



OFFICE OF THE
DEPUTY PRIME MINISTER

Preparing for



FLOODS

Interim guidance for improving the flood resistance of
domestic and small business properties

October 2003

Photo Acknowledgments

Environment Agency, Kyriacos Akathiotis,
Solent News Agency, HR Wallingford,
WS Atkins, Lucy and Anthony Rees.

Office of the Deputy Prime Minister
Eland House
Bressenden Place
London SW1E 5DU
Telephone 020 7944 4400
Internet service www.odpm.gov.uk

© Crown copyright 2002.

Reprinted with amendments 2003
Copyright in the typographical arrangement and
design rests with the Crown.

This publication (excluding the Royal Arms and
logos) may be reproduced free of charge in any
format or medium provided that it is reproduced
accurately and not used in a misleading context.
The material must be acknowledged as Crown
copyright with the title and source of the
publication specified.

Further copies of this report are available from:

ODPM Publications Centre
PO Box 236
Wetherby
West Yorkshire
LS23 7NB
Tel: 0870 1226 236
Fax: 0870 1226 237
Textphone: 0870 1207 405
E-mail: odpm@twoten.press.net

This document is also available on the ODPM
website: www.odpm.gov.uk

Published by the Office of the Deputy Prime
Minister. Amended and reprinted in the UK,
October 2002 on material containing 75% post-
consumer waste and 25% ECF pulp.

Product code 01CD1025

Contents

	Foreword	1
	Acknowledgments	3
<i>GENERAL</i>	1. Introduction	5
<i>GENERAL</i>	2. The Impact of Flooding	11
	The causes of flooding	11
	Flood damage – the effects of flooding	16
<i>EXISTING PROPERTY OWNERS</i>	3. Existing Property Owners	25
	Assessing the risk of flooding	25
	Choosing the right options	36
	Keeping the water out using flood barriers	40
	Other permanent measures to improve flood resistance of property	46
	Historic buildings	47
<i>DEVELOPERS</i>	4. New Development	51
	Introduction	51
	Planning Guidance	51
	General principles of flood resistant design for new development	52
	Interface with Building Regulations	54
<i>BUILDERS & EXISTING PROPERTY OWNERS</i>	5. Permanent Measures to Reduce Flood Damage – New and Existing Properties	55
	Introduction	55
	External walls	56
	Internal walls	62
	Floors	65
	Fittings and building services	72
<i>GENERAL</i>	6. Summary	83
<i>GENERAL</i>	7. Further Reading	87
<i>GENERAL</i>	8. Environment Agency Guidance	91

Foreword

I am pleased to welcome this interim guidance "Preparing for Floods".

Recent occurrences of flooding in the UK have shown the devastating effects that these events can have on people's homes and businesses. Following the floods during the autumn of 2000, the Parliamentary Select Committee for the Environment, Transport and Regional Affairs recommended that guidance be produced containing information for use by planning authorities and advice on ways to improve the resistance to flooding of existing properties. This document has been produced in response to those recommendations.

The information compiled in this document complements existing planning guidance and also advice on taking extemporary measures to protect against flooding, which is available through the Environment Agency. The production of this interim guidance has been overseen by the UK's leading research and technical experts on flooding, organisations representing construction and insurance companies, the Environment Agency and two Government Departments. It contains informed advice that is relevant to the owners of homes and small businesses and people undertaking building work as well as planning authorities.

This guidance has been produced quickly, so as to bring together information which will be of practical help to those at immediate risk of flooding. We have not been able to consult as widely as we would have wished with potential users on the content of the document, so any comments on the guidance, and how it can be improved, would be welcomed. Further research into improving the flood resistance of buildings is being undertaken and we will update the guidance in the light of the research and any comments received.

Since the impacts of flooding are so devastating, it is important that people whose properties are at risk take appropriate action to resist flooding. Much can be done to reduce the damage caused by floods as this guidance shows. We hope it will be of practical help to all those whose homes or businesses may be at risk.

As well as the damage caused to property, flooding has many other, less tangible, impacts on people's lives. These include the loss of sentimental belongings, the nuisance of cleaning up following a flood, inconvenience of having to live in temporary accommodation while this clean up takes place, and concerns over security of empty properties.

Since the impacts of flooding are so devastating, it is important that people whose properties are at risk take appropriate action to resist flooding. Much can be done to reduce the damage caused by floods as this guidance shows. We hope it will be of practical help to all those whose homes or businesses may be at risk.



Sally Keeble

A handwritten signature in black ink that reads "Sally Keeble". The script is cursive and fluid, with the first name "Sally" written in a larger, more prominent hand than the last name "Keeble".

Acknowledgments

Funding contributions for the project were provided by:

The former Department for Transport, Local
Government and the Regions
Department of Trade and Industry
Scottish Executive
Environment Agency
Association of British Insurers
NHBC (National House Building Council)
House Builders Federation.

The project steering group, who assisted with the development of the guidance, was managed by the Construction Industry Directorate of the Department of Trade and Industry.

The project steering group consisted of representatives from the following organisations:

The former Department for Transport, Local
Government and the Regions
Department of Trade and Industry
Scottish Executive
Welsh Assembly Government
Environment Agency
Association of British Insurers (ABI)
NHBC (National House Building Council)
House Builders Federation (HBF)
Building Research Establishment (BRE)
Construction Industry Research and Information
Association (CIRIA)
HR Wallingford.

The project steering group have contributed much of the technical information contained within this guide. The guidance therefore represents the industry's current consensus view on improving flood resistance of domestic properties.

This document was updated with minor revisions (e.g. organisations; details of current projects, etc) in October 2003. Consideration will be given to production of a new edition following the completion by CIRIA in 2004 of its collaborative R&D project on 'Standards for the repair of buildings following flooding'.

The guide was prepared by the research contractor, WS Atkins Consultants Ltd.

*Please send any comments on the usefulness of this guidance, and how it can be improved, to:
Buildings Division, ODPM, Eland House,
Bressenden Place, London, SW1E 5DU
(Fax: 020 7944 5739 or 5719;
E-mail: mike.johnson@odpm.gov.uk).*

1 | Introduction

If adopted, the principles set out within this guide should help reduce the stress and disruption of flooding and provide a more sustainable approach to flood risk.

Recent flooding events across the UK have shown the devastating impact that flooding can have on people's lives and businesses. During the autumn 2000 floods alone over 10,000 homes and businesses were flooded, causing damage to property and severe distress to thousands of people across the country.

While it is not possible to eliminate the risk of flooding altogether, many practical steps can be taken to reduce the cost of flood damage repairs and speed up recovery times. Although existing river and flood defences protect extensive areas of the UK, they cannot be designed to protect against extreme flooding events. Flood defences can only be implemented in areas where the potential benefits outweigh the financial costs.

The aim of this guide is to provide guidance to property owners on how they can improve the flood resistance of their properties. The guide is also intended for use by developers, local planning authorities and others involved in construction of new buildings, and renovation of existing buildings, at risk of flooding. If adopted, the principles set out within this guide should help reduce the stress and disruption of flooding and provide a more sustainable approach to flood risk.

In preparing this guide, information has been drawn from Government, the Environment Agency, the Insurance industry, local authorities and, most importantly, families and small businesses who have been through the experience of a major flood. This is the first time that best available information on improving the flood resistance of buildings has been collated within one document. The guide does not attempt to solve all the problems associated with

flood damage but it does provide a range of common-sense solutions and references to other sources of information.

The guide has been published as “Interim Guidance” and will be reviewed and updated in due course as additional information is obtained. This document has been prepared in response to a recommendation made by the Parliamentary Select Committee for the Environment, Transport and Regional Affairs following the autumn 2000 floods, to provide supplementary planning guidance for use by planning authorities and information on improving flood resistance of existing properties.

Before undertaking any works referred to within this guide it is important that professional advice is first obtained to ensure that the most appropriate improvement measures are chosen for the property concerned.

This document has been prepared in response to a recommendation made by the Parliamentary Select Committee for the Environment, Transport and Regional Affairs following the autumn 2000 floods, to provide supplementary planning guidance.

What can I expect to find out in this guide?

This guide provides practical information on the measures that can be taken to improve the flood resistance of both existing and new properties at risk of flooding within the UK. The guide is aimed at the following target audiences:

- Existing homeowners and small business owners whose properties are at risk of flooding.
- Developers, builders, local planning authorities, building control bodies (local authority building control or private approved inspectors) and others involved with:
 - Construction of new properties in areas of flood risk; and
 - Renovation of existing buildings in areas of flood risk.

Sections 1 and 2 provide a general introduction and some background information on the causes and impact of flooding.

Many areas prone to flooding are in historic towns and villages, and contain properties of special architectural or historic interest.

Section 3 is aimed principally at *existing homeowners and small business owners*. It provides information on assessing the risks of flooding and guidance on selecting appropriate measures to improve the flood resistance of properties. Information is also provided on measures to prevent or reduce the volume of floodwater entering the building, including the use of temporary flood barriers and other permanent measures to improve the flood resistance of the building structure.

Many areas prone to flooding are in historic towns and villages, and contain properties of special architectural or historic interest. Section 3 provides outline advice on the special considerations that apply to these buildings and gives references to more detailed guidance provided by English Heritage.

Section 4 of this guide is for use by *developers, local authorities, building control bodies and others involved with new development* in high flood risk areas. It provides guidance on the forms of construction that are most appropriate for developments at risk of flooding.

New development in areas at risk of flooding is now only permitted in exceptional cases in accordance with the Government's new planning guidance on development and flood risk (Planning and Policy Guidance Note 25: Development and Flood Risk (PPG25)). The guidance within PPG25 is based on a precautionary approach so that risk is avoided where possible and managed elsewhere. The relevant document in Scotland is National Planning Policy Guideline NPPG7 – Planning and Flooding. In Wales new policy on development and flood risk is emerging through Draft Planning Policy Wales (PPW) and the revision of Technical Advice Note 15 Development and Flood Risk (TAN 15).

Section 5 provides more technical information on the permanent measures that can be taken to improve the flood resistance of both *existing and new buildings* with sub-sections discussing walls, floors

In addition to this guide there are many other on-going initiatives to improve flood protection of homes and businesses, including the planning, design and construction of flood defence improvements by the Environment Agency and local authorities.

and building services and fittings (such as electrical wiring and fitted cupboards). This section is aimed principally at builders but may also be of interest to property owners.

Section 6 provides a summary of the key steps to reducing the consequences of flooding as outlined within the guide. Section 7 includes a list of related publications for further reading, and Section 8 gives guidance from the Environment Agency's Floodline service.

Case studies are included throughout this guide to give real-life examples of what steps homeowners and small business owners have taken to protect their properties from flooding. The first case study describes the measures taken by a fish and chip shop owner in the town of Bewdley, Worcestershire. Bewdley was severely affected by the autumn 2000 floods when the River Severn overtopped its banks.

In addition to this guide there are many other on-going initiatives to improve flood protection of homes and businesses, including the planning, design and construction of flood defence improvements by the Environment Agency and local authorities, and improvements to sewers by water companies. Other flood related research projects are also underway including work to provide national performance standards against which flood protection products can be tested, and work to improve knowledge on the flood resistance of building materials.

It should be noted that while this guide provides information on how to improve flood resistance of properties it *does not cover the steps required to clean, dry and restore properties after flooding* has occurred. Information related to this is provided by CIRIA and the Environment Agency in their leaflets 'After a Flood' and 'Flood Products'. Further information is provided on the CIRIA website (www.ciria.org/flooding) where a series of advice sheets aimed at the householder on how to improve the overall flood resistance of their home can be found together with other pages on repair and restoration of buildings following floods.

CS | Case Study

The Merchant's Fish Bar occupies a prime site in Bewdley, standing at the end of the main street, close to the river, next to a pub. It is used by local residents all year round, and by day-trippers, steam train enthusiasts, holidaymakers and fishermen through the summer. The popularity of Bewdley as a tourist town gives the shop one of the best turnovers for its size in the Midlands.



The chip shop and the tearoom next door belong to Kyriacos Akathiotis, who has owned the business for the last 17 years. In November 2000, the river rose to the windowsills of the tearoom, flooding the riverside houses, the chip shop, the pub forecourt and shops further up the street. Kyriacos suffered an uninsured loss of around £175,000. His insurance policy excluded flood cover.

All the equipment in the chip shop had to be stripped out. There was no way of saving the fryers and fridges from that depth of water. Not only was there the actual physical damage, but in a business supplying food, cleansing after a flood has to meet stringent standards of hygiene. "Everything went in the bin, everything." Much less damage was done in the tearoom, where the equipment and furniture was smaller and could be carried to safety.

He says he cannot afford for this to happen again and in the £100,000 refit following the flooding, he has adapted the shop and the equipment to take account of the possible risks.

The new fryers, which normally would have cost around £21,000, have been set on a hydraulic system which enables them to be raised above the flood level – this at an extra cost of £14,000. The ducting for the ventilation system has also been sealed to prevent water ingress. Before this work was carried out, water entering the ducting used to stop the ventilation from working and the shop had to close. The seven or eight fridges that the shop needs are now all made from stainless steel, with the motors set at the top rather than the bottom. Apart from the



fryers, all the other equipment can now be removed before flooding occurs.

These remedial works will substantially reduce any future flood damage repair costs and will allow the premises to re-open for business more quickly if flooding returns.

Source: Kyriacos Akathiotis

2 | The Impact of Flooding

The causes of flooding

Flooding generally occurs through a combination of events:

- Rainfall fills rivers, streams and ditches beyond their flow capacity. Floodwater overflows river banks and flood defences onto floodplains.
- Coastal storms can lead to overtopping and breaching of coastal flood defences due to storm surge and wave action.
- Blocked or overloaded drainage ditches, drains and sewers overflow across roads, gardens and into property.
- Overloaded sewers can sometimes backflow into property.
- Rain can be so heavy that run-off flows overland down hills and slopes.
- Rain soaks into the ground causing ground water levels to rise and flood.

Flooding in autumn 2000 was caused by a series of storms which crossed the country over a seven-week period. Areas soon became waterlogged, resulting in rivers and streams rising very quickly as more rain fell. Many of the rainfall storms would have been severe enough to cause flooding on their own, but the combination of storms led to repeated flooding in many places and to prolonged flooding in others.

In November 2000, the equivalent of two month's rain fell on the Yorkshire Dales in 10 days. It was the wettest autumn for 100 years resulting in the highest recorded water levels for many rivers downstream. Fresh rain produced new torrents of water flowing into rivers that were already dangerously swollen. The resulting floods caused havoc in Yorkshire and other regions. Along river banks in many parts of Britain water poured into houses, sometimes whole estates. Months later many victims were still not able to move back into their homes (BBC, Panorama 2001).

Flooding is not new

Flooding is not new to the UK and there are accounts of flooding causing severe damage and loss of life since records began.

"The 1894 floods were so spectacular, so catastrophic and so widespread that they were to take place in Berkshire's folklore as the greatest floods ever and the yardstick by which all future inundations in the county would be measured."

"The central arch of Wallingford Bridge was swept away. Water reached as high as parlour windows and many poor people 'lost their all'. At Windsor, the Eton Bridge was carried away and the fifteenth arch of the Eton to Slough Bridge capsized due to the violence of the surging waters. The people of Bisham also lost their Green Bridge and there was no churching on the following Sunday as the water was so high". The Great Thames flood of 1809 (Currie et.al, 1994).

"The 1894 floods were so spectacular, so catastrophic and so widespread that they were to take place in Berkshire's folklore as the greatest floods ever and the yardstick by which all future inundations in the county would be measured. The Thames burst its banks and invaded scores of towns, villages, hamlets and farmsteads, thousands were affected". (Currie et.al, 1994).

Despite the long history of flooding in the UK, experience in recent years suggests that the situation is getting worse. Changes in land and river management, development in floodplains and flood risk areas, and variations in the intensity of rainfall

may have all contributed to the severity of flood events and their impacts.

There is also growing evidence that our climate is changing because of pollution and that this changing climate will increase the likelihood of flooding. This is due to predicted increases in sea levels and increases in the duration and intensity of rainfall, especially in winter months. It is therefore likely that river, coastal and other types of flooding will affect more areas of the country with greater severity in future years. Over the last few years we have certainly seen worse than average weather conditions.

