APPENDIX F Guidance for Developers

Aylesbury Vale District Council

Aylesbury Vale Strategic Flood Risk Assessment – Level 1 Report August 2012 for publication.

Date	Revision	Stage
5 April 2012	A	For Environment Agency
24 April 2012	B	For Stakeholders
6 June 2012	**C**	Final Draft for EA Signoff
7 August 2012	**D**	Publication

APPENDIX F - GUIDANCE FOR DEVELOPERS

AVDC, August 2012

PART A: INTRODUCTION

1 PURPOSE OF THIS DOCUMENT

1.1 This developer guidance has been produced as a part of the Level 1 Aylesbury Vale Strategic Flood Risk Assessment (SFRA) to inform the Vale of Aylesbury Plan. This version is an update of that contained in the April 2007 developer guidance (in the 2007 SFRA Level 1) prepared by Royal Haskoning. It contains guidance for developers on the following aspects:

- Procedures for the various types of development proposals in relation to flood risk;
- Production of Flood Risk Assessments (FRAs);
- Assessment of development surface water runoff rates from large and small developments;
- Management of runoff using Sustainable Drainage Systems (SUDS) and strategic solutions -including their long-term maintenance;
- Monitoring of post development runoff; and
- Policy sources related to development and flood risk, existing guidance and useful contacts.

2 NATIONAL PLANNING POLICY FRAMEWORK

2.1 The National Planning Policy Framework paragraphs 93-108 and additional technical guidance on Flood Risk published in March 2012 (http://www.communities.gov.uk/documents/planningandbuilding/pdf/2115548.pdf) requires local authorities and developers to consider flood risk at all stages of the planning process. Assessing and mitigating flood risk helps deliver safe and sustainable development, which benefits future occupants, the wider communities and society as a whole. A robust assessment must consider flooding from all sources including groundwater, surface water, sewer flooding and the risk from artificial impoundments (e.g. reservoirs), as well as from rivers. It is also important to give due consideration to the impacts of climate change as the UK Climate Change Impacts Programme http://www.ukcip.org.uk/essentials/climate-impact/) predicts flooding will become more severe in the future.

3 RELATED GUIDANCE

3.1 Environment Agency advice and guidance, including downloadable leaflets can be obtained from the flood pages of their website (http://www.environment-agency.gov.uk/homeandleisure/floods/). Alternatively call the Floodline service on 0845 988 1188 for advice or to sign up to a free flood warning service.

3.2 The provision of guidance on flooding and flood risk is an important part of CIRIA's ongoing research programme. Further information can be found on CIRIA's flooding website at www.ciria.org/flooding/. Useful

information on SUDS and links to other related websites are available at www.ciria.org/suds .

3.3 The Environment Agency has produced practical advice on making developments better for people and the environment by focusing on key environmental issues including the management of flood risk, surface water and waste through to sustainable construction, recreation and social issues. It provides the details of consents and permissions that the developers should obtain from the Environment Agency and comprise an environmental checklist for further action by prospective developers. The latest updates on this guidance and links to useful websites can be found at www.environment-agency.gov.uk/developers.

PART B: INTRODUCTION TO FLOOD RISK ASSESSMENT

4 COMPONENTS OF FLOOD RISK

4.1 Flood risk is a combination of the **probability** of a flood hazard occurring and the magnitude of the potential **consequences** of the flood.

4.2 The **probability** of a flood hazard can be described as the chance that it will happen in any year. It is recommended that annual probability of flooding should be expressed as a percentage probability of a flood of a given magnitude being equalled or exceeded in any year rather than the expression of return periods. *Table 1* below gives examples of annual flood probability expressions.

Annual flood probability as percentage likelihood	Basis of expression	Equivalent return period for flood event
5%	**1 in 20 chance of being equalled or exceeded in any year**	**1 in 20 year**
1%	**1 in 100 chance of being equalled or exceeded in any year**	**1 in 100 year**
0.1%	**1 in 1000 chance of being equalled or exceeded in any year**	**1 in 1000 year**

Table 1: *Expressions of annual flood probability. Source: AVDC, 2012*

4.3 The **consequences** of flooding will depend upon the nature of the flood hazard and the vulnerability of an area. The nature of the flood hazard affects the potential for the flood to cause damage, and will be influenced by factors such as:

- Flood depth;
- Flood velocity;
- Rate of onset of flooding;
- Flood duration;
- Wave action effects; and
- Water quality.

4.4 The vulnerability of the area flooded affects the potential for damage to be caused and will be influenced by factors such as:

- The number of properties and/ or size of area affected;
- The type of development (e.g. more damage would be caused during the flooding of a supermarket than during the flooding of a playing field or an open public space);
- The nature of the population at risk (e.g. elderly or infirmed people are more likely to suffer during flooding); and
- The presence and reliability of mitigation measures to manage flood risk.

- The combined influence of the factors affecting probability and consequences will determine flood risk at a particular site. *Figure 1* below further illustrates the factors affecting flood risk

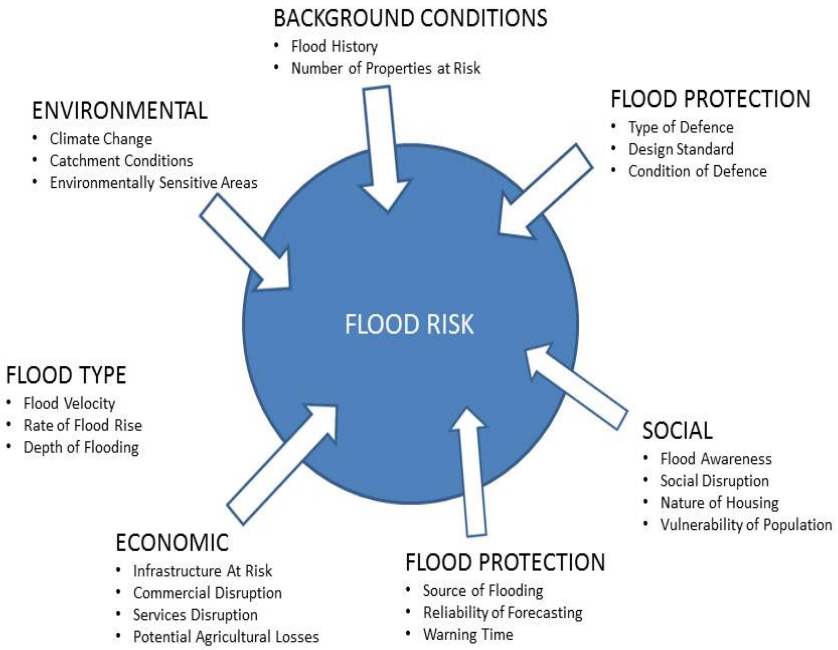

Figure 1: *Factors affecting flood risk (Source: AVDC, 2012 adapted from C624, CIRIA 2004)*

Sources and mechanisms of flooding

4.5 Flooding can arise from a variety of sources and not just due to fluvial flooding caused by rivers. Flooding occurs naturally, when specific environmental factors or combinations of factors occur. It can also result from human interference with natural processes, such as changes to river channels, increases in runoff and blocked drainage systems. *Box 1* overleaf provides the principal categories of flooding mechanisms that can potentially affect development sites. *Reference 6* (see References at back of this document) *gives* further details of each type of these flooding categories. Paragraph 6 of The NPPF Technical Guidance to the National Planning Policy Framework (March 2012) sets out that all forms of flooding to be considered in a FRA. For clarification these will include flooding from:-

- Rivers;
- Overland;

- Groundwater;
- Sewers;
- Reservoirs
- Canals and;
- other Artificial Sources.

Category	Mechanism
Fluvial flooding	Exceedence of the flow capacity of the channel of a river, stream or other natural watercourse, typically associated with heavy rainfall events. Excess water spills onto the flood plains
Coastal and tidal flooding	High tides, storm surges and wave action, often in combination
Estuarial flooding and watercourses affected by tidelocking	Often involving high tidal levels and high fluvial flows in combination
Groundwater flooding	Raised groundwater levels, typically following prolonged rain (may be slow to recede). High groundwater levels may result in increased overland flow flooding
Flooding from overland flow	Water flowing over the ground surface that has not reached a natural or artificial drainage channel. This can occur when intense rainfall exceeds the infiltration capacity of the ground, or when the ground is so highly saturated that it cannot accept any more water
Flooding from artificial drainage systems	Blockage or overloading of pipes, sewers, canals, and drainage channels or failure of pumping systems. Typically following heavy rain or as a result of high water levels in a receiving watercourse
Flooding from infrastructure failure	Structural, hydraulic or geotechnical failure of flooding infrastructure that transmits or controls the flow of water

Box 1: *Categories of flood mechanisms (Source: C624, CIRIA 2004)*

Implications of flood risk

4.6 Developments that are designed without regard to flood risk may endanger lives, damage property, cause significant disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. Such developments are therefore, not sustainable. A variety of development types, such as residential and commercial properties, public facilities, transport links and other infrastructure may be vulnerable to flood damage.

