

Crawley Borough Council
Level 1 Strategic Flood Risk Assessment
(SFRA)

August 2014



EXECUTIVE SUMMARY

Introduction

- i. Flooding can result not only in costly damage to property but can also pose a risk to life and livelihood. It is essential that future development is planned carefully to ensure it is steered away from areas of greatest flood risk, and it does not exacerbate existing known flooding problems elsewhere.
- ii. The National Planning Policy Framework (NPPF) and supporting Planning Practice Guidance requires local planning authorities to take a pro-active approach to managing the impacts associated with climate change, including flood risk.
- iii. In simple terms, the NPPF requires local planning authorities to review the variation in flood risk across their district and to steer vulnerable development (for example housing) towards areas of lowest flood risk. To minimise risks to property, inappropriate development should be avoided in areas which are at greatest risk of flooding, and directed to sequentially preferable areas of lowest risk. Where development is necessary in areas of flood risk, care should be taken to ensure it can be made safe without increasing flood risk elsewhere.
- iv. To guide the location of development, Local Planning Authorities are required to undertake a Strategic Flood Risk Assessment (SFRA). The objective of the SFRA is to provide sufficient information to enable site allocations and planning applications to be considered against the sequential test, and if required, the exceptions test.
- v. This SFRA therefore forms a key background document to the Local Plan (2014-2030). Working alongside the Environment Agency, it has enabled the council to evaluate and consider flood risk for each of the development allocation sites identified in the Local Plan. But it is not solely a strategic planning tool, and should be used in conjunction with Local Plan Policy ENV8 to ensure that development is directed to the most sustainable location in flood risk terms.

What is a Strategic Flood Risk Assessment?

- vi. The Strategic Flood Risk Assessment has been carried out to meet the following key objectives:
 - To collate all known sources of flooding, including river, surface water (local drainage), sewers, groundwater, overland flows and infrastructure failure, that may affect existing and/or future development within the borough;
 - To delineate areas that have a 'low', 'medium' and 'high' probability of flooding within the Borough, in accordance with the National Planning Policy Framework, and to map these:
 - Areas of 'high' probability of flooding are assessed as having a 1% (1 in 100) or greater chance of river flooding in any year, and are referred to as High Risk Zone 3;
 - Areas of 'medium' probability of flooding are assessed as having between 1% and 0.1% (1 in 100 to 1 in 1000) chance of river flooding in any year, and are referred to as Zone 2 Medium Probability;

- Areas of 'low' probability of flooding are assessed as having a less than 0.1% (1 in 1000) chance of flooding in any year, and are referred to as Zone 1 Low Probability.
- Within flood affected areas, to recommend appropriate land uses (in accordance with the NPPF *Sequential Test*) that will not unduly place people or property at risk of flooding
- Where development is found to be necessary in areas of flood risk, having had regard to the sequential test, the SFRA recommends flood mitigation solutions that may be integrated into the design by the developer to minimise the risk to property and life should a flood occur. This should give an indication of the feasibility of the proposed development passing the exception test, part of which is to ensure the development itself can be made safe and does not increase flood risk elsewhere.

The Sequential Test

- vii. The primary objective of the National Planning Policy Framework (Section 10) is to steer the most vulnerable forms of development towards the areas of lowest flood risk. A sequential approach is advocated to guide the planning decision making process (i.e. the allocation of sites), requiring planners to allocate sites for future development within areas of lowest flood risk in the first instance. **Only if it can be demonstrated that there are no sequentially suitable sites available should alternative sites (i.e. within areas that may potentially be at risk of flooding) be considered.** This is referred to as the Sequential Test.
- viii. Further detail is provided in *Planning Practice Guidance: Flood Risk and Coastal Change* (DCLG, 2014). Through Table 1, this establishes identifies the different levels of flood risk, ranging from Flood Zone 3b (functional floodplain), to Flood Zone 1 (lowest probability). Table 2 of the Planning Practice Guidance categorises different development types according to their susceptibility to flood risk, with Table 3 outlining which development types are suitable within each flood zone. Through applying the sequential test, the most vulnerable development types should be directed to the areas of lowest flood risk. The Sequential Test is described in more detail in Section 4.4.1 of this SFRA.

The Exception Test

- ix. Many towns are situated adjacent to rivers and are at risk of flooding. The future sustainability of these communities relies heavily upon their ability to grow and prosper. Accordingly, the NPPF recognises that, in some districts, including the borough of Crawley, restricting residential development from areas designated as Zone 3a High Probability may heavily compromise the viability of existing communities.
- x. For this reason, the NPPF provides flexibility for an Exception Test. Under the Exception Test, where a local planning authority has identified that there is a strong planning based argument for a development to proceed that does not meet the requirements of the Sequential Test, it will be necessary for the local planning authority or developer to demonstrate that the Exception Test can be satisfied depending upon the circumstance¹
- xi. For the Exception Test, as set out in NPPF Paragraph 102 to be passed, it must be demonstrated that:

¹ In a plan making context, it will be necessary for the developer to provide evidence to demonstrate that the Exception Test can be satisfied, potentially in conjunction with the Local Authority as part of a collaborative approach, if appropriate. In a Development Management context, the developer will be required to provide evidence to demonstrate that the Exception Test can be met.

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

Both elements of the test will have to be passed for development to be allocated or permitted.

Outcomes of the Crawley Borough SFRA

- xii. Crawley has been delineated into zones of low, medium and high probability of flooding from fluvial (watercourse) sources, based upon information in the Environment Agency Flood Map for Planning, which can be viewed at: http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=floodmap. The spatial variation in flood risk across the Borough has been delineated in the following manner:

Zone 3b Functional Floodplain

- xiii. Flood Zone 3 represents areas that are identified as being at greatest risk of flooding. *Planning Practice Guidance: Flood Risk and Coastal Change* sub-divides this area into Zone 3a (High Probability) and 3b (Functional Floodplain). Strategic Flood Risk Assessment are required to identify areas covered by Zone 3b (an annual probability of 1 in 20, or 5%), within which only water compatible uses and essential infrastructure will be permitted.
- xiv. As agreed with the Environment Agency, this SFRA takes a precautionary approach to identifying the Functional Floodplain. Therefore, within Flood Zone 3, all undeveloped areas and areas of open space will be treated as representing areas of Flood Zone 3b (Functional Floodplain).

Zone 3a High Probability

- xv. Developed or brownfield areas falling within Flood Zone 3 will be treated as Flood Zone 3a (High Probability) for the purposes of this SFRA. Land within Zone 3a has a 1% (1 in 100) or greater chance of flooding in any year. As such, residential and other vulnerable development should be avoided in these areas wherever possible. It is however recognised that there may be strong planning arguments as to why housing or other vulnerable development may be required in these areas.
- xvi. To meet the requirements of the Exception Test therefore, it will be necessary for the developer, or as appropriate the Council, to demonstrate that the development provides wider sustainability benefits to the community that outweigh flood risk. It must also be demonstrated through a site-specific flood risk assessment that the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.
- xvii. This SFRA recommends specific development management conditions that should be placed upon development within Zone 3a (High Probability) to minimise risks to people and to property in case of flooding. Where development is proposed in this area it is essential that the developer carries out a detailed Flood Risk Assessment to consider the site-based constraints that flooding may place upon the proposed development, and potential flood risk posed to other areas as a result of the development.

Zone 2 Medium Probability

- xviii. Areas that have a between 1% and 0.1% (1 in 100 and 1 in 1000) chance of flooding in any one year (i.e. Zone 2 Medium Probability) are identified by the Environment Agency Flood Map for Land Use Planning. Essential community services, including emergency services that are required to be operational during times of flooding, should be avoided in these areas. There are generally no other restrictions placed upon future development in these areas but it is important to ensure that the developer takes account of the implications of climate change to avoid a possible increase in the risk of flooding in future years (this should be achieved through the completion of a Flood Risk Assessment). The issue of climate change is considered in further detail under Section 5.6 of this SFRA.

Zone 1 Low Probability

- xix. There are no restrictions placed on development within Zone 1 Low Probability (i.e. all remaining areas of the Borough). It is important to remember however that development within these areas, if not carefully managed, may exacerbate existing flooding and/or drainage problems elsewhere. It is necessary therefore to ensure that proposals on all sites of 1 hectare or greater are accompanied by a Flood Risk Assessment, as required by *PPG: Flood Risk and Coastal Change*. This should demonstrate that the proposed drainage system design will mitigate any increase in surface water runoff that may occur from the site as a result of the proposed development, in terms of volume, flow and quality.

Identified Local Plan Sites

- xx. The Local Plan identifies a number of development sites, including sites carried forward from the Core Strategy (2008) and new sites identified through the SHLAA process. The SFRA identifies that in fluvial flood risk terms, the majority of sites are situated within Zone 1 Low Probability and there are no pressing restrictions placed upon future development on flood risk grounds. Where parts of identified sites have been identified as being at risk of flooding from fluvial sources, the Environment Agency has outlined site specific requirements to mitigate flood risk and ensure that development is acceptable in flood risk terms.
- xxi. As Lead Local Flood Authority, West Sussex County Council Drainage has assessed surface water and groundwater flood risk at sites identified in the Local Plan and SHLAA (Categories B, C, E). In terms of flood risk from surface water sources, most sites are at low risk from local sources or have small areas showing as being at surface water risk. Groundwater flood risk is low for all sites assessed. On this basis West Sussex County Council Drainage Team consider it unlikely that local flood risk would constrain development potential.

The Way Forward

- xxii. A relatively small, but significant proportion of Crawley falls within Flood Zones 2 or 3. The risk of flooding posed to properties within the Borough arises from a number of sources including river flooding, localised runoff, sewer and groundwater flooding and infrastructure failure.
- xxiii. A planning solution to flood risk management should be sought wherever possible, steering vulnerable development away from areas affected by flooding in accordance with the NPPF Sequential Test.

- xxiv. Where other planning considerations must guide the allocation of sites and the Sequential Test cannot be satisfied, this SFRA provides specific recommendations to assist the developer and council, as appropriate, in meeting the Exception Test. These should be applied as development management conditions for all future development.
- xxv. It is however important to recognise that all development can potentially have an adverse impact upon the existing flooding regime if not carefully mitigated. Therefore, flood risk should be taken account of not only where there is a direct risk of flooding to the proposed development site, but also to ensure that new development does not exacerbate flood risk elsewhere.
- xxvi. Planning policy is essential to achieving future sustainability within the Borough with respect to flood risk management, and ensuring that the recommended development management conditions can be imposed consistently at the planning application stage. The Local Plan therefore incorporates a specific policy (ENV8) relating to flood risk, which links to this SFRA to ensure that development proposals do not result in an unacceptable risk of flooding.
- xxvii. Emergency planning is imperative to minimise the risk to people posed by flooding within the Borough. The Council's Emergency Planning team has reviewed the content of this SFRA, and its findings have been taken into consideration in drafting the adopted flood risk response plan.

