Darlington Borough Council

Strategic Flood Risk Assessment Level 1

Volume III- SFRA guidance for Spatial & Development Management

December 2009

Karen Johnson
Spatial Planning
Town Hall
Feethams
Darlington
DL1 5QT

JBA Office

JBA Consulting
The Brew House
Wilderspool Park
Greenhall's Avenue
Warrington
WA4 6HL

JBA Project Manager

Sam Wingfield

Revision History

Revision Ref / Date Issued	Amendments	Issued to
Draft Report (v.1.0) 28.08.09		1 Digital Copy (as a pdf) to Cameron Sked (EA) and Karen Johnson (SBC)
Final Report (v.2.0) 18.12.09	Updated after comments from DBC and the EA.	

Contract

This report describes work commissioned by Karen Johnson, on behalf of Darlington Borough Council. Darlington Borough Council's representative for the contract was Karen Johnson. Sam Wingfield and Joanne Harvatt of JBA Consulting carried out this work.

Prepared by Joanne Harvatt BA MSc PhD

Reviewed by Sam Wingfield BSc MRes

Purpose

This document has been prepared as a Draft Report for Darlington Borough Council. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to Darlington Borough Council. If the scope of the development changed or this report is provided to third parties then any liability or explicit or implied warranty is voided unless the consent of JBA Consulting is obtained.

This report may be assigned by the Client by way of absolute legal assignment once only to another company taking over the whole of their interest in connection with the carrying

out of the Development without the consent of JBA Consulting being required and such assignment shall be effective upon written notice thereof being given to JBA. If further assignment is required please contact JBA Consulting.

Acknowledgments

JBA would like to thank all those who provided information and data for this report. From Darlington Borough Council: Karen Johnson. From the Environment Agency: Gemma Alecks.

Copyright

Carbon Footprint

A printed copy of this document will result in a carbon footprint of 273 if 100% post-consumer recycled paper is used and if primary-source paper is used. These figures assume the report is printed in black and white on A4 paper and in duplex.

JBA is a carbon neutral company and the carbon emissions from our activities are offset.

Executive Summary

Darlington Level 1 SFRA

This report has been produced as a Level 1 Strategic Flood Risk Assessment (SFRA) for Darlington Borough Council, in accordance with PPS25 and its Practice Guide.

Development & Flood Risk

Local Planning Authorities (LPAs) have a raft of issues to consider when planning future development. These are dictated by Government Planning Policy Statements.

Planning Policy Statement 25 (PPS25) relates to development and the constraint of flood risk, with its overarching aim of avoiding development in flood risk areas. This is achieved through PPS25 by the sequential approach to land allocation, meaning that development should be firstly avoided in flood risk areas wherever possible before considering the vulnerability of development planned or possible mitigation measures. The sequential approach is governed by two tests; the Sequential and Exceptions Test. The consideration of flood risk to people and development must be considered by the LPA at the earliest stage of spatial planning decisions and these tests allows this process to be transparent and affective.

In order to carry out these tests a coherent understanding of flood risk is needed at a local level. High level policy and guidance documents such as Catchment Flood Management Plans (CFMPs), Shoreline Management Plans (SMPs) and Regional Flood Risk Appraisals (RFRA) have provided a good introduction in to flood risk; however they do not provide the level of detail required for the LPA to make the right spatial planning decisions.

Strategic Flood Risk Assessments (SFRAs) offer this local level of understanding. SFRAs provide the LPA with a central source of all relevant flood risk information and the evidence base to make tough planning decisions and develop focused local policies required to inform the Local Development Framework (LDF). The SFRA therefore becomes a key planning tool that enables the LPA to select and develop sustainable site allocations.

A **Level 1 SFRA** offers the foundation of this evidence base. It is based purely on the collation of existing flood risk information. The Environment Agency Flood Map is the main source of fluvial and tidal flood information across England and Wales and is the basis of PPS25 Flood Zones used in the Sequential and Exception Tests. The Level 1 SFRA must also consider flooding from all other sources (surface water, sewers, groundwater and artificial sources). This is only achievable through consulting with those stakeholders with specific interest or knowledge in other sources of flooding.

The Level 1 SFRA is assisted greatly by the use of Strategic Flood Risk Maps providing information on flood risk factors needed to be taken into account. The PPS25 Flood Zone Map enables the LPA to carry out the first sweep of Sequential Testing. The additional maps produced as part of the Level 1 SFRA should be used during the Sequential Test 'sieving' process further identify inappropriate development.

Once the LPA has carried out the Sequential Test sieving process, they still may wish to allocate vulnerable development in high risk areas due to the wider need for economic growth and regeneration. In this case the allocations must pass the Exception Test. The evidence provided in the Level 1 SFRA is not detailed enough to justify development through the Exception Test. In order to achieve this Level 2 SFRA must be carried out.

A Level 2 SFRA provides the LPA with a detailed understanding of flood hazard, assessing flood depth, velocity and residual risks such as flood defence breaching or overtopping. This information provided in the Level 2 SFRA will give the LPA a much more detailed understanding of flood risk at potential development sites. Although it will not provide all the information needed to apply the Exception Test, it will include the appropriateness of the development and the likelihood of it remaining safe if flooded. If

the LPA has justified the development by passing parts a) and b) of the Exception Test, it must be supported by a site specific Flood Risk Assessment (FRA) in order to pass part c).

The Three Level 1 SFRA Volumes

The Level 1 SFRA is presented in three volumes, each with their own purpose and intended audience.

VOLUME I: Understanding the SFRA Process

Volume I of the Darlington SFRA introduces the SFRA process. It is an excellent reference document for current flood risk management drivers, national regional and local planning policy and introduced Environment Agency policy such as the Tees CFMPs and SMPs. The report also provides a brief understanding of the mechanisms of flooding and flood risk for those new to the subject. More importantly, it provides a comprehensive discussion on PPS25, the Sequential, Exception Test and links regional and local flood risk assessments.

Volume I holds the main 'Consultation & Data Management' section, identifying key stakeholders and their involvement in the SFRA process.

This Volume should be read by:

- The general public or those new to flood risk
- Those wanting to understanding current flood risk management drivers
- Those wanting to understand the sequential approach to flood risk management
- And generally by those involved in Development Control, Planners and Developers wanting to understand the wider constraints of developing in flood risk areas.

VOLUME II: SFRA Technical Report

Following on from the 'Consultation & Data Management' section in Volume I, Volume II provides the technical information and methods used in the assessment of flood risk across Darlington . It assesses six sources of flooding including; fluvial, tidal, surface water, sewers, groundwater and reservoirs and other artificial sources. The Volume also introduces the Environment Agency Flood Warning System and residual risks associated with flood defences.

As discussed, flood risk has many dimensions and as a result has been presented through a suite of maps. These extend the level of detail in the Environment Agency Flood Zone maps.

The SFRA maps include:

SET A: PPS25 Flood Zones

SET B: Flood Zone 3 Depths

SET C: Tidal Climate Change Sensitivity

SET D: Flood Risk Management Measures

SET E: Areas Naturally Vulnerable to Surface Water Flooding

Volume II along with the suite of SFRA maps, should provide the evidence base of the Darlington Level 1 SFRA. It has been arranged in one volume to allow technical information to be easily updated when reviewed. It is only this Volume that can be updated with new flood risk information when available. Volume I and III would be difficult to update without completely revisiting the SFRA process.

Section 4 provides the results of the first pass of the Sequential Test against Darlington Council's proposed development allocations.

This Volume should be read by:

- Spatial Planners
- Development Control
- Planners
- Developers
- Emergency Planners
- Key Stakeholders including the Environment Agency and Northumbrian Water

VOLUME III: SFRA Guidance for Spatial & Development Management

Volume III of the Darlington SFRA provides guidance and recommendations to spatial planners, planners, developers and emergency planners, how to use the flood risk information provided in Volume II and further plans which are required to improve the understanding of flood risk in Darlington .

Initially the Volume discusses further work required such as Level 2 SFRAs and SWMPs which has been informed by the findings of Volume II. This extra work will provide Darlington Council with a strategic and coherent framework for managing flood risk in their area.

This Volume should be read by:

- Spatial Planners
- Development Control
- Planners
- Developers
- Emergency Planners
- Key Stakeholders including the Environment Agency and Northumbrian Water

Contents

List of Figures

List of Tables

Abbreviations

ABD	Areas Benefiting from Defences
A.P.	Annual Probability
CFMP	Catchment Flood Management Plans
CLG	Communities and Local Government
COW	Critical Ordinary Watercourse
CS	Core Strategy
DPDs	Development Plan Documents
EA	Environment Agency
EU	European Union
FAS	Flood Alleviation Schemes
FEH	Flood Estimation Handbook
FCERM	Flood and Coastal Erosion Risk Management
FRA	Flood Risk Assessment
FRM	Flood Risk Management
IDB	Internal Drainage Board
IDD	Internal Drainage District
IFM	Indicative Floodplain Map
LDDs	Local Development Documents
LDF	Local Development Framework

LPAs	Local Planning Authorities
NEA	North East Assemble
NFCDD	National Fluvial and Coastal Defence Database
NPD	National Property Dataset
NWL	Northumbrian Water Ltd
PPG	Planning Policy Guidance
PPS	Planning Policy Statement
RBD	River Basin District
RBMP	River Basin Management Plan
RFRA	Regional Flood Risk Assessment
RPB	Regional Planning Bodies
RPG	Regional Planning Guidance
RSS	Regional Spatial Strategy
RVFD	Receptors Vulnerable to Flooding Database
SA	Sustainability Appraisal
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SFVI	Social Flood Vulnerability Index
SMP	Shoreline Management Plans
SoP	Standard of Protection
SPD	Supplementary Planning Document
SUDS	Sustainable (Urban) Drainage Systems
SWMP	Surface Water Management Plan
UDP	Unitary Development Plan
WCS	Water Cycle Study
WFD	Water Framework Directive

1 Influencing Land Use Planning

1.1 Management Decisions & Actions

Throughout the risk based sequential approach, management actions to avoid, substitute and mitigate flood risk should always be kept in mind and opportunities taken to minimise flood risk at every stage of the planning process. The principle aim of these actions is to ensure that risks to receptors are reduced to acceptable levels and the risks of flooding to people, their property and the environment.

As previously discussed the hierarchy of management decisions and actions include:

- **Avoidance** by locating new development outside areas at risk of flooding;
- **Substitution** by changing from a more to a less vulnerable land use; and
- **Mitigation** by instituting measures such as flood-protection schemes to protect property against flooding.

Whilst avoidance is clearly the preferred solution for new development, there are already substantial areas of development within flood-risk areas and some new development will have to take place there. For these situations, mitigation is needed to reduce flood risks to an acceptable level. This can comprise community protection through the use of flood protection barriers (flood walls or embankments), flood-detention reservoirs to attenuate flow upstream from the receptors at risk, increasing the flow capacity of rivers through dredging and construction of diversion channels. It can also include protection to individual properties using flood-resistance measures, such as temporary flood barriers to be installed on receipt of flood warning, and flood-resilience measures to make properties more easily repairable after a flood.

The fact that mitigation measures are discussed in this SFRA should not be taken as a presumption that the Sequential Test has been short circuited. It is included to give improved understanding of the consequences associated with allocation of a site for development, or assessing development proposals on a site in high risk areas. It is also used to provide additional indicative evidence for assessment of the Exception Test. Mitigation measures must be designed to provide an appropriate level of flood mitigation to a site for the lifetime of the development. At most sites it is technically feasible to mitigate or manage flood risk (if potential off-site impacts are ignored). However, where the depth of flooding is substantial, these mitigation measures may result in practical constraints to development with significant financial implications. The Exception Test needs to explicitly understand offsite impacts of development as well as the limiting factors that influence flood risk.

Often the determining factor in deciding whether a particular development can proceed is the financial feasibility of flood risk mitigation rather than technical limitations. It is important that recommendations for allocation should not be made when there is little or no chance of feasible and cost effective mitigation measures being realised. Demonstrating that a site can be developed is, however, difficult without a detailed Flood Risk Assessment.

At the SFRA stage broad assumptions need to be made about the feasibility of flood risk mitigation so that sites with realistic development potential are put forward. In this context the assumptions shown in the following table have been made. It is assumed that floor level raising will continue to be the traditional mitigation measure, however, it should be noted that the Environment Agency consider land raising to be a final option rather than a desired approach to flood risk management.

Suggested screening criteria for mitigation measures are shown in Table 1.1 below. This table refers to indicative depths of flooding before mitigation measures are put in place and should not be mistaken for acceptable levels of flooding after mitigation. These depths do NOT represent acceptable flooding.

