Bath & North East Somerset Council

Strategic Flood Risk Assessment of Bath and North East Somerset

Level 2 SFRA for Midsomer Norton / Radstock

July 2009

CAPITA SYMONDS

successful people | successful projects | successful performance

Contents

The B&NES SFRA is a 'live' document. The current version has been developed using the best information and concepts available at the time. As new information and concepts become available the document will be updated and so it is the responsibility of the reader to be satisfied that they are using the most up-to-date information and that the SFRA accounts for this information. All revisions to this summary document are listed in the table.

Version	Issue Date	Issued by	Issued to
First Draft	05/09//2008	Capita Symonds Ltd	B&NES
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Foreword

Bath and North East Somerset (B&NES) Council are required to prepare a Strategic Flood Risk Assessment (SFRA) to support the production of their Local Development Framework (LDF).

The SFRA creates a strategic framework for the consideration of flood risk when making planning decisions. It has been developed in accordance with Planning Policy Statement 25: Development and Flood Risk (PPS25), PPS25 Practice Guide, as well as additional guidance provided by the Environment Agency.

The guidance provided in PPS25 requires local authorities and those responsible for development decisions to demonstrate that they have applied a risk-based, sequential approach in preparing development plans and considered flooding through the application of a Sequential Test. Failure to demonstrate that such a Test has been undertaken potentially leaves planning decisions and land allocations open to challenge during the planning process.

The underlying objective of the risk-based sequential allocation of land is to reduce the exposure of new development to flooding and reduce the reliance on long-term maintenance of built flood defences. Within areas at risk from flooding, it is expected that development proposals will contribute to a reduction of flood risk.

A SFRA is essential in enabling a strategic and proactive approach to be applied to flood risk management. The assessment allows us to understand current flood risk on a wide-spatial scale and how this is likely to change in the future.

The SFRA is presented in a number of documents:

Level 1 SFRA for the whole of B&NES

- Non technical summary leaflet
- VOLUME I – decision support guide
- VOLUME II – technical report and flood maps
- VOLUME III – management and update guide

Level 2 SFRA for key areas

- Level 2 SFRA Report for each key area (Part 1)
- Sequential Test Report (Part 2)
- Scoping Study for Flood Risk Management Strategy (Part 3)

The partitioning of the SFRA into this series of reports enables B&NES to assess flood risk in increasing detail as they progress their Local Development Framework (see Figure A).

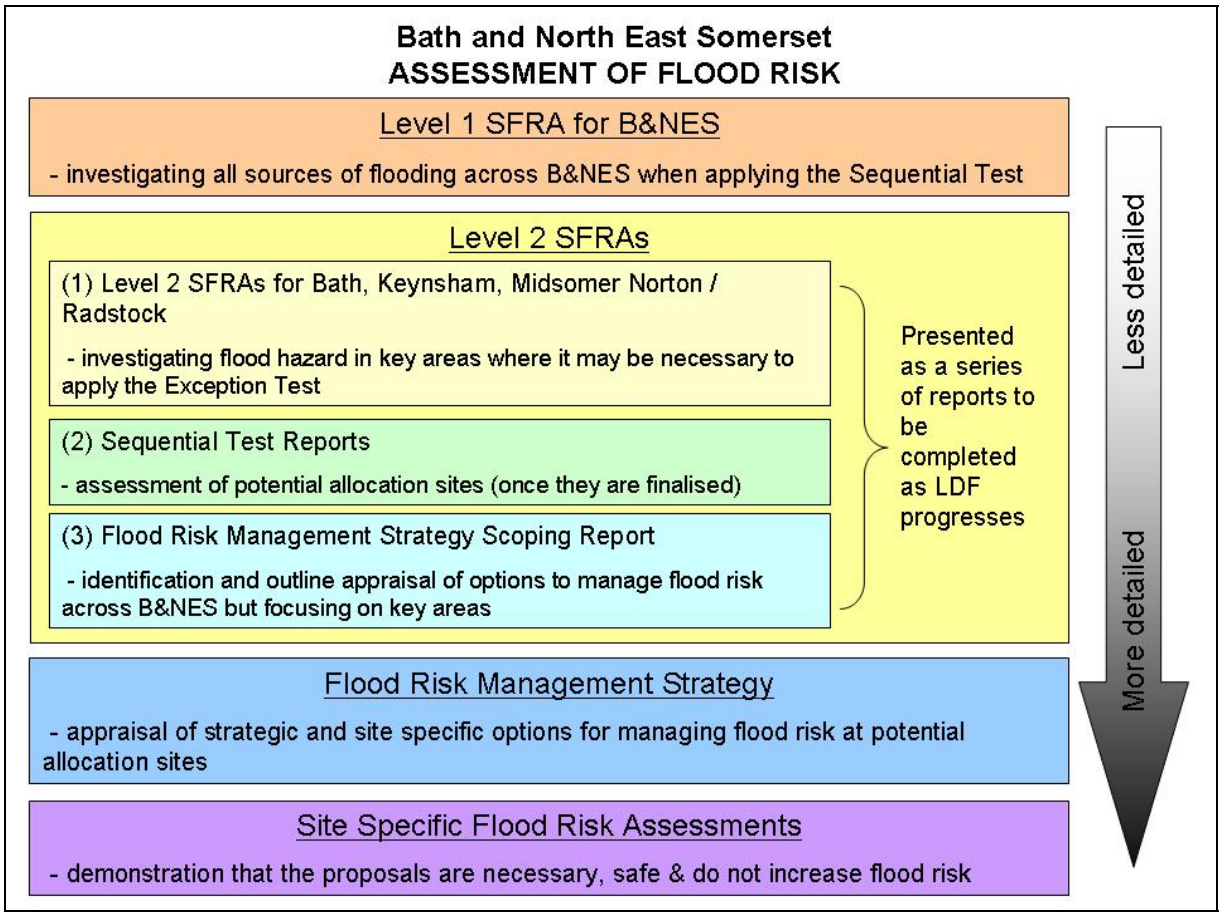

Figure A. Hierarchy of flood risk investigations

The SFRA are live documents which are intended to be updated as new information and guidance becomes available. The outcomes and conclusions of the SFRA may not be valid in the event of future changes. It is the responsibility of the user to ensure they are using the best available information when making a land planning decision.

1. Introduction

Purpose of this report

This Bath and North East Somerset (B&NES) SFRA has been developed to inform the Local Development Framework (LDF). The SFRA must be robust and be evidence-based so that it does not leave planning decisions and land allocations open to challenge through the land use planning process. It is crucial that there is transparency in the data and methods used in the assessment.

