

References (Additional supporting documents to be provided to the Committee)

1. Fairford, Whelford, Kempsford & Lechlade Floods Review July 2007, Environment Agency, 2008



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## **Fairford, Whelford, Kempsford & Lechlade Floods Review July 2007**

**An investigation into the causes and flood risk management options**

**Anya Bednarczyk – March 2008**

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# Executive summary

Following the flooding of July 2007, which affected more than 60 residential properties (fluvial\* flooding), we have investigated options to improve the level of flood protection. This review aims to document the extent of the July 2007 floods and recorded damage, summarise the response, outline the main characteristics of the ongoing Fairford Flood Alleviation Scheme (FAS) and investigate options for improvements in other locations.

The key findings are that an unusually wet May and June with rainfall up to 195% above the long term average combined with an exceptional level of rainfall on 19 and 20 July created unprecedented levels of flow in the river Coln. Flows were up to 8 times above the normal amount of flow for July. This caused widespread flooding across the area which was exacerbated by surface water flooding in places.

The key recommendations of the review are:

- Complete the feasibility study on Fairford FAS.
- Examine the potential of restoring old structures upstream of Fairford Mill to create a flood storage area (FSA)\*.
- Continuation of the current maintenance programme.
- Continuing public awareness campaigns to improve the uptake of Flood Warning Direct.
- Raising public awareness of riparian\* rights and responsibilities to increase channel maintenance where needed.
- Work with the Town Councils to produce Flood Plans.
- Promotion of flood resilience for properties at risk of flooding.
- We will continue in our planning process role to steer development away from flood risk areas.

\*- see *Glossary of terms* for definition

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# 1.0 Background

## 1.1 Scope, objectives & data available

Following the flooding of July 2007 we undertook a review to investigate the options to improve the level of flood protection in affected areas.

This review aims to:

- Understand natural factors and man activity that contribute to the increased flood risk\*.
- Explain weather conditions that contributed to July 2007 flooding.
- Examine flood mechanisms: sources, flood flow routes, etc.
- Outline the extent of the recent floods and recorded damage.
- Document the response.
- Outline the characteristics of the ongoing Fairford Flood Alleviation Scheme (FAS).
- Ensure that the proposed FAS for Fairford is considering the correct option in the light of the recent flood.
- Investigate options for improvements in other locations.

The information provided is based on that currently available to us and the main sources are as follows:

1. Feedback from surveys carried out by local Parish and Town Councils e.g. Kempsford or Cotswold District Council.
2. Information from Flood Forum organised by Cotswold District Council, Cirencester.
3. Data and comments collected during the Flood Surgery for Fairford. It was held on 19 September 2007. Its main purpose was to exchange information and discuss local flooding problems. Our teams gave advice and information on reducing flood impacts, preparedness for floods, river maintenance, possible engineering solutions, development within floodplains etc. More than 100 residents attended our event and most people gave us valuable first hand information.
4. Information from our staff who were out on the ground every day.
  - Our gangs who were out clearing screens and waterways on the morning of the event and they were on 24 hour standby for the following week.
  - Our call centre which was manned 24 hours a day from Friday 19 July for the following week to answer calls from the public.
  - Our Flood Ambassadors and Data Recorders who were out collecting data as well as giving advice and information on reducing the impact of flooding.

## 1.2 Locations

This review covers 4 locations within boundaries of south east Gloucestershire – Fairford, Lechlade, Whelford and Kempsford. They have been grouped together as they belong to the same geographical area and their environmental factors show many similarities. Flood mechanisms are different for each location and they will be examined separately.

**Fairford** (OS grid reference SP1490) is a market town, approximately 14 km east of Cirencester on the A417. It is located in the lower catchment of the river Coln (see Appendix B, Map 1).

**Kempsford** (OS grid reference SP1500) is a village located halfway between Cricklade and Lechlade where the River Thames parts Gloucestershire from Wiltshire. The Parish has most of its boundaries on watercourses with the River Coln providing part of the north east boundary. The south boundary with Wiltshire is formed by the river Thames. The west boundary is marked by the watercourse formerly called the County Ditch. The north west boundary of Kempsford is dominated by the airfield of Royal Air Force Fairford, with its main runway extending across the centre of the Parish (see Appendix B, map 2).

**Whelford** ( OS grid reference SU1714) is a village located half way between Fairford and Kempsford. Its boundary is the River Coln to the east and the River Thames to the south (see Appendix B, map 3).

**Lechlade** (OS grid reference SU2199) is a market town located at the southern edge of the Cotswold, beside the Thames, about 11 miles east of Cirencester, 12 miles north of Swindon and about 20 miles west of Oxford. The town is situated at an important cross roads, of the A417 with the A361. It is the highest point at which the River Thames is navigable. The town is named after the River Leach which joins the Thames near here (see Appendix B, map 4).

The number of properties at risk of flooding is presented in the table below:

<b>Properties at risk of flooding</b>		
	<b>Flood zone 3*</b> (i.e. with a 1% or greater chance of flooding per annum)	<b>Flood zone 2</b> (i.e. with a 1% - 0.1% chance of flooding per annum).
<b>Fairford</b>	142	157
<b>Whelford</b>	15	15
<b>Kempsford</b>	-	-
<b>Lechlade</b>	134	202

Appendix B, Maps 1, 2, 3, 4 present location of the review areas within flood zones 2 and 3.



### **1.3 Characteristics of the catchment\***

It is important to understand that due to a combination of environmental factors some places are more vulnerable to river flooding than others. During the Flood Surgery for Fairford local residents had many questions about how these natural factors impact flooding in the area they live. This chapter will try to provide the explanation.