Table 1.1 Suggested Screening Criteria for Mitigation Measures	
Depth of Inundation*	**Comments**
0 to 1.0 m	Sustainable mitigation and flood risk management may be feasible for both housing and employment purposes. There is a greater likelihood that the Exception Test can be passed.
1.0 to 1.5 m	Mitigation is likely to be costly and may not be economically justifiable for low value land uses. Housing allocations are considered appropriate, provided flood risk can be managed or mitigated (e.g. by using lower levels for car parks or public areas). Floor level raising for employment purposes is unlikely to be economically viable and employment allocations should be reconsidered in favour of alternative lower risk sites. The likelihood of passing the Exception Test is lower.
Above 1.5 m	Flood risk mitigation measures are unlikely to be economically justifiable and both housing and employment allocations should be reconsidered in favour of alternative lower risk sites. Development is unlikely to be sustainable and the likelihood of passing the Exception Test is low.
Notes: * Based on predicted depth of inundation for the 1% (Fluvial) event + 20% additional flow for Climate Change as per PPS25. Environment Agency flood zone data.	

In addition other screening factors may be used including:

- Speed and direction of flooding;
- Ability to achieve safe access and egress;
- Emergency Services ability to undertake safe and effective evacuation;
- Risk from multiple and combined flooding sources;
- Existing flood warning arrangements in place and/or potential for further application;
- Level of community awareness; and
- Impacts on local essential services infrastructure etc.

It is recognised that in some locations urban re-generation and redevelopment will be essential to maintain the long term viability and vitality of communities and the balance of planning considerations may support redevelopment. These social and economic considerations may justify some flexibility of the screening criteria set out above and the retention of housing and employment sites in certain areas. In these instances the commercial viability of the development and risks to public safety will need to be given careful considerations during the planning of the development. A range of flood management and flood proofing measures are available that can reduce the financial impacts of flooding.

Whilst flooding mitigation measures can be implemented in most sites, it is worth noting that in some instances the findings of individual Flood Risk Assessments may determine that the risk of flooding to a proposed development is too great and mitigation measures are not feasible. In these instances, the development will be subject to an objection by the Environment Agency. Further details on avoidance, substitution and mitigation are contained in the recent Department for Communities and Local Government publication

"Improving the flood performance of new buildings - Flood resilient construction - May 2007.

As part of the hierarchy of management decisions and actions to help provide a degree of confidence that individual development allocations may or may not pass the Exception Test, a small suite of flood risk indicators can be used to balance and weigh various sites and uses. This process is described below.

1.2 Flood Risk Indicators & Balance Sheets

The Strategic Assessment is precautionary, applying a longer term holistic approach to ensuring development does not compromise future flood management measures and vice versa. The Exception Test is not black and white, and needs to assess the acceptability of the residual risks. Where the residual risks are significant it is unlikely that further investment would exceptionally be justified, particularly if it introduces significantly more people into the flood risk area.

To provide this longer term view to spatial planning in flood risk areas, a number of indicators have been developed to allow a comparison of the appropriate land uses in each policy area and how they would fare within the PPS25 Exception Test. Whilst these indicators focus on flood risk issues, alternative sustainability measures could be added to the list to encapsulate all relevant issues into the assessment and help LPA assess whether developments have passed Part 'a' of the Exceptions Test. Further indicators could be found in the relevant LPA Sustainability Appraisal. The main flood risk indicators suggested within this SFRA are as follows:

- **Development is within existing flood risk area** – existing flood warning and evacuation in place. Importantly how easily will the area recover following a flood event? New development may lose local services for 12months if an event occurs.
- **Residual risk measures are easily applied and within a norm** – Low depths of flooding can be easily designed out by modest alteration of ground or floor levels. 1st floor accommodation has implications for the urban design and place setting of the development.
- **Egress and access. Impact on emergency planning provision and whether development would be safe** – This is a key issue and prime test in the PPS25 Exception Test. Access routes need to be natural and accessible in a flood to the emergency services
- **Change in the number of people at risk as result of development** – Introduction of more people will put a greater strain on the emergency services in an event. Whilst they may be accommodated at high elevation they will require support very quickly even after the inundation has stopped.
- **Change in number of properties at risk in 1% and 0.1% event before and after. Assumes mitigation measures put in place** – From an economic viewpoint development can replace existing property with lower vulnerability land uses and also development that is designed to be flood resistant or resilient. A reduction in economic risk can be achieved.
- **Scale and nature of flood risks** – The residual risk maps indicate likely depths and flow routes. From running the surface water screening assessment the scale and extent of the surface water flood risks can be considered.
- **Impact of mitigation measure on other areas downstream and adjacent** – How wide ranging does the impact assessment need to be to take account of the effects of significant land raising or alteration or blockage of flow routes.

LPAs should use these indicators to qualitatively assess each key type of vulnerable land use proposed in each of the policy areas being considered by the SFRA. Each of the indicators should be scored according to the system outlined in Table 1.2 below to produce a flood-risk balance sheet. The results should be assessed to produce one of

five possible outcomes on the acceptability of a particular type of development within a policy area. The five potential outcomes are:

1. Counter to strategic approach, flood risk unacceptable. It would be difficult to meet the criteria of the Exception Test. Development not recommended;
2. Sequentially not preferred but a limited range of land uses might be possible;
3. Sequentially not preferred but a wider range of land uses could be brought forward after careful consideration and subject to an appropriate site-specific FRA;
4. Acceptable with some detailed consideration of flood-risk issues to be resolved by an appropriate site-specific FRA; and
5. Acceptable subject to a satisfactory appropriate site-specific FRA.

This simple assessment through the flood-risk balance sheet allows an initial sequential approach to be adopted against flood-risk criteria to deliver a hierarchy of recommended land uses and development allocations that meet the criteria of the Exception Test, where appropriate. This will help support appropriate policies within LDFs & LDDs and provide the evidence for the LPA in reviewing any subsequent planning applications that attempt to use the Exception Test to support alternative land uses in these areas. An example of a completed flood risk balance sheet is contained in Appendix B of this report.

It should be noted that a detailed flood risk assessment will always be required.

1.3 Conclusion

Flood risk is a material consideration in land use planning decision making and can greatly impact on the sustainability of various land uses in all locations. Having completed a flood risk assessment for a development proposal under consideration, and applied the Sequential Test and Exception Test where necessary, the resultant assessment of associated flood risk information will then influence the land use planning decision at whatever level it is being considered. Land use policies and wider strategic decisions involving social and economic development in RSS, LDFs and LDDs will be influenced and shaped by the sequential approach informed by the RFRA and Local Authority SFRAs. In turn, individual planning applications will be influenced by the site-specific FRA having regard to the LDF and LDD, and either granted with flood risk conditions or rejected by the LPA. Planners and developers should take full account of the sequential approach, including the results of the sequential and exception tests to assist their decision making.

Table 1.2 Scoring of Indicators in Reviewing Indicative Acceptability of Proposed Development					
Flood-risk indicator	**Ultra-positive ++**	**Positive +**	**Neutral =**	**Negative -**	**Ultra-negative --**
Development is within existing flood-risk area		No risk		Risk area within resilient communities	Vulnerable community, which would struggle to recover
Residual risk measures	None required	Measures could reduce risk to existing development		Standard, no major alteration to layout and form	Flood resistance is dominant in design
Egress and access/emergency planning impact		No special provisions, risks acceptable		Needs to be managed, should be acceptable subject to FRA	Special provision, natural response will not be obvious. Risks may not be acceptable
Change in number of people at risk	Significant reduction	Reduction	No change	Increase	Significant increase
Change in number of properties at risk	Significant reduction	Reduction	No change	Increase	Significant increase
Scale and nature of flood risks	Benign and understood				Difficult to warn, unpredictable, may result in operational failure of defences, from multiple sources
Impact of mitigation elsewhere	Significant reduction in overall flood risk	Reduction	Neutral impact	Increase in flood risk elsewhere	Significant increase in flood risk elsewhere

2 Guidance for Planners & Developers

2.1 Specific Guidance

The guidance detailed below has been developed to provide a clear, concise and consistent means of assessing the feasibility and sustainability of potential development locations and to determine appropriate flood risk mitigation measures where required. The framework will aid Darlington BC and others in assessing flood risk associated with potential development locations within the Council. It will also allow policies on flood risk to be included in the LDDs, which draw upon national guidance for consistency, but provide the local detail and interpretation of these national policies.

PPS25 aims to direct development to lower flood risk sites wherever possible. ***"The aims of planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at higher risk"*** (paragraph 5). Only when the Sequential Test has been employed and new development is, **exceptionally**, necessary and no other lower risk sites have been shown to be available should the Exception Test be applied.

The guidance focuses on the technicalities of flood risk management rather than the other planning issues a LPA must consider in selecting allocations. It should therefore be assumed that:

- These other planning issues have been considered separately, and
- For land to be allocated within the high risk zone, the full range of planning issues has been evaluated and be evaluated in order of the flood risk management level.

It should also have been determined through a SEA (Strategic Environmental Assessment) and SA (Sustainability Appraisal) that the land is the most suitable for development.

It must be made clear that this SFRA does not preclude the need for site-specific Flood Risk Assessments. This chapter will present the guidance for Flood Zone 3, Flood Zone 2 and Flood Zone 1. It will then discuss issues relating to other known flood risk areas.

2.2 Planning Issues for Flood Zone 3a - High Probability

PPS25 states that water-compatible and less vulnerable developments are permitted in this Flood Zone, following testing within the sequential process. According to PPS25, highly vulnerable development is not permitted. Essential infrastructure and more vulnerable development need to pass the Exception Test, while essential infrastructure should be designed and constructed to remain operational and safe for users in times of flood.

According to PPS25, developers and local authorities should address the following policy aims:

- Reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of SUDS.
- Relocate existing development to land in zones with a lower probability of flooding.
- Create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Therefore a presumption for further development in existing floodplains is not supported by PPS25, and any future SFRA should review existing areas to see if relocation is a spatially sustainable strategy. The delineation of the subset zones of high risk Flood Zone 3 may be sufficient to allow the spatial planning process to continue, with development steered away from these high risk zones.

Regeneration of land or change in land use behind existing defended areas in the high risk Zone will continue to require a more detailed assessment of the flood risk (i.e. whether the scale of flood risk is worth taking, and how sustainable and effective the mitigation measures would be [i.e. whether the risk could be managed]). Where, due to wider sustainable development reasons there are no other suitable sites available in lower risk zones, an assessment of the actual risk within Flood Zone 3 is required. Annex G in PPS25 deals with managing residual flood risk.

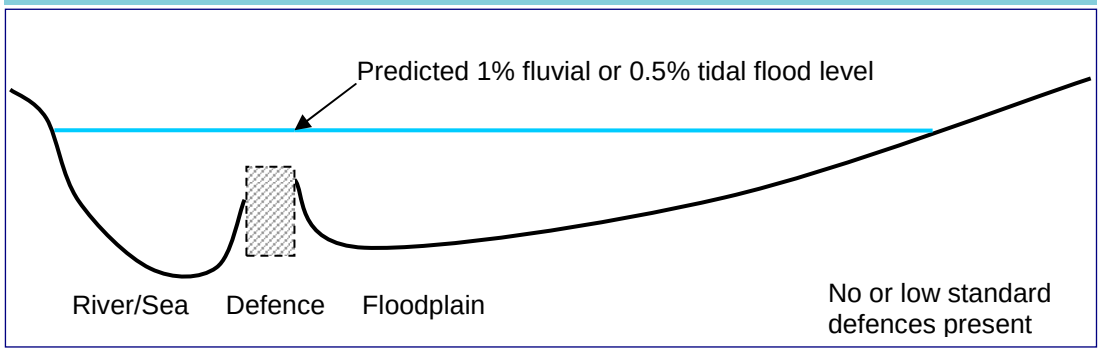
Flood Zone 3a should not be used for development where suitable alternative sites exist in Flood Zones 1 or 2. Paragraph G2 of PPS25 states that following application of the Sequential Test and Exception Test for development in Flood Zone 3a, a clear examination of the residual flood risks should be made and development:

"Should not normally be permitted where flood defences, properly maintained and in combination with agreed warning and evacuation arrangements, would not provide an acceptable standard of safety taking into account climate change.[1]"

It would be the responsibility of the developer to demonstrate how, in planning terms, this safety can be achieved and how the residual risks will be managed. A clear distinction between commercial flood standards of protection and management of loss of life should be explored in the FRA. A greater reliance on flood warning may be required, which is not always a tangible alternative to accepting a lower standard of protection.

