BS 8533:2011

BSI Standards Publication

Assessing and managing flood risk in development – Code of practice

bsi.

...making excellence a habit.™

Publishing and copyright information

ISBN 978 0 580 67892 9

ICS 91.120.30

The following BSI references relate to the work on this standard:
Committee reference CB/501
Draft for comment 10/30203835 DC

Publication history

First (present) edition, October 2011

Amendments issued since publication

Date	Text affected

Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 28, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 31 October 2011. It was prepared by Technical Committee CB/501, *Flood risk and watercourses*. A list of organizations represented on this committee can be obtained on request to its secretary.

Relationship with other publications

This British Standard is complementary to BS EN 752 which covers drain and sewer systems outside buildings.

Information about this document

This British Standard has been developed in order to bring together flood risk management guidance issued by the government and devolved administrations within the UK and to provide the user with recommendations that can help them to amass information for a planning application. Where applicable, this standard makes reference to the appropriate planning policies and guidance as correct at the time of publication. It is, however, the responsibility of the user to adhere to current policies and guidance.

This standard is intended to complement the following national planning policies and guidance for development and flood risk management in the UK.

- Planning Policy Statement (PPS) 25 – Development and flood risk (England) [1] supported by the *PPS 25 Development and flood risk practice guide* [2]
- Planning Policy Statement (PPS) 15 – Planning and flood risk (Northern Ireland) [3]
- Scottish Planning Policy (SPP) (Scotland) [4]
- Technical Advice Note (TAN) 15: Development and flood risk (Wales) [N1].

Use of this document

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

Presentational conventions

The provisions in this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Attention is drawn to the following statutory regulations.

- The Reservoirs Act 1975 [5]
- The Flood and Water Management Act 2010 [6]
- The Flood Risk Management (Scotland) Act 2009 [7]
- The Reservoirs (Scotland) Act 2011 [8]
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 [9].

This page deliberately left blank

Introduction

This British Standard has been created to help the user to analyse flood risk and to guide the selection of appropriate risk management solutions. The stage at which this guide is intended for use is after initial planning considerations pertaining to the development of the site have been applied, including the Sequential Test within England and the Justification Test within Wales, and after the need to carry out a flood risk assessment (referred to as a flood consequence assessment within Wales) has been established.

NOTE For further information regarding the Sequential Test (England) and the Justification Test (Wales), see PPS 25 [1] and TAN 15 [N1] respectively.

To enable effective navigation through this standard and allow for regional differences, route maps for users in England, Northern Ireland, Wales and Scotland are provided in figures 1 to 4.

