate the risk of contamination to groundwater sources such as wells, boreholes and springs used for public drinking water supply. The shape and size of a zone depends on the ground conditions, how the groundwater is abstracted, and other environmental factors.

The mapping below confirms that the site lies within Groundwater Source Protection Zone 1 (Inner Zone – defined as 50 day travel time from any point below the water table to the abstraction source) (Figure 2) and over a major aquifer with an low to intermediate groundwater vulnerability (Figure 3). This means that the groundwater (aquifer) directly below the site is extracted for potable water and the ground conditions above the aquifer are permeable. Therefore there is a potential for the movement of contaminants through the strata and pollution of the aquifer. The proposed surface water drainage strategy, takes this into account.

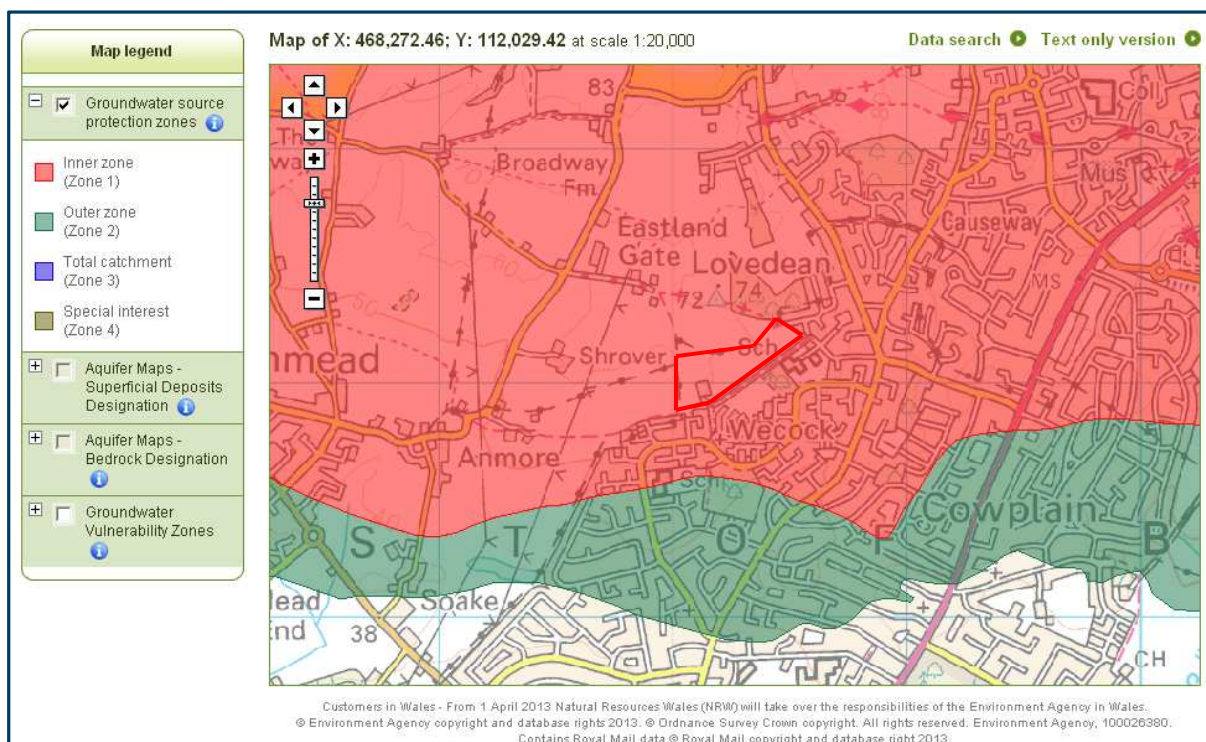


Figure 2: Extract from Source Protection Zone Map from EA website

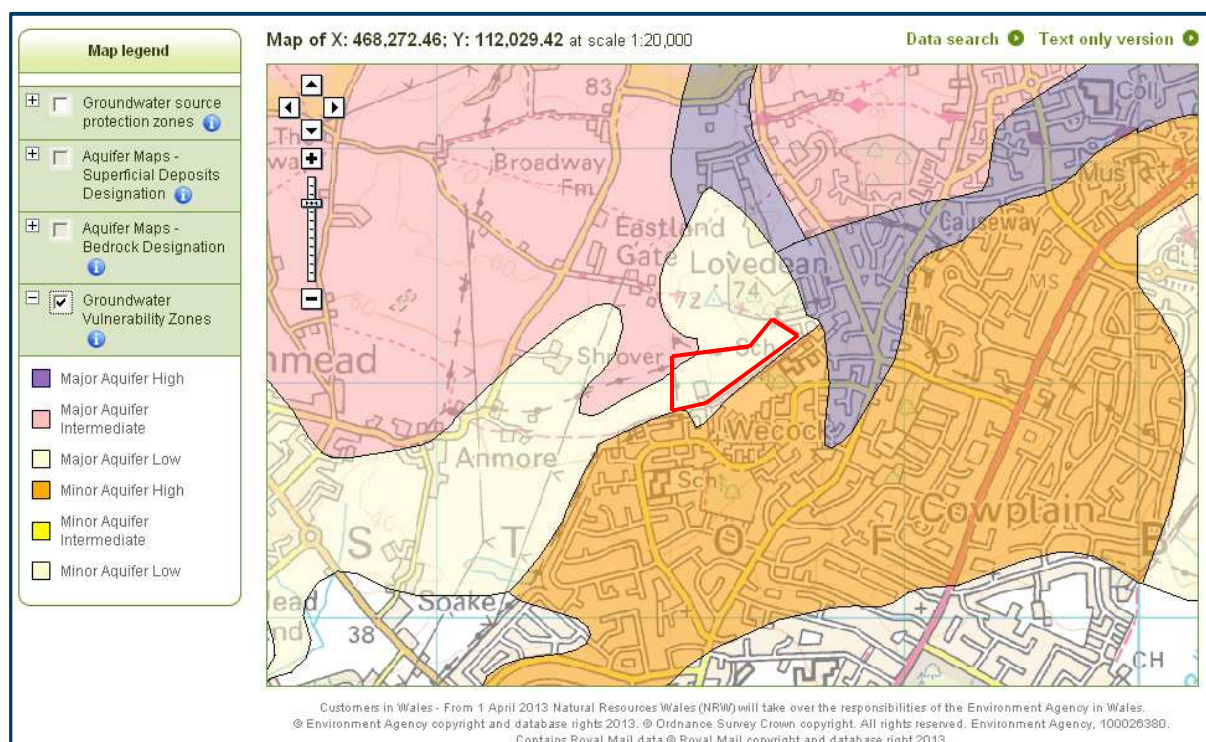


Figure 3: Extract from Groundwater Vulnerability Zone Map from EA website

The PUSH SFRA confirms that the site itself has not suffered from any historic groundwater flooding. The closest incident of groundwater flooding occurred approximately 1km to the west of the site. Extracts from the PUSH SFRA are contained in [Appendix 4](#).

3.5 Other Potential Sources of Flooding

The PUSH SFRA confirms that the site itself has not suffered from any historic flooding from Southern Water sewers. However, incidents of flooding from sewers have occurred with the vicinity of the site. The closest being an incident approximately 250m to the north east of the site.

Included in the PUSH SFRA is an assessment of potential sources of overland flow. The assessment takes account of the slope, surface geology and whether or not existing development is present. It is important to note that it does not take account of areas where overland flow may pass through or pond. The proposed use of the assessment is *'to ensure that sensitive or vulnerable development is not located 'downstream' of areas that may result in high overland flow during intense rainstorms'*.

The assessment shows the site to lie in an area of moderate to high potential of generating overland flow and upstream of the adjacent area of high potential. However, it is important to note that no reference to any existing surface water drainage networks which would remove water from developed areas is made in the description of the assessment process. Therefore it can be assumed that these have not been taken into account as part of the assessment.