In the context of this discussion, an undefended area (Figure 2-1) of floodplain under fluvial and/or tidal flood risk is considered to be an area where the water level for the 1% fluvial/0.5% tidal flood event will be similar to that of the river/sea. These areas may be entirely undefended, or if defences are present, they are discontinuous or constructed to a low standard. In these areas guidance provided in Section 2.2.1 (undefended areas) will be most relevant in assessing sustainability and determining mitigation requirements.

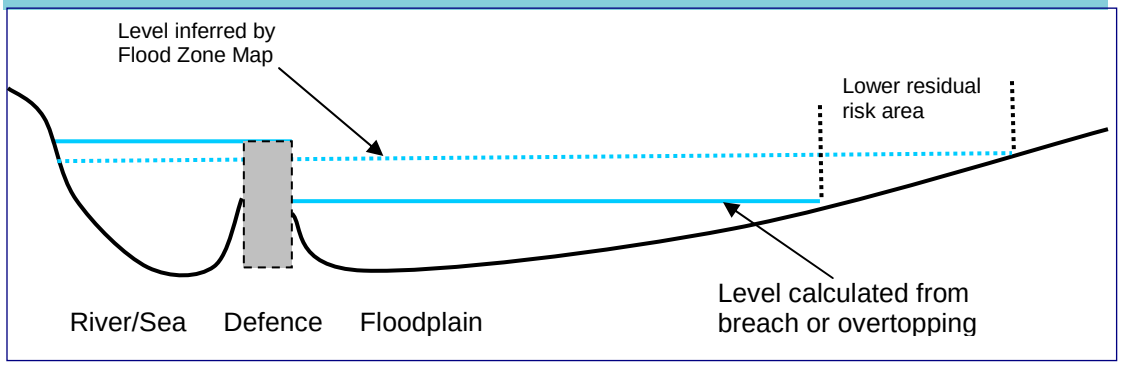
Figure 2 1: Illustration of the undefended scenario under fluvial and/or tidal flood risk



A defended area (Figure 2.2) is considered to be an area of floodplain where the defences will result in a water level for the 1% fluvial / 0.5% tidal flood event that is considerably lower than the source (river or sea). This means the defences substantially (but not necessarily completely) mitigate the flood risk associated with the 1% fluvial/0.5% tidal flood event. These areas will be defended to a minimum standard promoted by DEFRA, but not always necessarily to the 1% fluvial/0.5% tidal standards. In these areas guidance provided in Section 2.2.2 (defended areas) will be most relevant in assessing sustainability and determining mitigation requirements. Areas which are defended are highlighted in this report.

[1] Communities and Local Government (2006) Planning Policy Statement 25: Development and Flood Risk

Figure 2 2: Illustration of the defended scenario and residual flood risk behind fluvial/tidal defences



2.2.1 Undefended Areas – Flood Risk Mitigation

Within undefended or poorly defended Flood Zone 3a areas, floor levels for housing developments should, as a minimum, be situated above the acceptable standard of safety with sufficient freeboard to allow for uncertainties in flood level prediction and climate change. The following paragraphs define an appropriate standard of flood risk mitigation in undefended areas in the context of the Darlington BC SFRA.

The Sequential Test should be applied within the development location area, and it is considered appropriate to direct more vulnerable land uses to parts of the location at a lesser probability and lower residual risk of flooding. The lower floors of buildings in areas at both medium and high probability of flooding should seek to develop water-compatible and less vulnerable uses, including car parks or other public areas.

Housing developments (more vulnerable development) should provide a minimum habitable space floor level above the estimated 1% (for fluvial flooding) water level with the addition of allowances for modelling uncertainty and climate change (i.e. freeboard). This may be achieved by providing car parking or other public areas at ground floor level.

Employment development (less vulnerable development) should provide a similar standard of flood defence as housing developments. Within undefended or poorly defended Flood Zone 3a areas, employment development should remain dry during the 1% fluvial flood event, with sufficient freeboard to account for uncertainties in flood level prediction and climate change. Developers will need to carefully consider the commercial viability of developing in these areas. In exceptional circumstances, where there is significant planning justification for development and the provision of this standard of defence is not feasible, a greater acceptance of flood risk may be permitted for less vulnerable development in areas of high probability of flooding with the focus on providing safety to occupants, flood proofing and designing buildings to minimise flood damage.

Flood resilient construction may be considered in circumstances where there is a low probability of limited shallow depth water entry and buildings are not subjected to severe floodwater inundation depths. This type of construction is designed to reduce the consequences of flooding (the probability of flood occurrence remains unchanged) and facilitate recovery from the effects sooner than conventional buildings.

This may be achieved ‘through the use of water-resistant materials for floors, walls and fixtures and the positioning of electrical controls, cables and appliances at a higher than normal level’ and flood resistant construction to either reduce the amount of water or prevent entry of water into a building where resistant techniques are used. A means of safe access and egress in times of flooding must be provided so that at a minimum, emergency services and their vehicles are able to evacuate people, especially when considering those that are more vulnerable and/or with restricted mobility.

Whilst the basic level of protection afforded to residential and commercial development is the same, it is clear that approaches to how residual risk is managed may differ between these two types of developments. For residential development residual risk is a societal issue, for which a presumption of avoidance and removal is appropriate. Hence a significant freeboard should be incorporated into housing development floor levels, whereas for a commercial property the end user and insurer can assess and transfer this residual risk as appropriate. Therefore commercial and employment uses have a suitably different approach to the management of the residual risk, above that provided by the basic mitigation works. The onus would be on Darlington BC to determine whether these risks are acceptable, in conjunction with advice from the Environment Agency.

PPS25 advocates a risk based approach linked to vulnerability and does not provide a prescriptive set of flood protection standards. Wherever possible, the highest achievable standard should be provided, but in exceptional circumstances, where alternative or complementary flood risk management measures can be taken and are sustainable, a lower standard may be acceptable. Care must be taken that such an approach would not result in future public expenditure on retrospective flood alleviation measures. Therefore this approach is exceptional and only applicable in limited locations where the flood risks are fully understood.

Isolated small Greenfield developments may be sustainable in terms of their impact on floodplain storage and conveyance, however the cumulative effects of many small developments can be large and Greenfield sites must be viewed within a wider perspective.

The feasibility of mitigation measures may be assessed in accordance with the guidance established in section 4.1.

2.2.2 Defended Areas - Flood Risk Mitigation

Within defended areas, residual flood risk is primarily associated with overtopping and/or breach of defences (and localised flooding associated with drainage systems in some locations). These risks are related to the likelihood (standard of protection and structural integrity of defences) and the consequences of flooding.

The likelihood of overtopping can be estimated by comparison of modelled water levels (where available) and defence crest levels. An indication of the likelihood of defence breach can be gained by reviewing the flood defence condition data held within the National Flood and Coastal Defence Database (NFCDD) and more detailed surveys and investigations undertaken by the Environment Agency and/or others. The consequences of defence overtopping or breach failure can be estimated using flood inundation modelling and mapping.

For a development to proceed, it must also be shown that it will not increase flood risk elsewhere through a loss of storage or conveyance. Flood risk must be reduced or kept at current levels.

The feasibility of any proposed mitigation measures which might be introduced to address any residual flood risk may be assessed in accordance with the guidance established in section 4.1.

2.2.3 Overtopping

Where assessments show an area to be at risk of defence overtopping in the 1% event (with climate change), measures should be employed to mitigate the risk. Where floor level raising is the preferred mitigation technique, minimum floor levels for housing developments should be set above the estimated water level that would result behind the defences (with an allowance for uncertainty and climate change). In exceptional circumstances, where there is significant planning justification for development and the provision of this standard of risk mitigation is not feasible, a lower degree of flood risk mitigation may be permitted in employment developments with the focus on providing safety to occupants, flood proofing and designing buildings to minimise flood damage.

Assuming it can be demonstrated that occupants remain safe a maximum inundation depth of 0.6m may be considered appropriate for the 1% event with the addition of allowances for modelling uncertainty and climate change. Minimum floor levels may be lower than the main river level if the floodplain is large.

Where the defences consist of earth embankments, overtopping of the defences is likely to lead to erosion and weakening of the defence structure. In these circumstances failure of the defences is considered highly probable and an assessment of the consequences of defence breach is also required.

2.2.4 Breach

Where the defences are shown to be at risk of overtopping and/or NFCDD data or additional information indicate that the flood defences are in poor or very poor condition, for the purposes of the SFRA it may be assumed that there is a reasonable likelihood of defence breach in a major flood event during the lifetime of any new development. A high degree of flood risk mitigation needs therefore to be provided or it may be that due to the high risk, the location is deemed to be unsuitable for development. If mitigation measures are acceptable, then minimum floor levels in housing developments should be set above the estimated maximum breach water level for the 1% event with allowance for climate change and other uncertainties.

In locations where the defence is of a high standard, both in terms of stability and height, then the probability of a breach occurring is reduced and hence the risk reduces as well. The overall probability of the consequences associated with a breach occurring extend to the extreme end of the risk continuum. This does allow a more considered approach to residual risk, and some flooding of non-sensitive or vulnerable developments may be considered acceptable.

Where the defences are shown to provide a standard of protection greater than the 1% event (with climate change), NFCDD data indicate that the defences are in good or very good condition, and there is an absence of detailed survey data to suggest otherwise, for the purposes of the SFRA it may be assumed that the likelihood of defence failure in a major flood event is low. With the defences mitigating risk substantially, a lesser degree of site-based flood risk mitigation may be adopted, with the focus on providing safety to the development and its occupants from residual risks. Assuming it can be demonstrated that occupants remain safe, for housing developments it is recommended that minimum floor levels be set to the maximum breach level for a 1% event less 300mm, or 600mm above natural surface level, whichever is greater.

A maximum inundation depth of 0.6m may be considered acceptable when combined with the 1% (1 in 100 yr) event and a breach in these well defended areas in employment developments under these circumstances after consideration of uncertainty and climate change has been added to the minimum floor levels. However, occupants and users still need to remain safe. Identification of the rapid inundation zone is essential in these circumstances, before deploying a relaxation of the residual risk accepted within the design. In comparison to residential areas, where societal risks are generally designed out, it is considered appropriate to possibly transfer these residual risks via insurance or resilience in the design of the commercial use, if the users of the site can remain safe.

The effects of land raising within defended areas on potential breach risk also warrants careful consideration in the flood risk assessment. In confined floodplains where breach levels approach those in the main river, land raising is unlikely to have any impact on breach water levels and extents. However, where the floodplain is not confined by natural high ground or secondary defences, or where the passage of breach floodwater is restricted by partial barriers such as road or rail embankments, and consequently breach levels do not approach the main river level, then there is potential for land raising to lead to an increase in flood risk (extent and depth of breach) elsewhere. The potential for increasing breach related flood risk elsewhere is directly related to the loss of breach storage volume and conveyance, and single, small-scale developments are unlikely to have a significant impact. However, the cumulative effect of individual development proposals needs to be considered. Quantitative assessment of these effects may require

detailed breach modelling to be undertaken in individual flood risk assessments. This guidance is not restricted to Zone 3a and applies to any site that is located with a defended area that is at risk of flooding from defence failure.

2.2.5 Public Safety

For all Zone 3a allocations, and particularly in defended areas where a development site is close to a defence (i.e. within 500m), consideration must be given to residual risks and the risk to public safety associated with access and egress from properties. Residual risks are those associated with very low likelihood events, such as events of frequency less than 1% annual exceedance probability and failure of defences where defences provide a high standard of protection.

Development should not be sited where these risks unduly threaten public safety and/or the structural integrity of buildings and infrastructure. Early discussion with the Environment Agency, LPA and County Emergency Planning Officer is required in the consideration of the depth of flooding, flow velocity, rate of inundation and safe access / egress to assess these risks. This assessment is particularly applicable to areas at risk from both breach and overtopping.

There is a range of research and guidance available on flood hazards and public safety. DEFRA / Environment Agency Flood and Coastal Flood Defence Research and Development Programme, Project FD2317, Flood Risks to People consolidates flood hazard research from many sources.

The most recent flood hazard formula proposed by Phase 2 of the Risks to People Project is:

Flood hazard = d (v+0.5) +DF

Where:

d is depth m

v is velocity ms-1

DF is the debris factor with a value of 0-1

A number of flood hazard thresholds have been identified describing a flood hazard as “Dangerous for some”, “Dangerous for most” and “Dangerous for all”. At present the lower threshold for “dangerous for some” of 0.75 is appropriate with a conservative upper threshold of 1.5. The threshold of 2.5 for “Dangerous to all” has been set with a less conservative view and it should be noted that hazard is not purely a function of flood depth. Flood hazard thresholds are shown in Table 2.1 below.

