ARCH ASSOCIATES

APPENDIX 1

PFA OUTLINE PLANNING FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

ONE HORTON HEATH, EASTLEIGH

FLOOD RISK ASSESSMENT

EASTLEIGH BOROUGH COUNCIL

DECEMBER 2020

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1. INTRODUCTION

1.1. This Flood Risk Assessment has been prepared on behalf of Eastleigh Borough Council in connection with proposals for a mixed-use development on land at Horton Heath in Hampshire.

1.2. The overall site comprises around 124 hectares, and is located to the west of Horton Heath, which lies in Eastleigh Borough in Hampshire. The post code at the centre of the site is SO50 7DF, and the approximate grid reference for the site is 448500, 117500. The location of the site is shown edged red on **Figure 1** below and the Red Line Plan, Thrive Architects' Drawing Number EAST200403-RLP.01-P2, is reproduced in **Appendix 1**.

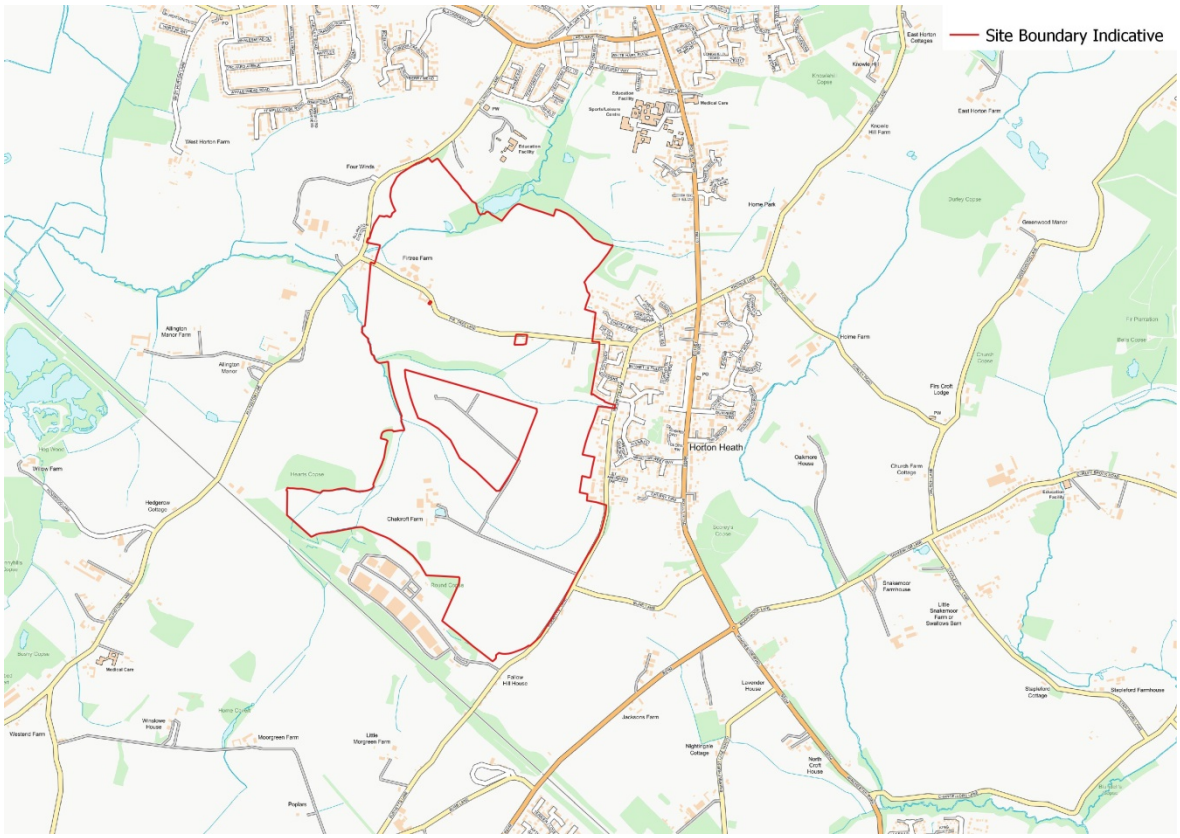

Figure 1: Site Location Plan

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1.3. The main purpose of this site-specific Flood Risk Assessment is to provide sufficient flood risk information to support a planning application for the development proposals in order to demonstrate that the development would be appropriately safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, would reduce flood risk overall.

2. SCOPE OF THE ASSESSMENT

2.1. The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these should be applied. It was published in February 2019 and replaces the first Framework published in March 2012, and includes minor clarifications to the revised version published in July 2018.

2.2. Policy on planning and flood risk in the NPPF is dealt with at paragraphs 155-165 in chapter 14 'Meeting the challenge of climate change, flooding and coastal change'.

2.3. The national planning practice guidance to the NPPF was launched as a web-based resource in March 2014. The category dealing with flooding is contained in Flood Risk and Coastal Change (Reference ID: 7 Updated: 16 11 2016).

2.4. Paragraph 155 of the NPPF states that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

2.5. Paragraph 156 states that strategic policies should be informed by a strategic flood risk assessment (SFRA), and should manage flood risk from all sources.

2.6. An SFRA was prepared by Atkins on behalf of Partnership for Urban South Hampshire (PUSH), in December 2007. The SFRA was subsequently reviewed in 2016 to provide an overview of flood risk from all sources including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

2.7. As set out in paragraph 157 of the NPPF, all plans should apply a sequential, risk-based approach to the location of development - taking into account the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property.

2.8. Paragraph 158 states that the aim of the sequential test is to steer new development to areas with the lowest probability of flooding, and the strategic flood risk assessment will provide the basis for applying the test.

2.9. A copy of the Environment Agency's Flood Map for Planning, obtained from the GOV.UK website, which shows the Flood Zones in the vicinity of the site, is reproduced as **Figure 2** below.

2.10. The Environment Agency's Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences, and show the extent of the natural floodplain and the additional extent of an extreme flood. The Environment Agency's Flood Map for Planning shows the area that could be affected by flooding, either from rivers or the sea, coloured dark blue corresponding to Flood Zone 3. The light blue area is Flood Zone 2 and shows the additional extent of an extreme flood from rivers or the sea. These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements. Where there is no blue shading, this shows the area where flooding from rivers and the sea is very unlikely corresponding to Flood Zone 1.

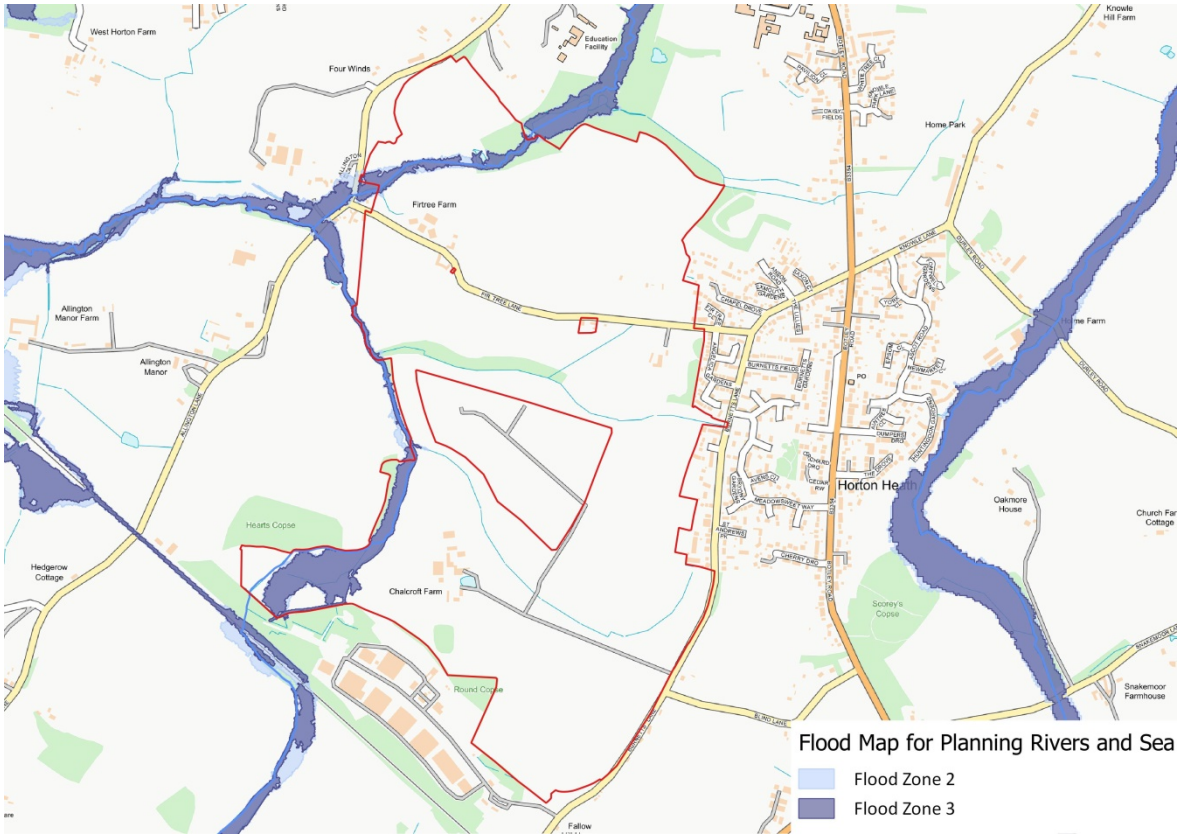

Figure 2: Environment Agency's Flood Map for Planning

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2.11. The site's red line boundary and the Environment Agency's Flood Map for Planning dataset has been used to produce Figure 2. From an inspection of the Flood Map it can be seen that the majority of the site falls within Flood Zone 1. Small areas of the site's western boundary and north-western corner are shown as falling within Flood Zone 2 and Flood Zone 3.

2.12. As set out in paragraph 163 of the NPPF, when determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood risk assessment.

2.13. Footnote 50 in the NPPF states that a site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

Flood Risk Assessment Guidance

2.14. Paragraph 30 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-030-20140306) advises that a site-specific flood risk assessment is carried out to assess the flood risk to and from a development site. The assessment should demonstrate how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its users.

2.15. For the purposes of applying the NPPF, paragraph 2 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-002-20140306) advises that "flood risk" is a combination of the probability and the potential consequences of flooding from all sources - including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

2.16. Paragraph 31 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-031-20140306) advises that the information provided in the flood risk assessment should be credible and fit for purpose. Site-specific flood risk assessments should always be proportionate to the degree of flood risk and make optimum use of information already available, including information in a SFRA for the area, and the interactive flood risk maps. A flood risk assessment should also be appropriate to the scale, nature and location of development.

2.17. Paragraph 68 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-068-20161116) provides a model checklist for a site specific flood risk assessment.

2.18. With regard to what further advice is available on the preparation of a site-specific flood risk assessment, paragraph 32 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-032-20150415) refers to the Environment Agency Standing Advice on flood risk.

