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## Flood Reviews July 2007

Brize Norton, Clanfield & Bampton

An investigation into the causes and flood risk management options

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# Executive Summary

Following the recent flooding of July 2007, which affected approximately 300 properties in Brize Norton, Clanfield and Bampton, we have investigated options to improve the level of flood protection. This study aims to outline the extent of the recent floods, record the damage and document the response. Opportunities for any improvements that could reduce flood risk for local residents and businesses will be investigated.

The key findings are that an unusually wet May and June with rainfall up to 195% of the long term average, combined with an exceptional level of rainfall on 19 and 20 July created unprecedented levels of flow in the Highmoor, Clanfield, Shill and Black Bourton Brooks and their tributaries. Water levels and flows exceeded the capacity of culverts and bridges forcing flood water over and/or around the structures, into roads and residential areas. This caused widespread flooding across the 2 villages and town which was worsened by surface water flooding in places.

A number of positive recommendations are made with the objective of reducing the consequences of future flooding. The key recommendations of the review are:

- we will work with riparian owners to increase awareness of riparian landowner rights and responsibilities on the Highmoor Brook, Clanfield Brook, Shill Brook and local land drainage system to improve maintenance
- we will continue to work with and offer assistance to the Mill Green, Bampton residents on their investigations to construct a flood defence
- we will undertake investigations into the technical and economic justification and feasibility of a Flood Storage Area (FSA) on the Highmoor/Shill Brook
- we will continue with the current maintenance programme
- we will continue to raise public awareness to improve the uptake and effectiveness of Flood Warning Direct – the free access to all, warning service
- installation of a river level gauge on the Shill Brook to enhance the warning service (2008/2009)
- we will continue to work with West Oxfordshire District Council (W.O.D.C) to prevent inappropriate development in the flood plain
- Increased flood resistance and resilience of properties at risk from flooding via flood prevention products and construction techniques
- we will work with communities to produce local flood plans so they are better prepared for future flooding and better able to respond.

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# 1 Background

## Introduction

Following the floods of July 2007, we have undertaken flood reviews to understand the meteorological conditions that contributed to the flooding, the mechanism of flooding and the number of properties affected in order to identify works to reduce flood risk and its impacts. The reviews will also identify responsibilities for flooding, and provide guidance on other flood risk management tools such as flood warning, flood resistant construction, flood resilience. The reviews have been written in consultation with W.O.D.C.

### **Brize Norton**

Brize Norton is a small village in West Oxfordshire approximately 4 km south west of Witney. The Highmoor Brook main river (See Glossary) limit starts to the north of Manor Farm in Brize Norton. It runs south parallel to Manor Road (A4095), behind and through Manor Road rear gardens before passing under part of RAF Brize Norton's runway and under Station Road (A4095). The Highmoor Brook discharges into the Shill Brook north of Bampton. (See figure 4).

### **Clanfield**

Clanfield is a small village in West Oxfordshire approximately 9 km south west of Witney on the A4095. The Clanfield Brook main river enters the village from the west, adjacent to Calcroft Lane. At the junction of Calcroft Lane and Black Bourton Road (A4020) the Clanfield Brook turns sharply south running adjacent to the A4020 to the south of the village where it discharges into the Broadwell Brook and then the Radcot Cut approximately 800 m west. (See figure 5).

### **Bampton**

The Shill Brook, a main river and its tributaries enter Bampton from the north passing under the Clanfield Road (A4095) and looping east around the south of the town. It then passes beneath the Buckland Road in a south easterly direction and discharges into the Great Brook approximately 3km downstream. (See figure 6).

# 2 The problem

## Flooding mechanism & history

### Meteorology

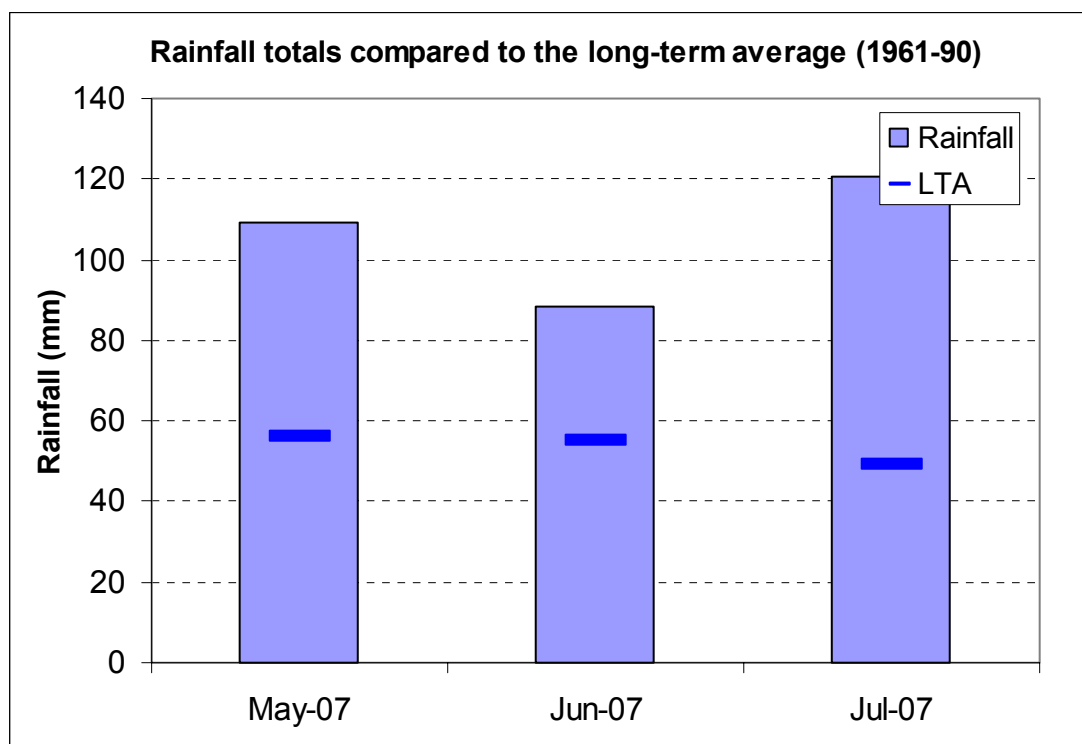
May and June 2007 were unseasonably wet months across the UK with many areas receiving rainfall above the long term average (LTA) for the period 1961-1990. The Thames Region received 109mm of rainfall in May and 88mm in June (195% and 160% of the long term average respectively).

The unsettled weather continued into July 2007 as low pressure dominated across the UK. This was due to the abnormal southerly position of the Polar Jet Stream, a narrow band of fast moving air in the upper atmosphere which steers weather systems from west to east across the Atlantic. The jet stream is usually further north during the summer period, allowing high pressure to form across the UK more frequently.