What are the risks of flooding?

It has been estimated that over 5% of the people in England live lower than 5 metres above sea level, including large parts of our major cities such as York and London. It has also been suggested that about 7% of the country is likely to flood at least once every 100 years from rivers. In addition, approximately 30% of the coastline is developed and around 1.5% of the country is at risk from direct flooding from the sea. As a result, about 1.7million homes and 130,000 commercial properties worth over £200 billion, are at risk from river or coastal flooding in England. Many more properties are at risk from localised flash flooding.



Weather claims (including those for storm damage, burst pipes and flooding) form just part of the overall claims picture for insurance companies. Nevertheless the insurance industry takes flood risk very seriously. In the autumn 2000 event over 10,000 homes were flooded resulting in over 200,000 insurance claims. The current cost estimate for the autumn 2000 floods is over £800 million (Association of British Insurers).

What are the sources of flooding?

There are a number of different sources of flooding including:

- Rivers and streams
- The sea
- Groundwater
- Overland flow (especially over tarmac and other hard surfaces)
- Blocked or overloaded drains and sewers
- Broken water mains.
- **Rivers and streams.** Excessive rainfall, snow or hail, or a combination of high river levels and high tides can cause river flooding. Flooding occurs when surface water run-off from the surrounding area exceeds the flow capacity of the river or stream. Saturation of surface soils due to wet weather can lead to greater run-off rates and higher flooding levels.



Human activity has increased the risk of flooding from rivers and streams in many areas.

Development has reduced the natural capacity of floodplains and increased the rate of surface water run-off.

Most areas are protected against river flooding by man-made flood defences. While these defences reduce the likelihood of flooding they cannot eliminate risk altogether. Defences are designed to withstand specific flood heights but they can be breached or overtopped should more extreme events occur.

- **The sea.** Flooding from the sea can be caused by high tides, storm surges, waves overtopping or breaching sea defences, or a combination of these factors.
- **Groundwater flooding.** Flooding from groundwater is most likely to occur in areas of chalk, limestone or other aquifers. This type of flooding generally affects older buildings that back onto hillsides, buildings close to winterbourne streams or houses with basements that are

particularly prone to groundwater flooding. Depending on the local geology, groundwater flooding can take a long time to recede. Properties can still be underwater many months after the heavy rains that caused the flooding have passed.



The heavy rainfall in autumn 2000 followed the wettest 12 months on record in many areas of England and Wales. These high volumes of rainfall led to many aquifers recharging earlier than normal, leading to unusually high levels of groundwater. In some areas, groundwater rose to the surface and formed springs, often in places where springs had not been seen for a generation or more. As a result approximately 1,000 homes and businesses were affected by groundwater flooding.

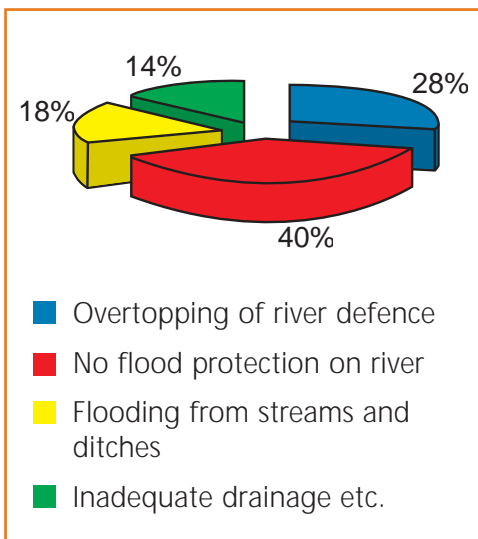
- **Flooding from overland flow.** Overland flows can be caused by heavy rainfall falling on saturated ground, where groundwater levels are already high, or on paved areas of tarmac or concrete with inadequate drainage. Properties can be flooded by overland flows if they are located in areas where floodwater can accumulate. Paved areas, such as roads, can act as channels for overland flows.
- **Blocked or overloaded drainage systems.** Localised flash flooding from blocked or overloaded drainage systems can occur at times of heavy rainfall. This type of flooding is unpredictable and often occurs in unexpected locations depending on the location and intensity of rainfall.



Such drainage systems include open **drainage ditches & culverts** and **buried drains and sewers**. Where flooding occurs from foul sewers the floodwater will often be contaminated with sewage. In some cases, contaminated floodwater can flow back through foul sewers causing flooding inside buildings.

Flooding can also be caused by blocked or overloaded roof drainage systems.

- **Broken water mains.** Localised flooding can be caused by burst water mains, although this rarely leads to property flooding above ground level. Basements can be flooded if a water main bursts close by.



Autumn 2000 floods: causes of property flooding

Adapted from the Environment Agency's Lessons Learned Report

Why do properties flood?

The extent to which flooding affects individual properties will depend on the speed and depth of the floodwater and the particular level and position of the building. The adjacent chart shows the distribution of flooded properties by flood type, based on information collated from the autumn 2000 floods.

Flood damage – the effects of flooding

Flood damage can range from being relatively minor, where very limited volumes of floodwater enter the building, to severe cases of deep water flooding where extensive damage occurs to the building and its contents. The amount of damage depends mainly on the depth and duration of flooding.

The most important aspect to remember is that the damage to property is only a small element of the true 'human cost' of a flood. The stress associated with losing personal belongings, having to live in temporary accommodation while repairs are undertaken, and the trauma of the clean-up and restoration can be considerable. There are many factors that contribute to the suffering of individuals affected by flooding. These can include:

- The loss of personal belongings, particularly those of sentimental value that cannot be replaced.
- The financial pressures of repairing flood damage, particularly for people who are not fully insured.
- Cleaning the property following flooding. Residual smells.
- Arranging repair work.
- The loss of employment or a business failure.
- The additional costs and stress of having to live in temporary accommodation while the property is renovated. Worries over the security of the empty property.
- The loss of pets.

- Damage to garages, garden plants/ponds, sheds and outbuildings.
- Potential reduction in property value.
- The fear of flooding happening again.

Flood depth

The water depth is clearly the key factor affecting the scale of flood damage. For very shallow flooding, where water does not rise above floor level, damage is unlikely to be significant for most properties. However, it should be remembered that even in shallow cases of flooding water can enter cellars, basements and voids beneath floors, and can cause problems of damp in walls.

Damage increases significantly once water rises above the floor level and comes into contact with internal surfaces, electrical sockets and equipment, kitchen cupboards, carpets, furniture, and personal belongings. Flood depths greater than 1 metre above floor level are likely to result in structural damage of buildings. The table on page 18 illustrates the typical increase in flood damage as the depth of floodwater rises.

Research by the insurance industry has shown that half a metre of floodwater within a modern semidetached house will result in an average cost of £15,000 to repair the building and around £9,000 to replace damaged belongings (Information provided by the Association of British Insurers).

Damage increases significantly once water rises above the floor level and comes into contact with internal surfaces, electrical sockets and equipment, kitchen cupboards, carpets, furniture, and personal belongings.

Flood damage for a typical residential property

Depth of floodwater	Damage to the building	Damage to services and fittings	Damage to personal possessions
Below ground floor level.	<p>Minimal damage to the main building.</p> <p>Floodwater may enter basements, cellars and voids under floors.</p> <p>Possible erosion beneath foundations.</p>	<p>Damage to electrical sockets and other services in basements and cellars.</p> <p>Carpets in basements and cellars may need to be replaced.</p>	<p>Possessions and furniture in basements and cellars damaged.</p>
Up to half a metre above ground floor level.	<p>Damage to internal finishes, such as wall coverings and plaster linings. Wall coverings and linings may need to be stripped to allow walls to dry.</p> <p>Floors and walls will become saturated and will require cleaning and drying out. Damp problems may result.</p> <p>Chipboard flooring likely to require replacement.</p> <p>Damage to internal and external doors and skirting boards.</p>	<p>Damage to downstairs electricity meter and consumer unit (fuse box).</p> <p>Damage to gas meters and low-level boilers and telephone services.</p> <p>Carpets and floor coverings may need to be replaced.</p> <p>Chipboard kitchen units are likely to require replacement.</p> <p>Washing machines, free standing cookers, fridges and freezers may need to be replaced.</p>	<p>Damage to sofas, other furniture, and electrical goods.</p> <p>Damage to small personal possessions, such as books, audio cassettes, videos, and photos.</p> <p>Food in lower kitchen cupboards may be contaminated.</p>
More than half a metre above ground floor level.	<p>Increased damage to walls. Possible structural damage.</p>	<p>Damage to higher units, electrical services and appliances.</p>	<p>Damage to possessions on higher shelves.</p>

Flooding duration

The length of time that floodwater remains in contact with buildings is another key factor in the level of damage caused. Generally the longer the duration of flooding, the more extensive the damage will be.

The village of Gowdall is a community that was still in crisis months after the floods in autumn 2000 had abated. Around a hundred homes were damaged and in March 2001 some homes were still under several feet of water. The water stayed in Gowdall for about two weeks and even three months after the flood had receded, Gowdall had still not returned to normal. In February 2001 some residents were told that it would be more than a year before they would be able to move back home again. Most people lived in caravans outside their homes while repairs were carried out (BBC, Panorama 2001).

Contamination of floodwater

Floodwater can be contaminated with sewage from blocked drains and chemicals from people's garages or commercial premises that have spilled into the floodwater. Once floodwater has receded a layer of contaminated silt is often left behind. Mould can also grow in the damp conditions following flooding.

Once floodwater has receded a layer of contaminated silt is often left behind. Mould can also grow in the damp conditions following flooding.

Contamination can add to the cost of cleaning and disinfecting buildings that have been flooded. Contaminated floodwater may create some risks to health. Protective clothing should be worn during the clean-up operation and other hygiene precautions should be taken. Advice on health and safety precautions to be taken when restoring flooded buildings can be found on the Environment Agency's Floodline website (www.environment.agency.gov.uk/flood) and the CIRIA website (www.ciria.org/flooding).

In cases of flooding from the sea, saltwater can lead to corrosion of metallic fittings, including metal ducting and switch boxes, and steel reinforcement within reinforced concrete. The insurance industry has estimated that saltwater flooding can increase flood damage repair costs by around 10%.

Other issues

Flooding can also damage property outside the building, such as cars, garages, sheds, garden furniture, gardening equipment and garden fences. Patio paving may need to be relaid, and garden ponds cleaned out and restocked.

Rats and other wildlife may also take shelter in property in or near flooded areas.

While some furniture, fittings and personal possessions may dry out after exposure to floodwater they may be permanently stained.

CS | Case Study

“ We had seen the water rising outside and knew it would be inside soon but we expected it to come through the doorways” , said Carol Mawle from Banbury in Oxfordshire. “ I put towels down to block them but it did not help at all. As I heard gurgling noises from the walls I realised that the water filled the holes in the cavities and then it came through the skirting boards of the floor. It was eerie. One minute we were dry, the next minute we were walking on a moving carpet.”

By 3am she was forced to leave the bungalow. Her dogs were swimming in a river of sewage. “ We live so far away from the river that even in our wildest dreams we didn’t expect this to happen to us.” Carol and her husband returned to the bungalow at around 8am to see the water receding and the dirt, covering everything like a layer of film, became visible. “ The shock doesn’t hit you until you realise that it wasn’t something that would disappear in a day” , continues Carol. “ Getting water out of your house is relatively easy, the problem starts when you’re left with everything wet and ruined. The initial damage is nothing compared to the problems coping afterwards.”

Carol was lucky because she had an insurance policy that covered her household and its contents. “ We lost everything. All our clothes, shoes, videos, cameras, kitchen electrical equipment, fridge, washing machine, dishwasher, all lost. I did a lot of tapestries as a hobby, they were all gone too, as they were kept in the bottom drawer.”

The only things Carol saved was the television and video recorder, as she had put them on the bed when the water first started to seep in, plus, the kitchen chairs which went on top of the kitchen table, and a set of glass coffee tables.

“ The biggest loss was my photographs – favourite moments of the years gone by were lost and you cannot bring them back. I also had a painting from someone who has since died and although it did not get destroyed, it has watermarks on it and the paint is peeling.”

“You work over the years and save up to buy bit by bit, so the reward of your work is visible in your surroundings. In 24 hours it’s all wiped out, all gone.”

Carol’s insurance policy covered the damage so she could get the bungalow renovated and decorated and was able to buy new furnishings, equipment and furniture, but she says it is not the same living in a home without the memories.

“ You work over the years and save up to buy bit by bit, so the reward of your work is visible in your surroundings. In 24 hours it’s all wiped out, all gone. We could at least pay for everything from the insurance money but I know others might not be so lucky as they might choose not to include everything in the policy.”

Carol is more careful now and she keeps her personal belongings in top drawers and cupboards. The floods hit her bungalow too fast to even think of what she should do to reduce the damage. Now she knows that if she had put her photographs, paintings and most precious and valuable belongings up high she could have saved them. “ There’s only so much you can do in a state of shock, especially in a bungalow. This is why it is most important to be prepared.”

Source: Environment Agency

CS | Case Study

Flooding can happen without much warning, as residents in Edinburgh's Stockbridge area found out in April 2000. However, they have used the experience to their benefit and have formed an action group to educate themselves on all aspects of flooding to help prevent them from being caught out again.

Built around 1860 to provide housing away from the slums of Edinburgh, the Stockbridge Colonies have a village air with rows of neat Victorian B listed two-storey flats. Although the current residents, around 380 in all, are modern city dwellers who relish the culture that Edinburgh provides, not much has changed the peace and tranquillity of the area over the past 140 years. Until one rainy night in April 2000 that is...

The rain started gently but by next day had turned into a downpour. Residents near the River Leith could see that it was rising fast. People were concerned but the river had always been there and it had never flooded for at least 120 years. Why would this one be any different? However, by one o'clock in the morning the peace of the area was shattered. A number of streets were in chaos as residents struggled to find sandbags to protect their property from the rising water, with some even digging up their gardens and putting the earth in black plastic bags to keep the water out of their homes.

The next morning those who had been flooded returned to witness what remained of their properties. Although only a few streets in the area had been hit badly, 50 people had been made homeless. One ground floor flat had only six inches of water throughout but it took a dehumidifier over 2 months, 24 hours a day to dry out the plaster on the walls. People still find it hard to talk about the irreplaceable personal possessions lost. Over a year later, only 75 percent of those left homeless were back in their homes with the others still waiting for rebuilding work to be completed.

*On a bright sunny day it is
hard to believe that the
floods really happened.*

While the peaceful ambience of the area has returned, the experience has left the inhabitants determined to take action. The local residents association spoke to other local victims of flooding in Edinburgh about their experiences and in December 2000 the Edinburgh Flood Prevention Group was formed. To date the group has had presentations from SEPA hydrologists, Edinburgh City Council, Scottish Natural Heritage and an insurance company. For those who can't attend the meetings, Newsline, a neighbourhood newsletter provides the 380 flats with all the information they need to know. On a bright sunny day it is hard to believe that the floods really happened. The group feel that way too but are determined to keep the momentum of the flood education programme going so that their experiences and the lessons learned are not forgotten.

Source: Scottish Environmental Protection Agency

3 | Existing Property Owners

Assessing the risk of flooding

Before considering ways to protect your property against flooding it is essential to assess the flood risk.

Flood risk for a property is a combination of both the likelihood of flooding occurring (how likely is it that flooding will affect the property?) and the consequence of flooding (what is the potential damage or impact that could be caused?) The higher the likelihood and impact of flooding, the higher the level of flood risk.

Once the level of flood risk for the property is understood, more effective decisions can be made about the type of flood protection measures to install.

How to assess the likelihood of flooding

To assess the likelihood or probability of flooding affecting your property, first consider the surrounding area:

- Is the property near a river, stream or ditch?
- Is the land in a hollow or at the bottom of a hill where floodwater could collect?
- Is the area at risk from flooding from the sea?
- Is the area at risk from groundwater flooding?
- Do river or coastal flood defences protect your property?

As much information as possible should also be obtained on the **history of flooding** in your area.

- How many floods have occurred in your local area in the past and what were the flood levels in relation to your property? You may have direct experience of flooding in your property, but you should also be aware of previous floods that happened before you moved in, that may have reached even higher levels.