Figure 1 **Guide to the application of BS 8533 in England**

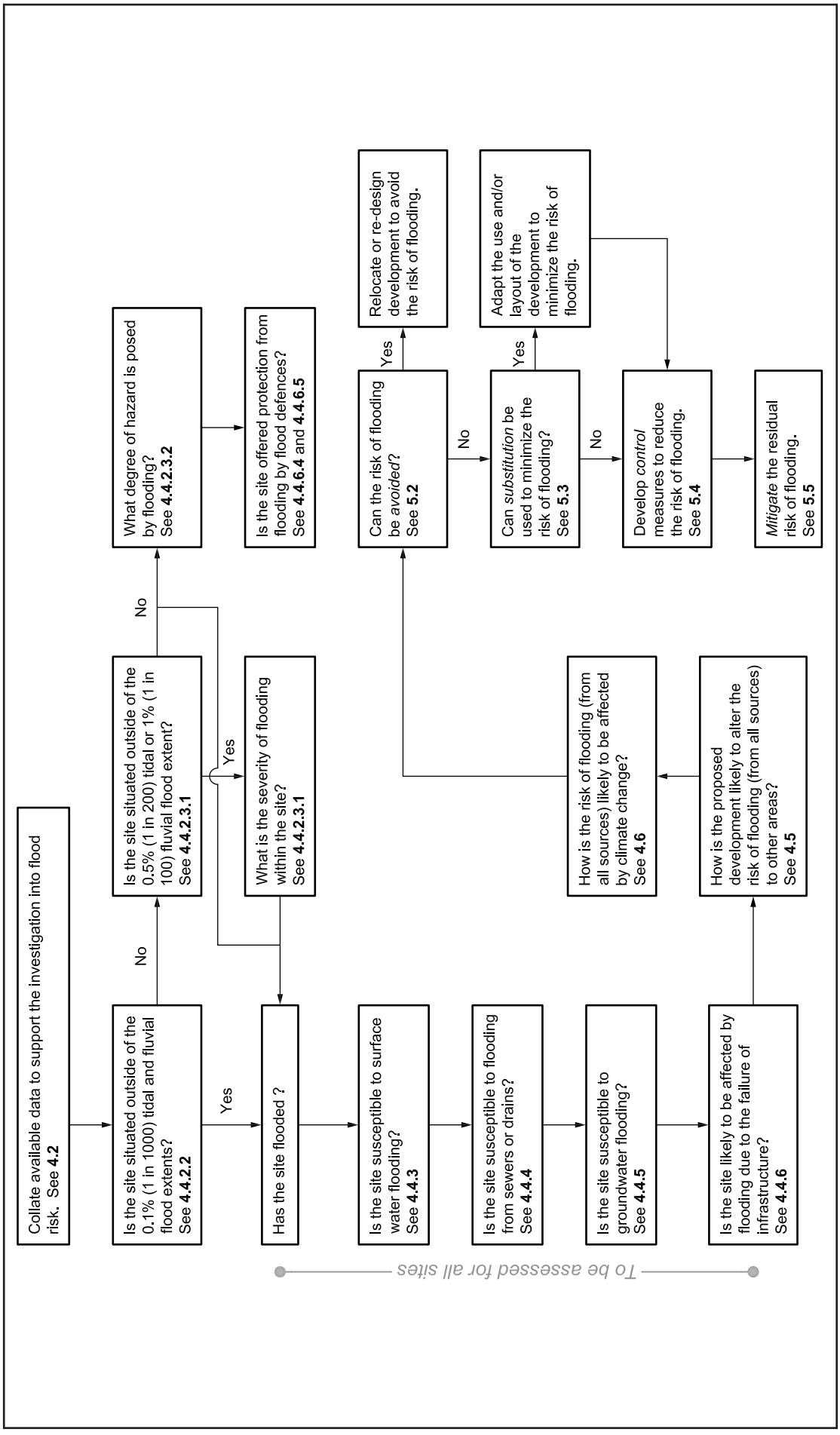


Figure 2 **Guide to the application of BS 8533 in Northern Ireland**

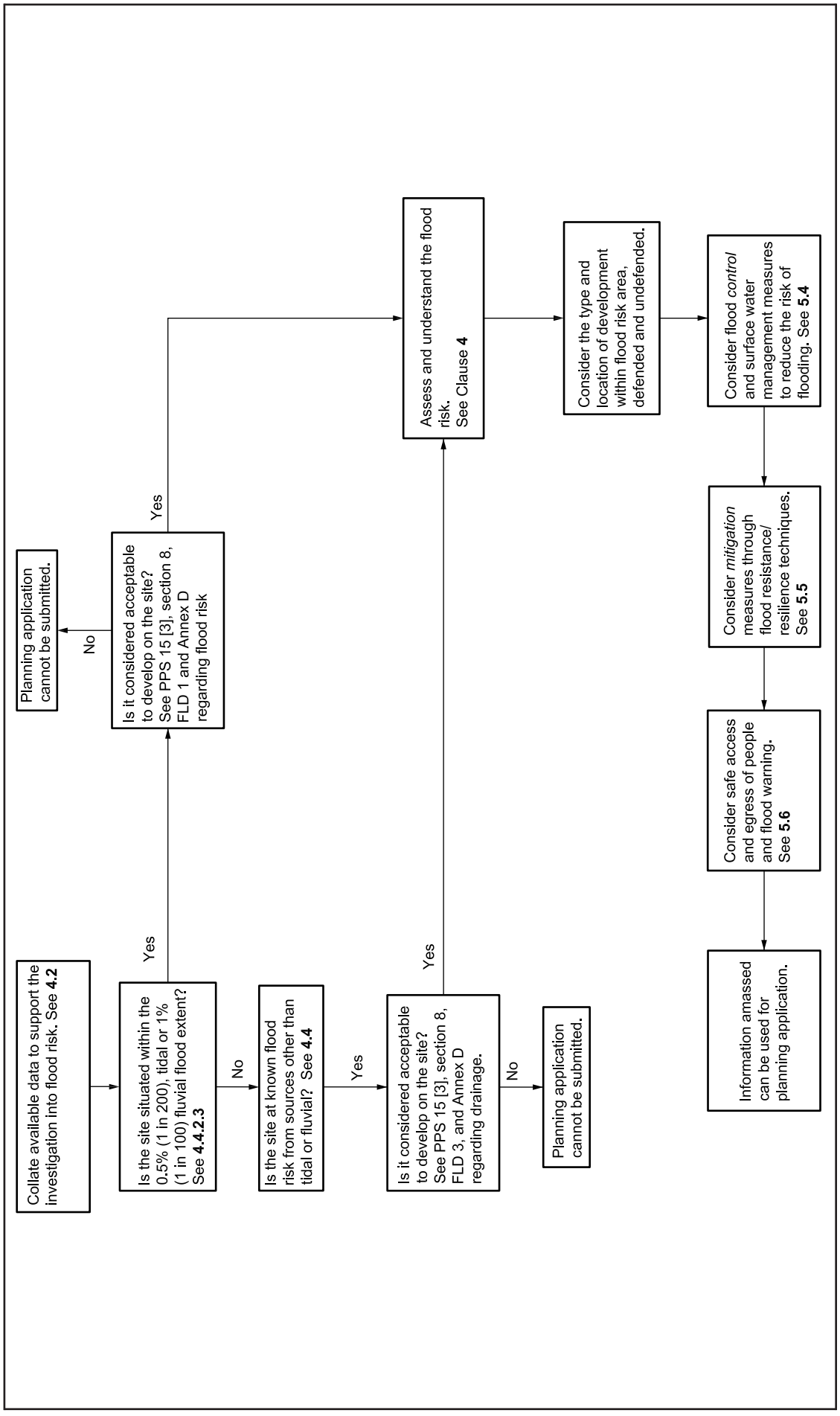


Figure 3 **Guide to the application of BS 8533 in Wales**

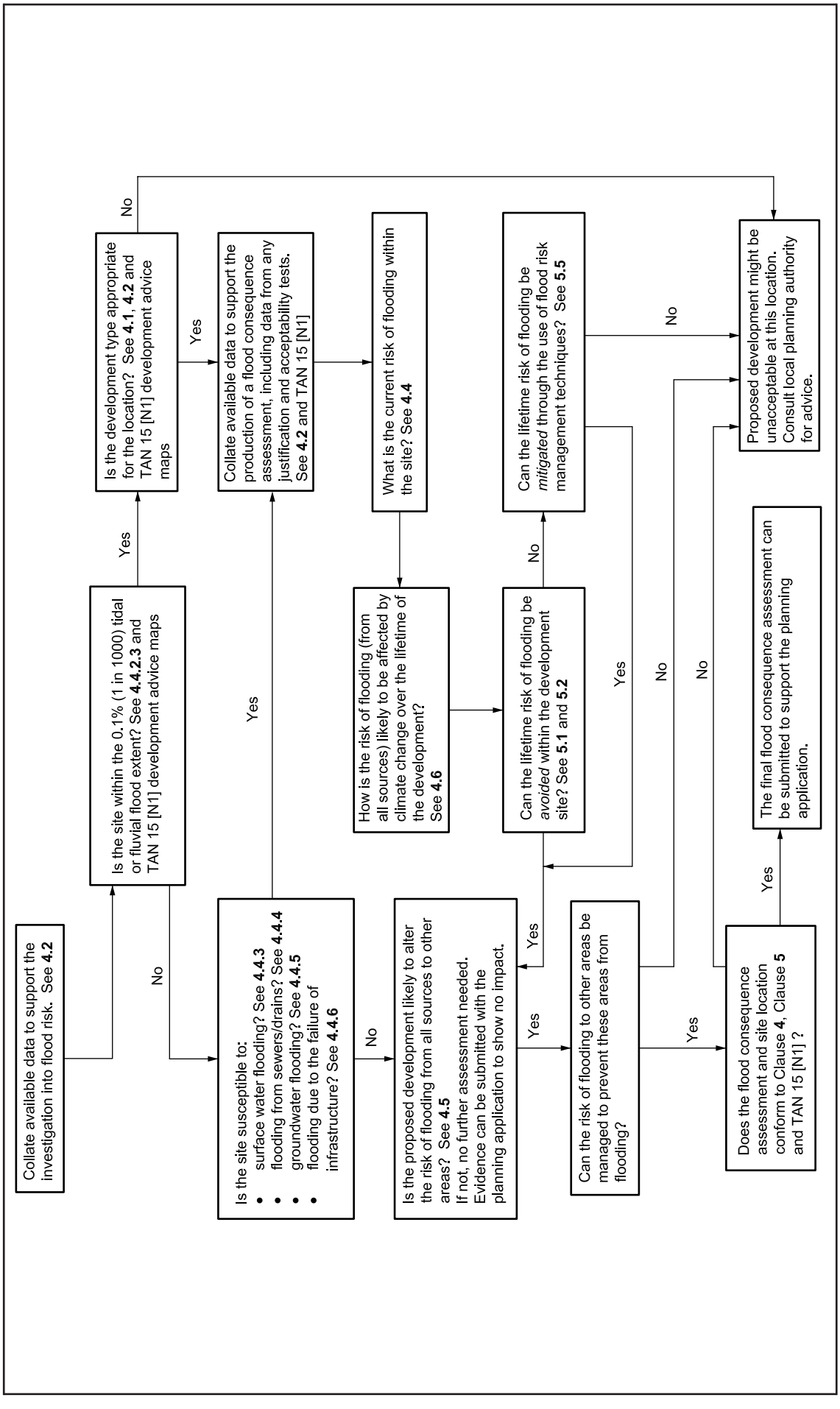
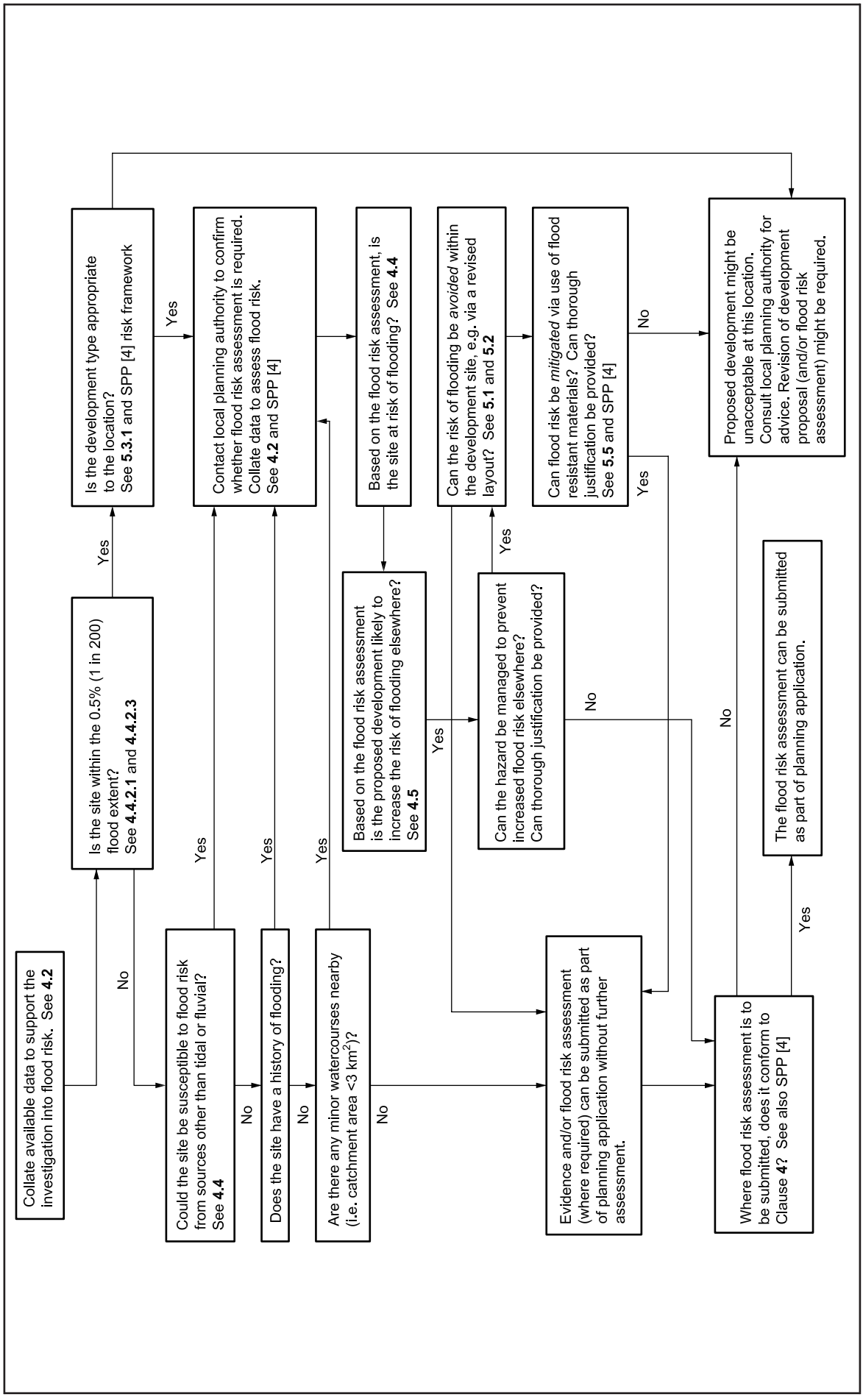


Figure 4 **Guide to the application of BS 8533 in Scotland**



1 Scope

This British Standard gives recommendations and guidance on the appropriate assessment and management of flood risk where development is proposed in the UK.