The proposed surface water drainage strategy, takes the site's potential to generate overland flow into account by collecting, attenuating and conveying surface water to suitable outfalls in the form of a main river and an adopted surface water sewer.

Extracts from the PUSH SFRA are contained in [Appendix 4](#).

3.6 Climate Change

In considering flood risk to the site, it is necessary to fully consider the potential impacts of climate change for the lifetime of the development within the mitigation measures.

The NPPF Technical Guidance states that *'in making an assessment of the impacts of climate change on flooding from the land, rivers and sea as part of a FRA, the sensitivity ranges in Table 5 (NPPF Technical Guidance) may provide an appropriate precautionary response to the uncertainty about climate change impacts on rainfall intensities, river flow, wave height and wind speed'*.

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak Rainfall Intensity	+5%	+10%	+20%	+30%
Peak River Flow	+10%	+20%		

NPPF Technical Guidance Table 5: Recommended National Precautionary Sensitivity Ranges for Peak Rainfall Intensities, Peak River Flows, Offshore Wind Speeds and Wave Heights

In accordance with NPPF Table 5, above, the proposed surface water drainage strategy will include a 30% increase in rainfall intensities to take account of climate change over the lifetime of the development.

3.7 Impact of the Development on Site Permeability

Although the proposed development will result in an increase in impermeability of the site, due to the existence of potential solution features on the site and the risk of creating additional features the proposed surface water strategy is not able to mimic the existing regime and discharge the water to ground (Section 4.5, Proposed Surface Water Strategy). However, the proposed surface water drainage strategy will restrict off-site discharge rates to less than the calculated greenfield rate and provide suitable mitigation for the resulting increase in discharge volume in accordance with current best practice and the Code for Sustainable Homes.

3.8 The Sequential Test and Exception Test

The NPPF follows a sequential risk based approach in determining the suitability of land for development in flood risk areas, with intension of steering all new development to the lowest flood risk areas. The SFRA provides the basis for applying the Sequential Test.

The NPPF states that *'the aim of the Sequential Test is to steer new development to area with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in area with a lower probability of flooding.'*

HBC's SFRA contains information that forms the basis of the Sequential Test for a proposed development site. As the Woodcroft Farm site lies within Flood Zone 1 and is therefore at the lowest risk of flooding it is considered to have passed the Sequential Test.

Table 3 of the NPPF Technical Guidance (a copy of which is contained in Section 3.3 Vulnerability) confirms that an Exception Test does not need to be carried out within Flood Zone 1.

4 Surface Water Drainage Strategy

4.1 Managing Surface Water and SuDS

As stated in Table 1 NPPF Technical Guidance (a copy of which is contained in Section 3.2 Flood Zone) *'for development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a Flood Risk Assessment'*.

The EA's FRA Guidance Note 1 also states that *'when considering site drainage in Flood Zone 1, the focus within the FRA must be on flood risk management, but the use of SuDS should also seek to maximise opportunities for water quality and amenity benefits'*.

4.2 Existing Surface Water Drainage

Surface water runoff currently arising on the majority of the site (catchments 2 and 3) runs southwards across the open fields, towards a ditch which runs east to west along Woodcroft Lane. This ditch turns sharply north at the entrance to the farmyard and runs along the line of the hedgerow before discharging into a large, deep, dry pond located behind the stables. Roof water from the Farm buildings also discharges into this pond. The Geoenvironmental and Geotechnical Ground Investigation Report (Doc Ref: 21834/030 R02/Rev00, dated November 2011) identifies this pond as a *'former pond and possible sinkhole'*.

Surface water runoff arising from the eastern corner of the site (catchment 4) also runs south across the surface of the open field towards the ditch adjacent to Woodcroft Lane. However, this eastern section of ditch runs from west to east and seems to peter out within the trees located in the south eastern corner of the site with no visible discharge point.