2.19. Guidance from the Department for Environment, Food & Rural Affairs (DEFRA) and Environment Agency (EA), published on the Government's GOV.UK website, includes guidance on how to carry out a flood risk assessment entitled: 'Flood risk assessment in flood zones 2 and 3', 'Flood risk assessment in flood zone 1 and critical drainage areas', and 'Preparing a flood risk assessment: standing advice'. This guidance provides information on the range of factors that need to be considered when assessing flood risk.

2.20. Reference has also been made to: BS 8533:2017 'Assessing and managing flood risk in development - Code of practice'; BS 8582:2013 'Code of practice for surface water management for development sites'; and the Local Authority SuDS Officer Organisation (LASOO) document entitled 'Non-Statutory Technical Standards for Sustainable Drainage :Practice Guidance'.

2.21. The DEFRA/EA guidance 'Review individual flood risk assessments: standing advice for local planning authorities' sets out when local planning authorities must consult the Environment Agency, their lead local flood authority or both, on any proposed developments at a higher risk from flooding before making a decision.

2.22. For 'major development' with surface water drainage local planning authorities need to consult their lead local flood authority (LLFA). In Flood Zone 1 they need to consult the EA if the development is in an area with critical drainage problems, other than minor development. In Flood Zone 2 they need to consult the EA if the development's flood risk vulnerability is:

- 'essential infrastructure'
- 'highly vulnerable'
- 'more vulnerable' and it's a landfill or waste facility site, caravan or camping site
- 'less vulnerable' and it's a waste treatment site, mineral processing site, water treatment plant, or a sewage treatment plant.

2.23. In Flood Zone 3 the local planning authority needs to consult the EA for all developments other than minor development. They also need to consult the EA for developments involving a change of use and the flood risk vulnerability will:

- be either 'more vulnerable' or 'highly vulnerable'
- change from 'water compatible' to 'less vulnerable'.

2.24. Local planning authorities also need to consult the Environment Agency if the development is within 20m of a main river in Flood Zones 1, 2 or 3.

2.25. The proposed development is classed as 'major development'. Main Rivers are located within the red line area of the site and the site contains areas of Flood Zones 1, 2 and 3. The local planning authority therefore needs to consult the lead local flood authority and the Environment Agency.

Local Plan Policies

2.26. The Eastleigh Borough Council Local Plan review (2001 – 2011) contains saved policies relevant to this assessment:

- Policy 41.ES – Development affecting water courses.
- Policy 42.ES – Development in a catchment of a water course.
- Policy 43.ES – Areas at risk of flooding.
- Policy 45.ES – Sustainable Drainage.

2.27. The Eastleigh Borough Local Plan 2016 – 2036 was submitted in October 2018 for public examination. The following policies in the submitted Local Plan are relevant to this assessment:

- Policy DM3 – Adaptation to climate change.
- Policy DM5 – Managing flood risk.
- Policy DM6 – Sustainable surface water management and watercourse management.
- Policy DM10 – Water and Waste Water.
- Policy DM11 – Nature conservation.

Summary of Scope

2.28. The scope of this Flood Risk Assessment is to provide sufficient information to satisfy the requirements of the NPPF, the planning practice guidance checklist, Local Plan Policies, guidance published by DEFRA/Environment Agency, the Government's 'Non-statutory technical standards for sustainable drainage systems' and Hampshire's Local standards.

3. FLOOD RISK ASSESSMENT

Development Site and Location

3.1. The site is located to the west of Horton Heath in Hampshire. The site is currently in agricultural use, mainly arable with some grassland.

3.2. The Site Location Plan and the Environment Agency's Flood Map for Planning are based on the Ordnance Survey map of the area, and show geographical features and identify watercourses and other bodies of water in the vicinity of the site.

3.3. A number of drainage features and watercourses are present within the site. The watercourses within the site are tributaries of the River Itchen which is located approximately 1.5km to the west of the site's boundary.

3.4. The watercourse on the western boundary is classified as a 'Main River' and flows from south to north under Allington Lane and into the River Itchen to the south of Chickenhall Lane Wastewater Treatment Works (WwTW). All other onsite watercourses discharge into this unnamed 'Main River'.

3.5. An ordinary watercourse is present on the site's southern boundary to the north of Chalcroft Business Park and drains from the southeast to the north. A second ordinary watercourse bisects the southern area of the site and flows from south-east (adjacent to Burnetts Lane) to west (running north of Charlcroft Farm, and south of the Solar Farm). A third ordinary watercourse bisects the central area of the site and flows from east (in the vicinity of Horton Heath) to west (to the north of the Solar Farm). A number of smaller ditches located within hedgerows drain into the onsite watercourses and are adjacent to the existing highways.

3.6. A second 'Main River' bisects the north-western area of the site and flows from the north-east to the west to the north of Firtree Farm. This watercourse is known locally as the Fair Oak Stream.

3.7. A number of ponds are also present within the site and in its immediate vicinity. A pond is present within the Chalcroft Farm site and another is present adjacent to the Fair Oak Stream in an area of woodland to the north of Firtree Farm. Quobleigh Pond is located to the north of the site on the Fair Oak Stream and an unnamed pond is present to the west of the site to the west of the unnamed 'Main River' south of Allington Lane. These waterbodies are supplemented by a number of ephemeral pools associated with the small watercourses on the site.

3.8. The natural catchments of the onsite watercourses are defined by the site's topography.

3.9. The existing surface water management arrangements at the site are indicated on Drawing Number G277/20 Rev A, a copy of which is contained in **Appendix 2**.

Development Proposals

3.10. The development proposals comprise a maximum of:

- Circa 2,500 dwellings comprising a mix of market and affordable housing.
- A Mixed Use Centre of 3.1 Ha comprising residential, retail, leisure, community, employment facilities.
- 3.3 Ha of employment land.
- A three form entry primary school and early years education facilities.
- Formal and informal publicly accessible open space, formal areas of play, youth provision and associated facilities, formal sports facilities, allotments and amenity space, including landscaping, green infrastructure and sustainable drainage systems.
- The utilisation of existing and provision of new and/ or amended highway access points along Allington Lane, Fir Tree Lane, Burnetts Lane and Bubb Lane.
- Any wider land outside the site boundary needed for development specific infrastructure.

3.11. A copy of the Illustrative Masterplan, Thrive Architects' Drawing Number EAST200403-CMP01-P13, showing the development proposals, is reproduced in **Appendix 3**.

Site Levels

3.12. A Topographical Survey was undertaken by Mayer Brown in 2014 and 2015. The survey is shown on Mayer Brown's Drawing Numbers IR.SAV.1.21.1 Rev E to IR.SAV.1.21.12 Rev E, copies of which are reproduced in **Appendix 4.**

3.13. The Topographical Survey indicates that high points are located in the vicinity of the northern, eastern and southern boundaries of the site. Areas of the site generally fall towards the onsite watercourses and ditches with the site overall having a gentle fall towards the main river on the western boundary.

Flood Risk Vulnerability and Flood Zone 'Compatibility'

3.14. Paragraphs 65-67 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-065-20140306) refer to three Flood Zone and Flood Risk Tables.

3.15. Table 1: Flood Zones provides a definition of each Flood Zone. Table 2: Flood Risk Vulnerability Classification categorises different types of development according to their vulnerability to flood risk. Table 3: Flood risk vulnerability and flood zone 'compatibility' maps these vulnerability classes against the flood zones to indicate where development is appropriate and where development should not be permitted.

3.16. The Environment Agency's Flood Map for Planning indicates that the majority of the site falls within Flood Zone 1 with areas of Flood Zones 2 and 3 present along the site's western boundary and crossing an area in the north-west of the site.

3.17. With reference to Table 2 of the Flood Risk and Coastal Change Planning Practice Guidance, the proposed residential development falls into the 'More Vulnerable' flood risk vulnerability classification, which includes buildings used for dwelling houses. The proposed employment development falls into the 'Less Vulnerable' flood risk vulnerability classification, which includes buildings used for shops, restaurants, offices, general industry, etc. The proposed primary school and early years education facilities are classified as 'More Vulnerable'. The highway access points are classified as 'Essential Infrastructure'.

3.18. With reference to Table 3, all uses of land are appropriate in Flood Zone 1. Flood Zone 2 is appropriate for most development but the highly vulnerable uses are only appropriate in this zone if the Exception Test is passed. In Flood Zone 3a the more vulnerable, which includes dwelling houses, and essential infrastructure, uses should only be permitted in this zone if the Exception Test is passed. In Flood Zone 3b new development should not be permitted but essential infrastructure is appropriate in this zone if the Exception Test is passed.

Probability

3.19. A definition of each Flood Zone and probability of river or sea flooding is provided in Table 1 at paragraph 65 of the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-065-20140306). Flood Zone 1 Low Probability is defined as land having a less than a 1 in 1000 (0.1%) annual probability of river or sea flooding.

3.20. Flood Zone 2 Medium Probability is defined as land having between a 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of river flooding; or between a 1 in 200 (0.5%) and 1 in 1000 (0.1%) annual probability of sea flooding. Flood Zone 3 High Probability is defined as having a 1 in 100 (1%) or greater annual probability of river flooding; or a 1 in 200 (0.5%) or greater annual probability of sea flooding.

3.21. Table 1 divides Flood Zone 3 into Zone 3a High Probability and Zone 3b The Functional Floodplain. Flood Zone 3a is defined as a 'high probability' zone assessed as having a 1 in 100 (1%) or greater annual probability of river flooding; or land having a 1 in 200 (0.5%) or greater annual probability of sea flooding. Zone 3b The Functional Floodplain is defined as comprising land where water has to flow or be stored in times of flood.

3.22. In relation to the identification of the functional floodplain, paragraph 15 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-015-20140306) advises that land which would naturally flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood (such as a flood attenuation scheme) in an extreme (0.1% annual probability) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.

The Sequential Test and Exception Test

3.23. Paragraph 157 of the NPPF states:

> **'All plans should apply a sequential, risk-based approach to the location of development - taking into account the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property.'**

3.24. Paragraph 158 of the NPPF goes onto state:

> **'The aim of the sequential test is to steer new development to areas 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 areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying the test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.'**

3.25. Paragraph 160 of the NPPF states:

> **'The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. For the exception test to be passed it should be demonstrated that*:***
>
> **a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and**
>
> **b) the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.'**

3.26. Paragraph 161 of the NPPF goes onto state:

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

3.27. Paragraph 163 of the NPPF states:

> **'When determining any planning applications, local planning authorities should ensure flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:**
>
> **a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;**
>
> **b) the development is appropriately flood resistant and resilient,**
>
> **c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;**
>
> **d) any residual risk can be safely managed; and**
>
> **e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.'**

3.28. The Notes to Table 3 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-067-20140306) indicate that the application of the sequential test should be applied first to guide development to Flood Zone 1, then Zone 2, and then Zone 3.

3.29. The majority of the site falls within Flood Zone 1 with areas of Flood Zones 2 and 3 present along the site's western boundary and crossing an area in the north-west of the site. In accordance with Paragraphs 158 and 163 of the NPPF, a sequential approach has been used such that no built development would be located in Flood Zones 2 or 3. On this basis the sequential test is passed.