An important source of information will be your friends and neighbours who have lived in the area for a long time, community groups, parish councils and flood action groups.

- What was the source of the flooding? For example from rivers, the sea or localised flooding from blocked or overloaded drains or sewers?
- Is the property protected by existing river or coastal flood defences? Have there been any recent improvement works that may have reduced your flood risk, and are any further works planned?

Where can I find information on flood history?

There are a number of sources of information depending on the type and severity of flooding.

An important source of information will be your friends and neighbours who have lived in the area for a long time, community groups, parish councils and flood action groups. It may also be worth a visit to the local history section of your local library to look for old photographs and reports.

This source of information is very important if you are new to the area or if your property was only built recently, as the local community will have historic knowledge of the area before the development.

You can also contact the following organisations for information:

The Environment Agency

The Environment Agency works to prevent development in flood prone areas and in locations that may increase the risk of flooding to others. The operational role of the Agency is to provide a flood warning service for flooding from rivers and the sea in England and Wales, working together with the emergency services and local authorities when flooding occurs. It provides and maintains flood defences along more than 34,000 km of rivers and coastline. The Agency operates a 24 hour **Floodline service on 0845 988 1188** that provides a useful source of information when investigating whether a particular location is at risk of flooding. You can also call Floodline and listen to any flood warnings that are in force in your area. Trained Floodline operators can also provide you with immediate practical advice on what to do before, during and after a flood.

The maps use the best information available based on historical flood records and computer models of river flows. They indicate where there may be a risk of flooding from rivers, streams, other watercourses or from the sea.

The Environment Agency's indicative floodplain maps provide a general overview of areas of land in natural floodplains that are at risk of flooding from rivers or the sea. The maps use the best information available based on historical flood records and computer models of river flows. They indicate where there may be a risk of flooding from rivers, streams, other watercourses or from the sea. However, these maps do not cover flooding from other sources such as groundwater flooding, burst water mains, road drains, run-off from hillsides, or sewer overflows, as this type of flooding can occur almost anywhere depending on the pattern of rainfall. The maps indicate the risk of flooding within the natural floodplain and do not take account of protection provided by man made flood defences.

Flood mapping is not a precise science. The maps only provide an indication of areas that could flood in the event of extremely bad weather. For example, they show the extent of river flooding that could occur once in 100 years – or in other words a flood with a 1 per cent chance of happening in any one year. For flooding from the sea and tidal estuaries, the maps indicate a 1 in 200 year return period, i.e. a flood with a 0.5 per cent chance of happening in any one year. It is important to remember that return periods are averages. Floods can occur in successive years or more than once in one year – the risk remains there all the time. For example there were 30 floods in the 30 months between December 1997 and June 2000.

For further information call the Environment Agency's **Floodline** on 0845 988 1188 or visit their website (www.environment-agency.gov.uk/floodline). The indicative floodplain maps can be viewed on the website or obtained from Agency local offices through Floodline.

In areas of particular risk, the Environment Agency can send a warning message direct to people at home or at work by telephone, fax or pager using an Automatic Voice Messaging (AVM) system.

Flood warnings

The Environment Agency provides a flood warning service in England and Wales and supports the public taking action to prepare and respond when these warnings are issued. The warnings are provided for flooding from rivers and the sea but not for localised flash flooding that cannot be predicted, for example from blocked or overloaded sewers or local groundwater flooding.

The Environment Agency issues warnings through the media on TV and radio weather bulletins and on its website (www.environment-agency.gov.uk/floodline). In areas of particular risk, the Environment Agency can send a warning message direct to people at home or at work by telephone, fax or pager using an Automatic Voice Messaging (AVM) system. Sirens and flood warden schemes may also operate, particularly in flood prone urban areas.

The Environment Agency's Floodline 0845 988 1188 service for England and Wales carries recorded information on flood warnings in force anywhere in England and Wales. The information is regularly updated and is available 24 hours a day.

The Floodline service which has been operational in England and Wales for several years has now been extended by the Scottish Environment Protection Agency (SEPA) to cover the whole of Scotland. As well as providing the latest information on the possible risk of flooding throughout Scotland 24 hours a day, anyone concerned about flooding can call the Floodline service for general advice and guidance on flooding. In a similar role to that of the Environment Agency in England and Wales, SEPA seek to avoid inappropriate development within the floodplain that could lead to increased flood risk.

Local authorities and building control bodies

Local planning authorities can also provide a range of useful information. They have a number of plans and documents that provide information on local flood defences and land-use planning and should also have

Local authorities provide and maintain flood defences on local watercourses and are responsible for controlling development within the floodplain and elsewhere within river catchments.

information on past flooding events. Local authorities provide and maintain flood defences on local watercourses and are responsible for controlling development within the floodplain and elsewhere within river catchments. The Building Control and Highway departments (or approved private sector bodies) may have information on more localised floods such as those caused by ditches, streams and the local drainage system. Water and sewerage companies may also be able to provide information on localised flooding from sewers.

Are flooding measures required?

If a property is at very low risk of flooding then steps to improve flood resistance are clearly unnecessary. The following list of general questions can help to assess whether flood protection measures, as set out later within this guide, are worth considering for a particular property:

- Has the property or surrounding land and gardens ever flooded in the past?
- Have neighbouring properties ever flooded?
- Is the property in a floodplain?
- Has the property been issued with a flood warning?
- Is the property close to a surface water drainage ditch or stream that could overflow?
- Is the property in a hollow or low-lying area?
- Is the property protected by river or coastal defences?

If you have answered “No” to all of these questions the risk of flooding affecting your property is small and flood resistance measures are unlikely to be necessary. Conversely if you have answered “Yes” to one or more of these questions then implementing some of the measures outlined in this guide may well be beneficial.

The potential flood repair costs associated with the building, and replacement costs for personal possessions and business stock, can only be considered once the likely frequency and depth of flooding are known.

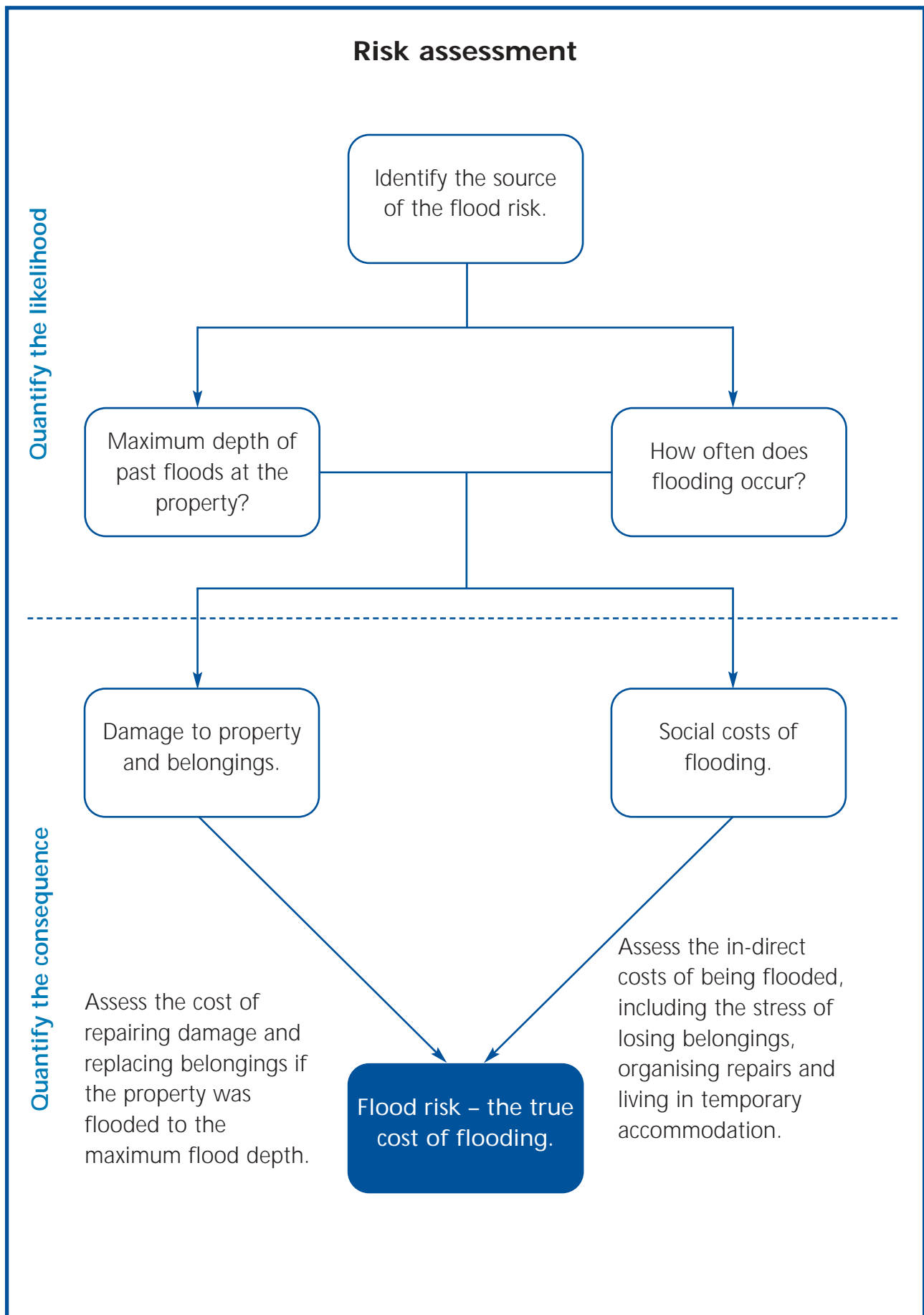
The consequences of flooding

The consequences or impacts of flooding in terms of flood damage and the associated stress caused by flooding have been discussed above in Section 2. The potential flood repair costs associated with the building, and replacement costs for personal possessions and business stock, can only be considered once the likely frequency and depth of flooding are known.

A summary of the key elements in assessing the flood risk for a particular domestic or small business property are illustrated by the flowchart on page 31.

Deciding what flood level to defend against

The following sections within this guide discuss the measures that can be taken to protect property against flooding. The measure or combination of measures chosen will depend upon the depth to which the property could be flooded and the flooding frequency. The case study on page 32 gives an actual example of how a householder has assessed the flood risk for her property and the appropriate level of protection to adopt.



CS | Case Study

“When the floods of autumn 2000 brought 0.5 metres of water into my house, I thought it would be wise to look at river levels over a longer period than I had personally experienced, and decide what steps I could reasonably take to minimise damage from flooding”, said Bewdley resident Gill Holland. “If I was going to move the electrical sockets, meters and boiler above the flood level, how was I going to decide how high they should go?”

“It was soon obvious that the records that had been carefully made by the police and borough council were no longer in existence. I phoned the Environment Agency and found that their flood warning section could send me a graph of local flood levels going back to 1925. If I had wanted information on Shrewsbury or Worcester, that would have gone back even further, 300 years or so. I think on the whole 75 years (a lifetime) is enough to give an idea of the extremes. I was delighted to find that the exact information I wanted was freely available. The office couldn't have been more helpful. The graph is very sobering. The normal pattern is for regular flooding of houses in the town. The floods are not exactly cyclical, but the peaks seem to be bunched into groups. The flood of 1947, 0.28 metres above the level I have just experienced, is always quoted locally as the worst in living memory. The level reached in 1946 was only a little less but is never mentioned.”

“To find out the effect that such a major flood had on the community, I went to look at copies of the local papers, which are held on microfilm at a local branch of the county library. These make fascinating reading, if only to put things in proportion. The County Record Office has, in our case, very little written evidence on floods, but better photographic evidence. The local Civic Society also has a large collection of old photographs of the town which give an accurate idea of the extent of the water up the main street in 1947.”

“I would now be sceptical about most verbal accounts of the height of the flood. After the 1947 flood, height markers were mounted on quite a few

Remember that all gas and electrical appliances that have come into contact with floodwater must be inspected by a qualified engineer before they are re-used.

houses. These were still there in the 1960s, but have by now all been taken down by occupiers keen to sell their properties. This has led to some wildly exaggerated claims of the flood height. People have described how the water was licking the ceilings of the houses, when it is clear that it could not have been much more than halfway up the windows. With this in mind, I think I should be looking not just at the 2000 level, which was 0.5 metres in my house, but should think how I would survive at least the 1947 level which was 0.78 metres. This is the level, which the Environment Agency is taking as the 1 in 100 year flood in my area, and up to last year seemed improbable. I am not so certain now."

"Some precautions are easily taken. It is not that expensive or inconvenient to have sockets a metre off floor level. Moving an electric meter is more expensive, but worth it to maintain supply upstairs for heating and lighting during and after a flood. Moving my existing gas boiler would be more difficult, as the plumbing system sets a limit on how high you can raise it. It seems at this stage better to leave it in position until it suffers one flood too many and it can't be resuscitated, and then replace it with a smaller, more efficient modern boiler set higher up, or even on the first floor. I think you're likely to review your own situation in a different way, depending on what you can afford, your lifestyle, and indeed how you see the risks during your lifetime but through some simple research and fact finding, you can significantly reduce the consequences of your property being flooded."

Source: Gillian Holland

Prepare a Flood Plan!

As well as the measures set out later in this guide to make the property more flood resistant, it is also essential to prepare a flood plan so that you know what immediate steps to take should a flood occur. The Environment Agency has produced a number of useful checklists which are included at the end of this guide in Section 8. Updated versions can be found on the Floodline website.

CS | Case Study

Carpets will normally need to be replaced following immersion in floodwater although specialist cleaning services are available. Consider using loose fitting rugs that can be moved and stored upstairs before flooding occurs.

Roger Dixon, a solicitor, is no stranger to the misery a flood can bring. In March 1999 his office at Stamford Bridge was flooded for a week when the River Derwent burst its banks. More than a year on, an industrial dehumidifier was still at work in the building.

Before the Stamford Bridge flood, his firm in Cumberland Street, York, was seriously damaged by floods in 1981 causing loss of business and huge insurance claims. Since then the office has suffered flooding two or three more times. "Stamford Bridge was unaffected – but it was touch and go at the York office. There was about three inches to go before the undercroft would have flooded. But we had our contingency plans in place," said Roger.

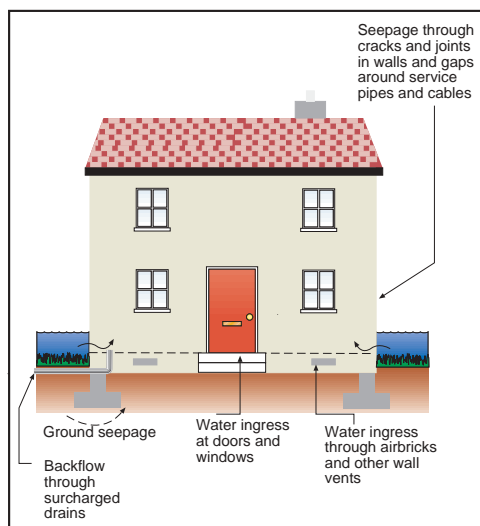
Since being flooded in the 1980s, the firm has adopted a 'be prepared' policy. Storm lanterns, non-electric heaters and camping stoves are all kept at the offices.

"Floods do happen to you," said Roger. "No-one is to blame for the elements but with an advanced warning system and a flood plan you can minimise the damage. When it rains heavily now, we don't just sit there remarking on the weather. We have a team of people responsible for finding out exactly what's happening weather-wise". We have educated ourselves and we can generally work out how high the river is likely to rise and what the critical levels are. We know what organisations are responsible for what and we take action."

Source: Environment Agency

Choosing the right options

Once the flood risk has been assessed the measures for protecting the property can be considered. It is essential that the nature and depth of flooding is properly assessed before any improvement measures are considered, otherwise the most appropriate and cost effective option for the property may not be chosen. Information related to this is given on the CIRIA website (www.ciria.org/flooding) in a series of advice sheets on improving the overall flood resistance of a property, and in the Environment Agency leaflet 'Flood Products', which is available through Floodline 0845 988 1188.



Where can floodwater enter my property?