This volume of the Bath & North East Somerset Strategic Flood Risk Assessment is the

Level 2 Strategic Flood Risk Assessment for Midsomer Norton / Radstock

This report is the first of a series of reports to provide Level 2 SFRA information for key areas within B&NES. This report builds upon all of the technical information and methods used in the Level 1 assessment of flood risk across the study area. This report is intentionally partitioned from the Level 1 SFRA, as it does not repeat guidance contained within the Level 1 SFRA. However, it is intended that the reader of this document refers to the Level 1 SFRA for further technical guidance where appropriate.

The other Level 2 SFRA reports (Sequential Test and Scoping Reports) will provide more specific flood risk information for potential allocation sites, and an outline appraisal of flood risk management options available to B&NES.

The need for a Level 2 SFRA is primarily driven by regeneration and new housing requirements outlined in the B&NES Local Plan and the draft South West Regional Spatial Strategy. A combination of urban infilling and urban extension has been proposed to meet this housing need and some areas identified for this development were shown to have a high probability of flooding (Flood Zone 3) in the Level 1 SFRA.

A Level 2 SFRA has been undertaken to provide greater understanding of the factors contributing to the probability of flooding in the potential development areas, provide guidance for LDF policy to ensure that the development would be safe from flooding and would not increase flood risk elsewhere, and identify the need for additional more detailed assessment to reduce uncertainty. The scope of the Level 2 SFRA is defined in the PPS25 (December 2007), and expanded in the recently published PPS25 Practise Guide (June 2008). This Level 2 SFRA is structured to address the requirements of PPS25 and the Practice Guide and in doing so includes sections on sources of flood risk, managing flood risk today, and in the future, and recommendations for implementing the Level 2 SFRA.

The user is referred to Volumes II and III of the Level 1 SFRA for guidance on how to interpret the information in this technical report and how to update the SFRA following improvements in data or changes in guidance. The SFRA is based on a range of data from different sources and of various degrees of certainty. It is the responsibility of the user to understand and take account of the source and certainty of the data when referring to the flood risk summaries and flood maps.

Overview of Midsomer Norton / Radstock

This section is intended as a brief contextual summary. A full description and maps describing the location, physical characteristics and human influences are located in the Level 1 SFRA for B&NES.

Location

Midsomer Norton and Radstock are adjacent, connected towns that lie to the South West of Bath at the edge of the B&NES district boundary. Both communities are dissected by the River Somer. Map O in the Annex of this document shows the location of Midsomer Norton / Radstock in relation to the district and the river network.

The urban boundary shown on Map O does not include the residential properties and green space located along Staddlestones, Furlong Close and Cautletts Close. B&NES consider this area to form part of the Midsomer Norton / Radstock urban extent and as such it has been included for the purpose of the SFRA. It is recommended that the urban boundary be updated by B&NES (see Recommendation 6 in Section 5).

Physical characteristics

Much of the urban conurbation of Midsomer Norton / Radstock lies on relatively high ground to the North of the Mendip Hills. The Rivers Somer and Wellow Brook are tributaries of the River Avon, joining just upstream of Bathampton. The clay soils in the study area are relatively impermeable. Map T2 provides an indication of the ground topography in the vicinity of Midsomer Norton / Radstock.

Human influences

Midsomer Norton and Radstock in particular owe their modern existence to their location at the heart of the Somerset Coalfields (although Midsomer Norton has a far longer historic existence as a market town). The mining industry and the majority of its infrastructure legacies have been lost over time. Local employment is comprised of commuters to Bath, Bristol and localised light industry.

Midsomer Norton and Radstock are identified as centres for regeneration in the Market and Coastal Towns Initiative (MCTi) run by the Regional Development Agency, the B&NES local plan and Radstock regeneration principles. Map N shows the potential new development sites as per the Bath and North East Somerset Local Plan (2007). In addition to these specific sites, Midsomer Norton and Radstock town centres are considered as regeneration areas.

2. Sources of flood risk

Introduction

Midsomer Norton / Radstock and the surrounding locality contain localised areas that are prone to flooding from a range of sources including rivers, sewers, land, and groundwater. The type of flooding is dependent on the interaction of rainfall and catchment characteristics. PPS25 identifies six sources of flooding to be investigated in an SFRA as flooding from rivers, the sea, groundwater, land, sewers and artificial sources.

Summary of flood risk in Midsomer Norton / Radstock

The dominant sources of flood risk in Midsomer Norton / Radstock are rivers, sewers and artificial sources, although there is very minor risk from groundwater sources. The main areas at risk are:

- Rivers - Map F shows the Flood Zones within Midsomer Norton / Radstock as per PPS25. Map FF shows the functional floodplain (land that would be flooded during an event with a 5% annual probability of exceedance (AEP)). As there are no formal defences within Midsomer Norton / Radstock (see Section 3), this map shows the "actual" risk of flooding. It should be recognised that Midsomer Norton benefits from the River Somer Flood Tunnel which comprises a low flow channel and high flow tunnel. This is considered by the Environment Agency as key infrastructure rather than a formal flood defence. As such the risk of this infrastructure failing is shown on Map A4.

  Map A2 indicates the depth of flooding during a 1% AEP event. The deepest floodwaters are shown along the more incised River Somer and upstream of structures. Map A3 shows the maximum velocities (averaged) that may be expected in the rivers during this same event.

  Sewers/Land – Map L shows the areas potentially more prone to flooding from land. Within urban areas the management of surface water relies on sewer systems and therefore for the purposes of this assessment flooding from land has been defined as potential areas of inundation as a consequence of direct runoff from agricultural land on the edges of urban areas.

  The majority of the urban area of Midsomer Norton / Radstock is shown to be highly prone to flooding from land, due to the topography and soils characteristics in the area, however there are no recorded incidents of surface water flooding within Midsomer Norton / Radstock. A more detailed technical assessment of the performance of the influential drainage infrastructure would be required to more precisely define the level and spatial distribution of risk (see Recommendation 1 in Section 5).

  Map S shows the recorded incidents of sewer flooding within Midsomer Norton / Radstock. There is a higher than average number of recorded incidents of sewer flooding in Midsomer Norton / Radstock, indicating that the sewer infrastructure plays an important part in surface water flooding within the towns.

- Artificial sources – no artificial sources of flooding have been identified in the Midsomer Norton / Radstock area.

Climate change is not expected to significantly increase the 1% AEP fluvial floodplain through Midsomer Norton / Radstock, however the largest increase in flooding is expected near the Riverside playing field, at Welton Hollow and downstream of Fox's Hill.

The predicted increases in rainfall intensity will place greater pressure on the existing drainage system within Midsomer Norton / Radstock, which has a history of sewer flooding.

Flood risk statistics in Midsomer Norton / Radstock

Table 2.2 provides a summary of the key flood risk statistics across Midsomer Norton / Radstock.

