FLOODING RISK TO WILLOUGHBY

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Introduction

The ancient village of Willoughby is in The Leam Valley to the West of the A45. The Willoughby Brook has its source at Tiltups Wood beyond Willoughby Fields (MR:- SP540688} and flows down to Willoughby through culverts beneath the Oxford Canal, passing under the A45 adjacent to Hayward Lodge, behind houses to the north of Main Street, to cross Main Street at the bridge in front of the Village Hall. The brook continues west along Main Street, crossing beneath it at the junction with Lower Street and continuing along the north side of Moor Lane until it veers off over pasture land to meet The River Leam between Sawbridge and Grandborough.

The construction of The Great Central Railway in 1898 caused interruption to the natural surface run off the fields to the east of the rail line, giving rise to accumulation of floodwater beneath the bridge at the old station. To alleviate this a drain was excavated, in 1937, to take floodwater from the A45 via the fields of White House Farm and College Farm, to flow into the Willoughby Brook opposite the Village Hall.

Photograph 1. Flooding at Willoughby Station 1932

Surface Water Flooding (Pluvial Flooding)

Surface water flooding occurs when rainfall is unable to soak into the ground or enter the drainage system and creates runoff which flows over the surface to low lying areas. It is usually the result of intense rainfall, often of short duration, (typically, greater than 30-40 mm /hr). Whilst surface water flooding is basically driven by the topography of the land, and permeability of the subsoils, it is influenced to a significant degree by man-made structures, bridges, culverts, fences and other development, especially that associated with significant areas of hard standing.

The most significantly affected point in the village during any flooding episode is the junction of Main Street and Lower Street, where the brook passes under Main Street via two culverts. As the water level downstream rises the brook backs up to top its bank. As seen in Photograph 2. the water level in the brook rises until the occupation bridge at the end of the footpath along Moor Lane is submerged.

Photograph 2. Water level rising to parapet of occupation bridge on Moor Lane

The water level rises to the top of the parapet because the increased head only gives rise to a relatively small increase in flow under the bridge. The increase in level is reflected to the two culverts at the end of Lower street, causing further inhibition of the flow and increased water level. During flood build-up the water flowing down the brook tops its bank at the bridge by the village hall (Photograph 3) and very quickly floods the road and gives rise to build up of floodwater at the Main Street/Lower Street junction. As the water builds up, houses in Lower Street are at risk of flooding as the increasing depth of water extends along the street towards Brooks Close.

Photograph 3. Brook topping bank at Village Hall Bridge

Photograph 4. Flooding at White Barn Close junction with Main Street on 6th October 2016.

Photograph 5. Flooding at lower section of Main Street on 6th October 2016

Photograph 6. Flooding - Lower Street 6th on October 2016

Flash Flooding

Flash Flooding occurs when rainfall of high intensity does not soak into the land or enter water courses and storm drains cannot take the full quantity of water. This can be because the land is saturated or parched. When sewers or road drains are overloaded the excess flood water bypasses them or, in some cases, re-emerges from such drains. See Photographs 7 and 8.

Photograph 7.

Photograph 8.

This was the cause of flooding at critical points in Willoughby on Sunday, 27th May 2018. Over 20 minutes, 25mm of rain fell over the village. This resulted in flooding to several garages and minor water ingress into properties. The roadway was flooded to a depth of 300-350mm, as shown in Photograph 9, and sewers and road drains were saturated. The Willoughby Brook and Great Central Station Drain were low in level. (Photograph 10). It took some 30 minutes for the flooding to abate and it was only after this time that the brook water level started to rise as runoff upstream of Willoughby began to fill the brook.

Such flooding will only be reduced by attention to surface water drainage into the water course and minimising rate of run-off from hard landscaping at neighbouring properties.

Photograph 9.

Photograph 10.

Photograph 10. shows the flooding event in May 2018. Note that the road flooded whilst the drain from the A45 at the old railway station is not at a high level.