Floodwater can find its way into properties through a variety of routes including:

- Ingress around closed doorways.
- Ingress through airbricks and up through the ground floor.
- Backflow through overloaded sewers discharging inside the property through ground floor toilets and sinks.
- Seepage through the external walls.
- Seepage through the ground and up through the ground floor.
- Ingress around cable services through external walls.

To reduce the likelihood of floodwater entering the property it is important to identify where the potential points of entry are located. The flooding routes will depend on the type of construction, the underlying ground conditions and the expected flood depth.

For example airbricks below ground floor level are normally only found in properties with suspended floors to allow the void under the floor to be ventilated. Other wall vents above the ground floor are likely to be present if gas appliances are in the room. If sinks and downstairs toilets are located below the expected flood depth it is possible that floodwater will flow back through the sewers and into the property, unless non-return valves are installed.

Seepage through the external walls will depend upon the flooding duration and the type of construction and condition of the wall. Water will tend to find its way through weak points within the wall such as cracks and voids in the mortar jointing, brickwork or rendering. For semidetached and terraced houses it is important to remember that floodwater may also seep through adjoining party walls with neighbouring properties, above or below floor level.

Depending on the permeability of the ground under the property, floodwater may seep through the ground and up through gaps or cracks in floors or other weak points. The actual rate of seepage is difficult to estimate, as this will depend on the type of ground, the duration of the flooding and the construction of the property.

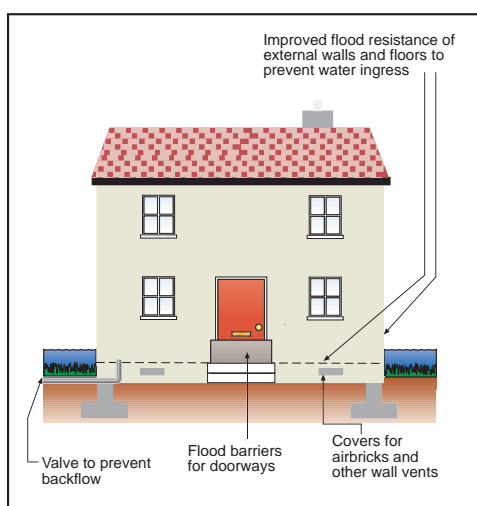
If your property has flooded in the past then you may already know where the entry points are located but it is recommended that these are reconsidered carefully before any measures to reduce the impact of flooding are taken.

What measures could be taken to improve the flood resistance of the property?

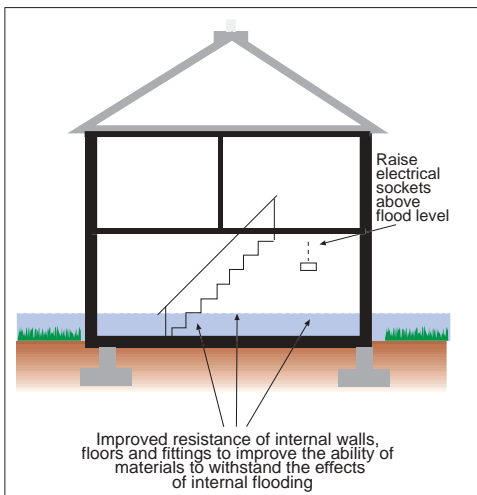
There are many measures that can be taken to reduce the impact of flooding on the home or business property. These measures generally fall within two main categories, those that are taken to keep water out of the building, often called **dry-proofing** measures, and those to improve the ability of the property to withstand the effects of flooding once water has entered the building, known as **wet-proofing**.

Dry-proofing measures include moveable flood protection barriers for doorways, low level windows and other openings that can be installed before the arrival of floodwaters, and the installation of non-return valves on sewers to prevent backflow.

Dry-proof measures



Wet-proof measures



Wet-proofing measures include the use of flood resistant building materials within walls and floors and in other parts of the structure, and the raising of electrical wiring above flood levels.

The measure or combination of measures chosen will be dependent on the depth and frequency of flooding. The following sections provide more detail on the measures available for both keeping the water out of the property (dry-proofing) and improving the flood resistance of the building elements (wet-proofing). It is recommended that all the dry-proofing and wet-proofing systems mentioned in this guide are considered so that the most appropriate measures for your particular circumstances can be identified.

Cost implications of flood protection measures

The cost of improving the flood protection of a property will vary depending on many factors including the flood depth, property size, construction type, internal finishes, and the location and type of fittings and services. It is therefore difficult to provide any meaningful cost figures within this guide for comparative purposes, however some useful information is given in the ABI 2003 report on the cost and effectiveness of flood resistant measures.

When considering flood resistance measures the costs of installation needs to be weighed against the potential cost savings that such measures could provide in terms of reduced repair costs, lower temporary accommodation charges, and reduced business losses following future flood events.

In the majority of cases taking steps to improve the flood resistance of properties at risk of flooding will provide long term financial cost savings in addition to reduced levels of stress experienced when flooding occurs.

Property audit table

Before considering the various measures set out in the following sections of this guide, the following table can be used as a simple property audit to help identify which measures may be appropriate for your property.

In the majority of cases taking steps to improve the flood resistance of properties at risk of flooding will provide long term financial cost savings in addition to reduced levels of stress experienced when flooding occurs.

Question	Consequence
House type? <ul style="list-style-type: none"> • Detached. • Semidetached. • Terrace. • Bungalow. 	For semidetached and terraced houses, floodwater may seep through adjoining party walls. In bungalows it will be more difficult to move personal possessions above the flood level.
Ground type? <ul style="list-style-type: none"> • Permeable (Chalk or gravel). • Impermeable (clay soils). 	With permeable ground conditions floodwater is more likely to seep up through floors, and flood barriers are less likely to be effective (Section 4).
Routes of entry for floodwater? <ul style="list-style-type: none"> • How many external doors are there? • Do you have patio doors? • Is there a connecting door to the garage? • Do you have a conservatory? • Are there any airbricks or vents below the flood level? • Are there any cables or pipes passing through the walls? 	Standard flood barriers are available for doors, windows and airbricks. Longer span barriers will be needed for larger windows and patio doors. It may not be possible to preventing floodwater entering conservatories.
Do you have a basement or cellar?	Specialist advice must be obtained before undertaking any measures to prevent water ingress to basements (Section 5).
Condition of external walls?	Cracks to walls and render can be repaired to reduce floodwater seepage.
Type of external wall? <ul style="list-style-type: none"> • Solid masonry, cavity, timber-framed, half-timbered. Type of internal wall? <ul style="list-style-type: none"> • Solid masonry, stud partitions, timber framed. 	The type of wall and surface finish affects the type of flood resistance measures that can be carried out. More detailed advice is given later under Section 5.
Type of external wall finish? <ul style="list-style-type: none"> • Painted or rendered. Type of internal wall finishes? <ul style="list-style-type: none"> • Plaster, plasterboard. • Painted, wallpapered. 	
Floor type? <ul style="list-style-type: none"> • Suspended timber, solid concrete, suspended concrete. 	
Fittings and services? <ul style="list-style-type: none"> • Height of boiler, consumer unit (fuse box), electrical sockets and gas meter above flood level? • Type of kitchen units/cupboards? 	Services can be raised above flood levels. Kitchen units of chipboard or MDF usually require replacement if exposed to floodwater. Units can be raised on plastic legs. More detailed advice is given later under Section 5.

Keeping the water out using flood barriers

Introduction

Keeping water out of a property, or limiting the ingress of floodwater, should always be the first priority when considering flood protection measures. Excluding water will help to reduce damage to the internal fabric of the building and its contents thus reducing the associated stress and suffering of householders and business users. These measures are often called dry-proofing and include:

- Temporary flood barriers.
- Measures to reduce seepage through walls and floors.
- The installation of non-return valves on sewers.

Movable flood barriers can be very effective in preventing or reducing the volume of floodwater entering through doors and other external openings in walls, such as windows and airbricks, as long as a good quality product is installed in accordance with the manufacturer's instructions.

Although barriers may not totally prevent the ingress of water into a building, as seepage may still occur through the floor or walls, they can provide valuable time in which to move personal possessions to higher levels before floodwater rises inside the building. Flood barriers on wall openings can also reduce the amount of contaminated silt and debris entering the property. Water that seeps through the ground or walls is likely to be filtered to some extent and therefore is usually cleaner than floodwater entering larger openings such as gaps around doors and airbricks.

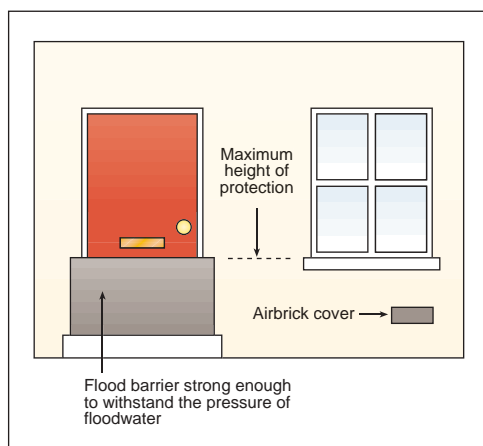
Permanent measures to reduce seepage through walls and floors are covered later within this guide under Section 5. The actual rate of seepage will depend upon the building's construction, the ground conditions and the duration of flooding. It should

Excluding water will help to reduce damage to the internal fabric of the building and its contents thus reducing the associated stress and suffering of householders and business users.

also be remembered that in certain circumstances floodwater can backflow through sewers into properties unless non-return valves are installed. Guidance on the installation of these valves is also included in Section 5.

Taking action to erect flood barriers

Although temporary barriers have a number of benefits they rely on the householder taking positive action in good time **before the floodwaters arrive**. If householders or business users are away from the property at the time of the flooding (for example on holiday), or if the barriers are not erected quickly enough following a flood warning, such temporary measures will provide no protection against flooding. Barriers may also not be suitable for use by vulnerable members of society who are not physically able to use them unless friends or family are at hand to help.



Remove all barriers after use!

Once the floodwaters have subsided it is very important that all temporary covers to airbricks and other vents through external walls are removed. Airbricks play a vital role in providing a flow of air beneath suspended floors to prevent condensation and possible decay of the structure. They are also required to disperse any build up of dangerous gases that could collect within the sub-floor void.

Vents through external walls are often required above floor level in rooms with gas appliances to avoid any dangerous build up of carbon monoxide. Flood barriers to such vents must be removed before gas appliances are switched back on. Keep a list of all vents that have been temporarily blocked before the flood so that they can be removed after the floodwater recedes, but keep listening for further flood warnings from the Environment Agency.

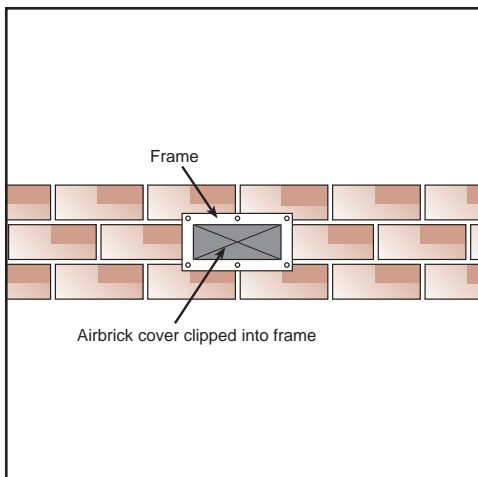
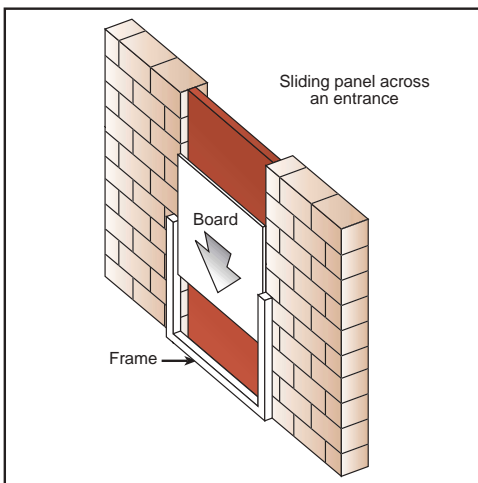
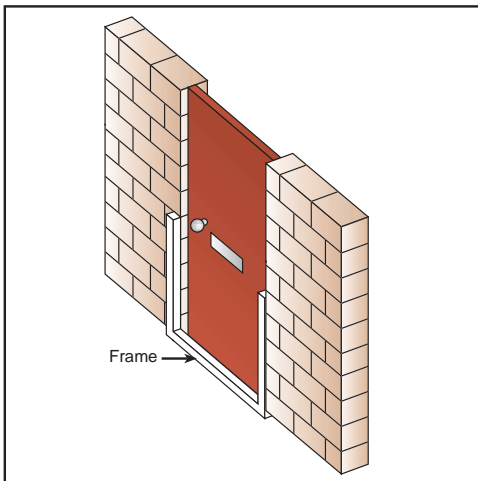
What is the maximum barrier height?

When deciding whether to install flood barriers it is important to consider the expected flooding depth.

Care must be taken to ensure that the external walls of your property are strong enough to withstand the weight of floodwater, which increases with depth. For example floodwater 1 metre deep on the outside a building (with no water inside the property) will exert a force of around half a tonne on an external door.

For most properties the external walls should have sufficient strength to retain flood depths up to 900mm (3 feet) above external ground level, with no water inside the building. However, the actual water level that can be safely retained by the external walls will depend upon the construction, age and condition of the walls. For expected flood depths between 600mm and 900mm above external ground level (2 to 3 feet) it is recommended that the external walls are inspected by a qualified building surveyor, architect or structural engineer, before any barrier system is installed. Similarly windows and patio doors have limited strength and must not be relied upon to withstand the pressure of floodwater, unless they are also protected with a robust barrier system. Floodwater can burst through unprotected windows and glazed doors.

If the maximum expected flood level is above the safe retention level for the walls (normally up to 3 ft) it has to be accepted that floodwater will enter the property should a flooding event of this magnitude occur. However, it should be borne in mind that flooding depths vary in accordance with weather conditions. Therefore although the maximum expected flooding event may be above the safe retention level, flood barriers may still be effective for other shallower flooding events below this level. The variability in flood depth is therefore another key issue when deciding whether temporary flood barriers are suitable for your property.



What types of barrier system are available?

There are a number of flood barrier products available in the UK (see Environment Agency leaflet on 'Flood Products'). The main types are as follows:

Barriers for external doors

Barriers for external doors usually take the form of plastic or aluminium flood boards that can be quickly installed across a doorway in advance of floodwaters arriving. The flood boards normally slide into a frame attached around the doorframe to provide a watertight seal. After the floodwater has receded the boards can then be removed, cleaned and stored for re-use.

Barriers for windows and patio doors

Barriers for windows and patio doors are similar to those for external doors. Flood boards, or beams for wider openings, are normally dropped into a frame attached around the opening. Such systems can also be used for shop windows and garage doors.

Airbrick covers

A number of plastic covers are available that can be fixed over airbricks and other vents in external walls. Such covers are usually clipped into a frame fixed around the airbrick or vent opening. As discussed above it is very important to remove such barriers once floodwaters have subsided.

Flexible skirting systems

As well as flood barriers for doors, windows and airbricks, more advanced systems are available for enclosing the bottom 600mm to 900mm of buildings with flexible plastic skirting to prevent the ingress of floodwater. The plastic skirting can be housed in underground ducts and then lifted up to protect the walls in advance of a flood. Such methods are likely to be expensive to install but could be beneficial in certain circumstances, such as for detached properties that are regularly flooded.

When choosing a barrier system make sure that the product is suitable for sealing the type of openings on your property, and is adequate to withstand the maximum expected flood depth.

Flood barrier manufacturers

Contact details for manufacturers of temporary barrier systems are listed on the National Flood Forum's website (www.floodforum.org.uk). Those with the Kitemark are listed on the Environment Agency's website (www.environment-agency.gov.uk/floodline).

It is recommended that a number of manufacturers are approached so that the most appropriate system for the property can be identified. When choosing a barrier system make sure that the product is suitable for sealing the type of openings on your property, and is adequate to withstand the maximum expected flood depth. Ask for a demonstration before purchasing any system to ensure it can be fitted quickly and effectively.