A Living Document

- xxviii. This SFRA has been developed in accordance with the NPPF and supporting PPG: *Flood Risk and Coastal Change* and draws upon existing knowledge with respect to flood risk within the Borough. The SFRA should be used as a 'living' document that is capable of responding to updated flood risk information. Therefore users will refer both to the SFRA and the most up-to-date Environment Agency Flood Map for Planning in addressing the requirements of Local Plan Policy ENV8.

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1 Introduction

1.1 Overview

1. The Borough of Crawley falls entirely within the upper reaches of the River Mole catchment. Flooding has been observed within the Borough a number of times in living memory, with no less than eight major flood events since 1947. In 2000, a number of homes and businesses were affected by floodwaters in both Crawley and Maidenbower, and the A23 under Gatwick Airport South Terminal was closed. More recently in December 2008, the River Mole burst its banks, leading to the evacuation of a Care Home at Ifield Green.
2. It is estimated that 876 properties within Crawley are at 'high' risk of flooding (i.e. a 1% (1 in 100) or greater chance of flooding in any particular year), with a further 59 properties at 'moderate' risk of flooding (i.e. a 0.1% (1 in 1000) chance of flooding in any particular year). It is also important to recognise that Crawley (including Gatwick Airport) is situated immediately upstream of the Borough of Reigate & Banstead, where a number of properties are susceptible to flood risk from the River Mole.
3. Future development within Crawley must therefore be carefully managed to ensure that the risk of flooding is not exacerbated. Flooding represents a risk to both people and property, and it is essential that planning decisions take due consideration of the flood risk associated with future development.
4. The National Planning Policy Framework (NPPF) requires local planning authorities to take a pro-active approach to managing impacts associated with climate change, including flood risk. In simple terms, this requires local planning authorities to assess the variation in flood risk across their administrative area, steering the most vulnerable forms of development (for example housing) towards the areas of lowest flood risk. Where development is necessary in areas of flood risk, care should be taken to ensure it can be made safe without increasing flood risk elsewhere.
5. This SFRA builds upon the April 2007 document originally prepared by Jacobs, and has been updated in-house by Crawley Borough Council (Forward Planning) to reflect changes in planning policy and regular updates to the Environment Agency Flood Map for Planning. The SFRA underpins the approach of the Local Plan, serving as a background document to assist in the identification of strategic development allocations, and providing guidance for users to apply Local Plan Policy ENV8 to ensure that development continues to be brought forward in a sustainable manner.

1.2 Study Area

6. Crawley Borough is situated within the River Mole catchment area, which encapsulates the administrative areas of several other local authorities, including Reigate and Banstead (Surrey), and Horsham (West Sussex). It is one of the eight post Second World War new towns that were built to provide improved housing and living conditions for Londoners who were encouraged to leave the cramped, overcrowded and bomb damaged areas of the city. The town has grown up around three pre-existing communities: Three Bridges, Crawley and Ifield.
7. At the time of the 2011 census, 106,597 people live in the Borough, and it is continuing to grow. It is a vibrant and relevantly prosperous part of West Sussex, playing a major role as a commercial and employment centre at the heart of the Gatwick Diamond. Crawley is the largest inland town in West Sussex and is expanding with the addition of a fourteenth neighbourhood at Kilnwood Vale, and a fifteenth neighbourhood at Forge Wood (formerly referred to as the North East Sector). Gatwick Airport is situated within the Borough, and is currently being considered by the Government as a possible location for additional runway capacity in the south east.

8. Topography of the area mirrors changes in the underlying geology. The upper reaches of the River Mole (i.e. upstream of the M23) is underlain by Upper Tunbridge Wells Sand and characterised by steeper slopes with incised valleys. To the north of the M25, the topography is relatively flat, underlain by Weald Clay. South of the M25 is the High Weald Area of Outstanding Natural Beauty, which includes wet woodland, a site of special scientific interest (SSSI) and ancient woodland. To the west of the M23, Tilgate Park is an important historical parkland.
9. Future development within Crawley, if not carefully managed, could influence the risk of flooding posed to neighbouring areas, particularly Horley. Equally, planning decisions within adjacent districts could potentially have an adverse impact upon flooding within Crawley.
10. Reflecting the National Planning Policy Framework (NPPF) Presumption in Favour of Sustainable Development, Crawley is committed to sustainable growth within the region and the protection of the environment for future generations. The Local Plan builds on these principles and to set out the spatial vision and planning policies that will guide development in Crawley up to 2030.

1.3 Strategic Flood Risk Assessment Approach

11. The objectives of the SFRA are twofold. Firstly, the document provides a robust evidence base to inform the policy direction of the Local Plan, particularly through informing the identification of site allocations. Secondly, the document underpins the approach of Local Plan Policy ENV8 (Development and Flood Risk), providing guidance to ensure that the relationship between development and flood risk is appropriately managed. This is to be achieved by:
 - Building upon the Environment Agency Flood Map for Planning to identify Flood Zones 1 (low risk), 2 (medium risk), 3a (high risk), and 3b (functional flood plain);
 - Assisting the development management process by enabling a more informed response to development proposals affected by flooding, influencing the design of future development within the Borough;
 - Helping to identify and implement strategic solutions to flood risk, providing the basis for possible future flood attenuation works;
 - Supporting and informing the Council's emergency planning response to flooding.
12. The NPPF provides no specific methodology for the SFRA process. Therefore, to meet these broader objectives, the SFRA has been developed through joint working between Crawley Borough Council, the Environment Agency, and West Sussex County Council.
13. A considerable amount of knowledge exists with respect to flood risk within the Borough, with information relating both to historic flooding, and the predicted extent of flooding under extreme weather conditions (i.e. as an outcome of detailed flood risk modelling carried out by the Environment Agency). The SFRA builds on this existing knowledge base, underpinning the delineation of zones of 'high', 'medium' and 'low' probability of flooding, in accordance with the NPPF. These zones have used to provide a robust and transparent evidence base for the development of flooding related policy and the allocation of sites for future housing and employment uses.

2 Existing Information

2.1 Overview

13. A considerable amount of knowledge exists with respect to flood risk within Crawley Borough, including (but not limited to):
 - Historical river flooding information;
 - Information relating to localised flooding issues (surface water, groundwater and/or sewer related), collated in consultation with West Sussex County Council

- and the Environment Agency;
- Detailed flood risk mapping;
- Environment Agency Flood Map for Land Use Planning;
- Topography (LiDAR).

14. This forms the core dataset that has informed the SFRA process. The application of this data in the delineation of zones of 'high', 'medium' and 'low' probability of flooding and the formulation of planning and development control recommendations is explained in Section 5. An overview of the core datasets, including their source and their applicability to the SFRA process, is outlined below.

2.2 Environment Agency Flood Map for Planning

15. The Environment Agency Flood Map for Planning shows the natural floodplain (undefended position), and therefore areas potentially at risk of flooding from rivers or the sea. It identifies land that is susceptible to a 1% annual exceedance probability (AEP) (1 in 100 chance) of flooding from rivers in any one year. It also indicates the area that has a 0.1% AEP (1 in 1000 chance) of flooding from rivers and/or the sea in any given year; this is also known as the Extreme Flood Outline.
16. The Flood Map for Planning outlines have been produced from a combination of a national generalised computer model, more detailed local modelling (where available) and records of historic flood event outlines, to provide a consistent picture of flood risk for England and Wales. The Environment Agency's knowledge of the floodplain is continuously being improved by a variety of studies, detailed models, data from river flow and level monitoring stations, and actual flooding information. Through its ongoing programme of improvement, updates are made to the Flood Map for Planning on a quarterly basis.
17. The Flood Map for Land Use Planning can be viewed at: <http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=en&topic=floodmap>

2.3 Historical Flooding

18. Over the years, Crawley has experienced significant flooding from Gatwick Stream, a major tributary of the River Mole. During the autumn of 2000, which was reported as a 1 in 15 year flood event, over 70 properties reported flood damage from various sources. Other disruptive floods occurred in 1980, 1993, 1994, 2002, 2007, and 2008.
19. Areas within the Borough known to have been susceptible to localised flooding in recent years. These are properties affected not only by flooding from local watercourses but also from surcharging of the underground sewer system, blockage of culverts and gullies and/or surface water runoff. This is an important reminder that the risk of flooding is not restricted purely to fluvial (river) flooding. Future development (and indeed a lack of regular maintenance) can exacerbate problems of this nature, increasing the severity and frequency with which localised problems can occur throughout the Borough.

2.4 Detailed Hydraulic Modelling

20. The Flood Map for Planning is informed by a number of available sources, including modelling carried out by the Environment Agency across the upper reaches of the River Mole. This includes the 1D Horley Flood Study² completed in 2004, and Gatwick Stream Feasibility Study (Environment Agency, 2006). These studies generally incorporate the development of a detailed hydraulic model, providing a more robust understanding of the

² There are known limitations with the model, particularly around the Gatwick area, as the mapping did not include the mole diversion channel built in the late 1990s, and mapping from this study should therefore be used with caution, and the limitations must be taken into account.

localised fluvial flooding regime in line with Section 105 (2) of the Water Resources Act.

21. The detailed hydraulic models developed on behalf of the Environment Agency assume 'typical' conditions within the respective river systems that are being analysed. The predicted water levels may change if the operating regimes of the rivers involved are altered (e.g. engineering works which may be implemented in the future), culverts are permitted to block, or the condition of the river channel is allowed to deteriorate.
22. The Flood Map for Planning incorporating the available modelling represents the best available data, and therefore forms the basis for identifying flood risk through the SFRA. Where flood risk is identified, the Environment Agency advise that developers look at site specific modelling in Flood Risk Assessments to inform development proposals and any potential works.