Climate Change

3.30. The NPPF requires development to take account of the impacts of climate change. The allowances to be made for climate change effects when assessing flood risk are related to the lifetime of the development.

3.31. Guidance on the lifetime of development is provided at paragraph 26 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-026-20140306). Residential development should be considered for a minimum of 100 years, unless there is specific justification for considering a shorter period. The lifetime of a non-residential development depends on the characteristics of that development. Developers would be expected to justify why they have adopted a given lifetime for the development.

3.32. Under heading 4 in the Site-Specific Flood Risk Assessment Checklist in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-068-20161116), it asks how flood risk at the site is likely to be affected by climate change and states that further advice on how to take account of climate change in flood risk assessments is available from the Environment Agency. Guidance published by the Environment Agency on 19 February 2016, and last updated on 22 July 2020, entitled 'Flood risk assessments: climate change allowances', sets out the climate change allowances to be used for peak river flow by river basin district, peak rainfall intensity, sea level rise, offshore wind speed and extreme wave height.

3.33. Table 1 of 'Flood risk assessments: climate change allowances' gives the peak river flow allowances by river basin district for 3 categories: central, higher central and upper end, and 3 time frames. The appropriate allowance to use depends on the flood zone and the flood risk vulnerability classification of the development.

3.34. The site lies in the South East river basin district, and the proposed development falls into the 'More Vulnerable' flood risk vulnerability classification. Based on the flood zone and flood risk vulnerability classification of the development, the higher central and upper end allowances need to be used to assess the range of impact. The total potential change anticipated for 2070 to 2115 is given as 45% for the higher central category and 105% for the upper end category.

3.35. The peak rainfall intensity allowances to be used when designing urban drainage systems are given in Table 2 of 'Flood risk assessments: climate change allowances'. Both the central and upper end allowances need to be assessed to understand the range of impact. The total potential change anticipated for 2070 to 2115 is 20% for the central category, and 40% for the upper end category.

Standard of Protection

3.36. In terms of providing an acceptable standard of protection against flooding for new development, paragraph 54 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-054-20150415) advises how development can be made safe from flood risk. Reference is made to the ability of residents and users to safely access and exit a building during a design flood. Paragraph 55 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-055-20140306) defines a "design flood" as follows:

'This is a flood event of a given annual probability, which is generally taken as:

- **fluvial (river) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year) or ;**
- **tidal flooding with a 0.5 per cent annual probability (1 in 200 chance each year),**

against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed.'

3.37. Therefore, in terms of providing an acceptable standard of protection against flooding for new development, no flooding of property should occur as a result of the 'design flood' corresponding to a 1 in 100 year fluvial flood event, or a 1 in 200 year tidal flood event, taking account of climate change.

3.38. The Government published its 'Non-statutory technical standards for sustainable drainage systems' in March 2015. They should be used in conjunction with the NPPF and planning practice guidance. Standard S7 states that the drainage system must be designed so that flooding does not occur on any part of the site for a 1 in 30 year rainfall event. Standard S8 goes on to state that the drainage system must be designed so that flooding does not occur during a 1 in 100 year rainfall event in any part of a building (including a basement); or in any utility plant susceptible to water within the development.

Site Specific Flood Risk

3.39. In addition to flooding from rivers and the sea it is also necessary to consider the potential consequences of flooding from all other sources, which include directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

3.40. The Government's GOV.UK website contains 'Long Term Flood Risk Information' which includes interactive maps showing 'Flood risk from rivers or the sea' and 'Flood risk from surface water'. These maps show the chance of flooding in one of four risk categories: High risk means that each year this area has a chance of flooding of greater than 3.3% (1 in 30); Medium risk between 1% and 3.3% (1 in 100 and 1 in 30); Low risk between 0.1% and 1% (1 in 1000 and 1 in 100); and Very low risk less than 0.1% (1 in 1000).

3.41. The 'Flood risk from surface water' map indicates the extent, depth and velocity of water for High, Medium and Low risk scenarios. The Long Term Flood Risk Information also includes a 'Flood risk from reservoirs' map, which includes flood depth and flood speed.

3.42. The GOV.UK website advises that this information is not suitable for use in land-use planning, and if planning a development the Environment Agency's Flood Map for Planning must be used for this purpose.

3.43. Enquiries have been made to the Environment Agency to obtain: the detailed Flood Map of the area; the latest available modelled flood levels for the watercourses in the vicinity of the site; the modelled flood extents; flood defence locations; details of historic flood events; and local flood history data from all sources of flooding. A copy of the Environment Agency's response, including copies of the detailed Flood Map, Model Nodes Maps and Modelled River Levels table, are reproduced in **Appendix 5**.

Flooding from Watercourses

3.44. A number of drainage features and watercourses are present within the site. The watercourses act as tributaries of the River Itchen which is located approximately 1.5km to the west of the site's boundary.

3.45. The watercourse on the western boundary of the site is classified as a 'Main River' and flows from south to north under Allington Lane and into the River Itchen to the south of Chickenhall Lane Wastewater Treatment Works (WwTW). All other onsite watercourses discharge into this unnamed 'Main River'.

3.46. An ordinary watercourse is present on the southern boundary to the north of Chalcroft Business Park and drains from the south-east to the north. A second ordinary watercourse bisects the southern area and flows from the south-east (adjacent to Burnetts Lane) to the west (running north of Charlcroft Farm, and south of the Solar Farm). A third ordinary watercourse bisects the central area of the site and flows from the east (in the vicinity of Horton Heath) to the west (to the north of the Solar Farm). A number of smaller ditches located within hedgerows drain into the onsite watercourses and are adjacent to the existing highways on the site.

3.47. A second 'Main River' bisects the north-western area of the site and flows from the north-east to the west to the north of Firtree Farm. This watercourse is known locally as the Fair Oak Stream.

3.48. A number of ponds are also present on the site and in its immediate vicinity. A pond is present within the Chalcroft Farm site and another is present adjacent to the Fair Oak Stream in an area of woodland to the north of Firtree Farm. Quobleigh Pond is located to the north of the site on the Fair Oak Stream and an unnamed pond is present to the west of the site to the west of the unnamed 'Main River' and south of Allington Lane. These waterbodies are supplemented by a number of ephemeral pools associated with the small watercourses on the site.

3.49. The Environment Agency's Flood Map for Planning shows the extent of the natural floodplain and the additional extent of an extreme flood. The Environment Agency's Flood Map for Planning indicates that the large majority of the site is unaffected by any floodplain and falls within Flood Zone 1 where flooding from rivers and the sea is very unlikely. In Flood Zone 1 there is a less than a 0.1 per cent (1 in 1000) chance of flooding occurring each year.

3.50. Modelled flood levels for the unnamed watercourses designated as 'main rivers' have been obtained from the Environment Agency, with relevant extracts shown in Appendix 5.

3.51. With reference to Table 1 of 'Flood risk assessments: climate change allowances' the appropriate allowances to use for the South East river basin district are the higher central and upper end allowances. The total potential change anticipated for 2070 to 2115 is given as 45% for the higher central category and 105% for the upper end category.

3.52. The Water Depths and Levels tables contained in Appendix 5 show the 1 in 100 year modelled flood levels taking into account a range of climate change allowances including the 45% and 105% increases.

3.53. On the basis of the available modelled flood levels provided by the Environment Agency, the areas of the site where built development is proposed are unaffected by the floodplain associated with the watercourses.

3.54. In terms of historic flooding, the Environment Agency has confirmed that it does not have any record of flooding in this location. However anecdotal evidence suggests that areas along the western boundary of the site and in the vicinity of the junction of Fir Tree Lane with Allington Lane have been affected by flooding. The Moon River development at the confluence of the unnamed Main River and the Fair Oak Stream has also suffered historic flooding. This is in line with the modelled flood extents shown on the Flood Map for Planning.

Flooding from Surface Water

3.55. The GOV.UK's Flood risk from surface water map indicates where surface water may be expected to flood or pond. Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead. The GOV.UK website advises that flooding from surface water is difficult to predict as rainfall location and volumes are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding. The information shown is a general indicator of an area's flood risk. A copy of the GOV.UK Flood risk from surface water map is reproduced in **Figure 3** below.

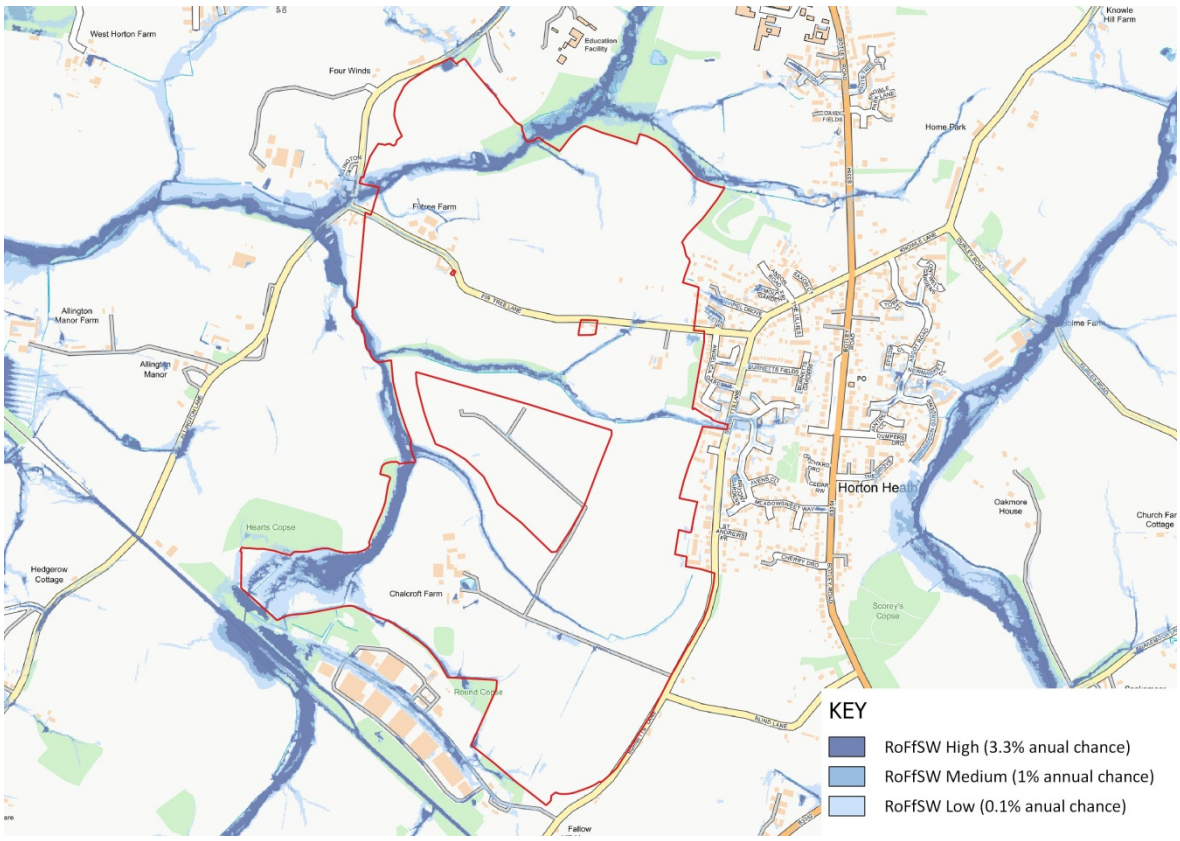

Figure 3: Flood risk from surface water map

3.56. The GOV.UK Flood risk from surface water map shows the majority of the site lies in an area with a Very Low: less than 1 in 1000 (0.1%) chance of surface water flooding.