Photograph 11. below shows excess water being ejected from a main sewer man access cover in the road by the parish car park. Sewer Flooding occurs when the sewer network cannot cope with the volume of water entering it. To minimise this, it is essential that sewers are adequately sized and maintained. Figure 1 shows the sewer configuration for Willoughby. It is noted that the entire underground system is based upon 150mm piping, which is inadequate to deal with excess water during heavy rainfall. Maximum loading of the sewage system is an important criterion when considering new development. It is also important that surface water, that can be drained elsewhere, should not be allowed into the sewer network, to reduce the loading on both the sewers and the sewage treatment plant. The possibility of increased bore size should be considered for parts of the network.

Photograph 11. Flooding on 27th May 2018 showing sewer refluxing.

Figure 1. Plan of Willoughby Sewer System

Willoughby Brook Flooding

In September 1992, when there was flooding in Willoughby, the level of flooding was greater than the regular pattern of flooding in the village. The Willoughby Brook substantially contributed to the flooding and water overflowed the watercourse flooding several houses to the north of Main Street including numbers 66 and 68. On two nights of the same week, water entered number 66 during the night, flowing through the property from rear to front, with water to calf level i.e. approx. 250mm deep. Numbers 56 and 58 Main Street were also affected. The A45 crossroads at Gate Farm was substantially flooded during this event.

This episode was recorded in the Rugby Advertiser in the 24th September edition where it stated that firefighters had to pump out some of the houses.

Photograph 12.

Flooded garden at Treetops, 56 Main Street in September 1992

It was widely recognised that the magnitude of 1992 floods and several earlier incidences in which substantial quantities of flood water flowed down Willoughby Brook were due to canal overtopping. Overtopping occurred along the section of canal above the culvert through which the Willoughby Brook passes. (Photographs 13. and 14.).

Photograph 13.

Raising the bank of the canal to prevent overtopping in 1998

Photograph 14.

The canal bank above the brook in 1998 (Note the waterlogging to the right of the parapet)

Oxford Canal Involvement in Willoughby Flooding:-

It was not until detailed investigation was carried out following the widespread flooding over Easter 1998 that it was, incontrovertibly, established that the Oxford Canal did contribute substantially to the flooding in Willoughby.

Over a period of two days, 9th & 10th April 1998 (Maundy Thursday and Good Friday), rainfall locally was approaching 75mm. This gave rise to extensive flooding in the district. With the ground saturated during the Thursday, when rain continued on the Friday, the runoff quickly led to overtopping of watercourses. Between 11.00 and 21.00 on the 9th, rainfall of 46.8mm was recorded at Church Lawford. Measurement of the 24hr rainfall at Wellesbourne was 64.5mm, which with statistics applied, gave a 'return' period of 35 years. (i.e. average frequency of occurrence).

It was during these two days that water was seen exiting the canal, in large quantities, at the weir and spillway at MR:-SP535666. The water enters a small stream which crosses under the A45 via two culverts and through a single culvert in the Great Central Railway embankment to join the Leam above Sawbridge. Under high flows a substantial part of the water is arrested at the two small culverts under the A45, which are partially silted, (Photograph 15.) and diverts across the fields northwards to cross the A45 at the site of the old station (Photograph 16.) and flowing along the drain described in the introduction, behind houses to the south of the village. During this event No. 45 Main Street saw water intrusion, together with other properties including Old Pastures, Barbary Cottage and Rose Cottage. The water that enters the village by this route is additional to that derived from the natural Willoughby catchment and serves to amplify the flooding in the village.

To minimise the quantities of canal water adding to flooding in Willoughby, the culverts under the A45, which are under the control of Northamptonshire Highways, need to be kept clear and the possibility of increased bore should be addressed.

Photograph 15.

Partly silted culverts under A45

Photograph 16.