Table 2.2 Key flood risk statistics for the urban area of Midsomer Norton / Radstock

	Approximate area or number	Percentage of total area or number
Midsomer Norton / Radstock statistics		
Midsomer Norton / Radstock town area	5.46 km²	100%
Flood statistics		
Flooding from rivers and sea		
Area of Midsomer Norton / Radstock within Flood Zone 3b (Functional Floodplain)	0.06km²	1.2%
Area of Midsomer Norton / Radstock within Flood Zone 3a (High flood risk)	0.08 km²	1.4%
Area of Midsomer Norton / Radstock within Flood Zone 2 (Medium flood risk)	0.334 km²	6.1%
Area of Midsomer Norton / Radstock within Flood Zone 1	5.05km^2	92.4%
Area of Midsomer Norton / Radstock within Actual Risk extent (1% AEP flood outline with flood defences in place)	0.08 km²	1.4%
Area of Midsomer Norton / Radstock covered by a flood warning service	0.06 km²	1.1%
Area of Midsomer Norton / Radstock covered by a flood emergency plan	5.46 km²	100%
Other sources of flooding		
Area of Midsomer Norton / Radstock potentially prone to flooding from land (high)*	4.2 km²	77.0%
Area of Midsomer Norton / Radstock potentially prone to flooding from groundwater (high)*	0 km²	0%
Area of Midsomer Norton / Radstock known to be affected by flooding from sewers (high)	14 Incidents	N/A
Area of Midsomer Norton / Radstock potentially at risk of flooding from artificial sources (high)	0 km²	0%

* based on the broadscale spatial analysis undertaken during the Level 1 SFRA

Flood risk from rivers

Flooding from rivers occurs when water levels rise higher than bank levels, causing floodwater to spill across adjacent land (floodplain). The main reasons that water levels can rise in rivers are:

- intense or prolonged rainfall causing runoff rates and flows to increase in rivers, exceeding the capacity of the channel. This can be exacerbated by wet antecedent conditions and where there are significant contributions of groundwater,
- constrictions in the river channel causing flood water to backup,
- blockage of structures or the river channel causing flood water to backup,
- high water levels and/or locked flood (tide) gates preventing discharge at the outlet of the river.

The consequence of river flooding depends on how hazardous the flood waters are and what the receptor of flooding is. The hazard of river flood water is related to the depth, velocity, speed of onset and rate of rise, which depends on the:

- magnitude of flood flows,
- size, shape and slope of the river channel,
- width and roughness of the floodplain,
- types of structures that cross the channel,
- hydrological characteristics of the catchment.

Flood hazard can vary greatly throughout catchments and even across floodplain areas. The most hazardous flows generally occur in steep catchments and towards the bottom of large catchments. Hazardous river flows can pose a significant risk to exposed people, property and infrastructure.

Whilst low hazard flows are of less risk to life, they can disrupt communities, require significant post-flood cleanup and can cause superficial and possibly structural damage to property.

Flood Zones

The definition, data used and approach for establishing Flood Zones for the Level 1 SFRA across the whole of B&NES is outlined in the Level 1 Technical Report (Vol II). Since the production of the Level 1 SFRA the Environment Agency has revised the Flood Zones within Midsomer Norton / Radstock. The flood information prepared for the Midsomer Norton / Radstock Level 2 SFRA is based on version 3.12 of the Environment Agency's Flood Zone maps

The revised Flood Zones provide greater certainty to the extents of Flood Zone 2, 3a and 3b along the River Somer and Wellow Brook within Midsomer Norton / Radstock. In accordance with PPS25, Flood Zone 2 and 3a extents are typically prepared with the assumption that flood defences are not present. However the revised Flood Zones (version 3.12) provided by the Environment Agency include the influence of the Midsomer Norton Flood Alleviation Tunnel and the maintained channel through Radstock. For this reason the Midsomer Norton tunnel and maintained channel have been considered 'infrastructure' rather than a 'formal flood defences' for the purpose of the Midsomer Norton / Radstock Level 2 SFRA. Map F therefore presents the actual risk of flooding.

The flood information prepared for the Midsomer Norton / Radstock Level 2 SFRA is based on version 3.12 of the Environment Agency's Flood Zone maps. It is the responsibility of the user to confirm that this data is the latest available when undertaking further flood risk assessments.

It is recommended that a note be drafted to explain that the Midsomer Norton / Radstock Level 2 SFRA has been updated (based on the Environment Agency Flood Zones version 3.12) without amendment to the Level 1 SFRA report or maps (see Recommendation 4 in Section 5).

Only a small portion of the existing built up area of Midsomer Norton / Radstock lies within an area liable to flood with a 1% AEP.

Despite this low probability, Midsomer Norton / Radstock has a relatively significant history of flooding. Midsomer Norton was originally named Midsummer – it is believed because due to regular flooding from the River that prevented easy crossing during the other seasons. Maps H(a) and H(b) in the annex to this document presents a record of the historic flood events for Midsomer Norton / Radstock. Events have been recorded in the study area in 1974 & 1975. Flood Risk in Midsomer Norton was largely alleviated by the construction of the Midsomer Norton Flood Alleviation Tunnel and later channel improvements (completed by 1981) which diverted high flows away from the normal river channel and into a very large culvert that runs under the town centre. Many smaller culverts and

bridges also restrict or manage river flow in Midsomer Norton and Radstock, but none are managed or operated as formal flood defences.

The probability of flooding within Midsomer Norton has reduced considerably since the construction of the flood alleviation tunnel. Whilst this is now considered key infrastructure rather than a defence for the purpose of defining Flood Zones, there remains a residual risk of failure. Map A4 in the annex to this document shows the residual risk of this infrastructure failing. Any proposed development within this area should consider this residual risk in the detailed flood risk assessment (see Recommendation 2 in Section 5).

Inspection of the results of the flood zone mapping and outline site reconnaissance it is evident that the modelled flood zones in the Radstock area are consistent with a river which has undergone flood defence or channel modification works. Information in the Environment Agency National Flood and Coastal Defence Database indicates that these rivers are modified to improve conveyance. This form of defence work is not considered a "formal" flood defence and as such has not been removed in the models used for Flood Zone prediction. Despite this status, it is evident that the maintenance plays a flood defence role and as such, any flood risk assessments prepared for development applications adjacent to the Wellow Brook in Radstock should consider the flood risk associated with changes in maintenance regime (see Recommendation 3 in Section 5). These channels whilst not defined by the Environment Agency as "defences" clearly provide a significant level of flood protection.

Functional floodplain

Flood Zone 3b (the functional floodplain) comprises land where water has to flow or be stored in times of flood. The PPS defines the Functional Floodplain as;

> *'SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5 %) or greater in any given year or is designated to flood in an extreme (0.1 %) flood, or at another probability to be agreed between the LPA and Environment Agency, including water conveyance routes.'*

Map FF in the annex to this document illustrates just the Functional Floodplain for Midsomer Norton / Radstock (which has been revised from the Level 1 SFRA for reasons outlined under the Flood Zones sub-heading of this chapter).