3.57. The required standard of protection against flooding for the development is that no flooding of property should occur as a result of a 1 in 100 year flood event, which corresponds to the Medium risk scenario on the GOV.UK 'Long Term Flood Risk Information' maps.

3.58. Localised areas with a higher risk correspond to the routes of the onsite ordinary watercourses and ditches and localised low spots.

Flooding from Groundwater

3.59. Groundwater flooding is most likely to occur in low-lying areas underlain by water-bearing permeable rocks such as sands, gravels, limestone and chalk. Groundwater flooding occurs as a result of water rising from the underlying rocks or from water flowing from abnormal springs. This tends to occur after long periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. In low-lying areas the water table is usually at shallower depths, so during very wet periods, all the additional groundwater flowing towards these areas can cause the water table to rise to the surface causing groundwater flooding.

3.60. An intrusive Ground Investigation undertaken on the site anticipates shallow groundwater in the vicinity of the watercourses within the site. As part of the investigatory work Boreholes were drilled across the site and groundwater levels recorded in the winter months. Groundwater levels varied between 0.9m below ground level (m bgl) and 3.04m bgl. It is considered that groundwater could be shallow on the site and shallowest in proximity to the onsite watercourses.

3.61. If groundwater were to emerge it would follow a similar route to surface water flows shown in Figure 3 above and collect at low lying areas adjacent to watercourses.

3.62. The majority of the site is at Low risk of flooding from groundwater with areas of elevated risk associated with the low lying areas in proximity to onsite watercourses.

Flooding from Overwhelmed Sewers and Drainage Systems

3.63. No public sewers are identified on the site and there are no known instances of flooding from overwhelmed sewers affecting the site. The risk of flooding from overwhelmed sewers is therefore assessed as Low.

Flooding from Artificial Sources

3.64. The GOV.UK Flood risk from reservoirs map indicates the site is unaffected by flooding from any reservoirs.

3.65. No significant upstream waterbodies that would pose a risk to the site have been identified.

3.66. The risk of artificial flood hazards affecting the site is therefore considered to be Very Low.

Summary of Flood Risk

3.67. A summary of the potential flood risk risk from all sources of flooding associated with existing conditions pre-development is shown in Table A below.

Table A: Pre-development Potential Flood Risk from All Sources of Flooding

Flood Source	Potential Risk				Description
	Very Low	Low	Medium	High	
Watercourses		X			The majority of the site, and all proposed built development, is located in Flood Zone 1.
Surface Water		X			The topography of the land indicates that any overland flow would be directed into the ditch network away from the site.
Groundwater		X			If groundwater were to emerge it would follow a similar route to surface water flows
Overwhelmed Sewers		X			No public sewers are identified on the site and there are no known instances of flooding from overwhelmed sewers affecting the site
Artificial Sources	X				The site is not affected

3.68. The pre-development potential flood risk to the site from all sources of flooding is considered to be low.

4. WATER MANAGEMENT STRATEGY

Sustainable Drainage Systems

4.1. Government policy set out in paragraph 163 of the NPPF states that development should only be allowed in areas at risk of flooding where it can be demonstrated that it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate.

4.2. Paragraph 165 of the NPPF states:

> **'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:**
>
> **a) take account of advice from the lead local flood authority;**
>
> **b) have appropriate proposed minimum operational standards;**
>
> **c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and**
>
> **d) where possible, provide multifunctional benefits.'**

4.3. Paragraph 51 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-051-20150323) advises that sustainable drainage systems are designed to control surface water runoff close to where it falls and mimic natural drainage as closely as possible. Sustainable drainage systems provide opportunities to:

- reduce the causes and impacts of flooding;
- remove pollutants from urban runoff at source;
- combine water management with green space with benefits for amenity, recreation and wildlife.

4.4. In terms of what sort of sustainable drainage system should be considered, paragraph 80 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-080-20150323) advises that, generally, the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:

- Into the ground (infiltration);
- to a surface water body;
- to a surface water sewer, highway drain, or another drainage system;
- to a combined sewer.

4.5. The Government's 'Non-statutory technical standards for sustainable drainage systems' relate to the design, construction, operation and maintenance of sustainable drainage systems and have been published as guidance. The Government expects these standards to apply to all developments of 10 homes or more and to major commercial development.

4.6. Paragraph 81 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-081-20150323) states that in considering a development that includes a sustainable drainage system the local planning authority will want to be satisfied that the proposed minimum standards of operation are appropriate. Paragraph 82 (Reference ID: 7-082-20150323) advises that the decision on whether a sustainable drainage system would be inappropriate is a matter of judgement for the local planning authority, taking advice from the relevant flood risk management bodies, including on what sort of sustainable drainage system they would consider to be 'reasonably practicable'. Paragraph 82 states that the judgement of what is reasonably practicable should be by reference to the technical standards and take into account design and construction costs.

4.7. Paragraph 85 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-085-20150323) advises that any sustainable drainage system should be designed so that the capacity takes account of the likely impacts of climate change.

4.8. The Government's 'Non-statutory technical standards for sustainable drainage systems' set out peak flow control standards (S2 and S3) and volume control technical standards (S4, S5 and S6). For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event. For developments which were previously developed, the corresponding runoff rate for these events must be as close as reasonably practicable to the greenfield runoff rate from the development, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

4.9. In terms of volume control, where reasonably practicable, for greenfield development, the runoff volume in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event. Where reasonably practicable, for developments which have been previously developed this runoff volume must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume, but should never exceed the runoff volume prior to redevelopment for that event. Where it is not reasonably practicable to constrain the volume of runoff as described it must be discharged at a rate that does not adversely affect flood risk.

4.10. Guidance on the design and construction of SuDS is provided in the 'Interim Code of Practice for Sustainable Drainage Systems', published by the National SUDS Working Group in July 2004, in other CIRIA documents including The SuDS Manual 2015 (CIRIA C753), in the Environment Agency's document entitled 'Sustainable Drainage Systems (SUDS) An introduction', as well as in the Design and Construction Guidance (DCG) published by Water UK.

4.11. There are a number of potential SuDS techniques that might be used on any particular site. These include pervious pavements, infiltration devices such as soakaways and infiltration trenches, bioretention systems, as well as flow balancing methods including swales, ponds/detention basins, constructed wetlands and underground storage facilities.

4.12. The use of soakaways, pervious pavements and infiltration devices to discharge surface water runoff to ground depends upon the underlying strata having a suitable permeability. In addition, the Environment Agency will seek to control discharges into underground strata from areas subject to contamination or where groundwater is judged to be at risk from pollution caused by possible contamination.

4.13. The SuDS Manual 2015, and CIRIA C687 'Planning for SuDs - making it happen', promote the use of a SuDS 'management train', which seeks to address the quality and quantity of runoff at all stages of a drainage system. It uses a hierarchy of techniques, namely: i) prevention, ii) source control, iii) site control and iv) regional control. The drainage strategy for the proposed development seeks to follow the concept of a SuDS management train.

Ground Conditions

4.14. The British Geological Survey (BGS) geological mapping of the area shows the majority of the site is underlain by the Wittering Formation, consisting of sand, silt and clay.

4.15. A Soil Site Report was obtained from the National Soil Resources Institute. Hydrology of Soil Type (HOST) data for the site characterises the underlying soils for the majority of the site as falling into HOST Class 25, which is defined as *"Slowly permeable, seasonally waterlogged soils over impermeable clay substrates with no storage capacity"*.

4.16. A site investigation was undertaken by Hydrock in April 2019. The ground conditions encountered on the site are described in the Ground Investigation Report as follows:-

> **"The ground conditions as proven by the investigation undertaken at the site comprise:**
>
> - **Topsoil – to between 0.40m and 0.50m bgl, comprising a light brown to brown sandy gravelly silt with rootlets.**
> - **Head Deposits – to between 0.95 and 1.60 in thickness, comprising a light brown to orange brown sandy gravelly silt.**
> - **River Terrace Deposits – found at BH09, in the north west of the site, to be 1.60m thick, comprising orange brown sandy, gravelly and cobbly clay/silt.**
> - **Wittering Formation – found in all locations, thickness not proven, comprising soft to firm orange and orange brown mottled grey often lenticular or laminated silt, sand and clay where weathered and soft to stiff grey, often laminated silt, sand and clay at depth.**
> - **Earnley Sand Formation – found in the south of the site in BH02, between 0.40 and 2.30m bgl, comprising light brownish grey slightly and slightly gravelly sand."**

4.17. With regards to the use of soakaways / infiltration drainage on the site, the Ground Investigation Report concluded the following:-

> **"Soakaway drainage is considered unsuitable for this site, subject to further BRE365 compliant testing."**

4.18. With regards to groundwater the Ground Investigation Report states the following:-

> **"Groundwater was not encountered during the investigation.**
>
> **"Water levels recorded post-fieldwork range from 0.93m bgl to 2.77m bgl (15.86m OD to 29.66m OD)."**

4.19. It is recommended that groundwater monitoring is undertaken in the locations of the proposed Strategic SuDS features to establish the highest annual groundwater levels to inform the detailed design of these features.

4.20. Based on the foregoing it is considered that the use of soakaways would not provide a suitable means of draining surface water runoff from development on the majority of the site. However, in line with the recommendations of the Ground Investigation Report, it is recommended that localised infiltration testing is undertaken within the individual development parcels to identify any localised areas of the site where infiltration drainage may be feasible.

Groundwater Source Protection

4.21. From an inspection of the Environment Agency's Aquifer Designation Map dataset held on Natural England's MAGIC website, the site is underlain by a Secondary A Aquifer. A copy of the Aquifer Designation Map dataset information is reproduced in **Figure 4** below.