Principally, river flooding occurs naturally as a result of the combination of environmental factors such as:

- characteristics of the catchment: geology, topography, size and shape, type of vegetation, land use, etc.,
- channel features: capacity, conveyance, gradient
- groundwater levels and ground conditions,
- rainfall: total amount, duration, intensity and extent area.

In many areas, including the review area, flooding problems have increased due to man activity and development within the floodplain\* which results in greater run-off\* and an overloaded drainage system.

#### **1.3.1 Watercourses**

The review area is predominantly located within the River Coln catchment (see Appendix B, Map 6). The River Coln rises at Charlton Abbots, southeast of Cheltenham at an altitude of about 200m AOD, and flows through the Cotswold Hills, via Bibury, Coln St Aldwyns and Fairford, southeast to the river Thames, which it joins at Lechlade at an altitude of about 75m AOD.

##### **River Coln in review area**

The River Coln flows through Fairford in a general north-south direction. It is crossed by 3 bridges at Fairford, from north to south these are: Mill Lane, Milton Street (or Town Bridge) and Dilly's Bridge and these serve as useful reference points when describing the nature of the watercourse.

Upstream of Mill Lane, the river Coln drains a catchment area of approximately 130km<sup>2</sup>. This is a rural, predominately permeable catchment. Just upstream of Mill Lane, Fairford Mill acts as a control on the largest, eastern most channel while two smaller watercourses, Back Brook and New Stream join the river Coln downstream of Fairford Mill but upstream of the road. Back Brook also supplies a small watercourse known as the Waterloo Brook via a small diameter culvert under Mill Lane.

Between Mill Lane and Milton Street lies an area of meadow between rising ground to the east and west with the main River Coln on the eastern boundary and the Waterloo Brook on the western boundary. This area is known as Waterloo Meadows.

At the southern end of Waterloo Meadows there are 9 properties that front onto Milton Street and back into the meadow. These have a small land drainage ditch to the rear that connects the Waterloo Brook to the River Coln. The River Coln flows under Milton Street (A417) at Town Bridge.

Just south of Town Bridge the River Coln splits for approximately 250m during which it joins up with the Waterloo Brook. Downstream of Dilly's Bridge the River Coln again becomes one channel with a riverside footpath on the left bank.

Downstream of Horcott farm the River Coln flows through disused quarries. On its left bank there are extensive gravel pits that are now redundant and form a number of lakes, which form components of the Cotswold Water Park.

At Whelford part of the flow has been diverted from a river and forms an artificial channel which supplies water to a watermill. Downstream of Whelford mill the Coln runs through the flat agricultural land where drains flow into it. Further downstream Dudgrove Brook joins the river and then the Coln flows into the Thames at Lechlade.

### **Court Brook at Fairford**

Court Brook is an ordinary (non-main river) watercourse\*, which drains the area of Fairford between the A417 London Street and the River Coln. It used to be the main town sewer in the middle ages. It was piped in 50s due to growing housing development in Fairford.

Currently the Court Brook carries surface water and highway drainage\* from the town and discharges it into the River Coln some distance downstream of the area under consideration.

### **Downington Ditch at Lechlade**

The Downington Ditch is located on the western edge of Lechlade running alongside the main road A417 and then in southern direction towards the River Thames. The Downington ditch was identified as a Critical Ordinary Watercourse (COW)\* and was enained on 1 April 2006 and jurisdiction was therefore changed from Cotswold District Council to us.

Location of the watercourses is presented in Appendix B, Maps 1,2,3,4.

## **1.3.2 Geology**

Geology of the catchment and soil type help determine how quickly the river will respond to the rainfall and how much water can reach the river.

The river Coln headwaters rise from the inferior oolites and then the river flows over great oolite, forest marble, cornbrash and oxford clay. The upper part of the catchment is predominantly permeable and could be compared to a sponge absorbing lots of rain water which then takes time discharging it into the river.

Fairford is located just upstream of the boundary between the great oolites and the forest marble and cornbrash, where the great oolites become confined. Springs are issuing from the oolites at this point and contributing further to flow/levels at Fairford.

The floodplain around Fairford is made up of soils containing clay. Due to the impermeable character of clay the river response is much quicker (high

rainfall run-off). In addition, once the flood waters from the rainfall move downstream of Fairford it is very likely that they will be followed by additional waters from the permeable section of the catchment upstream of Fairford.