2.5 Flood Defences

23. Flood defences are typically raised structures that alter natural flow patterns and prevent floodwater from entering property in times of flooding. They are generally categorised as either 'formal' or 'informal' defences. A 'formal' flood defence is a structure built specifically for the purpose of flood defence, and is maintained by its respective owner, which could be the Environment Agency, Local Authority, or an individual. An 'informal' flood defence is a structure that has not been specifically built to retain floodwater, and is not maintained for this specific purpose, but may afford some protection against flooding. These can include boundary walls, industrial buildings, railway embankments and road embankments situated immediately adjacent to rivers.
24. The Environment Agency has identified a small number of defence structures within the Borough of Crawley. These are situated at Titmus Lake (Tilgate Park), Water Lea (Furnace Green), Grattons Park (Three Bridges) and the River Mole diversion (Gatwick Airport). Most represent constructed embankments that encircle localised flood storage facilities, and none are considered to pose a potential risk to life.
25. The Environment Agency Risk of Flooding from Rivers and Sea map takes account of the impact of defences on flood risk. These establish a more realistic picture of flood risk, and do not set out the worst-case flooding scenario. However, the Environment Agency is clear that it is the Flood Map for Planning (i.e. the undefended position) that should be used alongside the SFRA to make land use planning decisions.

3 Flood Risk in Crawley

3.1 Overview

26. The River Mole (and its tributary Ifield Brook) flows in a northerly direction along the western boundary of Crawley. Gatwick Stream and Crawters Brook, major tributaries of the River Mole, also flow northerly through the Borough. The development of Crawley as a new town since the early 1950's has resulted in many reaches of these watercourses being culverted, with some culverts being undersized and others prone to blockage.
27. In recent history, flooding has notably occurred within the Borough in 2000 when over 70 properties were inundated. Of these 44 were in Maidenbower, 20 at Furnace Green and 14 at Ifield Green. It appears likely that the flooding at Maidenbower was caused by an undersized temporary culvert which has since been upgraded. More recently in December 2008, the River Mole burst its banks, leading to the evacuation of a Care Home at Ifield Green.
28. It is clear from the Flood Map for Planning that a relatively small, but nonetheless significant, proportion of the Borough is at risk of flooding from the River Mole and its tributaries. Much of the Borough is situated within Zone 1 Low Probability and the NPPF does not restrict the nature of development that takes place within this zone. Notwithstanding this, it is important to recognise that all development within the Borough can potentially impact upon the existing flooding regime, and for this reason, a Flood Risk Assessment will be required to support development proposals of 1 hectare or greater within Zone 1 Low Probability.
29. There are pockets of development within the Borough that are at risk of flooding in the 1% (100 year) flood event. Detailed modelling of the River Mole and Gatwick Stream system indicates that the risk of river flooding within the Borough is generally governed by constrictions within the system, including (for example) culverts passing beneath St Mary's Drive and Haslett Avenue East. Anecdotal evidence also shows that localised flooding occurs due to heavy localised rainfall resulting in rapid surface water runoff (flash flooding) and sewer failure. This is not reflected in the predicted flood extents provided by the Flood Map for Planning.
30. It is essential that a 'best practice' approach is adopted to ensure that future development within the Borough, particularly in areas not directly affected by flood risk, does not exacerbate existing potential flooding related problems downstream. It is important to recognise that areas downstream of Crawley, within adjoining Reigate & Banstead, suffer property damage due to river flooding. Careless development within the upper reaches of the catchment (i.e. within Crawley) has the potential to worsen this problem, potentially increasing both the frequency and severity of flooding to homes and businesses downstream.

3.2 Fluvial Flooding - Delineation of the NPPF Flood Zones

31. The **risk** of a flood event is a function of both the **probability** that the flood will occur and the **consequence** to the community as a direct result of the flood. The NPPF endeavours to assess the likelihood (or probability) of flooding, categorising flood risk into zones of low, medium and high probability. Having identified these flood zones locally using the Environment Agency Flood Map for Planning, the SFRA provides recommendations to help manage the risk and impacts of flooding in a sustainable manner.
32. A key outcome of the SFRA process is to enable application of the NPPF Sequential Test. To inform the planning process, it is necessary to review flood risk across the area, categorising the area in terms of the likelihood (or probability) that flooding will occur.
33. The Borough has been delineated into the flood zones identified in PPG: Flood Risk and Coastal Change as follows:

Zone 3b Functional Floodplain

This zone comprises land where water has to flow or be stored in times of flood

Zone 3a High Probability

Land assessed as having a 1% AEP (1 in 100 chance in any year) or greater of flooding.

Zone 2 Medium Probability

Land assessed as having between a 1% AEP (1 in 100 chance in any year) and 0.1% AEP (1 in 1000 chance in any year) of river flooding.

Zone 1 Low Probability

Land assessed as having a less than 0.1% AEP (1 in 1000 chance in any year) of river flooding in any year (i.e. 0.1% AEP).

3.2.1 Flood Zone 3b Functional Floodplain

34. Flood Zone 3b (Functional Floodplain) is defined by Planning Practice Guidance: *Flood Risk and Coastal Change* as comprising 'land where water has to flow or be stored in times of flood'.
35. The Environment Agency Flood Map for Planning does not delineate Flood Zone 3 into its sub-designation of Zones 3b and 3a. Therefore the SFRA, in agreement with the Environment Agency, identifies that within Flood Zone 3, all undeveloped areas and areas of open space will be treated as representing Flood Zone 3b (Functional Floodplain). This includes:
 - land where the flow of flood water is not prevented by flood defences or by permanent buildings or other solid barriers from inundation during times of flood;
 - land which provides a function of flood conveyance (i.e. free flow) or flood storage, either through natural processes, or by design (e.g. washlands and flood storage areas);
 - land subject to flooding in the 5% AEP (1 in 20 chance in any year) flood event (i.e. relatively frequent inundation expected).
36. Within Crawley, this encompasses primarily those low lying areas immediately adjoining Ifield Brook and Gatwick Stream. Development within these areas is likely to measurably impact upon the existing flooding regime, increasing the severity and frequency of flooding elsewhere.

3.2.2 Delineation of Zone 3a High Probability

37. Zone 3a (High Probability) is defined as those areas of the Borough that are situated below (or within) the 1% AEP (1 in 100 chance in any year) fluvial flood extent. For the purposes of the SFRA, Zone 3a is considered to represent developed sites and brownfield land falling within Flood Zone 3 of the Environment Agency Flood Map for Planning.

3.2.3 Flood Zone 2 Medium Probability

38. Flood Zone 2 (Medium Probability) is defined in accordance with the Environment Agency Flood Zone Map for Land Use Planning, comprising those areas that are situated between the 0.1% AEP (1 in 1000 chance in any year) and the 1% AEP (1 in 100 chance in any year) flood extents.

3.2.4 Flood Zone 1 Low Probability

39. Flood Zone 1 (Low Probability) is defined as those areas of the Borough that are situated above (or outside of) the 0.1% AEP (1 in 1000 chance in any year) flood extent. This includes all land that is situated outside of the shaded Zone 2 and Zone 3 flood risk areas (as defined above) on the Flood Zone Map for Land Use Planning.

3.3 Assessment of Risk to People (Flood Hazard)

40. The assessment of flood risk has thus far considered the maximum extent to which flooding will occur during a particular flood event. This provides the basis for assessing broadly the areas potentially impacted by flooding. Of equal importance however is the speed with which flooding occurs as river levels rise. The inundation of floodwaters into low lying areas can pose a considerable risk to people.
41. Substantial research has been carried out internationally into the risk posed to pedestrians during flash flooding. This has concluded that the likelihood of a person being knocked over by floodwaters is related directly to the depth of flow, and the speed with which the water is flowing. This is referred to as 'Flood Hazard'.
42. For example, if a flood flow is relatively deep but is low energy (i.e. slow moving), then an average adult will be able to remain standing. Similarly, if the flow of water is moving rapidly but is very shallow, then once again an average adult should not be put off balance. If however the flow is both relatively deep and fast flowing, then a person will be washed off their feet, placing them at considerable risk. The risk to health and safety as a result of submerged hazards during flooding conditions (given the often murky nature of floodwaters) is also a consideration.
43. Risk to life (as a result of flooding) within Crawley has been assessed in qualitative terms to inform the allocation of land within the Borough for future development. A brief summary of the findings is presented below:

➤ Flood hazard due to overbank flooding:

The speed and depth with which the River Mole and its tributaries flood into developed areas is an important consideration. Deep, fast flowing water may potentially pose risk to people, and must be considered when planning future development.

Detailed modelling indicates that the likelihood of a rapid river level rise within the River Mole system, resulting in the rapid inundation of urban areas that may pose a risk to people, is considered to be very small. This is primarily due to the relatively large and undulating catchment area, resulting in a generally extended response time. In simple terms, the time between a rainfall event occurring and river levels rising to the point at which flooding occurs generally exceeds 3-6 hours³. Furthermore, the depth of flooding within overbank (developed) areas is typically relatively low and is unlikely to pose a risk to people.

➤ Flood hazard due to reservoir failure

Tilgate Lake and Titmus Lake are large storage reservoirs situated upstream of the Furnace Green residential estate. The catastrophic failure of these reservoirs may potentially pose a risk to property and life downstream. Both reservoirs are managed and maintained in accordance with current UK legislation of the Flood and Water Management Act 2010, which amends the Reservoirs Act 1975, and introduces new arrangements for reservoir safety based on risk rather than the size of the reservoir. In short, The Act requires:

- reservoir flood mapping: on-site and off-site reservoir flood plans
- undertakers of the highest consequence reservoirs are requested to prepare an on-site plan to support off-site emergency planning
- flood (inundation) maps of every reservoir under the Reservoirs Act 1975 in England and Wales have been made available to Local Resilience Forums (LRFs) and to

³ It is highlighted that localised flash flooding, associated with surface water runoff from the local vicinity during heavy rainfall, will clearly occur much more rapidly. Flooding of this nature will tend to disperse relatively quickly however and is unlikely to result in deep, fast flowing floodwaters.

reservoir undertakers to assist them in the preparation of off-site and on-site emergency plans

- on-site emergency plans: prepared by reservoir owners

A Flood Plan is a set of documents that describe the arrangements to be put into operation in response to a sudden large release of water from a reservoir that could pose a threat to property and life downstream. It will include an assessment of the impacts of dam failure, a review of the measures that can be taken by the reservoir operator to prevent the catastrophic failure, and an assessment of the emergency response mechanism required to minimise risk to life and property should a failure occur.

Dedicated Flood Plans will be required for all reservoirs, including Tilgate Lake and Titmus Lake, within the next few years. In the interim, regular inspections are carried out by suitably qualified engineers. This ensures a risk-based approach, enabling mitigation measures to be put into place as early as possible should there be any cause whatsoever for concern. On this basis the possible risk of failure of these reservoirs is considered to be minimal. Indeed, research carried out on behalf of Defra and Thames Water has indicated that the average annual risk of failure for reservoirs that fall under the auspice the Reservoirs Act is approximately 2×10^{-5} , i.e. a 1 in 50,000 chance that the reservoir will fail in any one year.