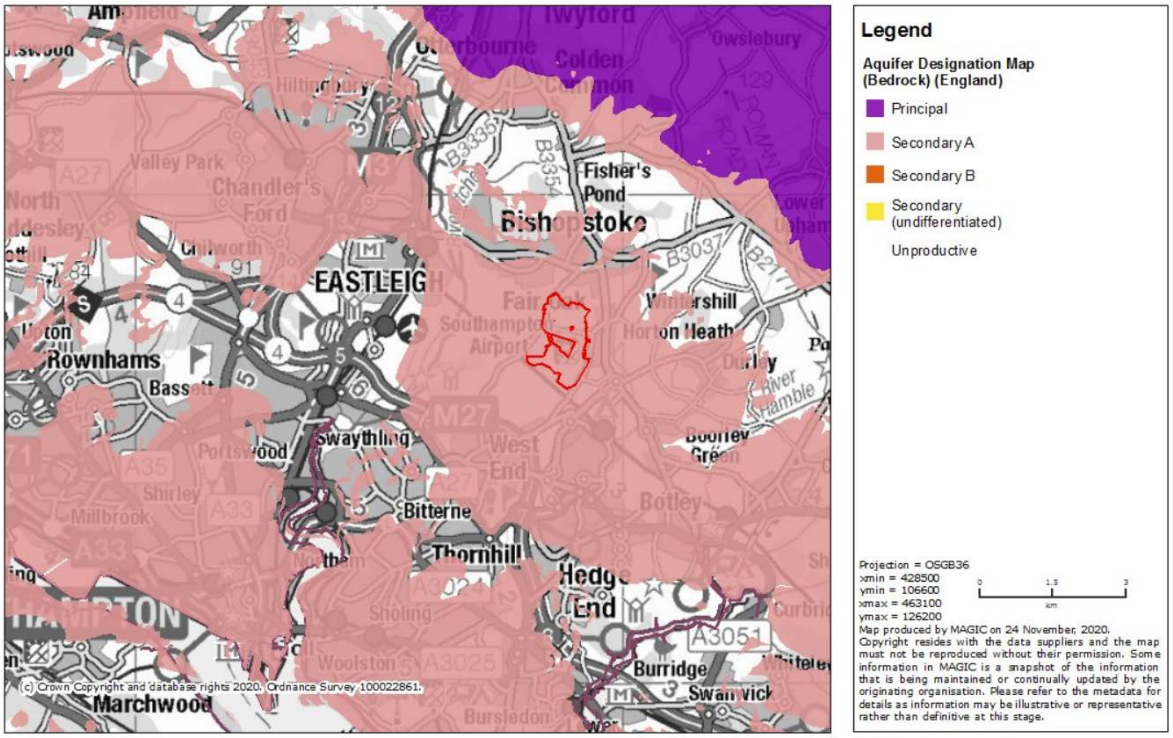

Figure 4: Aquifer Designation Map

4.22. From an inspection of the Environment Agency's Source Protection Zones dataset the site does not fall into a Groundwater Source Protection Zone. A copy of the Source Protection Zone Map dataset information is reproduced in **Figure 5** below.

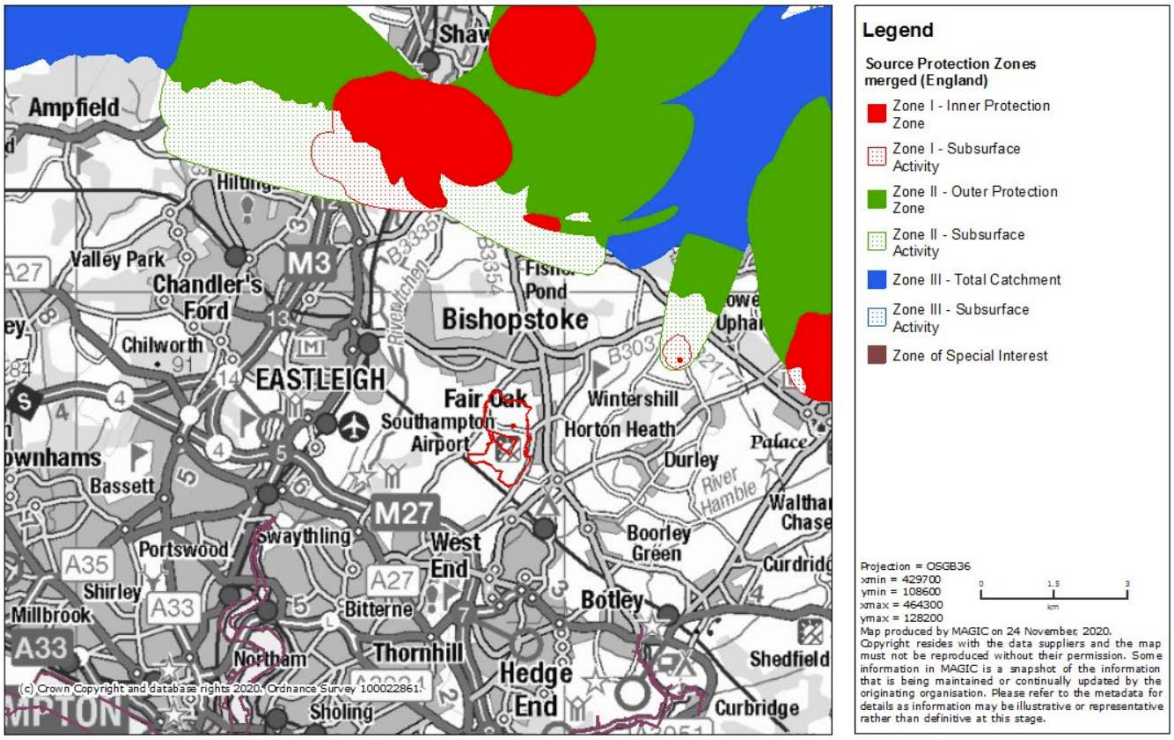

Figure 5: Source Protection Zones

4.23. With reference to the 'Environment Agency's approach to groundwater protection', the discharge of clean roof water to ground is acceptable both inside and outside SPZ1('inner zone') provided that all roof water down-pipes are sealed against pollutants entering the system from surface run-off, effluent disposal or other forms of discharge. If infiltration SuDS are to be used on any part of the site for surface run-off from roads, car parking and public or amenity areas, they would be suitably designed to ensure that the system does not pose an unacceptable risk to the source of supply.

Surface Water Management

4.24. A sustainable drainage strategy, involving the implementation of SuDS, is proposed for managing surface water on the site.

4.25. A full range of SuDS techniques have been considered for use on the site. Through early discussions with the Lead Local Flood Authority and other stakeholders it was agreed that the Strategic SuDS Features on the site should comprise above ground storage features within the green corridors that follow the onsite watercourses.

4.26. Additional source control measures should be utilised within the upstream development parcels. This approach provides flexibility for the detailed design of individual development parcels whilst maximising the water quality, water quantity, amenity and biodiversity benefits of the overall SuDS strategy.

4.27. A preliminary surface water management strategy is shown on the Preliminary Surface Water Management Strategy Plan, Drawing Numbers G277/21 Rev A and 22 Rev A, copies of which are contained in **Appendix 6**.

4.28. The proposed surface water management strategy would ensure that surface water arising from the developed site would 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.

4.29. A SuDS Management Train approach is proposed to be implemented on the site. Guidance on the SuDS Features that should make up the SuDS Management Train is shown on drawing number G277/24, a copy of which is contained in **Appendix 7**.

4.30. In terms of the SuDS 'management train', the surface water management strategy for the proposed development seeks to address the quality and quantity of runoff as follows:-

i) Prevention

4.31. Prevention is the use of good site design and housekeeping measures to prevent pollution. Good site design and housekeeping measures that should be considered include:

- Minimising the impermeable areas created on the site by providing soft landscaping and planting wherever possible.
- Good site wide housekeeping and maintenance to minimise blockages and prevent pollution arising.
- Provision of water butts for rear gardens.
- The use of green roofs for public / commercial buildings where appropriate.
- The use of rainwater harvesting / reuse systems for public / commercial buildings and irrigation where appropriate.
- Installation of separators and other proprietary pollution control systems where land use requires or specific risks necessitate their use.
- Silt traps and trapped gullies to retain sediment.
- Planting within landscaped areas to encourage nutrient / pollutant uptake and evapotranspiration.
- The implementation of a SuDS Maintenance Strategy. Advice on what should be included within a maintenance strategy for the Strategic SuDS Features is included with this report. The SuDS Maintenance Strategy should become a living document that is continuously reviewed.

ii) Source Control

4.32. Source control is defined in the The SuDS Manual 2015 (CIRIA C753) as the control of runoff at or near its source, so that it does not enter the drainage system or is delayed and attenuated before it enters the drainage system. Source Control techniques that should be used within development parcels include the following:

- **Pervious Paving:** Pervious paving intercepts rainfall that lands on its surface before it can run overland into the downstream drainage system. This provides a degree of interception, particularly in the most polluted first-flush events, as well as filtration through the various layers of construction and through the stone sub-base. Pervious paving would typically be used for parking areas such as driveways, parking courts and car parks. Through the inclusion of a suitable flow control device, the stone sub-base in the pervious paving structure can be utilised to provide additional attenuation storage.
- **Bioretention Areas / Rain Gardens:** Bioretention areas utilise planting and constructed soils to intercept rainfall from their contributing catchment areas and contribute to interception storage, evapotranspiration and pollution removal. They can be placed around downpipes to intercept roof runoff, particularly from larger commercial buildings

where they can form part of the landscape design. They can also be incorporated into traffic calming infrastructure such as build outs and into roadside planting and tree pits. Bioretetion Swales can be installed adjacent to larger areas of highway to provide water quality treatment and attenuation storage along their length.

- **Other filtration techniques:** Filter Trenches and French Drains can be used to intercept runoff from larger parking areas and highway areas. These will provide interception storage and filtration through the stone fill within the trenches.

iii) Site Control

4.33. Site control is the management of water from several sub-catchments within a development parcel. Through close consultation with the layout designers flow conveyance measures such as swales and filter trenches should be incorporated into the development parcels to provide additional attenuation, treatment, amenity and opportunities for habitat creation.

iv) Regional Control

4.34. Regional control is the strategic management of runoff across the wider site. The Strategic SuDS Features will provide the attenuation volume and flow control required to reduce post-development flow rates to below greenfield runoff rates.

4.35. Strategic SuDS Features will incorporate erosion control and sediment forebays, designed in accordance with the guidance given in The SuDS Manual, to enhance water quality. The creation of wetland areas and the use of wetland planting within the Strategic SuDS Features will further contribute to the sediment and nutrient removal capacity of the site wide sustainable drainage systems.

4.36. A typical layout of one of the Strategic SuDS Features is shown on drawing number G277/23, a copy of which is contained in **Appendix 8**. This typical layout should be used to inform the detailed design of the Strategic SuDS Features.

Greenfield Runoff

4.37. Defra published the 'Non-statutory technical standards for sustainable drainage systems' (the technical standards) in March 2015 as guidance to designers of SuDS schemes.

4.38. The standards relevant to greenfield runoff calculations at Horton Heath are as follows:-

4.39. Standard S2 states:-

> **"S2 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event."**

4.40. Standard S4 states:-

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

4.41. Due to the impermeable nature of the underlying soils and water stress in the downstream catchment it is not possible to reduce the volume of runoff from the proposed development in this way and so Standard S6 applies:-

> **"S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk."**

4.42. As the additional runoff generated cannot be disposed of by infiltration it is proposed that the outflow from the drainage system is constrained to Q_{BAR}, which approximates to a return period of 2.3 years, and hence a reduced rate of runoff for higher return periods.

4.43. In terms of what guidance is available on methods for calculating greenfield runoff rates, the 'Interim Code of Practice for Sustainable Drainage Systems' states that further information on the calculation of greenfield runoff can be found in DEFRA/Environment Agency R&D Technical Report W5-074/A 'Preliminary rainfall runoff management for developments'.