It is intended to provide developers, and decision makers (local authorities and regulators), with practical assistance for dealing with flood risk in and around their development.

This British Standard does not cover the allocation of development sites by local authorities.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[N1] WELSH ASSEMBLY GOVERNMENT. *Technical Advice Note 15 – Development and flood risk*. Cardiff: National Assembly for Wales. July 2004.[1)]

3 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

3.1 annual exceedance probability (AEP)
probability of a flooding event being exceeded in any year

NOTE For example, a 1% AEP flood event has a 1%, or 1 in 100, chance of occurring within any year.

3.2 development
building, engineering, mining or other operations, in, on, over or under land, or the making of any material change in the use of a building or other land

3.3 flood extent
area that is susceptible to flooding

3.4 flood risk
combination of the probability of a flood event and of the potential adverse consequences for human health, the environment, cultural heritage and economic activity associated with a flood event

(EC Directive 2007/60/EC [10])

3.5 flood risk management infrastructure
structure that protects land and/or buildings against flooding

NOTE The structure can be permanent or temporary and can have multiple ownership.

[1)] Copies can be obtained free of charge from: Publications Centre, Assembly at the Pierhead, National Assembly for Wales, Pierhead Street, Cardiff Bay, CF99 1NA or downloaded from the National Assembly for Wales website: http://www.wales.gov.uk.

3.6 residual risk
assessment of flood risks that remain after taking account of all flood mitigation measures over the development lifetime allowing for climate change and the long-term performance of infrastructure

3.7 reservoir
natural or artificial pond or lake, loch or lough, used for the storage and regulation of water

3.8 sustainable drainage system (SuDS)
sequence of management practices and control structures designed to drain surface water in a sustainable fashion

NOTE 1 SuDS are presumed to drain surface water in a more sustainable fashion than some conventional techniques and as close to source as practicable, with the aim of minimizing the impact on the natural water cycle and protecting the health of aquatic ecosystems.

NOTE 2 In Scotland, SuDS are referred to as SUDS and are defined as sustainable urban drainage systems.

4 Assessing the risk of flooding

4.1 General

A detailed, development-based flooding investigation should be undertaken to determine:

a) the likelihood and consequence of flooding in and around the development, from all sources, in accordance with **4.3** and **4.6**;

b) how the development might alter the existing flooding regime, potentially increasing the risk of flooding elsewhere, in accordance with **4.5**; and

c) the design measures needed to manage the risk of flooding in and around the development, in accordance with **5.4** and **5.5**.

NOTE PPS 25 (England) [1], TAN 15 (Wales) [N1], PPS 15 (Northern Ireland) [3] and SPP (Scotland) [4] require a detailed, development-based flooding investigation to be prepared and submitted to the planning authority as part of the planning application. By producing the flood investigation at such an early stage, it can be used to influence the conceptual layout and design of the development and reduce (or avoid) the risk of flooding.

4.2 Site information

Before undertaking a detailed assessment of the risk of flooding, information about the site and surroundings should be obtained, including:

a) details of existing infrastructure (e.g. reservoirs, canals, culverts, flood risk management infrastructure and/or drainage infrastructure);

b) details of existing raised flood risk management infrastructure (e.g. the level of protection afforded by them and their condition);

c) evidence of historical flooding;

d) topographic mapping including local features (e.g. boundary walls and hedges);

e) information on site ground conditions.

*COMMENTARY ON **4.2***

There are many sources of information relating to the risk of flooding, including:

a) published information, for example:

- *existing assessments of the risk of flooding, e.g. regional flood risk appraisals (RFRAs), strategic flood risk assessments (SFRAs), strategic flood consequence assessments (SFCAs), reports, maps and plans published under the European directive on flood risks or site-based flood risk assessments;*
- *surface water management plans (SWMP);*
- *river basin management plans (RBMP);*
- *catchment flood management plans (CFMP);*
- *shoreline management plans (SMP);*
- *estuary management plans (EMP);*
- *strategic asset management plans (SAMPS);*
- *drainage assessments;*
- *water level management plans (WLMP);*
- *coastal habitat management plans (CHAMP)*

b) regulatory authorities and stakeholder groups:

- *the Environment Agency, Scottish Environment Protection Agency or Rivers Agency of Northern Ireland;*
- *local authorities (attention is drawn to the Flood and Water Management Act 2010 [6] under which the Lead Local Flood Authority [LLFA]) was created;*
- *sewerage undertakers;*
- *internal drainage boards;*
- *highway authorities;*
- *the British Geological Survey;*
- *infrastructure (e.g. reservoir, canal and railway) operators;*
- *SuDS approval bodies;*
- *harbour authorities.*

4.3 Assessing the risk of flooding to the development site and beyond

The risk of flooding associated with a proposed development should be assessed as the combination of the likelihood of flooding and its consequence.

The following factors should be assessed:

a) how likely, and to what extent, the site might flood and the nature of that flood hazard;

b) the consequence of flooding (e.g. damage to property, injury to people or loss of life); and

c) the impact that the development could have on flooding elsewhere.

The assessment of flood risk should quantify the risk of flooding, both to and from the site, from the following:

1) tidal and fluvial flooding (see **4.4.2** and **4.5.2**);

2) surface water flooding (see **4.4.3** and **4.5.3**);

3) flooding due to surcharging of sewers and drains (see **4.4.4**);

4) groundwater flooding (see **4.4.5** and **4.5.4**);

5) flooding caused by the failure of infrastructure (see **4.4.6**).

4.4 Assessing the likelihood of flooding to the development site

4.4.1 General

The likelihood of flooding to the proposed development site, from all sources, should be assessed in accordance with **4.4.2**, **4.4.3**, **4.4.4**, **4.4.5** and **4.4.6**. Possible future changes to the likelihood of flooding as a result of climate change should be assessed in accordance with **4.6**.

4.4.2 Tidal and fluvial flooding

NOTE Fluvial flooding is flooding caused by rivers, watercourses or ditches overflowing. Tidal flooding is flooding caused by elevated sea levels or overtopping by wave action. In estuarine areas, flooding might arise from either fluvial or tidal flooding, or a combination of the two.

4.4.2.1 Flood maps

Flood maps should be used in the first instance to assess the likelihood of flooding in and around the development.

*COMMENTARY ON **4.4.2.1***

Areas that are susceptible to tidal (for the 0.5% and 0.1%) or fluvial (for the 1% and 0.1%), flooding events are shown on flood maps published by the Environment Agency (England and Wales). The Scottish Environment Protection Agency (Scotland) publishes flood maps that indicate the areas susceptible to flooding in a 0.5% fluvial or tidal flood event. These flood maps are available for download from the Environment Agency website, www.environment-agency.gov.uk and the Scottish Environment Protection Agency website, www.sepa.org.uk, respectively.

The Department of Environment (Northern Ireland) publish strategic flood maps for Northern Ireland showing areas susceptible to tidal and fluvial flooding in the 1% and 0.5% events only. These strategic flood maps are available for download from the Rivers Agency Northern Ireland website, www.riversagencyni.gov.uk.

It is important to note that none of the flood maps available in England, Wales and Northern Ireland take into account the presence of flood risk management infrastructure. Within Scotland, the flood maps also do not take account of hydraulic structures (bridges and culverts).

In Wales, Development Advice Maps (DAMs) are produced by the Welsh Assembly Government. The maps indicate the extent of flooding in the 0.1% (1 in 1 000) fluvial and tidal flood event, including areas where flood risk management infrastructure does (and does not) provide a level of protection. An interactive online DAM map is available at http://data.wales/gov.uk/apps/floodmapping.

4.4.2.2 Developments outside the 0.1% flood extent

Where the development is situated outside the 0.1% (1 in 1 000) flood extent in England and Wales, evidence of historical flooding within the site, the potential risk of flooding from other sources and the potential impact on the likelihood of tidal and fluvial floods elsewhere as a result of the development should be investigated in accordance with **4.4.3**, **4.4.4**, **4.4.5** and **4.4.6**. However, no further assessment of the likelihood of tidal or fluvial floods to the development itself needs to be undertaken.