A tiered modelling approach was used in preparing the Level 2 SFRA for Midsomer Norton/Radstock. This approach made use of more detailed Environment Agency model data to define Flood Zone 3b in areas of interest or perceived higher risk and other information to define this zone in other areas. There was no suitable model data available to define Flood Zone 3b on the watercourses outside of the Midsomer Norton/Radstock urban limits, or for the urban area adjacent to Clandown Bottom (north of Radstock). As these areas were predominantly rural or perceived to have a lower risk of flooding a detailed hydraulic model was not developed to define Flood Zone 3b.

In the absence of more detailed model data a precautionary approach should be adopted whereby Flood Zone 3a is used as an indication of functional floodplain. Any application for development in these areas will require a site specific flood risk assessment to provide more detailed flood risk data (see Recommendation 5 in Section 5).

Climate Change

It is expected that the influence of climate change will lead to increased river flows, and some increase in flood extent within Midsomer Norton / Radstock. However, flood depths and the time to peak on the rapidly reacting Rivers Somer and Wellow are expected to increase more than flood extents.

Map C in the annex to this document illustrates the predicted flood outlines for the 1% AEP with an increase in flood risk over 100 year time horizon to take into account the impact of increased flow

magnitudes generated by potential climate change effects (which has been revised from the Level 1 SFRA for reasons outlined under the Flood Zones sub-heading of this chapter). The areas most affected by climate change lie near Riverside playing field, at Welton Hollow and downstream of Fox's Hill.

Flood Hazard

Map A2 shows the flood depth expected during a 1% AEP flood event in Midsomer Norton/Radstock. The deepest floodwaters are shown in the floodplain upstream of Station Road in Midsomer Norton, and in-channel along the Wellow Brook through Radstock. As per the latest Environment Agency/Defra guidance[1] on assessing flood risk to people, all flood waters deeper than 1.25m which are still and free of debris are considered dangerous for some. In times of flooding the watercourses in the study area will not be still or free of debris and as such velocity and debris need to be considered when assessing flood hazard.

Velocity information which is detailed enough for mapping is only available in areas where detailed 2D hydraulic models have been prepared. There are no 2D models available within Midsomer Norton or Radstock and as such, the 1D hydraulic models of the River Somer and Wellow Brook have been used to provide an indication of the velocities that may be experienced during a 1% AEP flood event (note: the 1D model only provides averaged velocities for each cross-section).

The maximum velocities expected in the upper Wellow Brook (upstream of Station Road), upper River Somer (upstream of the river split) and Kilmersdon Brook are expected to be less than 0.5m/s. Slightly higher velocities (up to 1m/s) are expected in the lower River Somer and Snails Brook. The flood risk to people guidance[1] indicates that for a velocity of 0.5m/s, the depth of flood water only needs to be 0.75m for it to be considered dangerous for some.

In these areas floodwater is not expected to be very deep and as such the floodwater is mostly categorised as "dangerous to some." The most hazardous floodwater is upstream of Station Road where the flood water is expected to be deeper and lower River Somer and Snails Brook with slightly higher velocities. Here the floodwater during a 1% AEP flood event is considered to be "dangerous for most".

Maximum velocities in the lower Wellow Brook (downstream of Station Road) are expected to be higher (1.5m/s) and when combined with greater depths of flooding leads to extremely hazardous flood water which is considered "dangerous to most". This type of flooding is symptomatic of the channel improvement works that have been undertaken to enhance conveyance.

In addition to hazardous reaches of open channel, floodwater is expected to be accelerated through a number of structures within the study area including the River Somer Flood Tunnel and several small culverts in the upper Snails Brook. Here maximum velocities may reach more than 3m/s, indicating that all floodwater of any depth is considered "dangerous to some".

Site specific flood risk assessments should use this or more detailed flood depth and velocity information to assess flood hazard at potential development sites within the floodplain of Midsomer Norton and Radstock (see Recommendation 7 in Section 5).

Flood risk from the sea (tidal)

Midsomer Norton and Radstock are not at risk of flooding from the sea (or tides).

Flood risk from land (surface water)

[1] Defra/Environment Agency (2006) "Flood Risks to People Guidance Document" Technical Report FD2321/TR1

Flooding from land (surface water flooding), occurs when intense, often short duration rainfall is unable to soak into the ground or enter drainage systems. It is made worse when soils are saturated so that they cannot accept any more water. The excess water then ponds in low points, overflows or concentrates in minor drainage lines that are usually dry. This type of flooding is usually short lived, localised and associated with heavy downpours of rain. Often there is limited warning before this type of flooding occurs.

Urban areas usually have extensive drainage or sewer systems. In urban areas it is complicated to determine whether flooding has been caused by surface water or sewers. For the purpose of the SFRA, any flood risk associated with direct runoff from surrounding land onto the urban area has been considered as flooding from land (surface water). Any flooding within the urban area itself where a comprehensive sewer system exists has been considered flooding from sewers.

The spatial analysis undertaken during the Level 1 SFRA indicated that much of the urban may be affected by flooding from land (surface water flooding). This analysis did not consider the impacts of the sewer system in the area and as such may have over-estimated this source of flooding. The Environment Agency do not hold any records of flooding from land within Midsomer Norton / Radstock or surrounds, which indicates that this source of flooding may not be significant. A more detailed study would be necessary to precisely understand the extent and frequency of such flooding (see Recommendation 1 in Section 5).

The data provided by Wessex Water for sewer flooding indicates that there have been a number of incidents of sewer flooding within the urban area (as described in the Flooding from Sewers section of this report). It is probable that some of these flood incidents could have been attributed to both flooding from land (surface water) in combination with flooding from sewers.

Given the extensive urban drainage system within Midsomer Norton / Radstock all flooding within the urban area has been addressed as sewer flooding. And flooding from land is considered low.

Surface Water Management Plans should be prepared where a more strategic approach is required to effectively manage surface water disposal and flood risk. The requirement for SWMPs within Midsomer Norton / Radstock is discussed further in Chapter 4.

Flood risk from sewers

Flooding from sewers occurs when rainfall exceeds the capacity of networks or when there is an infrastructure failure. For the purposes of this SFRA sewer flooding is defined as any flooding which occurs in an urban area with a comprehensive sewer network. This includes combined and surface water sewers, culverted minor watercourses (lost watercourses), sewer pumping stations and water treatment facilities. It does not include flooding from over land drainage systems in rural areas.

A probabilistic assessment of the risk of flooding from sewers is not within the scope of this document. Instead the likelihood of flooding from sewers has been assessed using historic flooding information and consultation with relevant stakeholders.