During 19 July 2007, low pressure across northern France deepened and tracked northwards, extending a vigorous trough and active frontal system across southern Britain on the 20 July 2007. This meeting of warm, moist air from the south and colder air from the north resulted in widespread torrential downpours across the region, particularly between 0900 and 1500 GMT.

In July the Thames catchment received 121mm compared to the long term annual average rainfall amount of 49mm (247% of the long term average), as illustrated in Figure 1. The Brize Norton rain gauge recorded 127 mm in 20 hours.

Figure 1: Rainfall totals compared to the long term average (LTA) (1961-90)

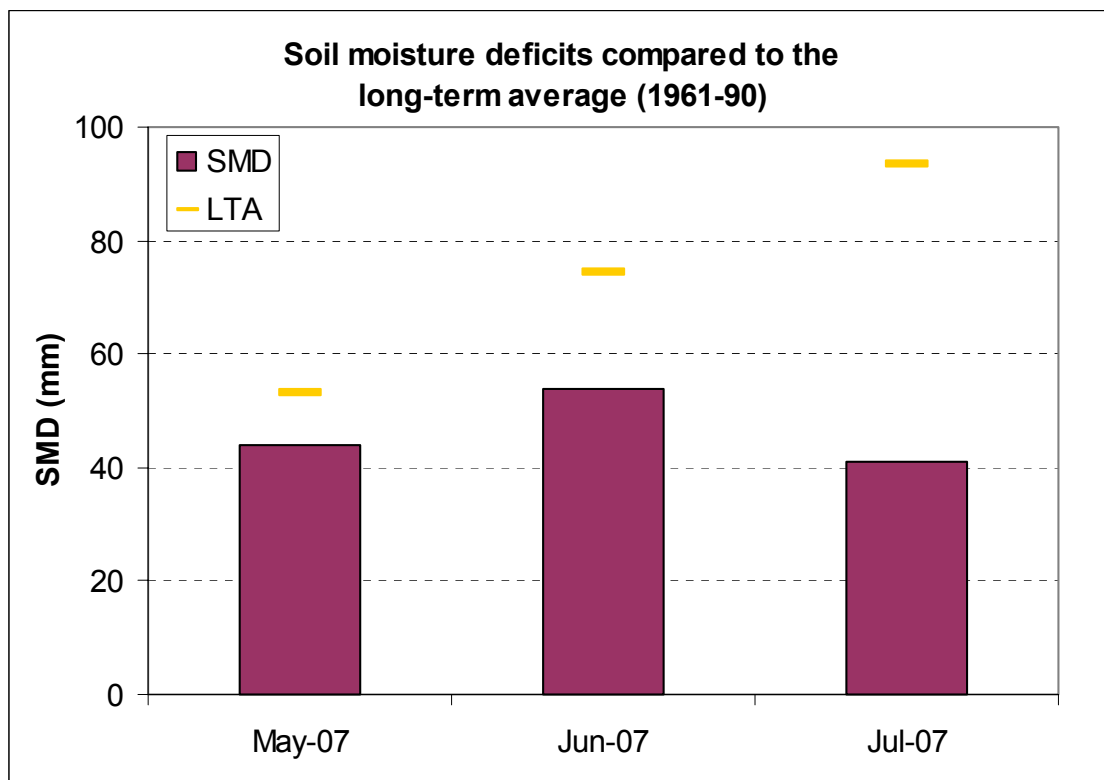


## Hydrology

Soil Moisture Deficit (SMD) is a measure of the saturation of the soil. Low SMD means that the soil is wetter than usual, and SMD above the LTA means that it is dryer than usual. The SMD in May and June 2007 are compared with long term averages for 1961-90 in Figure 2. Extended periods of wet weather across much of the Thames Region resulted in lower than average SMD leading up to the July 2007 event. This means that less rainfall was needed for the soils to become fully saturated, increasing the potential for greater runoff into rivers.

The extremely high rainfall totals and intensities coupled with the low soil moisture deficits for the time of year caused flows (i.e. the volume of water in the river) at many locations to increase rapidly. By the end of July 2007 average monthly river flows at many sites were the highest on record for July.

**Figure 2: Soil moisture deficits (SMD) compared to the long term average (LTA) (1961-90)**



The combination of exceptional rainfall and low soil moisture deficit resulted in extremely high flow and levels in watercourses.

## Hydrogeology

Groundwater levels were much higher by the end of the 2006-2007 winter period (end of March) than the same time last year. A wetter than average winter led to higher than average groundwater recharge rates – that is ground water contributed additional water to the rivers.

Base flow is the portion of river flow that comes from groundwater rather than surface water runoff. When groundwater levels are higher, the base flow in the rivers is also higher, contributing to the response of river level to the event.

## Flood History

There have been a number of major floods in the River Thames catchment since records began, most notably in November 1894, March 1947, October/November 2000 and January 2003. All occurred during the winter months and affected the upper Thames tributaries as well as the Thames itself.

Historically, summer floods on the Thames and larger tributaries are less common. However it is interesting to note that the highest levels at Thames locks upstream of Oxford since records began in the 1880s were generally recorded in the flood of June 1903. Also, the July 1968 floods caused severe flooding in the lower Thames tributaries and the highest flows on record in the neighbouring lower Severn catchment.

Table 1 gives a summary of the main historic flood events that have affected similar areas to those in the July 2007 event. It is by no means a comprehensive record of every flood in the Thames catchment.

**Table 1: Historic flood events**

Date	Description
November 1894	Catchment-wide flooding in the Thames catchment. Highest levels downstream of Oxford since records began. Numbers of properties affected unknown.
June 1903	Flooding on the upper Thames. Highest levels locks upstream of the Cherwell since records began. Numbers of properties affected unknown.
March 1947	Basin-wide flooding in the Thames, including the Lee catchment (over 10,000 properties affected).
July 1968	Flooding in the mid to lower Thames and severe flooding in the Mole and Wey catchments (about 10,000 properties affected).
November 1974	Flooding in the lower Thames and its tributaries including Addlestone Bourne, Blackwater, Beam, Loddon, Emm Brook.
Easter 1998	Flooding in the Cherwell catchment – Approximately 1000 properties affected
October/November 2000	Catchment-wide flooding in the Thames. Approximately 1100 properties affected.
January 2003	Catchment-wide flooding in the Thames. Over 500 properties affected.

The Mill Green area in Bampton is reported as having suffered from flooding in November 2006, January 2007, July 2007 and again in October 2007.