4.7 Flooding can have several impacts on developments. These may include:

- Physical impacts causing damage to buildings, services, fittings and other personal possessions;
- Economic impacts;
- Social impacts;
- Health, safety and welfare impacts; and

- Environmental impacts.

4.8 On the other hand, the developments may have some impacts on flood risk and environment in general; such as:

- Increase in the potential for flood damage due to direct exposure of developments;
- Change in runoff due to changes in catchment characteristics;
- Changes in flood risk upstream and downstream due to obstructions to flood flow and increased runoff; and
- Other environmental impacts such as pollution and impact on ecology and wildlife.

4.9 In light of the threat posed by climate change and in order to provide a sustainable approach to flood risk, the Government's strategy for flood and erosion risk management in England is set out in 'The National Flood and Coastal Erosion Risk Management Strategy for England' (Environment Agency/DEFRA, July 2011 - http://www.environment-agency.gov.uk/research/policy/130073.aspx. As opposed to the more classical though less sustainable and economically unviable approach that would use a number of flood defence measures (e.g. embankments, walls or reservoirs) put in place to protect areas at high risk of flooding, this new strategy seeks to manage watercourses and coastline so that greater environmental and social benefit is offered.

4.10 Thus, every opportunity to create natural storage space for flood water and reduce risk should be explored. This might include:

- Setting back of the defences with respect to the river channel to increase the floodplain;
- Managed breaching of existing defences to flood land of low vulnerability (e.g. agricultural land); and
- Refraining from culverting streams, as culverts have limited hydraulic capacities and are prone to blockage.

Such opportunities to promote sustainable management of watercourses should be encouraged and incorporated early on in the planning process.

5 FLOOD RISK ASSESSMENT WITHIN THE PLANNING PROCESS

Why do we need a FRA?

5.1 The National Planning Policy Framework (NPPF) states that flood risk is an important factor to be considered by LPAs when preparing Development Plans respectively and it must be taken into account at an early stage when determining planning applications. The NPPF confirms that they should apply a sequential approach to flood risk to steer developments away from high risk areas through a Sequential Test. The need for a precautionary approach to address the threat posed by projected climate change is an important aspect of any FRA.

5.2 LPAs should apply a Sequential Test as per Paragraph 101 of the NPPF and pp.2-7 of the NPPF Technical Guidance to avoid inappropriate development in areas at risk of flooding. Table 1 of the NPPF Technical Guidance sets out the Flood Zones that should be considered in this test and the requirements for appropriate land-use types and FRAs for each Flood Zone.

5.3 The NPPF distinguishes between 5 different land-use types with respect to Flood Risk:

- Essential Infrastructure;
- Highly Vulnerable;
- More Vulnerable;
- Less Vulnerable; and
- Water-compatible Development.

5.4 If necessary, application of the Exception Test as per The NPPF and NPPF Technical Guidance will ensure that new developments in medium to high flood risk areas will only be permitted where there is clear and robust evidence that flood risk is outweighed by other sustainability considerations and priorities. Therefore, the Exception Test ensures reasoned justification is provided for any decision to allocate land in areas at medium to high risk, where following the application of Sequential Test it is not possible for a development to be located in a zone with a lower probability of flooding.

5.5 Table 3 of the NPPF Technical Guidance provides broad clarification regarding the suitability of land-use types and requirements for Exception Test depending on the vulnerability classification of a specific development and the Flood Zone it is located.

5.6 The NPPF and NPPF Technical Guidance make it clear that in preparing their proposals developers will be expected to provide an assessment of flood risk, including runoff implications which is appropriate to the nature and scale of the development and the risks involved. This assessment

should be submitted to the Local Planning Authority (LPA) with the planning application.

5.7 The process from pre-purchase to submission of a completed planning application form with accompanying FRA is illustrated in Figure 2 below.

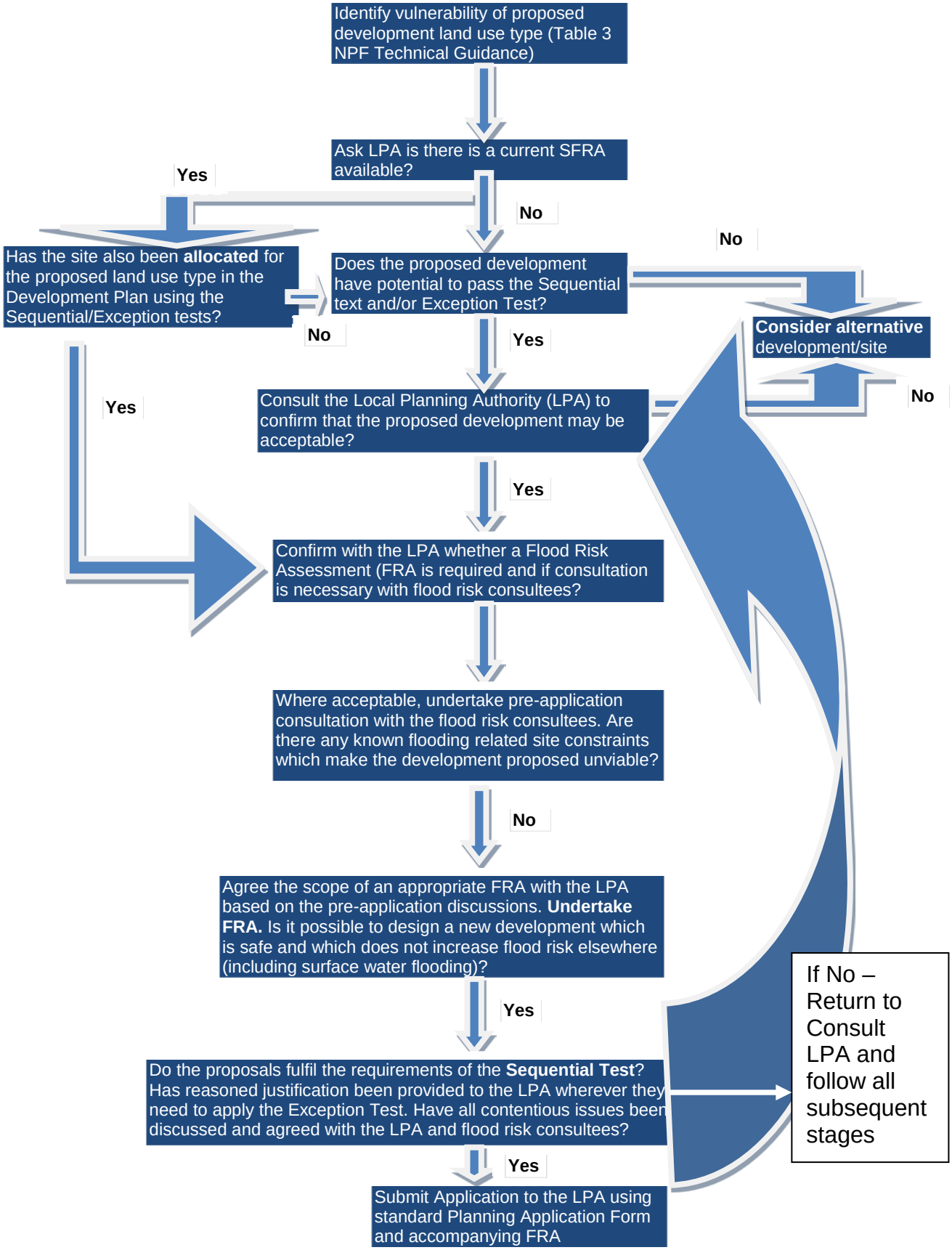

Figure 2: *Individual planning applications – guidance for developers. Source: AVDC and the Environment Agency, 2012)*

Notes for Figure 2:-

1. The scope of the Sequential Test should be agreed with the local authority, and the test undertaken before work on an FRA is undertaken. This ensures development is directed to areas of lowest risk and prevents abortive work on the part of the developer.

2. An SFRA can be defined as 'current' if it has been prepared in accordance with the NPPF and NPPF Technical Guidance as amended.

3. If the site has been allocated in the Development Plan then subsequent steps in the process are likely to be significantly more straightforward

4. If a site has not been allocated in the Development Plan because it was considered that the flood risk is unacceptable, it is unlikely that a proposed development at the site would pass the sequential test at the planning application stage

When do we need a FRA?

5.8 Table 2 of this guidance clarifies when a FRA is needed. Planning applications for development proposals of 1 hectare or greater in Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3 should be accompanied by a FRA.

What is a FRA?