Flood water crossing A45 at site of Old Station Bridge

Since Easter 1998, a Level 1 Strategic Flood Risk Assessment has been carried out for Warwickshire which includes a Flood Map for Surface Water '1 in 200 year' Flood Events. This map together with a map of predicted Fluvial Flooding, produced by the Environment Agency (EA) closely matches the conditions which existed during the 1998 floods (Figures 4 & 5). However, it predicts more extensive flooding extending along Lower Street towards the pond (Refer:- Appendix 1 and www.warwickshire.gov.uk/sfra - Figure A3xii).

The return period of 200 years used in the formulation of the Warwickshire map is by no means accurate since it is based upon historical information collected over a wide area, some of it anecdotal and an additional allowance for climate change. The impact of climate change can only serve to increase the frequency of such occurrences since its quantitative estimation is based on generalised predictions.

Following the 1998 floods and subsequent investigation, British Waterways (Now Canals and Rivers Trust) were contacted regarding the involvement of their weir in the flood event. They were very defensive, declaring that they had a right to discharge into watercourses at their discharge points (Figure 2) and it is was the responsibility of riparian owners to maintain the watercourses clear.

Volume 2 of the Final Assessment by the Independent Review Team into the Easter 1998 Flooding, prepared by the EA, stated British Waterways have confirmed that a large volume of water originated from the Grand Union Canal. Control structure data received from BW telemetry indicated that side weirs along the Braunston to Northampton reach were spilling into the Nene with a head of water up to 270mm. In addition both BW reservoirs (Drayton and Middlemore at Daventry which feed the Braunston Top Pound) were reported to have been spilling throughout the event.

Water levels in the canal are reported to have been rising on 9th April and appeared to be threatening residential areas of Northampton. To avoid this flooding, the paddles in all 17 locks on the Northampton reach were opened

The report made no reference to the operation of the paddles or sluices on the locks between Braunston Top Pound and the bottom lock at Braunston as it only dealt with flooding risk to urban areas such as Northampton and Leamington. Unquestionably, with this situation of excess water in the Braunston Top Pound, the bypasses on the locks in the Braunston staircase would have transferred large quantities of water into the Braunston Main Pound which could only be dealt with by the waste weirs. Indeed the bypasses were seen to be running full by several reliable observers with waterways experience.

If we are to mitigate the effects of flooding in the village, arising from canal overflow as described, it is essential that we pursue the following:

1. Ensure that as much water as possible by-passes the village by persuading the relevant authority to increase the water flow capability under the A45 at the County Boundary, firstly by clearing and possibly by increasing culvert size.
2. Pressure riparian owners into clearing and maintaining the watercourse between the canal and A45 by lobbying Northamptonshire County Council to use their enforcement powers under the Land Drainage Act.
3. Remind the Canal and River Trust of the consequences of excess water coming from the canal and to take account of this within their operating procedures. They must act responsibly to protect others by planned operation of sluices and maintenance of reservoirs and waterways.

Groundwater Flooding.

Groundwater flooding can occur when the water table rises, after prolonged periods of rain, and emerges above ground level. The underlying geology under Willoughby is primarily Jurassic Charmouth Mudstone which suggests that the risk of groundwater flooding should be relatively low. However, groundwater flooding risks are highly localised and dependent upon geological interfaces between permeable and impermeable subsoils as can exist in areas of superficial deposits of sand and gravel and river terrace deposits as are known to exist along the Willoughby Brook. It is therefore essential that an understanding of the site-specific ground conditions is established, if development in low lying areas is entertained.

When groundwater flooding needs to be considered, a quantitative assessment is difficult. This is due to a lack of groundwater level records, the variability of geological conditions and the lack of predictive modelling tools. The EA's Areas Susceptible to Groundwater Flooding (AStGWF} is a map showing some groundwater flood areas as 1 km square grids and is not particularly useful. Borehole investigation using piezometer installations provides the most accurate information but must be monitored over a significant period of time, at least 12 months.

Flood Risk to Properties in Settlement Area.