It has been reported that Brize Norton is also affected by regular flooding, recent flooding occurred in July 2006, August 2006, October 2006, November 2006, January 2007, May 2007 and July 2007.

The July flooding in Clanfield like many other areas was much worse than previous records we hold. See figure 3 in Appendix B for our historical records of flooding in Clanfield. The July 2007 flood event exceeded the recorded level on the River Thames for the 'Great Flood' of 1947.



## **Flood mechanism/source of flooding**

The flooding in July was from several sources: rivers (fluvial), surface water (pluvial) and sewers. It is very difficult to distinguish the exact source of flooding due to the complex connection between rivers and drainage systems.

All of the areas considered in this review are subject to potential flooding from more than one source. The timing of flooding is often critical in determining the major causal factor in the flood. Exceptionally heavy rainfall can accumulate where it falls and this can cause flooding immediately.

The smaller the area these systems serve the more rapidly they will respond: the larger the area they drain, it will take a longer time for the majority of the rainfall to reach any point. Flooding will often occur in a time sequence that reflects this e.g. first we see a puddle in the garden, then overflowing drains, ditches overspill, small river floods then finally large rivers flood.

In July, properties flooded as a result of river flows exceeding the capacity of the channel, causing inundation of the flood plain. In some locations, high river levels prevented the discharge of surface water sewers and drains, which surcharged and caused flooding, or added to flooding from main river or ordinary watercourses.

The flooding of roads, roadside drains and gullies immediately after the exceptionally heavy rainfall from mid morning to late afternoon on Friday 20 July occurred due to insufficient capacity to cope with the volume of water. Many of the main roads connecting the villages were impassable by Friday afternoon. The ditches, streams and larger watercourses were already rising due to the runoff from fields and built development surface water drainage systems. The local drains and watercourses discharged into the larger watercourses which started to flood in the afternoon of Saturday 21 July. The local watercourses cover a large area with local variations in runoff rates, structures and catchment response to the rainfall, thus the timing of the various main rivers bursting their banks varied from location to location.

## **Brize Norton**

The July flooding was a combination of surface water runoff and flooding from the Highmoor Brook. 17 properties were reported as flooding from the Highmoor Brook and 7 from surface water runoff. Records from other sources place the total number of properties affected by flooding from any source at 56. We understand that buildings on the RAF base also suffered extensive flooding. Large volumes of surface water flowed off the RAF base, other developments in Carterton and the Country Park adding to the overwhelmed land drainage system as flows were trying to enter the Highmoor Brook which was also full to capacity.

See figure 4 in Appendix B for a copy of our published flood plain outlines – (Flood Zones 2 & 3).

## **Clanfield**

55 properties were reported as flooded from the Clanfield Brook. The mechanism of flooding in the village would have been partly due to the numerous sections of culverts restricting the flow of water and blockages/lack of maintenance, which would have pushed flood water into roads fairly early in the flood event. However, it is accepted that optimum sized culverts and well maintained ditches would not have avoided the flooding due to the exceptional volume of water trying to pass through the catchment.

6 Days after the event (26 July 07) we noted that the junction of Black Bourton Road with Bampton Road was still flooded. This was due to the high levels in the Radcot Cut and the River Thames (downstream of Clanfield Brook) as the surrounding area drained, limiting drainage of the smaller watercourses. This is an indication of the scale of the flooding and the scale of the role that the vegetation in the brook played in the flooding at Clanfield.

See figure 5 in Appendix B for a copy of our published flood plain outlines – (Flood Zones 2 & 3).

## **Bampton**

50 properties were reported as flooded from the Shill Brook and 137 properties were flooded from surface water sources. Flows exceeded the capacity of both bridges at the A4095 Clanfield Road which carries the Shill Brook in Bampton, flood water was held back causing flooding to properties upstream. Flood water eventually overtopped the road causing damage to the bridge parapet and directly into the Mill Green area where significant numbers of properties were flooded. Surface water also flowed towards Bampton from land drainage in the Weald area. Similarly, the other main area of flooding from the Shill Brook in Bampton took place on the Buckland Road, where the Shill Brook passes under Fishers Bridge. Flood flows could not pass this structure, pushing flood water into residential areas.

The New Road area suffered significant flooding from surface water flowing off the fields to the north (Mount Owen).

See figure 6 in Appendix B for a copy of our published flood plain outlines – (Flood Zones 2 & 3).

## **Planning controls and floodplain development**

Current planning guidance contained in Planning Policy Statement 25 (PPS25 – published December 2006) states that flooding is a material planning consideration and explains how flood risk should be considered at all stages of the planning and development process. It places the onus on the developer to assess flood risk for a particular site and its impact on adjacent sites. It allows the planning authority to adopt the precautionary principle when determining planning applications within the floodplain.

We are a statutory consultee in the town and country planning process. We have provided local planning authorities with maps identifying the flood plains to guide development away from these areas.

Prior to PPS25, planning authorities were not obliged to incorporate our comments or advice into their final decision, this may in certain circumstances have resulted in development going ahead against our recommendations.

Under the 'Flooding Direction' issued in conjunction with PPS25, where a local planning authority is minded to approve a planning application for major development yet we have objected to it on flood risk grounds, the application must be referred to the appropriate Government Office to consider, on behalf of the Secretary of State, whether it should be called in for determination.

We will object to any inappropriate development within the floodplain that may result in:

- increased resident population in the floodplain;
- a loss of floodplain storage capacity;
- impede flood flows routes;
- result in increased flood risk elsewhere.

## **RAF Brize Norton ASP**

The MoD benefits from planning rights which include the ability to construct certain new buildings and hard standings required for operational purposes subject to consultation with the local planning authority. These rights are contained within the Town and Country Planning (Application of Subordinate Legislation to the Crown) Regulations 2006.

Defence Estates are constructing a new Aircraft Service Platform (ASP), consisting of increased impermeable drainage areas. The ASP at Brize Norton falls into the category of being 'permitted development' subject to consultation with the local planning authority.





We have met with consultants acting for Defense Estates and provided guidance relating to the control of runoff from hard paved (impermeable areas) and guidance relating to flood risk. The MOD agreed to design the ASP to a 1 in 100 year standard in accordance with PPG25, which was the relevant guidance at the time. As these works did not require planning permission, neither W.O.D.C. or ourselves have been able to review the drainage design of the surface water systems and therefore cannot comment on its effectiveness.

We are not aware of any other recently approved or proposed developments in the vicinity that may affect flood risk to the 3 villages, other than Carterton North which is discussed in a later section. We continue to work with W.O.D.C. to ensure that flood risk is considered at every stage in the planning process.