- Flood hazard due to flood defence failure

A small number of flood defence structures (formal and/or informal) have been identified within Crawley. These defences have been reviewed and in the event of their failure, it is not considered that the subsequent impact on flooding would pose a potential risk to people.

3.4 Surface Water Flooding

44. Known and/or perceived drainage problems may to be attributed to inundation as a result of poor maintenance, associated with (for example) culvert blockages and/or increased overland flow due to development during heavy rainfall. Issues of this nature are often relatively localised, generally affecting only a small number of properties.
45. A number of known localised problems have been identified throughout the Borough, highlighted as an outcome of flooding experienced by local residents or businesses. It is important to note that a number have subsequently been addressed through maintenance to rectify the problem (e.g. removal of localised blockages).
46. Within the urban centres of the Borough, localised flooding problems arising from under capacity drainage and/or sewer systems can occur, particularly given mounting pressure placed upon ageing systems as a result of climate change.
47. Issues of this nature are generally localised, and can be addressed as part of the design process. They therefore will generally not influence the decision as to whether or not land will be allocated for future development. It is essential however to ensure that future development does not exacerbate existing flooding problems, and planning conditions should be placed upon developers to ensure that best practice measures are implemented to mitigate any potential increase in loading upon existing drainage system(s).
48. The Water and Flood Management Act (2010) requires the use of Sustainable Drainage Systems (SuDS), an approach also recommended by the Environment and identified in the Gatwick Sub-Region Water Cycle Study (2011 & 2013) as a sustainable means of managing the relationship between development and flood risk. A wide variety of SuDS techniques are available (refer Section 4.5.3), potentially providing both water quality and water quantity improvement benefits on a site by site basis throughout the Borough. Wherever possible within brownfield areas, developers should seek to reduce the rate of runoff from the site to greenfield runoff rates (i.e. the rate of runoff generated from the site assuming an open grassed area). Collectively, the effective application of SuDS as part of all future development will assist in reducing the risk of flooding to the Borough.

3.5 Groundwater Flooding

49. The risk of groundwater flooding is typically highly variable and heavily dependent upon local conditions at any particular time, though in Crawley risk of groundwater flooding is considered to be relatively low. Two instances of groundwater flooding within the Borough have been identified by the Environment Agency, observed in 2001 at Bewbush and Furnace Green respectively.
50. The local geology is broadly Weald Clay to the north west of Crawley and Hastings Beds to the south east. Localised areas of superficial river terrace deposits are evident along the Gatwick Stream river corridor. There is no conclusive evidence of elevated susceptibility to groundwater flooding within the Borough.
51. In accordance with the NPPF, future development may require an appropriate Flood Risk Assessment (FRA) at the planning application stage, commensurate with the level of flood risk posed to the site. The FRA should incorporate a site based assessment of the potential risk of surface and groundwater flooding to the site, confirming (or otherwise) the absence of this source of flood risk.
52. As Lead Local Flood Authority, West Sussex County Council recommend that where historic records and models show elevated risk of groundwater flooding, this should be used to highlight a possible problem for further assessment.

3.6 Climate Change

53. The NPPF and supporting PPG: *Flood Risk and Coastal Change* require that climate change is taken into account in Strategic Flood Risk Assessments. Having regard to climate change predictions published by the UK Climate Programme (2009), the Gatwick Sub-Region Water Cycle Study (2011) outlines that increased winter rainfall and summer storm frequency are anticipated, and is clear that this should be considered with regard to fluvial and surface water flood risk.
54. It is therefore critical that SFRA's carefully consider the flood risk implications of climate change, and that developers factor in the possible change in flood risk over the lifetime of development as a result of climate change. Likely increase in flow over the lifetime of the development should be assessed proportionally to guidance provided by the Environment Agency as outlined above.
55. For planning and development management purposes, the SFRA provides a risk-based approach to future development within Zone 2 Medium Probability (approximately equivalent to the 1% AEP flood outline incorporating climate change). This takes due account of the relatively limited risk of flooding posed to 'highly vulnerable' development today (i.e. 2014) in accordance with the NPPF.
56. It also provides a robust and sustainable approach to considering potential impacts that climate change may have upon the Borough over the next 100 years, ensuring that future development is considered in light of the possible increases in flood risk over time.
57. The potential impacts of climate change affect not only the risk of flooding posed to property as a result of river flooding, but also potentially increase the frequency and intensity of localised storms over the Borough. This may exacerbate localised drainage problems, and it is important that both the site based detailed Flood Risk Assessment and the Drainage Impact Assessment take due consideration of climate change.

3.7 Residual Risk of Flooding

58. Though it is important to recognise that flood risk can never be fully mitigated and there will always be a residual risk of flooding, it is essential that the risk of flooding is minimised over the lifetime of development in all instances.
59. Residual risk is associated with a number of potential factors including (but not limited to):
 - a flooding event that exceeds that for which the flood risk management measures (for example, upstream storage) have been designed;
 - general uncertainties inherent in the prediction of flooding.
60. The SFRA process has carried out a review of flood risk within the Borough in accordance with the Sequential Test, identifying some areas that partially fall within Flood Zone 2 and Flood Zone 3a. The modelling of flood flows and flood levels is not an exact science, and there are limitations in the methodologies used for prediction, and the models developed are reliant upon observed flow data for calibration. For this reason, there can be inherent uncertainties in the prediction of flood levels used in the assessment and management of flood risk.
61. The adopted flood zones underpinning the Crawley Borough SFRA are based upon the detailed flood mapping within the area adjoining the River Mole and Gatwick Stream. Whilst these provide a robust depiction of flood risk for specific modelled conditions, all detailed modelling requires the making of core assumptions and the use of empirical estimations relating to (for example) rainfall distribution and catchment response. It is therefore incumbent on developers to carry out a detailed Flood Risk Assessment where identified in this SFRA and Local Plan Policy ENV8, as part of the design process.

4 Sustainable Management of Flood Risk

4.1 Overview

62. Planning positively for sustainable development is key objective of the NPPF. The definition of 'sustainability' encompasses a number of important issues ranging broadly from the environment (i.e. minimising the impact upon the natural environment) to energy consumption (i.e. seeking alternative sources of energy to avoid the depletion of natural resources). Of particular importance however is sustainable development within flood affected areas.
63. Recent history has shown the devastating impacts that flooding can have on lives, homes and businesses. A considerable number of people live and work within areas that are susceptible to flooding, and ideally development should be directed away from these areas over time. It is recognised that this is always not a practicable solution, and for this reason, careful consideration must be taken of the measures that can be put into place to minimise the risk to people and property posed by flooding. These should address flood risk not only in the short term but throughout the lifetime of the proposed development.
64. A key objective of the SFRA is to inform decision making as part of the planning and development management process, taking due consideration of the scale and nature of flood risk affecting the Borough. Responsibility for flood risk management resides with all tiers of government, as well as with individual landowners, as outlined below.

4.2 Responsibility for Flood Risk Management

65. There is no statutory requirement on the Government to protect property against the risk of flooding, though a number of other organisations have key responsibilities with respect to flood risk management as provided below.
66. The Environment Agency has a statutory responsibility for flood management and defence in England. It assists the planning and development management process through the provision of information and advice regarding flood risk and flooding related issues.
67. West Sussex County Council, as Lead Local Flood Authority, is required to take a lead role in managing flood risk from surface water, groundwater, and ordinary watercourses across the county. Its responsibilities also include the application and monitoring of a Local Flood Risk Management Strategy, the approval and adoption of all new Sustainable Drainage Systems (in its role as SuDS approving body), and liaison with other 'risk management authorities', including district and borough councils, water infrastructure providers, and the Environment Agency.
68. The Local Planning Authority is responsible for carrying out a Strategic Flood Risk Assessment. The SFRA should consider the risk of flooding throughout the Local Planning Authority administrative area, to inform the allocation of land for future development, and inform the application of Development Control policies and Sustainability Appraisal. Local Planning Authorities have a statutory responsibility to consult with the Environment Agency when making planning decisions.
69. Landowners & Developers have primary responsibility for protecting their land against the risk of flooding. They are also responsible for managing the drainage of their land such that they do not adversely impact upon adjoining properties.

4.3 Environment Agency Role and Responsibilities

4.3.1 Overview

70. The Environment Agency takes a strategic approach to flood risk management, with the assessment and management of flood risk carried out on a 'whole of catchment' basis. This enables the Environment Agency to review the impact that proposed defence works at a particular location may have upon flooding at other locations throughout the catchment. A number of flood risk management strategies are underway within the region, encompassing the large river system that includes the Upper Mole catchment and flood risk within Crawley Borough. A brief overview of these investigations is provided below.

4.3.2 Catchment Flood Management Plan (CFMP)

71. Catchment Flood Management Plans provide an overview of flood risk within a specific river catchment area, and set out the Environment Agency's preferred plan for sustainable flood risk management in the catchment over the next 50 to 100 years.
72. To help understand the nature of flood risks across the area, the River Thames CFMP divides the region into broad river catchment areas, and applies 1 of 6 policy approaches to each. The Thames CFMP identifies the Upper Mole area (referred to as Sub-Area 5 in the CFMP) as an area "of low to moderate flood risk where we [*the Environment Agency*] will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits."
73. Subsequently, the Thames CFMP identifies a recommended strategy to address flood risk within the sub-area. Key actions include the safeguarding of open space, the identification of opportunities for flood storage, maintenance and improvement of river flows in urban areas, improvement of existing drainage systems, increasing resistance and resilience of buildings through redevelopment, and the development of emergency response planning.
74. Four over arching key messages have been highlighted by the CFMP:
 - Flood defences cannot be built to protect everything;
 - Climate change will be the major cause of increased flood risk in the future;
 - The floodplain is our biggest asset in managing flood risk;
 - The ongoing cycle of development and urban regeneration is a crucial opportunity to manage flood risk.
75. The CFMP includes a specific section for each of the sub-areas. Sub-area 5 (which includes the Upper Mole) is characterised as "urbanised places with some flood defences" where "the river corridors have not been over-developed and there is not an over-dependence upon flood defence structures that are difficult and expensive to maintain". The CFMP proposes the following actions to implement the policy:
 - Maintain the existing flow of rivers in urban areas that reduce the risk of flooding from the smaller, more frequent floods and identify viable opportunities to make the existing drainage systems more effective (for example, where there are significant restrictions to flow from undersized pipes, culverts or bridges).
 - Make sure the recommendations in Strategic Flood Risk Assessments and Local Development Framework policies create the potential to reduce flood risk through adaptation of places at risk, managing run-off and retaining open spaces in the floodplain.
 - Identify locations where the attenuation of water could have local social and

economic benefits (by reducing flood risk) and environmental benefits (by increasing the frequency of flooding) and encourage compatible land uses. (Crawley in the Upper Mole is cited as a specific example.).