NOTE Within Scotland and Northern Ireland, the 0.1% flood extent is not published and therefore cannot be taken into consideration for development planning.

4.4.2.3 Developments within the 0.1% flood extent

NOTE In Northern Ireland, and Scotland the 0.1% flood extent is not published and therefore cannot be taken into consideration for development planning.

4.4.2.3.1 Outside the 0.5% tidal flood extent or the 1% fluvial flood extent

Where the development is situated outside the 0.5% (1 in 200) tidal flood extent, or outside the 1% (1 in 100) fluvial flood extent in England (or 0.5% (1 in 200) fluvial flood extent within Scotland), an assessment of the anticipated depth of flooding within the development during the 0.1% (1 in 1 000) event should be carried out. This assessment should be based upon:

a) the development site topography; and

b) the predicted flood levels.

In Northern Ireland or Wales, an assessment of the anticipated depth of flooding to developments outside of the 0.5% (1 in 200) tidal flood extent, or 1% (1 in 100) fluvial flood extent, is not required and therefore this subclause should not be applied to developments in these regions.

*COMMENTARY ON **4.4.2.3.1***

Predicted flood levels can be obtained from a number of sources, such as the Environment Agency or the relevant internal drainage board (England and Wales), as applicable.

Detailed hydraulic modelling is not usually necessary for assessments of developments outside the 0.5% tidal flood extent or the 1% fluvial flood extent.

4.4.2.3.2 Within the 0.5% tidal flood extent or the 1% fluvial flood extent

Where the development is situated within:

- the 0.5% (1 in 200) tidal flood extent or 1% (1 in 100) fluvial flood extent in England and Northern Ireland;
- the 0.5% (1 in 200) tidal flood extent or 0.5% (1 in 200) fluvial flood extent in Scotland; or
- the 0.1% (1 in 1 000) tidal flood extent and fluvial flood extent in Wales;

a more detailed assessment of the likelihood of flooding should be carried out. This detailed assessment should determine:

a) the depth of flooding in and around the development;

b) the velocity of the floodwaters in and around the development;

c) the flood hazard posed by floodwaters in and around the development based on the flood depth and velocity (in Wales, flood hazard should be assessed in accordance with TAN 15, **A1.15** [N1]);

d) the length of time for which the area in and around the development remain inundated;

e) the rate of rise of flood waters and the length of time available to forewarn of a potential flooding event at the development;

f) whether the development is likely to be cut off from other areas by floodwaters; and

g) the presence and level of protection provided by flood risk management infrastructure.

Information relating to the risk of flooding within (and around) the development should be obtained from historical evidence, previous flood risk assessments or detailed analysis and modelling.

NOTE 1 Such information might be available from the Environment Agency or the relevant internal drainage board (England and Wales), SEPA or Local Planning Authority (Scotland) or Rivers Agency NI (Northern Ireland), as applicable.

Advice should also be obtained (see Note 1) regarding the suitability of any existing data for the purposes of assessing the likelihood of flooding and the need for further investigations. Any existing flood risk management infrastructure should be taken into account when determining these characteristics (see **4.4.6**).

NOTE 2 Flood hazard can be calculated in accordance with the Environment Agency publication, Supplementary note on flood hazard ratings and thresholds for development planning control purpose*s [11].*

To provide a thorough understanding of the risk posed by flooding in and around the development, the characteristics of flooding should be assessed for a range of flooding events, including the 5% (1 in 20), the 1% (1 in 100), and the 0.5% (1 in 200). The 0.1% (1 in 1 000) flood extent should also be assessed in Wales.

The flood hazard assessment should cover the hazard posed by the floodwaters over the three phases of flooding: firstly, within the site as the floodwaters start to spill into the development, secondly, during the flood event, and thirdly, as the floodwaters retreat. Floating debris, contaminants in the water and unseen obstructions beneath the water can increase the hazard, and should also be considered within the assessment.

4.4.3 Surface water flooding

NOTE 1 Surface water flooding can occur as a result of either overland flow or ponding. Overland flow occurs following heavy or prolonged rainfall, or snow melt, where water can no longer be absorbed on the surface and results in surface run-off. Unless it is channelled elsewhere, the run-off travels overland, following the natural gradient of the land. Ponding occurs as the overland flow reaches natural depressions or blockages in the local topography.

The likelihood of surface water flooding should be assessed by examining the following information:

a) reports of observed flooding incidents in and around the development, where available;

   NOTE 2 These are sometimes available from published media and the local authority (or other relevant regulatory authorities and stakeholder groups). Local residents might also be able to provide information.

b) published reports including strategic flood risk assessments (SFRA), strategic flood consequence assessments (SFCA), surface water management plans (SWMP) or previous site specific assessments;

   NOTE 3 These studies can usually be sourced from the local authority website. SWMPs are only applicable to England and Wales.

c) a study of the local topography that identifies overland flow routes and areas that might be susceptible to ponding. This study should include:

   1) an assessment of the run-off characteristics of the local catchment area draining towards the development for a range of local storm events, from the 50% (1 in 2) to the 1% (1 in 100) design rainfall [or 0.5% (1 in 200) design rainfall in Scotland] for a range of storm durations;

   2) the rate and volume of run-off that naturally drains towards the identified overland flow routes and areas of ponding, and therefore the depth of surface water that might occur, as determined by the run-off characteristics;

NOTE 4 The critical duration of the storm event will be defined by the local catchment characteristics but is likely to last less than six hours.

d) a review of the level of service and functioning of the existing drainage system, and its susceptibility to blockages. This should be discussed with the authority responsible for its operation (see **4.4.4**).

4.4.4 Flooding from sewers and drains

NOTE Sewer and highway drainage flooding occurs when the capacity of systems is exceeded, or the function of the system is impeded (e.g. tide locking), which results in the surcharging and/or failure of the system and water being forced to the surface via gullies, manholes, dedicated overflows or connected infrastructure (e.g. toilets).

To assess the likelihood of flooding from sewers, open drains (natural and constructed) and SuDS, the level of service of the existing sewer or drainage system serving the development (and surrounds) should be discussed with those responsible for its operation (e.g. the local authority, the water utility, the highway authority or private owner). Any known incidents of historical flooding should also be discussed.

4.4.5 Groundwater flooding

NOTE 1 Groundwater flooding can occur on sites which are located on permeable ground. After a prolonged period of rainfall, a considerable rise in the water table can result in inundation for extended periods of time.

The likelihood of groundwater flooding in and around the development should be assessed through:

a) collating and reviewing observed incidents of groundwater flooding in and around the development;

NOTE 2 These might be available from the relevant regulating authority and the relevant local authority.

b) reviewing published information to identify significant groundwater influences such as potential sub-surface flow paths, e.g. groundwater vulnerability mapping, groundwater susceptibility mapping, geological mapping, pumping records and borehole records;

NOTE 3 Such information can be obtained from the British Geological Survey [2], in England and Wales the Environment Agency [3], and in Scotland the Scottish Environment Protection Agency. [4]

c) reviewing a qualitative appraisal of the potential impact of the cessation of groundwater management activities;

d) investigating the difference between the 1% (1 in 100) river level and ground levels within the development, in areas of permeable geology;

e) collating and reviewing observed incidents of groundwater emergence in the surrounding areas that could result in overland flooding of the development.

---

[2] The British Geological Survey can be contacted by writing to: Central Enquiries, British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham NG12 5GG, or through the British Geological Survey website, www.bgs.ac.uk.

[3] The Environment Agency can be contacted by writing to: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY or through the Environment Agency website, www.environment-agency.gov.uk.

[4] The Scottish Environment Protection Agency can be contacted by writing to: SEPA Corporate Office, Erskine Court, Castle Business Park, Stirling, FK9 4TR or through the SEPA website, www.sepa.org.uk.

4.4.6 Flooding caused by the failure of infrastructure

4.4.6.1 Water containment infrastructure

4.4.6.1.1 General

Water containment infrastructure, such as reservoirs or canals, situated above or upstream of the development should be identified and documented. It is essential to document whether the development is situated on higher or lower ground than the water containment structure, as failure of water containment structures can cause flooding with little or no warning to areas situated on lower ground.

4.4.6.1.2 Reservoir failure

The likelihood and consequence of dam failure at a reservoir should form part of the assessment.