Standards for flood protection products

A new British Kitemark standard has been established for the flood protection products described above, as well as for temporary freestanding barriers (see below). The Kitemark award certifies that the product has been rigorously tested to ensure that it is fit for purpose if installed and used in accordance with the manufacturer's or supplier's instructions.

Sandbags

As well as manufactured flood barrier products, sandbags can be effective in reducing the ingress of floodwater into buildings and are still widely used. The Environment Agency has produced separate advice on how sandbags should be used, and on alternatives such as earth filled bags. Details can be found within the Agency's leaflet 'Damage Limitation' and on their Floodline website. The leaflet also gives advice on how to make home-made flood boards.

Temporary freestanding flood barriers erected away from buildings

All the barrier solutions described above are for installation around single buildings, to block doors, windows, and other wall openings.

In addition to these measures for single buildings, there are a number of available barrier systems that can be erected away from buildings to protect groups of properties or surrounding land and gardens. Guidance on the use of these types of remote barrier is provided in the Environment Agency leaflet on 'Flood products' and the separate guide on 'Temporary and Demountable Defences'. Such barrier systems require careful selection and installation.

The Environment Agency has produced separate advice on how sandbags should be used, and on alternatives such as earth filled bags.

In certain circumstances where investment in conventional flood defences cannot be justified economically, or where there is an immediate need for protection, local authorities may consider the use of such temporary barriers to protect small groups of existing properties.

National Flood Forum

The National Flood Forum are a national organisation working with and representing those at risk of flooding. They can offer support to those affected by flooding including general information about all types of flood products, possible sources of help and strategies for coping. Visit the NFF website (www.floodforum.org.uk) or contact them on 01299 403055.

Other permanent measures to improve flood resistance of property

As discussed above it has to be accepted that floodwaters will enter a property if the flood depth is greater than the safe retention height for temporary barriers. Even in areas of shallow flooding, water may still enter properties unless suitable barrier systems can be put in place in good time. Seepage is also likely to occur through floors and walls depending on the type of construction, the ground conditions and the duration of flooding.

In these circumstances, due to excessive flood depth, uncertainty over whether barrier systems could be installed in time, or seepage through floors and walls, there are a number of measures that can be taken to improve the flood resistance of the internal building elements. These measures, often described as wet-proofing, can significantly reduce the cost of repairs following internal property flooding and can speed up restoration times. There are two main occasions when householders or business owners might consider adopting these measures:

- 1) When restoring a building after it has been flooded.
- 2) As part of planned improvement works, including new extensions.

After a property has been flooded the opportunity can be taken to replace damaged elements such as wall plaster, flooring materials and kitchen units with more flood resistant materials. Should flooding occur again the property will then suffer less damage and should dry out more quickly.

Similarly if you have suffered from flooding in the past or live in an area at risk of flooding and you are planning to carry out improvement works such as a new kitchen, or extension, this would be a good time to build in flood resistant measures.

The different elements of the building fabric that can be improved to resist the effects of flooding are discussed in detail under Section 5.

After a property has been flooded the opportunity can be taken to replace damaged elements such as wall plaster, flooring materials and kitchen units with more flood resistant materials.

Many of the properties affected by the autumn 2000 floods were historic buildings. These can be statutory listed buildings, unlisted buildings in conservation areas, locally listed buildings or buildings of architectural or historic interest.

It should be noted that the guidance provided within Section 5 is of a more technical nature than previous sections. Professional advice should always be obtained before any improvement measures included within this guide are carried out. When handling building materials care should also be taken to follow manufacturer's health and safety instructions.

Building warranties

If you live in a new house that has been built within the last 10 years, your property may have insurance cover for protection against building defects, such as 'Buildmark' cover given by the National House Building Council (NHBC). Similar cover may also apply to new extensions.

If this type of insurance applies to your property, it is important to read the terms of the policy and check with the insurance provider before carrying out any measures to improve flood resistance.

Historic buildings

Many of the properties affected by the autumn 2000 floods were historic buildings. These can be statutory listed buildings, unlisted buildings in conservation areas, locally listed buildings or buildings of architectural or historic interest. These properties are often more vulnerable to flood damage, particularly the stone-work, brick and mortar walls, timber frames, wattle-and-daub panels, timber boarding and panelling, earthen walls and floors, plaster, ceilings and many decorative finishes.

English Heritage is currently producing guidance in the form of a Technical Advisory Note (Flooding and Historic Buildings) for those whose property may be at risk from flooding. Interim guidance for historic buildings is already available on the English Heritage website: (www.english-heritage.org.uk). The equivalent bodies to English Heritage in Scotland and Wales are Historic Scotland and Cadw (Welsh Heritage).

The following section summarises some of the key points raised by English Heritage but it is recommended that the local authority conservation officer should be contacted in the first instance if a historic property has been, or is likely to be, inundated by floodwater.

Historic materials that may appear to be beyond restoration can often be restored and reused cost effectively.

- Flood protection measures must not damage the special interest or the integrity of the building. In particular, the existing structure, materials and appearance must be retained and respected. The materials and techniques used should be traditional and compatible with existing ones and any alterations should be detectable and reversible.
- Works that materially affect the character or appearance of a listed building, be they flood prevention barrier installations, or the removal and replacement of parts of the building fabric following flooding, may require consent from the local planning authority. Early consultation beforehand is recommended. Similarly, works that affect the external character or appearance of unlisted buildings in conservation areas may need planning permission.
- Historic property owners need to be more aware of the extra damage that can be caused by the unauthorised removal and disposal of wet timber panelling and removal of plaster wall coverings from listed buildings. In some cases the flood damage responses advised by cleansing contractors, insurance companies and loss adjusters can result in further damage. It is recommended that your local planning department's conservation officer is consulted before consenting to any 'clean-up' or 'drying-out' work.
- Historic materials that may appear to be beyond restoration can often be restored and reused cost effectively. The first principle of good conservation is to retain as much authentic original fabric as possible.

- Grants for emergency works may be available from English Heritage for the conservation and repair of nationally important listed buildings after flooding, for specialist works not covered by owners' flood insurance. Advice should be sought from the local planning authority's conservation officer before contacting English Heritage's regional offices.

4 | New Development

Introduction

This section of the guide has been prepared to provide supplementary planning guidance for use by developers, local authorities, building control bodies and others involved with new development in areas of high flood risk, in support of the Government's new planning guidance on development and flood risk.

Planning Guidance

Planning Policy Guidance Note 25: Development and Flood Risk (PPG25) was published in July 2001 by the former Department for Transport, Local Government and the Regions (DTLR). The guidance, which applies only to England, explains how flood risk should be considered at all stages of the planning and development process in order to reduce future damage to property and loss of life. It guides all parties involved in the planning and development process.

PPG25 requires a precautionary approach to ensure that any development is safe and not exposed unnecessarily to flooding. The guidance also requires that run-off from development should not increase flood risk elsewhere in the catchment, and that development must not constrain the natural function of the flood plain, either by impeding flood flow or reducing storage capacity. New development should therefore be located in zones of little or no flood risk wherever possible.

Under PPG25 new building works within areas of flood risk are only permitted in exceptional cases where the risks are managed and adequate flood defence measures and/or flood resistant construction techniques are adopted. Developments should also incorporate sustainable drainage systems where practicable and other mitigation measures to avoid

New development in high flood risk zones should only be permitted where it can be reasonably demonstrated that lower risk alternatives are not available.

increasing the risk of flooding further downstream. The guidance within PPG25 takes a sequential risk-based approach. New development in high flood risk zones should only be permitted where it can be reasonably demonstrated that lower risk alternatives are not available. The developer must demonstrate to the local planning authority that the proposed development fulfils the above requirements.

In Scotland guidance is provided by National Planning Policy Guideline NPPG7 – Planning and Flooding which was published in 1995 and is available from the Scottish Executive. It provides guidance to planning authorities, developers and the public so that flood risk can be properly taken into account in development plans and development control. Scottish Planning Policy 7, Planning and Flooding, was issued for consultation in 2003 (SPP7). Separate advice on sustainable drainage is given in Planning Advice Note 61 – Planning Sustainable Drainage systems. In Wales new policy on development and flood risk is emerging through the revision of Technical Advice Note 15 Development and Flood Risk (TAN 15). SPP7 and TAN 15 are expected to be issued in final form during 2003.

General principles of flood resistant design for new development

Where new development is proposed within areas of high flood risk, measures are required to reduce the impact of flooding. Such development can include new buildings and extensions to existing properties.

Applications for planning permission should be accompanied by a detailed and robust flood risk and run-off assessment for the particular site within its hydrological context. This assessment must be based on up to date information to establish the likely speed with which flooding may occur, flow rates, water depth, duration and social and environmental impacts. Detailed guidance on how to undertake such a risk assessment is provided within PPG25 and by the SEPA Planning Authority Protocol. Completion

of the risk assessment is essential in order that the nature of flooding can be properly taken into account in the design process.

Ground floor levels

The most important measure that can be taken to reduce the impact of flooding is to **raise the minimum floor level of the property or development above expected flood levels**. The local planning authority has the power to impose a condition on planning permissions by specifying a **minimum ground floor level**.

The local planning authority has the power to impose a condition on planning permissions by specifying a minimum ground floor level.

Clearly there are practical limits to which ground floor raising can be employed if visually obtrusive development is to be avoided, but it is essential that floor levels are fully considered in the design and planning process. For example on a sloping site it would be preferable to develop residential housing on higher parts of the site above projected flood levels and to use lower lying areas for landscape or recreational areas. For flatter sites it may be possible to raise ground locally to form higher formation levels for new buildings while reducing levels elsewhere on the site in garden/landscape areas to avoid reducing floodplain storage volumes. Other options can include the provision of flood defences within the landscaping of the site provided flood storage volumes are not reduced.

Forms of construction

Some types of construction may present particular problems for developments in areas of flood risk unless specific measures are adopted. These include *single storey buildings* where occupants will be unable to move themselves or personal possessions to an upper level at times of flooding, and *basements* that could be inundated with floodwater.

Innovative designs where residential living areas are raised to first floor level may be appropriate in some cases, with the ground floor used as garages or

Solid concrete floors are preferable to suspended floor construction as they can provide an effective seal against water rising up through the floor, provided they are adequately designed.

storage accepting that floodwater will enter from time to time. However such designs may result in access problems when floodwaters rise.

The type of floor construction should also be considered. **Solid concrete floors** are preferable to suspended floor construction as they can provide an effective seal against water rising up through the floor, provided they are adequately designed. Solid concrete floors generally suffer less damage than suspended floors and are less expensive and faster to restore following exposure to floodwater.

Detailed measures to improve flood resistance

In addition to adopting appropriate forms of construction and establishing raised ground floor levels, consideration should also be given to improving the flood resistance of the building fabric so that flood damage is minimised and properties can be re-inhabited as quickly as possible after floodwaters have subsided. Detailed measures for walls, floors, building services and fittings are set out within Section 5 of this guide. To provide adequate flood protection for new development, local planning authorities may seek to require such measures by attaching conditions to planning permissions.

Interface with Building Regulations

The Building Regulations are made to secure reasonable standards of health and safety, welfare and convenience of people in and around buildings.

The Building Regulations cannot be made for purposes of property protection. However, where flooding may have implications for health or safety, appropriate guidance may be given in supporting documents.

5 | Permanent Measures to Reduce Flood Damage – New and Existing Properties

Introduction

This section of the guidance provides information on the wide range of permanent measures that can be undertaken to improve the flood resistance of new and existing buildings. These measures can help to reduce the extent of flood damage, thereby reducing repair costs and speeding up building restoration times. Four sub-sections are provided covering improvements to:

- External walls.
- Internal walls.
- Floors.
- Building services and fittings.

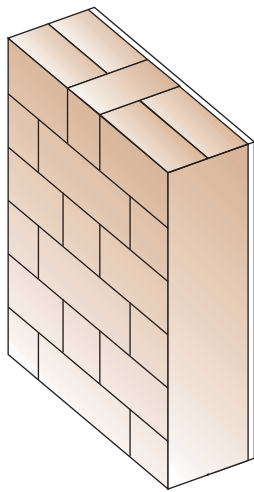
Whilst this section of the guidance is aimed principally at existing property owners it should also help to raise awareness of the flood resistance measures that can be adopted in the design and construction of new properties. Advice sheets on improving the overall flood resistance of a property are available on the CIRIA website (www.ciria.org/flooding). The use of temporary flood barrier systems for buildings is discussed in Section 3 and is not referred to within this part of the guide.

It should be noted that the guidance provided in this part of the guide is of a more technical nature than previous sections. Professional advice should always be obtained before any improvement measures contained within this guide are undertaken. When handling building materials care should also be taken to follow manufacturer's health and safety instructions.

Some flood resistance measures discussed within this section may require building control

It should be noted that the illustrations contained within this section of the guide are included to demonstrate the main differences between the most common wall and floor types found within domestic properties. They are not drawn to scale and are included for general information purposes only.

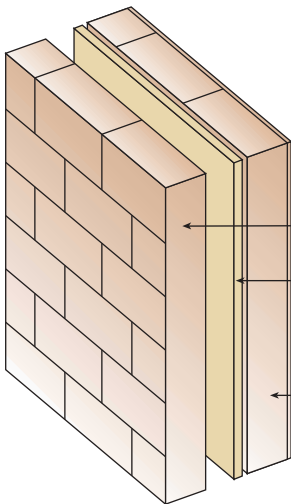
a) Solid walls



Solid wall of brick or blockwork, usually with inside finish of plaster

The external face is often rendered or painted to prevent rain/moisture penetration

b) Cavity walls

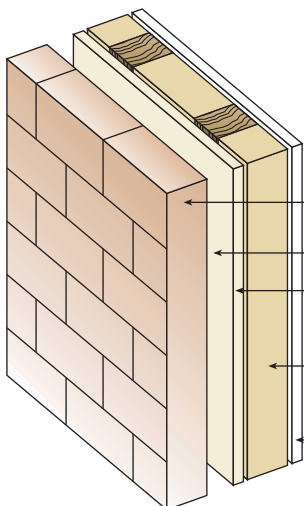


Outer leaf, normally of brick

Partial cavity fill insulation. Some walls may have no insulation or may be fully filled

Inner leaf of brick or blockwork, usually with a plastered finish

c) Timber-framed walls



Outer leaf, usually brick

Cavity

Plywood sheathing (with breather membrane)

Timber framing infilled with insulation

Plasterboard internal finish (with vapour membrane)

approval, depending on the type of property concerned. If in doubt advice should be sought from the local building control officer.

External walls

Introduction

A number of different external wall types are found within domestic and small business properties across the UK including solid masonry walls, cavity walls, timber-framed walls, and half-timbered walls. Before considering flood improvement measures it is necessary to establish the type of wall, if necessary by seeking professional advice.

Please note that guidance on improving the flood resistance of half-timbered walls, which are normally found in historic buildings, is not provided within this guide. English Heritage is currently producing guidance in the form of a Technical Advisory Note (see page 47).

The outside face of external walls

The outside face of most external walls is normally constructed of brickwork, which is either left exposed (fair faced), rendered and or/painted. For existing properties, cracks within the brickwork joints or render below the expected maximum flood level should be repaired to reduce the amount of seepage through the wall.

A variety of water-resistant paints and coatings (or tanking) are available that can help prevent floodwater soaking into the external face of the wall, thus allowing the wall to dry out more quickly. Specialist advice must always be obtained to ensure that the most appropriate system is chosen for the property. Coatings should be applied to 500mm above the maximum expected level of flooding. Any measures to improve water resistance must be compatible with the existing wall materials and must allow adequate water vapour transmission to avoid trapping moisture within the wall.

Consideration may be given to replacing gypsum plasters with more flood resistant materials.

For new properties the choice of materials including bricks, mortars and renders should be carefully considered to limit water penetration during flooding. Generally denser materials will provide greater flood resistance.

The outer leaf of a **timber-framed wall** is normally formed from masonry with or without a sand/cement render finish. Other cladding types, such as tiles, timber, plastic and metal sheeting, can also be found but these are often above the first floor level. Flooding is unlikely to damage these types of cladding, although some timber cladding boards may need to be replaced. All fixings should be corrosion resistant especially where there is a risk of seawater flooding.