We are also working with W.O.D.C. to produce their strategic flood risk assessment (SFRA). The purpose of an SFRA is to identify areas within a development plan that are at risk of flooding and make objective judgements on land allocations using a risk based approach as advised in PPS25.

## Flood warning

We offer a free flood warning service that is open to all business and residents within flood risk areas. This involves sending a warning via phone, fax, text or email. There are 4 flood warning codes:

	<b>Flood Watch</b> Flooding is expected. Be aware! Be Prepared! Watch Out!
	<b>Flood Warning</b> Flooding of homes, businesses and main roads is expected. Act now!
	<b>Severe Flood Warning</b> Severe flooding is expected. Extreme danger to life and property. Act now!
	<b>All Clear</b> Issued when flood watches or warnings are no longer in force. Check all is safe to return. Seek advice

We can provide a flood warning service using a variety of forecasting techniques. This is only possible where we are able to monitor river levels.

When a river comes out of banks, we will issue a flood watch. This means that flooding of low lying land is expected. From a land survey, we can also establish the lowest and nearest property to the river (and therefore the first to flood). When we are aware that property flooding is going to occur, we will issue a flood warning. A flood warning will be elevated to a severe flood warning if the situation worsens and over 100 properties and or major infrastructure will be flooded.

To issue our warnings we have a 24-hour flood warning service called Flood Warnings Direct (FWD). We encourage members of the public who are at risk from flooding can register with us. Our professional and media partners are also all registered to receive warnings via FWD. FWD is also used to update our Floodline telephone service and our website. Our professional partners includes emergency planning officers from Local Authorities, emergency services and utility groups.

Currently our flood warning areas are quite large and include long stretches of river which cover several towns or communities. Over the next two years we will be reducing the size of our flood warning areas into smaller areas. This will enable us to issue more accurate flood warnings.

In past years we have also made use of flood wardens as a method of warning people of imminent flooding. Flood wardens were volunteer residents who would help us issue messages to those members of the public who were not registered with FWD. However as more and more people have signed up to FWD, we no longer use flood wardens in the same way. Instead, a warden's role has become more of a neighbourhood advisor and we now encourage communities to produce their own self help community flood plan.

Floodline (not to be confused with Flood Warnings Direct – FWD) is our 24 hour telephone information service. When people are warned or become aware that a flood warning is in force, they should phone Floodline. They will then be able to hear what is happening locally in terms of river and flooding forecasts. When calling Floodline, the public need to know a second quick dial number which will take them to their local area information. For the 3 villages, the relevant quick dial code is: 0111221.

## Warnings issued

The first 'flood warning' was issued on 20 July 2007, once river levels had started to respond to the rainfall, and the first 'severe flood warning' was issued on the 21 July 2007. The last 'all clear' was issued on 6 August 2007.

The "at risk" residents in Clanfield and Bampton fall within the River Thames flood warning area (flood warning area: St Johns Lock at Lechlade to Eynsham Lock near Oxford). Residents from these villages who have registered to Flood Warnings Direct will have received a flood watch on Thursday 19 July 2007 for the River Thames. On Saturday 21 July 2007, a flood warning was issued for the above flood warning area (River Thames).

We can currently offer a full flood warning service to some areas along the length of the River Thames but not for the majority of the tributaries, including the Highmoor Brook which runs through Brize Norton, the Shill Brook which runs through Bampton and the Black Bourton Brook in Black Bourton near Clanfield. However we do provide Clanfield with warning as we have a river level gauge here.

The reason for this is that at the current time we do not have flood warning level gauges anywhere on the Shill Brook, Highmore or Black Bourton Brooks so are unable to forecast accurately for property flooding in areas that these watercourses affect.

This means that currently, residents at risk of flooding in Bampton, Black Bourton, Brize Norton and Carterton are only able to register to FWD to receive warnings for the River Thames, however, we have identified the area around Bampton as being a top priority for a river level gauge to be installed. This river level gauge will be installed during next year (2008/09).

# 3 Management of Flood Risk

## Catchment Flood Management Plan (CFMP)

Catchment Flood Management Plans (CFMP's) provide an overview for managing the long-term flood risk over the next 50 to 100 years.

A reliance on flood defence is no longer sustainable and we are moving towards managing the risks of flooding. This can be achieved by putting in place a range of flood risk management policies that can react to change.

Brize Norton, Clanfield and Bampton lie within the undeveloped natural flood plain catchment area as defined by the CFMP. The approach to flood risk management in these areas is about working with the natural characteristics of the catchments. The aim is to manage flood risk by taking opportunities to maximise the potential of the flood plain to retain water. Specifically the messages are:

- The flood plain is our most important asset in managing flood risk
- Maximising the capacity of the flood plain to retain water in these areas can have many advantages for people and the natural environment
- Managed flooding of some areas of the natural flood plain will reduce the risk to some communities
- We will do all that we can to prevent inappropriate development which reduces the capacity of the flood plain to retain water. Future maintenance work on river channels should aim to increase the capacity of the flood plain.

## Third party structures & maintenance

There are a number of sluice gates in private operation on the watercourses in the area. We are not aware of the operating regimes, however, we would expect these structures to be fully open in times of high flows or floods. Riparian owners are legally obliged to maintain and operate their structures properly. Owners of river control structures must also fulfil any obligations they have under the Thames Region Land Drainage Byelaws, this includes opening sluices before flooding occurs. We can offer advice and best practice guidance to riparian owners and expect them to work together.

Additional obligations include:

- Keeping gates and screens clear of obstructions, so they work properly
- Maintaining structures in a proper state of repair
- Use structures in such a manner as not to affect the efficient working of the drainage system of the area.

### **Brize Norton, Clanfield and Bampton**

There are no sluice gates in operation on the Shill Brook, Highmoor brook, Black Bourton Brook or Clanfield Brook that affect Brize Norton, Clanfield or Bampton.

There is a large trash screen on the Shill Brook in Alvescot which also acts as a security fence for RAF Brize Norton. Local residents have raised concern over the maintenance and clearance of debris from this screen, stating that during the July flooding debris built up raising water levels upstream. The debris was either overtopped or gave way, sending flood water downstream which added to the flooding locally. Due to the design of the screen (vertical bars) and its location it requires regular maintenance to remove debris and keep it clear. This issue has been raised with RAF Brize Norton who have confirmed that they have two security grills which require clearing; one at the Shill Brook end and one at the Highmoor Brook end. Currently, their grounds maintenance

contractor clear the grill when debris requires clearing. However, they are amending the grounds maintenance contract to include the clearance of the grill on a monthly basis. In addition, they have arranged for them to be cleared on an 'exceptional basis' in times of flooding.