### **1.3.3 Topography, size and shape of the catchment**

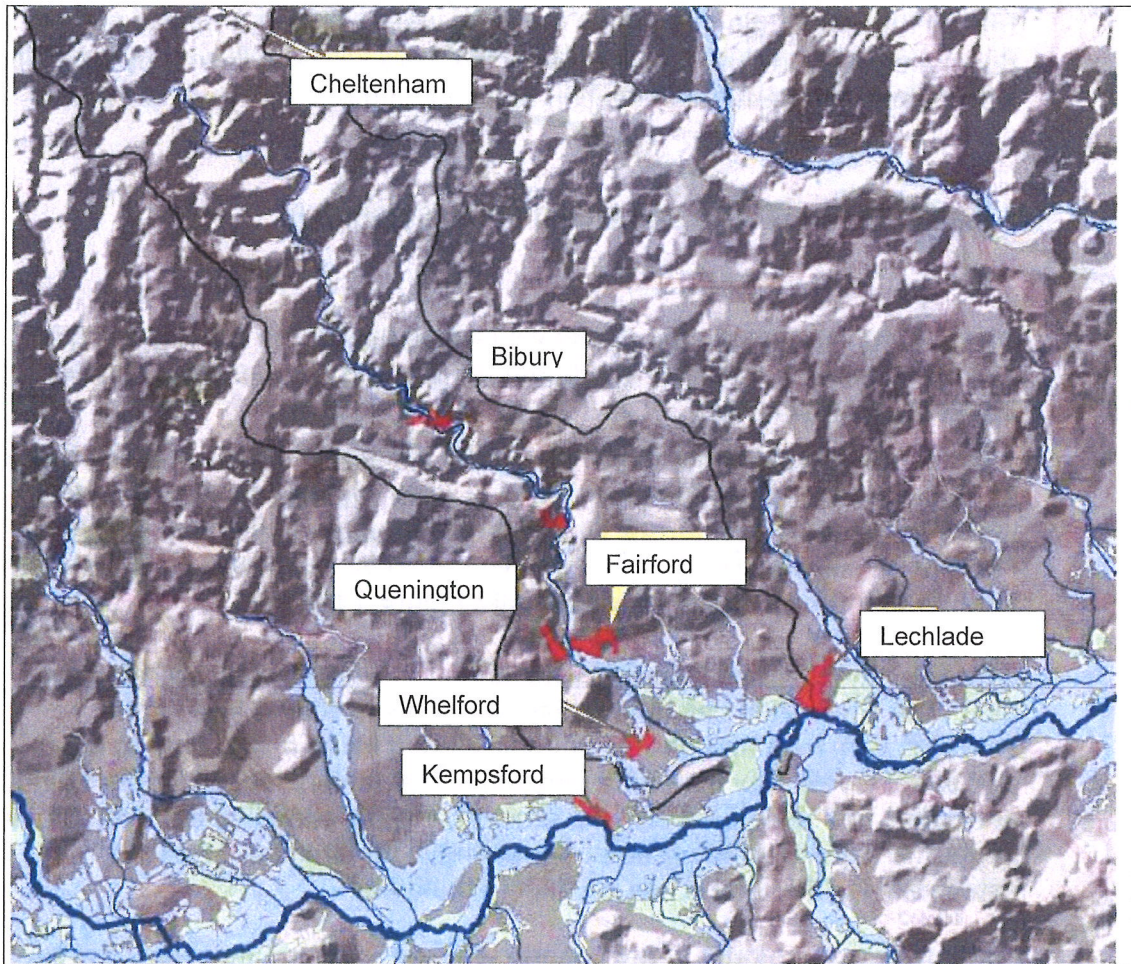
Topography determines the speed with which the run-off will reach a river. The Coln valley is relatively steep and narrow and it means that rain will reach the river very fast.

The town is located in the lower part of the catchment (see Appendix B, map 5) and in addition to local run-off it has to cope with headwaters from the upper catchment. The narrow floodplain in the upper catchment widens at Fairford posing significant risk of flooding. Also as Fairford is surrounded by the hills the run-off rate is very high (see Figure 1 below).

Also catchment shape influences the speed at which the run-off reaches a river. The River Coln catchment (see Appendix B, map 5 and Figure 1 below) is very long and narrow and therefore it takes a long time to drain and water levels stay high for a long time. This is very typical for the Fairford area. Size will help determine the amount of water reaching the river, as the larger the catchment the greater the potential for flooding. The Coln catchment is 130m<sup>2</sup> and has no major tributaries.

Land use will contribute to the volume of water reaching the river. The flood plain at Fairford is significantly urbanized and rainfall on roofs, pavements and roads is collected by the Coln with almost no absorption into the groundwater.

Figure 1. Coln Catchment – Digital Terrain Model (flood zone 2 in green, flood zone 3 in blue).



## 2.0 The Problem

### 2.1 Weather conditions

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 has been attributed 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 20th 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.

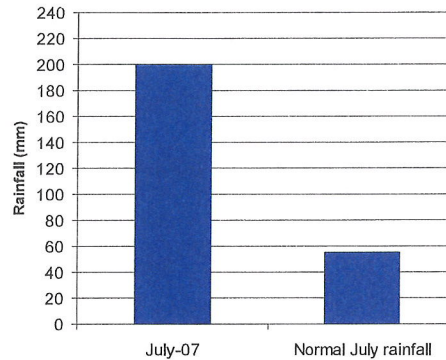
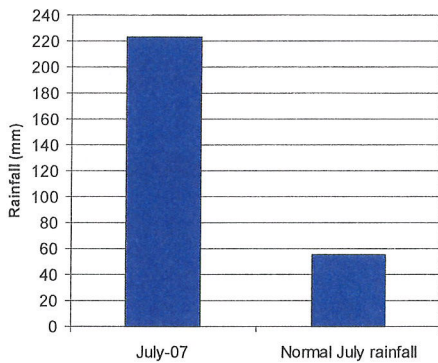


In May and June 2007, rainfall in the river Coln catchment was one of the highest on record. The May 2007 total of 150.7mm, at the manual rain gauge in Shipton Oliffe, was the second highest rainfall recorded for May in records going back to 1978. These conditions continued into June where rainfall was also well above average with a total of 158.8mm.

In July the total rainfall recorded in the Coln catchment was more than 200 mm. It is four times the normal July rainfall of 50 mm (see figure 2 and 3).