NOTE 1 At the time of publication, reservoirs having a capacity greater than 25 ML fall under the jurisdiction of the Reservoirs Act 1975 [5]. In these circumstances the operation and management of the reservoir is the responsibility of the operator. It is reasonable to assume that the likelihood of failure in these circumstances is very low, and therefore no further analysis is required. Upon implementation of the Flood and Water Management Act 2010 [6] and the Reservoirs (Scotland) Act 2011 [8], all reservoirs that are over 10 ML in volume will be regulated in England, Wales and Scotland.

NOTE 2 The Reservoirs Act 1975 [5] does not apply to Northern Ireland.

For reservoirs not falling under the jurisdiction of the Reservoirs Act 1975 [5], a risk-based approach should be taken to assess the level of detail of analysis that is appropriate for the site, as follows.

a) Where a sudden reservoir failure might result in the rapid inundation of the development with insufficient warning to allow a safe evacuation, a hydraulic assessment should be undertaken. The depth and velocity of the resulting flood wave as it approaches (and flows through) the site should be taken into consideration in this assessment.

b) The structural integrity of the reservoir should be assessed in discussion with the reservoir owner or reservoir operator. Consideration should be taken of the long term maintenance of the structure, over the lifetime of the development.

c) Where the development is situated at a distance from the reservoir that it can be evacuated safely in case of a sudden structural failure, or the predicted depth of flooding through the site as a result of the structural failure of a reservoir is less than 250 mm, it is not necessary to undertake a detailed assessment.

4.4.6.1.3 Canal failure

For canals, a flood risk assessment should be carried out to determine:

a) the likelihood of structural failure;

b) the consequence of structural failure, including the likely depth and velocity of the floodwaters through the site, and the warning time available for evacuation of the development site.

The need for detailed appraisal, and the scope of the analysis required, should be discussed at an early stage with the relevant regulating authority.

4.4.6.2 Land drainage infrastructure

An assessment of the likelihood and consequence of the failure of land drainage infrastructure should be undertaken (i.e. whether or not this failure increases the risk of flooding to the site). An assessment of the likelihood and consequence of the cessation of land drainage management activities should also be undertaken.

*COMMENTARY ON **4.4.6.2***

Some low lying areas are reliant upon artificial land drainage infrastructure to reduce the risk of regular and prolonged surface water and/or groundwater flooding. Examples of land drainage infrastructure include pumping stations, open drainage ditches and sluices. The operation and failure of such land drainage infrastructure can result in localized flooding and for this reason it is important to be aware of the impact and importance of land drainage infrastructure.

4.4.6.3 Culverts and bridges

The blockage of culverts or bridges can result in a rapid and unexpected increase in flood levels during a flood event, so the presence of culverts or bridges downstream of the development should be identified. The likelihood of blockage should be assessed based on upstream land use, stream morphology, stream vegetation, the size and shape of the culvert, and the presence and design of a trash or security screen. The impact of blockages on the frequency and depth of flooding in and around the development should be investigated where blockages are likely to occur.

The following instances should be taken into account:

a) for bridge openings and culverts that are less than 1 m^2, the increase in the depth and frequency of flooding within the site as a result of a 90% blockage of the cross-sectional area;

b) for bridge openings and culverts that are greater than, or equal to, 1 m^2, the increase in the depth and frequency of flooding within the site as a result of a 50% blockage of the cross-sectional area.

4.4.6.4 Raised flood risk management infrastructure

Where the development is situated within an area that is protected by the presence of raised flood risk management infrastructure, the residual risk of flooding to the development site as a result of the failure of a raised flood risk management infrastructure should be assessed. The impact of overtopping of the defence and of a sudden breach should be considered in the 1% (1 in 100) fluvial [or the 0.5% (1 in 200) fluvial event within Scotland] or 0.5% (1 in 200) tidal flood event, whichever is greater. The likelihood and consequence of a failure at different locations should be used to determine the maximum risk to the development.

The depth of flooding in and around the development, the velocity of floodwaters entering the site and the resulting hazard posed by the floodwaters should be assessed in accordance with **4.4.2.3.2**. Detailed hydraulic modelling should be included as part of the assessment.

Within Northern Ireland, the required minimum standard of protection of 1% (1 in 100) within fluvial areas, or 0.5% (1 in 200) in tidal areas (whichever is greater), can be expected to be provided by the existing raised flood risk management infrastructure. Existing raised flood risk management infrastructure should be assessed and ensured to be structurally sound. The raising and/or structural reinforcement of existing flood defences to make way for development is not permitted.

Within Wales, the structural adequacy of existing raised flood risk management infrastructure should be considered under a range of flooding conditions, up to and including the 0.1% (1 in 1 000) flood event.

4.4.6.5 Flood risk management infrastructure

The residual risk of flooding to the site owing to the failure of flood risk management infrastructure should be assessed. This infrastructure might include, for example, flood gates or sluices that prevent floodwaters from entering the site during a flooding event. The responsibility for maintaining and operating this infrastructure should be understood, and the likelihood and consequence of a system failure (i.e. whether or not this increases the risk of flooding to the site) should be assessed.

NOTE The intention to commit to the long term maintenance and operation of flood risk management infrastructure might be discussed in published plans including, for example, catchment flood management plans.

4.5 Assessing the likelihood of flooding as a result of the development

4.5.1 General

There should be no increase to the risk of flooding as a result of the proposed development. The following analyses should be carried out to assess the impact that the proposed changes to the site are likely to have upon the existing flooding regime (see **5.3**). This information should be used to inform the development of mitigation measures in accordance with Clause **5**.

Possible future changes to the likelihood of flooding as a result of climate change should be assessed in accordance with **4.6**.

4.5.2 Tidal and fluvial flooding

4.5.2.1 Developments outside the 0.1% flood extent

Where the development is situated outside the 0.1% (1 in 1 000) flood extent, no further assessment of the likelihood of tidal or fluvial floods as a result of the proposed development is normally required. However, the impact that the development might have upon the risk of flooding from other sources should still be investigated in accordance with **4.3** and **4.4**.

NOTE Within Northern Ireland, the 0.1% flood extent is not published and is not taken into consideration for development planning. Within Scotland, the 0.1% flood extent is not published.

4.5.2.2 Developments within the 0.1% flood extent

Where the development is situated within the 0.1% (1 in 1 000) flood extent, within the 0.5% (1 in 200) flood extent in Scotland, or within the 0.5% (1 in 200) tidal and 1% (1 In 100) fluvial flood extent in Northern Ireland, a more detailed assessment of the likelihood of flooding should be carried out to determine:

a) the change to the depth of flooding as a consequence of the proposed development;

b) the change to overland flow routes as a consequence of the proposed development;

c) the loss of available floodplain storage as a consequence of the proposed development;

NOTE The loss of available floodplain storage should be measured at 100 mm incremental increases in the depth of flooding.

d) the change to the level of protection provided by flood risk management infrastructure (where present) as a consequence of the proposed development.

Where flood risk management infrastructure is present, it should be taken into account when determining these characteristics (see also **4.4.6**).

Any changes to the characteristics of flooding as a result of the introduction of the development should be assessed for a range of flooding events, including the 5% (1 in 20), the 1% (1 in 100), and the 0.5% (1 in 200). In Wales, the 0.1% (1 in 1 000) flood event should also be included.

4.5.3 Surface water flooding

The increase in the likelihood of surface water flooding should be assessed through:

a) a study of the changes to local topography and drainage within the site. This study should include:

   1) an assessment of where overland flow paths might be altered or blocked;

   2) an assessment of where areas of surface water ponding or existing ditches might be lost, resulting in the displacement of water to other areas;

b) a study of the changes to the permeability and topography of the site as a result of the proposed development. This study should include:

   1) an assessment of the changes to the run-off characteristics of the local catchment area for a range of local storm events, from the 50% (1 in 2) to the 1% (1 in 100) flood event and in Scotland the 0.5% (1 in 200) flood event;

   2) the change in the rate and volume of run-off that naturally drains towards the identified overland flow routes and areas of ponding, and therefore the depth of surface water that might occur, as determined from the run-off characteristics given in **4.5.3**b)1).

4.5.4 Groundwater flooding

The increase in the likelihood of groundwater flooding should be assessed through a study of the changes (including possible truncations) to sub-surface flow paths as a result of underground structures (e.g. basements and sheet piling).

4.6 The impact of climate change

An assessment should be carried out of the potential impact that changes to the climate might have upon the risk of flooding. This assessment should cover changes to the likelihood of tidal, fluvial and/or surface water flooding that might occur over the lifetime of the proposed development. The lifetime of development should typically be defined as 75 years for non residential development and 100 years for residential development, unless otherwise agreed with the local planning authority.

The assessment of the impact of climate change should be used for developing flood management measures, in accordance with Clause **5**.