They are also awaiting quotes from technical officers regarding upgrading/remedial works to the current grills with a view to undertaking further work at the start of the financial year (April 2008). We remain available to offer best practice advice on trash screen design, maintenance and the need for our consent for such works.

## Maintenance Regime

The maintenance of all watercourses is legally the responsibility of the owner of the river (riparian owner). Many households own very small sections of the various watercourses and in many cases are also unaware of their responsibility for the watercourse. W.O.D.C. are currently working through a programme of minor flood defence work which involves identifying ditch and ordinary watercourse landowners and requesting maintenance if required.

All rivers, streams and ditches forming the natural drainage system fall into two categories. They are: main river and ordinary watercourses. We are the operating authority for all main rivers. W.O.D.C. are the operating authority for ordinary watercourses and have similar powers to us but only for Ordinary watercourses. Oxfordshire County Council Highways Department are responsible for the maintenance of structures that they own, this will generally include road culverts, bridges, gullies and some ditches.

We have permissive powers to carry out maintenance on any river that is classed as main river. Our maintenance role is scheduled on the basis of flood risk priority and resources. The primary main rivers that cause flood risk to the 3 villages are the Shill Brook, Highmoor Brook, Clanfield Brook and Black Bourton Brook.

We would support riparian owners wishing to undertake maintenance of watercourses, subject to them gaining our consent where this is required. Our support could include guidance and advice on various aspects of maintenance. Further information and advice relating to the need to gain our consent can be obtained from our National Customer Contact Centre on: 08708 506 506.

Details of the rights and responsibilities of riparian landowners are provided on the our website:

<http://www.environment-agency.gov.uk/subjects/flood/362926/>

The same information is also available on request from us in a hard copy booklet entitled 'Living on the Edge'.

We do not give a risk score to each watercourse, instead we categorise the flood risk management system in which it sits. The main rivers locally sit within the Radcot Cut system, which was first assessed in 2005, and reviewed in 2007. Since 2005 the Radcot Cut System has been categorised as a high risk system, however from April 2008 when assessed against flood risk, this system will be categorised as a medium risk system. This is because of the total number of properties within the flood plain is medium with little risk to life. Every year we aim to undertake work in all high risk systems and some medium risk systems. In some areas we are reconsidering the classification in light of the July floods, the Radcot Cut is one of these.

Our assessment of the main rivers in this area is that whilst increased maintenance could lead to reductions in the water levels during very minor flood events it would not have helped during the floods in July 2007 due to the scale of the flooding and volume of water involved.

## **Brize Norton**

The Highmoor Brook, from Ven bridge to the main river limit (close to Manor Farm, Brize Norton) has been maintained this Winter (2007), which consisted of trimming banks, cutting weed and the removal of larger woody obstructions. This will be undertaken on an annual basis every autumn to allow the higher winter flows to pass away from the village. Again, this is subject to ongoing resource availability. Due to the amount of historic culverting throughout this section it would be of no advantage to de-silt, this is because any increase in channel capacity would be negated by undersized culverts.

It is understood that the ditch (ordinary watercourse) that runs parallel to Station Road requires maintenance to increase its performance during high flows. See photographs of the floods in Appendix A. The riparian landowner will be contacted as part of W.O.D.C. program of minor flood defence works as detailed above. This issue has been discussed with Oxfordshire County Highways Department who have confirmed that they have cut extra channels into the carriageway to aid drainage of the highway at this location.

## **Clanfield**

The Clanfield Brook is part of the Radcot Cut System, which currently has a high risk designation and is cleared of vegetation every year, with works generally programmed for the autumn period, at the end of the summer growth to make maximum impact on the channel for the winter period. Our operatives also arrange ad-hoc clearances of blockages and make annual assessments of the silt levels, having de-silted the brook in 2003, with a minimal build up since then. Whilst additional clearance of waterways would benefit the brook in lower order flood events, the scale of the July event exceeded anything that could be alleviated by simple channel clearance alone.

The Black Bourton Brook is trimmed and weed cut annually from the confluence with the Shill Brook in Black Bourton downstream for 500 metres, this is to help pass river flows away from Black Bourton Village. Experience has shown this is sufficient enough to reduce flood risk.

Ad hoc removal of obstructions including fallen trees takes place on the lower reach, which runs down stream from the Bampton Road (A4095) to the Radcot Cut, again, when resources are available. This section was cleared during October/ November 2007. This reach is planned to be de-silted during July 2008, again providing all agreements are met. Flood risk benefits will not be significant here due to existing culverts which limit the amount of capacity and flow that can be provided in the channel. In-channel structures must be at least the same size as the carrying capacity of the channel, otherwise the structure will hold back flows and increase water levels.

## **Bampton**

The Shill Brook between Bridge Street & Fishers bridge in Bampton is maintained annually to remove the excess vegetation and clear blockages such as fallen trees. A de-silt is proposed on the 2008 maintenance programme for the Shill Brook from Fishers Bridge downstream to its confluence with the Great Brook, providing resources and the relevant landowners, public and internal agreements are met.

## **Intervention Options**

Our aim is to reduce flood risk. For defended areas at flood risk we will inspect, maintain and improve flood risk management assets, on main rivers and the coast on the basis of risk (i.e. the likelihood and consequences of failure). In undefended areas we build and maintain assets where it is considered to be an appropriate use of our flood risk management resources and meets our risk-based criteria, subject to availability of funding.

Our decisions consider the long term view of the economic, social and environmental impacts of an area at risk from flooding, generally on a river catchment basis. We look at a hundred year timescale (including an allowance for climate change), when carrying out extensive studies to

assess, not only the physical and environmental impacts, but the overall costs and benefits of a scheme.

We consider a wide range of options to determine the best social, environmental and economic outcome for reducing flood risk. However we cannot construct flood alleviation schemes at every location and we target investment at greatest need.

In assessing the viability of our schemes, we will always consider the resultant impacts on flood risk elsewhere.

There are a number of large scale engineering solutions that can be employed to protect against flooding. These have been outlined below but not looked at in detail at this stage due to the complex interaction of the various sources and pathways of flooding, the likely benefits compared to the costs of a scheme and the resultant knock on flood risk as a result of any scheme:

- Flood Storage Areas can be part of the existing flood plain or on the edge of the flood plain. They are areas of land that can be excavated to provide increased flood storage capacity to reduce flood water levels elsewhere.
- Bypass Channels can divert the flood water via an additional channel away from existing development therefore reducing flood risk.
- Increasing the capacity of channels and structures can reduce flood water levels and therefore flood risk to existing development. This is achieved by removing restrictions such as bridges or culverts or by enlarging watercourses. The effect is that flood water levels are lowered locally by increasing the flow capacity downstream.

