Mendip District Council
Strategic Flood Risk Assessment

Mendip District Council

April 2008

Final Report

9T1649

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SUMMARY

This Strategic Flood Risk Assessment (SFRA) was produced by Royal Haskoning in April 2008 for Mendip District Council (MDC). This SFRA represents the views of Royal Haskoning which have been guided by a steering group of representatives from MDC, the Environment Agency (EA), and Somerset County Council (SCC).

The content of the SFRA is presented as a series of A1 maps outlining historic, current and future flood risk, electronic data to be used in a Geographical Information System (GIS) and a report providing background information and technical guidance for managing flood risk. Combined use of these deliverables will enable consistent and sustainable decisions to be made with respect to both current and future flood risk.

A SFRA is an overview of Flood Risk within a specific area and aims to provide general guidance to local authority planners, developers and other interested people, including the general public about locations where flood risk is a potential issue. Information regarding flood risk is important because flooding may result in loss of life and can cause distress, harm, destruction and large scale and expensive damage to properties. The information in a SFRA helps to guide the local planning authority in making judgements on allocating land through the planning process.

It is a government requirement that flood risk is considered in the process of allocating land for development. Guidance recommends that sites for development should be allocated starting from those of lowest flood risk. This sequential process is documented in Planning Policy Statement 25 (PPS25): Development and Flood Risk. The government aims to reduce the risks from flooding to people and the developed and natural environment by discouraging further built development within floodplain areas and by promoting best practice for the control of surface water runoff.

Flooding is an issue with varying levels of severity across most of the study area with approximately 6% of properties within the district located in areas at risk of flooding or within a short distance of known flooding incidents. Significant flooding in the area is mainly caused by the overtopping of river banks, e.g. the Glastonbury Millstream around Glastonbury, whilst less severe flooding is predominantly from surface water runoff and the blockages of drains and culverts. MDC has no coastline and therefore tidal flooding is not a problem in the area, although the EA Flood Zones do highlight that tidal flooding does have an impact across the Somerset Levels and Moors.

Extensive records of historical flood events exist across the area with flooding in Glastonbury documented as early as 1894. These records have been sourced from MDC and the EA, and then supplemented with information from Parish Councils, local residents and Wessex Water. The historic information has been used in conjunction with other data such as Flood Maps detailing extents of flood risk and information about the location of defences, provided by the EA.

Information about the management of flooding has been provided with a particular focus on surface water flooding as this is a major cause of flooding incidents in the Mendip District. Where appropriate and relevant, developments should use Sustainable Drainage Systems (SUDS) to control surface water before it enters the watercourse. Within a large urban area such as Frome or Shepton Mallet the combined effect of water

discharge from SUDS must also be addressed to prevent further flooding issues downstream.

A SFRA does not provide definitive conclusions regarding the flood risk to an individual property. If the SFRA indicates that a property or possible area for development is within or adjacent to a flood risk area, then a detailed Flood Risk Assessment (FRA) will be required to assess the site before any decisions can be made. The effect of large development sites on the drainage of adjacent land also needs to be considered as part of an FRA. This is achieved through the identification of Vulnerability Classifications for categories of development and the application of the relevant PPS25 Decision Flow Chart which guides the user through the process step by step to arrive at a valid recommendation. It is designed to be used in conjunction with land allocations identified as part of the Local Development Frameworks.

Flooding is an important issue which must not be ignored. In the future it is likely that flooding could occur more frequently and with more severity due to climate change. By using this SFRA, in combination with site specific FRAs submitted with planning applications for development or change of use, it is possible to allocate land for development in a sustainable way.

CONTENTS

ACRONYMS

a.p	Annual Probability
AONB	Area of Outstanding Natural Beauty
CAMS	Catchment Abstraction Management Strategy
CFMP	Catchment Flood Management Plan
Defra	Department for Environment, Food and Rural Affairs
DPD	Development Plan Documents
DTM	Digital Terrain Model
EA	Environment Agency
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
FRIS	Flood Reconnaissance Information System
GIS	Geographic Information System
HFM	Historic Flood Map
LDD	Local Development Documents

LDF	Local Development Framework
LiDAR	Light Detection and Ranging
LPA	Local Planning Authority
MDC	Mendip District Council
NaFRA	National Flood Risk Assessment
NFCDD	National Flood & Coastal Defence Database
PFRA	Potential Flood Risk Areas
PPS25	Planning Policy Statement 25
RPB	Regional Planning Bodies
RSS	Regional Spatial Strategy
SCC	Somerset County Council
SFRA	Strategic Flood Risk Assessment
SOP	Standard of Protection
SPR	Standard Percentage Runoff
SSSI	Sites of Special Scientific Interest
SUDS	Sustainable Drainage Systems

1 INTRODUCTION

Mendip District Council (MDC) commissioned Royal Haskoning in December 2007 to undertake a Strategic Flood Risk Assessment (SFRA) for the areas within the Council boundary. This SFRA informs and provides evidence for part of the process MDC are undertaking to prepare their Local Development Framework.

This SFRA was produced in April 2008 and represents the views of Royal Haskoning, which have been guided by a steering group comprising of MDC planners and engineers, the Environment Agency (EA) and Somerset County Council (SCC) representatives.

1.1 What is a SFRA?

A SFRA is an overview of current and future flood risk to a particular local authority area. This predominantly desk-based study provides details of where flooding has occurred, where there is existing risk and where there could be risk in the future. It also provides details of the defences and structures in place to reduce that risk. Using all the information provided within the SFRA, Local Authorities can make informed judgements regarding the effects potential developments could have on the existing and future flood risk in the surrounding area.

Flooding is a serious environmental hazard and is caused by an often complex interaction of rainfall and associated runoff, tidal water, climatic conditions and the potential obstruction to flows from structures. The level of flood risk in the Mendip study area is the product of the frequency or likelihood of flood events and their consequences. Flooding of properties causes' disruption, damages, distress, harm and can result in loss of life. It is therefore very important to try and prevent any inappropriate new development taking place in an area that is at a high risk of flooding, or will increase the risk of flooding elsewhere.

Reducing the vulnerability of the MDC study area to the dangers and damage caused by unmanaged floods, contributes to promoting a better quality of life, achieving some of the objectives of sustainable development and maintaining existing communities. Local planning authorities have to address the problems which flooding can cause when determining planning applications both now and in the future.

The information in a SFRA helps to guide the local planning authority in making judgements on allocating land through the planning process. It also informs the preparation of strategic policy and development control policy towards flooding and flood risk to include in the Local Development Framework (LDF). The information can be used as evidence for planning policy-making and to inform development control decisions.

The government recommends (through Planning Policy Statement Note 25 (PPS25) Development and Flood Risk) that, when drawing up or revising development plans, sites should be allocated for development starting from those of lowest flood risk. This is because the government aims to reduce the risks to people and the environment from flooding, by discouraging further built development within floodplain areas and promoting best practice for the control of surface water runoff.

1.2 Aims and Objectives

The objectives of the SFRA for MDC are:

- To provide a reference and policy document that will be part of the evidence base to inform the LDF and any subsequent plans.
- To ensure that the MDC meet their obligations under the latest flood related planning guidance (PPS25).
- To provide a reference and policy document for use by the general public and developers to advise and provide information on their obligations under PPS25.
- To use as a tool to inform the development control process about the potential risk of flooding associated with future planning applications and the basis for requesting specific FRAs, if necessary.
- To promote working partnerships between MDC and the EA to develop best practice and data sharing with regard to flood risk information and it's application

1.3 Deliverables

The content of the SFRA is presented in a series of A1 maps, this report and Geographical Information System (GIS) data files (mid/mif files) for use electronically by MDC Officers. The information shown on the A1 maps has been grouped into two categories:

a) Existing and future flood risk (taking into account climate change)
b) Historic flood events and flood defences

These maps highlight areas where flooding is an issue, or could be an issue in the future, and therefore where development should be avoided.

The report provides background information on the details shown in the maps and highlights areas particularly at risk of flooding. It also provides technical information regarding the production of the SFRA and recommendations and guidance for managing future flood risk.

The GIS files provided show the information presented on the maps in an electronic format. These can be updated when new information becomes available therefore ensuring that any decisions being made by planning officers are based on the most up-to-date information available. The maps, GIS files and report combined will enable consistent and sustainable decisions to be made with respect to both current flood risk and into the future.

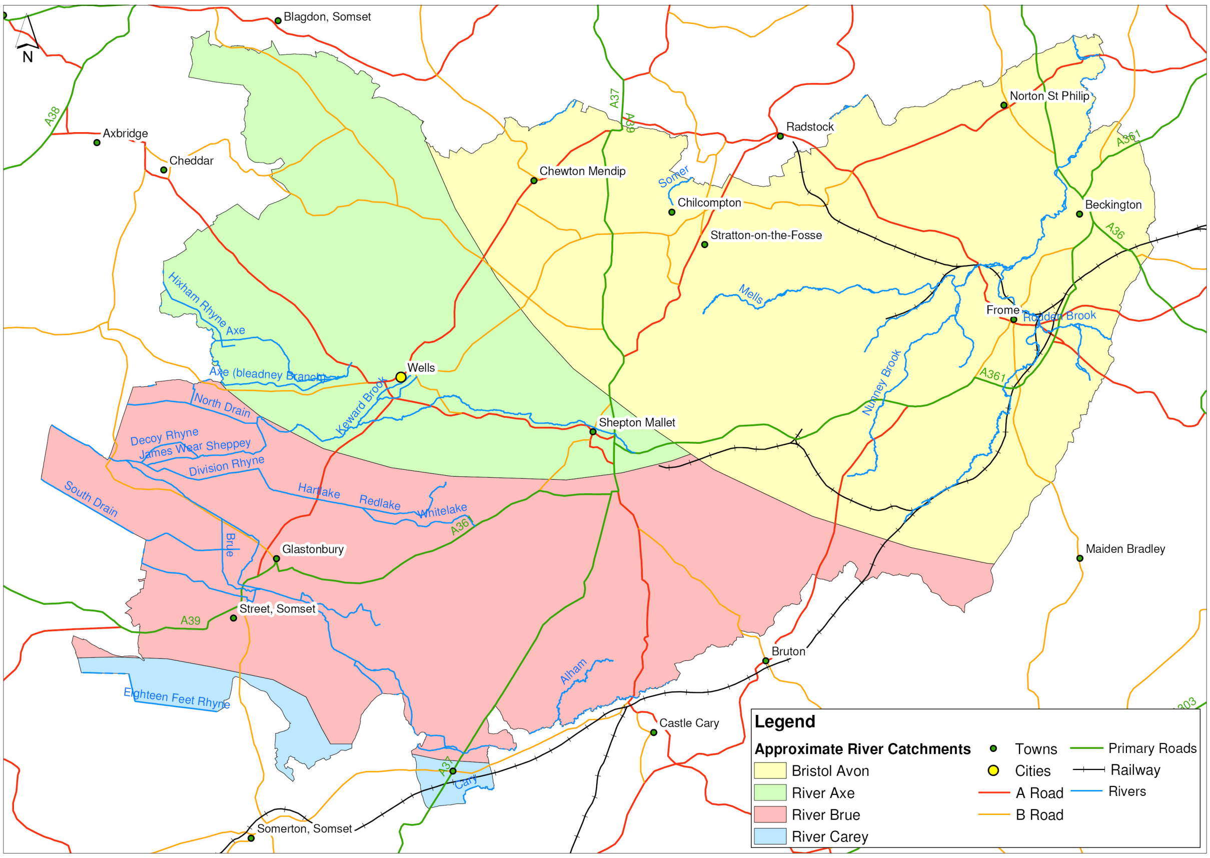
2 STUDY AREA INFORMATION

Mendip District is located in Somerset and is bordered by the districts of Salisbury, West Wiltshire, South Somerset, Sedgemoor, North Somerset and Bath & North East Somerset. The A36, A37 and A39 bisect the district providing a good transport network and links to the M5.

This SFRA covers the entire MDC area, which is approximately 739km^2 in size and split between 4 drainage basins; Bristol Avon, River Axe, River Brue and River Cary (See figure 2.1). These drainage basins reflect the influences of local geomorphology, particularly that of the Mendip Hills and Somerset Levels.

To the north and east of the Mendips, streams and rivers flow into the Bristol Avon system, which includes the River Frome. The principal river system to the west and south is the River Brue, which drains into the Somerset Levels. The River Axe, originating from springs from the Mendips, also drains into the Somerset Levels, eventually discharging near Brean Down to the south of Weston Super Mare. On the very southern fringes of the district, a relatively small area drains to the River Cary which forms part of the Parrett Catchment.

Figure 2.1 - Location Plan



2.1 Description of physical characteristics

2.1.1 River catchments

The majority of significant watercourses are defined as either main rivers or ordinary watercourses. Main Rivers are watercourses defined on a 'Main River Map' designated by DEFRA. The EA has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers, whilst the maintenance of ordinary watercourses is the responsibility of the Local Authority. The majority of the rivers in the MDC area are now designated as main rivers and the responsibility of the EA, although there are still over 370km of Local Authority maintained ordinary watercourses across the study area as well as rhynes that are the responsibility of Internal Drainage Boards.

Details of each drainage basin and the sub-catchments are presented in Table 2.1.

Table 2.1 – Drainage basins in the study area

Catchment	Area (km^2)	% of study area	Length of main river (km)	Sub-catchments
Bristol Avon	316	43	85	R. Frome, Rodden Brook, Redford Watercourse, Mells Stream, Nunney Brook, Sharpshaw Watercourse, Whatley Brook, Wellow Brook, R. Somer, Hollow Marsh Watercourse.
River Axe	161	22	42	Hixham Rhyne, R. Sheppey, Keward Brook, St Andrews.
River Brue	246	33	92	Coxbridge Brook, Baltonsborough Millstream, Barton & Lydford Millstream, R. Alham, West Lydford Millstream, North Drain, Panborough Relief Channel, Panborough Drain, Decoy Rhyne, James Wear, R. Sheppey, Hartlake, Division Rhyne, Redlake, Whitelake, Glastonbury Millstream, South Drain, Glastonbury Canal.
River Cary	17	2	7	Eighteen Feet Rhyne.

The Bristol Avon Catchment

The most significant river in this area is the River Frome, which is a major tributary of the Bristol Avon. The Frome rises near Witham Friary, and flows north through the town of Frome until it reaches the Bristol Avon at Freshford, south east of Bath. The river has a large number of weir structures therefore water levels are maintained longer than many other local rivers. Within MDC area the River Frome covers a length of 34.2 km and has a total catchment size of approximately 280km^2.

Other major watercourses are the Mells Stream, Rodden Brook and the Nunney Brook. The Mells Stream is a tributary of the River Frome. It rises in Nettlebridge, flows eastward through Mells until it joins the River Frome at Spring Gardens, north of Frome. Within MDC it covers a length of approximately 19.9km and has a catchment size of 134km^2. Of this catchment, 28.8km^2 is from the Nunney Brook, which rises to the north west of Wanstrow, flows north east and joins the Mells Stream to the south of Bedlam.

The Rodden Brook is a tributary of the River Frome, which flows in a north-westerly direction for approximately 4.1km until joining with the River Frome at Wallbridge in Frome. It has a catchment area of approximately 30km^2.

The Whatley Brook is another tributary of the Mells Stream, whilst the Sharpshaw Watercourse is a tributary of the Nunney Brook and the Redford Watercourse is a tributary of the Rodden Brook. The final main river in this basin is the River Somer, in the north of the MDC area, which joins with the Bristol Avon.

The Axe Catchment

The Limestone Aquifer on the Mendips is a source rock from which drains the headwater of the Rivers Sheppey and Axe.

The River Axe flows to the west and north-west of the study area. The geology of the area is limestone and the water proceeds down to Wookey Hole in a series of underground channels that have eroded through the soluble limestone. Within the study area the Axe covers a distance of 15km and has a total catchment of approximately 200km^2.

The River Sheppey has its source in a group of springs west of the village of Doulting, near Shepton Mallet in Somerset. It flows through the wetlands to the north of the Polden Hills and ultimately joins the River Brue, via James Wear. The Sheppey flows west onto the Somerset levels where a very complex artificial drainage system controls water levels using a series of rhynes and sluices. It then discharges near Brean Down to the south of Weston Super Mare. It covers approximately 21.6km of the study area and has a total catchment of approximately 55km^2.

The Brue Catchment

The Brue rises in the clay uplands in the east of the catchment near Bruton, before meeting the River Alham at Alford. The river flows slowly through the flat lowlands on the Somerset levels and Moors. This is an area with international, national and county designations for its conservation and landscape value. The most significant geological strata within the area with respect to water resources are the carboniferous strata of the Mendip hills which comprise of highly permeable Karstic Limestones renowned for their cave systems such as Wookey Hole. Within the study area the Brue covers a length of 26.5km and has a total catchment area of approximately 470km^2.

The other watercourses in the Brue catchment, other than the River Sheppey (see above for details) are rhynes or smaller watercourses.

The Cary Catchment

On the very southern fringes of the district, a relatively small area drains to the River Cary which forms part of the Parrett catchment. Within the study area the River Cary is approximately 1.6km in length and therefore its impact on MDC area is minimal.

2.1.2 Geology

There are a wide variety of landscapes within the study area, primarily due to the underlying geology, which varies from limestone karst, mudstone, sandstone and lias in the west to oolite, cornbash clay vales, limestone and mudstone in the east. The superficial geology is generally made up of sand and gravel, clay, silt and sand, along with some areas of peat in the west (Somerset Levels and Moors). This geology has resulted in several areas becoming designated as Sites of Special Scientific Interest for geological reasons, and includes the Mendip Hills and the Somerset Levels and Moors.

The oldest rocks are of Silurian age (443 – 417 million years ago), which comprise of lavas, tuffs, shales and mudstones, and are found in a narrow outcrop to the northeast of Shepton Mallet. Rocks of Devonian age (417 – 354 million years ago) are found in the cores to the folded masses of the Mendip Hills, whilst Carboniferous Limestone (354 – 290 million years old) form the landform of the Mendip Hills. Adjacent to the Mendip Hills, rock from the Triassic age (248 – 250 million years ago), e.g. red marls, sandstones, breccias and conglomerates, form the solid geology to the Somerset Levels and Moors.

Across the study area the bedrock is roughly between 100 and 300m thick, although in the west the thickness does fall to approximately 10m.

Due to the large quantities of limestone in the area water can flow through the rocks relatively easily, particularly through cracks and sub-surface flow routes. This results in the area having relatively high rates of runoff and a well drained area. The ground also quickly becomes saturated following heavy rainfall. This is particularly a problem where shallow quarrying removes the rock from the unsaturated zone above the water table. This reduces the quantity of rainfall that can be absorbed into the soil therefore resulting in more flashy floods of higher magnitude.

The Mendip Hills, which are located to the north east of the Somerset Levels, are moderately high limestone hills. The main habitat on these hills is calcareous grassland with some arable agriculture. 200 to 300 million years ago the Mendip Hills were considerably higher and steeper than they are today. Since then weathering has resulting in a range of surface features, including gorges, dry valleys, screes and swallets, as well as underground features such as caves. The Devonian and Silurian rocks are generally more resistant to weathering and therefore form the higher points of the hills.

The Somerset Levels and Moors, located between the Quantock and Mendip Hills, are a sparsely populated wetland area consisting of marine clay levels along the coast and inland peat based moors. The majority of the Somerset Levels and Moors fall with the Sedgemoor District, but a proportion are also included in the south west of Mendip District area.

Generally the Levels and Moors are flat and formed from reclaimed land, but there are some slightly raised parts e.g. Glastonbury Tor, as well as ridges and hills. It is an agricultural region predominantly covered by open fields of permanent grass used as pasture for dairy farming, surrounded by ditches with willow trees. The rivers Parrett, Axe, Brue and Cary, formed by the runoff from the hills, all run across the Somerset Levels and Moors and over time the course of these rivers have been altered to improve the flow. The water levels in the Somerset Levels and Moors are controlled and drained by a network of channels known as rhynes, and the use of sluices and pumping stations. The area is mainly used for grazing but some peat extraction is also carried out. Some parts are allowed to flood in winter.

More information regarding the geology for the area can be found on the British Geological Survey (BGS) website, www.bgs.ac.uk.