The fields located to the west of the farmyard (catchment 1) do not appear to be served by any existing ditch network, however the topography of this area would direct any surface water runoff arising from this area towards a low point on the sites western boundary. This boundary is defined by a fence line which separates the site from a public footpath and arable farmland. The site visit showed that this footpath is situated slightly lower than the site and falls from south to north into a small valley within the neighbouring field. It is possible that this path acts as a conduit for runoff from the Woodcroft Farm site.

A sketch showing these catchments is contained in [Appendix 5](#).

A copy of Southern Water asset records are contained in [Appendix 6](#).

4.3 Building Regulations Surface Water Drainage Hierarchy

The Building Regulations H3 stipulates that *'rainwater from roofs and paved areas is carried away from the surface to discharge to one of the following in order of priority:*

- *An adequate soakaway or some other infiltration system,*
- *A watercourse, or where that is not practical,*
- *A sewer.'*

4.4 Sustainable Drainage Systems (SuDS)

Flood risk and other environmental damage can be managed by minimising changes in volume and rate of surface water runoff from development sites through the use of SuDS, this being

complementary to the control of development within the floodplain. SuDS will not alleviate flooding in an area prone to flooding, however if properly designed SuDS have the potential to prevent the surface water runoff from new development increasing the off-site flood risk.

4.5 Proposed Surface Water Drainage Strategy

Due to the existence of potential solution features on the site and the risk of creating additional features, the proposed surface water strategy is not able to mimic the existing drainage regime and discharge surface water to ground.

A Phase 1 Ground Condition Report (PBA, Ref:21834 Rev0, dated August 2010), states that *'the majority of the site is underlain by the Reading Formation (part of the Lambeth Group), which is described as mottled locally sandy clay.... which is in turn underlain by Upper Cretaceous Chalk (Tarrant Chalk Member).'* According to this report due to the clayey nature of the Reading Formation it is unlikely that this strata which is recorded locally up to a depth of 8.7m below ground level, will be suitable for infiltrating drainage techniques.

In addition to the presence of clay within the Reading Formation the report also contains information regarding recorded chalk solution features both on and in the vicinity of the site, and the report states that *'the geological, hydrogeological and geomorphological setting of the site suggests that conditions are highly favourable to solution feature formation.'* *'The introduction of surface water into ground which is susceptible to the presence of natural solution features may cause re-activation of the features potentially triggering ground subsidence.'* CIRIA C574, Engineering in Chalk, recommends that in ground conditions that are prone to solution feature formation that soakways are located at least 20m away from a structure.

As recommended by the Phase 1 Ground Condition Report (PBA, ref:21834 Rev0, dated August 2010) additional ground investigations were undertaken to confirm the suitability of the site for infiltrating drainage techniques and inform a risk mitigation strategy against the formation of additional solution features. This additional investigation detailed in a Geoenvironmental and Geotechnical Ground Investigation Report (PBA, Ref:21834/030 R02/Rev00, dated November 2011) states:

'Ground subsidence over karstic weathering formed by dissolution of chalk is a consequence of a continuing natural process. The surface depressions created are generally referred to as sinkholes. There are four potential sinkholes caused by solution features within the Chalk present at the site. For ease of reference from this point in the report the sinkholes at the site are referred to as Sinkhole 1 to Sinkhole 4. The sinkholes are shown and labelled accordingly on Figure 2.' A copy of Figure 2 is contained in **Appendix 7**.

'Elsewhere on site the geological setting is typically favourable for solution feature development and the presence of loose compressible solution feature infill even though there might not be an actual sinkhole depression at the surface. Such conditions are present in Borehole BH02 where solution feature infill is present within the Chalk between 3.15 and 4.30m depth. The infill materials comprised silty sand with occasional fragments of chalk. The SPT N values for this borehole ranged from 1 to 13 between ground level and about 10m depth with values of 1 and 3 within the solution feature infill, these correspond to a very loose relative insitu density. From 10m depth the SPT N values increased to between 21 and over 50 blows. The profile of Borehole BH2 illustrates the combined effects of periglacial and dissolution weathering to a depth of 10m below existing ground level. While a sinkhole does not appear at this location, the ground conditions illustrated by this borehole do indicate favourable conditions for sinkhole development.'