### **Brize Norton and Clanfield**

Through our investigations, we have not been able to justify any engineering options for flood defence works for Brize Norton or Clanfield. The above type of schemes would not be viable here due to the high costs involved and the small number of properties that would benefit.

We understand the primary cause of flooding in Brize Norton and Clanfield was field drainage and surface water runoff from development with subsequent flood flow routes across farmland towards the Highmoor Brook and the village. The magnitude of the July flood event exceeded the capacity and overwhelmed the surface water and land drainage systems, and the numerous third party culverts, causing flooding greater than previous records.

W.O.D.C. have commenced their flood reports for the area and have also been working with riparian land owners to guide maintenance works and advise on land drainage responsibilities. They are also working with O.C.C. and others on a surface water drainage issues from existing developments in Carterton. Remedial works at the drainage source and in the upper reaches of a catchment can have positive flood risk benefit as the rainfall can be stored close to where it falls. This work will continue and we will continue to work with RAF Brize Norton to seek improvements to their surface water drainage systems.

Our continued role in the planning process will ensure that new development does not exacerbate future flooding by incorporating Sustainable Urban Drainage Systems (SUDS) where possible.

We will continue to review the condition of the Clanfield Brook and review the need to undertake increased maintenance, this is discussed in above under Maintenance Regime, page 14.

### **Bampton**

A local resident at Bampton has approached us proposing a small flood defence wall which would protect them from flooding in a repeat of the recent flood events. We are liaising with the promoters of this scheme but the findings of the preliminary assessments and a survey were not available for this review. This work is still ongoing.



Preliminary site investigations have identified an area on the Highmoor/Shill Brook upstream of Bampton that has potential for increased flood plain storage to be provided by excavating land. Further detailed assessments have yet to be undertaken to ascertain its technical feasibility and its economic justification. This work will continue after this review is complete.

### **Historic works**

There are currently no flood alleviation schemes in place for Brize Norton, Clanfield or Bampton. In the 1970's our predecessor completed a large scale project on the Shill Brook and Great Brook in the Bampton area. This was principally for land drainage purposes to reduce water levels to improve farming output rather than a flood defence scheme. The works primarily involved channel works such as deepening and straightening. Staff who were involved with the scheme recall that it provided a 1 in 15 year protection.

## **Flood Resilience**

Flood resilience refers to measures that reduce the amount of damage caused by water entering properties. There are a wide range changes that can be made to a property and any changes would be very specific to each property in order to ensure that they are suitable.

At present the our policy is not to provide financial assistance with any protection to individual properties, however the Department for Environment Food and Rural Affairs (DEFRA) are currently funding a pilot grant scheme to encourage flood resilience as part of the Making Space for Water strategy. The outcome of this study could influence the decision of householders in the future.

In the 3 villages it is unlikely that flood defences can be provided for the majority of homes at risk of flooding. Individual flood protection and flood resilience measures are recommended.

In general if such measures are installed as part of repairs after the recent floods then insurance companies will expect the householder or business to meet the extra costs themselves. Possible measures include:

- Raised cupboards & electrical circuits
- Water resistant door frames
- Non-return valves on drainage pipes
- Water resistant plaster
- Air brick covers
- Tanking (waterproofing internal walls).

Flood defence products for individual properties are also widely available and we support the BSI kite mark standard which signifies that the product has been rigorously tested. See 'references' for links to further information.

## **Community flood plans**

Following the July flooding we are working with affected communities to produce their own flood plans. We can assist by providing flooding advice, supplying maps and other relevant information. They can also be adapted to include other emergency situations, thus increasing the resilience of a community. The community flood plan contains information on:

- Setting up emergency management teams
- Flood event procedures
- Communications – useful numbers, local media, Environment Agency
- Flood Maps including vulnerable properties & residents
- Key community skills & equipment
- Emergency accommodation.

# 4 Conclusions & Recommendations

The floods of July 2007 were an exceptional event, particularly in terms of the rainfall and the catchment response. The widespread flooding experienced was caused by the volume of water and inability of the overloaded drainage systems including, drains, ditches, streams and rivers to convey the flood water.

Examination of the rainfall data and river flows from the July flood event has enabled an estimation of the return period of the flood. Flows and levels in the main Rivers in the 3 locations in July 2007 have been estimated as having a return period in excess of 1 in 100 years.

We worked with our professional partners throughout the flood event to ensure that residents and businesses were warned and then assisted where possible. The main physical structures that affect flood flows are road culverts, bridges and mills. These structures would have affected the way in which the floodplain operated but were not directly responsible for the flooding in the locality as the watercourses would have already been under capacity due to the volume of water.

Increased channel maintenance would not have significantly reduced the level of flooding experienced due to the volume of flood water. Increases in channel capacity would provide limited reduction in flood risk because the extra volume in the channel only equates to a very small proportion of the volume of water in the flood plain. However, it is recognized that channel maintenance will assist in flood risk reduction for smaller flood events and we will continue to work with landowners to offer guidance and advice.

An important element of flood risk management is to address the consequences of flooding. Communities should organise themselves with local initiatives, we can help here and have provided Parish Councils with a template for a Local Flood Plan. The Plans will:

- Identify the risks to the community and take action to mitigate them.
- Identify vulnerable people in the community and develop plans to assist/protect them.
- Identify resources in the community available to assist during an emergency.
- Provide key contact details for the Emergency Management Team, key community recourses, the Emergency Services and local authorities.

In order to reduce the impact of any future floods there are several actions that should be taken forward as a matter of priority:

- we will work with riparian owners to increase awareness of riparian landowner rights and responsibilities on the Highmoor Brook, Clanfield Brook, Shill Brook and local land drainage system
- we will continue to work with and offer assistance to the Mill Green, Bampton residents on their investigations to construct a flood defence
- we will undertake investigations into the technical and economic justification and feasibility of a FSA on the Highmoor/Shill Brook
- we will continue with the current maintenance programme
- we will continue to raise public awareness to improve the uptake of Flood Warning Direct – the free access to all, warning service
- installation of a river level gauge on the Shill Brook to enhance the warning service (2008/2009)
- being prepared - both at community (community flood plans) and householder level
- our continued role in the planning process – objecting to inappropriate development in the flood plain
- increased flood resistance and resilience for homes and businesses.