Table 2.1: Flood Hazard Thresholds

Flood Hazard d(v+0.5)+DF	Description	Alternative Name / Hazard Class
0	Safe (dry)	None
0 to 0.75	Caution	Low
0.75 to 1.5	Dangerous for some	Moderate
1.5 to 2.5	Dangerous for most	Significant
Over 2.5	Dangerous for all	Extreme

Environment Agency guidance suggests that all development should have a dry access and egress in the 1% event.

Greater depth and velocity may be permitted where elevated and safe access / egress to safe ground are provided.

2.3 Planning Issues for Flood Zone 3b – The Functional Floodplain

PPS25 states that only the water-compatible uses are permissible in Flood Zone 3b. Essential Infrastructure can be permitted after the Exceptions Test is passed. According to PPS25, developers and local authorities should aim to:

- Reduce overall level of flood risk in the area through the layout and form of the development and the appropriate application of SUDS.
- Relocate existing development to land with a lower probability of flooding.

In addition, according to PPS25, essential infrastructure should:

- Remain operational and safe for users in times of flood.
- Result in no net loss of floodplain storage.
- Not impede water flows.
- Not increase flood risk elsewhere.

Other than water-compatible and essential infrastructure (subject to the Exception Test) uses, Flood Zone 3b should not be used for development except for access road purposes. In this case, the roadway should be kept to the narrowest width possible and crossing the watercourse at 90 degrees to the direction the watercourse flows.

2.4 Planning Issues for Flood Zone 2 – Medium Probability

Flood Zone 2 is considered suitable for water-compatible, less vulnerable, more vulnerable and essential infrastructure. Highly vulnerable development is only allowed where the Exception Test is passed.

In this zone, developers and Darlington BC should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of SUDS.

For highly vulnerable development in Flood Zone 2, this SFRA also indicates whether part c. of the Exception Test is most likely to be met.

Where development is implemented, floor levels should be situated, as a minimum, above the 1% AEP fluvial flood level with sufficient freeboard to account for inherent uncertainties with respect to flood level prediction and potential climate change scenarios. A site-specific FRA should be undertaken at the planning application stage to facilitate the delineation and definition of the 1% AEP fluvial flood event envelope.

2.5 Planning Issues for Flood Zone 1 – Low Probability

In accordance with PPS25, all development (essential infrastructure, highly vulnerable, more vulnerable, less vulnerable and water-compatible development) is permissible in Flood Zone.

For development proposals on sites comprising one hectare or more, the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA.

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

In situations where a known flooding problem has been identified downstream, Darlington BC will require developers to ensure that the proposed development does not result in a worsening of existing flooding conditions.

2.6 Other Known Flood Risk Areas

In certain locations an increase in the rate of surface water runoff and/or volume from a new development situated upstream of an area that is known to be susceptible to localised flooding (e.g. as a result of problematic surface water drainage) may exacerbate the degree of flood risk to that downstream area.

Such areas will be sensitive to the drainage system implemented with that particular development site, as the drainage system will determine site runoff rates and volumes.

The capacity of drainage infrastructure is often limited and is at or near capacity under existing conditions. Development that leads to increased peak runoff within the drainage catchments may lead to infrastructure capacity being exceeded, with the potential for increased flood risk. As a result of being in a Critical Drainage Area a detailed FRA would be expected regardless of which Flood Zone that applies.

New developments upstream of these areas must be managed effectively to ensure that the impact upon downstream properties is fully mitigated. Wherever possible, this should be achieved through the implementation of a sustainable drainage or flow retention system, constructed within the boundaries of the development site.

Ideally the LPA should work closely with the Environment Agency, sewerage undertakers and developers to enable surface water runoff to be controlled as near to the source as possible. For Greenfield developments, the aim is not to increase runoff from the undeveloped situation and for Brownfield re-developments, to reduce existing runoff rates. Wherever possible, this should be achieved through the implementation of a sustainable drainage or flow retention system, constructed within the boundaries of the development site.

A FRA will be required in each instance to demonstrate that new development is not at risk from flooding from existing drainage systems. The FRA should also demonstrate that the development will not adversely affect existing flooding conditions by the use of appropriate mitigation measures and should define and address the constraints that will govern the design of the drainage system.

The effectiveness of a flow management scheme within a single site is heavily limited by site constraints including (but not limited to) topography, geology (soil permeability), development density, adoption issues and available area. The design, construction and ongoing maintenance regime of such a scheme must be carefully defined at an early stage, and a clear and comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system) is essential. In these areas a FRA will be required that demonstrates that the proposed development will not adversely affect existing flooding conditions either alone or in combination with other development.

Prior to making a planning application, discussions should be held with the Environment Agency, the Local Planning Authority and Northumbrian Water to ascertain the specific nature and most appropriate means of managing the flood risk.

The integration of drainage management is highlighted within the DEFRA strategy for flood risk management in England, detailed within the consultation document 'Making Space for Water[2]'. The strategy aims to achieve better overall management of surface water drainage through better co-ordination between the different bodies.

[2] DEFRA (2004) Making Space for Water; Developing a new Government strategy for flood and coastal erosion risk management in England, A consultation exercise. http://www.defra.gov.uk/environ/fcd/policy/strategy.htm

3 Guidance for Flood Risk Assessments

3.1 Guidance for Flood Risk Assessments

As discussed in Volume I of the Darlington BC SFRA there are principally three levels of flood risk assessment namely, Regional Flood Risk Appraisals (RFRAs), Strategic Flood Risk Assessments (SFRAs) and Site-specific (known as Detailed) Flood Risk Assessments (FRAs).

The FRAs are site or project specific and are the responsibility of those proposing development to undertake. The principle aims of a FRA are to determine the acceptable management of flood risk to the development proposal itself and any impacts elsewhere, and to ensure that the development and its users/occupants remain safe in times of flood. The FRA will determine any effective flood mitigation measures necessary and include these in the development proposal. The FRA needs to demonstrate that the proposed development will not increase flood risk either upstream or downstream of the site and all sources of flood risk, including fluvial, surface water runoff and drainage need to be considered. The FRA will then be submitted to the LPA in support of the developers outline and/or detailed planning application.

Flood Risk Assessments for proposed development should follow the approach recommended by:

- The Environment Agency (see its National Standing Advice to Local Planning Authorities for Planning Applications – Development and Flood Risk in England (March 2007). See www.pipernetworking.com for all guidance on the scoping and undertaking of detailed FRAs.
- CIRIA Report C624 Development and Flood Risk – Guidance for the Construction Industry (2004)
- PPS25 and its Practice Guide.

These documents describe when a FRA is required, what it should contain and are extremely helpful in guiding developers to produce a “fit for purpose” FRA and are commensurate with the advice given in this SFRA. All proposed development sites require at least an initial assessment of flood risks. A detailed FRA will be required for all developments that fall in the Flood Zone 2 and 3 and other sites where significant flood risk is identified. A full FRA will be required for sites in Flood Zone 1, which are greater than 1ha. For smaller sites a Screening Study will determine whether further FRA is required.

The information that follows serves to highlight key aspects of detailed FRAs and should be used in conjunction with the principle sources of information identified above.

3.2 General Principles

Annex E of PPS25 provides information on the general principles of flood risk assessment and states the minimum requirements for all stages of the planning process. These include:

- Be proportionate to the risk and appropriate to the scale, nature and location of the development;
- Consider the risk arising fro the development in addition to the risk of flooding to the development;
- Take the impacts of climate change into account;
- Be undertaken as early as possible in the planning process;
- Consider potential adverse and beneficial aspects of flood risk management infrastructure;
- Consider the vulnerability of the users of the development;
- Consider and quantify difference types of flooding from all sources;

- Include the assessment of residual risks;
- Consider surface water drainage systems; and
- Be supported by appropriate data and information.

Figure 3.5 of the Practice Guide provides information on the scope of FRAs and this should be used as a starting point for all development proposals and then supplemented to reflect any specific peculiarities or issues in respect of the particular development proposal or site under consideration.

Information on levels of flood risk assessment is provided in both the CIRIA C624 Publication and Figure 3.4 of the Practice Guide. There are principally three levels of FRA:

Level 1 - Screening study, to identify whether there are any flooding or surface water management issues that need to be considered further;

Level 2 – Scoping study, to be undertaken if the Level 1 FRA indicates that there are flood risk issues needing further consideration and these risk can be readily quantified; and

Level 3 – Detailed study, where further quantitative analysis is required to appropriately assess flood related issues and determine any effective mitigation measures needed to be put in place.

Figure 3.6 in the Practice Guide provides a helpful list of typical sources of information to help undertake an appropriate FRA.

In addition, typical outputs of a Level 1 or Level 2 FRA, supported by guidance notes and a FRA pro-forma are contained in the Practice Guide and these include:

- Development description and location;
- Definition of flood hazard;
- Probability of flooding;
- Effects of climate change;
- Detailed development proposals;
- Flood risk impacts and management measures; and
- Consideration and management of off site and residual risks.

For all levels of FRA developers are advised to make early contact with the Environment Agency and the LPA to discuss their proposals in outline and consider the site in respect of the risk based sequential approach contained within the SFRA.

3.3 Assessment of Fluvial Risk

The mitigation design criterion for development within floodplain areas are generally set to protect against the flood event coinciding with a 1% annual probability of occurrence, including the impact of climate change. Detailed consideration will need to be given to the impact these mitigation measures may have and it is a requirement to ensure that flood risk is not increased elsewhere as a result of development. Compensation measures may take the form of compensatory flood storage as mitigation for loss of floodplain, enhanced flood defences and flood compatible master planning. Compensation measures will be needed in both defended and undefended floodplains. This concept is included in PPS 25 and ensures that residual risk is appropriately managed in new and existing development.

Before embarking on detailed modelling, and in light of this SFRA, proposals for development should be discussed in detail with the Environment Agency at an early stage.

Detailed FRAs may need to be carried out using hydraulic models. However, before any modelling is undertaken a review of available information should be conducted to assess if modelling is necessary. For fluvial floodplains an assessment of the hydrological regime is required. This should be undertaken using available gauged records and Flood Estimation Handbook (FEH) techniques. Where hydraulic modelling is necessary, it will need to include structures, such as bridges and weirs that influence flood levels. This

modelling should also include floodplains to accurately determine the depth and extent of flooding.

Whenever possible models should be verified using historical records of flooding. Its sensitivity to modelling assumptions and climate change should also be investigated. Mapping the extent of flooding in a specific location will assist the risk of flooding to a specific development to be assessed.

Where allocations remain in high risk flood zone areas for other material considerations, it needs to be demonstrated that technically feasible flood mitigation options are available. A fuller appreciation of the sustainability of the site and its mitigation measures will be addressed via the Sustainability Appraisal. These measures must be designed to provide an appropriate level of flood mitigation to a site for the lifetime of the development. At most sites it is technically feasible to mitigate or manage flood risk (if potential off-site impacts are ignored), however the measures required may result in some practical constraints on development and/or require significant financial cost where flood risk is high. The detailed FRA should build on initial potential mitigation measures considered when determining the likelihood of the Exception Test being met as indicated earlier in Volume I of the SFRA.

3.4 Assessment of Surface Water Drainage Issues

Opportunities for developing an Integrated Water or Drainage Management Strategy across development site boundaries should be explored, and a catchment led approach should be adopted. This approach has been recognised in the consultation paper by Defra, Making Space for Water. An integrated approach to controlling surface water drainage can lead to a more efficient and reliable surface water management system as it enables a wider variety of potential flood mitigation options to be used. In addition to controlling flood risk, integrated management of surface water has potential benefits, including improved water quality and a reduction of water demand through grey water recycling.

Integrated drainage systems may be considered suitable for catchments where other development is being planned or constructed, and where on-site measures are set in isolation of the systems and processes downstream.

Surface water drainage assessments are required where proposed development may be susceptible to flooding from surface water drainage systems. The potential impact upon areas downstream of the development, including the impact on a receiving watercourse, also needs careful consideration.

The specific requirements for surface water drainage systems will need to be discussed with the Council's Land Drainage Engineers, Environment Agency and the Water Company. Consideration should be given to whether a "Greenfield runoff approach" to the assessment of source control is appropriate. This method is generally satisfactory in the cases where the development is relatively small, isolated from other planned sites and the runoff processes are fully understood.

The FRA should then conclude with an assessment of the scale of the impact, and the recommended approach to controlling surface water discharge from a proposed development.