- Develop emergency response planning to deal with extreme events, including raising public awareness and working with key partners to identify critical infrastructure at risk.
76. These objectives succinctly reinforce the over-arching requirements of the NPPF, i.e. it is important that Local Authorities seek to restrict development within flood affected areas, protecting and enhancing the natural floodplain wherever possible.

4.3.3 Upper Mole Flood Alleviation Scheme

77. In response to recent flood events, the Environment Agency has been working to bring forward the Upper Mole Flood Alleviation Scheme, comprising a number of flood detention reservoirs to temporarily store (detain) flood water upstream. The objective of the scheme is to reduce the risk of flooding to properties situated within the Upper Mole catchment, in particular reducing the risk of flooding to homes and businesses within Maidenbower, Three Bridges and Horley. The alleviation scheme will also result in a reduction in the risk of flooding to Gatwick Airport. When complete, the Upper Mole Flood Alleviation Scheme will reduce flood risk to over 1,000 homes in Crawley and Horley.
78. The scheme itself comprises work at a number of areas within and adjacent to Crawley, including the addition of flood detention reservoirs at Ifield and Worth Farm, alongside a wider programme of works at Tilgate Lake, Clays Lake, and Grattons Park. Work at Tilgate Lake is now complete, raising the height of the dam at Tilgate Park by approximately 2.5 metres to increase storage capacity during times of flood. Works to construct a temporary flood storage reservoir at Worth Farm are now also complete, with works at Grattons Park Stream nearing completion. Completion of these schemes will allow communities downstream to benefit from the reduction in flood risk offered. Construction of the scheme at Clays Lake is planned to commence in September 2014, with a completion date of September 2016.
79. The Environment Agency is continuing to investigate the feasibility of a flood attenuation scheme within the Ifield area, and is working with local stakeholders and undertaking further works to understand the full benefits a scheme in this area could offer. In addition, the Environment Agency is continuing to explore opportunities to secure external funding for flood alleviation works for the Ifield area.

4.4 Managing Flood Risk through the Planning System

4.4.1 Sequential and Exception Tests

80. Both the NPPF and PPG: *Flood Risk and Coastal Change* require that a sequential, risk based approach is applied to managing flood risk. This approach is designed to ensure that areas which are at the lowest risk of flooding are developed in preference to those areas of higher risk. To ensure that development is, so far as possible, steered away from the areas of greatest flood risk, the sequential and (as necessary) exception tests should be applied.

The Sequential Test

81. Historically urbanisation has evolved along river corridors, leaving many areas of England with a legacy of key urban centres that, due largely to their close proximity to rivers, are at risk of flooding. The ideal solution to effective and sustainable flood risk management is a planning-led one, based on an approach whereby the most vulnerable development is directed away from areas where flood risk is greatest. The NPPF advocates a sequential approach to guide the planning decision making process (i.e. the allocation of sites). In simple terms, this requires planners to seek to allocate sites for future development within areas of lowest flood risk in the initial instance. Only if it can be demonstrated that there

are no suitable sites within these areas should alternative sites (i.e. within areas that may potentially be at risk of flooding) be contemplated. This approach is referred to as **The Sequential Test**.

82. PPG: Flood Risk and Coastal Change, categories development types according to their vulnerability to flood risk (Table 2). Within the same document, Table 3 considers the degree of flood risk posed to the site, and the likely vulnerability of the proposed development to damage (and indeed the risk to the lives of the site tenants) should a flood occur, to establish the development types that are appropriate within each flood zone.
83. Wherever possible, development should be restricted to the permissible land uses summarised by Tables 1-3 of *PPG: Flood Risk and Coastal Change*. This may involve seeking opportunities to 'swap' more vulnerable allocations at risk of flooding with areas of lesser vulnerability that are situated on higher ground.

The Exception Test

84. It is recognised that only a relatively small proportion of the borough is situated within Zone 3a High Probability. However, there may be pressing planning 'needs' that may warrant further consideration of these areas. Should this be the case, potential future developers will be required to work through the **Exception Test** (NPPF Paragraph 102) where applicable. For the Exception Test to be passed:
 - *it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and*
 - *a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*
85. Both elements of the test will have to be passed for development to be allocated or permitted. A planning solution to removing flood risk must be sought at each specific location in the initial instance, seeking to relocate the proposed allocation to an area of lower flood risk (i.e. Zone 1 Low Probability or Zone 2 Medium Probability) wherever feasible.
86. Within the Borough of Crawley, land is restricted by Gatwick Airport to the north and by the Area of Outstanding Natural Beauty that encircles the southern boundary of the town. Land to the west of Bewbush will accommodate the new Kilnwood Vale neighbourhood of 2,500 dwellings and associated infrastructure, facilities and services. Outline planning permission has also been granted for a new neighbourhood in the North East Sector of Crawley of up to 1,900 dwellings and other uses, with potential capacity for up to 2,500 dwellings.
87. The SFRA has been developed in liaison with the Environment Agency and West Sussex County Council to work through the requirements of the Sequential Test (and, where necessary, the Exception Test) within Crawley. Where identified by the SFRA or Local Plan Policy ENV8, it will be the responsibility of the applicant to provide a detailed Flood Risk Assessment that demonstrates how the Sequential Test has been applied, and that risk of flooding has been adequately addressed in accordance with the NPPF.
88. Management of flood risk throughout the Borough must be assured should development be permitted to proceed and the SFRA provides specific recommendations that ultimately should be adopted as planning conditions for all future development. It is the responsibility of the prospective developer to comply with these recommendations as part of a detailed Flood Risk Assessment and through the planning application process to ensure that the specific requirements of the NPPF are met.
89. **Future planning decisions should consider the spatial variation in flood risk across the Borough, as defined by the delineated flood zone that applies at the specified site location, and apply the recommendations provided below accordingly.** The requirements of the NPPF apply equally to both allocated sites identified within the

emerging local plan and future windfall sites.

90. Specific planning and development management recommendations for future development within Crawley are presented below.

4.4.2 Future Development within Zone 3b Functional Floodplain (Undeveloped Areas)

91. Planning Recommendations – Allocation of Land for Future Development

Functional Floodplain should be protected for flood storage purposes. Should future development be necessary, this should be restricted to water-compatible uses and essential infrastructure, as identified in *PPG: Flood Risk and Coastal Change* Table 2, which needs to be located in such areas. 'More vulnerable' development should not be permitted. Careful consideration should be given to the Council's emergency response in times of flood to ensure that public safety is not compromised.

92. Development Management Recommendations – Minimum Requirements

Future development, with the exception of water compatible uses and essential infrastructure, should not be permitted. The frequency and severity of flooding within these areas are such that no engineered mitigation measures could be implemented to safely and effectively minimise the risk to life and property over the lifetime of the development.

4.4.3 Future Development within Zone 3a High Probability

93. Planning Recommendations – Allocation of Land for Future Development

1. Future development within Zone 3a High Probability should be restricted to 'less vulnerable' land uses, in accordance with *PPG: Flood Risk and Coastal Change* Table 2. 'More vulnerable' land uses, including residential development, should be steered towards zones of lower flood risk (i.e. Zone 2 Medium Probability or Zone 1 Low Probability) within which suitable land may be available in adjoining character areas.
2. Where non-flood risk related planning matters dictate that 'more vulnerable' (residential) development should be considered further, it will be necessary to ensure that the requirements of the Exception Test are satisfied. In planning terms, it must be demonstrated that "the development provides wider sustainability benefits to the community that outweigh flood risk", and that 'the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall'.
3. To satisfy the remaining criteria of the Exception Test, all development within Zone 3a High Probability should be conditioned in accordance with the development management recommendations below

94. Development Management Recommendations – Minimum Requirements

1. All proposed future development within Zone 3a High Probability will require a detailed Flood Risk Assessment (FRA);
2. Floor levels must be situated above the 1% (100 year) predicted maximum flood level plus climate change, incorporating an allowance for freeboard;
3. Dry access is to be provided (above flood level) to enable the safe evacuation of residents and/or employees in case of flooding. In exceptional circumstances where this is not achievable, safe access must be provided at all locations, defined in accordance with the Defra/EA research project FD2320⁴. It is essential to ensure that the nominated evacuation route does not divert evacuees onto a 'dry island' upon

⁴ FD2320 "Flood Risk Assessment Guidance for New Development" Defra/EA. Also web-based version: www.hydras.co.uk
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which essential supplies (i.e. food, shelter and medical treatment) will not be available for the duration of the flood event;

4. Basements are not to be utilised for habitable purposes. All basements must provide a safe evacuation route in time of flood, providing an access point that is situated above the 1% AEP peak design plus climate change flood level;
5. Implement SuDS to ensure that runoff from the site (post redevelopment) is not increased and, where possible, reduced. Any SuDS design must take due account of groundwater and geological conditions;
6. Ensure that the proposed development does not result in an increase in maximum flood levels within adjoining properties. This may be achieved by ensuring (for example) that the existing building footprint is not increased and/or compensatory flood storage is provided within the site (or upstream)⁵;
7. A minimum 8m buffer zone must be provided to 'top of bank' within sites immediately adjoining the main river corridor. This requirement may be negotiated with the Environment Agency in heavily constrained locations.

4.4.4 Future Development within Zone 2 Medium Probability

95. Planning Recommendations – Allocation of Land for Future Development

1. In accordance with *PPG: Flood Risk and Coastal Change*, land use within Zone 2 Medium Probability should be restricted to the 'water-compatible', 'less vulnerable' and 'more vulnerable' category (including residential development), or essential infrastructure, to satisfy the requirements of the Sequential Test.
2. Where non-flood risk related planning matters dictate that 'highly vulnerable' development should be considered further, it will be necessary to ensure that the requirements of the Exception Test are satisfied. In planning terms, it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, and that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.
3. To satisfy the remaining criteria of the Exception Test, all development within Zone 2 Medium Probability should be conditioned in accordance with the development management recommendations below.