# Appendix A – Photographs



Bampton, Bridge Street



Station Road (Brize Norton to Bampton Road) – flood water flowing over road

# Appendix B – Maps

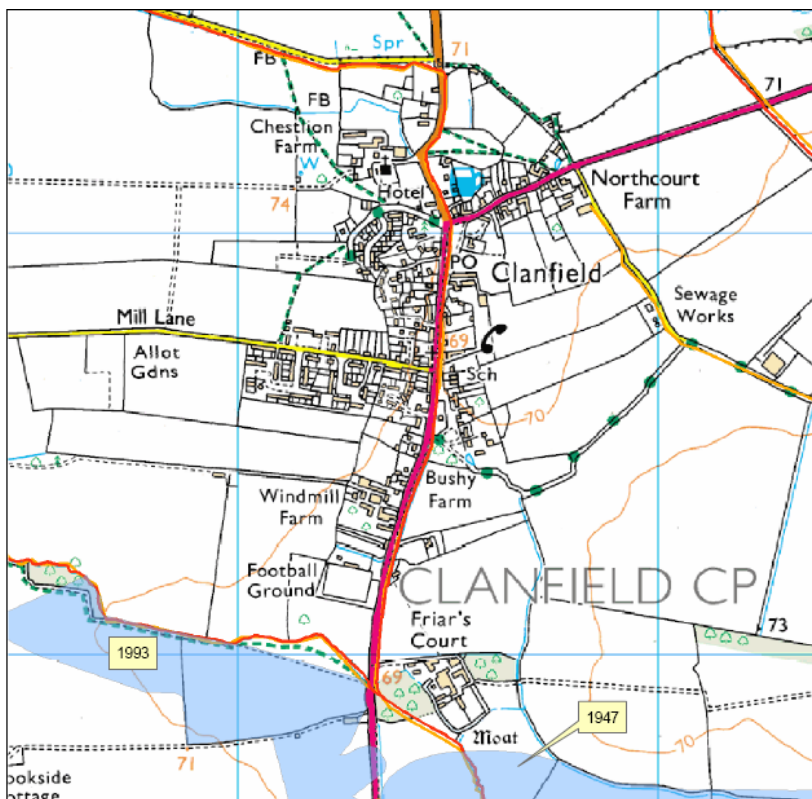


Figure 3 – Historic records of flooding in Clanfield



## Flood Map for Clanfield June 2007

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### Legend

- Main Rivers
- Rivers
- Historic Flood Map



0 125 250 500  
Metres

1:10,000

Created by J Wines (FRMDM) on 02/10/2007



Figure 4 – Brize Norton – Flood Zone 3 (1% annual probability of occurrence) and FZ2 (0.1% annual probability of occurrence)



## Flood Map for Brize Norton June 2007

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### Legend

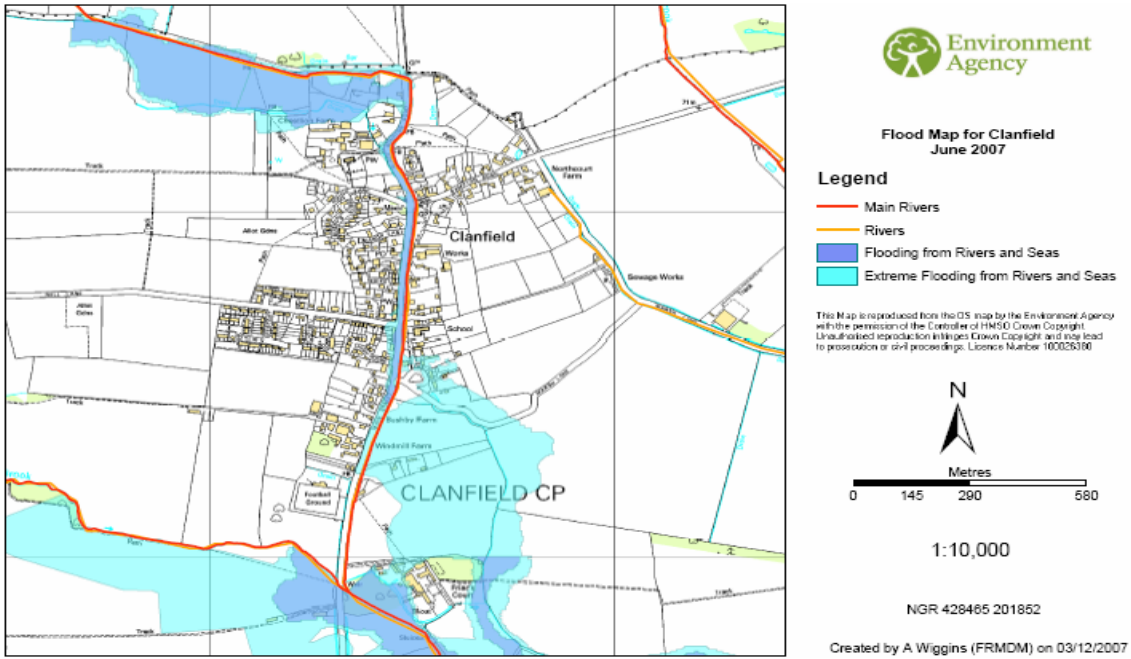
- Main Rivers
- Rivers
- Extreme Flooding from Rivers and Seas
- Flooding from Rivers and Seas