2.1.3 Climate

MDC area has a temperate climate which, like the rest of the South West, is generally wetter and milder than the rest of England. The annual mean temperature is approximately 10°C and shows seasonal and diurnal variation. The average maximum temperatures in January and July are 8.1°C and 21.7°C respectively. Clouds often form inland especially over the Mendip hills and act to reduce sunshine, resulting in an average annual sunshine total of around 1,600 hours.

Rainfall tends to be associated with Atlantic depressions or with convective storms. In summer, convection caused by solar surface heating sometimes forms shower clouds and a large proportion of the rainfall falls from showers and thunderstorms at this time of year. The average monthly rainfall ranges from approximately 80mm in winter to 49mm in the summer, with an average annual total of 725mm. This is relatively high due to the impact of the Mendip Hills.

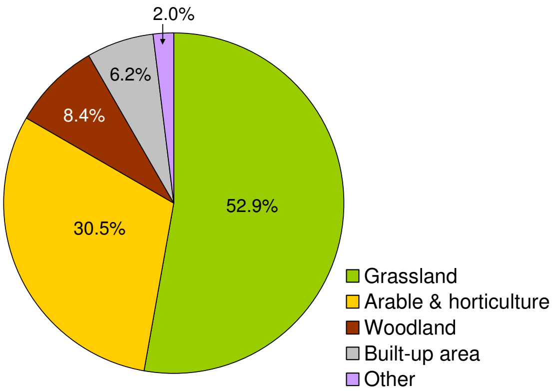
A combination of the geology and the rainfall due to the Mendip Hills leads to a high daily runoff from springs and boreholes in the area. This has been recognised as a good source of water and therefore a series of underground tunnels, pipes and aqueducts have been created to maximise the use of this water.

About 8 – 15 days of snowfall is typical within the study area and the predominant wind direction is from the south-west, with the highest mean wind speed between November and March.

2.2 Demographics, land use and economic features

The study area is predominantly rural with the vast majority of land use given over to agriculture of varying intensities. Figure 2.2 below shows the split of land use across MDC area with the percentages of the total area highlighted. Generally the arable land and grassland is in Grade 3 agricultural condition i.e. good to moderate quality.

Figure 2.2 – Land use within MDC area



The population is relatively sparse in many parts of the district. Frome is the largest settlement in the district with a population of around 24,000. The only city in the area is Wells, whilst the other towns are Shepton Mallet, Glastonbury and Street, all of which have a population of between 8,000 and 12,000 people.

Quarrying occurs across the study area, particularly around the Mendip Hills. There are currently nine active and a number of disused quarries across the Mendip Hills, resulting in this area becoming one of the major suppliers of road stone and concrete aggregate to southern England, producing approximately 12 million tonnes of limestone a year. Historically the Mendip Hills have been mined for lead, silver, coal, ochre, Fuller's earth and zinc, but this has now ceased.

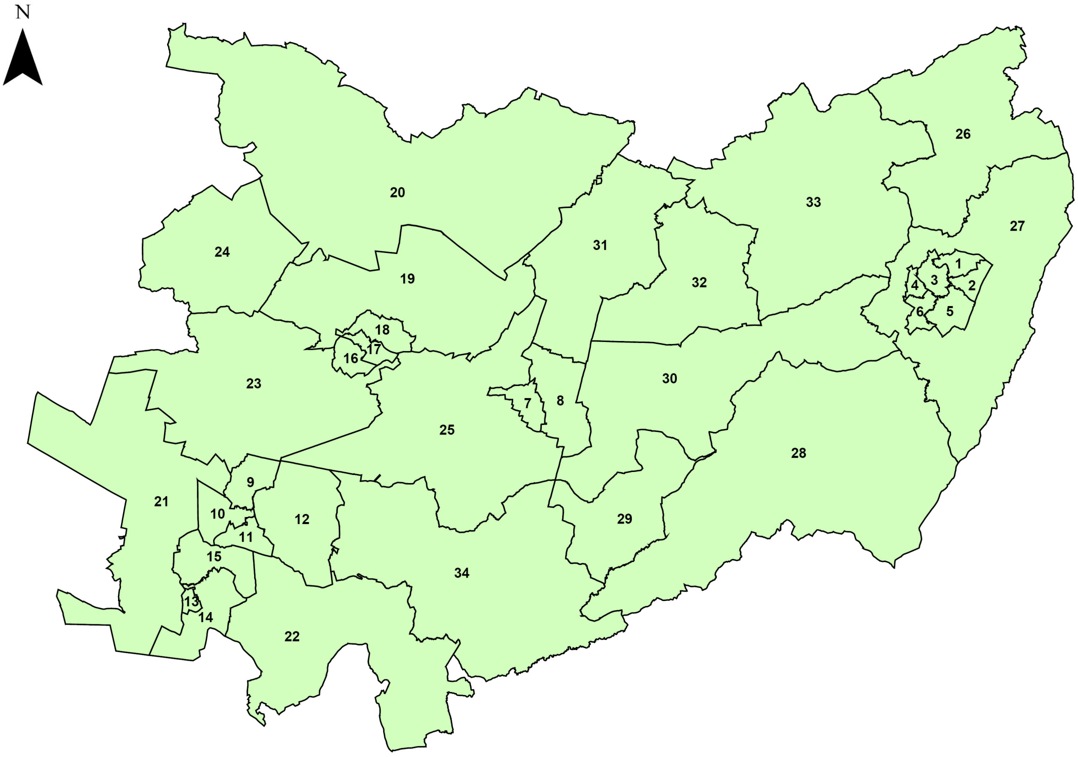
MDC area is split into 34 wards, as shown in Figure 2.3, with the ward code, id number and name detailed in Table 2.2. In total there are approximately 104,000 people living in MDC area (as detailed in the 2001 Census), producing a population density of approximately 146 per square kilometre, with 98.8% of the population being of white ethnicity.

Table 2.2 – Ward names and codes as shown on Figure 2.3

ID	Ward code	Ward Name	ID	Ward code	Ward Name
1	CN, CO	Frome College	18	BK	Wells St Thomas'
2	CL, CM	Frome Berkley Down	19	AK, BIA, BL, BO	St Cuthbert Out North
3	CV, CW	Frome Market	20	AB3, AD, AG, AQ, AV, BA	Chewton Mendip & Ston Easton
4	CX	Frome Oakfield	21	ALA, AR, BH	Moor
5	CP, CQ, CR	Frome Keyford	22	AA, AC, CH1	Butleigh & Baltonsborough
6	CS, CT, CU	Frome Park	23	AH, AP, BN	Wookey & St Cuthbert Out West
7	AZ	Shepton West	24	AX, BLA	Rodney & Westbury
8	AY	Shepton East	25	AI, AJ, AS, AU	Croscombe & Pilton
9	AN	Glastonbury St John's	26	CD2, CK, DD, DF, DH1, DH	Rode & Norton St Philip
10	AL	Glastonbury St Benedict's	27	CB, CC, DI	Beckington & Selwood
11	AO	Glastonbury St Mary's	28	CA, CJ2, DB, DL, DM, DN,	Postlebury
12	AM	Glastonbury St Edmund's	29	CJ1	Creech
13	BG	Street West	30	CG, DG, DP1, DP2, DQ	Cranmore, Doulting & Nunney
14	BE, BF	Street South	31	AB1, AB2, AE, AF, AT, DK	Ashwick, Chilcompton & Stratton
15	BB, BC, BD	Street North	32	CE, CZ, DC, DJ	Coleford & Holcombe
16	BJ	Wells St Cuthbert's	33	CD1, CY, DA, DE1, DE2, D	Ammerdown
17	BI	Wells Central	34		The Pennards & Ditcheat

No one town centre in MDC area dominates and there is no district centre. Instead all of the towns generally meet their own needs for convenience goods retail. In addition, the centres of the main towns and city of MDC area play an important role in the economic and social life of the District. There is at least one hospital in all of the towns except Street and a total of 49 schools spread across the main towns and villages of MDC area. Employment is also a major part of each town.

Figure 2.3 – Wards in MDC area labelled with ID number



2.3 Environmental Designations

There are a number of designated sites within MDC area, particularly focussed around the Somerset Levels and Moors. These designations also need to be considered in terms of flood risk. Table 2.3 below provides details of the designations within the study area and those at risk of flooding. The names of the sites and the general locations have been included in the table. This highlights that there are environmental designations across the whole of the MDC area, although the major habitat is the Somerset Levels and Moors that falls under 4 different environmental designations. Details of the Flood Zones mentioned in Table 2.3 can be found in section 3.1.

Table 2.3 – Environmental designations

		Number		
Designation	**Location**	**Study area**	**Flood Zone 3**	**Flood Zone 2**
Listed Buildings	Evenly distributed across area	2,853	146	325

		Area (km^2)		
Designation	**Location**	**Study area**	**Flood Zone 3**	**Flood Zone 2**
National Nature Reserves (NNR)	Somerset Levels & Moors in the Brue catchment	4.01	3.03	3.03
Environmentally Sensitive Areas (ESA)	Somerset Levels & Moors in the Brue and Axe catchments	82.10	82.10	82.10

		Area (km^2)		
Designation	**Location**	**Study area**	**Flood Zone 3**	**Flood Zone 2**
Scheduled Monuments	Generally across whole area, predominantly in Bristol Avon & Axe catchments	5.29	0.69	0.77
Sites of Special Scientific Interest (SSSI)	Moors in the Brue catchment, caves in the Axe catchment, quarries in the Bristol Avon catchment	18.89	5.41	5.43
Special Protection Areas (SPA)	Somerset Levels & Moors in the Brue catchment	5.09	5.09	5.09
Parks and Gardens	Predominantly the Bristol Avon catchment	11.53	0.26	0.31
RAMSAR	Somerset Levels & Moors in the Brue catchment	5.09	5.09	5.09
Areas of Outstanding Natural Beauty (AONB)	Predominantly the Mendip Hills in the Axe catchment	101.44	0.50	0.55
Special Areas of Conservation (SAC)	Mendip Woodlands in the Axe catchment, Mells Valley in the Bristol Avon catchment	3.49	0.04	0.04

3 TYPES OF FLOODING

3.1 General information

A floodplain is an area that would naturally be affected by flooding if a river rises above its banks, or where high tides and stormy seas cause flooding in coastal areas. Over hundreds of years, natural floodplains have been built on and today many towns and cities exist on floodplains. Some settlements and areas of agricultural land have flood defences in place to reduce the risk of flooding. It should be noted however that in these areas there will always be some risk (however low) of flooding.

Environment Agency Flood Zones

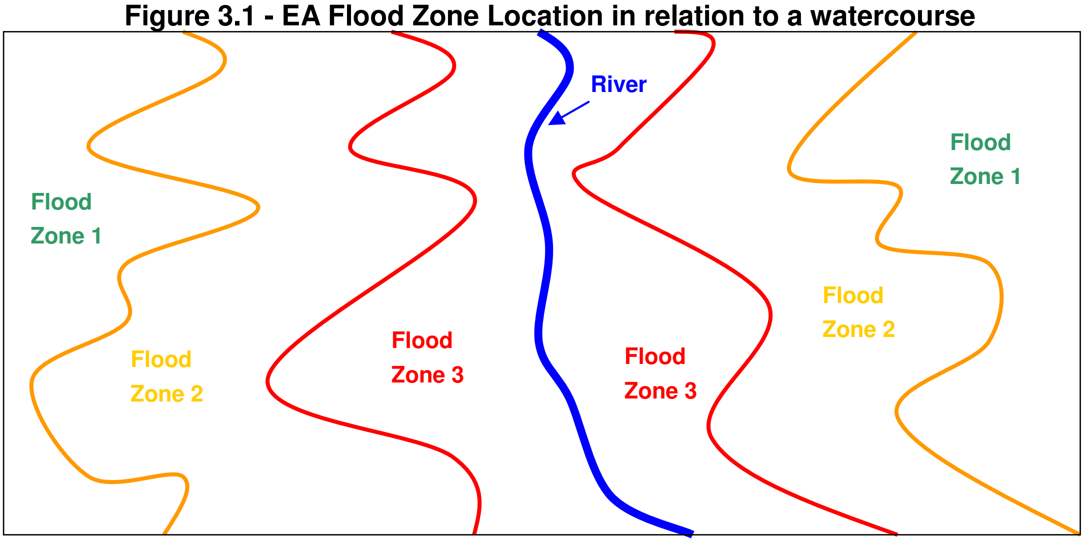
The EA produce a Flood Map (which is updated quarterly) depicting areas where there is a high risk (Flood Zone 3) or a low-to-medium risk (Flood Zone 2) of flooding from rivers and the sea. These zones do not take into account any flood defences that could reduce the impact of flooding if there was a flood event, because the defences can be breached, overtopped and may not be in existence for the lifetime of any development. The zones also **only** considered fluvial or tidal sources of flooding, therefore there may still be a risk of flooding from other sources in **any** of the three flood zones. The Flood Zones cover the watercourses in the study area which have a catchment area of greater than $3km^2$ and indicate where flooding can occur at postcode level. This Flood Map can be viewed on the EA website at www.environment-agency.gov.uk.

The Flood Map is split into three areas (as indicated in Figure 3.1):

- EA Flood Zone 3 is the area that could be affected by fluvial or tidal flooding if there were no flood defences. The probability of tidal flooding in this area is at or greater than 0.5% (1 in 200 years) and the probability of fluvial flooding is at or greater than 1% (1 in 100 years). This is described as a high risk area.
- EA Flood Zone 2 shows the additional extent beyond EA Flood Zone 3 of an extreme fluvial or tidal flood with no defences in place. These areas are likely to be affected by a major flood with between a 1% and a 0.1% (1 in 1000 year) chance of occurring each year. This is described as a low to medium risk area.
- All land not in EA Flood Zones 2 or 3 are in Flood Zone 1 which has little to no risk (less than 0.1% probability) of flooding from rivers or the sea, although there may still be flood risk from other sources in this area e.g. surface water flooding.

See www.environment-agency.gov.uk, table D1 of PPS25 or Section 7 for more details.

Figure 3.1 - EA Flood Zone Location in relation to a watercourse



Potential Flood Risk Areas (PFRAs) (as defined by Royal Haskoning)
Where there are historic records of fluvial flooding on a watercourse but the EA has not provided a flood zone in that area, for the purposes of this SFRA, we have plotted an estimate of the 1% probability (or 1 in 100 years) flood extent for the watercourse. This has been done solely using engineering judgement, without the benefit of sophisticated modelling techniques. The PFRAs therefore represent data of poorer quality than the EA Flood Zones and should be treated as a guide to indicative flood risk only. Information on how the Potential Risk Areas were produced can be found in Appendix B.

3.2 Current flood risk

Flooding is an issue with varying levels of severity across most of the study area. Significant flooding in the area is mainly caused by the overtopping of river banks, whilst less severe flooding in towns, and the road network is predominantly from surface water runoff, and the blockage of drains and culverts.

MDC area has no coastline therefore there is only limited risk from the sea. Flood Zone 2 and 3 both show a small section of tidal flood risk due to high tides causing backing up of the watercourses on the Somerset Levels and Moors.

The majority of the EA Flood Zones within MDC area are on the west side of the District, particularly covering the Somerset Levels and Moors. These flood zones boarder a number of towns and villages, including Glastonbury, Street and Wells. The aerial photo (Photo 3.1) shown below was provided by the EA and shows flooding to the north of Glastonbury.

Photo 3.1 – Flooding around Glastonbury

There have been a number of flooding issues along the River Frome at Frome, particularly alongside Rodden Road on the right bank. In Frome, the Devon & Somerset Fire and Rescue Service have been called out almost 20 times in the past 3 years to help assist with the removal of water from properties.

Shepton Mallet is also a location of known flood risk, with a large number of historic flooding incidents recorded, including up to 14 Fire & Rescue Service call-outs over the past 3 years. The main source of the flooding is surface water problems, although there are also recorded incidents of the River Sheppey flooding.

In Street, torrential rain in January 2008 led to 3 or 4 houses in a terrace along Silver Road and the junction of Merriman Gardens being flooded. Police had to reset the drain cover which had been moved by the pressure of water spouting out.

There have been a number of serious floods over the years in Westbury, all caused by surface water running off the land and hill. The surface water carries with it a large amount of soil which silts up the drains and gullies therefore the road drainage system cannot cope. In addition, the road cambers and directs the surface water to the opposite side of the road to the existing drains.

Stoke St Michael Parish has similar surface water flooding problems, with the drains becoming blocked with leaves and hedge cuttings. In addition, natural soak-aways are at risk of becoming covered due to new development in the area. Also, parts of Leigh upon Mendip regularly flood due to an un-named stream, surface water flooding and water flowing down the hillside.

In North Wootton the River Redlake floods following extreme rainfall, making it difficult to cross the bridges in Stock Lane and Northtown, whilst in Butleigh the junction of Henley Lane and Barton Road floods every winter. This causes particular problems when the water freezes.

3.3 Historic Flooding

Looking at historic flooding can highlight areas that are currently at risk to flooding. Historic information, as shown in figure 3.2, has been obtained from discussions with MDC Engineers, Parish Councillors, SCC and drainage boards and then combined with data from the EA Flood Reconnaissance Information System (FRIS). This system is a collection of geo-referenced events collated by the EA, which also highlights the source of the flooding and other key information about the event.

Particularly large events are described below:

30th January 1607
This was known as the Great Flood which killed 2,000 people across Somerset and has been described as one of the worst natural disasters to hit Britain. It is estimated that water covered 520 km^2 of land resulting from a tsunami.

9th – 25th August 1954
On the 9th and then again on the 13th the River Brue overflowed into Butt Moor causing serious flooding in Butt Moor and parts of Barton Moor. Actis and Read Mead at Glastonbury were under water for several days. The overflowing from the River Brue also caused the South Drain to overflow 1.5 miles below Sharpham Bridge resulting in flooding in Street Heath, Walton Heath and Sharpham. The extent of property flooding is not known. Gravitational drainage was resumed by 16th August but floods had not entirely gone until 25th August. Further flooding occurred on 9th and 10th December 1954 when the South Drain overflowed on the left bank flooding two properties.

28th August 1960
At least 4 properties were flooded by the River Brue in and around Westhay, 1 property in Glastonbury and an unknown count in Frome. Flooding reached a depth of several feet in places as shown in Photo 3.2 below.

Photo 3.2 – Flooding in 1960

10th July 1968
9 properties flooded in and around Mells due to the Mells Stream and storm water rushing down the hillside. The degree of property flooding varied with some properties flooded nearly to the ceiling of the ground floor. Five properties were also flooded in Nunney due to the Nunney Brook and an unknown number of properties were flooded in Frome as a result of the River Frome. Cossington School House was flooded to a depth of approximately 3 feet due to heavy rainfall. In addition, the bridge at Pensford Great Elm was swept away.

19th August 2006
Flooding in Oakhill High Street in the afternoon of 19th August 2006 resulted from intense rainfall in the catchment that generated flash runoff from roads, undeveloped land and developed areas. Roads received much of this runoff that overwhelmed and blocked the highway drainage systems. Several properties in the low area of the High Street suffered internal flooding and others were threatened with flooding.

The EA rain gauge at Stoke Bottom, about 3km east of the Oakhill catchment recorded 60mm of rainfall in 90 minutes, whilst the peak rainfall intensity was measured at about 50mm in an hour. These measurements, if representative of the Oakhill area, using Centre of Ecology and Hydrology methodology, estimates a return period of 1 in 200 years (0.5% a.p) for this event.

11th January 2008
In Shepton Mallet, the quantity of water within the viaduct at Victoria Grave resulted in a massive pressure building up, creating a lake around the viaduct. There was also substantial flooding of a property and the park. This was partly due to the balancing ponds being overwhelmed by the volumes of water involved. Near the prison wall water reached a depth of approximately 18 – 20 inches and started to pour through gaps in the wall, whilst at Lake Square the water was only 18 inches from the top of the footbridge. Photos 3.3 and 3.4 show the extent of some of this flooding.

Photos 3.3 and 3.4 – Flooding in Shepton Mallet

Other events include:

- The Brue Valley is known to have become flooded in 1784, 1794, and 1800,
- The majority of the Somerset Levels was flooded in 1919, covering an area of approximately 283.4 km^2.
- Severe flooding at Glastonbury Station occurred on 13th November 1894, as shown in photo 3.5.
- In the 1950's properties at Bedlam in Great Elm were flooded when the footbridge over the river became blocked by debris floating down the river.
- More recently three cottages were flooded in September 1992 due to 20mm of rain falling in 1 hour in the Mells Stream catchment.