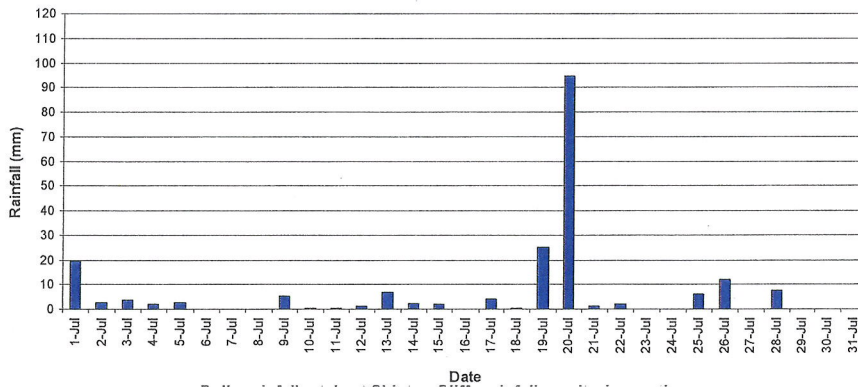
**Figure 2. Rainfall summary for Shipton Oliffe rainfall monitoring station**

**Figure 3. Rainfall summary for Stowell rainfall monitoring station**

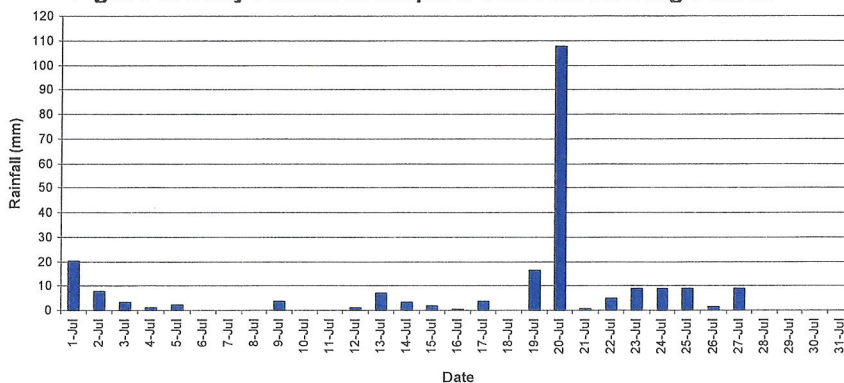


The extreme intensity of this rainfall exacerbated the problem (figure 4 and 5). In the Coln catchment 2 months rainfall fell just within 15 hours, between 05:00 and 20:00 on 20 July.

**Figure 4. Daily rainfall at Stowell Park monitoring station**



**Figure 5. Daily rainfall at Shipton Oliffe monitoring station**

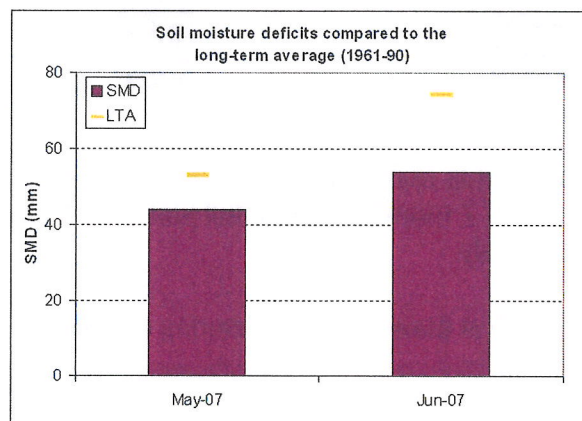


## 2.2 Hydrology and hydrogeology

Soil moisture deficit (SMD)\* is a measure of the saturation of the soil. Low SMD means that the soil is wetter than usual, and higher SMD means that it is dryer than usual. SMDs in May and June 2007 are compared with long term averages for 1961-90 in figure 6. Extended periods of wet weather across much of the Thames Region resulted in lower than average SMDs 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 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.

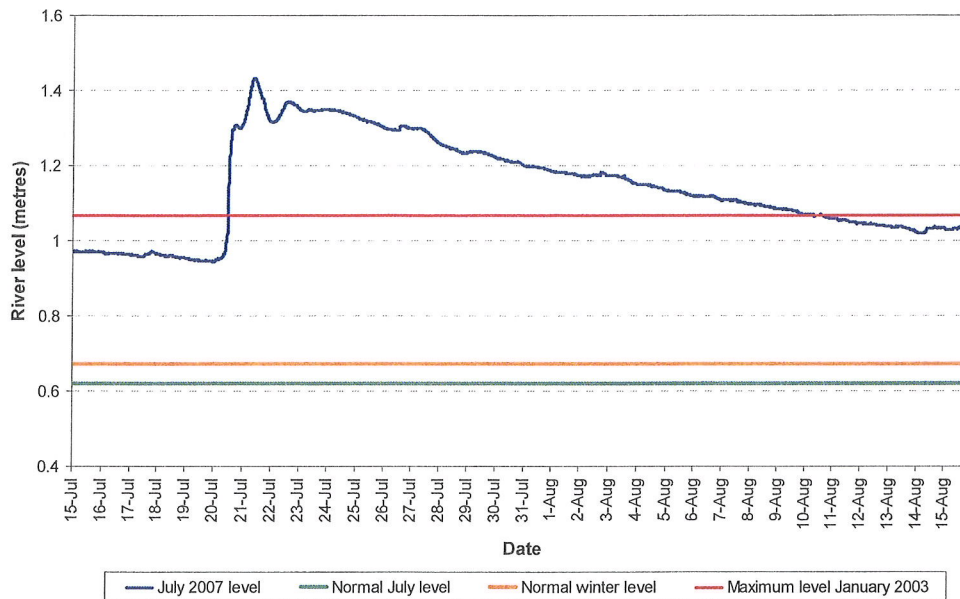
Figure 6. Soil Moisture deficits compared to the long-term average (1961-90)



The combination of exceptional rainfall and low soil moisture deficit resulted in extremely high flow and levels along the River Coln. This is reflected in the fact that there was approximately 8 times the normal amount of flow for July in the River Coln through Fairford. It has been estimated that at the highest level of flood the flow rate in the River Coln was about 10 m<sup>3</sup>/s, equivalent to approximately 2200 gallons per second. This compares to an average July flow of approximately 1.3 m<sup>3</sup>/s.