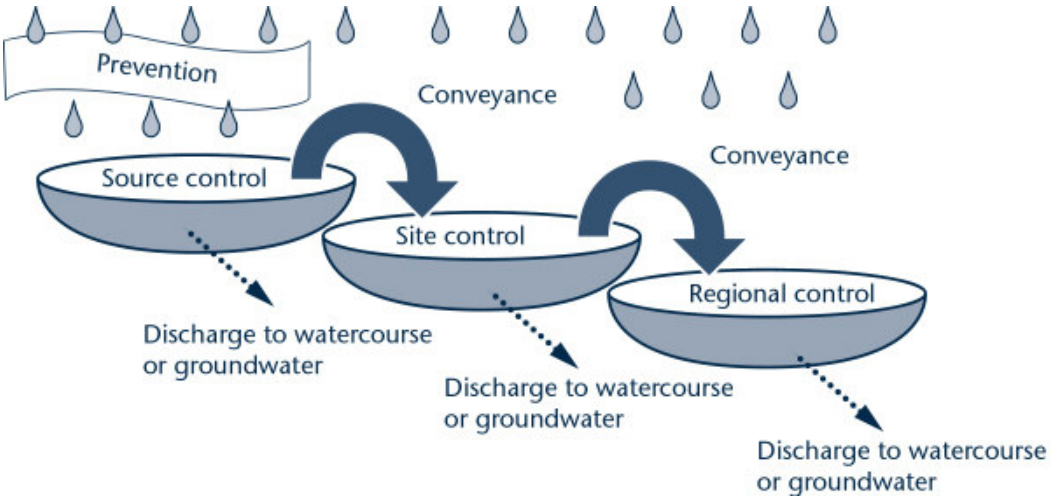
The recent Government consultation on surface water drainage as discussed in Section Volume I of the SFRA should be considered when assessing surface water drainage as part of the FRA. In addition, Guidance for Developers and Regulators in Scotland on Drainage Impact Assessments has been produced by the Scottish Environment Protection Agency (SEPA) and others, and this is a valuable reference document.

3.5 Assessment of the Application of SUDS

Sustainable Urban Drainage Systems (SUDS) are management practices which enable surface water to be drained in a more sustainable manner.

For Greenfield developments, the aim is to not increase runoff from the undeveloped situation; for Brownfield re-developments, the aim is to reduce existing runoff rates. Wherever possible, this should be achieved through the implementation of a sustainable drainage or flow retention system, constructed within the boundaries of the development site.

There are many different SUDS techniques which can be implemented. As a result, there is no one correct drainage solution for a site. In most cases, a combination of techniques, using the Management Train principle, will be required. Figure 3-1 shows the SUDS Management Train principle, where source control is the primary aim.



A good first assessment of the suitability of different SUDS components can be achieved be reviewing the techniques set out in Table 1.7 of the CIRIA SUDS Manual[4] , which shows the capability of different SUDS techniques.

The CIRIA SUDS Manual provides a detailed series of matrices that can be used as a screening process to select the best groups of SUDS for a development site. These are based around five selection criteria:

1. Land use characteristics
2. Site characteristics
3. Catchment characteristics
4. Quantity and quality performance characteristics
5. Amenity and environmental requirements

The effectiveness of a flow management scheme within a single site is heavily limited by land use and site characteristics including (but not limited to) topography, geology (soil permeability), and available area. In addition to potential ground contamination associated with urban and formerly industrial sites with concern being placed on the depth of the local water table and potential contamination risks. The design, construction and ongoing maintenance regime of such a scheme must be carefully defined, and a clear and comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system) is essential. Additionally, for infiltration SUDS it is imperative that the water table is low enough and a site specific infiltration test is undertaken.

At a catchment level characteristics determine whether there are any regulatory criteria that may restrict or preclude the use of a particular SUDS technique, or that may impose additional requirements on the performance of a particular system. The design of the

[3] CIRIA (2008) Sustainable Drainage Systems: promoting good practice – a CIRIA initiative.
[4] CIRIA (2007) The SUDS manual.

SUDS may for example be influenced by the characteristics of the downstream water body that will receive the storm water discharge. In some cases, high pollutant removal or environmental performance will be needed to fully protect aquatic resources and/or human health.

Catchment characteristics are generally related to the number of components in the treatment train that will lower the risk of poor water quality treatment performance rather than appropriateness of technique.

Regarding flood risk, those SUDS with a high/primary process for dealing with water quantity should first be investigated, before other benefits such as water quality and environmental befits are included. SUDS can reduce the amount and rate of runoff by a combination of:

- Infiltration;
- Storage; and
- Conveyance

There are a number of SUDS techniques which could be used individually or as part of a management train, however their suitability relies on the site and catchment descriptors discussed above but also their intended purpose (as shown in Table 3.1).

Table 3 1: Suitability of SUDS Techniques

SUDS Technique	Infiltration	Storage	Conveyance
Green Roofs	×	✓	✓
Permeable Paving	✓	×	✓
Rainwater Harvesting	×	✓	×
Swales	✓	✓	✓
Detention Basins	✓	✓	✓
Ponds	×	✓	✓
Wetlands	×	✓	✓

Source: PPS25 Practice Guide

PPS25 stresses that Regional Planning Bodies and Local Planning Authorities (LPAs) should:

- Promote the use of SUDS for the management of run-off.
- Ensure their policies and decisions on applications support and complement the Building Regulations on sustainable rainwater drainage, giving priority to infiltration over first watercourses then sewers.
- Incorporate favourable policies within Regional Spatial Strategies.
- adopt policies for incorporating SUDS requirements in Local Development Documents
- Encourage developers to utilise SUDS wherever practicable, if necessary through the use of appropriate planning conditions
- Develop joint strategies with sewerage undertakers and the Environment Agency to further encourage the use of SUDS.

Adoption and future maintenance of above ground SUDS facilities by Darlington BC as public open space requires early discussion between the developer, the Council and Northumbrian Water. Above ground attenuation can be adopted by Darlington BC as public open space, with the provision of a payment to Darlington BC via a Section 106 Agreement under the Town and Country Planning Act. This must, however, be agreed at an early stage and ideally discussed in advance of the planning application to allow the contribution to be ring fenced specifically for the facility.

If future maintenance arrangements are to be assigned to a Management Company, this should be discussed at an early stage with Northumbrian Water. This can have implications on the adoption of the remaining site drainage and consequently adoption of any highways on the development.

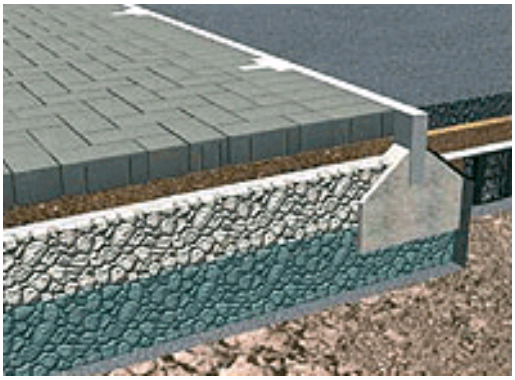
Allowance should be made by whomever is to take future responsibility for the SUDS facilities, for checking the SUDS designs and for inspection during construction, if necessary employing competent individuals to perform this task.

Information should be provided to make the end-users of the development aware of SUDS and in particular their responsibilities to maintain and not to remove any privately owned SUDS facilities. If deemed necessary the removal of permitted development rights or the inclusion of covenants in the deeds of properties could be considered.

3.5.1 Permeable Surfaces[5]

Pervious pavements such as permeable concrete blocks, reinforced grass, crushed stone or gravel and permeable asphalt will allow water to infiltrate directly into the subsoil before soaking into the ground.

It is also possible to incorporate attenuation into the sub base of porous paving construction if the infiltration potential of the ground is not ideal.



On brownfield sites where contaminated ground is an issue, a lined attenuation system can be built into the sub-base. The porous paving provides a filtering action and improves water quality. Additional products are available that provide a specific filtering function within the attenuation system.

The shallow excavation required to install such facilities in comparison to traditional over-sized pipes can have the added benefit of reducing surplus material and costly off-site disposal.

[5] Photographs courtesy of Charcon / Aggregate Industries

3.5.2 Living (Green) Roofs and Walls[6]

Living Roofs and walls can vary in type from Roof Gardens, Roof Terraces, Green Roofs and Green Walls.

This approach utilises plants and their substrate to provide temporary storage of rainfall. The water retained by the substrate and lost through evaporation and evapotranspiration minimises runoff from the roof. Even when saturated, the run-off rate is slowed by the roughness of the vegetation and so mimics more closely the run-off prior to development.

Commonly perceived problems are largely unwarranted. These include a lack of British Standards associated with green roofs.

However, the German FLL, the Landscape Research, Development & Construction Society, covers all aspects of green roofs from waterproofing, soils, vegetation, installation methods and maintenance and members include major UK suppliers.

There is also a perception that dry vegetation during the summer months could lead to fires being started on green roofs, however, the FLL have strict guidelines on this issues.

Maintenance requirements will depend on the type of roof system. An amenity space will require similar maintenance to a garden; otherwise a one to two year inspection is likely to suffice, to weed out unwanted plants.

[6] Photographs courtesy of livingroofs.org/greenroofconsultancy.com

3.5.3 Basins, Ponds and Wetlands[7]

Dry basins, ponds and wetlands can be designed to provide temporary storage for storm water through the regrading of site ground levels to form a contained storage area, in conjunction with a flow control to force water into the storage facility and allow it to drain down slowly at a controlled rate.

They can often be a key part of landscape strategies, providing amenity space and opportunities for the creation of wildlife habitats.

The permanent pool volume and pond planting can be designed to provide a cleaning function, diluting and removing pollutants from the storm water. Basins, ponds and wetlands can be fed by swales, filter drains or piped systems.

Safety should be carefully considered when designing the side slope gradients and water depths and, if required, fencing and barrier planting should be incorporated.

The future adoption and maintenance arrangements need to be agreed with Darlington BC and Northumbrian Water prior to designing the attenuation basin or pond, as this can potentially affect the adoption of site sewers and highways.

In areas susceptible to fluvial flooding, surface water attenuation facilities should be designed not to conflict with floodplains or flood mitigation measures. The basin or pond base level should be set above the peak 1 in 100 year fluvial flood level with climate change.

[7] Photos courtesy of Greenbelt Group

3.5.4 Filter Strips, Swales and Infiltration Devices

Swales provide temporary storage for storm water to help reduce peak flow runoff. While providing an alternative to traditional piped conveyance systems, the flow across vegetation provides a filtering function at low velocities. Check dams and flow controls can be introduced to further reduce flows and utilise the storage potential.

Filter Strips are vegetated areas that are intended to treat sheet flow from adjacent impervious areas. Filter strips function by slowing runoff velocities and filtering out sediment and other pollutants, and providing some infiltration into underlying soils. Filter strips were originally used as an agricultural treatment practice, and have more recently evolved into an urban practice.

Infiltration devices drain water directly into the ground. They may be used at source or the runoff can be conveyed in a pipe or swale to the infiltration area. They include soakaways, infiltration trenches and infiltration basins as well as swales, filter drains and ponds. Infiltration devices can be integrated into and form part of the landscaped areas.

Filter Drains are gravel filled trenches which trap sediments from run-off and provide attenuation. Flow is directed to a perforated pipe which conveys run-off back into the sewerage network or into a water body. Filter drains are used mainly to drain road and car park surfaces.

3.5.5 Rainwater Harvesting

Rainwater harvesting techniques can aid in increasing the attenuation of rainfall and contribute to the onsite recycling of water. Water butts are a common rainwater harvesting technique, however they are easily bypassed or full when a rainfall event occurs. If used on a strategic basis and it can be demonstrated that their use will make available volume for storage, the Environment Agency may consider whether they can count towards surface water attenuation.

4 Guidance for Making Development Safe

4.1 Mitigation Measures

Mitigation measures should be seen as a last resort to address flood risk issues. Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised, only then should mitigation measures be considered.

Where allocations remain in high risk Flood Zone areas, it needs to be demonstrated in a detailed FRA that technically feasible flood mitigation options are available. These measures must be designed to provide an appropriate level of flood protection to a site for the lifetime of the development. The measures required may result in some practical constraints on development and/or require significant financial cost where flood risk is high. The minimum acceptable standard of protection against flooding for new property within flood risk areas is the 1 in 100 year (1%) annual probability for fluvial flooding, with allowance for climate change over the lifetime of the development.

The fact that mitigation measures are discussed in this SFRA should not be taken as a presumption that the Sequential Test has been bypassed. It is included to give a fuller picture of the implications of allocating a site, and for use in a subsequent Sustainability Appraisal (SA). Normally, suitable mitigation measures for a proposed development will be determined through assessment of flood depths via hydrological and hydraulic modelling (or use of existing models) carried out as part of a FRA.