Photo 3.5 – Flooding of Glastonbury Station, 13 November 1894

The EA also have aerial photos showing the flooding during 1972, 1979, 1986 and 1998. The location of these photos can be seen on the A1 maps and GIS layer. The EA map historic flood events across England and Wales as part of their Historic Flood Mapping (HFM). These photos are currently being used to update the HFM for MDC area. The HFM shown used in this study is therefore a working draft and updates will be required (Figure 3.3a and b).

Historic flooding is a good indication of where flood zones should be highlighted. PFRAs have therefore been created where historic information suggests fluvial flooding that is not currently covered by EA Flood Zones. The PFRA do not cover all the watercourses in the study area, only those where flooding is known to be an issue.

Figure 3.2 – Historic Flood Incidents in MDC area

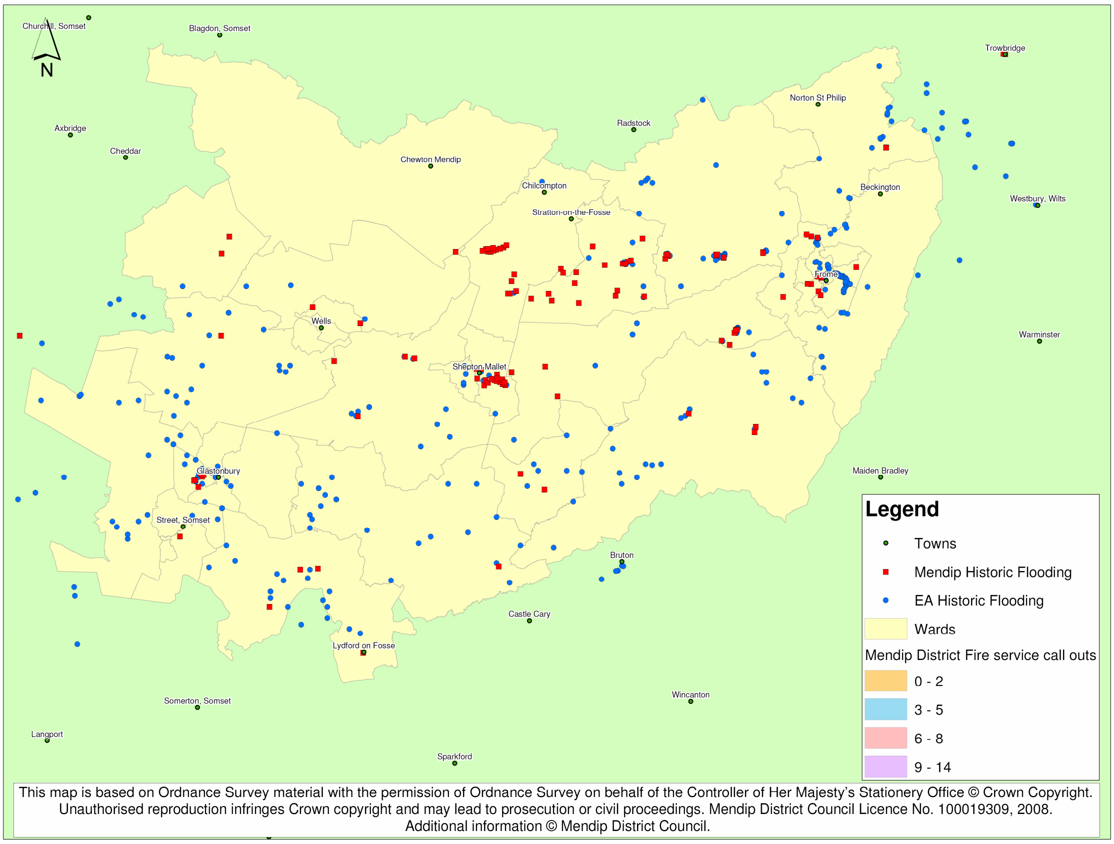


Figure 3.3a – Historic Flood Map overview (aerial)

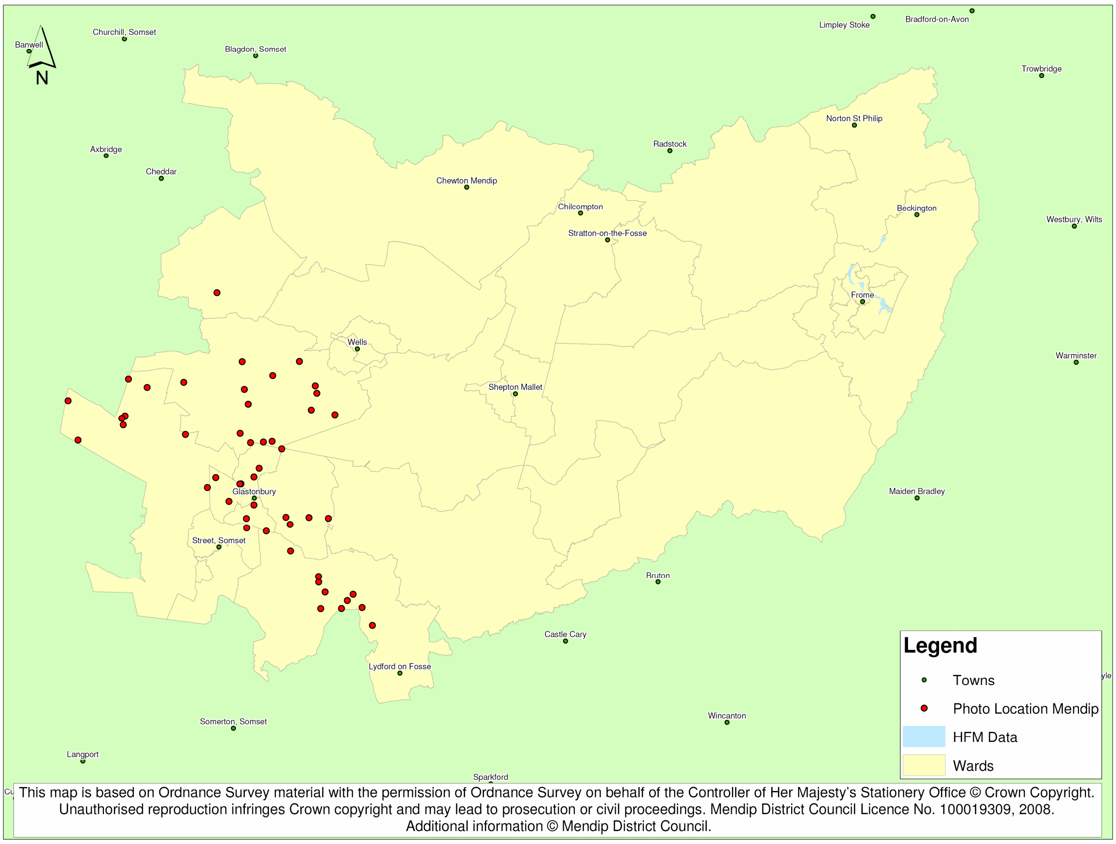
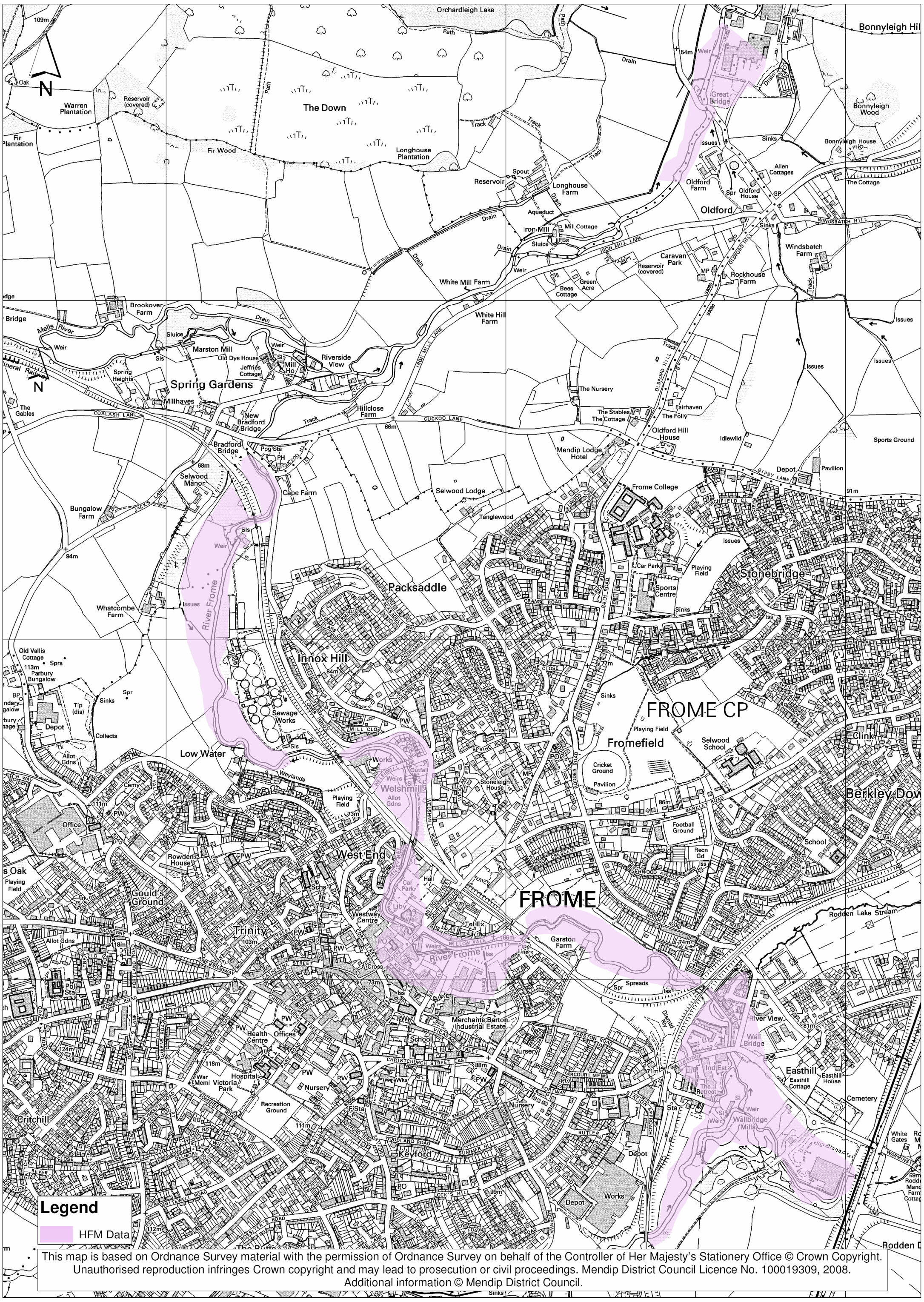


Figure 3.3b – Historic Flood Map (Frome)



3.4 Climate change

This SFRA is intended to be used as a long-term planning document. It is therefore necessary to consider the potential impacts of climate change in terms of fluvial flood risk.

At present it is difficult to quantify how the changing climate will affect the areas currently at risk of flooding. The limits of floodplains cannot be defined precisely because floods with similar probability can arise from different combinations of events that will have different impacts. However while climate change could have a significant impact on levels of risk, current information would suggest that the actual areas at risk are not expected to increase significantly.

Government guidance regarding future flood risk and development is detailed in PPS25. This guidance predicts that annual rainfall is expected to gradually increase over the years such that it will have increased by approximately 30% by 2115. This is expected to result in potential increases in peak flow of up to 20% for a given return period.

Assuming flows are increased by 20% as a result of climate change, new fluvial flood extents based on the existing Flood Zone 3 data have been created in certain key areas based on the LiDAR Digital Terrain Model (DTM) data. LiDAR DTM captures height information based on a 1- 2 metre grid (depending on the area) and was provided by the EA for the purposes of this study. The specific methodology using software tools such as ArcView GIS, Spatial Analyst and Profile Extractor is detailed in Appendix C. The locations chosen for these detailed studies were identified by locating FRIS hotspots and other known locations of high frequency flooding and the presence of existing Flood Zone 3 data. Therefore the locations where this methodology has been applied are Frome, Shepton Mallet, Glastonbury, Mells and Nunney and the results can be seen in section 5.3.

It is beyond the scope of this SFRA to apply this climate change methodology across the whole study area. The new fluvial flood extents as derived above serve as a guide for the likely changes that could occur as a result of increased flows of 20% particularly on the main towns and villages within the study area. It is assumed that similar lateral changes to flood extents will also occur at other locations in the study area with equivalent topography and settlement patterns. More details can be found in section 5.3.

3.5 Tidal and Coastal Risk

MDC area does not have any coastline and therefore tidal flooding is not a major issue for the area. The only area where tidal flooding is thought to have a small impact, with 1 property within EA Flood Zone 3, is on the Somerset Levels and Moors. Due to the limited nature of tidal risk to the study area this source of flooding has not been investigated in detail during this study.

3.6 Rapid inundation zones

Potential inundation could occur where there is risk of breaching or over-topping of raised defences and in steep catchments through flash flooding generally caused by heavy rainfall and excessive surface flow. Water behind a raised defence can build up to levels higher than the surrounding land and create additional strain on the defence. This may cause it to collapse or the retained water can spill over the top rapidly inundating adjacent low lying ground. Fast flowing water or deep flooding that occurs quickly can create a risk of loss of life.

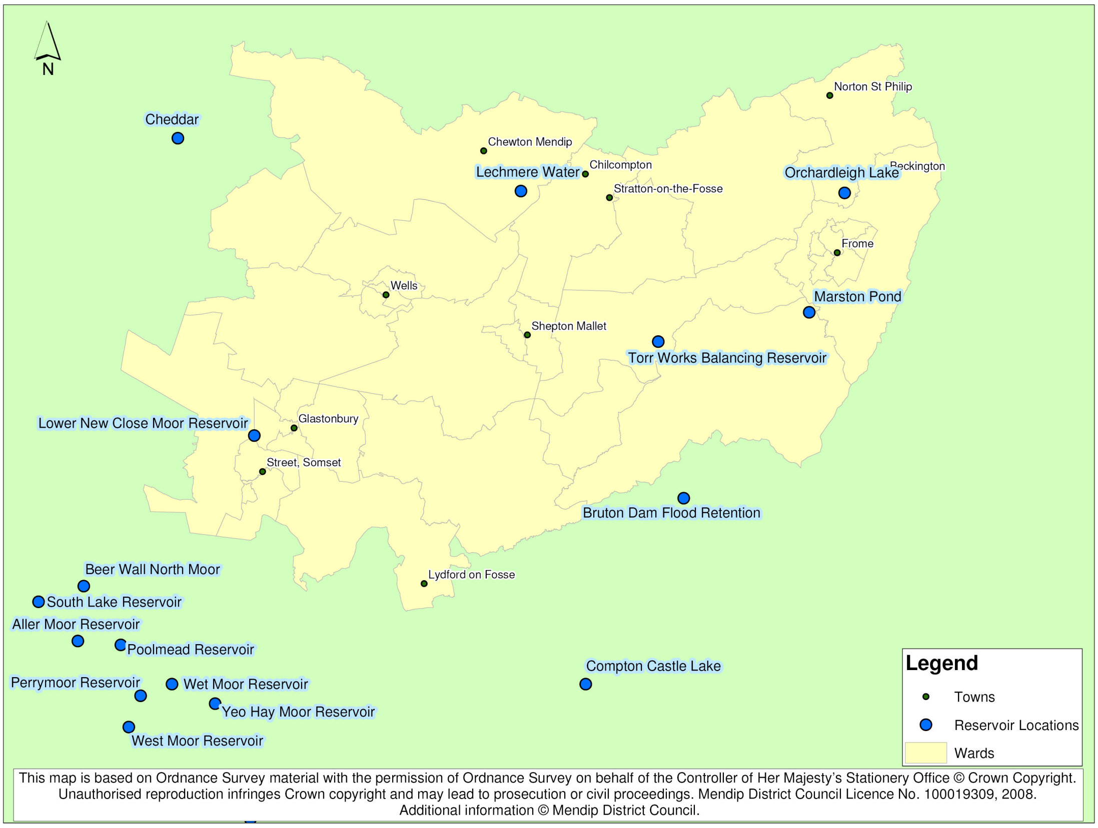
A combination of factors is considered when determining the level of residual flood risk behind a flood defence. This includes the depth of flooding and the distance from the defences. Directly behind a defence is known as the High Risk Rapid Inundation Zone, and then as you get further from the defence both the risk of flooding and the expected depth of flooding decrease. Where possible, new development should be built away from existing flood defences, particularly if the condition of the defence is poor and risk of failure is high.

Defences are indicated on the A1 maps and the GIS layer (based on data currently available from the EA National Flood and Coastal Defence Database (NFCDD)) and can be interrogated to determine their exact locations. At present in MDC area over 132km of defences are recorded as raised within NFCDD. These are predominately found in the West Mendip area. A broad scale analysis of some of raised defences within MDC area is detailed in section 4.2.

3.7 Reservoirs

The location of reservoirs (Figure 3.4) needs to be taken into taken when considering possible locations for development. This is for two reasons. Firstly, if a reservoir is breached or fails people and properties located downstream of the reservoir could be at risk from rapid inundation. Secondly, if the development is in the area drained by the reservoir, the additional surface water from the development could exceed the storage potential of the reservoir during a large event, causing problems downstream.

Figure 3.4 – Location of reservoirs in and around the MDC area



There are 5 reservoirs in the MDC area, as shown in Figure 3.4. There is also a reservoir at Cheddar and one at Bruton that are close to the study area. These should also be considered when determining potential development areas in the vicinity of these reservoirs and their catchments.

3.8 Ground water

Flooding due to ground water occurs when water stored beneath the ground reaches the surface and is generally associated with porous rocks such as sands, gravels, limestone and chalk. This generally occurs in wet winters, and can result in flooding for long periods of time. Because it is underground it is often not until a problem arises that we become aware of this issue.

Generally damage from ground water flooding is a result of human intervention, particularly where over-abstraction has occurred in the past lowering ground water levels. Now that there are more strict limits on pumping licensing, ground water levels have risen and flooded land that was dry and has therefore been developed.

There is limited information available regarding flooding due to ground water. The FRIS database identifies 2 locations of ground water flooding; one at Glastonbury and one at King’s Sedgemoor to the north of Henley. No other incidents of ground water flooding were highlighted during the data collection exercise.

For a development to be permitted it is a requirement of PPS25 that groundwater flooding and any potential effects it has must be assessed as part of any FRA.

3.9 Sewer flooding

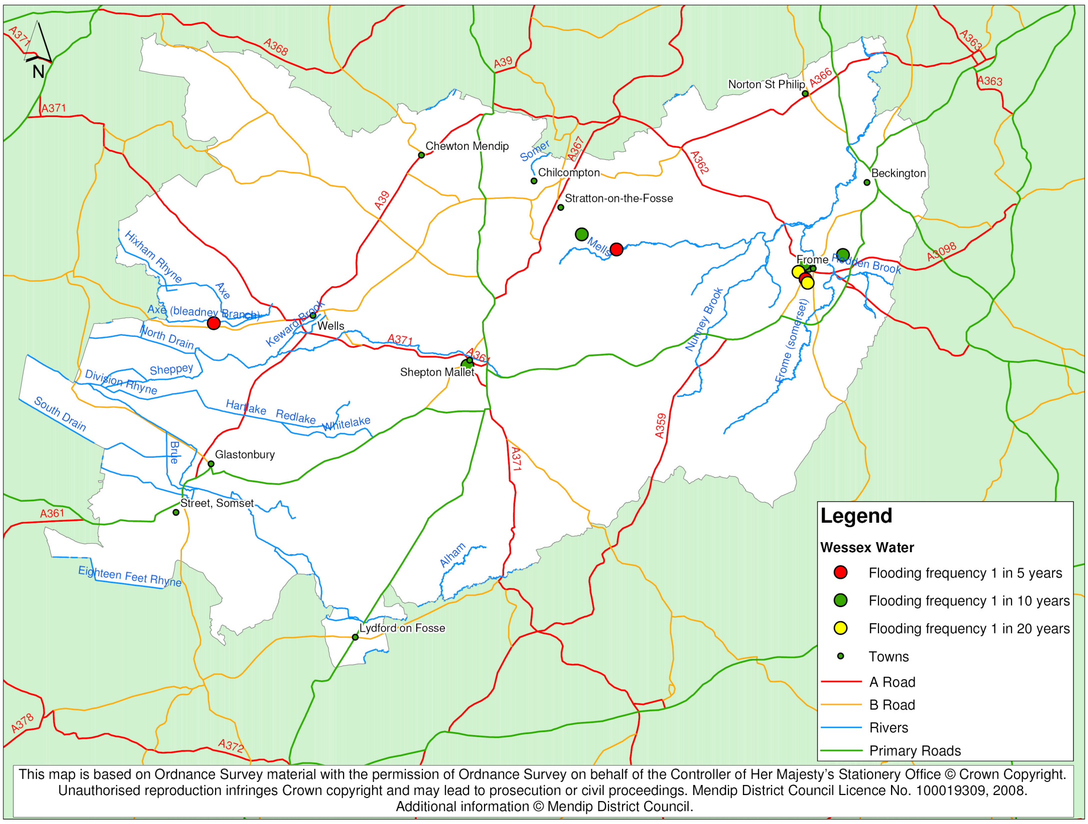
In urban areas, rainwater is frequently drained into surface water sewers, or sewers containing both surface and waste water, known as combined sewers. These sewers can be overwhelmed by heavy rainfall, become blocked, or be of inadequate capacity, resulting in flooding of the surrounding area until the water can drain away. This is particularly a problem when a combined sewer is involved because there is then a high risk of contaminated water flooding a property internally.