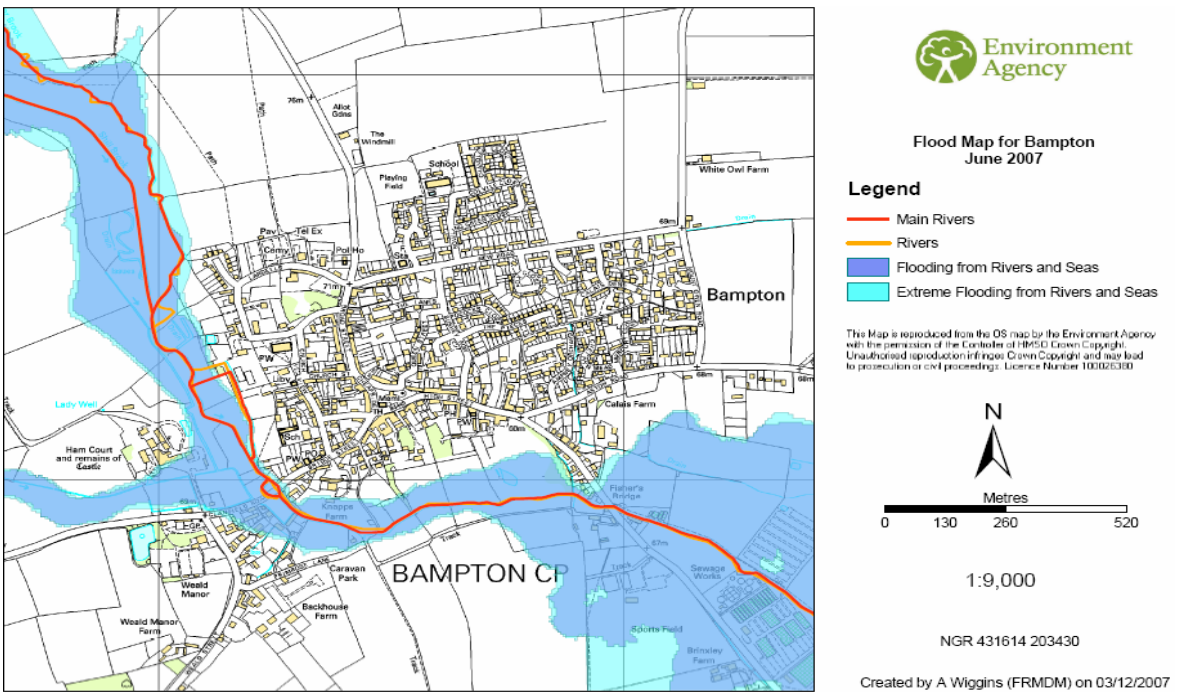
0 250 500 1,000  
Metres

1:15,000

Created by J Wines (FRMDM) on 02/10/2007



**Figure 5 – Clanfield –Flood Zone 3 (1% annual probability of occurrence) and FZ2 (0.1% annual probability of occurrence)**



**Figure 6 – Bampton –Flood Zone 3 (1% annual probability of occurrence) and FZ2 (0.1% annual probability of occurrence)**

# Glossary of terms

## **Cost Benefit Analysis**

In order to receive funding for a flood defence scheme an analysis must be made of the costs and benefits. The costs include the design, construction and maintenance over a 100 year period. This is compared against the benefits – i.e. the reduction in damage caused by flooding of properties in financial terms. The higher the ratio of cost to benefit the more likely the scheme is to gain funding due to the national prioritisation of flood risk capital funding.

## **Critical Ordinary Watercourse**

These are ordinary watercourses which have been identified by DEFRA as being strategically important and are to be enmained.

## **Culvert**

A closed conduit for the conveyance of water, e.g. a pipe underneath a road.

## **Enmained**

Procedure in which the Environment Agency assumes powers to legally change the classification of an Ordinary Watercourse to a Main River in order to maintain exercise its Permissive powers for maintenance, flood warning and flood alleviation works.

## **Flood plain**

A flood plain is an area of land over which river or sea water flows or is stored in times of flood. A flood plain can extend beyond the land immediately adjacent to a watercourse. (Living on the edge)

## **Flood Zone**

Flood Zones are the Environment Agency's nationally agreed geographical layers of information that define the extend of flood risk. They are split into Flood Zone 1, 2 and 3.

Flood Zone 2 is flooding from rivers without defences at a 1% (1 in 100) chance of happening each year. It is the natural flood plain area that could be affected in the event of flooding from rivers.

Flood Zone 3 is the outline of a flood extent in an extreme flood with a 0.1% (1 in 1000) chance of happening each year.

## **Flood storage area**

A flood storage area is a part of the flood plain that allows flood waters to be temporarily stored.

The purpose of such an area is generally to retard larger floods from reaching a main watercourse for a designed flood return period.

## **Fluvial Flooding**

Flooding where the source is river water.

## **Land Drainage Scheme**

Post World War II the emphasis in river engineering was on increasing the farming capacity of the UK. This was achieved through land drainage schemes that increased the quality of farmland by maximising the drainage of water.

## **Main rivers**

Main rivers are defined under the Water Resources Act 1991, they are usually larger streams and rivers, but also include smaller watercourses of strategic drainage importance. A main river is defined as a watercourse shown as such on a main river map, and can include any structure or appliance for controlling or regulating the flow of water in, into or out of the main river. The Environment Agency's powers to carry out flood defence works apply to main rivers only. Main rivers are designated by the Department for Environment, Food and Rural Affairs in England (DEFRA) and by the Welsh Assembly Government. (Living on the edge)

### **National Flood and Coastal Defence Database (NFCDD)**

The National Flood and Coastal Defence Database is a central store for Flood Risk Management related data. It aims to allow rapid access to national data, stored and maintained in a consistent manner.

### **Ordinary watercourse**

An ordinary watercourse as defined under the Land Drainage Act 1991 is every river, stream, ditch, drain, cut, dyke, sluice, sewer (other than public sewer) and passage through which water flows which does not form part of a main river. On ordinary watercourses, the local authority and, where relevant, Internal Drainage Boards (IDB) have similar permissive powers as the Environment Agency has on main rivers. (Living on the edge)

### **Pluvial Flooding**

Flooding where the source is surface water.

### **Priority Score**

The national scoring system that is used by the Environment Agency and DEFRA to prioritise the capital funding of flood defence schemes.

### **Professional Partners**

Professional partners are organisations we work with. Specifically, the emergency services, local authorities, health bodies, utilities, transport bodies and other Government agencies.

### **Public Surface Water Sewers**

The sewerage undertaker is responsible for maintaining surface water sewers that are vested in them. Surface water sewers are likely to go directly into a watercourse.

### **Roadside Ditches and Highway Drainage**

The County Council as Highway Authority is responsible for draining those highways, which are county roads, and has responsibility for certain bridges and culverts, under the Highways Act 1980. In general terms, it is usual for the roadside ditches to be the responsibility of the adjoining landowner; exceptions to this rule are where the ditch was constructed to drain the highway or where it falls within the land owned by the highway authority.

### **Riparian Owner**

The owner of the river in terms of property. The usual situation is for the landowner of each bank to own up to the centreline of the river. There are responsibilities and rights associated with owning the river – principally that of maintenance of the watercourse and associated structures.

### **Sewer**

Includes all sewers and drains which are used for the drainage of buildings and yards appurtenant to buildings, excluding a drain used for the drainage of a single building or of buildings within a single curtilage.

### **Trash Screen**

A grill or grate that is installed on a culvert or other limited opening on a river to collect debris and prevent blockages.



# List of abbreviations

AOD	Above Ordinance Datum
BSI	British Standards Institute
CFMP	Catchment Flood Management Plan
COW	Critical Ordinary Watercourse
DEFRA	Department for Environment, Food & Rural Affairs in England
FSA	Flood Storage Area
GMT	Greenwich Mean Time
NFCDD	National Flood and Coastal Defence Database
LTA	Long Term Average
PPS25	Planning Policy Statement 25
RICS	Royal Institute for Chartered Surveyors
SMD	Soil Moisture Deficit

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[http://www.environment-agency.gov.uk/commondata/acrobat/dlimitation\\_aug03\\_354620.pdf](http://www.environment-agency.gov.uk/commondata/acrobat/dlimitation_aug03_354620.pdf)



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