Figure 6. of Appendix 6 shows the Category 2 and 3 Flood Zone superimposed upon the Willoughby Settlement Boundaries. (Refer to Appendix 2 for Flood Zone Definitions). Within the settlement boundaries there is very little Cat 2 zone between Cat 1 and Cat 3 zones due to the topography of the catchment. (see Figure 5). It is important to note that the zones are constructed to show maximum accumulation and includes a 20% increase in flow to represent the effect of climate change. Of 150 properties (dwellings) within the settlement 70 are wholly or partially within the Cat 2 and 3 zones. In area this represents approximately 45% of the land area of the settlement.

The only areas within the settlement boundary in which development may be considered without substantial flood risk analysis (FRA) are those outside the Cat3 flood zone. (See Appendix 3 for FRA details) Where an area is identified as being at risk from flooding from an 'artificial source' such as a canal, the FRA for that site should consider the risk to the development and mitigation measures that would be effective to account for that source.

Policy

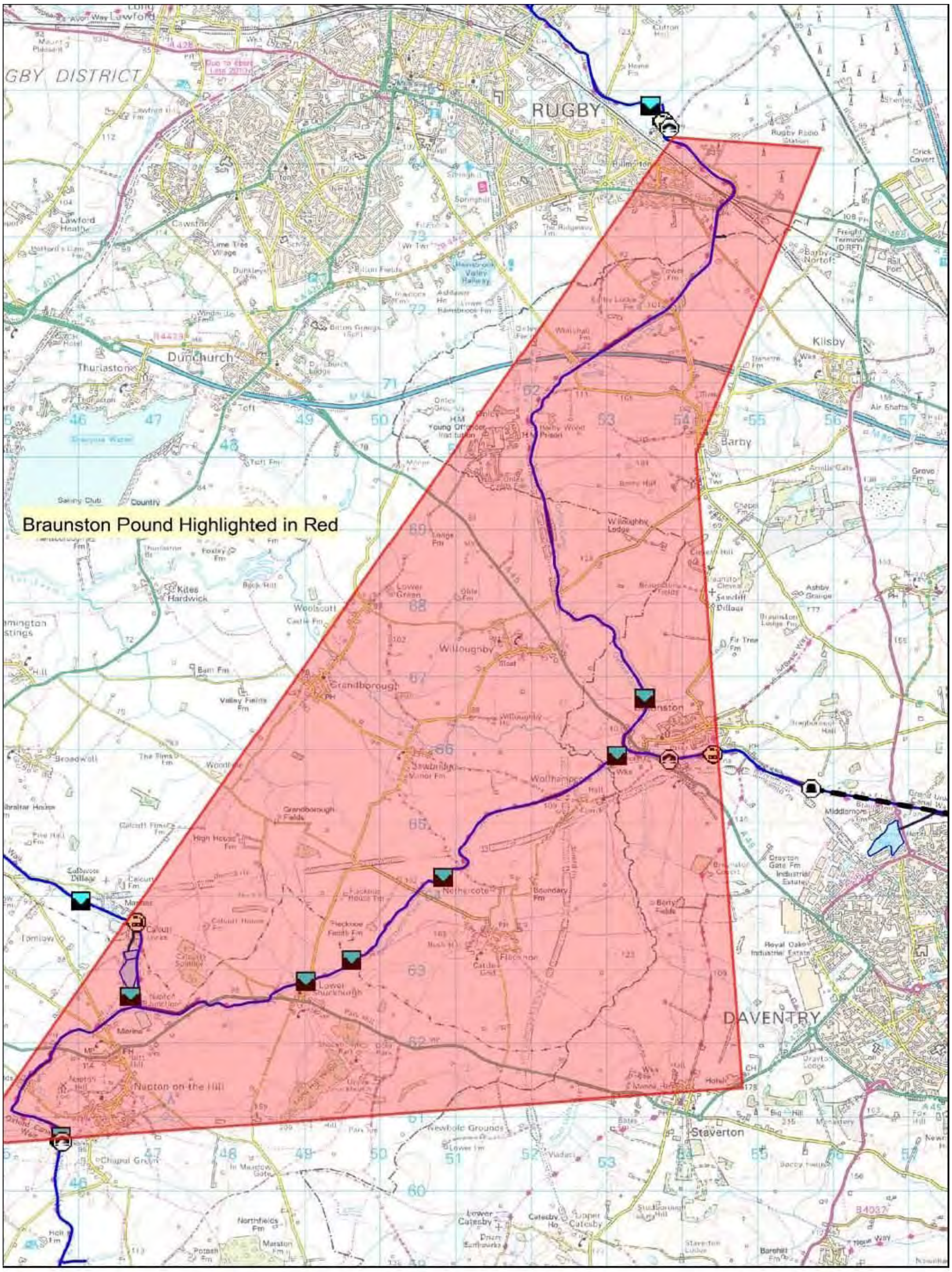
In accordance with NPPF, a specific policy on flood risk should exist to ensure:-