As part of this study, Wessex Water provided locations of sewer flooding as recorded for Ofwat, as shown in Figure 3.5.

The majority of this flooding is located in Frome. Note that the flooding highlighted may be internal or external of properties and will have been caused by a variety of operational and meteorological conditions. In addition, the information provided is only representative of the situation as of November 2007. Wessex Water are currently undergoing extensive work to eliminate the majority of foul sewage flooding incidents by 2010, therefore they would expect to see most or all of the locations highlighted in figure 3.5 removed by 2010.

Any new development needs to address the impact on the existing capacity of the sewer system and any associated sewage treatment works. Increases in discharge may lead to the overloading of receiving watercourses and consequently an increase in flood risk. It is a requirement of PPS25 that the potential of this occurring and any mitigating measures must be assessed as part of any site specific FRA.

Figure 3.5 – Sewer flooding incidents recorded by Wessex Water



4 MANAGING FLOODING

4.1 General information

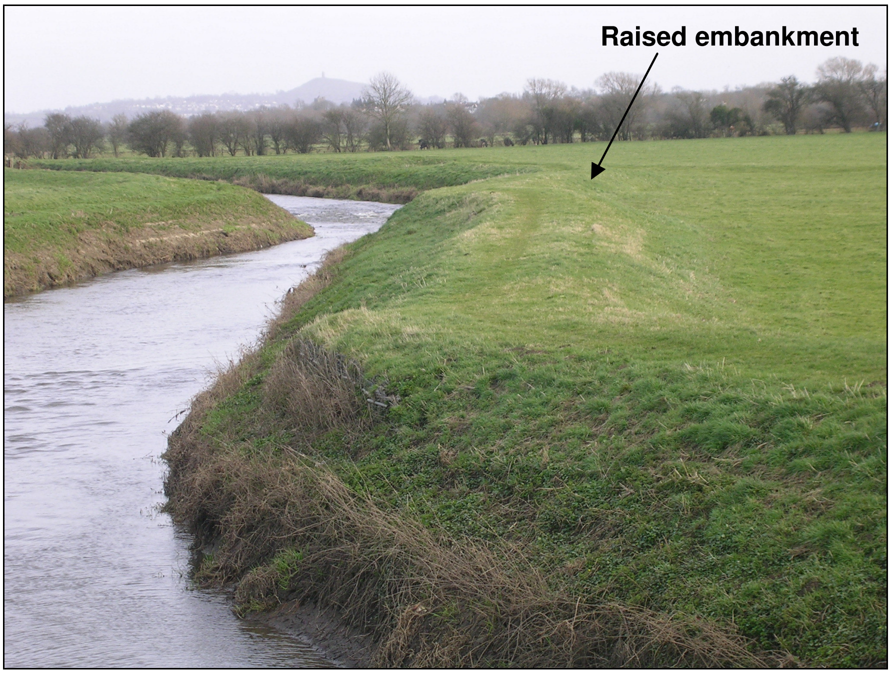
The government aims to reduce the risks to people and the developed and natural environment from flooding by discouraging further built development within floodplain areas. Government guidance (PPS25) has been produced for local planning authorities to help them when allocating land for development in order to meet this aim. In undertaking the SFRA this guidance has been examined and used to provide a robust and consistent system for assessing flood risk anywhere within the local planning authority.

The following issues concerning flood risk within the MDC area have been highlighted to provide additional awareness and assistance to aid the decision process outlined above.

4.2 Defences

Defences comprise a structure (or system of structures) for the alleviation of fluvial or tidal flooding. The SFRA has identified existing defences, for example an embankment at Westhay (photo 4.1), that are maintained by the EA or MDC. The SFRA also highlights a number of privately maintained defences that are currently within NFCDD. It should be noted that there may be additional private defences that have not been included in NFCDD. Private walls may also exist in the area but are not classed as 'flood defences'. Furthermore, not all banks are flood defences.

Photo 4.1 – Embankment defence along the River Brue at Westhay



Defences are designed to protect from flooding of a certain level - a standard of protection. The standard of protection is the maximum flood event that the defence can protect against before it is breached or overtopped. For example, the embankment at Westhay, shown in Photo 4.1, is stated to have a standard of protection of 50 years.

However it cannot be assumed that the level of defence is still at the original design standard because of changes to the way floods are estimated, the effects of climate change and deterioration of the structure.

Changes to the land use in areas near to defences can also have an effect on the standard of protection provided by the defence by changing the flow patterns of groundwater and surface water runoff. Therefore any proposed development must be closely examined during a detailed FRA to ensure that the existing and future development has the appropriate level of protection. PPS25 suggests that the appropriate level of defence against fluvial floods should be a 1 in 100 year standard (1% probability flood) and against tidal floods should be a 1 in 200 year standard (0.5% probability flood).

NFCDD highlights all information regarding the structure of watercourses in the area. It therefore shows areas of natural or maintained channel as well as raised defences or culverts. An example of a maintained channel can be found at Baltonsborough, photo 4.2, where gabions and timber posts have been used to resist erosion and keep the river bank in place. Only the raised defences have been considered as part of this study.

Photo 4.2 – Maintained bank at Baltonsborough along the Baltonsborough Millstream

Within NFCDD there are 196 entries classified as major defences, 100 of which are culverts with an unknown standard of protection and 11 represent raised defences, details of which are listed below. Generally the defences are made up of a number of sections.

- **Coxbridge Brook, East of Glastonbury and Street**
  - Located at ST 52048 36978
  - Embankment on the left bank of the watercourse at Cinnamon Lane
  - 1350m in length, 1.4m high with a lowest point of 9.11mOD
  - Standard of protection of 1 in 5 years (20% annual probability)

  - Maintained by the EA
  - Limited urban area in the surrounding area
- **South Drain to the north-east of Shapwick Heath Nature Reserve**
  - Located at ST 44921 39705
  - Embankment on the right bank downstream of the road bridge
  - 972m in length and 2.4m high with a lowest point of 2.38mOD
  - Standard of protection of 1 in 5 years (20% annual probability (a.p))
  - Maintained by the EA
  - Currently thought to protect 4 properties
- **Beckery Bridge in Northover**
  - Located at ST 48618 38105
  - Combination of embankment and wall on the left bank
  - 277m in length and of unknown height
  - Unknown standard of protection
  - Privately maintained
- **Hearty Moor, South of North Wootton**
  - Located at ST 54753 40325
  - Embankment on left bank downstream of road bridge
  - 339m in length and 0.9m high
  - Standard of protection of 1 in 5 years (20% annual probability)
  - Privately maintained
- **Westhay**
  - Located at ST 43640 42604
  - Embankment and floodwall on left bank, upstream and downstream of Westhay Bridge
  - 729m in length, ranging from 0.7 to 1.5m high, with a lowest point of 3.9mOD
  - Standard of protection between 1 in 20 years (5% annual probability) and 1 in 50 years (2% annual probability)
  - Maintained by the EA

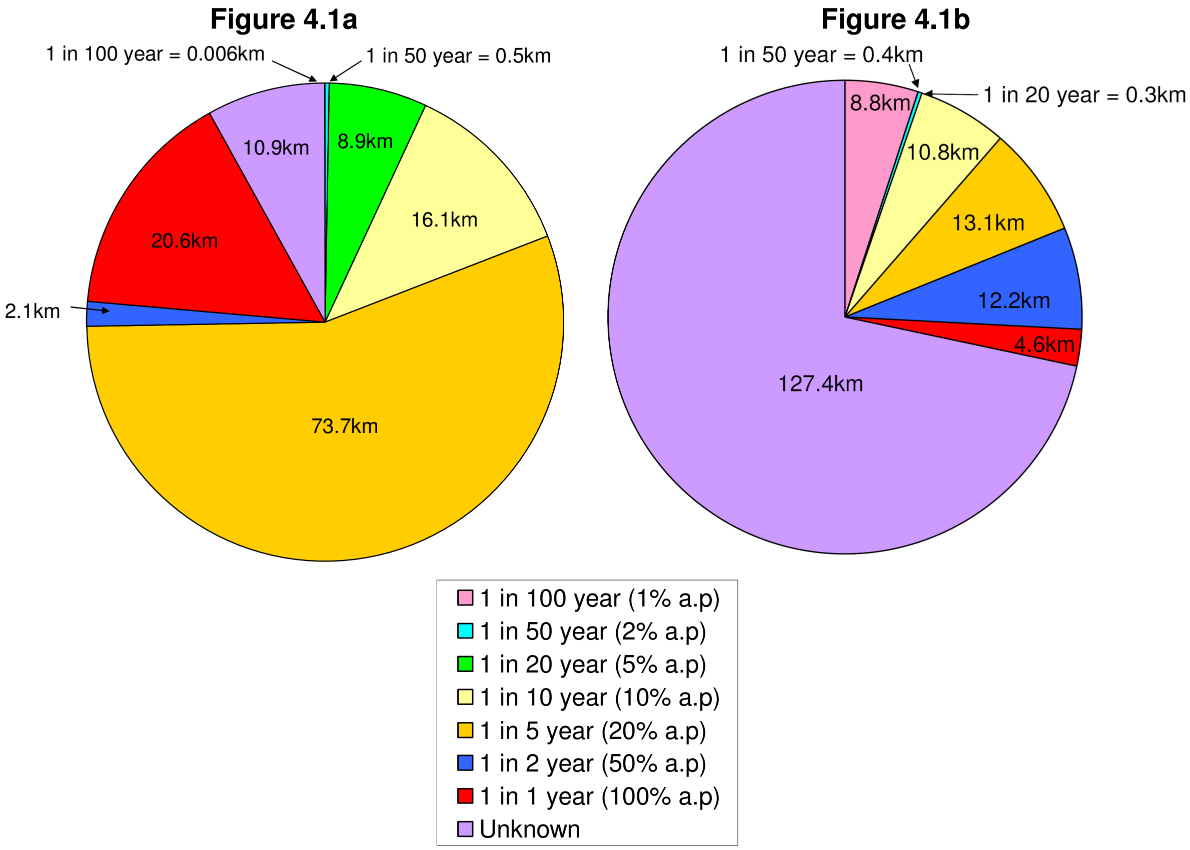
There are additional raised defences in NFCDD that are not classified as major defences. Figure 4.1 below details the number and length of the raised defences for different standards of protection.

Note that these standards of protection are taken directly from NFCDD. It should not be assumed that the standard of protection is still current, particularly when looking at increasing the development behind the defence.

Generally across MDC area there are 132 km of raised defences, 0.64 km of which are flood walls whilst the remaining 131 km are embankments. In addition, there is a total length of 177km of maintained channel across the study area.

As detailed in section 3.6, the breach, failure or overtopping of raised defences can cause significant damage. Therefore as part of this study we have investigated over-topping of a number of defences using broad crested weir analysis. The locations for this analysis were chosen based on the information provided by NFCDD and the number of properties protected by the defence.

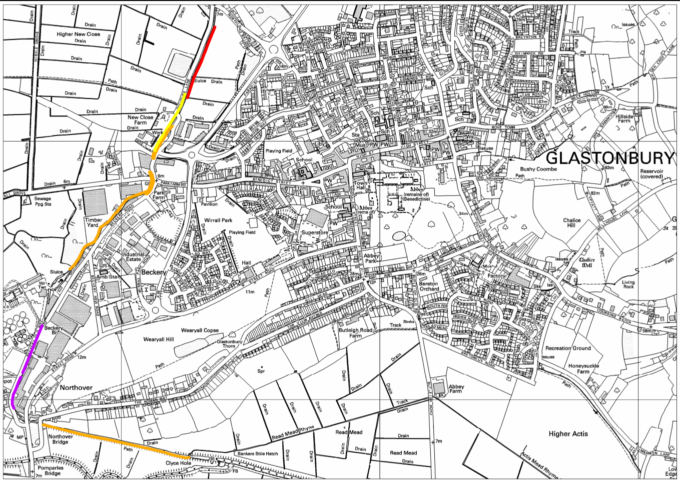
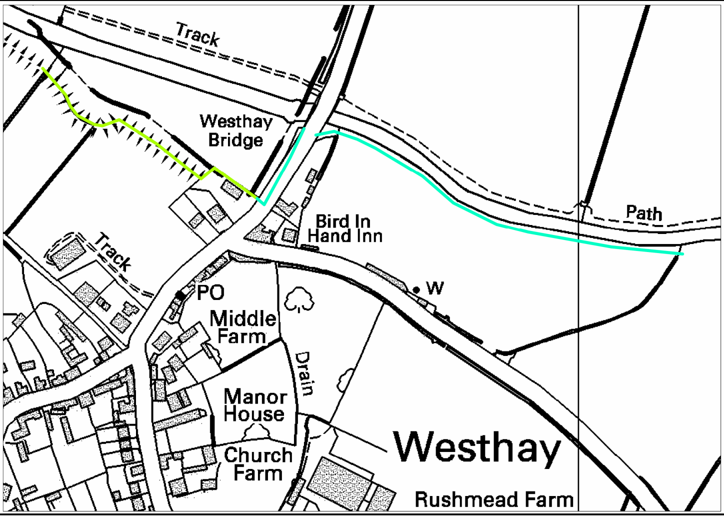
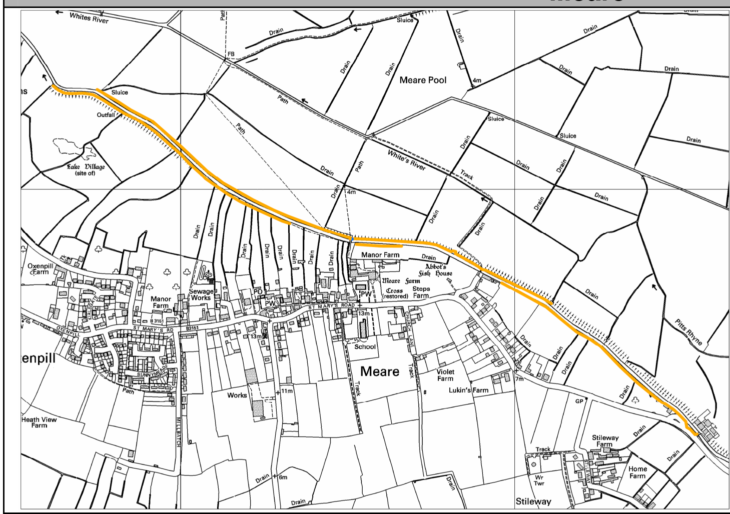
Figures 4.1a & b – Length of raised defences (a) and maintained channel (b) at varying standards of protection

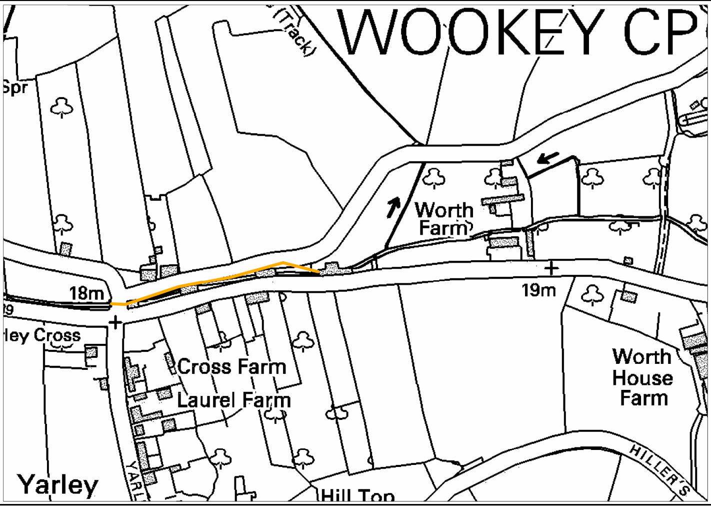


Within NFCDD a large number of the defences, particularly those that are privately maintained, have a standard of protection that is unknown. This therefore limited the choice of raised defences to investigate. After a thorough overview of the defences in the area the following 4 sites were chosen as detailed in Table 4.1.

Broad-crested weir calculations have been undertaken to approximate the extent of over-topping of defences during a 1 in 100 year (1% a.p.) fluvial flood event. This analysis looked at the difference in flood water levels between the stated standard of protection and the 1 in 100 year (1% a.p) fluvial flood event. The length of time that the defence would be overtopped was calculated by comparing the hydrographs for the two flood events (produced using Flood Estimation Handbook techniques), and then this volume was applied across the length of the defence, giving a total over-topping volume for a full hydrograph. Details of the volumes calculated are given in Table 4.1. It should be noted that some of the volumes are very large. This is due to the long duration of flood events in this area.

Table 4.1 – Sites where the defences have been investigated

Glastonbury	
	Major and minor defences on both banks of the Glastonbury Millstream. Standard of protection varies from 1 to 10 years. The defence is made up of embankment, bridge abutments and walls. Total length = 2228m Height = 0.2 – 2.4m Lowest point = 5.85mOD Potential overtopping volume of 49,748,000m^3 (left bank), 5,256,000m^3 (right bank) PTO for legend
Westhay	
	Major defence on left bank of the River Brue. Upstream of bridge standard of protection is 50 years, downstream is 20 years. Defence made up of a flood wall and earth embankment. Total length = 729 m Height = 0.7 – 1.5 m Lowest point = 3.9 – 4.51mOD downstream and 4.07mOD upstream Potential overtopping volume of 50,192,000m^3
Meare	
	Minor defence on the right bank of the River Brue. 5 year standard of protection. Defence made up of a bridge abutment and raised earth embankment. Total length = 1.54 km Height = 1.0 – 1.8 m Lowest point range = 3.94 – 5.56mOD Potential overtopping volume of 16,463,000m^3

Wookey	
	Minor defence on the right bank of the River Axe. 5 year standard of protection. Defence made up of a bridge abutment, flood wall and raised earth embankment. Total length = 205 m Height = 0.5 – 0.8 m Lowest point = 17.87mOD Potential overtopping volume of 353,000m^3
© Crown Copyright. Mendip District Council Licence No. 100019309, 2008.	**Legend** Standard Of Protection Unknown 1 Year Defence 5 Year Defence 10 Year Defence 20 Year Defence 50 Year Defence 100 Year Defence

Other Flood Risk Management Infrastructure can include the creation of wetland areas which are designed to store water during times of flood. An example of this within MDC area is at ASDA in Frome. As part of the ASDA development contract a new water meadow was created around the confluence of the Rodden Brook and the River Frome (see Photo 4.3). According to local residents, this helped to reduce the flooding of Frome on 11 January 2008. In addition to this wetland area, automatic weirs were also installed and these operated well during the January 2008 floods.