NOTE An assessment of the possible impact of changes in the climate on flood risk can be carried out in accordance with the DEFRA guidance given in PPS 25, Appendix B [1]. For Wales, see TAN 15, Appendix 2 [N1], for further information. In some local authority areas throughout the UK, there might also be a requirement to steer sensitive development away from areas that might be susceptible to flooding in the future as a result of climate change.

4.7 The consequence of flooding

*COMMENTARY ON **4.7***

*The recommendations given in **4.4** and **4.5** cover the likelihood of flooding and the characteristics of the floodwaters. To fully ascertain the flood risk to a development, or changes to the risk of flooding elsewhere as a result of the proposed development, it is important to assess the consequences of flooding to infrastructure and inhabitants.*

Effective flood management measures conforming to Clause **5** should be implemented to reduce the potential consequences of flooding by minimizing the damage that is sustained to property as a result of flooding, to help to safeguard inhabitants within the development during a flooding event and, where practicable, to maintain access to all areas by emergency services during flooding conditions.

5 Managing the risk of flooding

5.1 A risk-based approach for managing flood risk within a development

A sequential, risk-based approach should be taken to managing flood risk within a development. Each stage in this hierarchical process should be completed before moving onto the next. The stages should be completed as follows.

- *Stage 1 – Assessing and understanding the flood risk.* The first stage in this approach is to assess and understand the risk that is posed by flooding, in accordance with Clause **4**. Until a sound understanding of the variation in flood risk across the development site (and the surrounding area) has been achieved, it is not practicable to plan to avoid and manage the risk.
- *Stage 2 – Avoiding the risk.* Having assessed and understood the risk of flooding, the next stage is to avoid the risk (see **5.2**), where practicable. Developers should avoid building within flood affected areas of their site (see **5.2**).

  NOTE 1 Stage 2 is not applicable within Northern Ireland.
- *Stage 3 – Substitution*. Where flood risk cannot be avoided completely then the consequence of flooding within the development should be managed through substitution. This may include substituting land uses for ones that are less vulnerable to flooding, or orientating the development within the site so that more vulnerable uses are situated in areas that are least likely to flood frequently and/or to a significant depth, in accordance with **5.3**.

  *NOTE 2 Stage 3 is not applicable within Northern Ireland. Refer to **5.3.1** for the appropriate selection of land use.*
- *Stage 4 – Flood control/surface water management incorporation*. Where the flood risk cannot be managed completely through development location, flood control and surface water management infrastructure should be incorporated to the development, including (for example) SuDS, overland flow pathways or flood barriers in accordance with **5.4**.

  NOTE 3 Attention is drawn to the Water Environment (Controlled Activities) (Scotland) Regulations 2011 [9]. The incorporation of SuDS into development locations is a legal requirement in Scotland.
- *Stage 5 – Resistant/resilient building techniques.* As a final measure after stages 1 to 4 have been exhausted, the risk of flooding should be mitigated by adopting resistant and/or resilient building techniques to minimize the damage and disruption that is caused by flooding in accordance with **5.5**.

- *Stage 6 – Safety.* Consideration should be given to the safety of occupants in the event of flooding in accordance with **5.6**.

5.2 Avoid

Wherever practicable, development should be avoided in areas that are susceptible to flooding. This might involve reducing the developable area of the site, and restricting development to elevated areas of the site that are not susceptible to flooding. Only when this cannot be achieved should flood risk management measures be considered.

NOTE This subclause is not applicable within Northern Ireland.

5.3 Substitute

5.3.1 Appropriate land use

The proposed land use should be commensurate with the likelihood, scale and severity of flooding in and around the development.

*COMMENTARY ON **5.3.1***

The potential impact of a flooding event might increase if vulnerable members of the community, or critical infrastructure needed by the wider community, are situated in areas that are known to be at risk. For this reason, the administrations in the UK have identified various building and land uses in terms of their vulnerability and indicated whether or not these are likely to be appropriate in areas at different probabilities of river and tidal flooding.

The relevant national planning policy references are given in Table 1.

Table 1 **National planning policy references for appropriate land use**

Country	Reference
England	PPS25 [1] [A)]
Wales	TAN15 [N1] [B)]
Scotland	SPP [4] [C)]
Northern Ireland	PPS15 [3] [D)]

[A)] At the time of publication, the applicable sections are: Appendix D, Table D.2 (definition) and Table D.1 (application).

[B)] At the time of publication, the applicable sections are: Figure 2 (definition) and Section 9 (application).

[C)] At the time of publication, the applicable section is paragraph 204 (risk framework)

[D)] At the time of publication, the applicable section is Section 8 (policy FLD 1).

5.3.2 Site layout within an area without raised flood risk management infrastructure

The layout of the site should be in accordance with the following hierarchy:

a) all development should be situated outside of the flood affected area;

b) where a) is not practicable, buildings, utilities and access routes should be situated outside of the flood affected area, restricting only landscaping to areas at risk of flooding;

c) where b) is not practicable, buildings, utilities and access routes should be situated in areas of the site that are at the lowest risk of flooding;

d) where c) is not practicable, the design measures set out in **5.4** to **5.5** should be integrated into the development to mitigate the risk of flooding.

NOTE This subclause is not applicable within Northern Ireland.

5.3.3 Waterway corridors and overland flow routes

Where a development site is situated immediately adjacent to an open or a culverted watercourse or the landward side of a flood risk management infrastructure, a buffer zone should be provided, free of obstruction and at existing ground level, to allow access to the waterway for maintenance purposes. Discussions should be held with the relevant regulatory authority at an early stage to confirm the buffer requirements and, where considered necessary, buffers should be a minimum of 10 m wide.

NOTE 1 In tidally affected areas the buffer zone is likely to be higher than the minimum recommendation. During extreme conditions, buffer zones may also serve as conveyance routes.

The landscape design should be such that it provides a free and unimpeded passage of any likely flood flows, and makes provision for easy and unobstructed access to higher land as flood waters rise. Areas of isolated higher ground that could become islands in flooding conditions should be avoided for development. Landscaping furniture (e.g. seating) should be appropriately located and firmly fixed to minimize the risk of causing downstream blockages.

NOTE 2 Natural (or introduced) overland flow routes can, in flood or exceedance conditions, become waterways, even where they would usually be dry. Further guidance regarding designing for drainage can be found in the CIRIA publication, Designing for exceedance in urban drainage – Good practice [12].

NOTE 3 This subclause is not applicable within Northern Ireland.

5.3.4 Use of floor space within a building

Where a site is at risk of flooding, land uses that could leave inhabitants vulnerable (for example, residential uses) should be situated on upper floors of the building, above the 1% (1 in 100) flood level, or within Scotland, the 0.5% (1 in 200) flood level. The ground floor should, wherever practicable, be restricted to non residential uses (for example, commercial or industrial uses).

Basements should be planned and developed with internal access to a higher floor (above flood level) and they should be constructed using flood resistant and/or resilient design techniques.

The provision of industrial land uses at ground level can lead to a risk of pollution during flooding conditions. The risk of pollution should be considered at the design stage of the development process, and where it is believed that there might be a risk of pollution, appropriate measures should be incorporated into the development to manage it (e.g. through the raising and/or bunding of chemical stores).

*COMMENTARY ON **5.3.4***

This subclause is not applicable within Northern Ireland.

There is a significant risk to the safety of occupants when sleeping accommodation is provided at basement level within an area that is susceptible to flooding. As floodwaters enter the property, a basement can rapidly become inundated. It is therefore inadvisable to plan and build a development in which basement space is intended to be used for sleeping accommodation.

It is important that developers check with the regulating authorities, including the local planning authority regarding the acceptability of basements in areas at risk of flooding.

5.4 Control

5.4.1 General

Where the risk of flooding cannot be avoided (see **5.2**), then measures should be taken to defend or protect the development from flooding without increasing the flood risk to others.

5.4.2 Flood risk management infrastructure

Development proposals should not rely on new raised flood risk management infrastructure to protect against flooding.

NOTE 1 Raised flood risk management infrastructure provide a barrier to reduce the risk of flooding to a development. However, the overtopping and/or sudden failure of the defence can pose a risk to life. For this reason, development proposals that involve the construction of new raised flood risk management infrastructure are generally considered unsuitable.

The developer should ascertain and document who the responsible party is for the maintenance of flood risk management infrastructure.

NOTE 2 The developer may take on responsibility for the maintenance of flood risk management infrastructure, or the structure may be adopted (and maintained) by an appropriate authority.

Within Northern Ireland, the required minimum standard of protection of 1% (1 in 100) within fluvial areas, or 0.5% (1 in 200) in tidal areas (whichever is greater), can be expected to be provided by the existing raised flood risk management infrastructure. Existing raised flood risk management infrastructure should be assessed and ensured to be structurally sound. The raising and/or structural reinforcement of existing flood defences to make way for development is not permitted.