The inside face of external walls

To improve the flood resistance of internal wall surfaces (assuming that floodwater will enter the building), there are a number of measures that can be taken depending on the type of wall and surface finish as follows.

Gypsum plaster

Solid and cavity masonry walls normally have an internal finish of plaster applied directly to the brick or blockwork. Gypsum based plaster on masonry walls is likely to deteriorate following repeated exposure to floodwater.

It is normal practice for gypsum plaster to be removed from the wall face after floodwaters have subsided to a level just above the flood tidemark. This is normally carried out regardless of the plaster's condition to allow the underlying masonry to dry out.

Consideration may be given to replacing gypsum plasters with more flood resistant materials such as:

- An internal water-resistant render and lime based plaster finish.
- Ceramic tiles: particularly in kitchen areas.
- Hydraulic lime coatings.

Following immersion in floodwater lime based plasters over a water resistant render should dry out quickly and should not deteriorate even if subjected to repeated exposure to floodwater.

Any new water resistant lining should be installed to a height of 500mm above the maximum expected flood level to prevent water being absorbed into the old lining above. For refurbishment works and new buildings it may be more cost effective to install the lining to ceiling level.

Lime based plaster

Lime based plaster products have good water resistance properties and once installed over a water resistant render, such as sand/cement or proprietary sealant, should provide effective resistance to flooding provided such finishes are applied in full accordance with the manufacturer's instructions. Following immersion in floodwater lime based plasters over a water resistant render should dry out quickly and should not deteriorate even if subjected to repeated exposure to floodwater. The water-resistant render beneath the plaster reduces water penetration into the underlying masonry, allowing the wall to dry out more quickly without the need to remove the plaster finish. Hence repair costs can be reduced.

Hydraulic lime

Hydraulic lime finishes with water resisting additives can also provide effective flood resistance for masonry walls, both internally and externally. As with lime based plaster, hydraulic lime coatings have good water resistance properties and can allow walls to dry out without the need for replacement following immersion in floodwater.

Ceramic tiles

Ceramic tiles can also provide a water-resistant surface and can reduce the volume of floodwater penetrating through to the masonry from the inside face of the wall. Tiled finishes should not need to be replaced following exposure to flooding provided a water resistant grout, suitable for the wall surface, is used in accordance with the manufacturer's instructions. Tiles should be laid over a sand/cement render to provide a flat wall surface. For flood protection purposes, tiles should not be placed over gypsum based plaster.

It is essential that specialist advice is obtained before any low permeability linings (such as those listed above) are applied, to ensure that moisture is not trapped within the wall, otherwise problems of damp may occur.

Fixings should be of galvanised/stainless steel or copper rather than mild steel materials which may rust and cause staining of wall surfaces.

Plasterboard (solid walls and cavity walls)

Solid masonry walls and cavity walls may have plasterboard finishes, often known as 'drylining'. Plasterboard has low flood resistance and will almost certainly need to be replaced following exposure to floodwater. Existing plasterboard on solid masonry walls can be replaced with a water resisting liner such as a lime based plaster, ceramic tiles or hydraulic lime coating as discussed above. Where this is not practicable plasterboard sheets can be placed horizontally rather than vertically. In the event of future flooding this can reduce the amount of plasterboard exposed to water damage, reducing the cost and time of repairs.

Fixings should be of galvanised/stainless steel or copper rather than mild steel materials which may rust and cause staining of wall surfaces.

Internal finishes of timber-framed walls

There are no practical options for improving the flood resistance of the internal face of a timber-framed wall. In most cases the plasterboard will need to be removed to allow the timber frame to dry out and the plasterboard sheets themselves will also normally suffer damage if exposed to floodwater.

Replacing plasterboard sheets horizontally on a timber framed wall is unlikely to be practicable due to the presence of the vapour control layer between the timber frame and the plasterboard lining. The vapour control layer prevents condensation from forming within the centre of the wall, avoiding possible decay of the timber frame. It is therefore essential that the vapour control layer is repaired during flood damage restoration works. Replacing plasterboard sheets horizontally would create problems in providing an effective joint in the vapour control layer.

Solid walls with plasterboard finishes may incorporate an internal layer of insulation between the masonry and plasterboard.

There is unlikely to be any benefit in replacing plasterboard with water resistant timber sheeting as this would still need to be removed to allow the timber frame to dry out thus, negating any potential cost savings.

Insulation materials and cavities

Solid masonry walls

Solid masonry walls in modern properties may have an external or internal layer of insulation.

Solid walls with plasterboard finishes may incorporate an internal layer of insulation between the masonry and plasterboard. Low absorption boards or semi-rigid self draining mineral wool batts to 500mm above the expected flood level should be considered rather than quilted insulation materials. Insulation bonded to plasterboard will usually need replacement if exposed to floodwater.

External insulation incorporating self-draining mineral fibre batts or boards or rigid plastic insulation is likely to be only temporarily affected by flooding and will ultimately dry out.

Cavity walls

Even if measures are taken to improve the water resistance of the outside face of the wall it is likely that some floodwater will seep through to the cavity, particularly in the case of long duration floods.

After repeated exposure to floodwater the steel wall ties between the internal and outer leaf of the wall may begin to corrode, particularly in cases of saltwater flooding. Wall tie corrosion can often be detected from signs of cracking within the mortar joints. Should corrosion be identified the ties should be replaced with stainless steel ties. Specialist advice from a qualified building surveyor will be required for the inspection and replacement of wall ties.

Existing insulation within a timber-framed wall will typically consist of highly absorbent mineral wool that is susceptible to flood damage. Such materials will need to be replaced after exposure to floodwater.

Stainless steel ties should be used in all new build properties at risk of flooding.

The thermal performance of some insulation materials may be reduced following saturation from floodwater, particularly lightweight blown-in materials. For existing properties such materials can be replaced with closed cell insulation foam, which is not water absorbent, but this can be a difficult and expensive task. Specialist advice from cavity-fill installers should be obtained to establish whether replacement is necessary and to identify the options available.

Timber-framed walls

Existing insulation within a timber-framed wall will typically consist of highly absorbent mineral wool that is susceptible to flood damage. Such materials will need to be replaced after exposure to floodwater. Other more flood resistant insulation materials are available but it is unlikely that using such materials would provide any cost benefit as they would normally still need to be removed in order to allow the timber frame to dry out.

Replacing damaged insulation with new mineral wool is likely to be the most cost effective option after the timber frame has been allowed to dry out accepting that the material will need to be replaced should flooding re-occur.

Sheathing fitted on the outside of the timber frame (normally plywood or oriented strand board) provides additional stability to the timber frame called racking resistance.

Fibreboard sheathing may become weakened as a result of flooding. If a structural assessment by a qualified engineer shows the racking resistance to be inadequate new WBP bonded plywood sheathing should be added to the inside of the frame.

The timber frame within the wall is unlikely to be adversely affected by flooding provided it dries out within a few weeks. The longer the timber remains wet the greater the risk of decay.

The timber frame within the wall is unlikely to be adversely affected by flooding provided it dries out within a few weeks. The longer the timber remains wet the greater the risk of decay.

Steel Framed Walls

There are now a number of specialist steel framed wall systems available within the UK. Advice on what measures can be taken to improve the flood resistance of these systems should be sought from the product supplier.

Internal walls

Masonry walls

The flood resistance of internal masonry walls can be improved by following the principles set out on page 57 relating to external masonry walls (inside face).

Some partition walls in older properties may have lath and plaster linings. After exposure to floodwater linings of lath and plaster, in good condition, can dry out within a few weeks in a heated building. However, repeated flooding will almost certainly result in decay of the lining and the need for replacement.

Stud walls

Some stud partition walls may be load bearing (supporting walls and floors above) so it is important to seek professional advice before carrying out remedial works.

Stud walls, comprising of timber framing and plasterboard are vulnerable to damage from flooding. Consideration should be given to replacing untreated softwood timber with water-resistant timber sections. Plasterboard sheets can be replaced with timber panels, using WBP bonded plywood, but this is unlikely to provide a good finish for decorations. Alternatively, plasterboard can be replaced horizontally thus reducing the amount of plasterboard replacement should flooding re-occur.

In timber framed houses some internal walls may be load bearing. No vapour control layer will be present and hence plasterboard sheets could be replaced horizontally rather than vertically.

Partitions in timber-framed buildings

In timber framed houses some internal walls may be load bearing. No vapour control layer will be present and hence plasterboard sheets could be replaced horizontally rather than vertically.

Separating walls

Walls used to separate semidetached or terraced homes are designed to provide an effective sound and fire barrier. **Alterations to separating walls should not be made without prior approval from a Building Control inspector.**

Masonry walls of brick or blockwork are likely to be of solid or cavity construction finished with plaster or plasterboard.

In timber framed houses the separating wall is also likely to be timber-framed. These walls are finished with extra layers of plasterboard and incorporate sound absorbent material (interference with the sound absorbent material may permanently impair sound insulation properties). There are no practical measures that can be taken to improve the flood resistance of these walls.

CS | Case Study



Lucy and Anthony Rees took a calculated risk when they bought an attractive cottage that had been flooded the previous autumn. The young couple loved the house, weighed up the odds of it flooding again – it had only been flooded once in the past 30 years – and thought it was worth taking the chance. The next autumn it was flooded again, this time to a depth of 0.6 metres.

Anthony had just qualified as a building surveyor and after the kitchen units and plaster had been stripped out, he set about researching what should be put back. The loss adjuster (who was busy with a mass of other claims) gladly agreed to him writing the specification for the repairs, and organising the contractors to carry out the work. Of all the flooded houses in the town, his was probably the first to be re-occupied.

He decided that the first thing was to avoid using gypsum plaster, which had not withstood this flood or the one before, and rather to use a sand/cement render with a lime-based rather than gypsum-based skim coat.

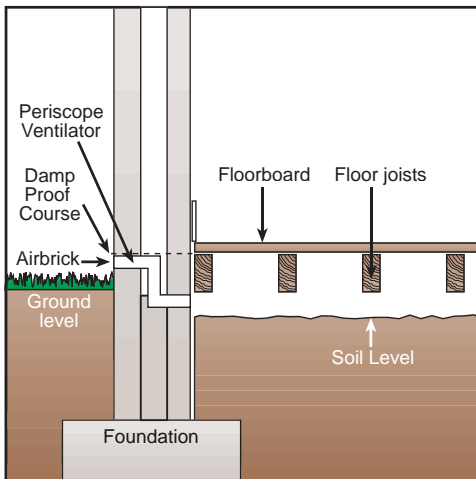
Before these were applied, he decided to waterproof the inside of the walls, using a sealant product used for basements, tunnels, and shower floors. In this way only the plaster layer would need to be dried out before the house was re-occupied, not the entire thickness of the wall.

To maintain the tanking, the skirting boards have been glued to the wall rather than screwed and can be quickly removed. He has also installed a sump for an electric pump, which he intended to use with flood doors as the first line of defence. Before they could test the system, Anthony and Lucy have moved house – not because of the threat of flooding, but because of a change of job. The fact that they sold the cottage at the asking price, within weeks of it being put on the market, must be partly due to the flood protection measures they put in place.

Source: Lucy and Anthony Rees

Floors

There are three main floor types used within residential buildings and small business properties in the UK, suspended timber floors, solid concrete floors and suspended concrete floors.



Suspended timber floor

Suspended timber floors

Timber joists and floorboards will normally dry out after being immersed in floodwater without any long term effects provided they have been treated with an appropriate preservative. Should joists need to be replaced they can, subject to professional advice, be supported on hangers rather than being built into walls. This can help to minimise the risk of future distortion following wetting and drying. Additional struts or battens can also be installed between joists to reduce the risk of future distortion.

Flooring materials

Chipboard flooring usually needs to be replaced following exposure to floodwater and should be replaced with appropriately treated floor boards or WBP plywood. Removable hatches should be installed to allow access to the sub floor void and to allow the void to dry out following flooding.

Insulation

Many suspended timber floors in modern buildings have mineral wool insulation between the timber joists. This material has poor flood resistance and will need to be replaced following exposure to floodwater.

Other more water resistant insulation materials are available, such as low absorption boards. Although it may be possible to re-use this type of insulation after exposure to floodwater it would be more expensive to install than mineral wool, and would need to be removed temporarily to allow the timber joists to dry out. The additional material and labour costs involved are likely to outweigh any replacement cost savings. Hence replacing damaged floor insulation with traditional mineral wool is likely to be the least cost option, accepting that this material will need replacement should flooding return.

Modern solid concrete floors with damp proof membranes are generally regarded as the most flood resistant floor type.

Sub-floor void

After floodwaters have subsided water is likely to be retained below the suspended floor within the sub-floor void. The sub-floor void should be cleaned of debris to allow future floodwater to be quickly pumped away and to avoid moisture retention. In the case of refurbishment works or new properties consideration should be given to providing a fall to the sub-floor surface to a sump at an identified drainage point where a pump can be installed to evacuate moderate seepage flow from future flood events.

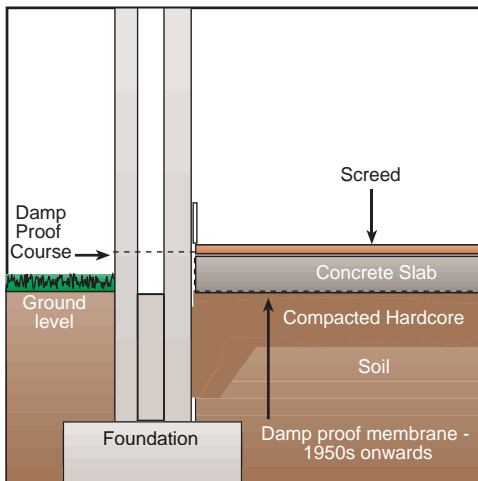
For modern buildings the sub floor area is likely to be covered with 100mm of concrete or heavy-duty polyethylene sheeting with concrete or sand blinding. Any damage to these linings as a result of flooding should be repaired during the drying out period.

Solid concrete floors

Modern solid concrete floors with damp proof membranes are generally regarded as the most flood resistant floor type as they can reduce the rate of seepage into the building and are generally easier to clean and restore when compared to suspended floors. In particular solid floors do not have sub-floor voids which often require cleaning out following flooding.

However it should be noted that very few solid floors in existing properties have effective connections between the damp proof membrane (dpm) and the damp proof course (dpc) in the walls, so floodwater ingress is likely to occur at the floor/wall joint. For new properties, or replacement floors, in areas at risk of flooding effective connections between the dpm and dpc should be provided.

Older properties with solid concrete floors, especially those built before the 1950s, have no dpm beneath the concrete slab and will be less effective in reducing floodwater ingress, particularly in areas of permeable ground conditions and where the floor slabs are cracked.



Solid concrete floor

Although concrete floor slabs are unlikely to be significantly damaged by flooding they can take a long time to dry out depending on the location of the (dpm). Floors with the dpm between the surface screed and the concrete slab will dry out more quickly than floors with the dpm below the concrete slab.

Floor materials

In more modern buildings, solid floors also include a layer of insulation which can be located either above or below the concrete slab. Insulation for solid concrete floors in areas of flood risk should take the form of rigid boards with low water absorption.

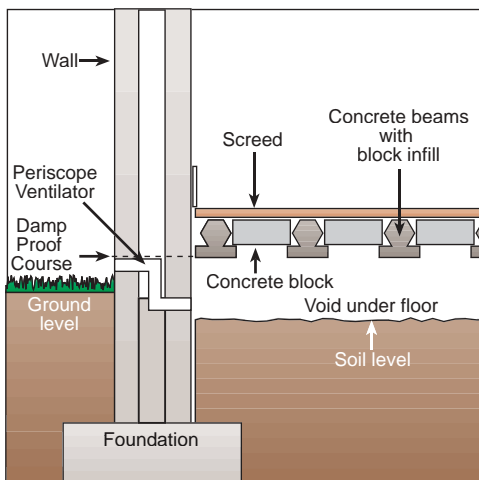
Some concrete floors have chipboard finishes above the concrete slab, sometimes supported on timber battens. If exposed to floodwater it is likely that such finishes will require replacement. Consideration should be given to replacing chipboard with screed (to a minimum thickness of 65mm), tiles or WBP bonded plywood.