Photo 4.3 – Location of water meadow in Frome

4.3 Surface Water and Sustainable Drainage Systems (SUDS)

Flood risk from surface water flooding is of concern within the study area. A number of flood incidents have occurred within the area caused by surface water alone, or in combination with river flooding. Some of these events are highlighted on the maps as recorded by the EA (FRIS) or historic information. The EA Flood Zone Maps do not show flood risk due to surface water flooding.

Urban developments can have a big effect on the quantity and speed of surface water runoff. By replacing vegetated ground with buildings and paved areas, the amount of water being absorbed into the ground is severely reduced, therefore increasing the amount of surface water present. This additional surface water increases the demand on drainage systems in built up areas. Traditional drainage systems are designed to get rid of the water as quickly as possible to prevent flooding in the built up area. This can cause problems, particularly downstream, by altering the natural flow patterns of the catchment. In addition, water quality can be affected due to pollutants from the built up areas being washed into the watercourse. One technique which can reduce this problem is the use of Sustainable Drainage Systems (SUDS).

Sustainable Drainage Systems (SUDS) are techniques designed to control surface water runoff before it enters the watercourse. They are designed to mimic natural drainage processes, along with treating the water to reduce the amount of pollutants getting into the watercourse. They can be located as close as possible to where the rainwater falls and provide varying degrees of treatment for the surface water, using the natural processes of sedimentation, filtration, adsorption and biological degradation.

SUDS are more sustainable than traditional methods because they can:

- Manage the speed of the runoff
- Protect or enhance the water quality
- Reduce the environmental impact of developments
- Provide a habitat for wildlife
- Encourage natural groundwater recharge.

In addition, they can be used to create more imaginative and attractive developments and are designed so that less damage is done, than conventional systems, if their capacity is exceeded.

Surface water management using SUDS can be implemented at all scales and in most urban settings, ranging from hard-surfaced areas to soft landscaped features, even if there is limited space. Most techniques use infiltration but even if the area has little or no infiltration SUDS can still be used in the form of green roofs, permeable surfaces, swales and ponds.

SUDS are made up of one or more structures built to manage surface water runoff, and used in conjunction with good site management. There are five general methods:

a. **Prevention** – this can involve minimizing paved areas, replacing tarmac with gravel, rainwater recycling, cleaning and sweeping, careful disposal of pollutants, and general maintenance.

b. **Filter strips and swales** – these are vegetated surface features that drain water more slowly and evenly off impermeable areas. Swales (figure 4.2) are long shallow channels whilst filter strips (figure 4.3) are gently sloping areas of ground. Both of these mimic natural drainage by allowing rainwater to run in sheets through vegetation, slowing and filtering the flow.

Figure 4.2 - Cross-section of a Swale

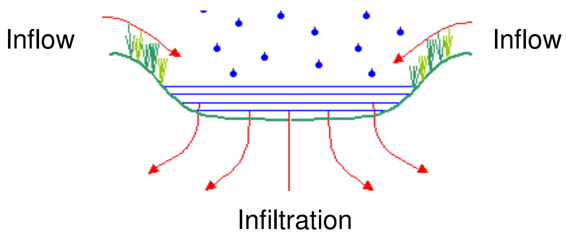
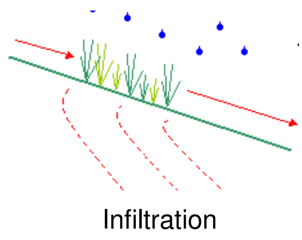


Figure 4.3 - Cross-section of a Filter Strip



c. **Permeable surfaces and filter drains** – these are devices that have a volume of permeable material below ground to store surface water. Runoff flows to this storage area via a permeable surface. On 2nd April 2008 the BBC's One show examined the effects of permeable pavings on surface water runoff during heavy rainfall. This can be viewed via the BBC website.

d. **Infiltration devices** – these enhance the natural capacity of the ground to store and drain water. They include soakaways, infiltration trenches and infiltration basins. See figure 4.4.

e. **Basins and ponds** – these are areas for storage of surface runoff e.g. floodplains, wetlands, and flood storage reservoirs. They can be designed to control flows by storing water then releasing it slowly once the risk of flooding has passed. See figure 4.5.

Figure 4.4 - Cross-section through an Infiltration Basin

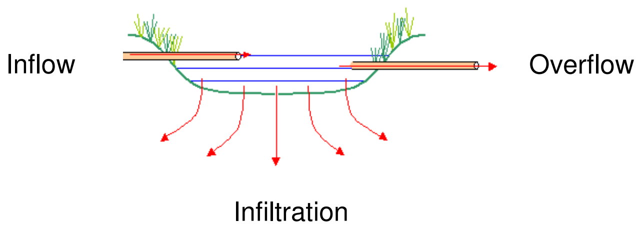
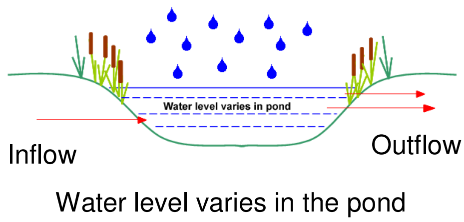


Figure 4.5 - Cross-section of a Pond



Surface water flooding appears to be a problem across the whole of the MDC area, except on the Mendip Hills to the north of the study area. There is some clustering of incidents around the wards of Beacon, Avalon, Glastonbury and Shepton Mallet but no one area stands out as having a significant surface water flooding problem.

SUDS are better suited to areas of new development than in-fill. This is because for new development the drainage system for the whole area can be considered and designed at the same time, ensuring a consistent system across the development area and surroundings. Retro-fitting produces pockets of SUDS which work in isolation and therefore are not as effective as they could be within a SUDS strategy.

It is imperative that when designing SUDS for an area that both the EA and the local drainage board are consulted at all stages of the design. This will ensure that the SUDS fit with the existing drainage network.

SUDS need to be regularly maintained to ensure they operate efficiently and effectively. The maintenance regime should be detailed and agreed during the design stage. Different SUDS techniques require different levels of maintenance therefore it is important to make it clear who is responsible for the maintenance at the start of the design and put a programme in place.

Government Guidance has been produced in the new water strategy for England, *Future Water,* which was published in February 2008. This strategy sets out the Government's long-term vision for water management in England. Following this publication, a consultation is currently underway (and due to finish 30th April 2008) regarding policy measures to improve the way that surface water runoff is managed. One of the suggested management tools is the development of Surface Water Management Plans. When completed, these should provide useful guidance for developers and local authorities. More information regarding these strategies and plans can be found on the Defra website (www.defra.gov.uk/Environment/water/strategy/index.htm).

4.4 River erosion

Throughout their lifetime, rivers can naturally change their course. Although no specific high risk areas have been identified in this SFRA, planners and developers should be aware that the course of rivers can change over time. Looking at County Series (1890 onwards) Ordnance Survey mapping can help identify where river erosion is a risk, by comparing the course of the river then and now. Such maps can be found in the Local Records Office. Where potential river erosion may occur this should be investigated as part of a FRA particularly if it could cause developed land to become at risk of flooding in the future.

4.5 Flood warning

The EA are responsible for flood watches and flood warnings across the whole of England and Wales. Warnings are provided for designated flood warning areas either directly or indirectly. The indirect system is based around the internet and the Floodline dial-up-and-listen service, where members of the public and other parties can obtain current flood warning information for their area. The Floodline number is 0845 988 1188 and the website is http://www.environment-agency.gov.uk/subjects/flood/floodwarning/. Flood warnings are also broadcast by television and radio services. Within the study area the designated flood warning areas are as shown on figure 4.6.

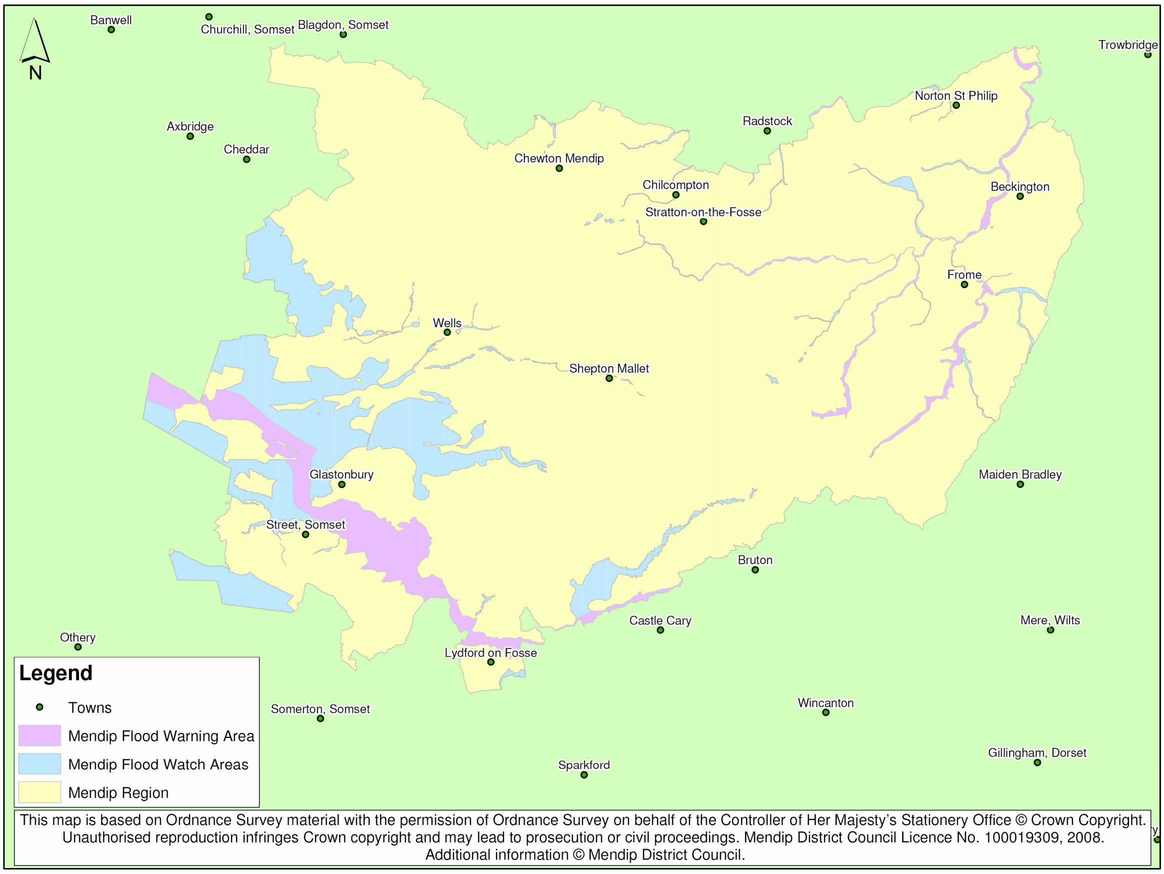
The EA will issue 4 codes, details of which are provided in Table 4.2. The direct warning service requires people in at risk properties in designated flood risk areas to register their telephone number with the EA under the Floodline Warnings direct scheme. They can then receive automatic warning messages if a flood is likely.

Table 4.2– EA Flood Warning Codes

Code	Flood Watch	Flood Warning	Severe Flood Warning	All clear
Symbol	Flood Watch	Flood Warning	Severe Flood Warning	All Clear
What it signifies	Flooding of low lying land and roads is expected	Flooding of homes & businesses is expected. Act now	Act now. Severe flooding is expected with extreme danger to life & property	No further flooding is expected. Water levels will start to go down

Code	Flood Watch	Flood Warning	Severe Flood Warning	All clear
What to do	Monitor news and weather forecasts; be aware; be prepared; check on pets etc: charge mobile phone.	Move cars, pets, food, valuables & important documents; get flood protection equipment in place; turn off supplies if safe to do so; prepare for evacuation; act on your flood plan.	Flood warning actions plus get to a high place with means of escape; avoid electricity sources; avoid walking or driving through the flood water; listen to emergency services.	Listen to weather reports; only return to evacuated buildings if told its safe to do so; beware sharp objects and pollution; contact insurance company and ask for advice before starting to clean up.

Figure 4.6 - Map of flood warning areas in MDC area



There are currently six Flood Watch areas in MDC area and seven Flood Warning Areas as shown in Figure 4.6 above and listed below. The warnings are based on catchment area rather than district boundaries so some areas are as a result of rivers in adjacent district boundaries.

Flood Watch Areas:

- Parrett Catchment, Levels and Moors covering:
  - Lower Parrett,
  - River Yeo,
  - River Tone,
  - River Isle,
  - River Cam,
  - River Cary and tributaries
- North Somerset Area covering:
  - Congresbury,
  - Yeo,
  - Cheddar Yeo,
  - Axe and tributaries

- East Somerset Rivers covering:
    - River Brue,
    - River Sheppey,
    - North Drain,
    - South Drain
- River Chew Catchment covering:
    - River Chew,
    - Chew Stoke Stream
    - Winford Brook from Chew Stoke to Keynsham
- Midford Brook Catchment covering:
    - Cam Brook,
    - Wellow Brook,
    - Midford Brook & tributaries
- Somerset Frome Area covering:
    - Somerset Frome,
    - Mells Stream,
    - Whatley Brook,
    - Nunney Brook & tributaries

Flood Warning Areas:
- River Brue (upper) Bruton Dam to Lovington
- River Brue (middle and lower) from Lovington to Highbridge
- Mells, Whatley and Nunney Brooks
- Somerset Frome at Frome Town
- Somerset Frome from Witham Friary to Frome
- Somerset Frome from Frome to Freshford
- Midford Brook, Cam and Wellow Brooks

Tables 4.3 and 4.4 below detail the flood watches and flood warnings respectively that have been issued by the EA for the MDC area since 2006.

Table 4.3 – Flood Watches issued in MDC area

Date	Location
19/01/2008	River Chew Catchment
15/01/2008	North Somerset Area, Somerset Frome Area, East Somerset Rivers, Midford Brook Catchment, River Chew Catchment
13/01/2008	Parrett Catchment, Levels and Moors
11/01/2008	Midford Brook Catchment, North Somerset Area, Somerset Frome Area, East Somerset Rivers, Parrett Catchment, Levels and Moors, River Chew Catchment
09/12/2007	East Somerset Rivers
08/12/2007	East Somerset Rivers, North Somerset Area, Parrett Catchment, Levels and Moors
06/12/2007	East Somerset Rivers
01/12/2007	East Somerset Rivers
21/11/2007	the Parrett Catchment, Levels and Moors
20/11/2007	East Somerset Rivers
26/07/2007	River Chew Catchment & North Somerset Area
22/07/2007	East Somerset Rivers
01/07/2007	East Somerset Rivers
29/06/2007	East Somerset Rivers
25/06/2007	East Somerset Rivers & North Somerset Area
06/03/2007	River Chew Catchment
04/03/2007	Parrett Catchment, Levels and Moors & East Somerset Rivers
02/03/2007	North Somerset Area

Date	Location
24/02/2007	East Somerset Rivers
23/02/2007	Parrett Catchment, Levels and Moors
18/01/2007	Parrett Catchment, Levels and Moors, East Somerset Rivers, River Chew Catchment
16/01/2007	East Somerset Rivers
10/01/2007	Midford Brook Catchment & River Chew Catchment
08/01/2007	Parrett Catchment, Levels and Moors
06/01/2007	East Somerset Rivers
30/12/2006	Parrett Catchment, Levels and Moors
03/12/2006	Parrett Catchment, Levels and Moors
28/11/2006	Parrett Catchment, Levels and Moors
25/11/2006	Parrett Catchment, Levels and Moors
25/11/2006	East Somerset Rivers
23/11/2006	East Somerset Rivers
17/11/2006	East Somerset Rivers
24/10/2006	East Somerset Rivers
20/10/2006	East Somerset Rivers
25/05/2006	East Somerset Rivers
22/05/2006	River Chew Catchment
20/02/2006	Parrett Catchment, Levels and Moors
20/02/2006	East Somerset Rivers
15/02/2006	East Somerset Rivers

Table 4.4 – Flood Warnings issued in MDC area

Date	Location
11/01/2008	Update for Somerset Frome from Frome to Freshford
11/01/2008	Somerset Frome at Witham Friary and Frome
11/01/2008	Somerset Frome from Frome to Freshford
11/01/2008	Mells, Whatley and Nunney Brooks
11/01/2008	Low lying properties on the River Brue Lovington to Highbridge
08/12/2007	River Brue from Lovington to Highbridge
08/12/2007	Low lying properties on the River Brue Lovington to Highbridge

Applicants for any proposed development which takes place in EA Flood Zone 3, which is not in an existing designated flood warning area, should assess the potential for such a service in conjunction with the EA and make provisions for such within any FRA, in order to meet PPS25 requirements.

Safety and evacuation procedures should also be addressed for developments within EA Flood Zone 3 and for civil infrastructure within Flood Zone 2 such as schools and hospitals. Provisions such as refuges, safe access and exit routes (which are above flood levels) should be incorporated into the design of such sites. Access for emergency vehicles will also need to be considered.

Emergency planning in the area is currently covered by MDC in their generic incident plan for the whole of MDC area. Any major development within the urban areas of MDC should consider the impact of new development on the existing plan. It should be ensured that the procedures can be applied to the new development or modified if necessary, in conjunction with SCC and the EA.

5 AREAS AT RISK OF FLOODING

5.1 Vulnerable areas

Areas sensitive to flooding have been highlighted by the information detailed on the EA Flood Zone maps and historic records of flooding from MDC and the EA. This has been supplemented with information from Parish Councils, SCC, Wessex Water and the Devon & Somerset Fire and Rescue Service via a data collection workshop session and information request. These areas are identified on both the A1 paper plans and the GIS layers. Flooding can be caused by overtopping of river banks or artificial bodies, surface water runoff, ground water, and blockages of drains and culverts within MDC area. Flood damage to properties largely results from conveyance issues where existing channels are not of sufficient capacity to cope with high flows due to heavy rainfall and increased surface water runoff mainly through urbanisation. Specific areas where this is known to be a problem are in Frome and Shepton Mallet.

5.2 Current levels of flood risk

Only a small proportion of the population of MDC area are currently at high risk of fluvial or tidal flooding. The main areas at risk from EA Flood Zone 3 are Glastonbury, Moor Wookey & St Cuthbert out West, Butleigh & Baltonsborough, which all have over 10% of their population within the boundary of the flood zone. Wells also has a high percentage of its population within the boundary of EA Flood Zone 2. The maps that accompany this report highlight that there are other sources of flooding, such as surface water flow, within the study area which affect additional properties.

Chart 5.1 shows the percentages of the population which live within either EA Flood Zone 2 or 3. It should be noted that the chart does not consider other sources of flooding.

Chart 5.1 - Proportions of the population at risk of fluvial or tidal flooding

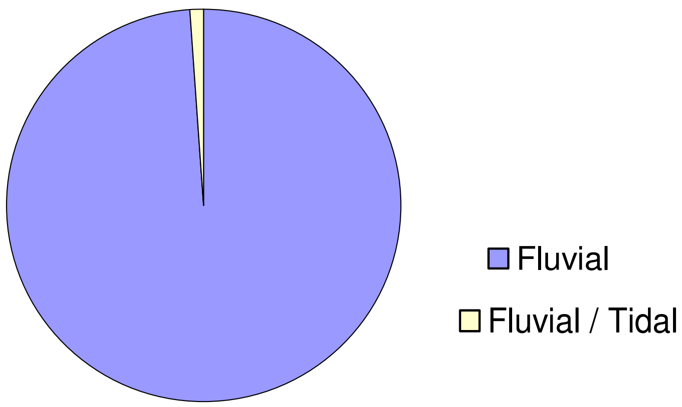


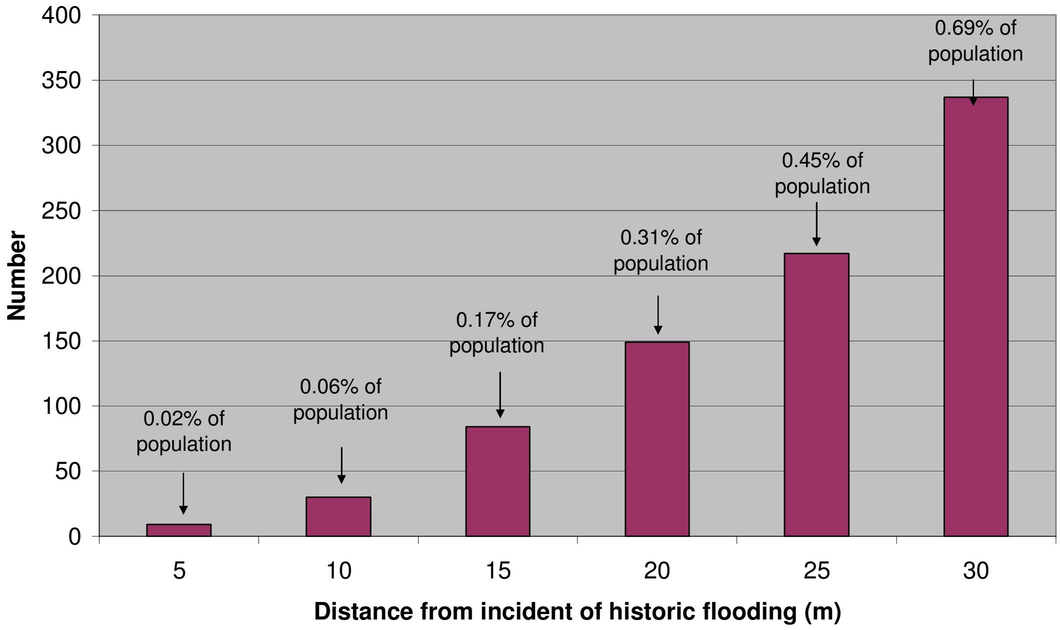
Table 5.1 highlights the main urban wards within MDC area where properties are located within EA Flood Zones. The table indicates the approximate number of properties at risk, and the primary sources of flooding.