5.9 A FRA should consider all types of flooding to satisfy the following four key objectives:

- To assess flood risk to the proposed development and to demonstrate that any residual risks to the development and its users would be acceptable
- To assess the potential impact of the proposed development on flood risk elsewhere and to demonstrate that the development would not increase flood risk elsewhere; and
- To satisfy the needs of the NPPF, FRAs to be submitted in support of planning applications.
- To reduce overall flood risk

5.10 A FRA should assess the issues that influence the acceptability of a development in terms of flood risk. It should either produce an acceptable development proposal or a conclusion that the proposed development is unacceptable due to flood risk issues. Acceptable development proposals should meet a number of key criteria (Box 2 below and overleaf) and will have a FRA report that demonstrates how these criteria have been met.

FRA Criteria To Be Achieved:
• The development should not be at a significant risk of flooding, and should not be susceptible to damage from flooding. • The development should show it has taken opportunities to reduce flood risk to off-site areas • The development should not be exposed to flood risk such that health, safety and welfare of the users of the development, or the population elsewhere, are threatened. • Normal operation of the development should not be susceptible to disruption as a result of flooding. • Safe access to and from the development should be possible during flood events. • The development should not increase flood risk elsewhere. • The development should not prevent safe maintenance of watercourses or maintenance and operation of flood defences. • The development should not be associated with an onerous or difficult operation and maintenance regime to manage flood risk. • The development should not lead to degradation of the environment. • The development should meet all of the above criteria for its lifetime, including consideration of the potential effects of climate change.

Box 2: *Key aims for a development that is sustainable in flood risk terms (Source: C624, CIRIA 2004, Environment Agency, 2012)*

5.11 Appendix A of this guidance document lists the relevant policies and other guidance applicable to FRAs in the Aylesbury Vale District.

The impact of climate change on flood risk

5.12 Increasing global temperatures and changing weather patterns indicate that human-induced climate change is a reality. Climate change has important implications for the assessment of flood risk and for the design of mitigation measures such as surface water drainage design and flood resilience measures.

5.13 The United Kingdom Climate Impacts Programme (UKCIP http://www.ukcip.org.uk/) is assessing the implications of climate change on the United Kingdom and, as part of this programme the impacts on flood risk are being assessed. There is considerable uncertainty associated with the results and therefore it is necessary to make a conservative allowance for climate change impacts, based on the latest predictions, when carrying out flood risk assessments.

PART C: TECHNICAL GUIDANCE ON FLOOD RISK ASSESSMENT

6 THE FLOOD RISK ASSESSMENT PROCESS

6.1 Flood Risk Assessments (FRAs) should be undertaken by competent professionals. FRAs at all levels should be undertaken under the supervision of an experienced flood risk management specialist (who would normally be expected to have achieved chartered status with a relevant professional body such as the Institution of Civil Engineers (ICE) or the Chartered Institution of Water and Environmental Management (CIWEM)). An appropriate level of FRA should be undertaken as soon as a site is considered for development – see Figure 2. CIRIA publication C624 recommends three levels of FRAs which can be undertaken at increasing levels of detail, as development proposals progress.

FRA Level	Description
1	Screening study to identify whether there are any flooding issues from all sources including surface water management issues related to a development site that may warrant further consideration. This should be based on readily available existing information including the SFRA, Environment Agency Flood Map and Standing Advice. The screening study will ascertain whether the sequential test is likely to be passed and whether or not an FRA is required.
2	Scoping study to be undertaken if the Level 1 study indicates that the site may lie within an area that is at risk of flooding or that the site may increase flood risk due to increased runoff. This study should confirm the sources of flooding which may affect the site. The study should include the following: • An appraisal of the availability and adequacy of existing information; • A qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere; • An appraisal of the scope of possible measures to reduce the flood risk to acceptable levels. The scoping study may identify that sufficient quantitative information is already available to complete a FRA appropriate to the scale and nature of the development.
3	Detailed study to be undertaken if the Level 2 study concludes that further quantitative analysis is required to assess flood risk issues related to the development site. The study should include: • Quantitative appraisal of the potential flood risk to the development; • Quantitative appraisal of the potential impact of development site on flood risk elsewhere; • Quantitative demonstration of the effectiveness of any proposed mitigation measures.

Table 2 Levels of Flood Risk Assessment *(Source: C624 Development and flood risk – guidance for the construction industry (CIRIA, September 2004)*

6.2 Figure 3 (overleaf) is a flowchart to illustrate the overall process associated with each level of FRA for development proposals. It is important that AVDC, and if appropriate, the EA, Bedford Group of IDB, other responsible bodies (e.g. Anglian Water and Thames Water) and the local community including other relevant stakeholders (e.g. British Waterways) are consulted at all levels of the FRA. The circumstances in which to consult the Environment Agency are set out in Flood Risk Standing Advice for planning authorities (http://www.environment-agency.gov.uk/research/planning/)

6.3 Sections 8, 9 and 10 of this guidance present further technical guidance on undertaking FRAs for Levels 1, 2 and 3 respectively.

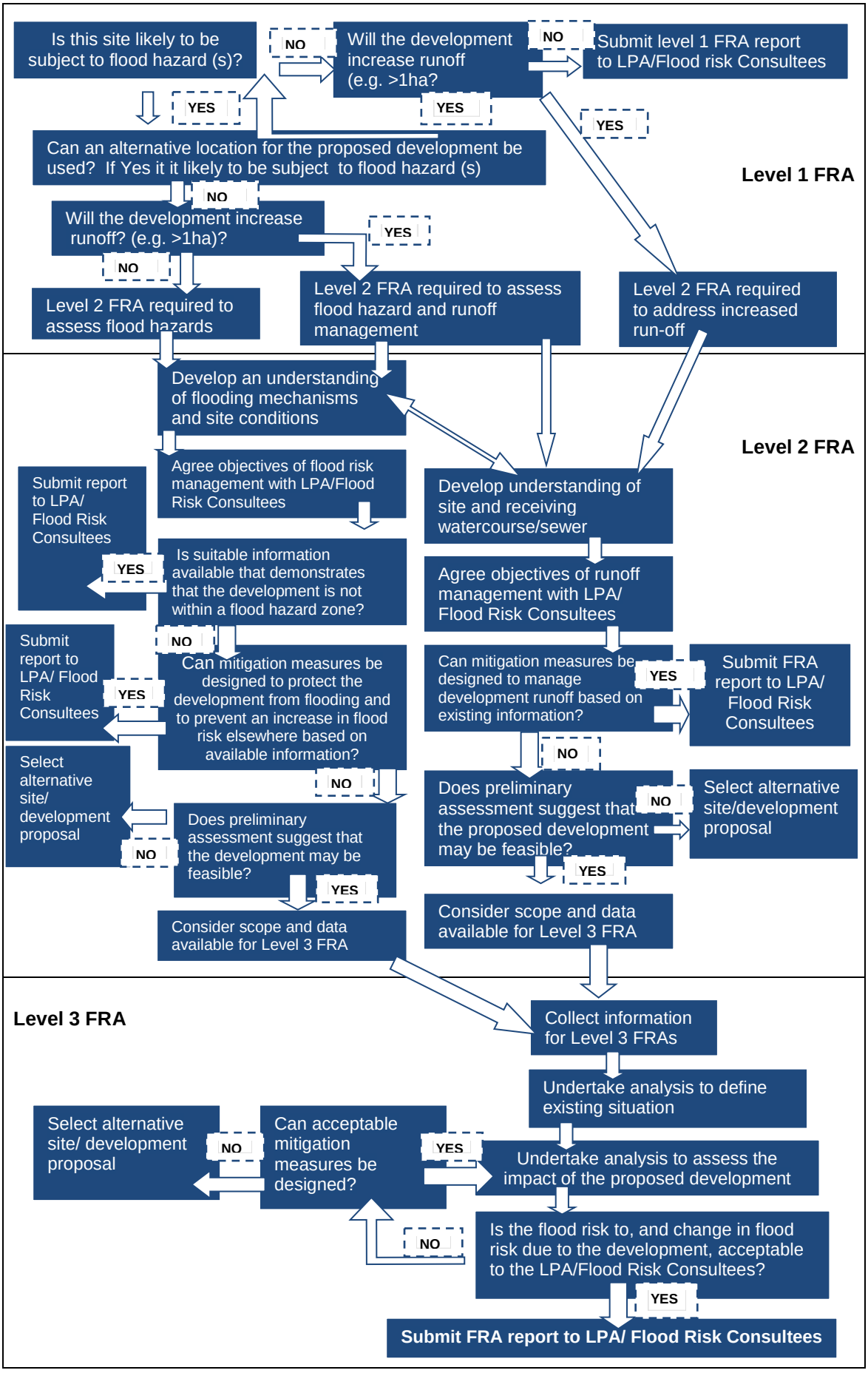
Is this site likely to be subject to flood hazard (s)?
NO
Will the development increase runoff (e.g. >1ha?
NO
Submit level 1 FRA report to LPA/Flood risk Consultees
YES
YES
YES
Can an alternative location for the proposed development be used? If Yes it it likely to be subject to flood hazard (s)
Level 1 FRA
NO
Will the development increase runoff? (e.g. >1ha)?
YES
NO
Level 2 FRA required to assess flood hazards
Level 2 FRA required to assess flood hazard and runoff management
Level 2 FRA required to address increased run-off
Develop an understanding of flooding mechanisms and site conditions
Level 2 FRA
Agree objectives of flood risk management with LPA/Flood Risk Consultees
Develop understanding of site and receiving watercourse/sewer
Submit report to LPA/ Flood Risk Consultees
YES
Is suitable information available that demonstrates that the development is not within a flood hazard zone?
Agree objectives of runoff management with LPA/ Flood Risk Consultees
NO
Submit report to LPA/ Flood Risk Consultees
YES
Can mitigation measures be designed to protect the development from flooding and to prevent an increase in flood risk elsewhere based on available information?
Can mitigation measures be designed to manage development runoff based on existing information?
YES
Submit FRA report to LPA/ Flood Risk Consultees
NO
Select alternative site/ development proposal
NO
NO
Does preliminary assessment suggest that the development may be feasible?
Does preliminary assessment suggest that the proposed development may be feasible?
NO
Select alternative site/development proposal
YES
YES
Consider scope and data available for Level 3 FRA
Consider scope and data available for Level 3 FRA
Level 3 FRA
Collect information for Level 3 FRAs
Undertake analysis to define existing situation
Select alternative site/ development proposal
NO
Can acceptable mitigation measures be designed?
YES
Undertake analysis to assess the impact of the proposed development
NO
Is the flood risk to, and change in flood risk due to the development, acceptable to the LPA/Flood Risk Consultees?
YES
Submit FRA report to LPA/ Flood Risk Consultees