Based on the results of the Geoenvironmental and Geotechnical Ground Investigation Report (PBA, Ref:21834/030 R02/Rev00, dated November 2011) the proposed surface water drainage strategy does not utilise the discharge of surface water to ground and instead utilises a restricted off-site discharge to the Soak Farm Drain, a main river located approximately 400m to the south west of the development, and the existing Southern Water surface water sewer network. SuDS in the form of cellular storage, ponds and a swale are utilised to provide attenuation up to and including the 1 in 100 year + 30% climate change rainfall event below ground (Section 3.6, Climate Change).

Due to the topography of the site three surface water drainage networks, known as 100, 200 and 300, are proposed across the development. Networks 100 and 300 collect runoff from the central and western parts of the development prior to discharge into the Soak Farm Drain. Land Drainage Consent for this connection has been obtained from the EA. A copy of the EA's consent is contained in **Appendix 8**. Network 200 collects runoff from the eastern part of the development prior to discharge into the existing Southern Water surface water sewer located in Woodcroft Lane approximately 50m south east of the development.

In accordance with the requirements of the EA and the Code for Sustainable Homes an assessment of the pre and post discharge rates and volumes has been undertaken. This assessment shows an increase in the site's discharge volume that needs to be managed. Therefore, to mitigate for the increase in volume discharge the proposed surface water drainage strategy restricts the off-site discharge from Networks 100 and 300 to the calculated greenfield mean annual peak flow (Q_{bar}), and Network 200 to 5 l/s, which is the minimum flow rate advocated by Preliminary Rainfall Runoff Management for Developments Rev E, Defra / EA, in order to achieve a 'compromise between attenuating to a satisfactory low rate while keeping the risk of blockage to an acceptable level.'

Rainfall Return Period	Calculated Greenfield Discharge per Hectare
Mean Annual Peak Flow (Q_{bar})	5.64 l/s/ha
1 in 1 year	4.80 l/s/ha
1 in 30 year	12.64 l/s/ha
1 in 100 year	18.01 l/s/ha

Table 1: Calculated Greenfield Discharge Rates

A copy of the greenfield discharge rate calculations are contained in **Appendix 9**.

Drawings detailing the proposed surface water drainage strategy are contained in **Appendix 10**.

Network 100 – 3.212ha		
Rainfall Return Period	Greenfield Discharge Rate	Proposed Discharge Rate
1 in 1 year	15.41 l/s	10.5 l/s
Q_{bar}	18.11 l/s	
1 in 30 year	40.60 l/s	14.6 l/s
1 in 100 year	57.85 l/s	-
1 in 100 year + climate change	-	17.8 l/s

Table 2: Proposed Discharge Rates – Network 100

Network 200 – 0.325ha		
Rainfall Return Period	Greenfield Discharge Rate	Proposed Discharge Rate
1 in 1 year	1.56 l/s	1.5 l/s
Q _{bar}	1.83 l/s	
1 in 30 year	4.11 l/s	2.3 l/s
1 in 100 year	5.85 l/s	-
1 in 100 year + climate change	-	4.4 l/s*

*Limited to 5 l/s practical minimum flow rate

Table 3: Proposed Discharge Rates – Network 200

Network 300 – 1.255ha		
Rainfall Return Period	Greenfield Discharge Rate	Proposed Discharge Rate
1 in 1 year	6.02 l/s	3.8 l/s
Q _{bar}	7.08 l/s	
1 in 30 year	15.86 l/s	5.5 l/s
1 in 100 year	22.60 l/s	-
1 in 100 year + climate change	-	7.0 l/s

Table 4: Proposed Discharge Rate – Network 300

The accompanying MicroDrainage calculations are contained in **Appendix 11**.