96. Development Management Recommendations – Minimum Requirements

1. All proposed future development within Zone 2 Medium Probability will require a Flood Risk Assessment (FRA) that is commensurate with the risk posed to the proposed development;
2. Floor levels must be situated above the 1% (100 year) predicted maximum flood level plus climate change, incorporating an allowance for freeboard;
3. Dry access is to be provided (above flood level) to enable the safe evacuation of residents and/or employees in case of flooding. In exceptional circumstances where this is not achievable, safe access must be provided at all locations, defined in accordance with the Defra/EA research project FD2320. It is essential to ensure that the nominated evacuation route does not divert evacuees onto a 'dry island' upon which essential supplies (i.e. food, shelter and medical treatment) will not be available for the duration of the flood event;
4. Implement SuDS to ensure that runoff from the site (post redevelopment) is not increased, and is where possible reduced. Any SuDS design must take due account of groundwater and geological conditions (Section 4.5.3 refers).

⁵ Compensatory flood storage should be located as close as practically possible to the proposed development. The Environment Agency can provide further advice in this regard
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4.4.5 Future Development within Zone 1 Low Probability

97. Planning Recommendations – Allocation of Land for Future Development

There are generally no flood risk related constraints placed upon future development within Zone 1 Low Probability (in accordance with the NPPF), however it is important to recognise that future development within this zone may adversely impact upon the existing flooding regime if not carefully managed. Flooding related issues of a localised nature may also occur within Zone 1 Low Probability. For this reason, all development should be carried out in accordance with the development management recommendation below. Within 'dry island' areas that are surrounded by a degree of flood risk, effective emergency planning measures should be in place to ensure that the risk to people is minimised in case of flooding.

98. Development Management Recommendations – Minimum Requirements

A Drainage Impact Assessment will be required. This will involve the introduction of SuDS techniques to ensure that runoff from the site (post redevelopment) is not increased and, where possible, reduced. Any SuDS design must take due account of groundwater and geological conditions.

4.4.6 Local Plan Development Site Allocations

99. The Local Plan identifies a number of development sites, including sites carried forward from the Core Strategy (2008) and new sites identified through the SHLAA process. The majority of sites are situated within Zone 1 Low Probability and there are no pressing restrictions placed upon future development on flood risk grounds. It is essential however that all future development within the Borough is, as far as is technically feasible, mitigated (for example, through the application of Sustainable Drainage Systems) to ensure that there is no worsening to existing flooding related problems elsewhere.
100. Table 1 below, produced by West Sussex County Council, provides an overview of flood risk at sites identified in the Local Plan and through the SHLAA process. Where sites or parts of sites are considered to be at risk of flooding from fluvial sources, the Environment Agency has detailed site specific requirements (4.47 refers) to ensure that flood risk is mitigated and that development is acceptable in flood risk terms.

Table 1. SHLAA Sites: Overview of Flood Risk from Fluvial, Surface Water and Groundwater Sources (Adapted from West Sussex County Council Data, 2014)

Red = large parts/all of site at risk							
Orange = parts of site at risk							
Yellow = minor areas of risk on site	FLOOD RISK LEVEL						
Green = low risk on site	Rivers and Sea		Surface water		Groundwater	Historic records?	Historic Comments
Site Name	FZ - 2	FZ - 3	1 in 30	1 in 100	Risk Level	Y/N	
Deliverable (Local Plan Policy H2)							
Breezehurst Drive, Bewbush	Yellow	Green	Green	Yellow	Green	N	
Land Adjacent to Desmond Anderson School	Orange	Orange	Yellow	Yellow	Green	N	
Kilnmead Car Park, Northgate	Green	Green	Yellow	Yellow	Green	N	
Ifield Community College	Green	Green	Yellow	Yellow	Green	N	
Forge Wood (North East Sector)	Orange	Orange	Yellow	Yellow	Yellow	Y	Northern part of site
Southern Counties	Green	Green	Green	Green	Green	N	
Fairfield House	Green	Green	Green	Green	Green	Y	Western edge of site
Former TSB Site, Russell Way, Three Bridges	Green	Green	Green	Green	Green	N	
Zurich House	Green	Green	Yellow	Yellow	Green	N	
15-29 Broadway	Green	Green	Green	Yellow	Green	N	
Langley Green Primary School	Green	Green	Yellow	Yellow	Green	N	
Tinsley Lane, Three Bridges	Green	Green	Green	Green	Green	N	
Goffs Park Depot, Southgate	Green	Green	Green	Green	Green	N	
WSSC Professional Centre, Furnace Green (Planning Permission Granted)	Orange	Green	Yellow	Yellow	Orange	Y	Much of eastern part of site
Developable (Local Plan Policy H2)							
Breezehurst Drive Playing Fields, Bewbush	Green	Green	Green	Yellow	Orange	N	
Henty Close, Bewbush	Yellow	Yellow	Green	Green	Green	Y	Narrow strip at eastern extent of site.
Longley Building	Green	Green	Green	Yellow	Green	N	
Land Adj. Horsham Road and South of Silchester Drive, Gossops Green	Green	Green	Green	Green	Green	N	
Town Centre Key Opportunity Sites (Local Plan Policy H2)							
Land North of The Boulevard	Green	Green	Yellow	Yellow	Green	N	
County Buildings	Green	Green	Yellow	Yellow	Green	N	
Telford Place, Three Bridges	Green	Green	Yellow	Yellow	Green	N	
Crawley Station and Car Parks	Green	Green	Yellow	Yellow	Green	N	
Broad Housing Locations (Local Plan Policy H2)							
North East Sector Residual Land	Yellow	Green	Yellow	Yellow	Green	N	
102-112 London Road & 2-4 Tushmore Lane	Green	Green	Green	Green	Yellow	N	
21-29 Tushmore Lane	Green	Green	Green	Green	Orange	N	
116-136 & 138-144 London Road	Green	Green	Green	Green	Green	N	
Oak Tree Filling Station, London Road	Green	Green	Green	Green	Green	N	
Brunel Hall	Green	Green	Green	Green	Green	N	
Cross keys and Church walk	Green	Green	Green	Green	Green	N	

4.4.7 Site Specific Guidance: Local Plan Allocations for 'More Vulnerable' Development in Flood Zones 2 and 3

101. As discussed in Section 4.4.1, national planning policy requires that identified development sites comply with the sequential test, and as necessary, the exception test. Through this approach, development should be guided to land where the risk of flooding is lowest. Where it is necessary to consider land at higher risk of flooding, it must be demonstrated that the development will be from safe future flood risk, will not exacerbate flood risk elsewhere, and will deliver sustainability benefits to the community that outweigh the overall flood risk.
102. Land supply in Crawley is severely constrained, and this presents significant challenges in identifying land to accommodate significant housing and employment needs. Crawley's tight administrative boundaries, which in most parts do not extend significantly beyond the built-up area, represent a significant constraint. Further, the requirement to safeguard land at the north of the borough for a possible second runway at Gatwick Airport currently renders a significant amount of land unsuitable for development and represents a key development constraint.
103. Through the Strategic Housing Land Availability Assessment (SHLAA), the council has undertaken a comprehensive assessment of sites within the borough to identify those which are suitable, available, and achievable for development. This has formed part of the evidence base used to identify housing sites through Local Plan Policy H2, the majority of which are situated within areas of lowest flood risk.
104. However, given Crawley's significant objectively assessed housing need and challenging land supply position, it is recognised that there are no sequentially preferable sites available, and sites which are partly situated within Flood Zones 2 and/or 3 have needed to be considered for development. These are: Breezehurst Drive, and Bewbush West Playing Fields (both Bewbush), Land at Desmond Anderson School (Tilgate), and WSCC Professional Centre (Furnace Green). Identification of these sites reflects the approach of Planning Practice Guidance: *Housing and Economic Land Availability Assessment*, which requires the council to work with partners to reconsider sites that are potentially constrained, to understand how constraints can be overcome to bring sites forward.
105. Local Plan Policy H2 therefore identifies four sites that are partly situated within Flood Zones 2 and/or 3, and for each site it is necessary to ensure that flood risk is considered and addressed through the planning process. The Environment Agency and West Sussex County Council have provided a high level overview of flood risk at each site, and have advised that in principle sites are likely to be developable subject to applicants demonstrating through a Flood Risk Assessment that proposals are acceptable in flood risk terms. The Environment Agency has provided commentary on the key flood risk considerations for each site below.
106. These sites are identified as being predominately at a low risk of flooding, although it is recognised that parts of each are to varying extents subject to areas of Flood Zone 2 and/or 3. The applicant will be expected to demonstrate through the design and development management process and a site specific Flood Risk Assessment that proposals are acceptable in flood risk terms.

Breezehurst Drive, Bewbush

107. The site at Breezehurst Drive has already been partly developed, with the rest of the site and the open land on the opposite bank to the old leisure centre now being brought forward for development. This site is located at the very top of the Douster Brook, close to the start of its main river reach.
108. The Environment Agency has stipulated that a Flood Risk Assessment should be carried out for any proposed development, and a major area that would need to be covered in the FRA is surface water disposal. The Environment Agency will push very strongly for SuDs and require a clear demonstration of a reduction in the run-off rate commensurate to the existing greenfield rate, or even a reduction on this.
109. The site is mostly situated within Flood Zone 1 (Low Probability), and it should therefore be achievable to keep all development out of the flood risk area (sequentially placing the development on the site so it is all in FZ1). On this basis, the key consideration will likely

focus on surface water runoff.

110. As Douster Brook splits the site, the Main River comments and Byelaw Margin would apply, and the Environment Agency would wish to see development kept as far back from the watercourse as possible. Should proposals to develop the site include crossing of the Brook for access, this presents concern about potential culverting and bridge soffit levels that would need to be addressed at the planning stage. The Environment Agency would wish to comment on any such proposals, which could require Flood Defence Consent (FDC) for any structure.

Land Adjacent to Desmond Anderson School, Tilgate

111. The Desmond Anderson School site, which is provisionally identified for residential development, is partly situated within flood zones 2 and 3. The Environment Agency has confirmed that it does not object to the principle of residential development in this location, provided that the local authority is satisfied that no sequentially preferable site is available (as per the requirements of the sequential test).
112. Subsequent to passing the Sequential Test, the Environment Agency has stipulated that a detailed Flood Risk Assessment (FRA) must be submitted in support of any planning application at Desmond Anderson in order for the Exception Test to be passed. The FRA must demonstrate the proposed development can be made safe against flooding without increasing flood risk elsewhere and preferably, should include measures which reduce flood risk. One point of concern is that Flood Zone 3 passes across the centre of the site which means any potential occupiers of property in the southern part of the site could have restricted access under flood conditions. The layout should also follow a sequential approach, by placing more vulnerable forms of development such as housing, in the area of least flood risk. As such, the Environment Agency would be opposed to residential development within the area of the site currently shown to be within Flood Zone 3.
113. Sustainable Drainage Systems (SuDS) should be considered at the early stages of planning with sufficient space made available when considering density of development. The FRA should therefore include a drainage strategy which informs the layout and demonstrates runoff from the site is restricted to less than the current rate of discharge, using sustainable drainage systems. Reinstating a length of approximately 150 metres of culvert to open watercourse would assist with options for sustainable drainage, along with enhanced landscaping, public amenity and biodiversity. This would also help meet the objectives of the Water Framework Directive.