Figure 3: *Flowchart to illustrate the overall process associated with each level of Flood Risk Assessment for development proposals. Source: AVDC and the Environment Agency, 2012*

Notes

1. *If existing information is inadequate the precautionary approach should be adopted and a "Yes" answer should be assumed.*
2. *If existing information is inadequate the precautionary approach should be adopted and a "No" answer should be assumed.*
3. *It is recommended that the findings of the FRA are discussed with the LPA/FRC prior to formal submission of the report.*
4. *Development proposals should only be progressed if the proposals are likely to be consistent with those of sustainable development, as defined in relevant planning policies.*
5. *If the site is a brownfield site, it is likely to be beneficial to demonstrate that the proposed development will reduce runoff rates and volumes compared to the existing situation and a Level 2 FRA of surface water management is therefore recommended.*
6. *LPA means Local Planning Authority (i.e Aylesbury Vale District Council's Planning Department); FRC means Flood Risk Consultees (i.e. EA, Bedford Group of IDB and Aylesbury Vale District Council's Engineering Services Department, Buckinghamshire County Council, Thames Water, Anglian Water and British Waterways)*

7.4 EA's standing advice to Local Authorities for consideration of flood risk issues within planning applications are given on http://www.environment-agency.gov.uk/research/planning/33098.aspx. The standing advice includes:

- Background information regarding the use of the advice and the user guidance note;
- Flood risk matrix;
- General advice on developments according to their classification within the matrix;
- Technical guidance notes for undertaking FRAs; and
- Requirements for the EA's land drainage consents for ordinary watercourses and their policy on culverting watercourses.

This website also contains a consultation matrix (see Figure 4 overleaf) which defines in which situations the Environment agency must be consulted. The EA is a statutory consultee for certain developments under the Town and Country Planning (Development Management (Procedure) (England) Order 2010 (DMPO) and in these cases it is not necessary to consult the EA separately.

PPS25 FRSA (national) version 3.0
Advice issued on 24th January 2011

Environment Agency

Route to this page | -->Matrix

Restart | Print Form | Cell Text | Development Vulnerability Classifications

	Consult Environment Agency with information as detailed. Note: Highly Vulnerable development (including basement dwellings) is NOT appropriate in Flood Zone 3 and only Water Compatible development is appropriate in functional floodplain (Flood Zone 3b)
	Do not consult the Environment Agency - no comment.
	Standing advice/standard comments.
*	EA has no comment to make regarding change of use applications not defined within the matrix, i.e. no change in vulnerability

A1 Development Category	B1 Development (including boundary walls etc.) within 20 metres of the top of a bank of a Main River	C1 Includes culverting or control of flow of any river or stream	D1 Within Flood Zone 3	E1 Within Flood Zone 2	F1 Within Flood Zone 1
A2 Non-residential extensions with a footprint of less than 250 sq. metres; and Householder development and alterations	B2 Consult EA on flood defence consent requirements	C2 Consult EA with FRA showing design details of any culvert or flow control structure proposed	D2 No Consultation - see standard comment	E2 No Consultation - see standard comment	F2 No EA consultation required
A3 Change of use FROM 'Water Compatible TO 'Less Vulnerable' development*	B3 Only consult EA if site also falls within Flood Zone 3. FRA Required	C3 No EA consultation required	D3 Consult EA with FRA	E3 No EA consultation required	F3 No EA consultation required
A4 Change of use RESULTING IN 'Highly Vulnerable' or 'More Vulnerable' development*	B4 Only consult EA if site also falls within Flood Zone 3 or 2. FRA Required	C4 No EA consultation required	D4 Consult EA with FRA	E4 Statutory standing advice MAY apply - choose from list	F4 No EA consultation required
A5 Operational Development less than 1 hectare	B5 Consult EA on flood defence consent requirements	C5 Consult EA with FRA showing design details of any culvert or flow control structure proposed	D5 Highly Vulnerable - EA likely to object but consult EA with FRA Other vulnerabilities- consult EA with FRA and Sequential Test evidence and where required confirm Exception Test has been applied	E5 Statutory standing advice MAY apply - choose from list	F5 No consultation required - see surface water management good practice advice - see
A6 Operational Development of 1 hectare or greater	B6 Consult EA on flood defence consent requirements	C6 Consult EA with FRA showing design details of any culvert or flow control structure proposed	D6 Highly Vulnerable - EA likely to object but consult EA with FRA Other vulnerabilities- consult EA with FRA and Sequential Test evidence and where required confirm Exception Test has been applied	E6 Highly vulnerable- consult EA with FRA and Sequential Test evidence and confirm Exception Test has been applied Other vulnerabilities- consult EA with FRA and Sequential Test evidence	F6 Consult EA with FRA

Figure 4 Consultation matrix (January 2011) – http://www.environment-agency.gov.uk/research/planning/82584.aspx

7 LEVEL 1 FLOOD RISK ASSESSMENT

7.1 A Level 1 FRA should be carried out for all development sites, considering all potential flooding hazards unless the initial review of key factors affecting sustainable development (see *Table 6 below*) clearly shows that the proposals are unsatisfactory.

Criterion	YES*1*	NO
Is the standard of protection of the proposed development in agreement with CIRIA C624 and/or the requirements of the LPA/FRC? Does the design of the proposed development take into account the potential impact of future climate change over its lifetime? Does the design of the proposed development take into account any likely future changes to the nature of the site that may occur over its lifetime? Is the residual flood risk to the proposed development from events that are more extreme than the design flood event acceptable? Will any anticipated disruption to the normal operation of the proposed development due to flooding be acceptable? Has the proposed development been designed so that any risks to health, safety and welfare are appropriately managed? Will adequate, safe, access to and from the proposed development be available during floods? Are the predicted impacts of the proposed development on upstream flood risk acceptable? Are the predicted impacts of the proposed development on downstream flood risk acceptable? Will runoff from the proposed development be managed in an appropriate manner? Are the potential environmental impacts of the proposed development acceptable? Are the operation and maintenance requirements associated with the proposed development acceptable, and is it clear who will be responsible for any required operation and maintenance over the lifetime of the proposed development? Has it been ensured that the proposed development will not obstruct any FRC maintenance access? Is the design of the proposed development such that it will not compromise any strategic flood risk management plans that the FRC		

may have for an area? Will arrangements be made to ensure that future owners/operators/occupiers of the site will be aware of any residual flood risks, mitigation measures, and operation and maintenance requirements? Is the design of the development such that future users will not have difficulty in obtaining insurance or mortgages, or in selling all or part of the development in the future, due to flood risk issues? Are any relevant consents or licences required from the FRC likely to be given?		

Table 3: *Key factors affecting sustainable development in relation to flood risk (Source: based on C624, CIRIA 2004)*

Notes

1. The questions above relate to issues that should be considered when determining whether or not a proposed development is likely to be sustainable in flood risk terms. In most cases, a proposed development is unlikely to be considered acceptable unless the answer to all of the questions is 'YES'.