The Environment Agency Flood Reconnaissance Information System (FRIS) does not contain any records of flooding from sewers, however Wessex Waters ‘Flood Properties Register’ contained 14 incidents of flooding (note: Wessex Waters’ register is a live document, a property is added to the register when a problem is encountered, and it is removed from the register when the problem is resolved).

Results from analyses of sewerage systems using hydraulic models provided by Wessex Water has also been used to assess areas more susceptible to sewer flooding. These were available for foul and combined sewer systems only, therefore do not provide full information on the capacity and flood risk from surface water sewers. Sewer systems which rely on pumps can also be more susceptible to flooding so the assessment has included consideration of the location of these pumping stations.

The assessment indicated that the majority of sewers within Midsomer Norton / Radstock do not have spare capacity to accept additional runoff from new development and/or climate change.

The sewers that are shown more likely to flood are concentrated in three areas; west of the town in the vicinity of Wellow Brook; Chilcompton Road / Redfield Road area to the southwest of the town; and east of the A367 in the Waterloo Road / Frome Road area. Floodwater from sewers is likely to follow major flow paths such as roads towards low-lying areas where flood depths may be high.

Flood risk from artificial sources

Midsomer Norton and Radstock are not currently at risk of flooding from artificial sources.

Flood risk from groundwater

For the purpose of the SFRA, groundwater flooding has been defined as flooding from sub-surface water. There are a number of mechanisms that can cause this type of flooding including regional groundwater rise, underground barriers to flow and rebound when pumping from mining activities ceases.

The spatial analysis undertaken for the whole of B&NES in the Level 1 SFRA (Map G3) indicated that there was a low to medium risk of groundwater flooding in Midsomer Norton / Radstock. The Environment Agency does not hold any records of groundwater flooding in this area and does not consider it a significant issue in Midsomer Norton / Radstock.

3. Managing flood risk today

Introduction

Structures and defences are built to help reduce the occurrence, and therefore consequences of flooding. These assets can be owned, operated and maintained by the Environment Agency, Local Authorities, private business and/or local residents.

In some instances, river processes have been modified over time by these defences (such as river walls, flood storage areas, flood alleviation channels and embankments) and by undertaking maintenance activities (such as river dredging, drain clearance and debris removal from trash screen).

The Environment Agency manages flood defences as groups of structures, rather than individual assets. These groups are termed 'management units' and will be identified and managed through System Asset Management Plans (SAMPs). The SAMP that includes Midsomer Norton / Radstock is shown in Map D1 and includes:

ID and map ref.	Name	Description	Draft FRM Systems Standard
FR/14/S084 (Map D1)	Wellow Brook HMR	The Wellow Brook between Tyning and Thicketmead Bridge, the River Somer, Snails Brook, and Kilmarsden Stream	High
FR/14/S085 (Map D1)	Wellow Midford Cam	The Cam catchment, Midford Brook, and the Wellow Brook from Tyning to the confluence with the River Cam at Midford	Low

The formal flood defences influencing flood risk management in Midsomer Norton and Radstock have been identified through interrogation of the Environment Agency National Flood and Coastal Defence Database (NFCDD). In accordance with the Environment Agency's "Areas Benefiting from Flood Defences" guidance, there are no formal flood defences in Midsomer Norton or Radstock (Map D2 in Annex A has been added for completeness).

However the results of the flood zone analysis indicate that the length of the watercourse defined by the Environment Agency as "Maintained River Channel" and Midsomer Norton Flood Alleviation Team afford a significant level of protection to the Midsomer Norton and Radstock areas. The NFCDD also includes information that indicates that the tunnel and maintained channel may provide protection up to a 1% AEP standard. Further investigation is recommended to determine the residual risk associated with the failure of this infrastructure (see Recommendations 2 and 3 in Section 5).

Midsomer Norton Flood Alleviation Scheme

The Midsomer Norton Flood Alleviation Scheme comprises a low flow channel through the centre of Midsomer Norton and a flood alleviation tunnel around it. The inlets start at Midsomer Norton cricket ground, with a second tunnel inlet immediately upstream of the town centre. In addition to this significant channel improvements (as implemented in 1981) have been undertaken some 500m downstream of the lower extent of the modelled reach. Two sluice gates are used to control flows continuing down the River Somer into the town centre.

The Environment Agency confirmed that there have been two incidents of property flooding since the scheme was completed, which may have been caused by a combination of surface water flooding and the sluice gates being left partially open during flood events.

The channel through the centre of Midsomer Norton is designed to take local surface flood water, and has a secondary sluice gate immediately upstream the High Street to help manage localised flooding.

Maintained River Channels

In addition to the flood defences identified some sections of maintained channel and steel piling are included in NFCDD as having a standard of protection between 20% AEP and 1% AEP. These maintained reaches include sections the River Wellow through Radstock (2.5 to 1% AEP) and limited sections of the Wellow and Somer around structures and former industrial developments (such as Welton Bag Factory).

Sections of maintained channel and sheet piling are not considered defences by the Environment Agency when assessing areas benefiting from defences. The SFRA methodology has adopted the Environment Agency advice when assessing the impact of flood defences in the SFRA. These assets have not been removed in the 'without defences' modelling scenario but it is evident that they do provide a significant degree of protection.

Current condition and upkeep of flood defences

The Environment Agency operates a formal flood defence scheme (FDS) in Midsomer Norton, which diverts high flows in the River Somer through a flood culvert to bypass the town centre. A sluice gate is used to control flows continuing down the River Somer into the town centre. A visual inspection of the flood culvert and sluice gate was completed during a site visit on 20 August 2008 and appeared to be in a fair to good condition which is consistent with the "quality flag" information in the Environment Agency's NFCDD dataset.

The Environment Agency operations procedures for the FDS include clearing of trash screens and any silt build-up in the channels, maintaining the penstock and sluice gates, and reporting any requirements for bank maintenance or tree surgery.

Closer to the town centre, there is another sluice gate operated by B&NES to prevent high flows in the River Somer continuing into the High Street area. There are also flapped surface water outfalls upstream of this point to prevent high river levels backing up through the sewer system. The condition of the sluice gate could not be observed during the site visit.

It is understood from B&NES that there are no defined operating or maintenance procedures in place for the sluice gate and that regular condition inspections are not currently completed although when resources are available B&NES aim to complete visual inspections at monthly intervals.

Probability and consequences of overtopping or failure

Failure of the Environment Agency flood defence scheme could occur through blockage of the flood diversion channel and / or leaving the sluice gate on the low flow channel in an open position during a flood event. The flood defence scheme operated by the Environment Agency includes a sluice gate on the low flow channel which flows along the Midsomer Norton High Street. The Environment Agency advise that the sluice gate is permanently locked in a ‘near-closed’ position, thereby reducing the risk of it being open during a flood event.