Underfloor heating systems can be found in some solid concrete floors, particularly in those constructed during the 1970s. Such systems may be damaged by flooding and should be checked by a qualified electrical engineer before re-use.

Suspended concrete floors

Suspended concrete floors are typically formed by in-situ or precast concrete beams with infill units of lightweight concrete or clay blocks. A damp proof membrane of polyethylene directly above the floor units is normally laid to prevent moisture from the sub-floor void reaching the floor surface. Insulation of lightweight blocks or moisture resistant material is often laid between the separating layer and surface screed.

As with suspended timber floors floodwater is likely to collect in the void beneath the floor. In the case of refurbishment works or new properties consideration should be given to providing a fall to the sub-floor surface to an identified drainage point.



Suspended concrete floor

Chipboard boarding is sometimes found with suspended concrete floors rather than a finishing layer of screed. As discussed above under solid concrete floors such finishes will nearly always need to be replaced following exposure to floodwater. A concrete screed of minimum thickness 65mm will provide a more flood resistant surface and if properly installed should not require replacement following exposure to floodwater, provided access panels are provided to gain access to the sub-floor void.

Concrete beams within suspended concrete floors contain reinforcement that can corrode if there is a high chloride content within the floodwater. During restoration of a property after flooding the condition of the concrete beams should be inspected for signs of corrosion.

Replacement floors

In cases of repeated flooding consideration may be given to replacing existing suspended floors with a new solid concrete floor. Solid concrete floors, provided they are properly designed to withstand the pressure of floodwater, can provide an effective seal to prevent water seeping up from the ground. Effective connections are however required between the damp proof membrane beneath the concrete slab and the damp proof course in the walls. Solid concrete floors generally suffer less damage than suspended timber floors and are normally less expensive and faster to restore following exposure to floodwater.

Radon and landfill gas barriers

In many parts of the country ground floors need to be sealed to prevent naturally occurring radon gas, or methane or carbon dioxide from landfill sites, from seeping into the building through the ground. For solid concrete floors the radon barrier also serves as the damp proof membrane beneath the concrete slab. For suspended timber floors polythene membranes are installed below ground level.

For existing properties with basements specialist advice must always be obtained before undertaking any measures to prevent water ingress.

In areas of high radon levels ventilation sumps are sometimes installed. Such sumps are likely to require maintenance following flooding.

When undertaking any measures to improve the flood resistance of ground floors it is important not to damage such gas barriers or sumps. If in doubt seek professional advice.

Basements

For existing properties with basements specialist advice must always be obtained before undertaking any measures to prevent water ingress. Restricting ingress through internal or external tanking for example may lead to an increase in hydrostatic pressure acting on the basement walls leading to possible structural damage.

Basement construction should usually be avoided for new properties within flood risk areas.

CS | Case Study

Andrew Arrol is a conservation architect living in Shrewsbury close to the River Severn. When he and his wife Meg moved into their house in 1972, the tide mark from the 1947 flood was still visible on the walls. When the floods of 1998 brought 75mm of water into their home, Andrew and Meg set about making it more flood-resistant. Using his professional knowledge combined with a practical, commonsense approach, they have adapted their house to be as flood-resistant as possible without using materials or finishes that look out of place.

They have chosen solid floors rather than suspended timber flooring, avoiding hidden spaces that can harbour moisture and be difficult to dry out. There are no fitted carpets on the ground floor. Electricity sockets, telephone points and electric and gas meters have been raised above likely flood levels enabling them to remain comfortably upstairs during a flood event. Temporary drain-stops are used in the sewers to prevent sewage being forced back up into the house by the rising floodwater. They also weight down manhole covers to prevent them lifting, seal overflow pipes, and cover ventilation grilles and airbricks before a flood. They use plywood flood boards on mastic bedding across the doors. Instead of MDF or chipboard kitchen units, they have designed a shelving system from marine ply, strong enough to take the weight of the white goods, which can then be temporarily stored on top.

For the interior lining of the walls, they have worked on the principle of air gaps and moisture breaks. For plaster they have used a hydraulic lime, applied to stainless steel mesh. The mesh is mounted on tanalised battens using stainless steel screws, and a thin layer of plastic membrane separates the battens from the wall. The hydraulic lime contains an additive making it impermeable to water but permeable to water vapour. It has been finished with a compatible permeable paint. The plaster layer sheds the water almost immediately and the gap between the plaster and the brickwork means that air can circulate freely, speeding up the drying process. The rooms are

habitable in a very short time and the brickwork can dry out at its own pace.

The skirting boards have been made of treated timber, and have been painted all over so that they don't absorb water and warp. The skirtings are boxed out from the wall so that there is an air gap behind them.

In 1998 the force of the rising water had actually cracked the concrete floor slab in the hall. This was renewed leaving a small gap around the edges to relieve the pressure of the water. Polystyrene insulation under the concrete was continued up round the edges to fill this space.

The precautions that Andrew and Meg have taken were tested by 0.525m of water in the floods of autumn 2000. The only damage sustained was a cracked floor slab in the hall, and that has now been renewed in the same way as the dining room floor which survived unscathed. Thanks to timely warnings from the Environment Agency, and much hard work all the furniture was moved upstairs beforehand – Andrew and Meg advocate a policy of “one hundred percent rescue”. In future they hope that redecoration will be the only repair work necessary after a major flood.

The steps they have taken to improve the flood resistance of their house has significantly reduced the cost of flood damage repairs and restoration times.

Source: Andrew and Meg Arrol

Fittings and Building Services

Kitchens

Cupboards

The majority of kitchen storage units are formed from chipboard and MDF with plastic coatings. Such units will almost always need to be replaced when exposed to floodwater. It is preferable to raise such units 100mm to 150mm above floor level by means of plastic legs to prevent damage during shallow flooding events.

Cupboard doors and worktops are also often made from chipboard or MDF and these will also usually require replacement if exposed to floodwater. Solid hardwood doors may dry out but warping or discolouration of the surface finish may still result in the doors needing to be replaced. If sufficient warning is provided cupboard doors may be removed in advance of floodwaters entering the property.

Water-resistant PVCu kitchen units that can be cleaned and re-used following exposure to floodwater are now available in the UK. Such systems should be considered when undertaking refurbishment works or building new properties within flood risk areas. It should be noted however that such water-resistant units would often still need to be removed temporarily following flooding to allow the floors and walls to be cleaned and dried.

Appliances

Separate hobs and built-in ovens are preferable to combined free-standing cookers as these are mounted above floor level and may not be affected by shallow flooding. Remember that all gas and electrical appliances that have come into contact with floodwater must be inspected by a qualified engineer before they are re-used.

Washing machines and fridge freezers usually need to stand on the floor due to their weight and should not be permanently raised to provide protection against

Remember that all gas and electrical appliances that have come into contact with floodwater must be inspected by a qualified engineer before they are re-used.

floodwater, unless specialist design measures are taken. It may be possible to empty and temporarily raise freezers on low-level blocks provided there is sufficient flood warning time.

For properties at risk of flooding separate fridge and freezer units should be considered rather than combined fridge/freezers as they would be easier to lift in the event of flooding.

CS | Case Study

In April 2000 Mary and Arthur Lynch moved into a cottage on the banks of the River Severn. They were informed by local residents and their surveyor's Home Buyer's Report, that the house hadn't been flooded even in 1947, when river levels had been the highest in living memory.

However, six months later, in a flood that fell considerably short of the 1947 level, the Lynch's had 0.7metres of water in their house. They retreated upstairs with supplies of bread and cheese and gin and tonic to sit out the flood.

When the river levels receded, their brand new kitchen, finished only weeks before, was completely ruined. The MDF panels had become soggy and swollen and the entire kitchen had to be ripped out and thrown away.

Rather than put back a second kitchen made of MDF, the kitchen fitter suggested that he should try and find a more durable material. He has constructed strong plastic base units that, are resistant to water, easy to clean and disinfect, and can be put back into service once the water has receded. The backs of the cabinets are designed so they can be removed, which allows the wall behind to be cleaned and dried. The clip-on plinths can be removed and stored in a dry place before the flood, and this allows easy access to the floor area for cleaning and drying afterwards. The quick fit-and-release doors can be easily removed, and so don't need to be waterproof, giving a complete choice of materials.

The kitchen offers other solutions: the electric oven can be disconnected, lifted out and placed on top of the work surface, and the units are also strong enough to support items such as the fridge and freezer, which then can still be used.

Mary is delighted with the kitchen, as she has no intention of moving. "I would rather live by the river and be flooded, than live without the river", she says.

Meanwhile the kitchen fitter is gathering other ideas for coping with flooding, and has established a small specialist firm installing flood-resistant cabinets in kitchens and offices lying in the floodplain.

Source: Mary and Arthur Lynch

Bathrooms

Toilets and hand basins are not normally affected by flooding. However, many plastic baths have integral chipboard bases to provide rigidity. These bases can often become contaminated on exposure to floodwater resulting in the need to replace the bath unit. Higher quality bath fittings should be considered during refurbishment works or for new build properties at risk of flooding.

Doors

There are a number of external and internal door types including timber, PVCu and aluminium. Generally solid doors and frames are less susceptible to flood damage than hollow types which can fill up with contaminated water during flooding which can be difficult to drain.

Timber doors

Hollow timber doors, although less expensive than solid timber, will often de-laminate on exposure to floodwater and will usually need to be replaced. Solid timber doors are likely to be only slightly affected by flooding but some distortion often occurs and re-fitting is usually necessary. Such distortion can be minimised by ensuring all faces of the timber, including the bottom face, are effectively sealed using either an oil-based or waterproof stain or paint.

Fire doors

Fire doors are often constructed with layers of fire resistant material that can become damaged if exposed to floodwater. Fire doors that have been immersed in floodwater should always be replaced, together with the door frame seals.

Solid timber doors are likely to be only slightly affected by flooding but some distortion often occurs and re-fitting is usually necessary.

During refurbishment works and for new properties, the installation of solid timber staircases should be considered below the expected flood level.

Windows

Timber windows

Timber window frames may distort following exposure to floodwater and may need to be re-fitted. As with timber doors such distortion can be minimised by ensuring the timber is effectively sealed using either an oil-based or waterproof stain.

Double-glazed aluminium and PVCu windows and patio doors

Modern double-glazed windows and patio doors are normally made from hollow extruded aluminium or PVCu sections. These can fill up with floodwater and can be difficult to drain.

For prolonged floods lasting more than a few hours water can penetrate through the edge seal of double glazed units into the cavity between the glazing. In such cases the glazed units will require replacement.

Staircases

Solid timber staircases will generally only be slightly affected by flooding. However care should be taken to ensure that the staircase has not become unstable and any loose treads should be replaced.

In some modern housing staircases are formed from MDF and these may need to be re-fitted or replaced following exposure to floodwater. During refurbishment works and for new properties, the installation of solid timber staircases should be considered below the expected flood level.

Skirting boards

Skirting boards are normally formed from softwood timber or MDF.

Solid timber skirting boards should not be affected by floodwater provided that all faces, including the back face and underside, are sealed with an oil-based paint or stain before fixing to the wall. Timber skirting boards will however normally need to be temporarily removed to allow the walls to dry out.

Carpets will normally need to be replaced following immersion in floodwater although specialist cleaning services are available. Consider using loose fitting rugs that can be moved and stored upstairs before flooding occurs.

Non-treated timber boards will distort following flooding and will usually need to be replaced.

Skirting boards formed from MDF are likely to require replacement if immersed in floodwater.

Floor coverings

For properties at risk of flooding fitted carpets should be avoided where possible. Carpets will normally need to be replaced following immersion in floodwater although specialist cleaning services are available. Consider using loose fitting rugs that can be moved and stored upstairs before flooding occurs.

For kitchens and bathrooms, the type of floor covering will depend on the floor type. For solid concrete floors, stone, concrete or ceramic floor tiles should not normally be affected by flooding. However care should be taken to ensure that the tile resin or grout is sufficiently water resistant.

For suspended concrete and timber floors, permanent floor tiles are not usually suitable as they would need to be removed following flooding to gain access to the sub-floor void. Less expensive synthetic floor covers should be considered such as lino etc although these floor coverings will normally need to be replaced following immersion in floodwater.

Wooden laminate flooring is also likely to be damaged by floodwater and will normally require replacement.

Wall coverings

Redecoration of the internal walls will almost always be required following flooding. Wallpapers will normally peel away from the wall or become badly stained following immersion in floodwater and will need to be replaced. Hence for properties at risk of flooding it is recommended that papered finishes should be avoided.

Painted walls will normally also need to be redecorated following flooding but will be less

For new properties within flood risk areas locating the meter box and internal consumer unit above the expected maximum flood level should be considered.

expensive to refurbish than papered walls. The use of low permeability lime-based paints rather than oil based paints or emulsion can allow walls to dry out more quickly following flooding.

Ceramic tiling may also be used as discussed above under solid masonry walls (on page 58) but specialist advice should be obtained to ensure that such low permeability finishes do not lead to problems of damp in the walls.

Electricity supply

Before floodwaters arrive the electricity supply should be turned off at the consumer unit (fuse box). Following internal property flooding a qualified electrician should be called to check the building's electrical system (and any appliances that have been immersed) before it is re-connected.

Location of meter and consumer unit (fuse box)

For many older properties both the electricity meter and consumer unit (fuse box) are located at low level inside the house, often in the cupboard under the stairs. If there is sufficient space raising the meter and consumer unit (fuse box) to a higher level above the expected flood level could be considered subject to approval by the local electricity supply company.

For modern houses the electricity meter is often located outside the property in a box mounted on the external wall. For new properties within flood risk areas locating the meter box and internal consumer unit above the expected maximum flood level should be considered.

Wiring

Modern electrical wiring is not normally affected by immersion in floodwater. However for long duration floods lasting several hours, water may penetrate the insulation and in such cases the wiring may need replacement. During refurbishment works, or when building new properties, moving the ground floor ring main cables to first floor level could be considered with drop down cables to ground floor sockets.

Following immersion by floodwater it is essential for safety reasons that the operation of the gas system and individual gas appliances are inspected by a CORGI registered engineer before the system is re-used.

It is also advisable to use plastic cable conduits rather than to plaster cables directly into the wall in order to reduce the cost of future rewiring should this be required. However care must be taken to ensure that cable conduits are installed to avoid low points that could collect water in the event of flooding.

Socket height

For properties at risk of flooding raising the sockets to an appropriate height above flood levels could be considered. Although this could lead to savings in flood repair costs it should be noted that the appliance cables would become more visible inside the room.

Gas supply

In the event of flooding the gas supply should be turned off at the meter. Following immersion by floodwater it is essential for safety reasons that the operation of the gas system and individual gas appliances are inspected by a CORGI registered engineer before the system is re-used.

During a flood, water and silt may find its way into gas systems affecting their safe operation. The appliances may light and appear to be working normally but the flue or ventilation systems may have been adversely affected by the floodwater or partially filled with water.

Gas meters may be affected by floodwater and it is worth considering raising meters above the expected flood levels during refurbishment works or for new build properties. Provision should be made for purging gas supply pipes through the installation of appropriate drain points.

When installing new heating systems, pipework routes should be easily accessible to allow pipes to be maintained and washed down following flooding.

Central heating systems

Boilers

Gas and oil fired boilers and associated pumps and controls should preferably be installed above the maximum expected flood level. Fittings that have been immersed by floodwater should be inspected by a qualified engineer before re-use and may need to be replaced.

Pipework

Hessian or fibre insulation to pipes below suspended floors can reduce in thickness following soaking leading to a reduction in thermal effectiveness. Pipe insulation below the expected flood level should preferably be replaced with closed cell insulation.

When installing new heating systems, pipework routes should be easily accessible to allow pipes to be maintained and washed down following flooding. Central heating pipework and radiators are unlikely to suffer damage from flooding, unless corrosion occurs as a result of several weeks of contact with water containing salts. This can happen if, for example, pipes are inaccessible within concrete floors.

Storage Heaters

Electrical storage heaters will normally require replacement following immersion in floodwater.