7.2 The purpose of Level 1 FRA is to identify:

- The potential flooding hazards which may pose a risk to the development, or which the development may affect so as to increase flood risk elsewhere;
- Whether the proposed development may obstruct access to watercourses or flood defences or affect the integrity of a flood defence;
- Whether the development may lead to an increase in runoff; and
- Whether there are any flooding or surface water management issues related to the development that may warrant further investigation.

7.3 Within the context of this guidance note for Aylesbury Vale District, the LPA is the Council's planning department. Flood Risk Consultees (FRC) is a generic term used for the EA and the others who act as technical advisors to the LPA on flood risk issues.

7.4 *Figure 5* gives guidance on how to carry out a Level 1 FRA. The decision not to proceed with a Level 2 FRA should only be taken when a Level 1 FRA clearly demonstrates that a development is not at risk of flooding and will not result in an increase in flood risk elsewhere. *Table 7* includes a summary of the key factors that need to be considered within a Level 1 FRA. If this summary report concludes a very low risk of flooding, then it may be submitted to the LPA and FRC with the planning application as background information, otherwise undertake a Level 2 FRA or consider an alternative site/ development proposal.

7.5 The principal data sources within the Aylesbury Vale context are:

- EA's Flood Zone Map;
- Aylesbury Vale District Level 1 SFRA;
- Buckinghamshire County Council's PFRA
- Existing documentation relating to flooding problems and flood risk management such as site specific FRAs and historic flooding records;
- Flood alleviation scheme design reports/ project appraisal reports/ strategy studies that may be available from the EA and other Flood Risk Consultees;
- EA's flood defence asset survey information;
- EA's Catchment Flood Management Plans;
- Consultations with the EA and other Flood Risk Consultees;
- Walkover surveys and site surveys; and
- Interviews with local people

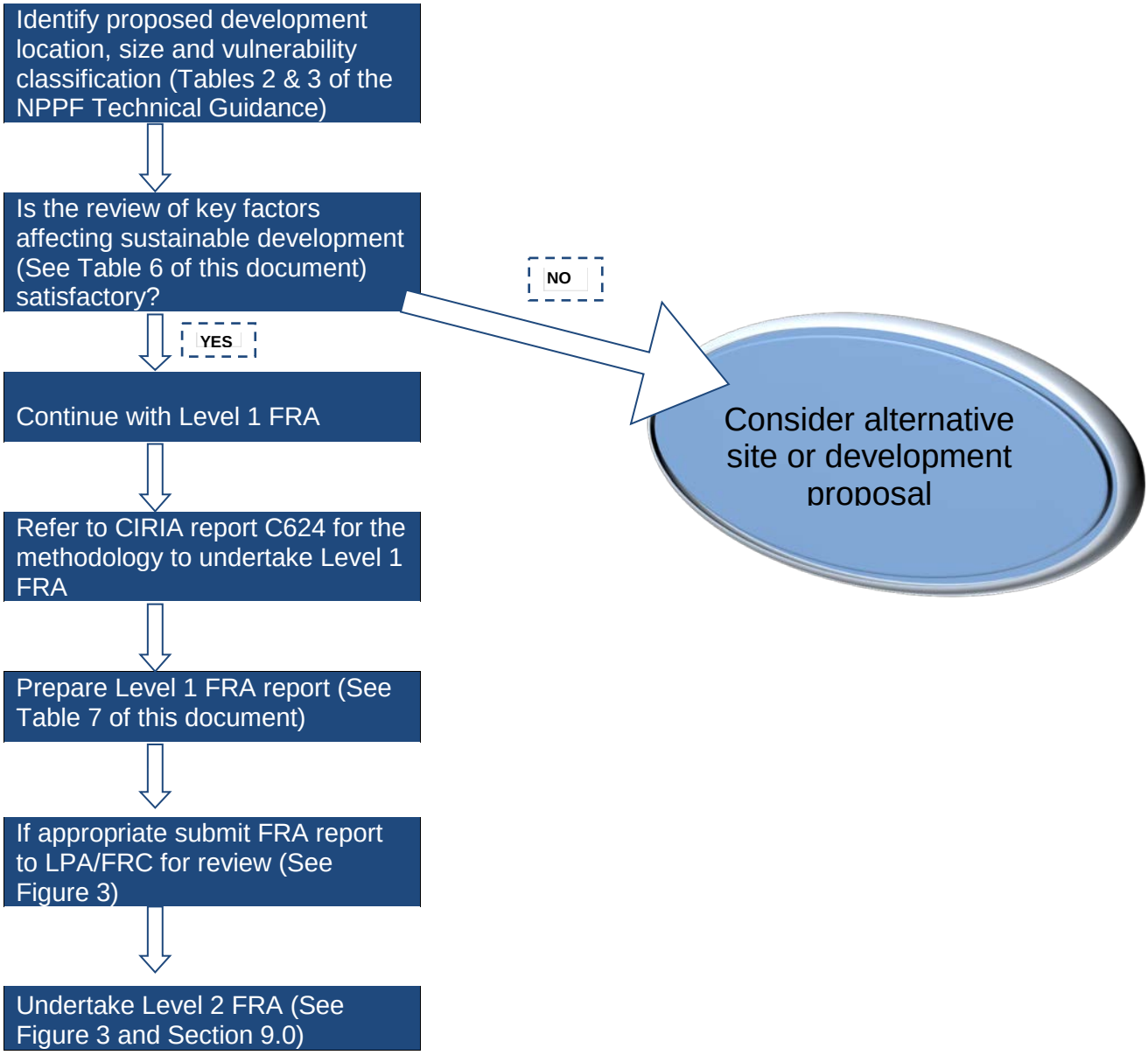

Figure 5: *Guidance for undertaking Level 1 FRA. Source: AVDC, 2012*

Question	Flood Hazard				
	River (Fluvial)	Ground water	Land – Overland Flow	Sewers	Reservoir, Canals and other artificial sources
Is the development site adjacent to the sea or any watercourse shown on Ordnance Survey maps?					
Is the development site, or part of the development site, identified as being at risk of flooding within available documentation?					
Is the development site, or part of the development site, identified as being at risk of flooding within Aylesbury Vale Level 1 or Level 2 SFRA?					
Is the development site, or part of the development site, within Flood Zones 3a or 3b? *1*					
Is the development site, or part of the development site, within Flood Zone 2? *1*					
Is the development site, or part of the development site, situated on alluvium based on consideration of geological maps of the area?					
If there is an existing property on, or adjacent to the site at the same level, is the property within a flood warning area?					
Is the LPA/FRC aware of any existing, historical or potential flooding problems that may affect the site?					
Do the physical characteristics of the					

site suggest that it may be prone to flooding?					
Is the development located within a natural or artificial hollow, or at the base of a valley or at the bottom of a hill slope?					
Does examination of historical maps indicate any likelihood of flood risk at the site?					
Do the names of surrounding roads, areas or houses suggest the possibility of seasonal or historical flooding?					
Is the site likely to involve excavation/construction below existing ground levels (excluding foundations)?					
Is the land use upslope of the site such that the generation of overland flow may be encouraged, and can water from this area flow onto the site?					
Are there any artificial drainage systems on or adjacent to the site, at the same level, or upslope of, the site?					
Is the development site protected by an existing flood defence?					
Is the development site protected by a flood control structure (e.g. flap valve, sluice gate, tidal barrier etc)					
Is the development site located upstream of a culvert which may be prone to blockage?					
Are water levels in a watercourse located in or adjacent to a development site controlled by a pumping station?					

Is the development site adjacent to or downstream/downslope of a canal? *2*					
Is the development site downstream/downslope of a reservoir or other significant water body? *2*					
Is the development site > 1ha?					

Table 4 Template for a Typical Level 1 FRA Summary Report for Aylesbury Vale District (Source: Based on C624, CIRIA 2004)

Notes
1) Refer to Table 1 of the NPPF Technical Guidance for the definition of Flood Zones.
2) If a development site is downslope of such features, flooding may occur in the event of failure of a water retaining structure. Those developments downstream of a reservoir, canal or other feature will only be at risk if they are sufficiently close to the source to be at risk of inundation following failure of the infrastructure in question.
3) If the answer to any of the questions is 'yes' then a Level 2 FRA will be required – Note that shaded cells mean that they are not directly relevant within the context of a particular question.

8.0 LEVEL 2 FLOOD RISK ASSESSMENT

8.1 The objectives of the Level 2 FRA are to:

- Develop an understanding of the mechanisms of flooding at the site;
- Develop an understanding of the proposed development site within the context of the wider catchment;
- Identify available data for the FRA and its suitability;
- Confirm the classification of the site is according to the NPPF Technical Guidance Flood Zones and Flood Risk Vulnerability depending on the proposed land use;
- Produce a preliminary qualitative assessment of the potential impact of, and constraints to, the proposed development (including consideration of flood risk impact elsewhere);
- Develop an understanding of the potential development design and flood risk mitigation that may be employed at the site; and
- Define additional work required to produce a Level 3 FRA and/or produce a level 2 FRA report if the scoping study identify that sufficient quantitative information is already available to complete a FRA appropriate to the scale and nature of the development.