West Sussex County Council Professional Centre, Furnace Drive, Furnace Green

114. This site is currently subject to planning permission for the erection of 76 dwellings, of which 8 have to date been built out.
115. Flood Zone 3 only affects a very small area in the north east corner of the site. Approximately half of the site falls within Flood Zone 2. There is a large surface water culvert under Sylvan Road which leads from Tilgate Lake to Three Bridges. There are also foul and surface water sewers which cut across the front of the site and for which an easement exists.
116. The submitted drainage strategy for the permitted development is to dispose of surface water by infiltration (Use of SUDs) or attenuated discharge to the surface water system reusing the existing connections designed such that there would no increase in the discharge rate.
117. Following correspondence and discussions between the Council's own drainage engineers, the applicant's engineers and those of the Environment Agency, the latter concluded that its previous concerns could be met by the imposition of conditions. Accordingly the Environment Agency withdrew their objection by letter dated 11th November 2010.

Land at Henty Close, Bewbush

118. A small proportion of the Henty Close site falls within Flood Zones 2 and 3, with the remainder of the site falling within Flood Zone 1. As the site is undeveloped, areas of Flood Zone 3 should be considered as representing Flood Zone 3b (Functional Floodplain).
119. Development should follow the sequential approach, placing the most vulnerable development into Flood Zone 1, then appropriate uses through FZ2. A Flood Risk Assessment will be critical at this site, not only for layout but also ensuring no loss of flood storage; setting out surface water drainage proposals through the use of SUDS to deliver a reduction/no increase in rate of run-off. The Spruce Hill Brook is a Main River, and both Main River and Byelaw comments will apply, potentially triggering the requirement for a Flood Defence Consent.

Main Employment Areas

120. The Local Plan formally designates a number of well-established economic locations as Main Employment Areas. This is to help ensure that Crawley plans positively to accommodate a significant demand for employment land over the plan period to 2030. Of these, locations at Three Bridges Corridor, Maidenbower Business Park, Broadfield Business Park, Lowfield Heath, and Broadfield Stadium/K2 are situated in areas that fall partly within Flood Zones 2 and 3.
121. In all cases, the sites as designated are currently occupied and in employment use, representing brownfield land that subsequently falls within Flood Zone 3a (High Probability). Where parts of Main Employment Areas are identified as falling within Flood Zone 3, development should be limited to less vulnerable uses, with water sensitive uses directed to parts of the site that are sequentially preferable. Where development is proposed within Flood Zone 3a, a Flood Risk Assessment will be required. For proposals within Flood Zone 2, a Flood Risk Assessment will be required that is commensurate with the risk posed to the proposed development.

4.4.8 Other Local Plan Site Allocations

122. All remaining areas are situated within Flood Zone 1 Low Probability. There are no specific flood risk related constraints placed upon future development within Zone 1 Low Probability, however as identified in *PPG: Flood Risk and Coastal Change*, a Flood Risk Assessment will be required to support proposals on sites of 1 hectare or greater, in particular to demonstrate how issues of surface water drainage will be managed. The introduction of SuDS techniques should form an important part of FRA, demonstrating how SuDS design takes due account of groundwater and geological conditions.

4.4.9 Flood Risk from Surface Water Sources

123. In its capacity as Lead Local Flood Authority, West Sussex County Council has assessed flood risk at key SHLAA sites falling within categories B (adopted Core Strategy sites), C (Local Plan 2014 Key Housing Sites) and E (suitable sites that are deliverable). This has considered flooding risk from fluvial, surface water (1 in 30, and 1 in 100 risk levels), and groundwater sources.
124. The assessment identifies that in general most sites are at low risk from local sources or have small areas showing as being at surface water risk. Groundwater flood risk is low for all sites assessed. On this basis West Sussex County Council Drainage Team consider it unlikely that local flood risk would constrain development potential. Detail of the assessment for each SHLAA site is set out in Table 1 above.
125. The Environment Agency's updated Flood Map for Surface Water provides a high level overview of the areas where surface water flooding can be a risk, though is not suitable for making decisions at the individual property level. Rather, it is designed to offer an overview of surface water flood risk within an area and enable the Lead Local Flood Authority to target the areas that are at greatest risk to surface water flooding to be subject to further, more detailed studies. Therefore, whilst the Environment Agency

updated Flood Map for Surface Water may be used to provide an initial indication of the likely level of surface water flood risk in an area, this should form part of a suite of evidence, and the onus will be on the applicant to provide sufficient detail to support their proposal.

4.5 Detailed Flood Risk Assessment (FRA)

4.5.1 Scope of the Detailed Flood Risk Assessment

126. The SFRA is a strategic document that provides an overview of flood risk throughout the area. It is imperative that where necessary, a site-based Flood Risk Assessment (FRA) is carried out by the developer, and submitted as an integral part of the planning application.
127. As required by *PPG: Flood Risk and Coastal Change*, a site-specific Flood Risk Assessment will be required:
 - For proposals in Flood Zones 3 and 2, including minor development and change of use;
 - For proposals of 1 hectare of greater, including those in Flood Zone 1;
 - For proposals situated within any area of Flood Zone 1 that has been identified as having critical drainage problems (as notified to the local authority by the Environment Agency);
 - Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

4.5.2 Flood Risk Assessment Requirements

128. The FRA should be commensurate with the risk of flooding to the proposed development. For example, where the risk of flooding to the site is negligible (e.g. Zone 1 Low Probability), there is little benefit to be gained in assessing the potential risk to people and/or property as a result of flooding. Rather, emphasis should be placed on ensuring that runoff from the site does not exacerbate flooding elsewhere in the catchment. The particular requirements for FRAs within each delineated flood zone are outlined below.
129. FRA Requirements for Development Proposals in Flood Zone 3

All FRAs supporting proposed development within Zone 3b Functional Floodplain and Zone 3a High Probability will be required to include an assessment of the following:

 - The vulnerability of the development to flooding from other sources (e.g. surface water drainage, groundwater) as well as from river flooding. This will involve discussion with the Council and the Environment Agency to confirm whether a localised risk of flooding exists at the proposed site.
 - The vulnerability of the development to flooding over the lifetime of the development (including the potential impacts of climate change), i.e. maximum water levels, flow paths and flood extents within the property and surrounding area. The Environment Agency may have carried out detailed flood risk mapping within localised areas that could be used to underpin this assessment. Where available, this will be provided at a cost to the developer. Where detailed modelling is not available, hydraulic modelling by suitably qualified engineers will be required to determine the risk of flooding to the site.
 - The potential of the development to increase flood risk elsewhere through the addition of hard surfaces, the effect of the new development on surface water runoff, and the effect of the new development on depth and speed of flooding to adjacent and surrounding property. This will require a detailed assessment, to be carried out by a suitably qualified engineer.
 - A demonstration that residual risks of flooding (after existing and proposed flood management and mitigation measures are taken into account) are acceptable.

Measures may include flood defences, flood resistant and resilient design, escape/evacuation, effective flood warning and emergency planning.

- Details of existing site levels, proposed site levels and proposed ground floor levels. All levels should be stated relevant to Ordnance Datum.

130. FRA Requirements for Development Proposals in Flood Zone 2

- For sites within Zone 2 Medium Probability, a high level FRA should be prepared based upon readily available existing flooding information, sourced from the EA. It will be necessary to demonstrate that the residual risk of flooding to the property is effectively managed through, for example, the provision of raised floor levels and the provision of a planned evacuation route and/or safe haven.
- The risk of alternative sources of flooding (e.g. urban drainage and/or groundwater) must be considered and sustainable drainage systems (SuDS) must be employed to ensure no worsening to existing flooding problems elsewhere within the area.

131. FRA Requirements for Development Proposals in Flood Zone 1

- The risk of alternative sources of flooding (e.g. urban drainage and/or groundwater) must be considered and sustainable drainage systems (SuDS) must be employed to ensure no worsening to existing flooding problems elsewhere within the area. Within all areas of the Borough, the risk of alternative sources of flooding (e.g. urban drainage and/or groundwater) must be considered and sustainable drainage systems (SuDS) must be employed to ensure no worsening to existing flooding problems elsewhere within the area.
- The SFRA provides specific recommendations with respect to the provision of sustainable flood risk mitigation opportunities that will address both the risk to people and the residual risk of flooding to development within particular 'zones' of the area. These recommendations should form the basis for the site-based FRA.

4.6 Raised Floor Levels and Basements (Freeboard)

132. The raising of floor levels above the 1% Annual Exceedance Probability (AEP) fluvial flood level will ensure that the damage to property is minimised. Given the anticipated increase in flood levels due to climate change, the adopted floor level should be raised above the 1% AEP predicted flood level assuming a 20% increase in flow (climate change) over the next 100 years.
133. Wherever possible, floor levels should be situated a minimum of 300mm above the 1% AEP plus climate change flood level, determined as an outcome of the site based FRA. A minimum of 750mm above the 1% AEP flood level should be adopted if no climate change data is available. The height that the floor level is raised above flood level is referred to as the 'freeboard', and is determined as a measure of the residual risks. For certain types of commercial development, such as warehousing, it may, subject to consultation with the Environment Agency, be appropriate to relax the freeboard height.
134. The use of basements within flood affected areas should be discouraged. Where basement uses are permitted however, it is necessary to ensure that the basement access points are situated 300mm above the 1% AEP flood level plus climate change. The basement must be of a waterproof construction to avoid seepage during flood conditions. Habitable uses of basements within flood affected areas should not be permitted.

4.7 Sustainable Drainage Systems (SUDS)

4.7.1 Overview and Responsibilities

135. SuDS is a term used to describe the various approaches that can be used to manage surface water drainage in a way that mimics the natural environment. The management of rainfall (surface water) is an essential element in reducing future flood risk to both site and surroundings. Reducing the rate of discharge from sites to greenfield runoff rates is one of the most effective ways of reducing and managing flood risk. Although in catchment terms any reduction in the amount of water that originates from a given site is likely to be small, if applied across the catchment in a consistent way, the cumulative affect of a number of sites can be significant.
136. As required by the Flood and Water Management Act (2010), the Department of Environment, Food and Rural Affairs (Defra) is drafting national standards for SuDS design that will apply across England and Wales, making SuDS a formal requirement of development. West Sussex County Council is the Lead Flood Authority and SuDS Approving Body (SAB) for Crawley, and will be responsible for the approval, adoption, and future maintenance of surface water drainage infrastructure for new development once the national SuDS guidance is adopted. This two-tiered system means that planning applications will require SAB approval from WSCC, in addition to obtaining planning consent from Crawley Borough Council.