5 Foul Drainage Strategy

5.1 Existing Foul Drainage Strategy

Asset records provided by Southern Water do not show any foul drainage infrastructure serving the Woodcroft Farm site. This along with the lack of inspection chambers / manholes recorded on the topographical survey suggest it is likely that the Farm is currently served by a cesspit or septic tank.

A copy of Southern Water asset records are contained in **Appendix 6**.

5.2 Proposed Foul Drainage Strategy

The proposed foul drainage strategy will utilise the existing Southern Water foul sewer located within the neighbouring residential development, with connections to the properties provided by a new foul drainage network constructed to adoptable standards in accordance with Sewers for Adoption 7th edition. Southern Water has confirmed that adequate capacity is available within their network to accept the proposed flows from the development. Two connections to the Southern Water sewer will be made via the existing Southern Water manholes located to the east and south of the site (MH Ref: 5202 and 2801). As per discussions with Southern Water connection to Southern Water MH ref: 5202 requires construction of approximately 60m of off-site sewer while connection to MH ref 2801 requires construction of a pumping station, 35m of rising main and 50m of off-site sewer.

Drawings detailing the proposed foul drainage strategy are contained in **Appendix 12**.

6 Summary

The EA Flood Zone mapping shows the site to lie in Flood Zone 1; land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%). As such the Woodcroft site has little or no risk of fluvial flooding, being in the lowest flood risk zone, and is therefore considered to have passed the Sequential Test.

The NPPF Table 2 and 3, show that all development classes are appropriate for Flood Zone 1 and that an Exception Test is not required.

EA groundwater mapping confirms that the site lies within a Groundwater Source Protection Zone 1 and over a major aquifer with a low to intermediate groundwater vulnerability. In addition the PUSH SFRA confirms that the site itself has not suffered from any historic groundwater or sewer flooding but lies in an area of moderate to high potential of generating overland flow. However, the proposed surface water drainage strategy takes these items into account by collecting, attenuating and conveying surface water to suitable outfalls in the form of a main river and an adopted surface water sewer.

Due to the existence of solution features on the site and the risk of creating additional features the proposed surface water strategy is not able to mimic the existing regime and discharge surface water to ground. In accordance with best practice the proposed strategy utilises a restricted off-site discharge to the Soak Farm Drain, a main river located approximately 400m to the south west of the development, and the existing Southern Water surface water sewer network. SuDS in the form of cellular storage, ponds and a swale are utilised to provide attenuation up to and including the 1 in 100 year + 30% climate change rainfall event below ground.

In accordance with the requirements of the EA and the Code for Sustainable Homes an assessment of the pre and post discharge rates and volumes has been undertaken. This assessment shows an increase in the site's discharge volume that needs to be managed. Therefore, to mitigate for the increase in volume discharge the proposed surface water drainage strategy restricts the off-site discharge from Networks 100 and 300 to the calculated greenfield mean annual peak flow (Q_{bar}), and Network 200 to 5 l/s, which is the minimum flow rate advocated by Preliminary Rainfall Runoff Management for Developments Rev E, Defra / EA, in order to achieve a '*compromise between attenuating to a satisfactory low rate while keeping the risk of blockage to an acceptable level.*'

As a result the precautionary principle advocated by the NPPF to the uncertainties of flooding has been satisfactorily addressed and there are no flooding or drainage related constraints to development on the site.

Appendix 1 – Site Location Plan

Appendix 2 – Proposed Site Layout

Appendix 3 – Environment Agency Flood Zone Mapping

Appendix 4 – Partnership for Urban South Hampshire Strategic Flood Risk Assessment Mapping

Appendix 5 – Natural Surface Water Catchments

Appendix 6 – Southern Water Asset Records

Appendix 7 – Geotechnical Features Location Plan

Appendix 8 – Environment Agency Land Drainage Consent

Appendix 9 – Greenfield Discharge Rate Calculations

Appendix 10 – Proposed Surface Water Drainage Strategy

Appendix 11 – Proposed Surface Water Drainage MicroDrainage Calculations

Appendix 12 – Proposed Foul Drainage Strategy