Within Wales, development proposals within flood affected areas should (wherever practicable) have land raising incorporated, in accordance with **5.5.3.1**. Only where this is not feasible should raised flood risk management infrastructure be considered. Flood defences should be assessed and ensured to be structurally sound under a range of flooding conditions, including the 0.1% (1 in 1 000) flood event.

5.4.3 Bridges and culverts

The effects of blockages of bridges or culverts upon the risk of flooding within the site should be considered, in accordance with **4.4.6.3**.

Where there is evidence that blockages occur frequently and might increase the risk of flooding to the development site, then ownership and responsibility for the bridge or culvert should be established. Where an increase in flood risk is likely, the implementation of contingency measures should be considered, such as the implementation of an unobstructed overland flow route to direct the excess floodwater through the development site, reducing the risk of damage to property (see **5.3.3**).

5.4.4 Water containment infrastructure

The consequence of failure of water containment infrastructure should be considered, in accordance with **4.4.6**. Where there is clear evidence of a potential risk to life as a result of the sudden failure of a reservoir or canal, then consideration should be given to avoiding building a development at this location. Where it is not practicable to avoid building the development at this location, then consideration should be given to ensuring the long term safety of the users of the site in light of the risk that has been identified. As a minimum, the responsibility for the long term maintenance of reservoirs and/or canals should be established.

*COMMENTARY ON **5.4.4***

Attention is drawn to the Reservoirs Act 1975 [5] and the Flood and Water Management Act 2010 [6]. The Reservoirs Act 1975 [5] does not apply to Northern Ireland.

It should be noted that at the time of publication all reservoirs above ground greater than 25 ML capacity are regulated in England, Wales and Scotland under the Reservoirs Act 1975 [5]. The owners of regulated reservoir are required to assess and manage the risk of flooding that might occur as a result of reservoir failure. This is achieved through monitoring, maintenance, and operation. During 2010 and 2011, the Reservoirs Act 1975 [5] will be replaced such that:

- *the Flood and Water Management Act 2010 [6] will reduce the threshold of capacity of regulated reservoirs to 10 ML within England and Wales;*
- *the Reservoirs (Scotland) Act 2011 [8] will require reservoirs greater than 10 ML to be regulated within Scotland.*

5.4.5 Existing sewer and drainage infrastructure

The consequence of failure of existing sewer and drainage systems should be considered, in accordance with **4.4.4**. Where there is evidence of a risk of flooding due to the serviceability or structural condition of the existing sewer system, then consideration should be given to rehabilitating the sewer system as part of the development process. In all circumstances, the responsibility for the long term maintenance of the systems over the lifetime of the development should be established and documented.

5.4.6 Surface water management

It should be demonstrated that the rate of surface water runoff from the development site, and the frequency and severity of surface water flooding to surrounding areas, would not increase as a result of the proposed development. Where practicable, the risk of surface water flooding to surrounding areas should be reduced.

*COMMENTARY ON **5.4.6***

Attention is drawn to the Flood and Water Management Act 2010 [6] in England and Wales and the Flood Risk Management (Scotland) Act 2009 [7].

Sustainable Drainage Systems (SuDS) are designed to mimic the response of the natural environment, mitigating the impact of the proposed development upon the local flooding regime. Further guidance for developers regarding the selection, design and implementation of SuDS can be found in the CIRIA SuDS Manual [13].

It might be advisable for developers to check with regulating authorities, including the local planning authority, regarding required surface run off rates.

5.4.7 Groundwater management

Where a risk of groundwater flooding has been identified (see **4.5.4**) then basement areas should be waterproofed to avoid the ingress of water. The ground floor level should be raised above the predicted groundwater flood level and flood resistant building techniques should be adopted to minimize the damage sustained as a result of prolonged flooding (see **5.5.4**). Access routes should be designed in such a way that they remain safe during periods of groundwater flooding (see **5.6.2**).

5.5 Mitigation

5.5.1 General

Where the risk of flooding cannot be avoided, and the development site cannot be defended or protected against flooding, then residual risks should be safely managed and rapid recovery techniques incorporated into the building design in accordance with **5.5.2** to **5.5.6** and **5.6**.

NOTE This subclause is not applicable in Wales.

5.5.2 Mitigation within an area with raised flood risk management infrastructure

Within Northern Ireland and Wales, greenfield development should not be constructed in areas that have raised flood risk management infrastructure.

NOTE 1 See PPS 15 (Northern Ireland) [3] and TAN 15 [N1] for further information.

A minimum standard of protection of 1% (1 in 100) within fluvial areas, or 0.5% (1 in 200) in tidal areas (whichever is greater), should be assessed and ensured to be provided by the existing raised flood risk management infrastructure. The existing defences should also be assessed and ensured to be structurally sound. The raising and/or structural reinforcement of existing flood defences to make way for development is not permitted.

NOTE 2 Within Scotland, where a minimum standard of protection of 0.5% (1 in 200) is provided, brownfield development is generally acceptable.

Where a site is protected against flooding by flood risk management infrastructure, the consequence of overtopping or breach should be assessed, in accordance with Clause **4**.

The following should be included in the development process.

a) The layout of the site should be arranged to reduce the risk of flooding to buildings or access routes by orienting these away from areas that would be inundated as a result of defence failure, wherever practicable.

b) Buildings should be designed so that floor levels are situated 300 mm above the 1% (1 in 100) fluvial flood level, or 0.5% (1 in 200) tidal flood level (whichever is higher) and include an allowance for climate change in accordance with **4.6**. This should be computed using the overtopping or breach of the flood risk management infrastructure, whichever results in the worst case conditions within the site.

c) Within Northern Ireland, floor levels should be situated 300 mm above the 1% (1 in 100) fluvial flood level, or 0.5% (1 in 200) tidal flood level (whichever is higher) and include an allowance for climate change in accordance with **4.6**. Where climate change has not been calculated, floor levels should be situated 600 mm above the design flood level.

d) Within Scotland, floor levels should be situated a minimum of 500 mm above the 0.5% (1 in 200) fluvial or tidal flood level (whichever is higher) and include an allowance for climate change in accordance with **4.6**.

e) Building floor levels should be situated above the predicted 1% (1 in 100) surface water flood level, or maximum anticipated groundwater flood level, whichever is higher.

NOTE This takes into account the potential for surface water and groundwater flooding within the defended site.

f) Where floor levels cannot be raised due to access and/or planning constraints, flood resistance and/or resilience techniques should be incorporated into the building fabric, in accordance with **5.5.4** and **5.5.5**;

g) Within Wales, building resistance and/or resilience measures should only be considered in the refurbishment of existing buildings. The adopted land use should be appropriate, in accordance with **5.3.1**.

h) The developer should establish that a commitment is in place for the long term maintenance and safe operation of the existing flood risk management infrastructure in accordance with **4.4.6**.

5.5.3 Mitigation within an area without raised flood risk management infrastructure

NOTE This subclause does not apply within Northern Ireland. Built development is only permitted within the planning process in undefended areas under exceptional circumstances, see PPS 15 [3].

5.5.3.1 Raising development site ground levels

Where measures are proposed to raise the ground levels of the development site, such measures should be demonstrated not to cause an increase in flood risk elsewhere (see **5.5.6**).

NOTE Raising ground levels reduces the risk of flooding to the development. This is likely to result in a change to the passage and storage of flood flows within the floodplain, which in turn can increase the frequency and severity of flooding to other areas.

5.5.3.2 Raising floor levels

Where buildings cannot be moved outside the flood risk area, finished floor levels should be raised above the 1% (1 in 100) flood level in areas at risk of surface water and/or fluvial flooding, or raised above the 0.5% (1 in 200) flood level in areas at risk of tidal flooding. Within Scotland, finished floor levels should be raised above the 0.5% (1 in 200) fluvial or tidal flood level, whichever is greater. The building floor level should be raised by applying a freeboard to a height above the maximum predicted flood level that takes into account:

a) the height of waves that might occur; and

b) any anticipated increase in the predicted flood level as a result of climate change.

NOTE 1 The minimum freeboard is generally 600 mm where there is a lack of information on which to base the flood level, or 300 mm where there is confidence in the predicted flood level.

Building floor levels should be situated above the predicted 1% (1 in 100) surface water flood level, or maximum anticipated groundwater flood level, whichever is higher.

NOTE 2 The design of buildings should also consider the potential for surface water and groundwater flooding.

Before raising floor levels, discussions should be held with the local planning authority regarding the impact that raised floor levels could have on:

i) disabled access into buildings; and

ii) roof levels of buildings within designated heritage or character areas.