4.44. Table 1 in the 'Rainfall Runoff Management for Developments – Interim National Procedure Principles' set out in Report – SC030219 states that one of two approaches can be used:

> **'1. The Institute of Hydrology (IH) Report 124 Flood Estimation for Small Catchments (1994) method can be used to estimate the greenfield site flow rate, QBAR (the Mean Annual Flood).**
>
> **2. The Index Flood, QMED (the median of the set of annual maximum flood peaks) regression equation that forms part of the FEH statistical method can also be used where the appropriate parameters are known or can be derived/estimated.**
>
> **Where developments are smaller than 50 ha, the analysis for determining the greenfield index flood flow rate should use 50 ha in the formula and linearly interpolate the flow rate value based on the ratio of the development area.'**

4.45. Hydrology of Soil Type (HOST) data for Horton Heath has been obtained from the National Soil Resources Institute to allow derivation of the parameters required for the FEH methodology. The validity of this data has been confirmed by the findings of the Ground Investigation undertaken on the site. It is therefore considered that the FEH methodology should be followed to calculate the greenfield runoff rate for the site. The FEH methodology is one of the methods recommended by CIRIA C753 – The SuDS Manual.

4.46. Section 6.2.1 in Report – SC030219 sets out the revised FEH statistical method correlation formula equation for Q_{MED}, which requires the user to input Area, SAAR, FARL and BFIHOST. It is suggested that the HOST soil categories in IH126, 'Hydrology of Soil Types: a hydrologically based classification of soils of the United Kingdom' (1995) is used to obtain the site value for BFIHOST.

4.47. A Soils Site Report, including the 1:250,000 scale National Soil Map and HOST classes for the site, has been obtained from the National Soil Resources Institute at Cranfield University. An extract from the Soils Site Report is reproduced in **Appendix 9**. The vast majority of the site falls into HOST class 25.

4.48. From Table 3.4 in IH126, HOST Class 25 has a BFI coefficient of 0.178. Inserting this into the revised FEH statistical method correlation formula gives the following:

Q_{MED} $= 8.3062AREA^{0.8510} \times 0.1536^{(1000/SAAR)} \times FARL^{3.4451} \times 0.0460^{BFIHOST^2} \times 1000/50$

$= 8.3062 \times 0.5^{0.8510} \times 0.1536^{(1000/800)} \times 1 \times 0.0460^{0.178^2} \times 1000/50$

$= 8.03$ l/s/ha

4.49. To confirm these results the Greenfield Runoff Tool developed by HR Wallingford and available at www.uksuds.com, was used. Copies of the HR Wallingford Greenfield Runoff Tool outputs for the site are included in **Appendix 10**. A summary of the greenfield runoff rates for the various return period events is shown in **Table B**.

Table B: Greenfield Runoff Rates

Return Period (Years)	1	2 (Q_{MED})	2.33 (Q_{BAR})	30	100
Greenfield Runoff Rates (l/s/ha)	7.8	8.1	9.2	21.2	29.4

4.50. As the additional runoff generated cannot be disposed of by infiltration it is proposed that the outflow from the drainage system is constrained to Q_{MED}, which is equivalent to a return period of 2 years, and hence a reduced rate of runoff for higher return periods.

4.51. By limiting the developed rate of runoff to the median annual peak rate of runoff, Q_{MED}, for all rainfall events up to the 100 year return period event, including an allowance for climate change, the proposed development would reduce flood risk overall when compared to existing greenfield rates.

4.52. It is therefore proposed to limit the runoff rate for this site to 7.8 l/s/ha for the 1 in 1 year return period and to 8.0 l/s/ha (Q_{MED}) for all other return periods up to and including the 1 in 100 year return period including an allowance for climate change.

Surface Water Flow Balancing

4.53. It is proposed to use a SuDS Management Train in order to attenuate surface water runoff to greenfield runoff rates with discharge to the local watercourse and ditch system.

4.54. Preliminary storage calculations have been undertaken to establish the required storage for the development catchment areas on the site using the Source Control module in the MicroDrainage design software for return periods up to the 1 in 100 year event plus a 40% increase in peak rainfall intensity to take account of climate change. The outflow from the drainage system has been constrained to Q_{MED}, a return period of 2 years, and hence a reduced rate of runoff for higher return periods. Copies of the MicroDrainage outputs are reproduced in **Appendix 11**.

4.55. For the preliminary storage calculations it has been assumed that the developed areas would give rise to net impermeable areas of 100% for primary roads within the site, 65% of the respective development catchment area for residential development, 85% for employment, and 50% for the school. **Table C** below shows the development catchment areas, the required storage volume for the 1 in 1 year and 1 in 100 year event, including a 40% allowance for climate change, and the resulting discharge rates.

Table C: Runoff Rates and Storage Volumes

Dev Catchment Area	Area (ha)	Assumed % Imperm-ability	Catchment Q_{MED} (l/s)	1 in 1 yr Storage Volume (m^3)	Resulting Discharge (l/s)	1 in 100 yr + 40% CC Storage Vol. (m^3)	Resulting Discharge (l/s)
A	2.037	65	18.39	165	17.8	802.0	18.3
	0.260	100					
B	3.750	65	30.04	260	28.1	1224.1	29.9
C	6.808	65	54.53	405	50.1	2171.9	54.4
D	3.381	65	27.08	244.3	23.7	1111.5	27
E	3.650	65	32.30	337	24.8	1706.4	32.3
	0.382	100					
F	3.360	65	26.92	241	23.9	1103.4	26.9
G	2.762	65	41.47	267	34.7	1449.7	40.3
	2.415	50					
H	1.603	30	70.83	683	44.1	2694.1	70.8
	0.409	100					
	6.831	65					
I	1.556	65	29.60	314	26.7	1338.5	28.7
J	2.139	65					
K	1.696	65	13.58	127	11.0	560.3	13.5
L	3.894	65	39.57	433	32.5	1859.9	39.5
	1.046	100					
M	2.213	65	17.73	156	16.2	727.6	17.7
N	5.759	65	46.13	477	31.1	1924.3	46.0
EM	2.029	85	16.25	150	15.5	877.9	16.3

4.56. The Strategic SuDS Features shown on the Preliminary Surface Water Management Strategy Plan, in Appendix 6, indicate the location and sizes of the required storage facilities to serve the various development areas and are subject to detailed design and more detailed modelling as the details of the individual development parcels come to light.

4.57. From an inspection of Table C it can be seen that the peak runoff rate from the development for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event never exceed the peak greenfield runoff rate for the same event. The proposed surface water drainage measures therefore ensure the proposed development satisfies the peak flow control standards in the Government's 'Non-statutory technical standards for sustainable drainage systems'.

Water Quality

4.58. The proposed SuDS scheme provides treatment of surface water runoff which in turn delivers water quality benefits.

4.59. Until very recently, surface water drainage systems that were being offered for adoption by sewerage undertakers were required to be designed in accordance with Sewers for Adoption (SfA). SfA required the system being offered for adoption to comprise a continuous pipe system from inlet to outfall. This led to SuDS features being moved 'offline' such that the treatment processes associated with them were bypassed in the most polluting events. This was often implemented by removing the hydraulic link from SuDS features back in to the system being offered for adoption. The effect of this was that attenuation storage for rainfall events up to the 1 in 30 year return period was often located within the underground system being offered for adoption.

4.60. The issue was exacerbated by SfA's requirement for surface water pipe systems to be 'self-cleansing'. These requirements forced designers to produce surface water drainage systems that transported sediment, and other contaminants, through the drainage system to the outfall to avoid the siltation of underground assets.

4.61. With OFWAT's approval of the Code for Adoption in October 2019, and its implementation in April 2020, designers now have much more flexibility to utilise the treatment processes within SuDS features.

4.62. The proper implementation of a SuDS management / treatment train using a combination of upstream Source Control and Strategic SuDS Features will create greater resilience and allow the system to collect silt at various points which can then be removed as part of periodic maintenance. Creating a diverse SuDS scheme that encourages sedimentation, filtration and biological uptake throughout the site overcomes the issues previously faced.

4.63. Ensuring that the principles of the Water Management Strategy are taken forward into the future detailed design of the individual development parcels and ensuring that effective maintenance and management procedures are followed will be the key to ensuring the overall effectiveness of the SuDS scheme.

4.64. With reference to Chapter 26 of the CIRIA SuDS Manual 2015, and using the simple index approach, to deliver adequate treatment the SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type):

Total SuDS mitigation index > pollution hazard index

4.65. From Table 26.2 in the CIRIA SuDS Manual 2015 the pollution hazard indices for each contaminant type for the proposed land use are shown in **Table D** below.

Table D: Pollution hazard indices

Land Use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very Low	0.2	0.2	0.05
Other roofs (commercial)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach)	0.05
Property driveways, residential car parks, low traffic roads and non-residential car parking with infrequent change (eg school, offices)	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change, all roads except low traffic roads and trunk roads/motorways.	Medium	0.7	0.6	0.7
Sites with heavy pollution, sites where chemicals and fuels are to be delivered, handled, stored, used or manufactured, industrial sites, trunk roads and motorways.	High	0.8	0.8	0.9

4.66. From Table 26.3 in the CIRIA SuDS Manual 2015 the indicative SuDS mitigation indices for discharges to surface waters for the SuDS components proposed on the site are shown in **Table E** below.

Table E: Indicative SuDS mitigation indices for discharges to surface waters

Type of SuDS component	TSS	Metals	Hydrocarbons
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention Basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

4.67. It is proposed that surface water runoff from all development areas on the site will be treated by a SuDS Management Train consisting of Source Control techniques and Strategic SuDS Features. The Source Control techniques designed for the individual development parcels should take account of the Pollution Hazard Indices and the Mitigation Indices shown in Tables D and E above.

4.68. In addition to the upstream Source Control measures, runoff from all development areas on the site will pass through at least one Strategic SuDS Feature. The Strategic SuDS Features will incorporate the following treatment processes as a minimum:-

- Sediment forebays at inlets.
- Extensive wetland areas.
- Wetland Planting.
- Secondary sedimentation areas prior to outlets.

4.69. An example of a typical layout for the Strategic SuDS Features is shown on the 'Typical Layout of Strategic SuDS Features Plan' in Appendix 8. It is intended that this drawing should be used to inform the detailed design of the Strategic SuDS Features to ensure that the treatment processes outlined above are fully incorporated.

4.70. With reference to Tables D and E above it can be seen that the total pollution mitigation associated with the wetland areas equals or exceeds the pollution hazard index (for each contaminant type), for the land uses proposed on the site with the possible exception of B2 and B8 land uses.

4.71. Where individual land uses present a 'High' pollution hazard level then bespoke solutions will need to be designed for these locations. For example, bioretention systems and proprietary treatment systems should be considered and their design should be targeted at the specific contaminant types associated with the proposed land use.

4.72. An ongoing monitoring and management plan is proposed to monitor the effectiveness of the SuDS system at removing fine sediment and nutrients from surface water runoff.