4.7.2 Approach and Implementation

137. SuDS may improve the sustainable management of water for a site by:
 - reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
 - reducing volumes and the frequency of water flowing directly to watercourses or sewers from developed sites;
 - improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
 - reducing potable water demand through rainwater harvesting;
 - improving amenity through the provision of public open space and wildlife habitat;
 - replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.
138. There are numerous different ways that SuDS can be incorporated into development and the most commonly found components of a SuDS system are described in Table 2 below⁶. The appropriate application of a SuDS scheme to a specific development is heavily dependent upon the topography and geology of the site and its surrounds, and careful consideration of site characteristics is needed to ensure the future sustainability of the adopted drainage system.
139. The Gatwick Sub-Region Water Cycle Study (2011) and subsequent 2013 update recommends that new developments apply sustainable drainage techniques to control flood risk and deliver benefits in terms of water quality, amenity value, and green infrastructure. The study has undertaken a high level assessment of infiltration potential in Crawley, finding that most sites have medium to low potential, though it is recommended that all new developments undertake more detailed assessments to consider the most appropriate SuDS method for each site.

⁶ The SuDS Manual (C697) CIRIA 2007
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Filter strips	Wide, gently sloping areas of grass or other dense vegetation that treat runoff from adjacent impermeable areas
Swales	Broad, shallow channels covered by grass or other suitable vegetation. They are designed to convey and/or store runoff, and can infiltrate the water into the ground (if ground conditions allow)
Infiltration basins	Depressions in the surface that are designed to store runoff and filtrate the water into the ground. They may also be landscaped to provide aesthetic and amenity value.
Wet ponds	Basins that have a permanent pool of water for water quality treatment. They provide temporary storage for additional storm runoff above the permanent water level. Wet ponds may provide amenity and wildlife benefits.
Extended detention basins	Normally dry, though they may have small permanent pools at the inlet and outlet. They are designed to detain a certain volume of runoff as well as providing water quality treatment.
Constructed wetlands	Ponds with shallow areas and wetland vegetation to improve pollutant removal and enhance wildlife habitat.
Filter drains and perforated pipes	Trenches that are filled with permeable material. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site. A slotted or perforated pipe may be built into the base of the trench to collect and convey the water.
Infiltration devices	Temporarily store runoff from a development and allow it to percolate into the ground.
Pervious surfaces	Allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse or release to surface water.
Green roofs	Systems that cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation.
Rainwater harvesting.	Water is stored and re-used for non-potable uses, such as toilet flushing and garden watering.

Table 2: Possible SUDS Approaches

140. To assist in the identification of the most appropriate SuDS type, the Water Cycle Study recommends that surface water should be managed as close to its source as possible in line with the following drainage hierarchy;
- Store rainwater for later use;
 - Use infiltration techniques, such as porous surfaces in non-clay areas;
 - Attenuate water in ponds or open water features for gradual release to a watercourse;
 - Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse;
 - Discharge rainwater direct to a watercourse;
 - Discharge rainwater to a surface water drain;
 - Discharge rainwater to the combined sewer.
141. The preferred hierarchy of managing surface water drainage from any development is through first infiltration measures, secondly attenuation and discharge to watercourses, and if these cannot be met, through discharge to surface water only sewers. As such, it is recommended that new development does not discharge surface water into combined sewers, and that surface water/highway drainage is disconnected from foul or combined sewers when brownfield sites are redeveloped. In this way, flow volume entering the foul sewer can be decreased from the existing arrangement where surface water run-off is discharged to the foul sewer network.
142. For more guidance on SuDS, the following documents and websites are recommended as a starting point:
- The SuDS Manual, (C697) CIRIA, 2007
 - www.susdrain.org
 - SuDS: A Guide for Developers, Environment Agency.

- Water People Places: Planning Sustainable Drainage into Developments, prepared by the Lead Local Flood Authorities in the South East, AECOM, 2014

4.8 Community Actions to Reduce Flood Damage

143. It is estimated that approximately 2870 homes within the Borough are at risk of flooding. It is essential therefore to ensure a broad awareness with respect to flood risk, providing the community with the knowledge (and tools) that will enable them to help themselves should a flood event occur.
144. 'Community based measures' are cost effective steps that local communities may introduce to minimise damage sustained to their own homes in the case of flooding. Flood proofing in particular can help to reduce the impact of flooding to homes and property.
145. The 'flood proofing' of a property may take a variety of forms:

For new homes and/or during redevelopment

- Raising of floor levels

The raising of floor levels above the anticipated maximum flood level ensures that the interior of the property is not directly affected by flooding, avoiding damage to furnishings, wiring and interior walls. It is highlighted that plumbing may still be impacted as a result of mains sewer failure.

- Raising of electrical wiring

The raising of electrical wiring and sockets within flood affected buildings reduces the risks to health and safety, and reduces the time required after a flood to rectify the damage.

For existing homes

- Flood boards

The placement of a temporary watertight seal across doors, windows and air bricks to avoid inundation of the building interior. This may be suitable for relatively short periods of flooding, however the porosity of brickwork may result in damage being sustained should water levels remain elevated for an extended period of time. This may lessen the effectiveness of flood proofing to existing properties affected by flooding from larger river systems such as the Thames.

Further guidance is given in "Flood Resilient Construction"⁷, which can also be applied to existing buildings.

4.9 Emergency Planning

146. Emergency planning is a critical element of any sustainable flood risk management solution. Liaison with the Environment Agency and emergency services is imperative.
147. The Environment Agency monitors river levels within the main rivers affecting the Borough, including Gatwick Stream and the upper reaches of the River Mole. Based upon weather predictions provided by The Met Office, the Agency makes an assessment of the anticipated maximum water level that is likely to be reached within the proceeding hours (and/or days). Where these predicted water levels are expected to result in the inundation of populated areas⁸, the Environment Agency will issue a series of flood warnings within defined flood warning areas, encouraging residents to take action to avoid damage to property in the first instance.
148. As water levels rise and begin to pose a risk to people and/or livelihood, it is the responsibility of the Council to warn and inform vulnerable residents, and coordinate the evacuation of residents. This evacuation will be supported and facilitated by the

⁷ "Improving the Flood Performance of New Buildings: Flood Resilient Construction" Department for Communities and Local Government May 2007

⁸ Restricted to those urban areas situated within Environment Agency flood warning zones
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emergency services. It is essential that a robust plan is in place that clearly sets out (as a minimum):

- roles and responsibilities;
- paths of communication;
- evacuation routes;
- community centres to house evacuated residents;
- contingency plans in case of loss of power and/or communication.

149. 'Dry' access (i.e. above flood level) should be sought wherever possible to ensure that all residents can be safely evacuated in times of flood. As part of their long term strategy for road maintenance and improvement, the Council progressively should seek to raise critical evacuation routes above the greater of the 1% AEP + 20% flow (i.e. climate change) flood level. As an absolute minimum, 'safe' access must be assured during the 1% AEP fluvial flood level, defined with due consideration to the Defra/Environment Agency research project FD2320. It is highlighted that road raising must not have a detrimental impact upon flow routes and/or the effectiveness of floodplain storage.
150. Coordination with the emergency services and the Environment Agency is imperative to ensure the safety of residents in time of flood. Areas within the Borough that are at risk of river flooding are typically susceptible to relatively long duration rainfall events and considerable forewarning will generally be provided to encourage preparation in an effort to minimise property damage and risk to life
151. In contrast, areas suffering from localised flooding issues will tend to be at greater risk. These areas are susceptible to 'flash' flooding, associated with storm cells that pass over the district resulting in high intensity, often relatively localised, rainfall. It is anticipated that events of this nature will occur more often as a result of possible climate change over the coming decades. Events of this nature are difficult to predict accurately, and the rapid runoff that follows will often result in flooding that cannot be sensibly forewarned.
152. All areas are potentially at some degree risk of localised flooding due to heavy rainfall. The blockage of gullies and culverts as a result of litter and/or leaves is commonplace and this will inevitably lead to localised problems that can only realistically be addressed by reactive maintenance.
153. It is recommended that the Council's Emergency Response Plan is reviewed in light of the findings and recommendations of the SFRA to ensure that safe access can be provided during a major flooding event.

5 Conclusion & Recommendations

154. A number of properties within the Crawley Borough are at risk of flooding. The risk of flooding posed to properties within the Borough arises from a number of sources including river flooding, localised runoff and sewer flooding.
155. Planning policy needs to be informed about the risk posed by flooding. A collation of potential sources of flood risk has been carried out, developed in close consultation with both the Council and the Environment Agency. The Borough has been broken down into zones of 'high', 'medium' and 'low' probability of flooding in accordance with the NPPF, providing the basis for application of the Sequential Test.
156. A planning solution to flood risk management should be sought wherever possible, steering vulnerable development away from areas affected by flooding in accordance with the Sequential Test.
157. Where other planning considerations must guide the allocation of sites and the Sequential Test cannot be satisfied, specific recommendations have been provided to assist the Council and the developer to meet the Exception Test. These should be applied as development management conditions for all future development (refer Section 4.4).
158. Planning policy is essential to ensuring that the recommended development management conditions can be imposed consistently at the planning application stage. This is essential to achieve future sustainability within the Borough with respect to flood risk management. It is therefore recommended that the policy approach of the emerging Local Plan refers specifically to the development management recommendations of this SFRA (and future revisions as appropriate), and requires that development proposals are in conformity with both the national planning guidance of the NPPF and accompanying practice guidance, and the locally specific recommendations of the SFRA.
159. Emergency planning is imperative to minimise the risk to life posed by flooding within the Borough. It is recommended that the Council review their adopted flood risk response plan in light of the findings and recommendations of the SFRA.
160. The core data used to underpin the development of the SFRA will be superseded over time as the Environment Agency provides further investment in detailed modelling of the River Thames and its tributaries, reviewing its Flood Map for Land Use Planning on a quarterly basis. It is recommended that the Flood Map for Land Use Planning is retained as the 'first pass' filter at the development application stage, triggering (or otherwise) the need for a more detailed site-based investigation.