The river levels were correspondingly high as is illustrated in figure 7 below. The river levels at Fairford in July are normally approximately 0.6 metres. On the morning of 21 July the estimated maximum level measured at Fairford river monitoring station was 1.4 metres. The estimated maximum level measured at Fairford prior to this July was 1.1 metres, measured in January 2003.

Figure 7. River level in the River Coln at Fairford



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.

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

Groundwater levels can respond at very different time scales to rainfall depending on the geology. Rain falling on the oolites in the Coln catchment takes very little time to percolate through to the aquifer, meaning levels respond quickly to any substantial rainfall.

## 2.3 FLOODING HISTORY

### Fairford

During the December 2000 floods, 8 properties were flooded at the eastern end of Milton Street and a further 5 properties were flooded within White Heart Court. 1 property in Milton Street and all 5 of the properties in White Heart Court were flooded as a result of water backing up through the drainage system.

In addition 4 properties within Court Brook, downstream of Town Bridge had their gardens flooded. This was as a result of flows overtopping the left bank at the Dilly's bridge.

The 2000 flood event was a result of extreme river flows following long periods of wet weather and very high ground saturation (upstream and downstream Town Bridge). Therefore run-off from localised rainfall had a greater impact would then otherwise have been the case. It has been estimated that the return period\* for this event was 1 in 25 years. According to some of the local residents flooding similar to the one of 2000 last occurred in 1966.

### **Lechlade, Whelford, Kempsford**

There is no data on historic river flooding at these locations available to us.

## **2.4 Mechanisms of flooding**

### **2.4.1 FAIRFORD**

Flooding in Fairford occurs from 3 sources:

- river
- sewers and road drains
- run-off.

However, it can be very difficult to distinguish the exact source of flooding due to the interconnected nature of the rivers and the drainage systems.

### **Fluvial flooding**

During the afternoon and evening of 20 July water levels and the flow in the river Coln rose uncharacteristically quickly and then the River Coln downstream of Fairford Mill spilled into Waterloo Meadows. In the evening properties and roads started to flood.

Properties in the Milton Street were flooded as a result of water passing through the stone wall (between the affected properties and the Town Bridge), as well as rainwater collected in the A417. The stone wall is highly permeable and is capable of passing a significant flow onto Milton Street. On Saturday 21 July the volume of water continued to build in the River Coln as the headwaters progress through the river system. The highest water level occurred at 9 am. During the morning the River Coln overflowed its left bank just downstream of the Town Bridge. Water flowed into Back Lane, but the majority surged down the A417, London Street, some diverting down the Plies into Moor Lane and Courtbrook. The Coln also overflowed at Dilly's Bridge adding more water heading towards Courtbrook and Moor Lane. Surface water run-off flowed into the drainage system which became overloaded causing houses at East End, Moor Lane and Courtbrook to be flooded.

A huge amount of water collected in Milton Street and the Courtbrook area resulting in the A417 in Fairford being closed to traffic. Local residents installed a temporary flood defence wall downstream of the Town Bridge



(White Heart area) to prevent further flooding in London Street and Back Lane. They also placed sandbags along the Town Bridge and Milton Street.

Flood water receded slowly throughout Sunday 22 July but the river levels remained high. The standing water remained in Milton Street, Waterloo Meadows and in the fields at East End. Water was still backing up in the Moor Lane and Courtbrook. Local residents placed sand bags along the riverside footpath to prevent water from flowing down into the Courtbrook area. The 'All Clear' was issued on Monday 6 August after the River Coln returned to within its banks.

It has been estimated that more than 60 properties were flooded from the River Coln.

Flood event outline and flood flow routes are presented in Appendix B, Map 6.

### **Surface water run-off and sewers flooding**

The impermeable ground around Fairford meant that the exceptional rainfall was unable to soak into the ground and led to high rates of surface water runoff. The rainwater collected in the lowest areas of Fairford and flooded many properties in Milton Street, Court Brook and East End due to overloaded surface water drainage system.

At the Flood Surgery in Fairford, local residents reported that since year 2000 they have suffered repeated incidents of sewage influx. In 2003 and 2007 approximately 80 houses were affected by sewage problems (source: local residents information, Fairford Flood Surgery).

In 2006 Thames Water installed a new pumping station at Moor Farm. However, in July 2007, due to the extreme rainfall its design standard was exceeded, resulting in flooding of the houses in East End, Moor Lane and Courtbrook area.

### **2.4.2 Lechlade**

Flooding problems in Lechlade refer to:

- flooding from Downington ditch
- flooding along the A417 at various locations
- the impact of drainage works associated with the Butlers Court Development.

During the July floods the main road A417 was closed for the traffic and Downington area was totally cut off. It is considered that lack of maintenance to the roadside ditches contributed to the problem.

It has also been reported that on several occasions, the new relief channel in Downington running to the south of the A417 and discharging towards the River Thames, west of Green Farm, had been blocked off.

As a result of the building work at Butlers Court capacity is still restricted. It has been reported that the drainage system provided for the development in the Butlers Court was not working correctly. The EA has requested confirmation that the development has been built in accordance with the approved drainage plans.