An indication of the area that may flood if the flood alleviation tunnel were to fail is shown on Map A4. Any proposed development within this area should consider this scenario further as part of a detailed flood risk assessment. The likelihood and consequence of blockage of the diversion culvert is discussed below.

The second manually operated sluice gate further downstream is the responsibility of B&NES and it is understood that B&NES do not currently have set procedures for operating this gate. The risk of failure through the gate being left open is therefore considered relatively high. The upstream defence scheme should reduce fluvial flows in the River Somer, thereby reducing the consequence of failure of this sluice gate. However, high flows from more localised storms still pose a risk to properties in the town centre downstream. It is anticipated that failure to close the sluice gate could lead to localised flooding. This form of flooding should be considered in more detail as part of detailed flood risk assessments for

any proposed development in the High Street of Midsomer Norton. Similarly the "Maintained River Channel" through Radstock affords a significant degree of flood protection and failure to make a commitment to the continued maintenance of this facility would significantly affect the residual flood risk.

The potential impact of blockage upon flood risk (residual risk)

Having been identified as key infrastructure, the probability and consequence of blockage of the Midsomer Norton flood alleviation tunnel has been assessed during the Level 2 SFRA.

An assessment of the probability of blockage has been completed using an Environment Agency Blockage Risk Assessment Tool[2]. The data used in the assessment included construction photographs, ground survey, and a site visit by senior flood engineers. The culvert is large, with trash screens fitted to the upstream and downstream faces. The trash screens appear to be well designed for ease of maintenance and clearance of debris. Using the Blockage Assessment Tool, the tunnel is estimated to have a low probability of blockage.

Despite the low probability of blockage, the hydraulic model obtained during the Level 1 SFRA was used to estimate the area that may be expected to flood during a blockage scenario. The model showed that if a significant blockage were to occur, the river levels immediately upstream of the tunnel would be increased. However due to the number of weirs and drop structures through the tunnel, the number of properties affected by this increase in water level is uncertain. Any proposed development upstream of the Midsomer Norton flood alleviation tunnel should consider the impact of blockage through a detailed flood risk assessment.

Several trash screens are present on minor culverts at road crossings throughout Midsomer Norton. The risk of blockage of these culverts is relatively high. However the consequence is considered relatively low, with blockage of the trash screens likely to cause very localised flooding as flood waters overtop the road and return back to the channel.

Summary of flood warning and emergency planning

PPS25 states, 'the receipt of and response to warnings of floods is an essential element in the management of the residual risk of flooding'. Thus it recognises that flood warning and emergency planning is an important measure for managing flood risk from extreme events.

The Environment Agency is responsible for monitoring flood events and to issue warnings to people in properties and businesses at risk of flooding. Forecasting uses a combination of Meteorological Office weather forecasts and real-time data (rainfall, flow, level and soil moisture).

The Environment Agency provides a warning service for Radstock, but at the time of writing the Flood Warning Services does not extend as far as Midsomer Norton. Map W in the annex to this document outlines the areas included in the Flood Warning services. The codes for the Environment Agency Flood Warning Services are:

Area code	Flood warning area
112FWF3G5A	Midford Brook, Cam and Wellow Brooks

B&NES are encouraged to work with the Environment Agency to ensure that as many homeowners as possible as signed up to this service, and that any new properties are also aware of the service. It is also suggested that the decision for not providing Midsomer Norton with a Flood Warning Service is re-examined by the Environment Agency.

The Civil Contingencies Act 2004 classifies Local Authorities as Category 1 responders along with other organisations such as the Police, Fire, Ambulance services. The role and responsibilities for emergency

[2] Environment Agency, South West Region, Culvert Blockage Risk Assessment, Version 1.04 (January 1998)

planning is set out by legislation following the implementation of the Civil Contingencies Act 2004. The Act defines the term 'emergency' as:

- *'an event or situation which threatens serious damage to human welfare;*
- *an event or situation which threatens serious damage to the environment, or*
- *war, or terrorism, which threatens serious damage to security'.*

During flood incidents the Environment Agency issues warnings to those likely to be affected, operates flood defences on certain rivers and advises the emergency services on the expected level of flooding. The Environment Agency and Local Authority also liaise closely during a flood incident, and B&NES will implement a range of contingency plans which detail how local services will work together to respond to any type of incident or disaster. These plans include but are not limited to a Civil Emergency Manual, Flood Plan, and Emergency Communications plan.

Further details on the Flood Warning and Emergency Planning procedures are contained in the Technical Report of the Level 1 SFRA.

4. Managing flood risk in the future

Flood defences

Likely future flood management policy regarding maintenance and upgrade

The River Avon Catchment Flood Management Plan (CFMP) covers most of the B&NES District. The CFMP is divided into management units which have a policy assigned to provide an overall direction in the way flood risk should be managed in each unit. The urban area of Midsomer Norton / Radstock is defined as its own policy unit and has a policy of "sustain the current level of flood risk". This means that works can be undertaken to ensure that the current level of flood risk today is maintained into the future (given the potential impacts of climate change). Or conversely implement measures so that the existing level of flood risk is not increased in the future.

The Environment Agency prepares System Asset Management Plans for the flood defence infrastructure under its responsibility. These are regularly reviewed and updated, and should be referred to for up to date information on planned maintenance and upgrades.

Managing surface water flood risk

Identifying the scope and need for a surface water management plan

The responsibilities for surface water management fall to a number of bodies including the Environment Agency, B&NES, Wessex Water and highways authority. Management of surface water is therefore a complex issue, best dealt with using a strategic and co-ordinated approach. SWMPs therefore have an important role in developing a coordinated strategic approach to managing surface water drainage and reducing flood risk and provide a platform so that climate change effects do not give rise to exacerbation of urban flooding.

The PPS25 Practice Guide outlines the key purposes of Surface Water Management Plans (SWMP) as:

- ensuring that allocations within an area are properly supported by adequate surface water management;
- providing a common framework for stakeholders to agree responsibilities for tackling existing drainage problems and preventing future problems;
- where development pressures are high it can be part of a Water Cycle Strategy; and
- demonstrating how capital investment, infrastructure and maintenance can deliver the required surface water management.

SWMPs are required for a number of reasons including:

- to identify locations where there is evidence of existing problems with the drainage infrastructure and therefore a requirement for upgrade to deal with surface water now and into the future;
- consideration of the implications of potential large-scale development where surface water may be best managed with a strategic approach, rather than on an individual development scale; and
- the evaluation of the potential opportunities to implement a coordinated approach by several bodies to plan infrastructure improvements.

The preparation of the SWMP should be specific to the location and nature of the drainage surface water infrastructure and flooding mechanisms.

We have identified critical drainage areas in a number of ways, including;

- An analysis of historic flooding information and existing capacity assessments;
- An assessment of potential allocation sites; and
- Consultation with key stakeholders including Wessex Water, Highways Authority, Bristol Water, the Environment Agency and B&NES technical specialists.