Often the determining factor in deciding whether a particular development can or cannot proceed is the financial feasibility of flood risk mitigation rather than technical limitations. Detailed technical assessments are required in the FRA to assess this feasibility, together with a commercial review by the developer of the cost of the mitigation works. At the SFRA stage, broad assumptions are therefore required regarding the feasibility of flood risk mitigation to ensure that only sites with realistic development potential are put forward.

Some mitigation measures as outlined in PPS25 are presented in Figure 4-1. It is not assumed that floor level raising will continue to be the traditional mitigation measure. It should be noted that the Environment Agency see actual land raising as a last option. Thought will also be required to ensure safe access and egress is available for flood events including climate change.

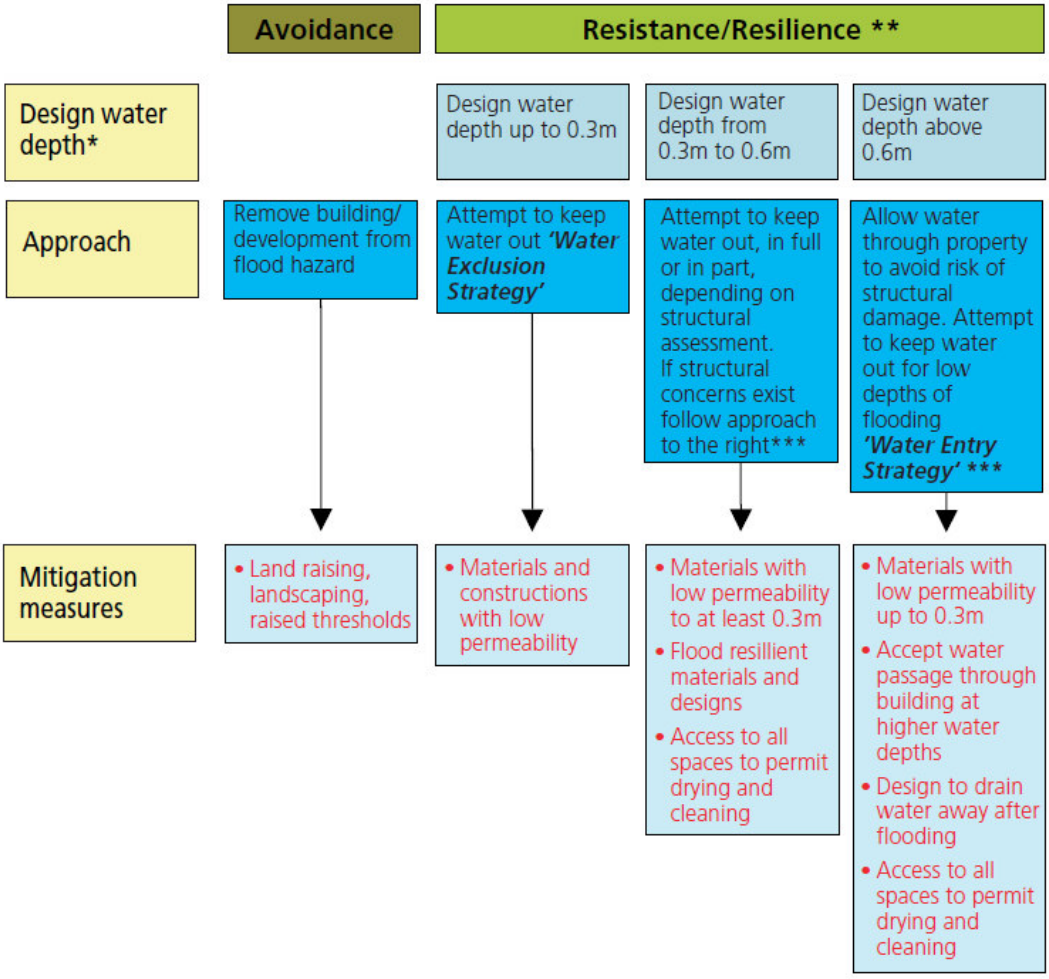
Whilst flooding mitigation measures can be implemented in most sites, it is worth noting that in some instances the findings of individual FRAs may determine that the risk of flooding to a proposed development is too great and mitigation measures are not feasible. In these instances, the development will be subject to an objection by the Environment Agency.

4.2 Reducing Flood Risk

The minimum acceptable standard of protection against flooding for new property within flood risk areas is 1% annual probability for fluvial flooding, with allowance for climate change over the lifetime of the development.

The measures chosen will depend on the nature of the flood risk. Some of the more common measures appropriate to Darlington BC are outlined here, and more detail is given in Chapter 6 of the PPS25 Practice Guide[8].

[8] Communities and Local Government (2008) Planning Policy Statement 25: Development and Flood Risk – Practice Guide



Notes:

* Design water depth should be based on assessment of all flood types that can impact on the building

** Resistance/resilience measures can be used in conjunction with Avoidance measures to minimise overall flood risk

*** In all cases the 'water exclusion strategy' can be followed for flood water depths up to 0.3m

4.2.1 Reducing Flood Risk through Site Layout and Design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development.

The PPS25 Practice Guide states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational space) can be located in higher risk areas.

Waterside areas, or areas along known flow routes, can be used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas, and avoid the creation of isolated islands as water levels rise.

The Environment Agency will have to consent to any works within 5 meters of a main river. It is likely that they will object in principle to any development within these areas.

4.2.2 Modification of Ground Levels

Modifying ground levels to raise the land above the required flood level is a very effective way of reducing flood risk to the site in question.

However, in most areas of fluvial flood risk, conveyance or flood storage would be reduced by raising land above the floodplain, adversely impacting on flood risk downstream. Compensatory flood storage must be provided, and should be on a level for level, volume for volume basis on land that does not currently flood but is adjacent to the floodplain (in order for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary (unless the site is strategically allocated).

Where the site is entirely within the floodplain it is not possible to provide compensatory storage at the maximum flood level and this will not be a viable mitigation option. Compensation schemes must be environmentally sound.

The need for compensatory storage must been discussed at the earliest stage of planning as this will be a major constraint as this requirement may have significant implications for the yields achieved for individual sites the associated land take this may require.

4.2.3 Raised Defences

Construction of raised floodwalls or embankments to protect new development is not a preferred option, as a residual risk of flooding will remain. Compensatory storage must be provided where raised defences remove storage from the floodplain.

Temporary or demountable defences are not acceptable flood protection for a new development unless flood risk is residual only.

4.2.4 Developer Contributions to Flood Defences

In some cases, it may be necessary for the developer to make a contribution to the improvement of flood defence provision that would benefit both the development in question and the local community.

4.2.5 Building Design

The raising of floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of flood. If it has been agreed with the Environment Agency that, in a particular instance, the raising of floor levels is acceptable, they should be raised to 600mm above the maximum water level during a 1% annual flood event plus climate change. This additional height that the floor level is raised is referred to as the 'freeboard'.

Making the ground floor use of a building water compatible (for example a garage), is an effective way of raising living space above flood levels.

Putting a building on stilts is not considered an acceptable means of flood mitigation for new development. However it may be allowed in special circumstances if it replaces an existing solid building, as it can improve flood flow routes. In these cases attention should always be paid to safe access and egress and legal protection should be given to ensure the ground floor use is not changed.

4.2.6 Resistance and Resilience

There may be instances where flood risk remains to a development. For example, where the use is water compatible, where an existing building is being changed, where residual risk remains behind defences, or where floor levels have been raised but there is still a risk at the 0.1% annual probability. In these cases (and for existing development in the floodplain), additional measures can be put in place to reduce damage in a flood and increase the speed of recovery. These measures should not be relied on as the only mitigation method.

The 2007 document 'Improving the Flood Performance of New Buildings' provides further details on possible resistance and resilience measures[9].

Temporary Barriers

Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water.

Permanent barriers

Permanent barriers can include built up doorsteps, rendered brick walls and toughened glass barriers.

Wet-proofing

Interior design to reduce damage caused by flooding, for example:

- Electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level.
- Water-resistant materials for floors, walls and fixtures.

If redeveloping existing basements, new electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level to minimise damage if the development floods.

Resilience measures will be specific to the nature of flood risk, and as such will be informed and determined by the FRA.

4.3 Making Development Safe

4.3.1 Safe Access and Egress

The developer must ensure that safe access and egress is provided to an appropriate level for the type of development. This may involve raising access routes to a suitable level.

As part of the FRA, the developer should review the acceptability of the proposed access in consultation with the Environment Agency.

4.3.2 Flood Warning and Evacuation

Emergency/evacuation plans should be in place for all properties, large and small, at residual risk of flooding; those developments which house vulnerable people (i.e. care homes and schools) will require more detailed plans.

4.4 Making Space for Water

4.4.1 Opportunities for River Restoration and Enhancement

All new development close to rivers should consider the opportunity presented to improve and enhance the river environment. Developments should look at opportunities for river restoration and enhancement as part of the development. Options include backwater creation, de-silting, in-channel habitat enhancement and removal of structures. When designed properly, such measures can have benefits such as reducing the costs of maintaining hard engineering structures, reducing flood risk, improving water quality and increasing biodiversity. Social benefits are also gained by increasing green space and access to the river.

[9] Communities and Local Government (2007) Improving the Flood Performance of New Buildings – Flood Resilient Construction.

4.4.2 Buffer Strips

Developers should set back development from the landward toe of fluvial defences (or top of bank where defences do not exist) and this distance should be agreed with the Environment Agency. This provides a buffer strip to 'make space for water', allow additional capacity to accommodate climate change and ensure access to defences is maintained for maintenance purposes.

5 Guidance for Emergency Planners

5.1 Introduction

As discussed within Section 1 of Volume I of the Darlington BC SFRA, there is a recent trend developing since the publication of the PPS25 Practice Guide in 2008 that SFRAs are more than a land use planning tool, and can provide a much broader and inclusive vehicle for integrated, strategic and local Flood Risk Management (FRM) assessment and delivery. This is especially the case when it comes to informing emergency planning.

Under the Civil Contingencies Act, Category 1 responders to emergencies are required to produce risk assessments and contingency plans in dealing with emergencies and to provide advice and information to the public. Under the Act, risk assessments and planning is arranged through Local and Regional Resilience Forums (L/RRF).

At a local level, it is the local authorities that play a critical role in civil protection. They have a wide range of functions which are likely to be called upon in support of the emergency services during an emergency, including key statutory responsibilities such as environmental health, housing, social services and highways, and crucially, exercise a community leadership role.

The role of local authorities in relation to the initial response phase is to provide support for the people in their area. Resources of local authority departments will be utilised to mitigate the effects on people, property, and the environment and to co-ordinate the response from the voluntary sector.

Local authorities will provide, in liaison with the Police, “Rest Centres” for people who have been evacuated, arrangements for friends and relatives of people bereaved and seriously injured, and “Survivor Reception Centres”. In addition, the local authority will have responsibility for establishing, in liaison with H.M. Coroner and the Police, emergency mortuary capacity in emergencies that exceed existing mortuary provision.

Emergency planning is essential for individual developments at flood risk and therefore should be considered within a FRA.

Flooding is a natural process and cannot wholly be avoided. As was seen in the summer 2007 floods, flooding can cause massive disruption to communities, damage to property and possessions and even loss of life. The aim of the SFRA so far has been to try an avoid development in flood risk areas in the first instance. However it has also been accepted that there is current development in flood risk areas and there will need to be a level of continued regeneration. Minimising flood risk to people, property and the environment should be considered

Flood defences go some way in reducing the current flood risk by providing a standard of protection, however there is still a residual risk associate with them as they can be overtopped or breached. Flood Warnings are an integral part of flood defences, in which the Environment Agency are the lead authority responsible for warning the public, local authorities and emergency services.

Along with the Environment Agency flood warning systems, there are other “Flood Plans” at a regional and local level, outlining the major risk of flooding and the tactical and operation plan for key responders.

5.2 County Durham and Darlington Local Resilience Forum

Darlington BC falls within the County Durham and Darlington LRF. The purpose of the forum is to ensure all agencies, which are exposed to risk or to be required to respond to events, can effectively deliver their duties under the Civil Contingencies Act. The County Durham and Darlington LRF provides information and advice about actions to take to ensure that residents, visitors and businesses in County Durham and Darlington are ready to respond to incidents and, wherever possible, to reduce their impact. At times of

emergency, the website (http://www.durham.police.uk/lrf/index.php) is used to publish information about what is happening, how the incident is being addressed and by whom, and potentially how the public can assist. Strategic decision-making and resource allocation are determined by reference to the County Durham and Darlington LRF Community Risk Register (CRR) which considers the likelihood and consequences of the most significant risks facing Cleveland over the next five years.