For flood event outline see Appendix B, map 7.

### **2.4.3 Whelford**

It has been reported that twenty nine properties in Whelford suffered from flooding. Sources suggest flash and surface water flooding.

Drawing on the information collected at the Flood Surgery and results of the Kempsford Parish Council survey, possible causes of flooding are as follows:

- Problems with ditches and lack of ditch clearing by riparian owners.
- Problems with highway drainage.
- Inadequate temporary measures on road works are believed to increase the problem with local drainage.
- Concerns were raised that the RAF air base had pumped a lot of water off the base. This is believed to cause flooding down the Horcott road and then into the village.
- The river Coln overflowed, travelled over the fields, across road and into Townsends Farm and then to the nearby properties

It is likely that all of the above factors contributed to the flooding brought about by rapid surface run off due to the high intensity and volume of rainfall. It is thought that the rapid run off inundated ditches, rivers, sewers, highway drains and highways and caused the flash flooding.

The suggested problems with ditches, highway drainage and watercourses could well have made the flooding worse.

For flood event outline see Appendix B, map 8.

### **2.4.4 Kempsford**

It has been reported that 5 properties in Kempsford were flooded. Main sources of flooding include river and surface water flooding.

It is suggested that the problems were as follows:

- Cottages in Reevey were flooded from the River Thames
- Problems with highway drainage - one incident was from water flowing off the road.

For the flood event outline see Appendix B, map 9.

## **3.0 Management of flood risk\***

### **3.1 Catchment Flood Management Plan**

The Catchment Flood Management Plan\* (CFMP) provides an overview for managing the long-term flood risk over the next 50 to 100 years. Within the Thames CFMP Fairford is regarded as ‘the extensive flood plains, with small clusters of development in a rural landscape’. The approach for this type of location includes:

- The flood plain is our most important asset in managing flood risk.
- Maintaining, and in some places enhancing, the capacity of the natural flood plain to retain water, combined with maintaining conveyance of watercourses in urban areas reduces the risk of flooding and has benefits for the natural environment.
- We want to safeguard the natural flood plain from inappropriate development.
- Managing the consequences of flooding will become increasingly important, particularly by buildings and communities becoming more resilient to flooding and those who are at risk taking effective action at times of flooding.

If justified, urban areas can be protected with new flood defences. The presumption will be that schemes should be based on holding water back unless there are over-riding reasons.

There is a considerable potential for implementing this policy in Fairford by enhancing the capacity of Waterloo Meadow as well as creating a flood storage/compensation area upstream of the Cascade Weirs (see Appendix B, Map 10. See section 3.3).

### **3.2 Third party structures & maintenance**

There are a number of sluice gates in private operation on the River Coln. Sluices in proximity of the Fairford Mill are managed by the Ernest Cook Trust agents and the rest of the sluices by the local mill owners.

There are 5 flow control structures in the vicinity of Fairford Mill. Sluice management has been based on the level of rainfall and it is differentiated into a summer and winter regime. In addition, it correlates to management of sluices upstream - in Quenington and downstream in Whelford. Depending on rainfall, particular sluices are gradually opened and the winter management starts usually mid October extending to December/January.

During the flood of July 2007 these sluices were kept at their normal summer position. Due to their size they would have no material effect on flood risk for this magnitude of flood event.




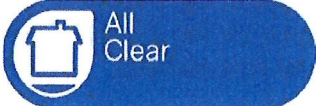
There are also a number of sluices upstream of Fairford Mill which in the past contributed to water level control downstream but are now disused with minor control on flows. They are located within the natural floodplain with no residential housing. In line with CFMP approach and development control requirements, the ongoing scheme is looking at the potential to restore or improve these structures to fair condition and utilise them to retain excess water where it could bring benefits to the local environment and help mitigate flooding problems downstream. There is an opportunity to create a flood storage area (FSA) which at the same time would provide compensation for loss of storage downstream (see Appendix B, Map 9 for location of the control structures and area of possible FSA).

The idea has met with a great support from the land owner – Ernest Cook Trust.

There are not any river control structures in third party operation in Whelford, Kempsford or Lechlade (Downington) that would have had any effect on the size and severity of this flood event that we know of.

### 3.3 Flood warnings

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 to register with us for this service. 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 companies.

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 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 quick dial number which will take them to their local area information. The relevant quick dial number for the River Coln is 0112314 and the Thames in this area is 011121.

For Fairford the following flood warnings were issued during the July floods:

- On Thursday 19 July, flood watches were issued for most river stretches in our area, including the Coln catchment. Watches were issued in readiness for the bad weather that had been forecast on Friday 20.
- On Friday the 20 at 16:36 a flood warning was issued for the River Coln (The flood warning area: Compton to Cricklade), this was issued 23 minutes before the property threshold was breached. We don't know the actual time the first property flooded. There are 281 properties at Risk in the 100 year flood map in the Coln flood warning area, but only 6 properties are signed up to our Flood Warning Service
- 67 properties registered on FWD in Lechlade – Thames flooding

- A flood warning issued for the Thames, (from Kemble to Lechlade) at 19.40 hrs on 20 July based on property flooding expected in Purton Stoke
- According to data from the gauging station located at St Johns lock, Lechlade property flooding began at 09.45 hrs on 21 July.

We can currently offer a flood warning service to areas in Fairford that are at risk of flooding from the River Coln. This flood warning area covers Compton to Lechlade.

We can also offer a flood warning service to Lechlade and some areas in Kempsford, which are at risk of flooding from the River Thames.

### **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 and supplying maps and other relevant information. They can also be adapted to include other emergency situations, thus increasing the resilience of a community.