Table 5.1 - The number of properties at risk of fluvial flooding within wards of MDC ranked by percentage in EA Flood Zone 3

	Number of properties			Percentage	
Ward name	**Total**	**In FZ3**	**In FZ2**	**In FZ3**	**In FZ2**
Wookey & St Cuthbert Out West	1,034	151	216	14.60	20.89
Glastonbury St Mary's	971	138	138	14.21	14.21
Moor	1,050	145	145	13.81	13.81
Butleigh & Baltonsborough	944	96	99	10.17	10.49
Glastonbury St Benedict's	1,516	115	115	7.59	7.59
Cranmore, Doulting & Nunney	1,029	54	55	5.25	5.34
Croscombe & Pilton	969	45	62	4.64	6.40
Ammerdown	1,058	44	51	4.16	4.82
The Pennards & Ditcheat	940	33	35	3.51	3.72
Wells St Cuthbert's	2,005	70	390	3.49	19.45
Beckington & Selwood	977	31	41	3.17	4.20
Glastonbury St John's	835	26	26	3.11	3.11
Street North	1,959	49	49	2.50	2.50
Creech	1,059	26	30	2.46	2.83
Chewton Mendip & Ston Easton	861	21	21	2.44	2.44
Rodney & Westbury	921	20	21	2.17	2.28
Postlebury	895	19	22	2.12	2.46
Ashwick, Chilcompton & Stratton	1,845	38	39	2.06	2.11
St Cuthbert Out North	1,121	17	27	1.52	2.41
Wells St Thomas'	1,974	29	46	1.47	2.33
Glastonbury St Edmund's	1,071	11	11	1.03	1.03
Rode & Norton St Philip	994	10	12	1.01	1.21
Coleford & Holcombe	2,036	18	22	0.88	1.08
Shepton West	2,031	17	29	0.84	1.43
Frome Keyford	2,011	8	13	0.40	0.65
Shepton East	2,334	3	83	0.13	3.56
Street South	2,217	1	1	0.05	0.05
Frome College	2,006	0	0	0.00	0.00
Frome Berkley Down	1,742	0	1	0.00	0.06
Frome Market	2,639	0	112	0.00	4.24
Frome Oakfield	1,098	0	0	0.00	0.00
Frome Park	2,107	0	0	0.00	0.00
Street West	839	0	0	0.00	0.00
Wells Central	1,431	0	696	0.00	48.64
TOTALS	**48,519**	**1,235**	**2,608**	**2.55**	**5.38**

The EA Flood Zones only consider the fluvial and tidal flooding. To measure the effect of other sources of flooding the historic flooding information has been considered. Chart 5.2 and Table 5.2 show the number of properties within a specified distance of a historic location of flooding within each ward area. This is only an indication of the flood risk because the historic information is only shown based on approximate location, but it acts as a guide as to where other sources of flooding may be an issue.

Chart 5.2 - The number of properties within MDC that are near to historic locations of flooding.



* Percentages are of the total MDC population

Table 5.2 – The number of properties within each ward that are within 30 metres of a known location of flooding (ranked by percentage)

Ward	Number of Properties	Percentage of population
Cranmore, Doulting & Nunney	29	2.82
Frome Market	62	2.35
Shepton East	51	2.19
Ashwick, Chilcompton & Stratton	39	2.11
Frome Oakfield	20	1.82
Coleford & Holcombe	33	1.62
Rode & Norton St Philip	16	1.61
Frome Park	30	1.42
Postlebury	12	1.34
Butleigh & Baltonsborough	11	1.17
Beckington & Selwood	8	0.82
Frome Berkley Down	9	0.52
Wells St Thomas'	8	0.41
Glastonbury St Benedict's	6	0.40
The Pennards & Ditcheat	3	0.32
Street South	6	0.27
Shepton West	5	0.25
Ammerdown	2	0.19

Ward	Number of Properties	Percentage of population
Rodney & Westbury	1	0.11
Frome Keyford	2	0.10
Wookey & St Cuthbert Out West	1	0.10
Other wards	0	0.00

This shows that the main areas where historic flooding could or has effected properties is in Cranmere, Doulting & Nunney, Frome Market, Shepton East and Ashwick, Chilcompton and Stratton, although the percentage of population effected in each ward is low.

A check has been made of the extent of EA Flood Zone 2. This extent should cover all areas that are at risk of fluvial flooding with an annual probability of 0.1% or more of occurring. None of the fluvial historic events highlighted during the data collection exercise are thought to have a return period of greater than 1 in 1000 years (0.1% annual probability) and therefore they should all fall within the EA Flood Zone 2. In a number of areas fluvial historic records do fall outside of EA Flood Zone 2. Some of these are next to watercourses not covered by EA Flood Zones and therefore this has been incorporated into the PFRAs e.g. at Wanstrow, (Figure 5.3). In other areas, we recommend that the historic information needs reviewing further as it may represent a need to extend EA Flood Zone 2 or be an indication of where the boundary of extreme events may fall. These are at Batcombe, Croscombe, Mells, Frome, Henton, Street, Shepton Mallet, Milton Clevedon, Trudoxhill CP and Nunney, as shown in Figure 5.4.

Figure 5.3 – Example of PFRA

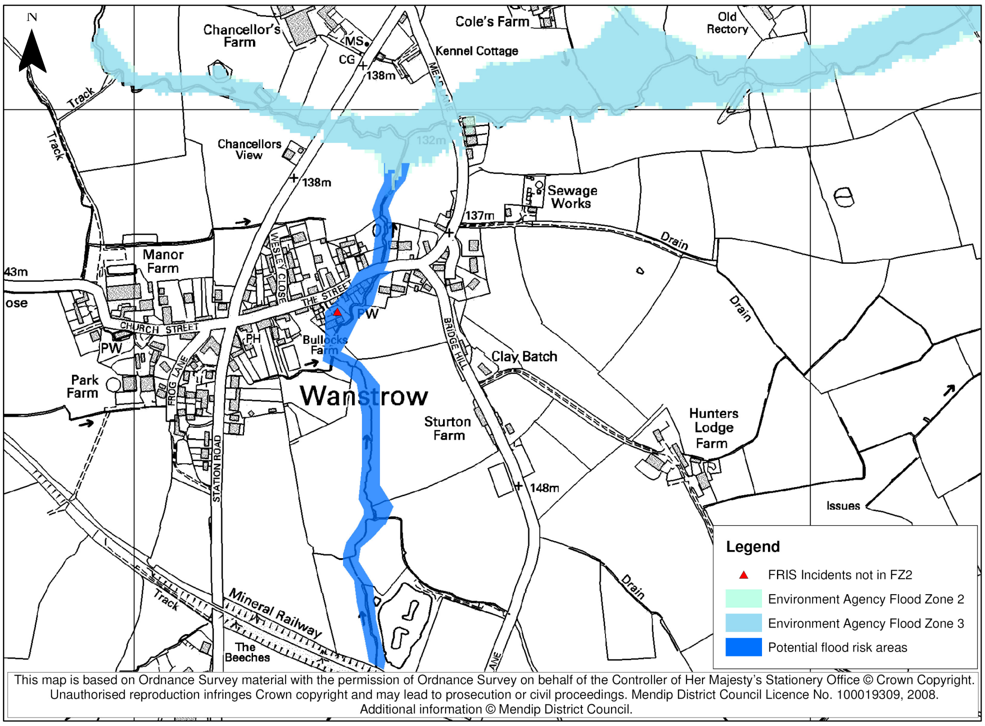
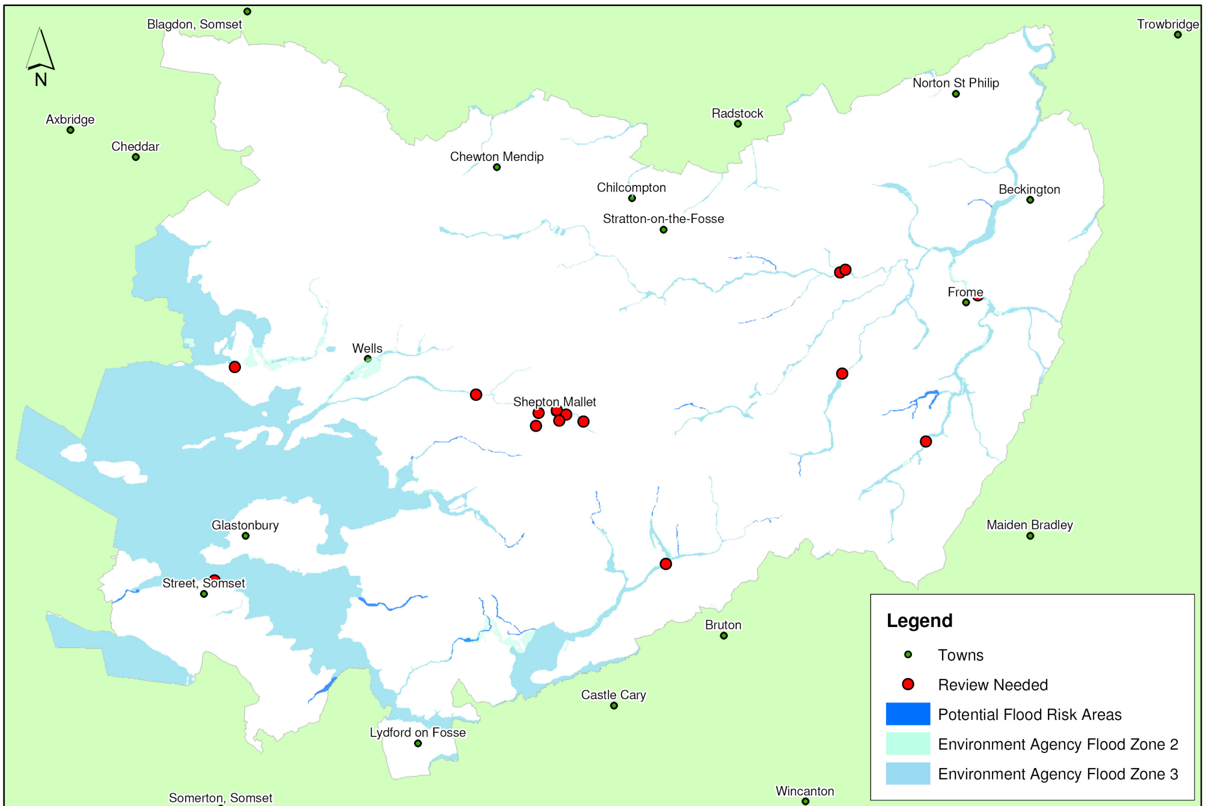


Figure 5.4 – Locations where EA Flood Zone may need reviewing



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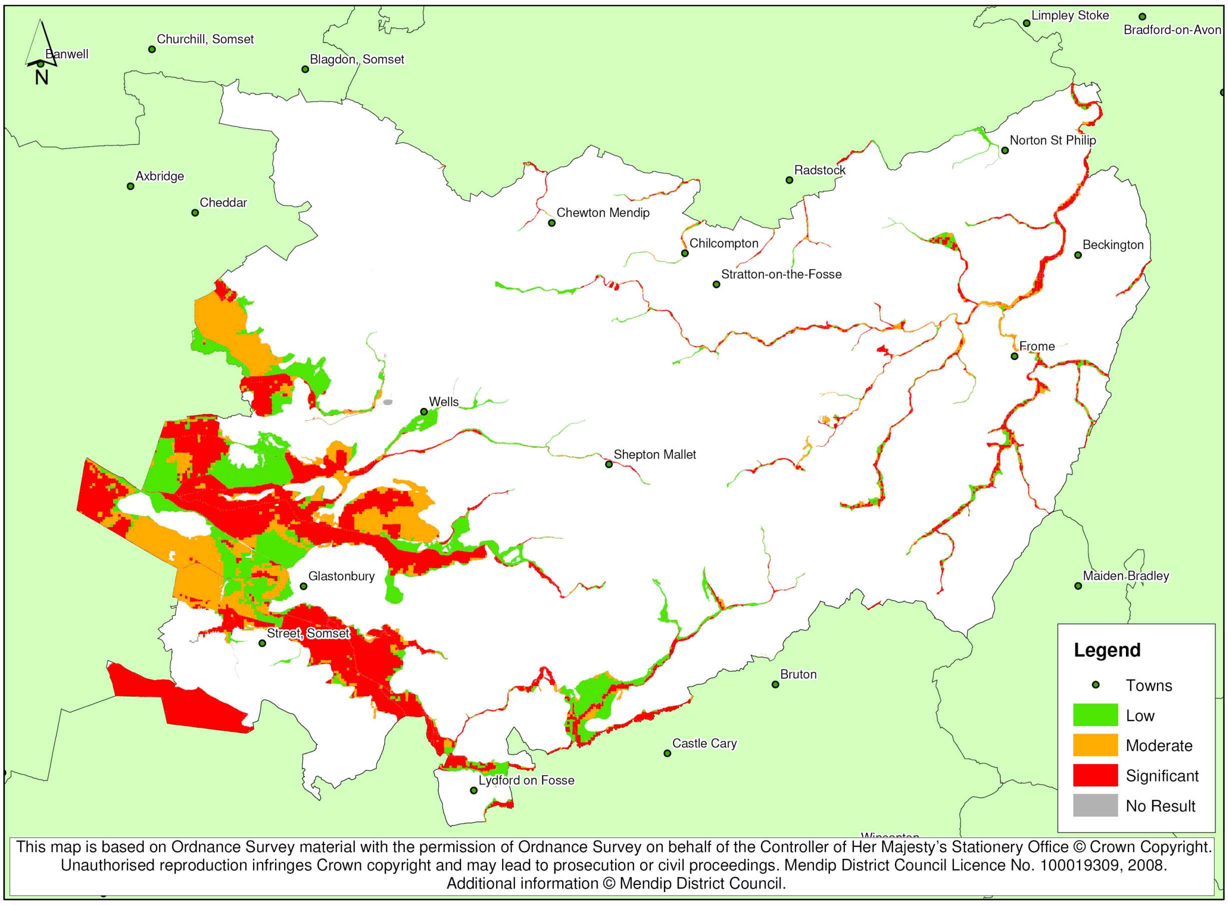
The results from the National Flood Risk Assessment (NaFRA), produced by Halcrow, have also been investigated during this study. The NaFRA used a risk based approach to assess the flood risk to the whole of England and Wales, factoring in location, type, condition and effect of defences. This methodology, called the Risk Assessment for Strategic Planning (RASP), used the EA Flood Zone 2 as a boundary, split the floodplain into impact zones (100m square) and then calculated the actual likelihood of flooding within each impact zone. A range of floods varying from regular to extreme events were investigated and the likelihood that the centre of each impact zone became wet was calculated. Three risk categories were then created:

- Low risk means a 0.5% or less annual probability of flooding
- Moderate risk means between a 1.3% and 0.5% annual probability of flooding
- Significant risk means greater than a 1.3% probability of flooding.

The location of the 3 categories within MDC area are shown in Figure 5.5. A property count highlights that 68% of MDC properties that fall within EA Flood Zone 2 are in the low risk category, 19% are in the moderate risk category and 13% are in the significant risk category. The properties at significant risk are mainly within the wards of Shepton East, Cranmore, Doulting & Nunney, Wookey & St Cuthbert Out West and Ammerdown. This roughly equates to the same areas as the analysis of EA Flood Zones 2 and 3.

Figure 5.5 – NaFRA risk category areas



Hydraulic models can also be used to assess the risk to properties but at a more localised scale. Within MDC area there are currently five 1 dimensional hydraulic models owned by the EA, four of which use HecRAS, and the other uses iSIS. These models cover areas of the River Axe at Wookey, the Frome at Frome (iSIS), the River Sheppey at Shepton Mallet, the Keward and St Andrews Brook at Wells, and Street. Care should be taken when using existing hydraulic models for two reasons:

a. The channel and / or floodplain could have changed significantly since the model was created.
b. The model was built and designed for one particular purpose, it therefore may not be suitable for other uses.

5.3 Climate change results

Lateral changes to existing flood extents and the increases (if any) in numbers of properties affected due to 20% increases in flows, as a result of climate change and the guidance available from PPS25, are given in table 5.3 below. The new fluvial flood extents (shown in figure 5.6) were based on the existing Flood Zone 3 data and have been created in certain key areas using the LiDAR Digital Terrain Model (DTM) data.

Table 5.3 – Total lateral changes to flood extents and properties affected due to fluvial climate change

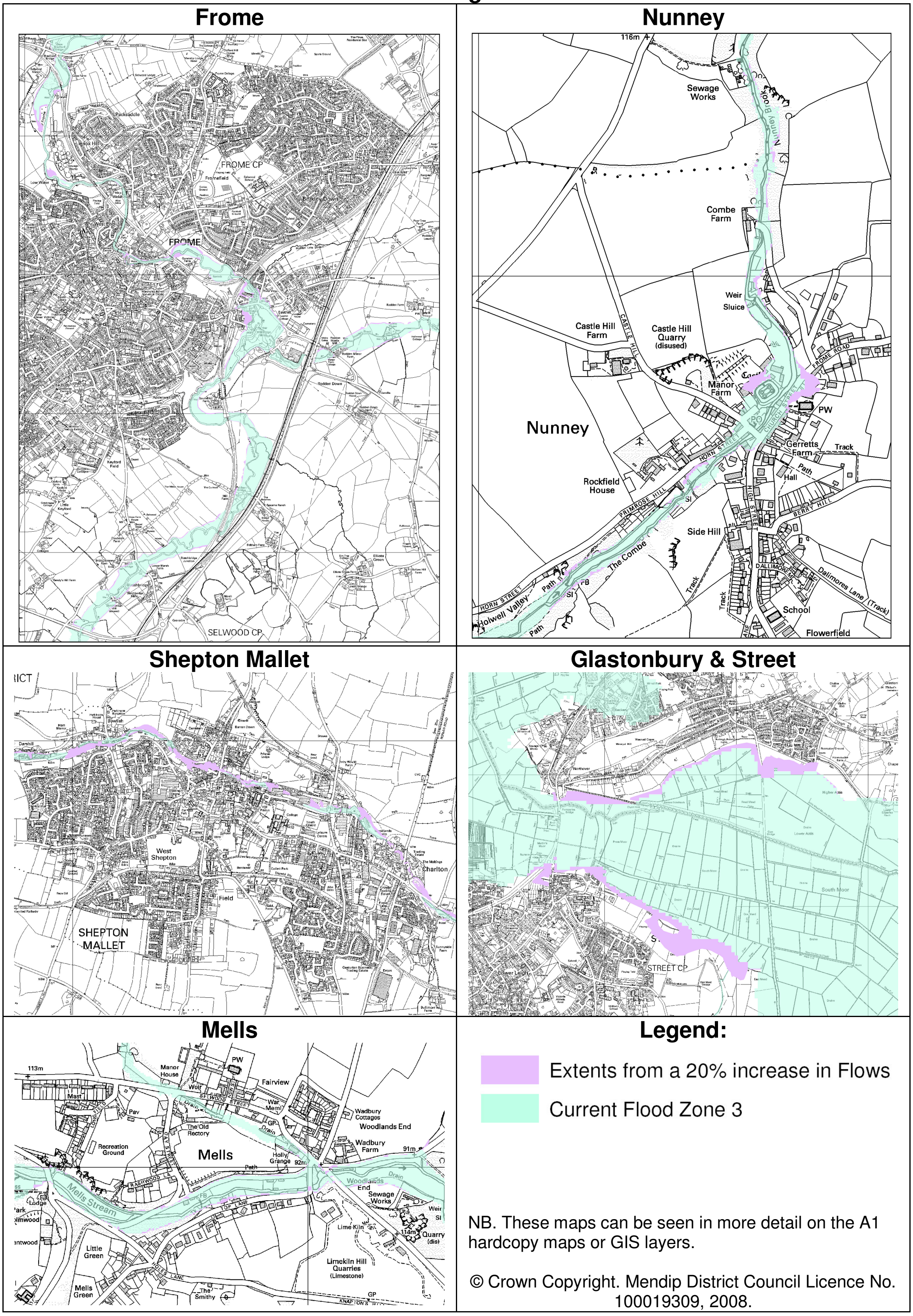
Area	Lateral extent changes (m)	Additional properties affected	Comments
Frome	4m	2	Minimal increases in FZ3 extent. There are discrete areas where the extent increases more significantly, the maximum increase in horizontal flood zone occurring at Wallbridge Industrial Estate.
Glastonbury	60m	32	The extent of increased flood zone is comparatively large, with a high average increase covering mostly agricultural land. The new extent encompasses a further urban area at The Boardwalk, Street.
Mells	1m	1	The extent of flood zone 3 does not increase significantly at Mells. Slight increases are seen, however no further properties are affected.
Nunney	3m	2	Increases in horizontal flood extent are seen particularly on church street encroaching onto Nunney Castle and Manor Farm. Otherwise little increase in horizontal extent is seen.
Shepton Mallet	24m	128	The increase in flood zone is relatively large with the flood zone not only increasing in width in numerous locations, but also it has produced new areas at risk of flooding following the course of the river through the urban area. Maximum increase occurs at Draycott Road.