The following specific drivers for SWMPs have been identified in Midsomer Norton / Radstock, which should be addressed through the preparation of SWMPs and subsequent drainage strategies:

- The majority of the existing sewer infrastructure throughout Midsomer Norton / Radstock is unlikely to have sufficient capacity to cope with additional runoff resulting from climate change and future developments. A SWMP for the town is recommended, which should consider appropriate policies and strategies to prevent additional load on the existing system and a co-ordinated investment strategy for future improvements. The SWMP should consider appropriate policies for encouraging water cycling at existing properties and any new infill properties. Separate SWMPs and / or drainage strategies may be required for the following areas where the likelihood of flooding is greater and a more comprehensive upgrade may be required:
  - West of the town in the vicinity of Wellow Brook;
  - Chilcompton Road / Redfield Road area to the southwest of the town; and
  - East of the A367 in the Waterloo Road / Frome Road area.
- Future development for Midsomer Norton / Radstock is likely to consist mainly of infill development within the existing urban boundary. It is recommended the SWMP for the town examine the potential impacts of future development. The SWMP should aim to ensure that different land owners and land managers can contribute to the system to ensure that the new development as a whole is safe from flooding and would not exacerbate surface water flooding elsewhere. Where possible the SWMP should include appropriate policies and strategies to prevent surface water runoff from new developments contributing to the existing drainage system, and if possible use the new development to reduce the existing load on the system. The SWMP should also consider options for managing water onsite which could be used to reduce the requirement for other water resources within the area

There are a number of mechanisms for delivering the SWMPs, including through the location and design of new development, preparing for emergencies, and investment in capital infrastructure and maintenance.

Using the planning process to reduce flood risk

Policies for sites which will need to satisfy Part C of the Exception Test

Proposals which are required to satisfy Parts a) and b) of the Exception Test have, by definition, been located in an area which is not generally considered to be appropriate for development. Part c) of the Exception Test requires that these developments are safe, do not increase flood risk elsewhere and, where possible, reduce flood risk overall.

A Flood Risk Assessment (FRA) will be required to demonstrate that Part c) of the Test has been passed. The specific requirements will depend on the development and location in question; however general items to consider are outlined below.

'Safe' development requires that development is designed such that the likelihood of flooding at the development, and the consequences of flooding that does occur are not too severe and in particular are unlikely to lead to loss of life and disruption to normal living. The flood hazard, related to flood depths and flood velocities is one of the most important considerations for safe development with respect to access and egress during a flood for the public or attendance of emergencies by the Fire Rescue Service. Guidance and advice on acceptable flood hazard for different circumstances is regularly updated and therefore it is advisable that B&NES set policies that refer to using up to date guidance rather than setting fixed policies within the LDF. B&NES may wish to consider policies for the following items:

- Development layout – the development layout should be designed so that where possible more vulnerable (e.g. residential) land uses are located at the lower risk areas of the site.

- Basement dwellings within a flood risk area can be at particular risk and therefore should be avoided where possible.

- Development and floor levels may need to be raised for safety. Development levels set above the estimated flood level (to remain dry during an event) are the safest however developments that flood can still be considered safe. FRAs should refer to the latest guidance when assessing acceptable flood depths, velocities and freeboard allowances.

- Safe access is a requirement stated in PPS25. Dry vehicular access is preferable, although pedestrian and flooded access may also be acceptable provided it is safe. FRAs should refer to the latest guidance when assessing acceptable flood depths, velocities and freeboard allowances.

- For the residual risk events consideration should be given to the capacity of the emergency services to operate effectively in the light of anticipated level of flood hazard (most influential being flood depth and flood velocity).

- The requirement to ensure that all proposed critical civil infrastructure is implemented so that it remains operational during the residual risk and overtopping and failure events.

- The potential impact of residual risk events (high intensity rainfall events) should be analysed and proposed information should be designed so that it is not harmed by surface water or land flooding episodes.

Developments can increase flood risk elsewhere through three main flood mechanisms:

- Increase in surface water runoff

- Loss of flood plain storage

- Impacts on flood flow routes

FRAs should demonstrate that the development will not adversely impact on flood plain storage or flood flow routes, and that where necessary competent mitigation measures are provided. SuDS systems should be employed to manage surface water runoff, according to the system priority as set out in the User Guide. Alternatively, surface water management should be in accordance with a relevant SWMP.

FRAs should provide evidence that the possibility of reducing flood risk through the development has been considered. This could be by providing additional flood plain storage enhance the existing capacity, reducing surface water runoff below existing levels and replacing more vulnerable land uses with less vulnerable land uses. The FRA should provide justification why it is not possible to reduce flood risk if this is the case.

Flooding from sewers (and the 'backing up' of the sewer network when the river is in flood) should be managed by the development control process. Further collation of all relevant data, such as sewer capacity, past events and consultation with water companies and operating authorities should be undertaken when preparing site specific flood risk assessments, particularly for extensive development.

Guidance on the preparation of Flood Risk Assessment (FRA)

The FRA will be required to demonstrate that flood risk to the development and from the development can be managed now and in the future. Planning applications for development proposals of 1 hectare or greater in Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3 require a FRA.

The FRA is required whether the site is a windfall site or an allocated site (i.e. in the Local Plan). Furthermore, a FRA is still required if a site has been subject to a sequential test and, if necessary, an exception test.

Flood Risk Assessments should consider all sources of flooding and where appropriate, mitigation measures and should evaluate conditions for the proposed lifetime of the development so that climate change effects are considered. Where risk of flooding from sources other than the sea or rivers has been identified such as groundwater or surface water flooding the FRA needs to consider the risk of flooding at the site. FRAs should also consider the impact of the development on flood risk elsewhere. Residual risks should also be assessed.

The SFRA User Guide (Volume II of the Level 1 SFRA) contains detailed advice on the scope of the FRA (section 5.3) and advice for developers in undertaking the FRA (section 5.2).

The scope of the FRA should always be consummate with the scope and scale of flood risk, the scope should be determined in consultation with the Environment Agency and B&NES at the earliest opportunity. The scope must always include a statement of the existing flood risk, details of the proposed development, a statement on the flood risk management measures and their affects upon the baseline risk and finally a statement of residual risk. Consideration must always be given to both the site, and potential off site impacts.

PPS25 advocates a three tiered approach to undertaking a FRA (Table 2.3, 2.4) that is presented in CIRCA publication C624 Development and Flood Risk – guidance for the construction industry. The three tiers are;

- Screening study
- Scoping study
- Detailed study

More details of the scope of each study can be found in the PPS25 Practice Guide.