Community flood plan templates have been requested by both the Fairford Town Clerk and Kempsford Parish Council (which covers Kempsford and Whelford). Lechlade have also requested a template be sent to them.

The generic Flood Action 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

### **3.4 River maintenance**

The maintenance of all watercourses is legally the responsibility of the riparian\* owner. Within the review area many households own very small sections of the various watercourses and in many cases they are also unaware of their responsibility for the watercourse.

We have permissive powers to carry out maintenance on any river that is classed as 'main river\*', where the risk of flooding has been assessed as significant.

River maintenance within the review area includes the Thames, the Coln, the Leach and the Downington Ditch (on the annual basis).

In Fairford, we carry out weedcutting every year from the Town Bridge to the ford at Horcott Farm. The weeds are also cut around the gauge weir to

ensure accurate flow measurements. The high ecological value of the river determines a method of cut. A margin of vegetation must be left so that disruption to the local wildlife is reduced to minimum. In addition, particular cautions must be undertaken when maintaining the river downstream of Town Bridge, around the island, where the River Coln splits for about 250 meters. Inappropriate methods could disrupt balance of water on both sides of the island and could result in drying out one of the channels.

We remove trees from watercourses where they could increase the risk of flooding if we have the available resources to do so.

The last weedcutting took place in August 2007. It is usually carried out in late summer to avoid further excessive vegetation growth before winter. Trees and branches downstream of Fairford, vicinity of Horcott Farm, have been removed subject to man power, time and safe ground conditions. There are more reported trees fallen across watercourse downstream of Horcott Farm however due to them causing only a very minor flood risk upstream they will be removed next year. The river is reasonably silt free in this area.

Our assessment of the channels through Fairford, Lechlade, Kempsford and Whelford is that whilst increased maintenance could lead to reductions in the water levels during very minor flood events it would not have materially helped during the floods in July due to the scale of the flooding and volume of water involved.

Since dredging in the late 80s the river bed has not changed significantly and there is no justification in undertaking any channel modification works in the future. The minor benefits, risk to bridge abutments and significant damage to the river habitats weighs heavily against the promotion of such disruptive maintenance.

Guidance on the rights and responsibilities of riparian owners is provided on our website <http://www.environment-agency.gov.uk/subjects/flood/362926/> and in hard-copy booklet form - Living on the Edge.

If riparian owners wish to undertake further maintenance of the watercourses this would be supported by us. We can provide advice and guidance on how best to do this.

### **3.5 Options for improvements**

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 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.

We 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 our investment at greatest need.

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

Due to the history of river flooding in Fairford and initial cost benefit analysis we investigate the flood alleviation scheme for the town. An overview of our proposal is outlined below and in section 4 of this report.

The property flooding in Whelford, Kempsford and Lechlade was mainly due to surface water and lack of maintenance of local ditches. The options for improvements therefore lies beyond our responsibility and hence we have no justification in investigating flood alleviation schemes for these communities. Flood risk could be reduced by riparian owners carrying out routine maintenance of ditches and by property owners making their property more flood resistant. Further recommendations for each location are presented below.

### **Fairford: Flood Alleviation Scheme - fluvial flooding**

A flood incident in December 2000 showed that areas of Fairford are at risk of flooding, affecting residential property and highway infrastructure. As a response to this event the Pre-feasibility report was undertaken in 2001 and 5 options to alleviate the problem had been identified. These options are: do nothing, do minimum & three major schemes – flood bund (option 3), channel modifications (option 4) and upstream storage area (option 5) (for overview see Figure 10 below). Option 3 (see Appendix B, Map 10) has been taken forward as it brings best benefit for the cost with minimum impact on the local environment.

These are the elements of preferred option:

- Replacement of the existing rear boundary wall to the properties upstream of Milton Street with a flood defence wall;
- An additional flood defence wall behind and adjacent with the existing dry stone highway boundary wall between Milton Cottages and Town Bridge;
- Raising the left bank riverside footpath downstream of Town Bridge
- Flap valve on the Court Brook.
- Compensation area/flood storage area upstream of Fairford Mill.

The scheme is being designed to the standard of protection 1 in 100 years event and it is to protect approx. 142 residential properties, 9 commercial properties, 2 electricity sub-station, telephone exchange and A417 public highway.



The flood event of July 2007 has shown that the flood risk at Fairford is significant (see Appendix A with photos). One of the main tasks is to ensure that the proposed FAS is considering the correct option in the light of the recent flood (e.g. flood route downstream of the Town Bridge) and possible modifications to the route of the proposed flood bund are under investigation.

Information collected during the Flood Surgery helped us to identify an area of higher ground which possibly could be implemented into the final design of the flood bund at Courtbrook and hopefully shorten its length (see Appendix B, map 10).

	OPTION	Description	Cost	Engineering Considerations	Environmental Considerations	Reasons for Selection/ Rejection
1	<b>Do Nothing</b>	Stop all maintenance	Slight saving over existing	Not applicable	Not evaluated but possibly slightly negative	Rejected: increase in flood risk
2	<b>Do Minimum</b>	Maintain as existing (weed clearance)	Existing maintenance budget	Not applicable	No impact	Rejected Flood Risk as existing
3	<b>Defences</b>	Defences to the rear of Milton Street and Left Bank downstream Town Bridge	Least expensive	Straightforward construction and low risk	Impact on existing trees. Limited visual impact	Selected: Cost effective, easy to build and limited environmental impact
4	<b>Upstream Storage</b>	Flood storage areas upstream of Town & Mill Bridges	Most expensive	Generally easy to construct but control structures will require specialist input Reservoirs Act Compliance	Impact of embankments and control structure(s) Change to hydrological regime	Rejected: Least cost effective
5	<b>Dredging</b>	Lower bed from Mill Street to Court Brook area	Second most expensive option	Reasonably straightforward to undertake May not provide sufficient additional capacity at extreme events	Significant environmental impacts	Rejected: environmental impact very significant

**Figure 10. Options summary.**

#### *Sewage Network.*

As it has been discussed during Cotswold District Flood Forum Thames Water have received a list of concerns to deal with.