Drainage

Non-return valves

Flooding can create blockages in drains and sewers which can lead to the backflow of sewage into properties through low level drain gulleys, toilets, and washing machine outlets. Backflow through drains is particularly likely where floodwater is prevented from entering the property using temporary barriers and where the external flooding depth outside is above the internal level of the drain entry points.

Such flooding can be effectively controlled by installing non-return valves, often called anti-flooding devices, within the private sewer of a property upstream of the public sewerage system. These

It is important to remember that anti-flooding devices require careful installation and must be regularly maintained. Maintenance depends on the type of device fitted, but is normally required every six months.

devices are typically between 0.5 to 1 metre in length and are installed in-line within an inspection chamber to allow access for maintenance. They are designed for installation within gravity sewers or drains and normally use flap gates to prevent backflow. Further details are provided by the CIRIA publication 'Low-cost options for prevention of flooding from sewers'.

It must be remembered that once an anti-flooding device has closed to prevent backflow, it effectively disconnects the property from the public sewerage system. Appliances within the property, such as toilets, and washing machines cannot be used until the flooding has subsided and the device re-opens, otherwise the property may be flooded by its own discharges.

It is important to remember that anti-flooding devices require careful installation and must be regularly maintained. Maintenance depends on the type of device fitted, but is normally required every six months.

Private sewage systems

Flooding of a private sewage system can create a back-up of sewage into the property and lack of sanitation. Damaged septic tanks, cesspools, or small package sewage systems should be inspected by a qualified engineer before the drainage system is re-used.

Water supply

Water meters and pipework will not normally be affected by flooding but some pipework insulation materials may become damaged. This should be replaced with flood resistant closed cell material below the expected flooding level.

Telephone and cable services

Following flooding some problems have been found with communications wiring due to the collection of floodwater within cable conduits. Suppliers of the

relevant services should be consulted on suitable installation methods in areas liable to flooding. Where possible incoming telephone lines, and internal control boxes, should be raised above the expected flood levels.

6 | Summary

The aim of this guide has been to bring together best available information on the measures that can be taken to minimise the impact of flooding on existing domestic and small business properties and to provide guidance on how the most appropriate options can be selected.

Advice and guidance is also provided to developers and local authorities involved in new build construction and the renovation of existing properties at risk of flooding in support of the Government's new planning policy on development and flood risk (PPG25).

The table below illustrates some of the main impacts of flooding that can be reduced by effective pre-planning and implementation of appropriate flood protection measures detailed within this guide. The key message is that a combination of both pre-planning and flood protection measures will provide the greatest benefit.

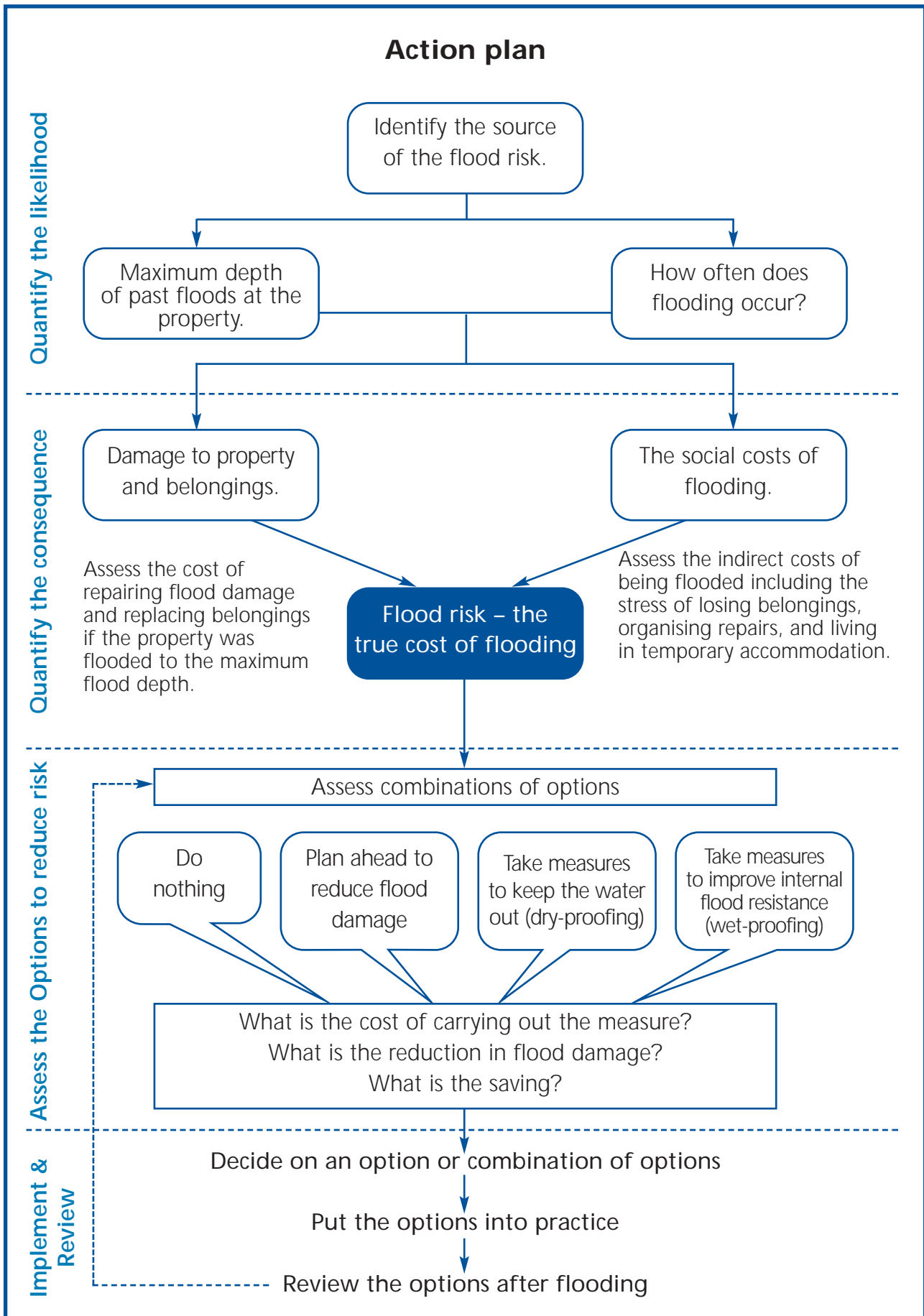
✓✓	Some reduction in flood impact
✓✓✓	Significant reduction in flood impact

How preventative measures can reduce costs and stress	Preparing a Flood Plan	Measures to keep the water out	Measures to improve the internal flood resistance of the building	Combination of measures
Loss of personal belongings	✓✓	✓✓	-	✓✓✓
Temporary loss of home/business	✓✓	✓✓	✓✓	✓✓✓
Clean-up costs	✓✓	✓✓	✓✓	✓✓✓
Restoration costs	✓✓	✓✓	✓✓	✓✓✓
Replacement and purchase costs	✓✓	✓✓	✓✓	✓✓✓

The guidance is the first attempt to collate such information in one source document and will continue to be improved and updated as new information becomes available and feedback is received.

For existing householders and small business owners at risk of flooding the adoption of measures discussed within this guide should help to reduce the fear and stress of flooding, reduce the cost of flood damage repairs and enable individuals and businesses to return to normality more quickly.

The guidance is the first attempt to collate such information in one source document and will continue to be improved and updated as new information becomes available and feedback is received. In particular, work is now underway to provide national performance standards against which flood protection products can be tested, and to improve knowledge on the flood resistance of building materials.



7 | Further Reading

General reading

- Floodline information pack contains basic advice on the Environment Agency's flood warning service and what to do before, during and after a flood (Available from Floodline).
- Information guides; Flood Products – Using Flood Protection Products – A Guide for Homeowners, After a Flood – how to restore your home, Drainage Limitation – how to make your home more flood resistant and Flooding in Gardens (Available from Floodline).
- Lessons Learned Autumn 2000 Floods (Environment Agency).
- Webpages on Repair and restoration of buildings following floods. Includes advice sheets aimed at the householder on how to improve the overall flood resistance of their home. (CIRIA – www.ciria.org/flooding)

Technical reading

- DETR (2001) Planning Policy Guidance Note 25: Development and Flood Risk (DTLR, London).
- Learning to Live with Rivers, Institution of Civil Engineers (November 2001).
- Flooding: A Partnering Approach to Protecting People, ABI (November 2001).
- Assessment of costs and effectiveness on future claims of installing flood damage resistant measures. ABI May 2003. ISBN 1-903-193 24-9
- Floods and Historic Buildings: Technical advisory note (in preparation), English Heritage.
- Flooding and Historic Buildings: Proceedings of the joint conference of English Heritage and Shrewsbury and Atcham Council held in Shrewsbury 27th March 2001 (in preparation), English Heritage.

- Temporary and Demountable Flood Protection – Interim Guidance on Use. Environment Agency, R&D Publication 130, 2002.
- Reducing the Impacts of flooding – Extemporaneous Measures. Special Publication SP15S (CIRIA) 2001.
- DETR (2001) The Government's Response to the Second Report in Session 2000-01 of the Environment, Transport and Regional Affairs Committee: Development on, or Affecting, the Floodplain (HMSO, London).
- Environment Agency (2000) An Environmental Vision: The Environment Agency's contribution to sustainable development (Environment Agency).
- Scottish Office (1996) Design Guidance on Flood Damage to Dwellings (HMSO).
- Federal Emergency Management Agency (1995) Engineering Principles and Practices for Retrofitting Flood-prone Residential Structures Independent Study Course (USA).
- Building Research Establishment (1997) Repairing Flood Damage Part 1: Immediate Action. Good Repair Guide 11 (CRC, Watford).
- Building Research Establishment (1997) Repairing Flood Damage Part 2: Ground Floor and Basements. BRE Good Repair Guide 11 (CRC, Watford).
- Building Research Establishment (1997) Repairing Flood Damage Part 3: Foundations and Walls. Good Repair Guide 11 (CRC, Watford).
- Building Research Establishment (1997) Repairing Flood Damage Part 4: Services, Secondary Elements, Finishes, Fittings. Good Repair Guide 11 (CRC, Watford).

Useful websites

- Association of British Insurers (ABI):
www.abi.org.uk
- British Damage Management Association (BDMA):
www.bdma.org.uk

- Building Research Establishment (BRE):
www.bre.com; www.ask.bre.com; and
www.brebookshop.com
- National Flood Forum (NFF):
www.floodforum.org.uk
- Flood Protection Association:
www.floodprotectionassociation.org
- Construction Industry Research and Information Service (CIRIA):
www.ciria.org.uk/flooding
- Office of the Deputy Prime Minister
www.odpm.gov.uk
- English Heritage:
www.english-heritage.org.uk
- Environment Agency:
www.environment-agency.gov.uk/floodresearch
for electronic copies of Environment Agency R&D outputs.
- Middlesex University's Flood Hazard Research Centre:
www.fhrc.mdx.ac.uk
- Scottish Executive:
www.scotland.gsi.gov.uk

8 | Environment Agency Guidance

What to do before, during and after a flood

The Environment Agency recommends that the following steps are taken to prepare for possible flooding and offers advice on what to do when warnings are issued and how to cope in the aftermath. For more information call the Agency's 24 hour Floodline on **0845 988 1188** or check their website (www.environment-agency.gov.uk/floodline).

Be prepared

- Keep a list of useful numbers to hand: for example your local council, the emergency services, your insurance company and Floodline – 0845 988 1188.
- Have a few sandbags or floorboards prepared to block doorways and airbricks.
- Make up a flood kit, including a torch, blankets, waterproof clothing, wellingtons, a portable radio, first aid kit, rubber gloves and key personal documents. Keep it upstairs, if possible.
- Talk about possible flooding with your family or those you live with. Consider writing a flood plan, and store these notes with your flood kit.
- Make sure you know where to turn off your gas and electricity. If you're not sure, ask the person who checks your meter when they next visit. Mark the tap or switch with a sticker to help you remember.
- What about your pets? Where will you move them to if a flood is on the way?
- Think about your car. Where could you move it to in the event of a flood warning?
- Get into the habit of storing valuable or sentimental personal belongings upstairs or in a high place downstairs.
- Think about medication. In the event of a flood, you'll still need to take it.
- Contact your insurance company to check you have adequate flood cover.

Ideas for a family action plan

- ✓ Do know how to contact each other. Your family could be anywhere when a flood happens.
- ✓ Do find out where your family would be evacuated to. Make sure you all know where that is. Floods may force you to leave your home.
- ✓ Do put the emergency numbers in a safe place. Prepare a flood kit which can be kept in a safe place.
- ✓ Do know where to turn off your power supplies. Do you have a torch handy in case it's dark?
- ✓ Do make sure you understand what the flood warning service for your area is.
- ✓ Do find out whether your area has flooded before. Look in the library or ask neighbours what happened and how they coped.
- ✓ Do tell a friend or neighbour about your plan. You may need their help if there's a flood, or they may need yours.
- ✓ Do read through the Agency fact sheet 'Are you prepared for a flood?'
- ✓ Do think if there is someone who will need your help.
- ✗ Don't wait for a flood to find out whether your plan works. Try it now.

Coping after a flood – the first steps:

- ✓ **Do** open your doors and windows to ventilate your home. It takes a brick about an inch a month to dry out. Do take care to ensure your house is secure. Remember to unblock airbricks and doorways.
- ✓ **Do** wash your hands with disinfectant if you come into contact with the water directly. Watch out for any broken glass or nails while you're clearing up.
- ✓ **Do** check in Yellow Pages under Flood Damage for suppliers of cleaning materials or equipment to dry out your property.
- ✓ **Do** wash taps and run them for a few minutes before use. Mains tap water should not be contaminated but check with your local water company if you're concerned.
- ✗ **Don't** attempt to operate any damaged electrical goods until they have been checked by a certified electrical engineer. Floodwater conducts electricity.
- ✗ **Don't** attempt to operate any gas appliances until a certified gas engineer has checked them. Be careful with naked flames. Gas pockets, oil and other contaminants can build up in and around floodwater.
- ✗ **Don't** eat food that has come into contact with the water – floodwater contains sewage and other contaminants.
- ✗ **Don't** walk through fast flowing water in the home or outside – floodwater can be fast moving. Just six inches of water can knock you off your feet. Be careful of holes and dips when moving around. Use a stick to gauge depth.

Claiming on your insurance

- ✓ **Do** telephone your insurance company's 24 hour emergency helpline as soon as possible. They will be able to provide information on dealing with your claim, and assistance in getting things back to normal.
- ✓ **Do** commission immediate emergency pumping and repair work to protect the property from further damage. This can be undertaken without insurer approval (remember to get receipts).
- ✓ **Do** get advice where detailed, lengthy repairs are needed. Your insurer or loss adjuster can give advice on reputable contractors and tradesmen. Be aware of bogus tradesmen.
- ✓ **Do** check with your insurer if you have to move into alternative accommodation as the cost is normally covered under a household policy.
- ✓ **Do** make sure your insurance company knows where to contact you if you have to move out of your home.
- ✓ **Do** make notes to assist your insurer in dealing with your claim, including:
 - time of flood warning.
 - time the flood waters entered your home.
 - the maximum depth of the flood (this can be marked on a wall).
 - how long the flood water was in your home.
 - presence of any contaminants (oil, sewage, etc).
 - what damage was done to building (walls, floors, etc) and contents (carpets, sofas, electrical goods). If possible, take pictures of what was damaged.

Restoring your property – first steps

- ✓ Do check the external walls and roof of your home for structural damage to make sure it is safe to enter. If necessary, contact your local authority for advice.
- ✓ Do leave all the internal and external doors and windows open in the house where possible. This will help walls and floors to dry out.
- ✓ Do try to keep an inventory of correspondence after the flood (e.g. letters to local authority, builders, your insurer, loss adjuster)
- ✗ Don't attempt to dry out paper or photographs. Place them in a plastic bag and if possible place them in the fridge.
- ✗ Don't panic if you feel you can't cope. Your local Citizens Advice Bureau and other organisations may be able to help if you feel under pressure – check their number in the phone book.
- ✗ Don't think it can't happen again. Restock your supplies.