- Development is in the lowest risk area.
- Where required, new and extension to existing development is flood proofed to a satisfactory degree and does not increase flood risk elsewhere.
- Surface water is managed effectively on site.

Summary of Measures to Mitigate Flooding in Willoughby

1. Maintain watercourses and ditches clear of significant vegetation and remind riparian owners (including Local Authority) of their responsibility in this regard.
2. Maintain ditches and culverts clear of silt and obstruction and implement a regular inspection plan.
3. Limit surface water drainage into sewers and encourage use of porous hardstanding which retains water and gradually releases to drainage systems and aquifers.
4. Consider increase in sewer bores along critical lengths, in conjunction with Severn Trent Water.
5. Attempt to prevent canal related flooding by pursuing recommendations proposed under section relating to Oxford Canal Flooding.
6. New development proposals should not be allowed within the Cat3 zone and, if considered in a Cat2 zone, should be accompanied by a comprehensive FRA generally in line with APPENDIX 3 and having regard for the recommendations of APPENDIX 4.
7. Where planning application is made for extension or development of an existing site within the Cat 2 or 3 zones a FRA must be included in accordance with the relevant parts of APPENDIX 3.
8. During 2013, the Warwickshire Flood Resilience Community Project was set up and Willoughby was selected by Rugby Borough Council to develop a Flood Action Plan. The resultant plan is available on the Parish Council website and aims to give guidance to residents in the event of severe flooding. Residents, particularly those living in vulnerable areas, should be familiar with this document.

Figure 2.



title		scale	
Braunston Pound Waste Weirs		1:70,815	British Waterways
		date 17/03/2011	

APPENDIX 1.

Environment Agency (EA) Flood Maps:-

Flood zones have been created by the EA to be used within the planning process as a starting point in determining how likely somewhere is to flood. However, they only refer to flood risk from rivers or the sea, and not all rivers are included. It is stated that a flood zone is created as a planning tool and does not necessarily mean somewhere will or will not flood.

The Environment Agency Flood Maps are shown in Figures 3. and 4. Figure 3. is described as 'Flood Risk from Surface Water' and Figure 4. as 'Flood Risk from Rivers and Sea'.

The "Flood Risk from Surface Water" map shows water entering the village from the east by several routes. The significance of The Great Central Railway embankment in holding up water is clearly shown.

Water supply to maintain the Oxford Canal, when it was built as a single level contour canal (i.e. without locks) was intended to rely on water from streams and springs. It can be seen from the surface water map, (Figure 3.) that where the cut crossed land which contained ridge and furrow these created artificial swales (ditches), allowing local surface water to be more readily fed into the canal. At MR:-SP535666 the stream which originates at Braunston Cleeves and flows to the north of housing in Braunston enters the canal. The accumulation of water shown to the east of the point of entry to the canal on both maps can only occur if there is a significant rise in the water level in the canal itself.

The canal system is protected by overflows located at points along the canal where surplus water can spill over into local watercourses. Figure 2 above shows the location of these spillways on the Braunston Pound.