#### *Highway Drainage.*

Issues related to highway drainage have been discussed during Cotswold District Flood Forum and are going to be addressed by Gloucestershire County Council Highways Department.

## **Lechlade**

Gloucestershire County Council Highways has agreed to investigate problems with highway drainage.

It has been highlighted that regular maintenance of the drainage system should be a priority. Gloucestershire County Council Highways has agreed to investigate the problem further, in liaison with us.

We will continue river maintenance of Downington Ditch on the annual basis, this was discussed during the meeting for Lechlade held during the Flood Surgery for Fairford.

## **Whelford and Kempsford**

Gloucestershire County Council Highways has agreed to look at the problems with highway drainage.

Information about run-off from RAF Airbase has been forwarded to Cotswold District Council for further investigation. Also the Ministry of Defence had been asked for comments. Given the information about the Airbase drainage system and topography they stated that it seemed to be unlikely that the water from the runway had flooded properties in the village. RAF Fairford would be the most appropriate institution to provide further information. Drawing on the current information available they have been liaising with local councillors to explain the problem.

It has been reported that the road works which are believed to contribute to flooding in Whelford, have been now completed.

### **3.6 Flood resilience**

Flood resilience refers to measures that reduce the amount of damage caused by water entering properties. There are a wide range of 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 our national 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.

Although a study for a flood alleviation scheme for Fairford is in progress, flood resilience measures are still recommended. This would be particularly beneficial where problems were caused by surface water run-off. Individual flood protection measures are also highly recommended in Kempsford,

Whelford and Lechlade where properties were affected mostly by surface flooding and where there is no likelihood for any flood alleviation scheme.

Flood resilience measures should be based on advice from either the Royal Institute of Chartered Surveyors (RICS) or the Flood Protection Association. For further information please see the National Flood Forum website at: [www.floodforum.org.uk](http://www.floodforum.org.uk)

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:

- timber floors above solid concrete;
- raised cupboards;
- water resistant door frames;
- non-return valves on drainage pipes;
- water resistant plaster.

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

## **4.0 Preliminary costs, benefits, contributions**

### **Fairford Flood Alleviation Scheme**

The main purpose of this chapter is to provide general information about costs and benefits of preferred option. In-depth economic analysis will be presented in the Project Appraisal Report (PAR). The PAR is an output of the feasibility study and as our business case for the project its role is to "sell" the investment decision. Approval of PAR by Internal Boards means that the project satisfies economic, engineering and environmental criteria and in theory can be taken forward to construction. The PAR for this scheme is due to be presented to Project Approval Board in Spring/Summer 2008. However, approval of PAR doesn't guarantee immediate allocation of any funding to progress with the scheme.

The 2001/02 pre-feasibility study produced an initial cost benefit ratio of 4.79 for the preferred option (figure 11), what in turn gave an initial DEFRA priority score of 11. This was based on 2001 prices and the basic method of calculating benefits and annual average damage. The cost of the scheme was calculated on the information we had at the time and using very simplistic methods. There is now a concern, in the light of the latest flood and current DEFRA guidelines, that it was underestimated. The economic assessment is therefore being updated as a part of the current feasibility process.

Scheme	Existing	Control structure on Waterloo Brook, bunding and raised bank levels
	Do minimum	
Costs, PVc	£0	£24,533
Flood damage (properties & traffic disruption), PVd	£120,360	£2,927
Total flood damage, PVd	£120,360	£2,927
Flood damage avoided, PVda	£0	£117,433
Total benefits, PVb	£0	£117,433
NPV	£0	£92,900
Average benefit cost ratio	0	4.79

**Figure 11. Fairford Flood Alleviation Scheme benefit/cost summary.** (Source: *Pre-feasibility Study, 2001/02*)

Even if the updated benefit value is higher it is very likely that already low benefit cost ratio and equally DEFRA priority score would in fact decrease as a result of increases in construction costs due to the changes to the original design assumptions for the scheme.

Early in 2007 only schemes with a priority score higher than 25 were eligible for grant in aid payments from DEFRA and this score is constantly under review. It means that for this scheme to go ahead it was necessary to seek funding from alternative sources. So far the scheme has been funded from the Local Levy and has been provisionally allocated funding for the next two years. However, it must be highlighted here that if the priorities change or other schemes are identified with a higher score then the project could be delayed or suspended.

## 5.0 Conclusions & recommendations

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

We worked with our professional partners throughout the event to warn and assist residents and businesses. In order to reduce the impact of any future floods there are several actions that should be taken forward as a matter of priority:

- Complete the feasibility study on Fairford FAS.
- Examine the potential to restore old structures upstream of Fairford Mill to create flood storage area
- Continue with the current maintenance programme.
- Continuing public awareness campaigns to improve the uptake of Flood Warning Direct.
- Raising public awareness of riparian\* rights and responsibilities to increase channel maintenance where needed.
- Work with the Town Council to produce of Flood Plans
- Promotion of flood resilience for properties at risk of flooding.
- Our continued role in the Planning Process to steer development away from flood risk areas