8.2 In order to determine the suitability of the site, a Level 2 FRA should be undertaken to address each potential flood risk issue that is identified for further consideration during a Level 1 FRA. It must consider the potential interaction of different sources of flooding to assess the potential cumulative effects that the site may be subjected to in terms of flood risk related issues.

8.3 The process of undertaking Level 2 FRA is summarised within *Figure 3* and further detailed information is available from CIRIA report C624 in

Section 6. It contains a flowchart to provide guidance on the procedures to be followed when undertaking a Level 2 FRA. Depending on the conclusion of this assessment a Level 3 FRA may be undertaken or an alternative site/ development proposal considered.

8.4 As illustrated in *Figure 3*, if sufficient information has been obtained and reviewed to progress the outline design of the development in sufficient detail, it may be possible to submit a Level 2 FRA report in support of a planning application in consultation with the LPA/ Flood Risk Consultee (FRC). A Level 2 FRA Report will often provide an adequate level of detail for a development in Flood Zone 2, unless the development is of such a type that the NPPF recommends that it should be avoided (e.g. hospitals, fire stations, emergency depots etc.) or development site is > 1ha. If a Level 3 FRA is required then it may be advantageous to submit a Level 2 FRA to the LPA/ FRC to obtain agreement as to the potential viability both of the development and the proposed methodology for the Level 3 FRA.

8.5 If it is considered that sufficient information exists to fully assess flood risk issues relating to a proposed development, the Level 2 FRA Report should contain the same information as a Level 3 FRA (see *Section 10*).

9 LEVEL 3 FLOOD RISK ASSESSMENT

9.1 A Level 3 FRA should provide a quantitative assessment of the flood risk issues identified and scoped in FRA Level 2. Typically, the objectives of a Level 3 FRA include:

- Review of Level 1 and 2 FRAs;
- Modelling to define the existing flood hazard to the development, including assessment of conditions with projected climate change over the lifetime of the development;
- Modelling to assess the potential impact of the proposed development on flood risk elsewhere;
- Outline design of flood mitigation measures, and associated modelling to demonstrate that the development will be safe during its lifetime whilst not increasing flood risk elsewhere;
- Sensitivity testing to demonstrate that the estimates of flood risk to and arising from, the site are not overly dependent on the assumed model parameters;
- Demonstration of management of residual risk over the lifetime of the development involving appropriate developer contributions, flood resilience and resistance measures and flood warning and evacuation plans; and
- Preparation of report to satisfy the minimum requirements of Annex E of the NPPF and NPPF Technical Guidance on Flood Risk

9.2 The process of undertaking Level 3 FRA is summarised within *Figure 3* and further detailed information is available from CIRIA report C624 in Section 6.0. It contains a flowchart to provide guidance on the procedures to be followed when undertaking a Level 3 FRA. Depending on the conclusion of the assessment, the Level 3 report should be submitted as

a part of the planning application or consider an alternative site/ development proposal.

9.3 Careful assessment of the residual risk needs to be undertaken. The DEFRA/EA guidance 'Flood Risks to People' provides useful guidance on the assessment of flood risk to life and makes it possible to gain an understanding of the severity of hydraulic conditions. An advice note is available to view at http://evidence.environment-agency.gov.uk/FCERM/Libraries/FCERM_Project_Documents/FD2321_7400_PR_pdf.sflb.ashx. Outputs from hydraulic models could be readily used to ascertain the residual risk to people.

PART D TECHNICAL GUIDANCE ON SURFACE WATER MANAGEMENT

10 ASSESSMENT OF PRE-DEVELOPMENT RUNOFF RATES

10.1 To mitigate the additional flood risk elsewhere, post-development runoff from the development site should be limited to be pre-development run-off rates or less. It is also important that the runoff volumes are controlled from the developed site. This can be achieved by using a variety of SUDS techniques and strategic solutions as described in Section 12. It is also important that there would be no detrimental impacts to biodiversity and water quality from the post-development runoff.

10.2 Pre-development runoff rate is often termed as the greenfield runoff rate, which is the maximum rate of discharge before the site is developed.

10.3 The method of calculation of peak rates of runoff from greenfield sites is related to catchment size. The values derived should be regarded as indicative due to the limitations of the existing tools. Table 8 below summarises the techniques suggested by the 2007 CIRIA publication. This report is aimed at Regulators, Developers and Local Authorities to advise them on the management of stormwater drainage for developments and in particular to assist in sizing of storage elements for the control and treatment of stormwater runoff. The findings are generally supported by the Environment Agency.

Size of development	Method
0-50 ha	The Institute of Hydrology (IoH) Report 124 Flood Estimation for Small Catchments (1994). Where developments are smaller than 50ha, the analysis for determining the peak greenfield discharge rate should use 50 ha in the formula and linearly interpolate the flow rate value based on the ratio of the development to 50ha. Flood Studies Supplementary Reports (FSSR) 2 and 14 regional growth curve factors are to be used to calculate the Greenfield peak flow rates for 1 in 30 and 1 in 100 annual probability events.
50 ha – 200 ha	IoH Report 124 will be used to calculate greenfield peak flow rates. Regional growth factors to be applied.
Above 200 ha	IoH Report 124 can be used for catchments that are much larger than 200 ha. However, for schemes of this size it is recommended that the Flood Estimation Handbook (FEH) should be applied. Both the statistical approach and the unit hydrograph approach should be used to calculate peak flow rates. The unit hydrograph method will also provide the volume of greenfield runoff. However, where FEH is not considered appropriate for the calculation of greenfield runoff for the development site, for whatever reasons, IoH 124 should be used.

Table 5: *Tools recommended for calculation of greenfield runoff criteria (The SUDS Manual, CIRIA Document C697, 2007)*

10.4 Brownfield runoff rates and volumes can be determined using a variety of techniques. Chapter 3 of the SUDS Manual (CIRIA, 2007) provides comprehensive details on this. The calculations should take into account existing mechanisms that control flow from the site (e.g. reduced pipe sizes, hydrobrakes). The NPPF states that the Government's policy is to mitigate and to adapt to climate change. Therefore redevelopment of a brownfield site should be seen as providing an opportunity for environmental enhancement, as such; the development should aim to reduce runoff below existing condition. When developing on a brownfield site (in certain situations) it may be acceptable to ensure that the proposed development does not increase runoff rates and volumes above existing conditions but this has to be agreed with the LPA and where appropriate in consultation with Flood Risk Consultees including the Environment Agency.

11 USE OF SUSTAINABLE DRAINAGE SYSTEMS AND STRATEGIC SOLUTIONS

11.1 The SUDS approach to drainage involves controlling the runoff from development sites so that it mimics greenfield runoff and maintains the natural drainage patterns as far as possible. SUDS aim to control runoff at source and are increasingly being used to mitigate the flows and pollution from new developments. They can also provide other environmental benefits such as enhanced biodiversity and amenity value. The NPPF gives priority to SUDS for surface water management through the planning system. Under the provisions of the Flood and Water Management Act 2010 a SuDs approval body (SAB) is being brought under the auspices of the Lead Local Flood Authority: Buckinghamshire County Council. The SAB will receive relevant applications under new regulations and approved SuDs schemes associated with planning applications. At the time of writing this report the SAB is anticipated to come into effect in Mid 2013.

11.2 The growing interest in the use of SUDS has resulted in the publication of several guidance documents by CIRIA and other organisations (e.g. National SUDS Working Group and various Local Authorities). They are listed under the references section of this guidance document.

11.3 SUDS techniques must meet a number of criteria before being considered for general use:

prevention (use of good site design and housekeeping measures)

source control (control of runoff at or very near its source)

site control (management of water from several subcatchments)

regional control (management of runoff from several sites)

11.4 SUDS give more preference to “prevention” and “source control” than just “site control” and “regional control”. In certain situations strategic solutions to manage flood risk may be cost effective and easy to maintain, but such solutions should always be considered in accordance with the SUDS “management train” principle to maximise their environmental benefits. For example, strategic flow balancing methods alone have very little effect on controlling runoff volumes and water quality although they can attenuate runoff rates. Therefore, strategic solutions must be always considered and developed in conjunction with prevention, source control and site control. *Section 4* of the Level 1 SFRA report highlighted the need for SUDS within the entire Vale District and the opportunities that may be presented by any allocations of growth in a DPD . These opportunities in particular are to address some of the existing flood risk issues on the urban watercourses.

11.5 Developers should prepare a SUDS strategy incorporating suitable measures to demonstrate how these objectives and the management train principles are achieved.