NOTE 3 Loss of available floodplain storage due to raising floor levels can result in an increase in the risk of flooding elsewhere. It might be necessary to consider other measures to compensate for this loss.

5.5.4 Building design – resistance to flooding

Where it is not feasible to raise floor levels or development site ground levels above the flood level, buildings should be constructed using water-resistant materials.

NOTE 1 This is designed to resist the full hydrostatic head of flood water, with an allowance for uncertainty and the potential effects of debris in flowing flood water. Brickwork may be used to prevent water ingress for limited depths of flood water.

Water should be allowed to enter the building once the depth of flooding exceeds 600 mm. In these circumstances, resilient building techniques should be adopted, in accordance with **5.5.5**.

NOTE 2 Allowing water to enter the building once the flood depth has exceeded 600 mm can help to reduce the risk of structural damage due to differential hydrostatic heads. Guidance for developers regarding resilient building techniques is provided in the communities and local government document, Improving the flood performance of new buildings – Flood resilient construction *[14].*

Within Wales, building resistance and/or resilience measures should only be considered for the refurbishment of existing buildings. The adopted land use should be in accordance with **5.3.1**, and the frequency and severity of flooding should be limited to the criteria set out in TAN 15, **A1.14** and **A1.15** [N1].

5.5.5 Building design – resilience to flooding

Where it is not practicable to raise floor levels above the flood level, or to construct the building using resistant materials, the building should be constructed using materials that are not affected by water or are sacrificial. Where such building materials are used, services should be located above the 1% (1 in 100) peak design flood level, including an allowance for climate change in accordance with **4.6**.

NOTE Guidance for developers is provided in Improving the flood performance of new buildings – Flood resilient construction *[14].*

Within Wales, building resistance and/or resilience measures should only be considered for the refurbishment of existing buildings. The adopted land use should be in accordance with **5.3.1**, and the frequency and severity of flooding should be limited to the criteria set out in TAN 15, **A1.14** and **A1.15** [N1].

5.5.6 Mitigating the impact of development (compensatory floodplain storage)

Where a proposed development reduces the available storage volume of a flood plain, compensatory flood plain storage should be provided to prevent a net increase in the frequency or severity of flooding elsewhere.

The compensatory floodplain storage should:

a) be in close proximity to the development, where practicable;

b) provide the same volume at the same topographic level as that lost;

c) be connected hydraulically to the flood plain and able to freely fill and drain by gravity; and

d) be open and unlikely to be enclosed throughout its life;

e) not affect the flow of water over land;

f) be protected from future development through the planning process.

For **5.5.6**b), the net volume of available floodplain storage should be measured at 100 mm incremental increases in the depth of flooding, up to (and including) the maximum predicted 1% (1 in 100) design flood level, or the 0.5% (1 in 200) design flood level in Scotland.

NOTE The use of compensatory floodplain storage is not applicable to development sites that are susceptible to flooding in Northern Ireland.

5.6 Public safety

5.6.1 General

Public safety should be considered in all aspects of managing flood risk. Although the development might not be directly affected by flooding, access routes to the site might be hindered by floodwater. The provision of a safe access route and the establishment of an emergency plan, where appropriate, should be carried out in accordance with **5.6.2** and **5.6.3**.

5.6.2 Safe access to the development site and evacuation of people during flooding

A safe access route to the development site should be provided in accordance with **5.6.2**a) or **5.6.2**b) or **5.6.2**c). These should be considered in hierarchical order, from **5.6.2**a) to **5.6.2**c). Within Scotland, access and egress routes should be designed for the 0.5% (1 in 200) flood event.

a) Wherever practicable, the safe access route should be situated above the 1% (1 in 100) fluvial flood level or 0.5% (1 in 200) tidal flood level (whichever is greater), including an allowance for climate change, in accordance with **4.6**. The safe access route should be constructed to allow those within the development site to be able to exit the development to an area of safety while remaining dry.

b) Where it is not practicable to construct an access route to the development site that is situated above the design flood level given in **5.6.2**a), the flood hazard along the access route should be assessed for the 1% (1 in 100) fluvial flood event, or 0.5% (1 in 200) tidal flood event (whichever is greater), including an allowance for climate change, in accordance with **4.6**. The assessment should be carried out as follows.

   1) Where flood depth is $\leq$0.25 m, flood hazard = [(velocity + 0.5) x depth] + 0.5;

   2) Where flood depth is >0.25 m, flood hazard = [(velocity + 0.5) x depth] + 1.0.

   Wherever practicable, the access route should be designed such that the flood hazard in the 1% (1 in 100) fluvial flood event or 0.5% (1 in 200) tidal flood event (whichever is greater), including an allowance for climate change in accordance with **4.6**, is less than 1.25.

   NOTE 1 Under these circumstances, it is likely that most occupants will be able to evacuate the site without undue danger. Some people such as young children, older and disabled people might require the assistance of the emergency services.

   *NOTE 2 For guidance regarding assessing flood hazard in Wales, see **4.4.2.3.2**c).*

c) Where it is not practicable to construct an access route with a flood hazard of less than 1.25 in accordance with **5.6.2**b), the access route should be designed such that the flood hazard in the 1% (1 in 100) flood event is less than 2.0. A development should not be proposed where the flood hazard is greater than 2.0.

NOTE 3 Under these circumstances, the safe access route can provide access for the emergency services to rescue the occupants.

*NOTE 4 For guidance regarding assessing flood hazard in Wales, see **4.4.2.3.2**c).*

In all instances, an emergency plan should be prepared, in accordance with **5.6.3**.

5.6.3 Emergency planning

The emergency plan should include:

a) the availability of flood warnings, and how these can be accessed;

b) the responsibility for monitoring and acting upon flood warnings;

c) the triggers for action in response to a flood warning;

d) the procedure required for safely evacuating people from the site;

e) the route by which people can be safely evacuated;

f) the safe area to which evacuees should proceed;

g) the safe shut down procedures for machinery or plant.

Buildings which cannot be evacuated easily should be provided with an on-site refuge. However, a safe access route conforming to **5.6.2** should also be provided for evacuation in case of an emergency (e.g. medical or fire) or where the flooding exceeds predicted levels.

*COMMENTARY ON **5.6.3***

Where a development is situated within an area that is at risk of flooding, it is important that the users of the site are made aware of that fact. This can help them to prepare for a flood, when one occurs, thereby reducing not only the physical danger, but also the stress of being flooded and, potentially, the damages sustained. There are, however, some situations where it is preferable for people to remain in a place of safety within a flooded property, rather than risk injury during the evacuation.

The developer is expected to submit an evacuation plan as part of the planning application process.

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 752, *Drain and sewer systems outside buildings*

Other publications

[1] DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT. Planning Policy Statement 25 – Development and flood risk. London: The Stationery Office. March 2010.

[2] DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT. *Planning Policy Statement 25 – Development and flood risk practice guide*. London: Communities and Local Government Publications. December 2009.

[3] DEPARTMENT OF THE ENVIRONMENT. Planning Policy Statement 15 (PPS 15) (Northern Ireland) – Planning and flood risk. Belfast: The Planning Service. June 2006.

[4] SCOTTISH GOVERNMENT. Scottish Planning Policy (SPP). Edinburgh: The Stationery Office. February 2010.

[5] UNITED KINGDOM. The Reservoirs Act 1975. London: The Stationery Office.

[6] UNITED KINGDOM. The Flood and Water Management Act 2010. London: The Stationery Office.

[7] SCOTLAND. The Flood Risk Management (Scotland) Act 2009. Edinburgh: The Stationery Office.

[8] SCOTLAND. The Reservoirs (Scotland) Act 2011. Edinburgh: The Stationery Office.

[9] SCOTLAND. The Water Environment (Controlled Activities) (Scotland) Regulations 2011. Edinburgh: The Stationery Office.

[10] EUROPEAN PARLIAMENT. 2007/60/EC. European Council Directive 2007/60/EC of 23 October 2007 on the assessment and management of flood risks. Luxembourg: Office for Official Publications of the European Communities, 2007.

[11] ENVIRONMENT AGENCY AND HR WALLINGFORD. *Supplementary note on flood hazard ratings and thresholds for development planning control purposes*. London: Environment Agency. May 2008 [5)]

[12] CIRIA. *Designing for exceedance in urban drainage – Good practice*, C635. London: CIRIA. 2006.

[13] CIRIA. *The SuDS manual,* C697. London: CIRIA. February 2007.

[14] DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT. *Improving the flood performance of new buildings – Flood resilient construction*. London: RIBA Publishing. May 2007.

[5)] This is available for download from the Environment Agency website at: http://evidence.environment-agency.gov.uk/FCERM/Libraries/FCERM_Project_Documents/FD2321_7400_PR_pdf.sflb.ashx

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™