5.2.1 The County Durham and Darlington Local Resilience Forum Community Risk Register

The County Durham and Darlington LRF CRR has been developed in accordance with the Guidance to part 1 of the Civil Contingencies Act 2004 - Emergency Preparedness and supplementary guidance from the Civil Contingencies Secretariat. Consultation has also taken place with the Regional Resilience Team and other LRFs in the North East Region. The Community Risk Register is designed to provide an agreed position on the risks affecting County Durham and Darlington and on the planning and resourcing priorities required to prepare for those risks. Its purpose is to enable each Category 1 responder to:

- Be fully informed of the risks of emergency in County Durham & Darlington;
- Benefit from a range of views on risk of its partners on the LRF;
- Identify collectively the main local emergency plans and capabilities which appear to be needed across all Category 1 responders;
- Decide which of the plans and capabilities should properly fall to it; and
- Know which of its partners in the LRF acknowledge responsibility for developing plans and capabilities against the various risks.

Guidance to the Act indicates that it is more efficient for individual Category 1 responders to fulfil their risk assessment duties by participating in a collaborative exercise that results in a single, collective risk assessment.

5.2.2 Risk Assessment Working Group of the County Durham and Darlington Local Resilience Forum

The Risk Assessment Working Group (RAWG) of the County Durham and Darlington LRF has undertaken the collaborative exercise on behalf of the LRF using the six-step risk assessment process. The six steps undertaken were:

- Contextualisation;
- Hazard Review and Allocation for Assessment;
- Risk Analysis;
- Risk Evaluation;
- Risk Treatment (not a statutory duty under the Act, but recommended practice has been adopted); and
- Monitoring and Reviewing (ongoing requirement).

The Community Risk Register is a 'living document' and is a work in progress with ongoing work required to further refine information on a small number of lower risk hazards and how best to address the issue of prioritising and mitigating threats. The CCR is approximately 95% complete and comprises the following sections:

- Contextualisation. Provides a brief overview of County Durham and Darlington as a means of broadly setting the scene for the type of environment in which the risk register is based.
- Community Risk Register – Hazards & Threats. This is the completed guidance template which lists the hazards in risk rating order and identifies the risk priorities. The risk priorities are based on what the risk rating is and what capabilities we currently have in place to deal with the hazard or threat. Where a shortfall exists the hazard receives a higher score on the 1 to 5 rating scale, with 5 being the highest risk priority.
- List of Hazards. Provides the list of local hazards assessed, lead assessors, likelihood and impact scores and an overall risk rating.

- Risk Matrix. Provides a graphical representation of the assessed hazards plotted against likelihood on the horizontal axis and impact on the vertical axis.
- Excluded List. Provides a list of hazards that were excluded from further consideration in the assessment process an indication of why they were excluded.

The key risks identified by the risk assessment process are detailed in the Community Risk Register 9 (this can be obtained from http://www.durhamdarlingtonccu.gov.uk/?lrf-community-risk-register).

5.3 County Durham and Darlington Emergency Plans and Civil Contingency Arrangements in Darlington

Darlington Borough Council plays a full role in the Local Resilience Forum and has specific arrangements in place to deliver its own duties. Darlington Borough Council funds the Durham and Darlington Civil Contingencies unit to provide it with an expert resource. The Unit carries out a range of functions including:

- Writing plans for the Council – corporate and departmental plans identifying key roles and responsibilities, consequence-specific plans such as for flooding and pandemic influenza and testing and exercising those plans;
- Training Darlington Borough Council staff and Elected Members;
- Providing expert advice on emerging issues and during an actual emergency, including the recovery phase; and
- Facilitating the development of business continuity management plans.

The Council has a suite of plans to help it respond to an emergency situation. These identify specific roles for departments and individuals, which are regularly tested and exercised.

In an emergency incident the Council's primary role is to support the blue light services. This can involve setting up evacuation centres, providing information to the public, media management, debris clearance, traffic management, friends and family centres counselling etc.

Once the immediate emergency is over the incident can enter the recovery phase at which time the Local Authority becomes the lead agency. This recovery phase can in severe incidents last for months or even years (as was the case in the Carlisle and Boscastle flooding incidents) and critical activities relate to health and welfare, housing, rebuilding communities, regenerating the economy, financial support and environmental clean up.

5.3.1 County Durham and Darlington Emergency Flood Response Plan

The severe floods of 2000 which caused devastation to large areas of County Durham and Darlington highlighted the importance of planning for flooding incidents within the area. As a result of this the County Durham and Darlington Civil Contingencies Unit, is working closely in conjunction with the nine local authorities and other responding agencies to produce a 'County Durham and Darlington Emergency Flood Response Plan'. In summary the plan details:

- Definition of the Flood Warning Codes;
- How flood warnings and severe weather warnings are disseminated to its recipients;
- The roles and responsibilities of all responding agencies;
- How a flooding incident would be managed by responding agencies;
- The individual response arrangements of each local authority pertaining to a major flooding incident including identifying their 'areas at risk' of flooding;
- Details of financial assistance available to local authorities in dealing with a major flooding incident;
- Resources available both locally and nationally; and
- The availability of public information.

In producing this Plan the Civil Contingencies Unit is seeking advice and guidance from external agencies including the Environment Agency and local authorities.

5.4 SFRA Emergency Planning Recommendations

All sources of flooding have been assessed within this Level 1 SFRA and the hazard associated with that flooding has been mapped where information has been available. As a result, the following recommendations are made:

- It is recommended that the County Durham and Darlington LRF CRR is updated using information contained within the SFRA. The latest version of the CRR is available on their website (http://www.durhamdarlingtonccu.gov.uk/?lrf-community-risk-register). Updating the register with information within the SFRA will enable a more effective and direct response to those people/communities at greatest risk.
- The findings of this SFRA should be incorporated within the Multi-Agency Flood Plan and Risk Registers to ensure that safe evacuation and access for emergency services is possible during times of flood for both existing developments and those proposed sites identified in the SFRA. Within the study area particular attention should be given to those current locations or planned developments in already vulnerable locations.
- Those involved in large developments should consult with Darlington BC's Emergency Planning Officer, to assist in the production of the evacuation plan needed as part of an FRA.
- Flood Plans should also be updated with Environment Agency reservoir inundation maps once available.

6 Recommendations for Future Plans

6.1 Introduction

There is a recent trend developing since the publication of the PPS25 Practice Guide in 2008 that SFRAs are more than a land use planning tool, and can provide a much broader and inclusive vehicle for integrated, strategic and local Flood Risk Management (FRM) assessment and delivery. Since publication of the Pitt Review, it is apparent that SFRAs will provide the central holder for data, information and consideration for all flood risk issues relating to flooding from all sources at a local level; and provide the linkage between CFMPs, SMPs, RFRAs, SWMPs and appropriate sustainable land uses over a number of planning cycles.

The Darlington BC SFRA has provided this pivotal vehicle in the introduction and promotion of a local authority, post Pitt Review, role in local flood management. The SFRA has been produced to be fit for the future, to help communities meet the considerable FRM and climate change related challenges that lay ahead.

In order to achieve this, Darlington BC must take a lead role in FRM and continue the work of this Level 1 SFRA and increase the understanding and information available on flood risk issues. There are a number of future plans which could provide this comprehensive understanding and acknowledgement of flood risk from all sources. These are outlined below with recommendations of whether or not they would benefit Darlington BC.

6.2 Level 2 SFRA Assessments

This Level 1 SFRA has provided the evidence base for Darlington BC to apply the Sequential Test as set out in PPS25. Whilst the suite of Flood Risk Maps provided will help inform the decision making process and go some way in informing the likelihood of passing the Exception Test, they do not provide the detailed local understanding required to carry out the Exception Test (where required).

An initial assessment of the residential allocations at risk of flooding from the River Skerne was undertaken, using strategic flood hazard and depth mapping. This provided some evidence as to whether these sites would pass the Exception Test. However, a more detailed modelling assessment was recommended.

This would involve modelling Cocker Beck where it converges with the River Skerne in the centre of Darlington. A greater understanding of the flood risk mechanisms and the level of flood risk is required for this watercourse. In addition, a breach assessment of the defences on the River Skerne (adjacent to the potential residential allocations) would be required. This would show the potential hazard to people if residential development took place adjacent to the Skerne.

This level of assessment would only be required for the sites in the centre of Darlington (identified in Volume II). This detailed Level 2 assessment would produce a greater understanding of the flood mechanisms and residual risks to provide the data needed to pass part c) of the Exception Test - whether the development will be safe.

The investigations carried out within the Level 2 SFRA will inform the flood risk balance sheet and confirm the sequential approach to site layout and help the design of possible mitigation measures.

The scope of a Level 2 SFRA is provided in PPS25 and its Practice Guide. It should include the detailed nature of the flood hazard within a flood zone including:

- Flood probability
- Flood depth
- Flood velocity
- Rate of onset of flooding.

The Level 2 SFRA should also provide information of flood defences including their location, Standard of Protection (SoP), condition and an assessment of defences breaching and overtopping. The final Level 2 assessment for these sites will contribute towards the evidence base of the allocation of sites within the LDF along with the Level 1 SFRA.

6.2.1 Level 2 surface water assessment

Surface water management is also an area that would require further work in Darlington Borough (possibly as part of a Level 2 assessment).

Once feedback on the 'candidate' Critical Drainage Areas (identified in this Level 1 SFRA) has been obtained from Northumbrian Water (NWL), it is likely that certain sites will need further investigation.

This next level of assessment should investigate these sites further, initially through a meeting with NWL and other relevant stakeholders. NWL have confirmed they will provide the next level of DG5 (sewer flooding) information as this stage (area and street level). This assessment should be able to 'whittle the sites down' between those issues NWL have actually resolved (or plan to) or those which will need further work. On the back of this, more precise recommendations for Surface Water Management Plans (SWMP), Drainage Impact Assessments (DIAs) and guidance on runoff rates etc. can be provided. These recommendations should then be use to kick start SWMP/DIA work (see section 6.2.1).

6.2.2 Surface Water Management Plans (SWMPs)

The 'Pitt Review', 'PPS25', the 'Making Space for Water', 'Integrated Urban Drainage' pilots and the 'Draft Flood and Water Management Bill' recognise the need for clearer roles and responsibilities for different sources of flood risk, with the current legislative framework leading to a fragmented and piecemeal approach for managing urban flood risk. A local leadership role for local flood risk issues has emerged whereby local authorities will need to have in place a strategy to manage these risks.

Surface water flooding is a major source of flood risk and as demonstrated by the summer 2007 floods can lead to serious flooding of property and possessions. These impacts can typically be mitigated through the implementation of established 'best practice' drainage techniques including Sustainable Urban Drainage Systems (SUDS) at the planning application stage. However, in some circumstances site constraints dictate that a catchment-wide, holistic approach to surface water flood management is required through urban catchment planning and strategic consideration of the design, construction, maintenance and improvement of sewers and watercourses. Local Authorities need to take a lead role when liaising between Water Companies and the Environment Agency. This will be essential to ensure a consistent and co-ordinated approach to surface water management and this may be best achieved by the production of appropriate Surface Water Management Plans (SWMPs).

SWMPs are developed by a partnership between a Local Authority, Water Company and the Environment Agency. They provide an opportunity to:

- Develop a framework for joint working and data sharing (which is a fundamental part of flood risk management under the draft Flood and Water Management Bill),
- Collate a central geographic database of drainage assets and flood risk issues,
- Assess the likelihood of surface water flooding through various modelling approaches,
- Assess the risk of surface water flooding to people, properties and the environment,
- Communicate this risk to local communities,
- Assess the costs and benefits of various flood risk reduction measures,
- Provide a drainage strategy for areas of significant development if appropriate, and

- Provide a framework for implementation and monitoring of the surface water strategy for a given area.

The Defra SWMP guidance is based on the Integrated Urban Drainage pilots undertaken as part of Making Space for Water and is currently being tested by six national pilot studies. The government outlined its future intentions towards the development of SWMPs in the Government Response to the Pitt Review into the 2007 floods, setting aside £5m for the development of a further 50 SWMPs for high priority locations (which will be decided on a national basis). SWMPs should achieve the level of data sharing with water companies and analysis using detailed sewer network models.

SFRAs provide the opportunity for local authorities to assess at a strategic level the risk from multiple sources of flooding, which can then feed into more detailed assessments where appropriate by both themselves and other operating authorities.