Figure 3. Flood Risk from Surface Water

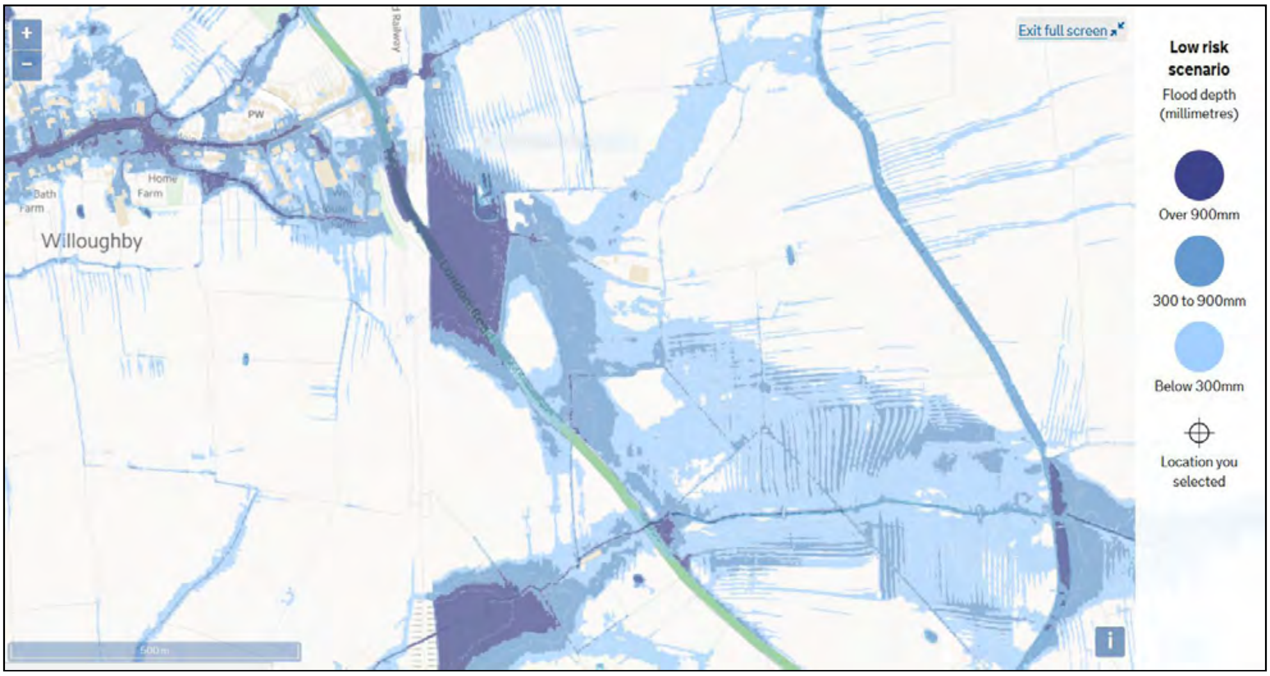


Figure 4. Flood Risk from Rivers and Sea

Figure 5. Flood Events and National Risk Outline

APPENDIX 2.

Flood Zones and Application to Development:-

There are 3 flood zones defined by the EA; Zones 1, 2 and 3. These are based on the likelihood of an area flooding, with flood zone 1 areas least likely to flood and flood zone 3 areas more likely to flood.

Flood Zone 1
Areas classed as being in flood zone 1 have been shown to be at less than 0.1% chance of flooding in any year, this is sometimes known as having a 1:1000 year chance of flooding.

There are very few restrictions in terms of flood risk to development on flood zone 1 areas, the exception is for development over 1ha in size which must have a flood risk assessment undertaken as part of a planning application.

Flood Zone 2
Areas classed as being in flood zone 2 have been shown to have between 0.1% – 1% chance of flooding from rivers in any year (between 1:1000 and 1:100 chance).

Flood zone 2 development needs FRA (Flood Risk Assessment) as part of its planning application which shows the risk of flooding to the site.