The specific methodology is detailed in Appendix C. The locations chosen for these detailed studies were identified by locating FRIS hotspots and other known locations of high frequency flooding and the presence of existing Flood Zone 3 data. An existing hydraulic model had been built previously for the EA for flood mapping purposes. This model was therefore used to calculate the Frome climate change extents rather than method detailed in Appendix C. Confidence is therefore higher in the results at Frome as the method is more site specific. Note that the climate change extents, like EA Flood Zone 3 assume no defences are in place.

The two areas where significant numbers of additional properties are affected due to climate changes are Shepton Mallet and Glastonbury. Shepton Mallet in particular highlights an additional part of the town in the east that could become affected due to climate change. This suggests that more investigation may be required for this area. Glastonbury, on the other hand shows a gradual increase in the extent rather than adding new areas of flood risk.

Sea level rise has not been investigated as part of this study due to the limited extent of tidal flooding.

Figure 5.5 - New flood extents taking into account the predicted affects of climate change



5.4 Impacts of Development

This SFRA is designed to aid the identification of sites for development. PPS25 identifies the following aims:

- Developing in areas of flood risk should be avoided where possible. If this is not possible the risk should be reduced and managed.
- Decisions should take full account of:
  - the present and future flood risk, involving both the statistical probability of a flood occurring and the scale of its potential consequences
  - the wider implications for flood risk of the development
- Flood risk should be considered at all stages in the planning process to avoid inappropriate development
- The development must be sustainable, meaning that the development must deliver improved environmental, social and economic services to all residents of a community without threatening the viability of natural, built and social systems.

MDC is a rural area and it has been proposed that the bulk of development should be directed to the towns where approximately 60% of the population live. The main reason for this is to reduce the need to commute, plus the infrastructure is already in place there. In addition, brownfield sites i.e. sites that have previously been developed, should be developed before green field (un-developed) sites.

Around Wells there is an AONB, National Trust Woodland and Historic Parks, whilst Frome, Glastonbury, Shepton Mallet and Wells are all Outstanding Heritage Settlements. Shepton Mallet also has a County Wildlife Site to the west. All these factors constrain the possible areas for development around these towns, particularly in Glastonbury and Wells only modest development is proposed.

As part of this SFRA we broadly investigated the possible impact of developments on the flood risk to the surrounding area. At the time of undertaking this study MDC were assuming a development level of 450 houses per year over 20 years (i.e. 9000 properties in total). This is in line with the value of 8,300 recommended in the South West Regional Spatial Strategy (RSS) following the Examination in Public. The distribution of houses is expected to be approximately as follows:

- Frome – 2,500
- Glastonbury – 850
- Shepton Mallet – 1,300
- Street – 1,400
- Wells – 950
- Villages – 2,000

Using the Flood Estimation Handbook (FEH) and Modified Rational Method the effect on the percentage and volume of surface water runoff at each of the 5 towns has been investigated for the 1% annual probability (a.p) event (1 in 100 year return period) and the 20% annual probability event (a.p) (1 in 5 year return period). This is to check the effect of both high and low order events. Not enough information was available regarding the distribution of houses in the villages for an assessment to be carried out for smaller settlements. This is only a broad scale investigation looking at the whole catchment and therefore detailed assessment would be required for any proposed development site as part of a site specific FRA.

Generally as urbanisation increases the amount of surface water runoff from the area also increases. The FEH catchment descriptor Standard Percentage Runoff (SPR) has been used to assess the impact of increased urbanisation in the selected areas. The SPR values before and after development have then been factored into a theoretical assessment using the FEH Rainfall Runoff Method to determine the effect on the flow and volume of water for large scale areas.

Frome, Shepton Mallet, Street and Glastonbury all fall within one river catchment and therefore all of the proposed development was assumed to be within the same catchment. Wells is spread across two river catchments and therefore a number of scenarios, detailed below, were investigated based on which catchment the proposed development fell within.

- Scenario 1 – all of the proposed development falls within the Keward Brook catchment, i.e. to the east and south of Wells
- Scenario 2 – all of the proposed development falls within the River Axe catchment, i.e. to the north of Wells
- Scenario 3 – the proposed development is split across the two catchments. Currently 82.9% of Wells falls within the Keward Brook catchment, whilst 17.1% falls within the Axe catchment. This same split was assumed for the proposed development.

The results of the assessment are shown in Tables 5.4.

Table 5.4 – Impact of development on SPR, flow (cumecs) and volume (m^3) during the 1% annual probability (a.p) event and 20% annual probability (a.p) event

Location	% increase in SPR	% increase in flow (cumecs)		% increase in volume (m^3)	
		1% a.p.	20% a.p.	1% a.p.	20% a.p.
Frome	1.84	1.4	1.6	1.5	1.7
Glastonbury	0.35	0.4	0.4	0.4	0.4
Shepton Mallet	33.33	21.4	26.8	22.1	29.4
Street	8.50	7.6	8.7	7.7	9.0
Wells Scenario 1	9.49	6.7	8.2	6.9	8.8
Wells Scenario 2	22.68	15.7	20.2	16.3	22.3
Wells Scenario 3	11.72	4.6	5.7	4.8	6.3

For example, at Frome the development could increase the SPR value by 1.84% therefore for the 1 in 100 year fluvial flood event would increase flows from approximately 100 cumecs up to 102 cumecs, and increase the volume of surface water runoff by 63,900m^3.

This assessment shows that the most sensitive areas to development are Shepton Mallet and Wells, particularly if scenario 2 is taken forward at Wells. In these locations SUDS would be essential to ensure that the effect of the development on the surrounding area is reduced. Glastonbury appears to be the least sensitive, most likely due to the location within the river catchment. A more detailed assessment would still be required for this area in an FRA when the exact location of development is known. Generally, the high increases in surface water runoff occur where there are small overloaded drainage systems in place. This means that the drainage capacity, particularly in these sensitive areas, needs to be a major aspect of any design.

6 DATA AND MAPPING

6.1 Data collection

To produce this SFRA data have been collected from both the EA and MDC. This has been supplemented with data from SCC, Wessex Water, Drainage Boards, Devon & Somerset Fire and Rescue Service and Parish Councils via phone, email, post and a data collection workshop held on 25 January 2008 at MDC Offices in Shepton Mallet.

Data collected from the EA include:
- EA Flood Zone mapping
- EA data on flood defences (NFCDD)
- EA Historic Flood Map
- Flooding Incidents recorded by the EA (FRIS)
- Flood warning areas and flood watch areas
- LiDAR DTM data
- Photos of flooding events
- Historic Flood Map (HFM)
- NaFRA outputs
- Location of hydraulic models in the area

Data collected from MDC:
- Ordnance survey mapping at 1:10,000 scale
- Mastermap for the area
- Aerial photographs
- Contour mapping
- Known flooding problems and observations as described at the data collection workshop
- MDC boundary
- Ward outlines
- Proposed housing allocations
- Photos of flooding events

We also obtained information from the following sources:
- Wessex Water
- Devon & Somerset Fire and Rescue Service
- SCC (reservoir information)
- Somerset Highways Authority
- Somerset Consortium of Drainage Boards
- A number of Parish Councils, Town Councils, Wells City Council and residents of MDC area.

As part of the study, we produced the following GIS based data
- PFRAs (section 3.1)
- Limited new flood extents (as discussed in section 6.3.2) based on existing EA Flood Zone 3 and climate change predictions (section 5.3 and Appendix C)

We also produced the following guidance documents:
- Guidance on the process to follow when assessing a possible site for development (Appendix D)
- PPS25 Decision Flow Charts (Appendix E)
- Guidance for developing housing in a flood resistant manner (Appendix F)

6.2 Data quality

The quality of the flood related data collected and produced varies due to the source and age of the data. In addition, some areas have been carefully mapped using hydraulic modelling, whilst other areas are less precise. For that reason a cautious approach has been taken in this SFRA, using the best data available at the time of writing.

Each data set has been given a data quality suffix reflecting the views of Royal Haskoning about the quality and accuracy of the data when considering flood risk, as detailed in Appendix A. This is to help planning officers, developers and members of the public judge how to use the data when considering flood risk and the need for further study.

Improvements may be made to the data and therefore the data collected must be updated regularly to ensure that the most up-to-date and accurate data are used to guide any decisions regarding flooding and flood risk. Where data is not available for the SFRA, it has been necessary to make assumptions based on professional experience, local knowledge and recorded literature. The least reliance is placed on those cases where only assumptions based on engineering judgement is available. The latter category should be used with particular caution. For this reason, whilst information is shown on the maps in a relatively precise way, it is not possible to be completely certain from the outputs of this SFRA that any individual property, particularly those near the boundaries of zones of risk, is definitely within that risk zone.

In particular, the locations of flooding from Devon & Somerset Fire and Rescue Services and Wessex Water are only general areas and should not be thought of as property specific.

6.3 Mapping

The following sets of A1 maps have been produced to accompany this report:

- Existing and future flood risk areas (inc. climate change predictions)
- Historic flood events and locations of defences

Each map covers a 5x5 kilometre area equating to 40 A1 maps. The maps help to class land into different categories of current and future flood risk and are to be used as an aid when considering sites for development. It must be noted that these maps are part of a strategic analysis of the flood risk and should not be used to make decisions regarding flood risk to individual properties.

6.3.1 Existing and future flood risk

These maps show the EA Flood Zones 2 and 3, the PFRAs and climate change predictions.

The mapping of flood risk is helpful in the SFRA process as it shows where flooding could occur, and therefore where potential new developments should be carefully considered before giving planning permission. Where possible, the type of flooding e.g. fluvial, tidal or a combination has been shown on the map to highlight the problems that occur in each area.

Most of the EA Flood Zones have been defined using hydrological and hydraulic models and mapped using detailed information on the topography of the ground. It should be noted that the Flood Map is published by the EA every quarter. This is to ensure the latest flood maps are being used. The Flood Maps shown in this report and in the A1 maps are the most up to date versions at the time of writing this report.

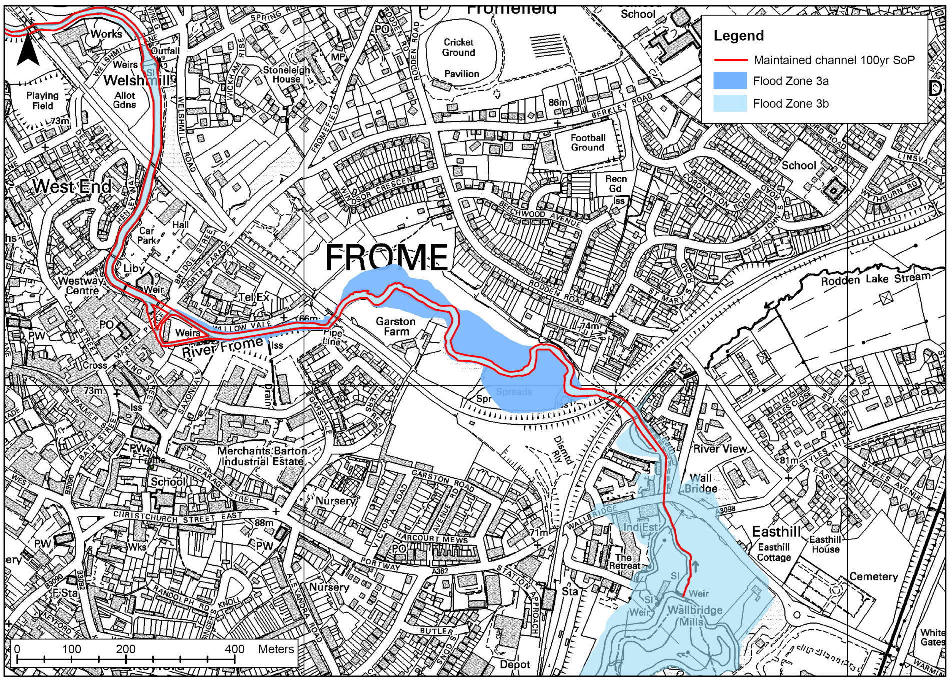
PPS25 further splits EA Flood Zone 3 into two types:

- Flood Zone 3a – High Probability of flooding
- Flood Zone 3b – Functional Floodplain

Functional floodplain comprises of land where water has to flow or be stored in times of flood. Defences therefore provide a split between Flood Zones 3a and 3b. Particularly in urban areas, the river channel up to the top of the banks or flood defence is classified as functional floodplain, whilst providing the defences are of a high enough standard, the land behind the defences is classified as Flood Zone 3a. This is a way to highlight the work done by developers in reducing the flood risk to a site, i.e. changing the land from functional floodplain to Flood Zone 3a. An example of this is the work undertaken at ASDA in Frome.

For this study the land behind defences within urban areas that have a standard of protection of at least 1 in 20 years (5% annual probability) are shown as in Flood Zone 3a whilst the river channel and area upstream and downstream of the defence are shown as Function Floodplain, Flood Zone 3b. The majority of defences within MDC area are quoted to have a standard of protection of less than 20 years. In addition, some areas with raised defences in some places are not protected in others and therefore at this stage cannot be classified as Flood Zone 3a, e.g. at Glastonbury. Therefore the only location of Flood Zone 3a highlighted during this study is at Frome, as shown in Figure 6.1 below. This Flood Zone distinction has been undertaken following consultations with the EA and MDC.

Figure 6.1 – Example of Flood Zone 3a and 3b split at Frome



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It should be noted that this is only an indication of the functional floodplain and before development can be permitted it must be shown that the standard of protection is high enough via a FRA.

The exact changes to EA fluvial Flood Zone 3 extents due to climate change have not been carried out for the whole study area. Therefore the new extents are only shown in the locations where the work was carried out. From the localised studies carried out using LiDAR DTM data, an average increase in the EA Flood Zone 3 lateral extent of approximately 4 - 30m in urban areas and 1 and 3m in rural areas is predicted for a 20% increase in flows until 2110.

It is beyond the scope of this SFRA to apply this climate change methodology across the whole study area. The new fluvial flood extents as derived above serve as a guide for the likely changes that could occur as a result of increased flows of 20%. It is assumed that similar lateral changes to flood extents will also occur at other locations in the study area with equivalent topography and settlement patterns.

As an approximation, land which lies between the boundaries of EA Flood Zones 2 and 3 and is closer to the boundary of EA Flood Zone 3 than EA Flood Zone 2 should be treated as being within EA Flood Zone 3 for the purposes of guiding planning officers about the possible effects of climate change. The effects of climate change also need to be considered with regard to PFRAs following a pragmatic but cautious approach to take account of their uncertainty. As a guideline, possible flood risk should be considered for land within a 10m lateral distance and 2m height of the PFRAs. However, any development within or close to EA Flood Zone 3 and/or a PFRA should undertake a site specific FRA which considers in detail the possible effects of climate change.

6.3.2 Historic flood events

One method to investigate flood risk is to look at the areas which have flooded in the past. The flooding can be from a range of sources e.g. fluvial, tidal, surface water runoff, groundwater, highways, artificial bodies or a combination, although the majority of events indicated on the maps are from fluvial or surface water runoff.

Where the information is of good quality, the map shows the area which is thought to have flooded. This information has been provided by the EA in the form of HFM. Where there is no information about the extent and exact location of the flooding, the map is marked with a dot-symbol indicating the flood event. This information has been obtained from a range of sources via phone, email, post and the data collection workshop. It should be noted that this dot-symbol does not mean that flooding happened at this exact point, but that flooding did occur in the general location. This information can be used for assessing future flood risk, particularly for small catchments or urban areas where repeat flooding occurs, but there is little mapping or other data to substantiate the risk.

6.3.3 Defences

The map shows the location of existing flood defences maintained by either the EA or MDC. This is useful for a number of reasons:

- This allows planners, developers and the general public to put the potential flood risk into context, especially where historic flooding and flood defences are shown in the same location; the historic flooding may have occurred before flood defences were in place.

- Knowing where flood defences are can indicate areas where flood risk may be reduced, although further investigation regarding the standard of protection that is currently afforded by the defence will be required.
- By referring to the current Standard of Protection, areas of floodplain which are classed as defended can be incorporated into development plans as part of an FRA.

Where there are no defences, the floodplain can be defined as functional or natural floodplain i.e. an area that can store water which has overtopped river banks in times of a flood. This floodwater can then drain away through watercourses. A general principle of PPS25 is to maintain a constant amount of functional floodplain. Providing defences will therefore reduce the amount of functional floodplain

6.3.4 Geographical Information System (GIS)

A Geographical Information System (GIS) is a computer-based system for using data that is spatially referenced. This means the information can be viewed on electronic maps, where the maps also provide links to the underlying database and attribute information about the graphics displayed on the maps. The data sets that have been collected to undertake the SFRA have either been supplied in a GIS format, or have been adapted to a GIS format from hardcopy data by Royal Haskoning.

The information is provided to MDC in MapInfo Mid Mif format to be integrated within their own corporate GIS system. This will allow users to view additional GIS layers such as development sites and designations within the context of the SFRA datasets. In addition, users will be able to carry out appropriate analysis and assessment using both sources of data to quickly locate areas and assess flood risk at potential development sites.

By using a GIS based system, staff at MDC can add to the existing datasets keeping records up to date and link to the latest data, such as the updated Flood Zone datasets supplied from the EA. Therefore the SFRA GIS project becomes a fluid and adaptable information source that is not referenced to a set point in time like hardcopy maps and can always be made into hardcopy or pdf as and when required.

7 SFRA USER GUIDANCE

This SFRA is a strategic overview of flood risk throughout the MDC area. In accordance with Government planning policy flood risk within the area has been categorised into three flood risk zones – Zone 1 (Little or no risk), Zone 2 (Low to medium risk) and Zone 3 (Medium to high risk). This categorisation into zones is intended to give an indication only of flood risk at any particular location within the area and is not intended to represent a detailed assessment of the flood risk appertaining to any particular building or piece of land within the study area. It is to be noted that the all maps (paper and GIS based) included as part of this SFRA show only the extent of Zones 2 and 3, that is any areas not assessed as lying within a Zone 2 or Zone 3 are deemed to be Zone 1 as described in section 3.1.