The evidence supplied within this SFRA has identified those areas which are naturally vulnerable to surface water flooding by providing a suite of vulnerability maps (Appendix A in Volume II). These maps, along with areas known to be sensitive to climate change and have high development pressures, should give the Council an indication of locations which would benefit from a SWMP (see section 2.4.1 of Volume II for a recommended location).

This mapping has also highlighted development allocations where surface water management should form an integral part of the development plan, possibly through a surface water management strategy (see section 4.3.4 of Volume II for a list of these sites).

The National Surface Water Map provides a good indication of areas at risk of surface water flooding but this should be refined so that it picks up flow paths along roads and around buildings. The risk to properties can then be assessed with more confidence to provide recommendations for SWMPs.

Further consultation is required particularly to obtain sewer information and the use of available models from Northumbrian Water.

A detailed practice guide on SWMPs will be produced within Defra's Water Strategy and is due for publication in autumn 2008, where delivery of SWMPs should be planned for 2010.

Until a SWMP has been completed, all developments identified at risk from surface water flooding should adhere to the guidance in PPS25 and the recommendations outlined in this SFRA. Integrated drainage solutions should be prepared for larger sites or areas that fall within the identified CDAs. Where major flow paths have been identified these should be considered in the master planning of the site and the sequential placement of development. Where available, SUDS techniques should be identified within the development at the earliest possible stage.

6.3 Water Cycle Studies (WCS)

Water Cycle Studies (WCS) are an all encompassing study of the capacity in water supply, waste water infrastructure and water in the environment, aimed at those regions that are expecting growth. Its main aim is to ensure that new development can be supplied with the required water services it needs in a sustainable way.

To ensure that growth at a district scale can be supplied with sufficient water supply and wastewater treatment facilities, without detrimentally affecting the natural water cycle, it is essential to consider the water infrastructure needs as early in the planning process as possible. A WCS will provide Darlington BC and development organisations with the necessary planning tool for this purpose and the planning base to support their LDF.

A SWMP and a WCS should be twin tracked when they are prepared for the areas of interest. Whilst the SWMP would address surface water management the remaining issues of water supply and sewage treatment should be included within the WCS. However, in the instance where a SWMP is being prepared and WCS is not automatically essential. Both plans are required as part of the evidence base for Growth Point Sites

though.Consultation with Northumbrian Water, the Environment Agency and other critical stakeholders will help determine the need for them.

Until a WCS is carried out, all developers within Darlington BC should apply for a Pre-Development Enquiry from Northumbrian Water. This enquiry will lead to a response detailing capacity studies in our water and sewerage networks and any other relevant issues. A Pre-Development Enquiry Application Form (June 2008) has been attached in Appendix A: - for reference.

6.4 Green Infrastructure Framework

The Green Infrastructure (GI) Darlington BC is part of the council area's life support system. It is a planned and managed network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and rural fringe. Table 6.1 shows the classification of GI at local, city and regional scale.

Table 6 1: Green Infrastructure asset classifications

Local, neighbourhood and village scale	Town, city and district scale	City region, regional and national scale
Street trees and verges Swales, ditches Green roofs Pocket parks Private gardens Urban plazas Village greens and commons Local rights of way Cemeteries Institutional open spaces Ponds, brooks, streams Small woodlands Play areas Local nature reserves School grounds Sports pitches	City/district parks Urban canals Urban commons Forest parks Country parks Continuous waterfront Municipal plazas Lakes Major recreational spaces Car parks Rivers and floodplains Brownfield land	Regional parks Rivers and floodplains Shoreline Strategic and long distance trails Forests, woodlands and community forests Reservoirs Road and railway networks Designated greenbelt Agricultural land

Source: Landscape Institute Draft Green Infrastructure Position Statement

The identification and planning of GI is critical to sustainable growth. It merits forward planning and investment as much as other socio-economic priorities such as health, transport, education and economic development.

GI is also central to climate change action and is recurring theme in planning policy statements, regional spatial strategy, the sub-regional action plan and the New Growth Point declaration of July 2008.

GI is recognised as having multiple benefits: environmental (biodiversity), social (health and well being) and economic (attractive places to live have higher value and attract more investment). With regards to flood risk, green spaces can be used to manage storm flows and free up water storage capacity in existing infrastructure to reduce risk of damage to urban property, particularly in city centres and vulnerable urban regeneration areas. In general it allows space for SUDs and promotes sustainable vegetation cover, which stores water, increasing surface roughness and improves permeability of soils. GI can also improve accessibility to waterways and improve water quality, supporting regeneration and improving opportunity for leisure, economic activity and biodiversity.

When considering the potential of GI to contribute to water management, it must also be understood that GI is an holistic approach with potential to provide many benefits. It is

equally the case that water management benefits should not be sought without consideration for other issues such as biodiversity, or amenity and play value of landscapes. Table 6.2 demonstrates the multiple benefits that GI offers.

This evidence base provided in this SFRA should be used to enhance Darlington BCs Green Infrastructure Framework. River corridors identified as functional floodplain or land identified in the Surface Water Vulnerability Map are an excellent linkage of GI and can provide storage during a flood event. Areas identified within the urban environment or upstream of a critical surface water flood areas should be incorporated into the council GI strategy. Opening up land to create flow paths or flood storage areas can help protect current and future property.

Table 6 2: Green Infrastructure multiple benefits

The functions of green infrastructure	Community engagement	Healthy living	Wellbeing	Education	Climate change mitigation	Climate change adaptation	Economic value	Regeneration	Sense of place	Environmental awareness	Habitat provision	Recreational opportunities	Waste minimisation	Increased property and land values
Informal recreation	■	■	■											
Active recreation	■	■	■											
Food production	■	■	■	■	■					■	■		■	
Sustainable transport		■	■		■									
Cultural events	■		■	■			■	■	■					■
Places to interact	■		■						■	■				
Biodiversity habitat				■		■					■			
Sustainable energy					■		■							
Place making / character enhancement	■		■											■
Green space provision			■	■	■	■	■	■	■	■	■	■		■
Flood management						■						■		■

Based on: Landscape Institute Draft Green Infrastructure Position Statement

Appendices

A . NWL Developer Pre-Development Enquiry Application Form

Pre - Development Enquiry Application Form

NORTHUMBRIAN WATER

When completed, please return to:

New Development, Northumbrian Water Limited, Leat House, Pattinson Road, Washington, NE38 8LB

As briefed out by the HBF Technical Committee, we are now complying with the Water UK Developer's Charter as of the 1st April 2008. Therefore we ask that you complete all mandatory fields (*) on this application to assist us to ensure that a suitable response is issued to you.

For assistance in completing this form please refer to the accompanying Guidance Notes.

If you require any further assistance then please contact our New Development Team at developmentenquiries@nwl.co.uk or alternatively on 0191 419 6652 or 0191 419 6746.

Section 1 – Customer Details

Name and Address of Applicant/Agent:

*Contact Name:	
*Company Name:	
*Address:	
	*Postcode:
*Tel. No. (inc. STD):	
Fax. No. (inc. STD):	
Mobile No.:	
Email address:	

Please select how you would prefer to be contacted (✓):

Post:		Telephone:		Mobile:		Email:	

Section 2 – Proposed Site Details

Location and Address of the Site:

*Site Name:			
*Address:			
	*Postcode:		
	*6 Figure OS Site Grid Reference (Mid Point):	N	Z

*What was the site previously used for? (✓):

Greenfield/Agricultural:		Housing:		Industry:		Landfill:	

Other, please specify:

*If the site is Brownfield, does it currently have sewerage connections? (✓):

Yes:		No:		Not established:	

If 'yes', please detail::

*Does the site contain contaminated ground? (✓):

Yes:		No:		Not established:	

If 'yes', please detail::

*If non-domestic, is there Trade Effluent? (✓):

Yes:		No:		Not established:	

Pre - Development Enquiry Application Form

NORTHUMBRIAN WATER

Section 3 – Proposed Development & Enquiry

a)* Type of Development Enquiry (✓): (Charges not including VAT)

Water Only - £200.00:		Sewerage Only - £311.00:		Combined - £469.00:	

Please supply the details of the company to be invoiced should it be different to that of the applicant:

*Company Name:									
*Address:									
		*Postcode:							

b)* Estimated Number Unit ('s):

Domestic:		Non-Domestic:		Mixed:	

c) *Size of Development (hectares):

Domestic:		Non-Domestic:		Mixed:	

d) *Phasing of the Development:

Phase No.:	Start Date:	End Date:	Phase No.:	Start Date:	End Date:
1			3		
2			4		

Section 4 – Planning Status of Site

Status	Y/N	Date	Reference
*Is the site identified on the local plan?			
*Does the site have Outline Planning Permission?			
*Does the site have Full Planning Permission?			
*Does the site have Building Regulation Permission?			

Section 5 – Proposed Flow Rate & Discharge Rate

Required Water Supply (l/s)?	*Foul Water Discharge (l/s)	*Surface Water Discharge (l/s)

*Please provide the method of calculation with this enquiry and your proposed connection point:

Foul Water			Surface Water		
	MH Ref:			MH Ref:	

*Does the site have existing sewerage connections? (✓):

Foul Water	Yes		No		*Surface Water	Yes		No	

*If 'yes', what is the impermeable area (hectares):		Can soakaways be utilised?	Yes		No	

Section 6 – Declaration

I have completed the application form and attach the following information:

*Application fee as shown section 3	£			
*A site location drawing of scale 1:2500 (Preferably in electronic format emailed to us at developmentenquiries@nwl.co.uk)	Yes		No	

I agree, that for the purposes of the Water Industry Act 2003 and the Data Protection Act 1998, the information provided in this form and in any accompanying documents, may be held on a computer and processed by Northumbrian Water Ltd and its servants and agents for all purposes connected with the Company's statutory water and sewerage undertakings.

*Signature:		*Name:	
*On behalf of:		*Position:	
		*Date:	

B . Flood Risk Balance Sheet (Example)

		Flood risk indicators adopted as measure of Acceptability (-ve indicates flood risk will be required to be managed or maybe considered unacceptable when viewed with all the other flood risk indicators)							
		A	B	C	D	E	F	G	Recommendation
Policy area	Proposed land use	Is the development within existing flood risk area?	What are the scale and nature of flood risks?	What scale of residual risk measures will be required?	How will egress and access be assured? What will the emergency planning impact?	Will there be a change in the number of people at risk?	Will there be a change in the number of properties at risk?	Will there be an impact of the mitigation measures elsewhere?	Counter to strategic approach, flood risk unacceptable. Exception Test would be difficult to pass. Not recommended Sequentially not preferred, where limited land uses maybe possible Sequentially not preferred but a range of land uses could be put forward after careful consideration and FRA Acceptable with some detailed consideration of flood risk issues Acceptable subject to FRA
Site 1	Housing	--	-	--	--	+	---	-	
Site 1	Commercial	-	+/ -	-	=	+/++	---	+/-	
Site 2	Housing	--	--	--	--	-	--	=	
Site 2	Commercial	--	-	--	-	+	--	=	
Site 3	Housing	-	-	--	--	-	-	=	
Site 3	Commercial	-	-	-	-	+	-	=	
Site 4	Housing	-	+	-	-	+	-/+	+	
Site 4	Commercial	-	-	--	+	+	-	=	
Site 5	Residential	-	-	--	-	+	-	=	
Site 5	Commercial	-	-	+	+	+	-	=	

Indicator						
A	B	C	D	E	F	G
+ = no risk - = risk area within resilient communities -- = vulnerable community, which would struggle to recover	+ = no special provisions, safe - = needs to be managed, should be safe, must be proven in FRA -- = special provision, natural response will not be obvious. Safety not guaranteed, and may not convince LPA/EA when examined in detail	++= None required + = Measures could reduce risk to existing development - = standard, no major alteration to layout and form -- = flood resistance is dominant in design	+ = reduction - = increase	+ = reduction (preferable outcome in PPS25) - = increase	+ + = Benign, and understood -- = difficult to warn, unpredictable, may result in operational failure of defences, from multiple sources	+ = reduction = neutral impact - = inc in flood risk elsewhere (Exception test requires no impact)

Offices at

Atherstone
Doncaster
Edinburgh
Haywards Heath
Limerick
Newcastle upon Tyne
Northallerton
Northampton
Saltaire
Skipton
Tadcaster
Wallingford
Warrington

Registered Office
South Barn
Broughton Hall
SKIPTON
North Yorkshire
BD23 3AE

t:+44(0)1756 799919
e:info@jbaconsulting.co.uk

Jeremy Benn Associates Ltd
Registered in England 3246693

Visit our website:
www.jbaconsulting.co.uk