Element	How achieved?
Quantity	• minimise impermeable surfaces by good planning of development layout; • control of runoff at source to reduce extra runoff; • limit peak discharge and volume (where feasible) to an agreed allowable runoff rate(s) and a magnitude of a storm event(s) -normally 1 in 100 annual probability with allowances for climate change; • low flow routes for frequent storms including treatment stages and also to hold first part of runoff volume of rare storms and route through treatment stage to address quality requirements; and • provide high flow routes for extreme events via overland flood paths/ roadways.
Quality	• prevent pollution by good planning of development layout and site management; • route “low flows” along the surface to maximise potential for water quality treatment through a combination of infiltration/filtration by plants/ bio-accumulation of nutrients in plant-life and breakdown of pollutants by sunlight; • maximise treatment stages within the “management train”; • use appropriate techniques in series to treat runoff from roads and hard pavements; • ‘source control’ preferred to control silt and pollution; and • provide ‘first flush’ treatment or “treatment volume” for all roads and hard pavements
Amenity	• techniques should maximise opportunities for improving amenity including social, environmental and biodiversity where possible; • techniques should protect existing amenity; and • surface water should be treated as a resource (e.g. reuse).

Table 6: *Achievement of SUDS objectives. Source: AVDC, 2012*

11.6 For cost-effective SUDS designs they must be designed at the feasibility stage of any development to ensure that they can be integrated into the overall site design. There are four generally established methods of control related to SUDS. Traditionally used on-line or offline storage within underground tanks or oversized pipes must be only considered as a last resort in conjunction with other SUDS measures. The main categories of SUDS may include:

- filter strips and swales;
- filter drains and permeable surfaces;
- infiltration devices; and
- basins, ponds and wetlands.

11.7 Figure 6 illustrates the common SUDS techniques and their function within the management chain.

11.8 The use of appropriate and easily understood and maintained control devices, especially inlets and outlets, is required in particular for housing where supervision during design life will be difficult and maintenance often can be neglected or limited.

11.9 Filter strips are gently sloping grassed areas or other vegetated surfaces that drain water evenly from impermeable surfaces. They are particularly useful for protecting infiltration devices, such as filter drains from silt.

11.10 Swales are shallow channels that are designed to convey, infiltrate, store and treat runoff. Although swales are typically broad and shallow they can be designed to be space efficient and are simple to construct and manage.

11.11 Filter drains are linear devices that drain water from impermeable surfaces in a diffuse manner. They are trenches filled with permeable material into which runoff is collected, stored and conveyed.

11.12 Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer. They have a volume of permeable material below ground to store and infiltrate surface water and include grass, reinforced grass, gravelled areas, permeable blocks and porous surfaces (e.g. porous concrete or porous asphalt).

11.13 Infiltration devices drain water directly into the ground. They include soakaways, infiltration trenches and infiltration basins as well as swales, filter drains and ponds. Infiltration devices work by enhancing the natural capacity of the ground to store and drain water.

11.14 Soakaways have been used traditionally in housing where ground conditions are suitable but are usually forgotten in a few years. Poor infiltration capacity of clay type soil may restrict the use of soakaways within the Aylesbury Vale District (please see the SuDs potential map developed by Halcrow for the Water Cycle Strategy, summer 2012). Neglected maintenance may cause problems due to deteriorated infiltration capacity of the devices and surrounding soil.

11.15 There are no distinct boundaries between the various types of basins, but they are characterised by the length of time water is held and whether some water is retained for amenity and treatment functions:

- Detention basins – temporarily store water until the flood has passed (normally dry);
- Extended detention basins – temporarily store water and allow settlement of solids (normally dry);
- Retention basins/ wet ponds – hold water back for treatment of pollution and are permanently wet ponds with rooted aquatic vegetation; and
- Wetlands – are shallow ponds and marshland areas which are covered almost entirely in aquatic vegetation.

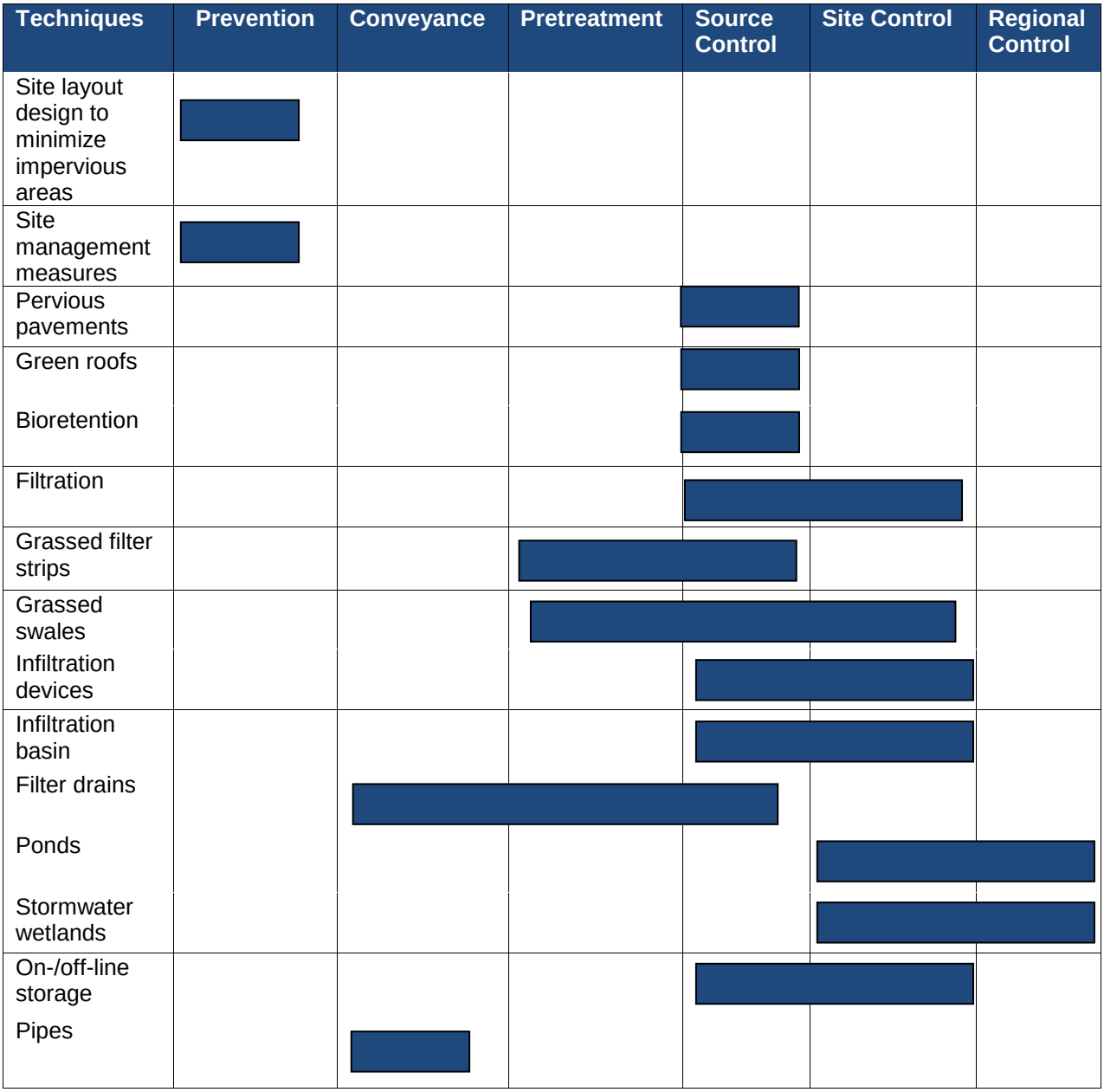

Figure 6: *Common SUDS techniques (Source : C609, CIRIA 2004)*

11.16 There are some techniques which are the result of technical innovation. Examples include:

- Green roofs;
- Proprietary box storage; and
- Rainwater harvesting.

11.17 'Green roof' technology offers a number of environmental benefits including attenuation of rainwater and flow control similar to a 'greenfield' situation. Green roof is a roof on whose surface plants can grow. The vegetated surface provides a degree of retention, attenuation and treatment of rainwater, and promotes evapotranspiration. Please see technical guidance on green roofs from the Green Roof Centre at http://www.greenroofguide.co.uk.

11.18 Another major SUDS innovation is the development of proprietary storage box systems (e.g. geocellular plastic structures). Although it is cheaper and environmentally better to manage attenuation in open landscape features, the underground storage of runoff is acceptable subject to suitable silt management and treatment of pollution. Deep box storage is difficult to manage because the boxes require substantial cover to prevent damage and therefore cause problems for discharge to natural drainage systems. Shallow box storage offers a better solution and can replace conventional sub-base construction.

11.19 The storage available in rainwater harvesting systems, such as water butts may not be fully considered as available attenuation storage, although they do help with controlling rapid surges of potentially polluted roofwater following dry periods and also provide some attenuation.