The Government aims to reduce the risk from flooding to people and the developed and natural environment by discouraging development within areas at medium to high risk of flooding. Government guidance has been produced for local planning authorities to help them when allocating land for development in order to meet this aim. The current guidance is contained in Planning Policy Statement 25 (PPS25) – Development and Flood Risk.

Therefore, this SFRA is intended to be used by planners and developers alike to assess the suitability of any particular site to support or not a particular type of development. This is subject to the level of flood risk, the vulnerability of the proposed usage and the extent to which the combination of other factors and mitigation might exempt the development from the application of this guidance (i.e. flood risk would not be a reason for refusal at planning).

7.1 Planning Policy Statement 25

PPS25 provides Government policy that sets out a number of important points in relation to planning and flood risk. These are that:

- Flooding cannot be wholly prevented, but its impacts can be avoided through good planning and management.
- Climate change will lead to increased and new risks of flooding within the lifetime of planned developments.
- All forms of flooding and their impact on the natural and built environment are material planning considerations.
- Good planning and management avoids, reduces and manages flood risk by taking full account in decisions on plans and applications of:
    1. Present and future flood risk involving both the statistical probability of a flood occurring and the scale of its potential consequences, whether inland or on the coast; and
    2. The wider implications for flood risk of development located outside flood risk areas.
- Flood risk should be taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding.
- Regional planning bodies (RPBs) and local planning authorities (LPAs) should prepare and implement planning strategies that help to deliver sustainable development by appraising, managing and reducing risk using a partnership approach.

PPS25 does recognise that in some areas it will be necessary to locate some development in an area at higher risk of flooding. However, this will happen in exceptional cases only and these developments must not only be safe from flooding, they must make sure that flood risk elsewhere does not increase as a consequence of the development. In addition, where possible this type of development should try to reduce the overall flood risk to the wider surrounding area.

The assessment of land for development requires 4 stages:

1. Flood Zone Classification (Table D1 PPS25)
2. Sequential Test through the use of PPS25 Decision Flow Charts (Appendix E)
3. Flood Risk Vulnerability Classification (Table D2 PPS25)
4. Exception Test where indicated by table D3 of PPS25

Details and advice for undertaking this process is provided in Appendix D.

7.2 Flood Zone Classification

Table 7.1 below sets out the Flood Zone classification from PPS25. This classification is used as the basis of the Sequential test described in Section 7.4 of this report. It identifies the probability of flood risk in each type of flood zone.

Table 7.1- Flood Zone Classification

Flood Zone	Definition
Zone 1 Low Probability	This zone comprises land assessed as having a less than 1 in 1000 annual probability of fluvial or tidal flooding in any year (<0.1%).
Zone 2 Medium Probability	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of fluvial flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of tidal flooding (0.5% – 0.1%) in any year.
Zone 3	Zone 3 is split into two parts; Flood Zone 3a High Probability and Flood Zone 3b Functional Floodplain. All areas within Zone 3 should be considered as Functional floodplain (Zone 3b) unless an appropriate FRA shows that it can be considered as Zone 3a and the EA agrees this.
Zone 3a High Probability	This zone comprises land assessed as having a 1 in 100 or greater annual probability of fluvial flooding (>1%) or a 1 in 200 or greater annual probability of tidal flooding (>0.5%) in any year.
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. It is defined as land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the EA. This includes water conveyance routes. Flood storage areas are considered to be Functional Floodplain due to the essential role they provide in storing flood water.

All areas in Flood Zone 3 should be considered as functional floodplain (3b) until an appropriate FRA demonstrates otherwise. For the purposes of this Level 1 SFRA we have identified the functional floodplain in a number of key areas in order to allow Flood

Zone 3 to be differentiated between zones 3a and 3b. Where this has not been undertaken, all land in Zone 3 should be considered as Zone 3b until it can be demonstrated to the satisfaction of the EA that it can be considered otherwise. Washlands and flow conveyance routes, including the river channel itself between bank tops, should also be treated as zone 3b.

7.3 The Sequential Test

Local Authorities and developers can both use the Sequential Test to highlight areas of development. The aim of the Sequential test is to direct development to Flood Zone 1. Where there is no reasonable land available, development can then be considered in Flood Zone 2, and then Flood Zone 3, taking account of flood risk vulnerability where sites have to be placed in these higher risk areas. The types of development allowed in each Flood Zone, classified using the Flood Risk Vulnerability Table, becomes more limited the higher the risk of flooding becomes, with development in land classified as Functional Floodplain (Zone 3b) extremely limited in order to maintain space for water to be stored naturally, a central aim of PPS25.

Table 7.2 below details the type of development permitted in each flood zone, along with any FRA or developer requirements. Table 7.3 summarises the relationship between the different Flood Zones and the Flood Risk Vulnerability classifications.

The Sequential Test should be applied by local planning authorities in land allocation for spatial plans e.g. LDF. Developers will also need to apply the sequential test if a site they wish to develop is not identified by the LDF and is at risk from fluvial or tidal flooding. If developers make applications on sites that have already been through the sequential test as part of the LDF process then they are not required to undertake the test again, although they should apply a sequential approach at the site. Additionally this type of approach should be used in areas at risk from other forms of flooding.

Table 7.2 – PPS25: Planning response to sequential characterisation of flood risk

Zone 1 Low Probability **Appropriate uses** All uses of land are appropriate in this zone.
Zone 2 Medium Probability **Appropriate uses** The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure are appropriate in this zone. Subject to the Sequential Test being applied, the highly vulnerable uses are only appropriate in this zone if the Exception Test is passed.
Zone 3a High Probability **Appropriate uses** The water-compatible and less vulnerable uses of land are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. The more vulnerable and essential infrastructure uses should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.

Zone 3b The Functional Floodplain
Appropriate uses Only the water-compatible uses and the essential infrastructure that has to be there should be permitted in this zone. It should be designed and constructed to: • remain operational and safe for users in times of flood; • result in no net loss of floodplain storage; • not impede water flows; and • not increase flood risk elsewhere. Essential infrastructure in this zone should pass the Exception Test.

Table 7.3 – Summary of appropriate uses in each flood zone

Flood Zone	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	ET	✓	✓
Zone 3a	ET	✓	×	ET	✓
Zone 3b	ET	✓	×	×	×

Key:
✓ = Development is appropriate in terms of flood risk
× = Development should not be permitted due to flood risk
ET = Exception test must be passed for the development to be permitted on the basis of flood risk.

In applying the sequential test, local planning authorities should consult and take the advice of the EA on the distribution of flood risk and the availability of flood defences in their areas. Flood defences for most new housing developments should be designed and constructed to protect against a flood with an annual probability of 1% for fluvial flooding and 0.5% for coastal flooding (for a period of 50 years). Commercial and industrial development should aim to achieve the same minimum standard of defence.

As part of this SFRA, guidance on the process to follow when considering a possible site for development is including in Appendix D. This links to PPS25 Decision Flow Charts that have been produced using the information given in the sequential test. The flow charts can be followed by planning officers, potential developers and members of the public to assess at a strategic level the flood risk to a piece of land. They clearly indicate whether a piece of land would require a specific and detailed FRA to be provided with a planning application and are designed to provide a robust and consistent system for assessing flood risk anywhere within MDC area. The PPS25 Decision Flow Charts can be found in Appendix E. There is a flow chart for each of the Vulnerability Classifications given in table 7.4.

7.4 Flood Risk Vulnerability Classification

Following the Sequential Test a flood risk classification which groups land uses, infrastructure and buildings into five categories of vulnerability needs to be carried out to assign one of five vulnerability criteria to the proposed development site(s). A summary of these classifications, with examples of the elements which lie within them, are outlined in table 7.4 below.

Table 7.4 - PPS 25: Flood Risk Vulnerability Classification

Flood Risk Vulnerability Classification	
1.Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
2. Highly Vulnerable	• Police stations, Ambulance stations, Fire stations, Command Centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.
3. More Vulnerable	• Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non-residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan**.**
4. Less Vulnerable	• Buildings used for: shops; financial; professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non-residential institutions not included in 'more vulnerable'; and assembly and leisure. • Land and building used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment plants. • Sewage treatment plants (if adequate pollution control measures are in place).
5. Water-compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports, recreation and essential facilities e.g. changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Flood Risk Vulnerability Classification
Notes • *This classification is based partly on Defra/Environment Agency research on flood risks to people and also the need of some uses to keep functioning during flooding.* • *Buildings with combined activities should be placed in the higher of the relevant classes of flood risk sensitivity. Developments that allow uses to be distributed over the site may fall within several classes of flood risk sensitivity.* • *The impact of a flood on the particular uses identified within this flood risk vulnerability classification will vary within each vulnerability class. Therefore, the flood risk management infrastructure and other risk mitigation measures needed to ensure the development is safe may differ between uses within a particular vulnerability classification.* • *Some elements of classifications are subject to a specific warning and evacuation plan.*

7.5 The Exception Test

In circumstances where the Sequential Test has been applied, and possible development locations cannot be found in zones of lower probability of risk, then the Exception Test can be applied as indicated on the PPS25 Decision Flow Charts. The Exception Test should only be used under specific circumstances where the wider aims of sustainable development need to be addressed. When required the decision-makers should apply the Exception Test at the earliest possible stage of the planning process. It should be applied to all Local Development Documents (LDD) as well as all planning applications with the exceptions of domestic extensions and householder developments.

PPS25 states that the following criteria must be met for the Exception Test to be passed:

a. it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the Development Plan Documents (DPD) has reached the 'submission' stage the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;
b. the development should be on developable brownfield (previously-developed) land, unless no reasonable alternative options exist; and
c. a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

The Exception Test should be used in locations with extensive areas liable to flooding or areas where restrictive designations such as landscape and nature conservation designations, e.g. Areas of Outstanding Natural Beauty (AONB) and Sites of Special Scientific Interest (SSSIs) reduce the amount of available land for the sustainable development required.

The Exception Test should not be used to justify 'highly vulnerable' development in Flood Zone 3a or 'less vulnerable'; 'more vulnerable'; or 'highly vulnerable' development in Flood Zone 3b. The Exception Test should only be used in exceptional circumstances where no suitable land for development can be found in a lower flood risk area or the wider sustainable development objectives outweigh the residual flood risk.

7.6 Additional guidance

As part of this SFRA certain properties will fall within a Flood Zone or PFRA. This information is not meant to alarm residents of MDC area, but provides a warning to prepare for potential flooding should it happen. Flooding could happen at almost any time, but in any individual year the risk of a flood may be low. The EA publishes advice on dealing with flood risk and installing preventative measures. The advice can be obtained by contacting Floodline on 0845 988 1188 or through the EA website at www.environment-agency.gov.uk/. Individuals and developers should also consider their responsibilities for what to do to reduce the flood risk to themselves and others, their property and the people who use it. Guidance is provided in Appendix F for developing housing in a flood resistant manner. Further guidance can be found in *Development and Flood Risk: A practice guide companion to PPS25 'Living Draft'* (February 2007), or *Improving the Flood Performance of New Buildings: Flood Resilient Construction* (May 2007), both written by the Department for Communities and Local Government.

7.7 Sustainability drivers

The test in PPS25 means that development is directed first to Flood Zone 1, to avoid places of higher flood risk. But it is not always possible for development to be in the lowest risk areas and flood risk is not the only consideration. There are strategic sustainability drivers to be taken into account. These are key matters, which determine the broad sustainability of plans and proposals. They are a mix of targets, objectives and constraints. The drivers shape the plans' objectives, policies and proposals. Singly or together those drivers may justify having development in higher risk areas as an exception if the drivers mean it cannot be delivered only in the low risk areas. If necessary, development in higher risk areas must pass the Exception Test set out in PPS25.

The 'development plan' for the plan area is the main source of the strategic drivers. It must be taken into account when determining applications. Development Plan Documents are updating the existing development plans. When adopted, those Documents will replace the adopted Local Plans.

8 RECOMMENDATIONS AND CONCLUSIONS

Flooding is an important issue which must not be ignored. In the future it is likely that flooding could occur more frequently and with more severity due to climate change. By using this SFRA, in combination with site specific FRAs submitted with planning applications for development or change of use, it is possible to allocate land for development in a sustainable way. For example, new housing developments in areas at an unacceptable risk of flooding could be restricted and guided towards areas of lower risk and functional floodplain could be maintained or improved through areas at high risk of flooding.

1) Every application for development or change of land use must be considered by planning officers in terms of its potential flood risk using the GIS information supplied as part of this study. This is because:

   a) There are a range of potential sources of flood risk within MDC area including fluvial, surface water runoff, channel obstructions and ground water.
   b) Most areas within MDC have the potential to be at risk of flooding from at least one of these sources or have the potential to increase flood risk elsewhere.
   c) Although a site may already be developed, a proposed change in land use may not be suitable for that site (based on the Flood Risk Vulnerability Classifications), or may increase flood risk elsewhere.
   d) Climate change may increase areas at risk of flooding over time. Land should be allocated today in a way which will be sustainable in the future.
   e) Where development is proposed behind existing flood defences it should not be assumed that the standard of protection originally designed for is the same as what would be found today, using updated flood estimation techniques.

2) The data and information contained within this SRFA constitutes the best available data at the time of writing. Some GIS datasets are periodically updated and it is advised that MDC update these accordingly. Details of the datasets to update can be found in Appendix A. We also strongly encourage MDC to maintain their records of flooding via the GIS layers. This will ensure that decisions are made by MDC using the best available data at all times.

3) Land which is found to be unsuitable for certain types of development (e.g. residential) due to flood risk, may still be suitable for other uses, for example environmental and recreational areas. The PPS25 guidance in conjunction with the PPS25 Decision Flow Charts (Appendix E) can be used to suggest suitable alternative land uses.

4) If the site has potential flood risk, Vulnerability Classifications (section 7.4) must be applied and the relevant PPS 25 Decision Flow Chart (Appendix E) should then be used to test whether the land is suitable for the development proposed, and if so, whether a specific FRA is required. This is to be completed by the developer.

5) If a specific FRA is required, this must be submitted with the planning application. Planning officers, developers and the general public should consult the PPS25 best practice advice and refer to sections 3 and 4 which cover types of flooding and management of flooding.

6) All site specific FRAs must be considered by the EA as part of the planning consultation process. It is recommended that EA comment is taken seriously and applied wherever possible.

7) This SFRA should be used in testing general locations for strategic growth and site specific allocations in the LDF being produced by MDC. This includes investigating the impact of proposals for new development in the vicinity of, and particularly upstream of, areas sensitive to flooding (where there have been past flood events).

8) The LDFs, through their policies, justification and proposals, should make clear the implications for development and regeneration particularly regarding town centres in areas of high flood risk, including where there is risk of rapid inundation and reflect the guidance in this SFRA. This will need to reflect any programmes and proposals, or otherwise, for providing or improving flood defences.

9) The policies from the CFMPs should be considered when allocating land for development. Currently the CFMPs state that policy 3 (continue with existing flood risk management at the current level) and policy 4 (take action to sustain current level of flood risk) should be applied to the study area. Policy 6, increasing the frequency of flooding e.g. washland creation, is not suitable for this area due to the steep nature of the channels and limited potential areas of functional floodplain. These policies are subject to change and therefore the LDF may need to be reviewed following completion of the CFMPs.

10) Following this SFRA, Royal Haskoning are undertaking a Level 2 SFRA at Wallbridge in Frome. This Level 1 SFRA has highlighted two additional areas where a Level 2 SFRA may be required: Shepton Mallet, and Glastonbury.

    a) This SFRA has highlighted that the number of properties at risk of flooding within Shepton Mallet could significantly increase in the future due to climate change. In addition development within or around Shepton Mallet could have a large effect on the quantity of surface water runoff from the town. These two issues could impact significantly both on the residents of Shepton Mallet and the surrounding villages. We therefore recommend that further investigation of this area is required in the form of a Level 2 SFRA.
    b) Glastonbury is sensitive to climate change and is surrounded by complex network of watercourses, therefore will also benefit from additional investigations via a Level 2 SFRA.

11) This SFRA is a working document that will require updating in the future in order to fulfil changes to Government guidance and recommendations from the EA. As Local Development Framework policies should reflect the guidance in this SFRA they will need to be reviewed as and when the SFRA is updated.

9 REFERENCES

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Websites

- www.ciria.org/flooding/advice_sheets.html
- http://www.ciria.org/suds/
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- www.metoffice.gov.uk
- www.defra.gov.uk
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10 GLOSSARY OF TERMS

AONB	Area of Outstanding Natural Beauty. An environmental designation.
CAMS	Catchment Abstraction Management Strategy. Document produced by the Environment Agency, summarising the abstraction that occurs in a catchment.
Catchment	The area contributing surface water flow to a point on a drainage or river system (the area drained by that river, including areas away from the watercourse network). Can be divided into sub-catchments.
CFMP	Catchment Flood Management Plan. An Environment Agency document that summarizes the flood risk of a major river catchment.
Defra	Department for Environment, Food & Rural Affairs. A Government body.
DPD	Development Plan Documents. Produced by the Local Planning Authority
DTM	Digital Terrain Model. A grid showing the height of the surface.
EA Flood Zone 1	Little or no risk
EA Flood Zone 2	Low to medium risk. Probability of fluvial flooding is 0.1 – 1% and probability of tidal flooding is 0.1 – 0.5%
EA Flood Zone 3	High risk of flooding. Probability of fluvial flooding is 1% or greater and probability of tidal flooding is 0.5% or greater.
EA Flood Zone 3a	High risk areas. Flood Zone 3.
EA Flood Zone 3b	Functional floodplains of Flood Zone 3.
Environment Agency (EA)	Non-departmental public body responsible for the delivery of government policy relating to the environment and flood risk management in England and Wales.
FEH	Flood Estimation Handbook. EA approved hydrology techniques.
Flood Defence	A structure (or system of structures) for the alleviation of fluvial or tidal flooding.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption).
Flood Risk Assessment	Considerations of the flood risks inherent in a project, leading to the development of actions to control, mitigate or accept them.
Floodplain	Any area of land over which water flows or is stored during a flood event, or would flow but for the presence of flood defences.
FRIS	Flood Reconnaissance Information System. This is an EA database of historic flood events.
Fluvial	Pertaining to a watercourse (river or stream).
GIS	Geographical Information System. A computer-based system for capturing, storing, checking, integrating, manipulating, analysing and displaying data that are spatially referenced.
Groundwater	Water occurring below ground in natural formations

	(typically rocks, gravels and sand).
HecRAS	1 dimensional hydraulic modelling software.
Hydraulic model	A computerised model of a watercourse and floodplain to simulate water flows in rivers to estimate water levels and flood extents.
iSIS	1 dimensional hydraulic modelling software.
Lagoon	A pond designed for the settlement of suspended solids or storage of excess river flow.
LiDAR	Light Information Detection and Ranging. This is a form of DTM produced by flying over the land and measuring the surface height.
Main River	Watercourses defined on a 'Main River Map' designated by DEFRA. The EA has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only.
Modified Rational Method	A hydrology technique detailed in the FEH.
NFCDD	National Flood & Coastal Defence Database. Maintained by the EA.
Potential Flood Risk Area	The possible extent of flooding along watercourses that have not been covered by the EA Flood Zones.
PPS25	Planning Policy Statement 25: Development and Flood Risk. Government Guidance.
Probability	The likelihood of an event occurring.
Rainfall Runoff Method	A FEH hydrology method which predicts rainfall for an event and then converts the rainfall into flow in a watercourse. Produces a hydrograph for the event.
Return Period	The average time period between rainfall or flood events with the same intensity and effect.
Sheet runoff	The flow of water across the land surface which can occur when the rainfall rate exceeds the infiltration capacity of the soil.
Standard of protection	The level of flood that a defence is designed to protect against before it is outflanked or overtopped.
Standard Percentage Runoff (SPR)	FEH catchment descriptor used to represent the percentage runoff from a catchment.
Surface Water Runoff	Water flowing over the ground surface to the drainage system. This occurs if the ground is impermeable, is saturated or if rainfall is particularly intense.
Sustainable Drainage Systems (SUDS)	A sequence of management practices and control structures designed to drain surface water in a more sustainable fashion than some conventional techniques.
Topography	The shape and form of the land, in terms of hills, steepness of slopes, or flat land

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