Screening study in Midsomer Norton / Radstock

The screening study for Midsomer Norton / Radstock is captured in the content of this document, and the Level 1 SFRA for B&NES. These documents define the Flood Zones, and in doing so the areas where there are further flooding or surface water issues that warrant further consideration. Furthermore, the site specific assessments presented in the annex to the User Guide (volume I of the level 1 SFRA) include screening studies for specific sites identified in the B&NES adopted local plan.

All sites greater than 1.0ha in size (even if located in an area with a low probability of flooding), are required to prepare a flood risk assessment that considers the implications of increased runoff rates from the site.

Scoping studies in Midsomer Norton / Radstock

According to Table 3.5 in the PPS25 Practice guide, the Scoping study to be undertaken if the Level 1 FRA indicates that the site may lie within an area that is at risk of flooding or that the site may increase flood risk due to increased run-off.

The scoping study should explore and assess whether there is sufficient existing quantitative information to undertake an appropriate FRA. The assessment should be based on the existing information presented in the full Level 1 SFRA for B&NES, and other documents listed in Table 3.6 of the PPS25 Practice Guide.

Preparing a FRA at this stage assumes that no new data is required. FRAs prepared for Midsomer Norton / Radstock should pay particular attention to;

- the source and certainty of information as outlined in the Technical Report,
- variation of river flood depth, velocity and climate change information (Maps A2 and A3),
- design flood levels (as advised by the Environment Agency),
- the availability of a safe and dry access routes (safe) (Maps F and A1),
- whether the site may be at risk of reservoir flooding (Map R),
- consideration of which SuDS features may be used in the development.

In any case, statements on the proposed development type and vulnerability of the intended residents and any flood risk mitigation / management measures will be required.

Detailed studies in Midsomer Norton / Radstock

According to Table 3.5 in the PP25 practice guide, a detailed study is to be undertaken if the Level 2 FRA concludes that further quantitative analysis is required to assess flood risk issues related to the development site. Usually this quantitative analysis will be based on extending or improving an existing flood risk model or by producing a new flood risk model where the development:

- is located in an area where the source and certainty of information is considered low,
- is located within 50m of an area already identified with a higher probability of flooding (following an assessment of the local topography),
- lies within the area at risk of flooding from failure of the River Somer flood alleviation scheme,
- is located within 100m upstream or downstream of a sluice gate,
- is located in an area identified as a critical drainage area, and in particular if it falls under a surface water management plan (SWMP).

A detailed study would usually be required if any form of flood risk mitigation / management were required (even for sites in Flood Zone 1, where a Greenfield runoff calculation is usually made in preparation for the design of suitable sustainable urban drainage and / or compensatory storage).

Guidance on the use of Sustainable Drains Systems (SuDS)

Flooding from rivers, sewers, and surface water is likely to increase throughout Midsomer Norton and Radstock in the future as a result of climate change. However in addition to this the impact of new development on flood risk needs to be considered, both at the new development site and existing developments within the catchment. SuDS aim to control surface water runoff as close to its origin as possible, before it is discharged to run over the surface, into a watercourse or sewer. This involves moving away from traditional piped drainage systems towards softer engineering solutions which seek to mimic natural drainage regimes.

Section 2-15 to 2-18 of the technical report in the Level 1 SFRA contains detailed documentation on what SuDS are, what options exist and their relative sustainability in terms of flood reduction, pollution reduction and wildlife / landscape benefit. A methodology for appraising the strategic suitability for SuDS as also been applied and a series of Maps (Map L2a to L2f) produced to accompany guidance on the capacity for using SuDS in B&NES, as outlined in the Level 1 assessment.

There may also be some benefit to be realised in managing sustainable urban drainage using economies of scale, particularly for any new developments, by designing in larger community scale SuDS at the outline planning application stage.

5. Recommendations

The long term management of flood risk, from all sources of flooding, will require a multi-lateral, multi-agency approach. The following recommendations are made on the basis of the findings of this SFRA.

Understanding the sources of flood risk

1. Further assessment is required of the potential of sewer / surface water flooding in Midsomer Norton / Radstock. This should consider the potential impacts of increased runoff from new development in the town, and the impacts of locked-outfalls in the development sites adjacent to the River Somer and Wellow Brook.

2. Prior to any development being permitted on land adjacent to the River Somer low flow channel in Midsomer Norton, a detailed flood risk assessment is required to understand the probability and resultant consequences of flooding associated with blockage or failure of the Midsomer Norton Flood Alleviation Scheme (including failure of operational procedures).

3. Prior to any development being permitted on land adjacent to the Wellow Brook in Radstock, a detailed flood risk assessment is required to understand the risks associated with a change in maintenance regime of the "Maintained River Channel".

4. A cover note should be added to the Level 1 SFRA to outline the amendments that have been made to the Midsomer Norton / Radstock Level 2 SFRA (based on the Environment Agency Flood Zones version 3.12) and to explain that the Level 1 SFRA has not been updated.

5. Prior to any development being permitted adjacent to Clandown Bottom a detailed hydraulic model should be developed to improve Flood Zones in that area.

6. B&NES to update the urban boundary shown on Map O to include the residential properties and green space located along Staddlestones, Furlong Close and Cautletts Close.

7. Site specific FRAs should include an assessment of the flood hazard[3] using both depth and velocity information for development proposed within the floodplain of Midsomer Norton / Radstock.

8. B&NES to prepare/commission a 'Sequential Test' report which provides an assessment of food risk at potential allocation sites, site-specific policy recommendations, and site-specific flood risk assessment guidance.

9. B&NES to prepare/commission a 'Scoping Report' for flood risk management to identify potential options for managing flood risk in key areas, and provide an outline assessment of these options.

Managing flood risk today

10. B&NES and the Environment Agency should continue to work together so that all properties at risk of flooding in Radstock are "signed up" to the Environment Agency Flood Warning Service.

11. Consideration should be given to extending the flood warning service to include Midsomer Norton.

12. A new flood risk/drainage officer to be appointed in B&NES and funded by new development.

13. B&NES to formalise in writing current inspection, maintenance and operational procedures for the channel and sluice gates on the River Somer.

[3] Defra/Environment Agency (2006) "Flood Risks to People Guidance Document" Technical Report FD2321/TR1

14. B&NES and the Environment Agency to agree and formalise operational procedures for the second sluice gate (closest to the Midsomer Norton High Street) on the low flow channel of the Midsomer Norton flood alleviation tunnel.

Managing flood risk in the future

15. Prepare a surface water management plan in Midsomer Norton / Radstock, considering flood risk from existing sewer systems and land surrounding the towns, as well as the additional pressures placed due to new development. This should consider the potential impacts of climate change and be incorporated with the water cycle strategies. In particular the SWMP should cover infrastructure improvements in the areas highlighted in chapter 4.

16. Review the capacity of the Fire Rescue Services to respond to residual risk events.

17. Ensure that any critical civil infrastructure that is implemented remains operational during residual risk events.