4.73. An Outline Monitoring and Management Plan produced by Johns Associates is contained in Appendix 11.5 of Volume 2 of the Environmental Statement.

Flood Risk Management Measures

Minimum Ground Floor Levels

4.74. All inhabitable development proposed on the site is located within Flood Zone 1. Some development areas on the western and north-western edges of the site are located approximately 20 metres from the extent of Flood Zones 2 and 3. From an inspection of the topographical survey, the existing ground levels in these locations are significantly higher than the associated flood levels.

4.75. Notwithstanding the above, based on the Environment Agency's standing advice for new development ground floor levels should be set at least 600mm above the 1 in 100 year annual probability river flood level in any year, including an allowance for climate change.

4.76. The Flood Map for Planning and associated modelling is periodically updated. As Reserved Matters Planning Applications come forward for the individual development parcels, the latest flood modelling data should be obtained from the Environment Agency's Customers and Engagement Team to inform their design.

Safe Access and Egress

4.77. Safe access and egress to and from the development is a route that is safe for use without the intervention of the emergency services or others.

4.78. Paragraph 39 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-039-20140306) advises that access routes should allow occupants to safely access and exit their dwellings in design flood conditions. Wherever possible, safe access routes should be provided that are located above design flood levels and avoiding flow paths.

4.79. The proposed access arrangements for the site are shown on the Access Parameter Plan, Thrive Architects Drawing Number EAST200403-PP01 P22, a copy of which is reproduced in **Appendix 12**. From an inspection of the Access Parameter Plan it can be seen that the proposed link road and internal distributor roads cross the onsite watercourses in a number locations. The locations of watercourse crossings are highlighted on the Preliminary Water Management Strategy Plan in Appendix 6.

4.80. The detailed design of the link road and internal distributor roads should ensure that watercourse crossings are clear span of watercourse channels so as to create zero afflux. Bridge soffit levels should be set a minimum of 600mm above the relevant 1 in 100 year annual probability river flood level in any year, including an allowance for climate change.

4.81. Any loss of floodplain storage associated with watercourses should be compensated for on a direct level-for-level basis.

4.82. Where clear span structures are not feasible and/or there is a risk of bridge structures inhibiting flows within a watercourse, the detailed design of the watercourse crossing will need to be supported by hydraulic modelling in order to demonstrate that the proposed mitigation measures would be effective in protecting the bridge structure without negatively impacting on flows and water levels outside of the site.

4.83. The proposed built development is located entirely in Flood Zone 1 and so safe access and egress routes would be available for vehicles and pedestrians via the access roads to the development.

Overland Flood Flow Paths

4.84. Standard S9 in the Government's 'Non-statutory technical standards for sustainable drainage systems' states that the design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of 1 in 100 year rainfall event are managed in exceedance routes that minimise the risk to people or property.

4.85. Overland flood flow paths would follow the natural topography of the land towards the onsite network of watercourses and ditches. The design of the internal road network would convey flows towards Strategic SuDS Features and away from properties.

4.86. The detailed design of ground levels on the site should ensure that localised low points are not created where ponding could affect properties or create a hazard.

4.87. Indicative overland flow paths for an extreme event are shown on the Preliminary Water Management Strategy Plan in Appendix 6.

Off Site Impacts

4.88. By reducing the rate of runoff and intercepting uncontrolled overland flows the proposed development would reduce flood risk overall.

Residual Risk

4.89. Paragraph 41 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-041-20140306) advises that residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions.

4.90. The majority of the site falls within Flood Zone 1. In accordance with the NPPF a sequential approach has been applied so that all built inhabitable development on the site would be located within Flood Zone 1.

4.91. The proposed water management measures would ensure that there is little or no residual risk of property flooding occurring during events well in excess of the minimum acceptable standard of protection for new property, which requires that no flooding of property should occur as a result of a one in 100 year storm event including an appropriate allowance for climate change.

4.92. For extreme events it is considered that the proposed development would intercept any uncontrolled overland flow and direct it into the proposed water management system. The proposed SuDS measures would ensure the proposed development would have adequate flood protection for extreme events over the lifetime of the development.

Summary of Flood Risk with Management Measures

4.93. A summary of the potential risk from all sources of flooding post-development with the various development mitigation measures incorporated is shown in **Table F** below.

Table F: Post-development Potential Flood Risk from All Sources of Flooding

Flood Source	Potential Risk				Description
	Very Low	Low	Medium	High	
Watercourses		X			Minimum ground floor levels would be set 600mm above the design flood level. Road crossings of watercourses would be clear span structures and soffit levels would be 600mm clear of the design flood level.
Surface Water		X			Overland surface water flows would be intercepted by the onsite SuDS measures.
Groundwater		X			The majority of the site is at Low risk of flooding from groundwater with areas of elevated risk associated with the low lying areas in proximity to onsite watercourses where inhabitable development is not proposed.
Overwhelmed Sewers		X			No public sewers are identified on the site. There are no known instances of flooding from overwhelmed sewers affecting the Site.
Artificial Sources	X				The site is not affected
Off-site Impacts	X				By reducing the rate of runoff and intercepting overland flows the proposed development would reduce flood risk overall.

4.94. Through the incorporation of water and flood management measures the proposed development would further reduce any risk from river, surface water, and groundwater flooding. By reducing the rate of runoff and intercepting overland flows the proposed development would reduce flood risk overall.

Non-statutory technical standards for sustainable drainage systems

4.95. The Government published its 'Non-statutory technical standards for sustainable drainage systems' in March 2015. The technical standards relate to the design, construction, operation and maintenance of sustainable drainage systems and have been published as guidance. The Government expect these standards to apply to all developments of 10 homes or more and to major commercial development.

The 'Non-statutory technical standards for sustainable drainage systems' set out peak flow control standards (S2 and S3) and volume control technical standards (S4, S5 and S6).

4.96. Standard S2 states:

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

4.97. Standard S3 states:

'S3 For developments which were previously developed, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.'

4.98. In terms of volume control, standard S4 states:

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

4.99. Standard S5 states:

'S5 Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.'

4.100. Standard S6 states:

'S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.'

4.101. In accordance with Points 8 and 10 of the 'Rainfall Runoff Management for Developments – Interim National Procedure Principles' in the Environment Agency's Report – SC030219, the limiting discharge rate that does not adversely affect flood risk, for any return period up to the 100 year event, is the mean annual peak rate of runoff for the greenfield site referred to as Q_{BAR} or 2 l/s/ha, whichever is greater.

4.102. In terms of flood risk within the development, the Government's 'Non-statutory technical standards for sustainable drainage systems' include standards S7, S8 and S9.

4.103. Standard S7 states:

'S7 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.'

4.104. Standard S8 states:

'S8 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (eg pumping station or electricity substation) within the development.'

4.105. Standard S9 states:

'S9 The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of 1 in 100 year rainfall event are managed in exceedance routes that minimise the risk to people or property.'

4.106. **Table G** demonstrates how the proposed development complies with the relevant standards of the Government's 'Non-statutory technical standards for sustainable drainage systems'

Table G: Compliance with Non-statutory technical standards for sustainable drainage systems

Standard	Justification for compliance
Flood risk outside the development	
S1	N/A
Peak flow control	
S2	The peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event never exceed the peak greenfield runoff rate for the same event.
S3	N/A. Greenfield development so S2 applies.
Volume control	
S4	Not reasonably practicable due to low infiltration rates so S6 applies.
S5	N/A S6 applies.
S6	Runoff volume to any drain, sewer or surface water body is discharged at a rate that does not adversely affect flood risk, corresponding to less than Q_{BAR} (Q_{MED}).
Flood Risk within the development	
S7	The surface water management system would be designed so that, unless an area is designated to hold and/or convey water, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.
S8	The surface water management system would be designed so that, unless an area is designated to hold and/or convey water, flooding does not occur during a 1 in 100 year rainfall event in any part of a building within the development.
S9	The design of the site ensures that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are able to be managed in exceedance routes that minimise the risks to people and property.
Structural integrity	
S10	Components would be designed to ensure structural integrity of the drainage system under anticipated loading conditions over the design life of the development.
S11	The materials specified by the designer at the detailed design stage would be of a suitable nature and quality for their intended use.
Designing for maintenance considerations	
S12	N/A. Pumping is not proposed.
Construction	
S13	No connection to existing surface water sewers is proposed. As the development is built out in phases, connections to the surface water management system of previously constructed phases may be required. The mode of construction of these connections would comply with the appropriate standards and be inspected by the relevant authority so would not be prejudicial to the structural integrity and functionally of the drainage system.
S14	Any damage to the drainage system would be rectified before the drainage system is completed to the satisfaction of the relevant authority.

Local Standards

4.107. The emerging drainage strategy was presented to the Flood and Water Management team at Hampshire County Council's offices on 14th January 2020 as part of a pre-application meeting. At the pre-application meeting there was broad agreement of the emerging surface water drainage strategy that was presented. Summary minutes of the meeting are included in **Appendix 13**, along with Hampshire County Council's Engineer's agreement to the minutes.

4.108. At the pre-application meeting Hampshire County Council provided a copy of the 'Surface Water Checklist' and associated guidance that sets out the information that is required by the Lead Local Flood Authority (LLFA) for new development proposals in Hampshire. A completed copy of the checklist is included as **Appendix 14**.

Foul Water Drainage

4.109. There are no existing foul water sewers present within the site. It is therefore assumed that all foul sewage generated by existing dwellings and farmsteads is currently treated on-site by septic tanks and drainage fields, discharging leachate ultimately to local watercourses or groundwaters.

4.110. Due to site topography foul water flows arising from the Proposed Development will be collected in foul sewers and directed to onsite foul water pumping stations. The proposed locations of the Strategic Foul Water Pumping Stations are shown on the Preliminary Water Management Strategy Plan in Appendix 6.

4.111. The pumping stations would pump foul water to the public sewer network via a rising main. The preferred point of connection is to the public sewerage system to the south-east of the development which drains to the Peel Common Wastewater Treatment Works (WwTW) which is operated by Southern Water and discharges into the Solent.

4.112. Southern Water has a statutory duty to provide sewerage conveyance and treatment infrastructure for new development and to provide additional capacity as and when required.

4.113. The details of the connection to the Peel Common WwTW would be agreed with Southern Water as part of a detailed S106 / S98 application. Any offsite works delivered by Southern Water will be designed to current standards and would mitigate the effect of additional foul water flows on sewer flood risk.

Maintenance Strategy

4.114. Paragraph 81 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-085-20150323) advises that in considering a development that includes a sustainable drainage system the local planning authority will want to be satisfied that there are clear arrangements in place for ongoing maintenance. Paragraph 85 goes onto advise that when planning a sustainable drainage system, developers need to ensure their design takes account of maintenance requirements of both surface and subsurface components so that it continues to provide effective drainage for properties.

4.115. The foul water drainage systems would be offered for adoption by Southern Water, in its role as sewerage undertaker, under a Section 104 Agreement of the Water Industry Act 1991. Southern Water would therefore be responsible for the future maintenance of the adopted drainage systems.