11.20 The C697 SUDS Manual (http://www.ciria.org/service/AM/ContentManagerNet/Default.aspx?Section=knowledgebase&Template=/TaggedPage/TaggedPageDisplay.cfm&TPLID=17&ContentID=6634) is a comprehensive publication on SUDS and provides up-to-date best-practice guidance on the planning, design and construction of Sustainable Drainage Systems (SUDS) to assist engineers, designers, planners, owners, developers and contractors with the incorporation of SUDS in developments. 'Climate Neutral Development Good Practice – SuDs' Best Practice Guidance produced by Wokingham Borough Council also provides a range of practical examples of using SUDS within residential developments http://www.woking.gov.uk/planning/service/publications/sustainabledrainage). Also useful is the Lambs Drove Monitoring Project (2008-11) undertaken by Cambridgeshire County Council and Royal Haskoning and funded by the European Regional Development Fund (http://www.cambridgeshire.gov.uk/environment/planning/drainagesystems/monitoring.htm). This information should be used to plan and design suitable techniques within the Aylesbury Vale District as the Level 1 SFRA highlighted the importance of using SUDS to address runoff issues within the District.

12 LONG-TERM MANAGEMENT OF SUSTAINABLE DRAINAGE SYSTEMS

12.1 A key factor for the successful implementation of SUDS is the ongoing operation and maintenance of the various system components. Effective maintenance helps ensure the hydraulic capacity and pollutant removal efficiency of SUDS as they were originally designed. Maintenance of SUDS is generally no more difficult than maintaining piped systems as they can easily be undertaken by a landscape contractor during general landscape maintenance visits. SUDS maintenance needs a minimum monthly site attendance for general site care by landscape contractors or site managers.

12.2 A handover inspection is needed to ensure that the client has a robust SUDS scheme which takes into account all potential defects attributed to design and/ or implementation.

12.3 Table 9 overleaf gives a brief summary of maintenance requirements for SUDS. CIRIA report C625 Model agreements for sustainable water management systems – Model agreements for SUDS (http://www.ciria.com/suds/model_agreements.htm) provides background and a long-term framework for operation and maintenance of SUDS containing model agreements for specific scenarios:

- implementation and maintenance of SUDS through the planning process, either as a planning obligation under Section 106 of the Town and Country Planning Act 1990 or as a condition attached to planning permission;
- implementation and maintenance of SUDS between two or more parties (outside of the requirements for planning permission), i.e. private SUDS model agreement.

From 2012 onwards new forms of implementation are likely to be:-

- Implementation of SuDs through approval by the SAB (Flood and Water Management Act provisions estimated to come into effect in October 2012)
- The Community Infrastructure Levy (estimated to come into effect in Spring 2014 and will then replace Section 106 under the Town and Country Planning Act)

12.4 Report C625 also discuss the adoption of SUDS and funding mechanisms that are available for local authorities, highway authorities, sewerage undertakers and private organisations for the operation and maintenance of these systems.

12.5 The Interim Code of Practice for Sustainable Drainage Systems (National SUDS Working Group 2004) provides a strategic approach to the allocation and maintenance of SUDS in England and Wales and also refers to the model agreements in CIRIA C625.

12.6 More detailed information on maintenance can be found on CIRIA publications C697 SUDS Manual, which also accounts for an “Owner’s Manual”.

12.7 The long-term management of waste from maintenance, which has the potential to include toxic pollutants, must be guided by the latest regulations and legislation. It is the responsibility of the SUDS scheme operator to keep abreast of the latest requirements and ensure compliance with them.

12.8 SUDS often form part of public open space and thereby have the potential to promote interaction between communities and their local environment, resulting in additional amenity benefits. Public engagement is a powerful tool that can bring about environmental and behavioural changes. Raising understanding of the function of SUDS and engaging the community in the decision-making processes regarding sustainability and environmental enhancement is likely to result in a sense of empowerment and a responsible approach to the components.

Process	SuDs	Frequency of Maintenance (see below key)
FILTER STRIPS AND SWALES		
Considerations	Filter strips and swales accumulate slit naturally due to their primary position in the SUDs management plan	-
Regular Maintenance	Grass Cutting	R/M
	Litter Removal	M
	Removal of Excess Silt	M
	Inlet and Outlet Cleaning (if necessary)	R/S
	Disposal and Management of Silt	R
Inspections. Regular inspections of the filter strip or swale should be undertaken. Inspections should:	Identify erosion and deposition deposition	R
	Identify Areas of Excess Waterlogging	R/M
Remedial/occasional maintenance. Remedial work may include:	Reinstatement to edgings	-
	Reinstatement of levels and turf due to erosions	-
	Realignment of erosion controls	-
Overhaul	-	-
PERMEABLE SURFACES		
Considerations	The use of grit and salt may adversely affect the treatment and drainage potential of pavement. Use of weedkillers may disrupt the biological breakdown of contaminants in the sub base.	
Regular Maintenance	Surface should be cleaned	B

	to keep voids clean using brush and vacuum (start of spring and winter)	
	Good housekeeping and litter removal	M/S
	Control of weeds and cut surrounding grass (35-50mm)	R
	Remove accumulated silt from site and dispose of appropriately	R
Remedial/occasional maintenance. If infiltration is found to be decreasing significantly, then:-	Remove permeable paving and clean	-
	Remove bedding grit and geotextile and dispose of safely	-
	Replace geotextile, replace grit bedding layer	-
Overhaul	Likely to be every 15-25 years (or greater)	
SuDs SUPPORT STRUCTURES		
Regular Maintenance	Litter Removal	M
	Trimming of the grass adjacent to the structure (1m radius)	M
	Removal of impending debris/silts	M
	Ensure free moving parts	M
Inspections	Inspections for evidence of erosion or blockage	M
Remedial/occasional maintenance.	Repair damage/erosion to structure of surrounding banks	-
INFLITRATION DEVICES		
Considerations	This includes filter drains, infiltration trenches and soakaways. Grounds around these devices should be kept clear of silt to prevent it getting washed into the device, which will eventually reduce the permeability of the soil.	-
Regular Maintenance	Litter Removal	M
	Surface Kept Clear of Silt and Voids Kept Clear	B
	Control of weeds and cutting of surrounding grass (35-75mm)	R
Inspections. Regular inspection should be undertaken, particularly	Areas that are not working properly, blockages	M/S
	Erosion around outfalls	M/S

after significant storm events. Inspections should identify:	Areas where damage is evident	M/S
	Silt/Vegetation Accumulation	M
Remedial/occasional maintenance. If the permeability of the system appears to be reducing with time, then Remedial action may have to be considered, including:	Removal of stone above geotextile in infiltration trenches	-
	Removal and safe disposal of geotextile	
	Replacement of clean stone top layer	
Overhaul		
BASINS AND PONDS		
Considerations.	The maintenance of ponds and wetlands depends on the type of effect desired. Wetland management is based on a 'little and often' approach.	-
Regular Maintenance	Litter Removal	M/S
	Regular grass cutting (basins 35-75mm)	R
	Management of meadows for wildlife	A/B
	Inlet and outlet cleaning	M/S
	Clearance of bankside vegetation	R
	Control and removal of aquatic plants (if required)	R
Inspections. Maintenance depends on the nature of the landscaping employed. If planted with low ground cover and shrubs, twice-yearly inspection and repair should be sufficient.	Inlet and outlet structures should be inspected twice a year and after large storms	B/R/S
	Silt accumulation should be monitored	M
Remedial/occasional maintenance.	Silt accumulation should be removed when required	-
	Damage or erosion should be repaired	-
	Care should be taken to avoid damaging any liner	-
	Repair or rehabilitation of inlets, outlets and overflows	-
Overhaul		The frequency to overhaul or even undertake the remedial activities is difficult to determine. This may be a regular activity or undertaken every three years.

KEY TO TABLE:

Frequency Abbreviation	Meaning
A	Annually
B	Biannually
M	Monthly
R	As Required
S	Following a Significant Storm Event

Table 7: *Maintenance requirements for SUDS components (source: C625, CIRIA 2004)*

13 MONITORING OF POST DEVELOPMENT RUNOFF

13.1 For large development sites (such as proposed growth areas in Aylesbury) it may be required to monitor post development runoff (e.g. flow rates and water quality) as directed by the LPA or Flood Risk Consultees (FRC). If this is the case, then monitoring should commence well before the construction stage i.e. during the initial planning stages so that a sufficiently long record of monitoring data can be obtained to represent the existing conditions. For any strategic sites that may be considered for allocation in the Vale of Aylesbury Plan, monitoring will be a key requirement to ensure that the existing flooding problems on the urban receiving watercourses are not further increased due to the proposed large scale developments.

13.2 The frequency type and length of monitoring will largely depend on the scale and nature of the development and the type of the issues associated with the receiving watercourse. The actual requirements for monitoring should be established in consultation with the LPA/FRC and other relevant parties.

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