Flood Zone 3
Flood zone 3 is actually split into 2 separate zones; 3a and 3b by the local planning authorities however the EA do not split the zone and as such their maps only identify a general flood zone 3. Areas within flood zone 3 have been shown to be at a 1% or greater probability of flooding from rivers. Flood zone 3 development needs to submit a flood risk assessment as part of its planning application which determines if the site is classified as flood zone 3a or 3b as well as reviewing flood risk on the site and proposing suitable mitigation.

The types of development that can occur within flood zone 3 is not only controlled by the vulnerability of these usages but also if the site is located within flood zone 3a or 3b.

Flood Zone 3b

Flood zone 3bs are classified as functional floodplain, and are deemed to be the most at risk land of flooding from rivers or the sea. Local planning authorities have classified areas at significant risk of flooding to be within flood zone 3b. This classification is usually classified as land which had a 5% probability of flooding also known as a 1:20 chance.

There are significant restrictions as to what can be developed on areas of flood zone 3b.

APPENDIX 3.

Flood Risk Analysis (FRA)

A site specific flood risk assessment must show:-

- What the flood risks are and how they could change
- Whether the project will increase flood risk
- How any flood risk can be effectively managed.
- Whether the eventual development can provide safe movement of people to and from the building without the use of emergency services during a flood event.
- The assessment for planning submission will typically consist of key elements:-

    1. A clear assessment of the likelihood and extent of potential flooding for the site and surrounding area
    2. A summary of any existing information or history of flooding on the site
    3. Details of any existing flood alleviation measures which could protect the site
    4. Recommendations for surface water management and a sustainable drainage system (SUDS)
    5. Recommendations to reduce the risk of flooding

APPENDIX 4.

Recommendations to reduce Flooding for Developers

1. Sustainable Drainage Systems must be included in new developments as a way to manage surface water;
2. For Greenfield development sites, the rate of surface water runoff generated as a result of the development must be equivalent to the rate of surface water runoff generated from the undeveloped site.;
3. Brownfield development sites, developers are expected to deliver a substantial reduction in the existing rate of surface water runoff generated from the development and, where possible, limit the rate of surface water runoff to the equivalent Greenfield rate.
4. Where practicable, runoff rates should be restricted to greenfield runoff rates in areas known to have a history of sewer flooding;
5. Where practicable, the separation of surface water from sewers should be undertaken, through consultation with Severn Trent Water.
6. Sustainable Drainage Systems should be considered in line with the Management Train hierarchy set out in The SUDS Manual, C697, whereby 'Prevention' techniques are considered initially. Adopted techniques should also be located in accordance with the restrictions set out in Policy and Practice for the Protection of Groundwater

APPENDIX 5.

Planning

- Surface water flow paths should be taken into account in spatial planning for urban developments. Local topography and built form can have a strong influence on the direction and depth of flow. The design of development down to a micro-level can influence or exacerbate this.
- Where an area is identified as being at risk from surface water flooding, site specific flood risk assessments should consider localised flow paths to establish the risks to the site.
- Surface water runoff from all new developments should be attenuated to the greenfield runoff rate for equivalent rainfall events, up to and including, the 1% AEP (1 in 100 year) plus climate change return period event.
- Developments should aim to use SuDS, wherever practicably possible, in order to achieve surface water runoff requirements for all developments. Infiltration measures should be the preferred means of surface water disposal where ground conditions are appropriate. Where an area is identified as being at risk from groundwater flooding, site specific flood risk assessments should consider localised groundwater levels and geology to establish the risks to the site.
- Developments within each flood zone should be directed to sites with lower flood risk i.e. towards the adjacent zone of lower risk in respect of surface water, groundwater, sewers and artificial sources.
- Where an area is identified as being at risk from flooding from an artificial source, a site specific FRA should consider the risk to the development and potential mitigation measures to account for this flood source

APPENDIX 6.

Figure 6.   Flood Risk to Properties in Settlement Area - referenced on Page 10. of this report.