4.116. A summary of maintenance responsibilities for the various stages of the SuDS Management Train is shown on the SuDS Management Train drawing in Appendix 7. It is proposed that the Site and Regional Control elements of the Management Train are offered for adoption by Southern Water under the Code for Adoption Agreement, or would be maintained by a Management Company.

4.117. Roads and footways, including highway drainage and gullies, to be adopted under Section 38 of the Highways Act 1980, would be maintained by Hampshire County Council in its role as local highway authority.

4.118. The maintenance of Source Control measures would be the responsibility of the property owners or management companies in the case of shared SuDS Features.

4.119. Guidance on the operation and maintenance requirements of sustainable drainage systems is contained in The SuDS Manual 2015 (CIRIA C753). There are three categories of maintenance: regular, occasional and remedial. The sewerage undertaker/Management Company would be responsible for putting in place a suitable maintenance plan.

4.120. Regular maintenance consists of basic tasks including litter and debris removal, grass cutting, and vegetation management, and includes inspections and monitoring to identify potential system failures such as blockages, silt and sediment build-up, eroded or damaged areas, and condition of inlets and outlets.

4.121. Occasional Maintenance comprises tasks that are likely to be required periodically for example sediment removal and vegetation replacement.

4.122. Remedial Maintenance comprises intermittent tasks to rectify faults and would comprise inlet/outlet repairs, erosion repairs, and dealing with a spillage event.

4.123. Surface water quality monitoring of the on-site watercourses is necessary pre development (to establish a baseline) and during construction and operation of the development to give certainty to the effectiveness of the proposed Water Management Strategy at capturing fine sediment and reducing nutrient levels.

4.124. Water quality from the SuDS Features on the site will be subject to an ongoing monitoring and management programme. An Outline Monitoring and Management Plan produced by Johns Associates is contained in Appendix 11.5 of Volume 2 of the Environmental Statement.

4.125. A monitoring programme will be established whereby regular sampling of discharge from the Strategic SuDS Features is undertaken to ensure that there is no adverse impact on the quality of any surface water discharging into on-site watercourses.

4.126. It is proposed to sample surface water quality in catchpit ‘monitoring‘ inspection chambers downstream of the Strategic SuDS Features’ final flow controls. This targeted monitoring is advocated to minimise the risk of confounding variables (several variables interacting causing a spurious association) resulting from wider catchment activity outside of the site.

4.127. Water samples from the ‘monitoring‘ chambers will be sent for laboratory analysis of suspended solids, turbidity, nitrites, nitrates, ammonia/ammonium, and total nitrogen.

4.128. It is proposed that dissolved oxygen concentrations of the runoff will be measured to monitor the chemistry of the runoff draining into on-site watercourses. This can be monitored using a handheld meter.

4.129. Visual evidence of sediment deposition or silty runoff should also be captured in the monitoring scheme.

4.130. A point downstream of the Moon River should be monitored pre development to establish a baseline and to capture wider catchment trends. This monitoring point can be used to support the monitoring scheme for the Wider OPA.

4.131. The intensity and duration of the monitoring will vary depending on the phase of the development. The monitoring effort will be more frequent at first and lessen as the Strategic SuDS Features become more established. Monitoring should occur at the same time each year to allow for the assessment of long term trends in the data and should be conducted in both spring and autumn to capture seasonal variations.

4.132. The maintaining body will produce an annual maintenance report summarising the maintenance activities completed by the maintenance contractor and the results of the surface water quality monitoring. The annual report will also set out the recommendations for the inspection and maintenance for the following year.

4.133. It is recommended that the maintaining body review the maintenance and monitoring regime with Natural England after 5 years to ensure the surface water discharging to the designated sites is of sufficient quality and assess whether any remedial measures are required.

4.134. If, or when, the SuDS scheme has been fully adopted by the Southern Water which has a statutory responsibly for the maintenance and monitoring of adopted drainage systems the scheme may need to be revised.

4.135. The monitoring and management plan allows for adaptive management to ensure that if an issue is identified targeted adaptive mitigation measures can be put in place. Adaptive mitigation measures include:

- Enhanced management including increased sediment / vegetation removal frequencies;
- Enhanced planting of Strategic SuDS features to increase sediment entrapment or nutrient uptake;
- Retrofit Source Control in problem areas;
- Retrofit hydrodynamic vortex separators in problem areas; and
- Education / enforcement if pollution is as a result of unconsented activities on the Site.

4.136. The CEMP will include monitoring of on-site watercourses to establish sediment loadings being discharged downstream. A management plan will be put in place to adapt construction site management to ensure that silt management techniques are working effectively.

4.137. The monitoring and management plan and CEMP can be secured by way of a planning condition.

4.138. The delivery of the First Residential Parcel will test the effectiveness of construction management mitigation measures and through implementation of a monitor-manage feedback loop these measures can be refined in future phases of the site.

5. CONCLUSIONS

5.1. This Flood Risk Assessment has been prepared in connection with proposals for a mixed-use development on land at Horton Heath in Hampshire.

5.2. The overall site comprises around 124 hectares, and is located to the west of Horton Heath, which lies in Eastleigh Borough in Hampshire

5.3. The development proposals comprise a maximum of:

- Circa 2,500 dwellings comprising a mix of market and affordable housing.
- A Mixed Use Centre of 3.1 Ha comprising residential, retail, leisure, community, employment facilities.
- 3.3 Ha of employment land.
- A three form entry primary school and early years education facilities.
- Formal and informal publicly accessible open space, formal areas of play, youth provision and associated facilities, formal sports facilities, allotments and amenity space, including landscaping, green infrastructure and sustainable drainage systems.
- The utilisation of existing and provision of new and/ or amended highway access points along Allington Lane, Fir Tree Lane, Burnetts Lane and Bubb Lane.
- Any wider land outside the site boundary needed for development specific infrastructure.

5.4. With reference to the Environment Agency's Flood Map for Planning, the majority of the site falls within Flood Zone 1. Small areas of the site's western boundary and north-western corner are shown as falling within Flood Zone 2 and Flood Zone 3.

5.5. In accordance with the NPPF, a sequential approach has been used such that no built development would be located in Flood Zones 2 or 3. On this basis the sequential test is passed.

5.6. In addition to flooding from rivers and the sea, this Flood Risk Assessment has considered the potential consequences of flooding from all other sources, which include directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

5.7. The available flood risk information includes: The Environment Agency's Flood Map for Planning; modelled flood levels for the watercourse in the vicinity of the site; flood defence locations; details of historic flood events; local flood history data from all sources of flooding; the GOV.UK 'Long Term Flood Risk Information' interactive maps; and flooding information in the SFRA.

5.8. The pre-development potential flood risk to the site from all sources of flooding is considered to be low.

5.9. In terms of providing an acceptable standard of protection against flooding for new development, no flooding of property should occur as a result of the 'design flood' corresponding to a 1 in 100 year fluvial flood even taking account of climate change.

5.10. The British Geological Survey (BGS) geological mapping of the area shows the majority of the site is underlain by the Wittering Formation, consisting of sand, silt and clay.

5.11. A site investigation was undertaken by Hydrock in April 2019. Based on the site investigation it is considered that the use of soakaways would not provide a suitable means of draining surface water runoff from development on the majority of the site.

5.12. A sustainable water management strategy, involving the implementation of SuDS, is proposed for managing the disposal of surface water runoff from the proposed development on the site.

5.13. A full range of SuDS techniques have been considered for use on the site. Through early discussions with the Lead Local Flood Authority and other stakeholders it was agreed that the Strategic SuDS Features on the site should comprise above ground storage features within the green corridors that follow the onsite watercourses.

5.14. Additional source control measures should be utilised within the upstream development parcels. This approach provides flexibility for the detailed design of individual development parcels whilst maximising the water quality, water quantity, amenity and biodiversity benefits of the overall SuDS strategy.

5.15. The proposed water management strategy would ensure that surface water arising from the developed site would 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.

5.16. Greenfield runoff peak flow rates have been derived using the guidance in the Environment Agency's 'Rainfall runoff management for developments' Report – SC030219 published in October 2013. In accordance with this guidance the limiting discharge for any return period up to the 100 year event, including an allowance for climate change, would not be greater than the median annual peak rate of runoff for the greenfield site, referred to as $Q_{MED,}$ which approximates to a return period of 2 years, and hence a reduced rate of runoff for higher return periods.

5.17. By limiting the development rate of runoff to the mean annual peak rate of runoff, Q_{MED}, for all rainfall events up to the 1 in 100 year return period event, including an allowance for climate change, the proposed development would reduce flood risk overall when compared to existing greenfield rates.

5.18. Minimum ground floor levels for all built development on the site would be set at least 600mm above the 1 in 100 year annual probability flood level in any year, including an allowance for climate change, in accordance with guidance for new development. In addition, all built development would be set well away from any watercourse.

5.19. The detailed design of the link road and internal distributor roads should ensure that watercourse crossings are clear span of watercourse channels so as to create zero afflux. Bridge soffit levels should be set a minimum of 600mm above the relevant 1 in 100 year annual probability river flood level in any year, including an allowance for climate change.

5.20. Any loss of floodplain storage associated with watercourses should be compensated for on a direct level-for-level basis.

5.21. The proposed drainage measures would ensure that there is little or no residual risk of property flooding occurring during events well in excess of the minimum acceptable standard of protection for new property, which requires that no flooding of property should occur as a result of a one in 100 year storm event taking account of climate change.

5.22. For extreme events it is considered that the proposed development would intercept any uncontrolled overland flow and direct it into the proposed drainage system. The proposed drainage measures would therefore ensure the proposed development would have adequate flood protection for extreme events over the lifetime of the development.

5.23. The MicroDrainage calculations contained in this Flood Risk Assessment demonstrate that a suitable means of drainage can be provided to drain the developed site in terms of surface water runoff in accordance with the guidance and standards laid down.

5.24. The proposed development complies with the relevant standards of the Government's 'Non-statutory technical standards for sustainable drainage systems'.

5.25. The proposed surface water drainage measures would ensure the proposed development satisfies the peak flow control standards and volume control technical standards in the Government's 'Non-statutory technical standards for sustainable drainage systems'.

5.26. In terms of foul water drainage, it has been demonstrated that a suitable means of drainage can be provided to serve the proposed development.

5.27. The proposed foul and surface water drainage arrangements can be covered by a suitably worded condition requiring the submission of details to be submitted to and approved by the Local Planning Authority.

5.28. A maintenance strategy for the proposed foul and surface water drainage measures to serve the development has been set out in this document.

5.29. This Flood Risk Assessment has demonstrated that the proposed development complies with the relevant requirements of the NPPF, the planning practice guidance checklist, Local Plan Policies, guidance published by DEFRA/Environment Agency, the Government's 'Non-statutory technical standards for sustainable drainage systems' and Hampshire's Local standards.

5.30. The overall conclusions drawn from this Flood Risk Assessment are that the development would be appropriately safe for its lifetime taking account of the vulnerability of its users, the development would not increase flood risk elsewhere, and would reduce flood risk overall.